APPENDIX 33-D
COMMINUTION CIRCUIT ENERGY COMPARISON BETWEEN HPGR CIRCUIT AND SABC CIRCUIT

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Report to:

SEABRIDGE GOLD

SEABRIDGE GOLD INC.

Kerr-Sulphurets-Mitchell (KSM) Comminution Circuit Energy Comparison Between HPGR Circuit and SABC Circuit

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AUGUST 2012

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GLOSSARY

TERM	ABBREVIATION
abrasion index	Ai
annum/year	a
British Columbia Hydro and Power Authority	BC Hydro
Bond ball mill work index	BWi
cubic metre	m^3
dollars – Canadian	Cdn$
dollars – United States	US$
drop weight index	DWi
effective grinding length	EGL
foot	ft
G&T Metallurgical Services Ltd.	G&T
gigawatt hour	GWh
gram	g
grams per tonne	g/t
High Pressure Grinding Rolls	HPGR
Hazen Research Inc.	Hazen
hours	h
inch	in
JKTech Pty Ltd.	JKTech
KHD Humboldt Wedag International Ltd.	KHD
kilometre	km
Koeppern Machinery Australia Pty Ltd.	Koeppern
Kerr-Sulphurets-Mitchell	KSM
kilowatt	kW
kilowatt hour per tonne	kWh/t
kilowatt second per hour	kWs/h
kilovolt	kV
kilovolt amps reactive hours	kVARh

TERM	ABBREVIATION
life of mine	LOM
locked cycle tests	LCTs
megawatt	MW
metre	m
microns	µm
millimetre	mm
million	M
million tonnes	Mt
million tonnes per year	Mt/a
Mitchell Treaty Tunnel	MTT
Newton per square millimetre	N/mm^2
Treaty Ore Preparation Complex	Treaty OPC
Polysius Corporation	Polysius
preliminary economic assessment	PEA
run-of-mine	ROM
semi-autogenous grinding	SAG
SAG mill-ball mill-pebble crushing	SABC
Seabridge Gold Inc.	Seabridge
semi-autogenous mill comminution	SMC
SGS Minerals Services	SGS
tonnes seconds per hour metre cubed (specific throughput constant)	ts/hm^3
tonnes	t
tonnes per year	t/a
tonnes per day	t/d
tonnes per hour	t/h
University of British Columbia	UBC
Tetra Tech Wardrop.	Tetra Tech

1.0 SUMMARY

This energy study report evaluates the application of a cone crusher crushing/high pressure grinding rolls (HPGR) ball mills circuit (HPGR option) as an alternative technology to conventional semi-autogenous grinding (SAG)/ball mills circuit (SABC option) for the Kerr-Sulphurets-Mitchell (KSM) Project owned by Seabridge Gold Inc. (Seabridge).

1.1 KSM Project Background

The KSM Project will be a 130,000 tonnes per day (t/d) open pit operation with ore processed in a conventional flotation and cyanide leach plant. The proposed process plant will produce gold-silver doré, copper-gold concentrate, and molybdenum concentrate from the porphyry mineralization. The produced concentrates will be transported to the Port of Stewart for shipment to offshore smelters. After receipt of construction and operating permits, the KSM Project will take approximately five years of construction time to complete; with an additional possible six months of start-up and commissioning activities. The overall life of mine (LOM) will be approximately 55 years. Production is scheduled to commence at the Mitchell pit, to be augmented by Sulphurets and Kerr pits and then underground mines at the lower Mitchell deposit and Iron Cap deposit. The LOM average mill feed grades are 0.207% copper, 0.0045% molybdenum, and 0.549 g/t gold.

Tetra Tech Wardrop (Tetra Tech) completed a preliminary economic assessment (PEA) report for the KSM Project in 2008 for Seabridge, in which a SABC circuit was used for the grinding process. Tetra Tech subsequently updated the PEA report in 2009 by choosing HPGR circuit as an alternative to the SABC milling option. In 2010, the KSM Project was further investigated at a prefeasibility level by Tetra Tech and a HPGR circuit was again used in that evaluation.

1.2 Work Scope

In this report, the SABC option is further compared with the HPGR option in terms of energy consumption and capital and operating cost estimates using pre-feasibility-level data and information. All currencies are expressed in Canadian (Cdn) dollars, unless otherwise specified. When it is applicable, costs in US currency have been converted using a fixed currency exchange rate of Cdn$1.00 to US$0.96. The expected accuracy range of the capital cost estimate is +25/-15%.

1.3 Test Work Review

The related test work for SABC option was conducted by Hazen Research Inc. (Hazen) in 2008 and G&T Metallurgical Services Ltd. (G&T) in 2011. Contract Support Services Inc. performed the circuit power requirement simulations based on the semi-autogenous mill comminution (SMC) test results. For the HPGR option, SGS Minerals Services (SGS) conducted a bench scale testing program in 2009, which was followed by a pilot testing program conducted in the Koeppern Machinery Australia Pty Ltd (Koeppern) facility at the University of British Columbia (UBC), Vancouver.

The test work results, combined with industry experience, indicated that the KSM Project mineralization is amenable to either SABC grinding or crushing using secondary crushers and HPGR crushers followed by ball mill grinding.

1.4 Energy Consumption Comparison

The estimates showed that the total installed power requirement for the HPGR option is approximately 106.7 MW with a running power of approximately 83.1 MW. The energy consumption on a yearly basis is estimated to be 673 GWh/a. The SABC option has a total installed power of 122.9 MW, with a running power 100.6 MW. The SABC option requires additional 17.5 MW of running power when compared to the total running power of the HPGR circuit. The annual energy consumption of the SABC option is approximately 821 GWh/a, which is 147 GWh/a more than the HPGR option.

The capital cost of the HPGR option will be approximately Cdn$141 million higher than the SABC option. However, the total operating cost savings will be significant, at approximately Cdn$33 million per year, which includes energy savings of Cdn$14 million, and other non-energy savings of Cdn$19 million per year.

Considering only the energy savings, the simple payback period of the HPGR option versus the SABC option is about 10 years. If considering the overall operating cost savings, the simple payback will be just under five years.

Table 1.1 summarizes the energy conservation comparison between the SABC and HPGR options, where the SABC option is the baseline option.

Table 1.1 Total Energy Conservation Measures

Energy Savings (kWh/a)	Electricity Cost Savings per Year (Cdn$'000)	Capital Cost (HPGR Option) (Cdn$'000)	Incremental Capital Cost Using HPGR Option (Cdn$'000)	Simple Payback (years)
147,221,666	14,109	819,831	140,919	10

1.5 CONCLUSIONS

There are some additional project risks with HPGR circuits when compared to conventional and widely used SABC milling circuits, including potential HPGR crushing problems involving wet/frozen ores. However, the significant energy and operating cost savings indicate that these risks should be manageable by using expensive ore stockpile covers. Thus, the preferable option is to use a HPGR circuit for the KSM Project.

2.0 SCOPE OF WORK

At Seabridge's request, Tetra Tech prepared an order of magnitude energy study and trade-off study to evaluate the application of HPGR and related crushing as an alternative process to the SABC milling process for the KSM Project.

This study will compare operating power requirements, operating costs, and capital costs between the conventional SABC comminution circuit and the HPGR comminution circuit (secondary crushing + HPGR crushing + ball mill milling). Other potential circuit configurations are not considered in the study. The comparison will start with the Treaty Ore Preparation Complex (Treaty OPC) coarse ore stockpile at the Treaty plant site and end with the ball mill grinding circuit. The boundary of this trade-off study is outlined in the simplified flowsheet in Figure 2.1 and Figure 2.2.

Figure 2.1 Simplified Flowsheet – SABC Option

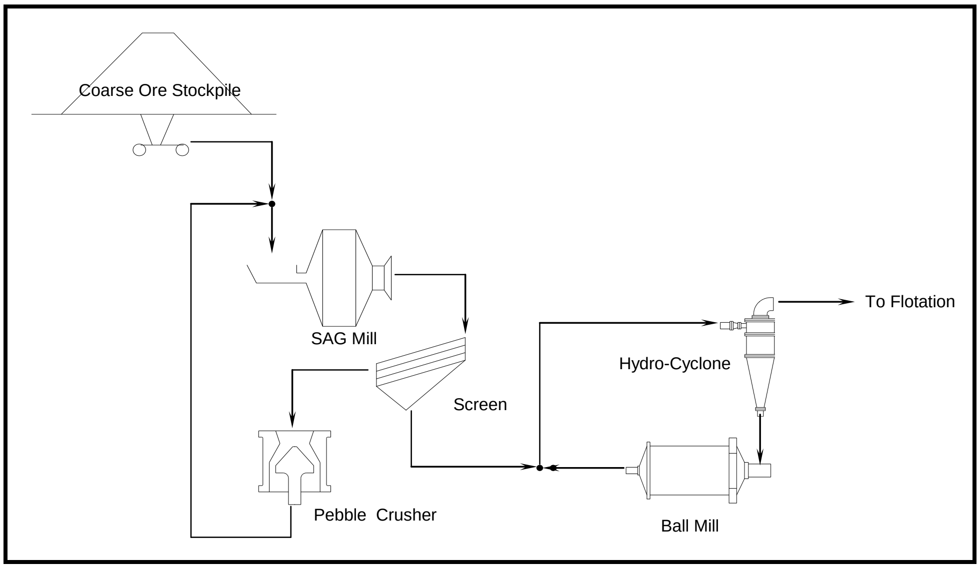
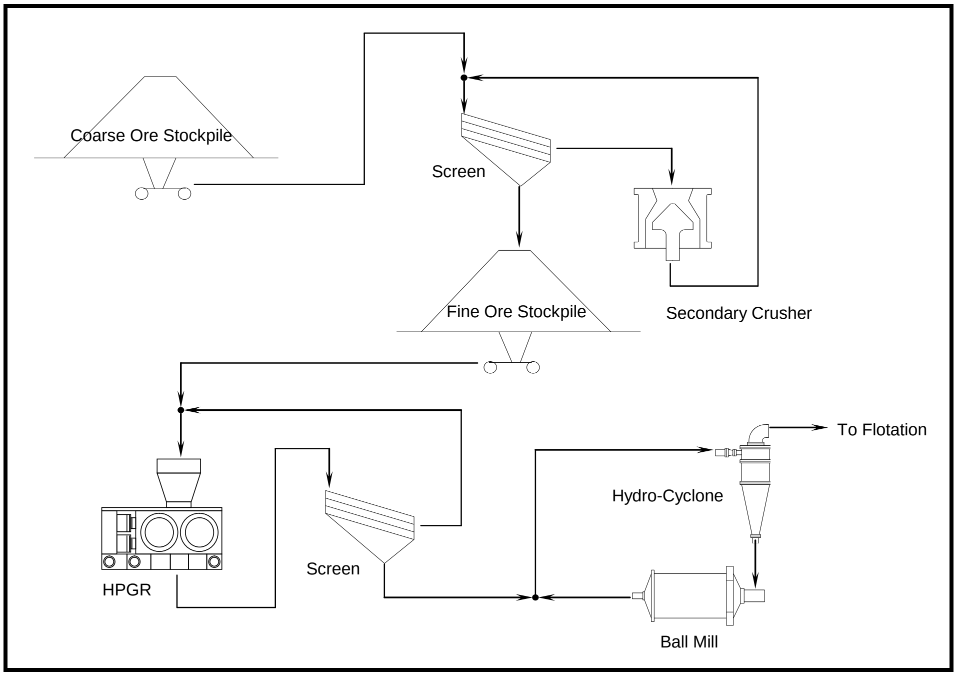


Figure 2.2 Simplified Flowsheet – HPGR Option



3.0 INTRODUCTION

The conventional SABC circuit has been widely used in various mineral process plants due to relatively inexpensive capital costs and large capacity. It is a proven circuit that is familiar to metallurgists and operators. The SABC grinding process, however, is a relatively energy inefficient process. Energy is mainly lost to the environment in the forms of heat and sound.

The development of the HPGR circuit has provided a more energy-efficient alternative to the SABC circuit. There are several significant benefits for using HPGR in the mining industry, including:

- significant energy cost savings
- reduced grinding media consumption and operating costs
- improved equipment delivery schedule compared to SAG mills
- potential benefits for downstream mineral recovery.

The higher roller surface wear rate in HPGR initially deterred the mining industry from making use of HPGR technology. However, due to significant improvement in wear protection technologies in recent years, HPGR circuits have become more attractive for the comminution of hard ores.

The main HPGR manufacturers are Polysius Corporation (Polysius), KHD Humboldt Wedag International Ltd. (KHD), and Koeppern from Germany. Polysius favours a high aspect ratio design (large diameter, small width), while KHD and Koeppern prefer a low aspect ratio design. The high aspect ratio design provides for a larger operating gap and reduced wear. Compared to Polysius and KHD, Koeppern's machine is smaller with a maximum roll diameter of 1.5 m. This is due to manufacturing constraints and surface wear considerations. All these companies have independently spent considerable time and resources in an effort to reduce wear rate. This has resulted in a new generation of superior rolls in the current market. The rolls use studs, segments, edge protection inserts, and advanced materials to reduce the surface wearing rate.

Mining companies are now beginning to incorporate HPGR technology in ore processes. Freeport-McMoRan Copper & Gold Inc. has already introduced HPGR at the Cerro Verde copper mine in Peru. The comminution circuit at Cerro Verde uses four HPGR units (2.4 m diameter x 1.7 m wide; 5,000 kW) processing 2,500 t/h per unit. The mill has a design capacity of 108,000 t/d. The Newmont Mining Corp. Boddington Gold Project in Australia has also included HPGR technology in their comminution circuit.

4.0 TEST WORK REVIEW

4.1 SABC Test Results (2007 to 2011)

During 2007 to 2011, various test programs determined the ore hardness for Mitchell, Sulphurets, Kerr, and Iron Cap deposits. All the test work reports can be found in Appendix I

Mitchell Mineralization

Conventional grinding test work was conducted for the 2007 scoping study by G&T on three Mitchell composite samples. The test results show that the mineralization has an average Bond ball mill work index (BWi) of 14.8 kWh/t.

SMC testing (a laboratory comminution test) was conducted by Hazen in 2008. The Mitchell samples used were identified as QSP, IARG, CL-RICH, QSP STW/QTVN, and H FELDS. The SMC test results are shown in Table 4.1.

Table 4.1 SMC Test Results

Parameter	Value				
	QSP	IARG	CL-RICH	QSP STW/QTVN	H FELDS
Specific Gravity	2.81	2.42	2.78	2.69	2.71
A (maximum breakage)	70.7	75	68.1	82.6	81.6
B (relation between energy & impact breakage)	0.71	0.40	0.57	0.60	0.44
A x b (overall SAG hardness)	50.2	30.0	38.8	49.6	35.9
DWi	5.5	7.9	7.1	5.4	7.5
Mia (kWh/t) (power based index for SMC tests)	16.1	24.8	19.9	16.3	21.2
Ta (estimated abrasion parameter)	0.47	0.33	0.37	0.49	0.35

Notes: DWi = drop weight index; Mia = work index for the grinding of coarser particles (> 750 um) in tumbling mills; Ta = JK abraision parameter

The DWi and A x b data indicate that on average, the materials were moderately hard in comparison to the JKTech Pty Ltd. (JKTech) database.

A separate standard BWi determination testing was carried out by G&T on five Mitchell composites identified as High Quartz 0-10, High Quartz 10-30, IARG 0-10, QSP 0-10, and QSP 10-30. The test results in Table 4.2 show that the samples have an average BWi of 14.8 kWh/t, indicating medium to moderate hardness.

Table 4.2 BWi Test Results – Mitchell (2008)

Samples	High Quartz 0-10	High Quartz 10-30	IARG 0-10	QSP 0-10	QSP 10-30	Average
BWi (kWh/t)	15.2	15.3	13.9	14.5	15.2	14.8

During 2009/2010, ten composite samples were tested by G&T and one sample by SGS to determine the hardness of the mineralization using the standard BWi procedure. As indicated in Table 4.3, the BWi ranges from 12.5 kWh/t to 15.5 kWh/t. The data suggest that the Mitchell composite samples are of moderate hardness. The abrasion index (Ai) of Composite PP1 was measured at 0.293 g by SGS.

Table 4.3 Bond Work Index – Mitchell (2009/2010)

Samples	BWi (kWh/t)	Ai (g)
2009 G&T		
Composite 40	15.5	-
Composite 41	14.8	-
Composite 42	15.2	-
Composite 43	14.6	-
Composite 44	13.4	-
Composite 45	14.1	-
Composite 46	12.8	-
Composite 47	13.3	-
Composite 48	12.5	-
Sub-average	**14.0**	**-**
2009/2010 SGS		
Composite PP1	13.8	0.293
Total Average	**13.9**	**-**

4.1.1 Sulphurets Mineralization

The test results, as presented in Table 4.4, indicate that the Sulphurets samples have a higher resistance to ball mill grinding compared to the Mitchell samples. The average BWi is 19.0 kWh/t for the Sulphurets samples; the Ai of the overall Sulphurets composite is 0.233 g.

Table 4.4 Bond Work Index Test Results – Sulphrets

Samples	BWi (kWh/t)	Ai (g)
2009 G&T		
Composite 49	15.8	-
Composite 50	20.8	-
Composite 51	19.8	-
Sub-average	**18.8**	**-**
2009/2010 SGS		
Composite	19.1	0.233
Total Average	**19.0**	

4.1.2 KERR MINERALIZATION

The samples from the Kerr deposit show the lowest ball mill work index in comparison to the samples from the other two deposits. As shown in Table 4.5, the average BWi is 13.4 kWh/t. These results agree with previous test results.

Table 4.5 BWi Test Results – Kerr

Samples	BWi (kWh/t)
2010 G&T	
Composite 52	13.8
Composite 53	13.0
Average	**13.4**

In 2011, SMC Test® programs were performed on 11 composite samples from varied mineralization. The results are summarized in Table 4.6.

Table 4.6 SMC Test Results – Mitchell, Sulphurets, Kerr 2011

Samples	DWi		Mia				
	kWh/m^3	%	kWh/t	A	b	Ta	Deposit
Composite 1	5.12	42	15.2	59.8	0.91	0.51	Mitchell
Composite 2	4.83	38	14.4	57.3	1.01	0.54	Mitchell
Composite 3	6.21	57	17.8	68.8	0.65	0.42	Mitchell
Composite 4	5.96	54	16.9	60.0	0.79	0.43	Mitchell
Composite 5	4.61	35	14.2	66.2	0.90	0.56	Mitchell
Composite 6	5.86	52	16.9	55.3	0.86	0.44	Mitchell
Composite 7	5.23	43	15.4	53.2	1.00	0.50	Mitchell
Composite 8	6.58	62	19.0	63.2	0.66	0.39	Sulphurets

table continues

Samples	DWi		Mia	A	b	Ta	Deposit
	kWh/m^3	%	kWh/t				
Composite 9	7.17	69	19.9	57.7	0.67	0.36	Sulphurets
Composite 10	6.25	58	17.3	56.9	0.81	0.41	Kerr
Composite 11	6.11	56	17.0	65.3	0.72	0.42	Kerr

4.2 SABC Circuit Sizing Simulation (2008 to 2011)

A number of mill sizing simulations were conducted by Contract Support Services Inc. using JK SimMet software in 2008 and 2011.

2008 Simulation

The simulations conducted in 2008 were based on the data generated from SMC testing on Mitchell samples in 2008. The simulation input conditions are based on 120,000 t/d (two streams at 60,000 t/d each), 92% availability, a feed particle size of 80% passing 150 mm, and one of the following conditions:

- Simulation 1: BWi of 14.8 kWh/t and a product particle size of 80% passing 150 µm.
- Simulation 2: BWi of 16.0 kWh/t and a product particle size of 80% passing 150 µm.
- Simulation 3: BWi of 15.0 kWh/t and a product particle size of 80% passing 120 µm.

Simulation results for each primary grinding stream are summarized in Table 4.7. The simulations are based on the phantom hydrocyclone assumption.

Table 4.7 JK SimMet Simulation Results for 60,000 t/d (One Stream), 2008

Simulation		1a	1b	2a	2b	3a	3b
SAG Mill	Size, D x L (EGL) (ft x ft)	40 x 24	38 x 21	40 x 24	38 x 21	40 x 24	38 x 21
	Circulation Load (% of Feed)	19.5	18.4	19.5	18.4	19.5	18.4
	Mill Number	1	1	1	1	1	1
	Gross Power Draw (kW)	18,843	15,570	18,843	15,570	18,843	15,570
Transfer Particle Size, mm		2,500	3,035	2,500	3,035	2,500	3,035
Ball Mills	Size, D x L (EGL) (ft x ft)	22 x 36	22 x 36	22 x 36	22 x 36	22 x 36	24 x 38
	Mill Number	2	2	2	2	2	2
	Gross Power Draw* (kW)	15,644	17,293	16,912	18,695	19,283	21,017
Total Power Draw (kW)		34,487	32,863	35,755	34,265	38,126	36,587
Hydrocyclone Diameter (in)		26	26	26	26	26	26

Notes: * With phantom hydrocyclones.
EGL = effective grinding length

The simulation results appear to show that when the grind size is 80% passing 120 µm, either one 12.2 m (40 ft) diameter x 7.3 m (24 ft) long SAG mill and two 6.7 m (22 ft) diameter x 11.0 m (36 ft) long ball mills, or one 11.6 m (38 ft) diameter x 6.4 m (21 ft) long SAG mill and two 7.3 m (24 ft) diameter x 11.6 m (38 ft) long ball mills will meet the primary grinding requirement for each grinding circuit.

2011 Simulation

Three additional simulations were carried out at the end of 2011, using the new hardness test results determined in 2011 and the product particle size of 80% passing 125 µm. The simulated circuit is based on a single line SABC circuit of 60,000 t/d and 92% availability. The Bond ball mill work index 16.0 kWh/t was used in the simulation for all the ore types and for the ore blend. The blended ore breakage parameters that were based on the 2008 and 2011 test results are summarized in Table 4.8.

Table 4.8 Blended Ore Breakage (2008 and 2011)

Samples	A	b	A x b	ta	Mia	BWi	SG
Blend	64.18	0.76	49.1	0.48	16.23	16.0	2.78

Simulation 1 was performed using a 40' x 24' SAG mill and a 38' x 21' SAG mill. With each SAG mill, a conservative simulation (1a) and an optimistic modelling method (1b) were tested. The conservative method is using the historical data from the JK Tech DW database established since 1990s while the optimistic modelling is based on one existing 40″ mill circuit. Simulation 1 results are summarized in Table 4.9.

Table 4.9 JK SimMet Simulation 1 Results, 60,000 t/d (One Stream) – 2011

Simulation 1		1a		1b	
SAG Mill	Size, D x L (EGL) (ft x ft)	40 x 24	38 x 21	40 x 24	38 x 21
	Circulation Load (% of Feed)	18.0	21.9	19.9	19.0
	Mill Number	1	1	1	1
	Gross Power Draw (kW)	21,146	17,485	20,418	16,894
Transfer Particle Size T80, µm		3,569	4,954	2,789	3,246
Ball Mills	Size, D x L (EGL) (ft x ft)	24 x 40	25 x 38	24 x 40	24 x 40
	Mill Number	2	2	2	2
	Gross Power Draw* per Unit (kW)	12, 745	13, 635	12, 206	12, 899
Pebble Crusher	Crusher Number	1	1	1	1
	Gross Power Draw per Unit (kW)	530	668	656	614
Total Gross Power Draw (kW)		**47,166**	**45,423**	**45,486**	**43,306**

Notes: a = conservative modelling
b = optimistic modelling.

Simulation 2 was performed using the conservative methods as mentioned in Simulation 1 to compare two modified grinding circuits (2a and 2b) which included pre-screening and pre-crushing to reduce mill feed size and power requirements.

In Simulation 2a, the crushed ore of 80% passing 150 mm is pre-screened at 75 mm. The coarse fraction is further crushed by cone crusher to about 80% passing 25 mm. The cone crusher discharge is combined with screen undersize reporting to the SABC circuit.

In Simulation 2b, the crushed ore of 80% passing 150 mm is pre-screened by double deck screens at 90 mm and 15 mm. The coarse fraction +90 mm and the fine fraction -15 mm are combined and sent to SABC circuit. The middle fraction +15 mm -90 mm with SAG pebbles are crushed to 80% passing 12 mm and sent to the SAG mill as well.

The Simulation 2 results are summarized in Table 4.10.

Table 4.10 JK SimMet Simulation 2 Results for 60,000 t/d (One Stream) – 2011

Simulation 2		**2a**	**2b**
SAG Mill	Size, D x L (EGL), (ft x ft)	34 x 17.5	36 x 19
	Circulation Load, (% of Feed)	18.0	19.0
	Mill Number	1	1
	Gross Power Draw, (kW)	10,587	13,654
Ball Mills	Size, D x L (EGL), (ft x ft)	25 x 38	25 x 38
	Mill Number	2	2
	Gross Power Draw* per Unit (kW)	13,790	13,411
Cone/ Pebble Crushers	Crusher Number	5	2 to 3
	Gross Power Draw Subtotal (kW)	4,854	1,987
Total Gross Power Draw (kW)*		**43,021**	**42,463**

Notes: *Excluding screening and additional conveying power requirements.

Simulation 3 was performed by adding a pre-screening stage prior to SABC circuit. The coarse fraction material larger than 50 mm is sent to the SAG mill; the middle fraction +18 mm -50 mm is crushed with pebbles from the SAG mill discharge by HPGR units. The simulated total power draw is 42.3 MW, excluding screening and additional conveying power requirements.

4.3 HPGR Option

4.3.1 *SGS Laboratory-scale Testing (2009)*

SGS conducted bench scale LABWAL tests (laboratory HPGR tests) on the Mitchell and Sulphurets composite samples. The tests included batch open tests and locked cycle tests (LCTs). The results obtained indicated that the Sulphurets mineralization is harder than the Mitchell mineralization. The average net specific energy requirement for the Mitchell sample was 2.33 kWh/t compared to 3.08 kWh/t for the Sulphurets sample. The LCT results are summarized in Table 4.11, including specific grinding force and specific throughput rate.

Table 4.11 HPGR Average Test Results – LCTs (2009 – 2010)

Parameter	Unit	Mitchell	Sulphurets
Operation			
Pressure of Operation	bar	65	66
Moisture	% H_2O	1.8	1.7
Dry Net Throughput	t/h	1.9	1.6
Circulating Load	%	34.7	47.1
Net Power	kW	4.4	5.1
Gross Specific Energy Requirement	kWh/t	2.96	3.80
Net Specific Energy Requirement	kWh/t	2.33	3.08
HPGR Product Analysis			
50% Passing	µm	694	1,046
80% Passing	µm	1,988	2,220
Percent Passing 100 mesh		25.3	17.7
Percent Passing 6 mesh		100	100
Flake Thickness	mm	6.0	5.8
Performance Indicators			
Specific Grinding Force	N/mm^2	3.24	3.31
Specific Throughput	ts/hm^3-(m_f)	226	213
Specific Throughput Rate	ts/hm^3-(m_c)	195	187
Ratio m_j/m_f		0.86	0.88
Specific Power	kWs/m^3	528	657
New minus 100 Mesh Produced	%	19.6	11.9
New minus 6 Mesh Produced	%	73.5	60.6

4.3.2 *KOEPPERN PILOT-SCALE TEST RESULTS (2010)*

Koeppern conducted a pilot plant test at its HPGR pilot plant in UBC, using approximately 5.5 t of drill core samples collected from Mitchell deposit. The pilot plant HPGR rollers were 0.75 m in diameter and 0.22 m in width.

The test report gave the following main observations:

- Effective and efficient size reduction was achieved with the KSM material, when compared to the materials tested from other projects by the UBC laboratory.
- A specific pressing force of 4 N/mm^2 was considered to be optimum, on the basis of both size reduction and throughput performance.

- Varying the roll speed did not produce a significant improvement on HPGR performance.
- An increase in feed moisture resulted in a negative impact on throughput, and energy consumption. An increase in feed moisture from 0.4% to 5% resulted in a 56% increase in net specific energy consumption.
- Variation in feed top size did not produce a significant difference in 50% passing particle size of the HPGR product.
- Higher HPGR throughputs were achieved with closed circuit tests than with single pass tests using the equivalent machine.
- A lower net specific energy consumption (approximately 1.94 kWh/t) was recorded for the closed circuit tests, in comparison with 1.99 kWh/t obtained from the single pass tests.

The typical LCT data are presented in Figure 4.1 and Figure 4.2.

Figure 4.1 HPGR Net Specific Energy Consumption vs. Cycle Number (2010)

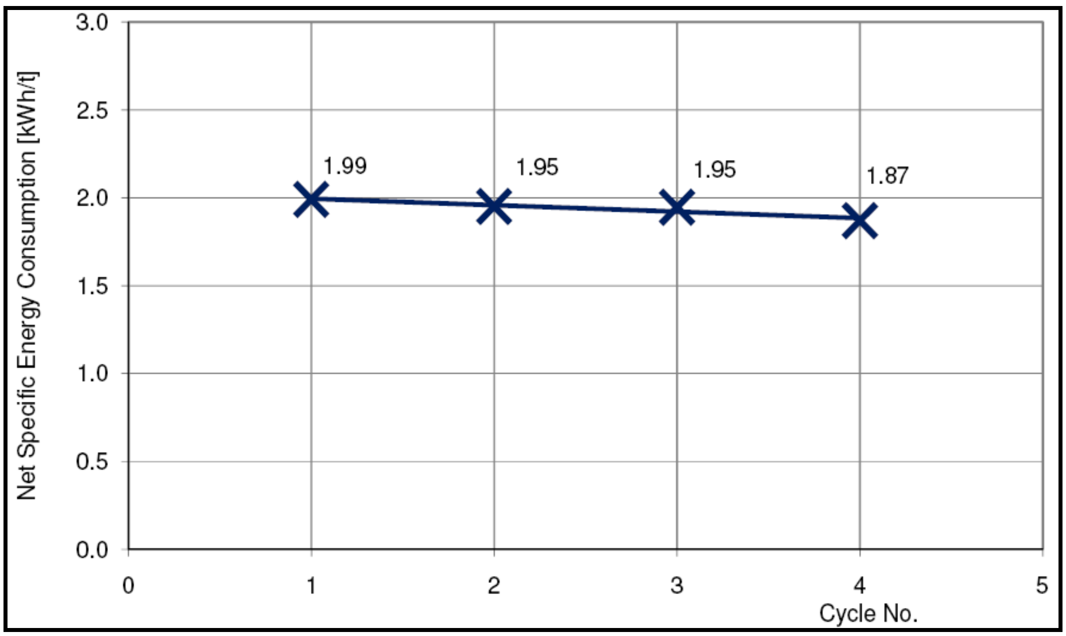
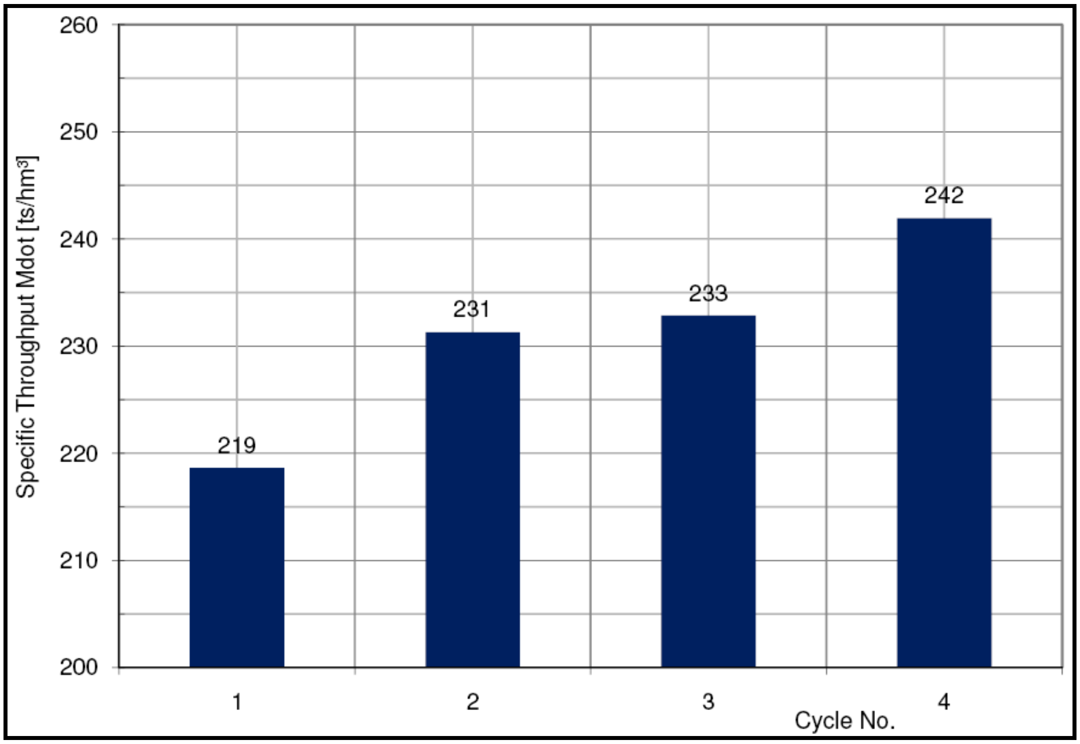


Figure 4.2 Specific Throughput (ts/hm^3) vs. Cycle Number (2010)



The HPGR test work program showed that Mitchell material is very amenable to the HPGR crushing process. Koeppern's test work report states that the results from the testing program are sufficient for sizing the HPGR units and their motors.

For this trade-off study, four 24/17 HPGR machines were suggested for the crushing circuit. Each HPGR is capable of processing 32,500 t/d.

5.0 PROCESS COMPARISON

5.1 DESIGN CRITERIA

The LOM of the KSM Project is estimated to be 55 years. The mill feeds will be porphyry copper ores with associated gold, silver, and molybdenum. The process rate will be 130,000 t/d at an availability of 94%, or an annual throughput of 47,450,000 tonnes per year (t/a).

The general design criteria for this energy study are shown in Table 5.1.

Table 5.1 Process Design Criteria

Criteria	Unit	Value
Plant Feed Rate	Mt/a	47.45
Plant Feed Rate	t/h	5,762
Milling Availability	%	94
Average BWi, Mitchell	kWh/t	14.8
Average BWi, Sulphurets	kWh/t	19.0
Average BWi, Kerr	kWh/t	13.4
Design BWi	kWh/t	16.0
Milling Product P_{80} (Flotation Feed)	µm	150

5.2 SABC OPTION

5.2.1 EQUIPMENT SPECIFICATIONS

The proposed equipment used for the comminution circuit with SAG grinding mills will be composed of the following items at the Treaty OPC:

- two SAG mills, each of 12.2 m diameter and 6.7 m length (EGL), installed power of 22,500 kW each
- four ball mills, each of 7.6 m diameter and 11.9 m length, installed power of 14,000 kW each
- four pebble crushers each with 750 kW installed power
- associated conveyors, feeders, screens, and pumps.

5.2.2 PROCESS DESCRIPTION

A conventional SABC comminution process could be located at the Treaty OPC site. The SABC option scope is outlined on the simplified flowsheet in Figure 2.1.

The SABC option starts from a 60,000 t live capacity coarse ore stockpile which receives the feed from a tunnel conveying system transporting two gyratory crusher's discharges from the mine site. Apron feeders will be used to reclaim the crushed ores to the conveyors, which will transport the crushed material to the SAG mills. The ground material from each of the SAG mills will gravity flow to SAG mill screen. The screen undersize will report to a closed ball mill grinding circuit and the screen oversize will be conveyed to the pebble crushers. The crushed pebbles will return to the SAG mills.

The ball mills will operate in closed circuit with hydrocyclones to grind the SAG mill discharges to 80% passing 150 µm at the Treaty OPC site. The hydrocyclone overflow will report to the downstream copper rougher flotation circuits while the hydrocyclone underflows will flow by gravity to the ball mills.

5.3 HPGR OPTION

5.3.1 EQUIPMENT SPECIFICATIONS

The comminution circuit with HPGR grinding rolls will consist of the following major equipment at the Treaty OPC:

- five cone crushers with four in operation and one in standby mode, each equipped with a 750 kW motor
- four 24/17 model HPGR units, each with 5.8 MW installed power
- four ball mills, each of 7.6 m diameter and 11.9 m length, installed power 14,000 kW each
- associated conveyors, feeders, screens, pumps, and tanks.

5.3.2 PROCESS DESCRIPTION

Similar to the SABC option, the HPGR option would be located and operated at the Treaty OPC site. As shown on the simplified flowsheet in the Figure 2.2, the HPGR option starts from a 60,000 t live capacity coarse ore stockpile. The material reclaimed from the coarse stockpile will be fed to cone crushers producing a product of less than 50 mm in size. These secondary crushers will operate in closed circuit with double-deck vibrating screens. The screen oversize will return to the cone crushers, while the screen undersize will report to a fine ore stockpile with a live capacity of 60,000 t.

Material reclaimed from the fine ore stockpiles will be conveyed to HPGR surge bins. From there, the materials will be fed to HPGR crushers at a controlled rate via belt feeders. The HPGR products will report to double-deck vibrating screens. The oversize material will return to the HPGR feed surge bins while the undersize material in the 6 to 8 mm size range will report to the ball mill grinding circuit.

The ball mill grinding circuit will operate in closed circuit with hydrocyclones. The hydrocyclone underflow will return to the ball mills; the hydrocyclone overflow with a particle size of approximately 80% passing 150 µm will gravity flow to the downstream copper rougher flotation circuits while the hydrocyclone underflows will flow by gravity to the ball mills.

5.4 Flowsheets/Layout

The process flowsheets for the SABC and HPGR circuits can be found in Appendix A and Appendix E, respectively. The layouts for the two options are presented in Appendix B and Appendix F.

5.5 Equipment/Load List

The major process equipment for each option is described in Sections 5.2.1 and 5.3.1. Detailed load lists for both the SABC and HPGR options are presented in Appendix C and Appendix G, respectively.

5.6 Energy Consumption Comparison

The energy consumption estimate was based on the nominal running power loads and utilization factors. The nominal power loads were determined by considering the installed powers, motor loading factors, and motor efficiencies. These factors and estimated energy consumption results are presented within the equipment load list as shown in Appendix C for the SABC option and Appendix G for the HPGR option.

The equipment and load lists are limited to the comminution circuits, including the the coarse ore stockpile, secondary and tertiary crushing (if applicable), and primary grinding at the Treaty OPC. The remainder of the process circuit, including primary crushing, flotation, regrinding, leaching and dewatering, was not included in this study comparison.

5.6.1 SABC Option Energy Data

Table 5.2 summarizes the proposed installed power capacity, running power, and annual energy consumption for the SABC option. The comminution process includes combined SAG and ball mill grinding at the Treaty OPC site. The total electrical power requirement is estimated as 122.9 MW for the SABC option, while running power is about 100.6 MW with the estimated energy consumption as 820.7 GWh per annum.

Table 5.2 Estimated Electrical Power – SABC Option

Equipment Description	Proposed Electrical Power (MW)	Nominal Electrical Power (MW)	Annual Energy Consumption (MWh)
Two 12.2 m x 6.7 m SAG Mills, 22.5 MW each	45.0	42.2	347,250
Four Pebble Crushers, 750 kW each	3.0	1.9	15,671
Four 7.6 m x 11.9 m Ball Mills, 14 MW each	56.0	44.3	364,875
Screens, Conveyors, Pumps and Others	18.9	12.2	92,946
Total	**122.9**	**100.6**	**820,742**

The power requirement for the mills was estimated by the grinding circuit simulations for the SAG mills and the Bond ball mill equation for ball mills. The Bond ball mill specific energy requirement equation is as follows:

$$W = 10 \times Wi \times (1/(P_{80})^{0.5} - 1/(F_{80})^{0.5})$$

Where:

- W = specific energy requirement, kWh/t
- Wi = Bond ball mill work index, kWh/t
- F_{80} = feed particle size, 80% passing, µm
- P_{80} = product particle size, 80% passing, µm.

5.6.2 *HPGR Option Energy Data*

Table 5.3 summarizes the proposed electrical power capacity, running loads, and yearly energy consumption for the HPGR option. The comminution process includes the secondary crushing by cone crushers, tertiary crushing by HPGR and primary grinding by ball mill at the Treaty OPC. The current preliminary estimate shows that the proposed electrical power requirement is approximately 106.7 MW. The running power is approximately 83.1 MW, which translates to an estimated yearly electrical energy consumption of 673.5 GWh.

Table 5.3 Estimated Electrical Power – HPGR Option

Equipment Description	Proposed Electrical Power (MW)	Nominal Electrical Power (MW)	Annual Energy Consumption (MWh)
Four Cone Crushers, 750 kW each	3.0	2.6	19,341
Four HPGR, 5.8 MW each	23.2	17.9	147,588
Four 7.6 m x 11.9 m Ball Mills, 14 MW each	56	43.2	355,871
Screens, Conveyors, Pumps and Others	24.5	19.3	150,720
Total	**106.7**	**83.1**	**673,521**

5.6.3 Energy Cost Savings

The energy assessment discussion (Section 5.6.1 and 5.6.2) shows by choosing HPGR option, the annual energy consumption is approximately 147 GWh lower than SABC option. In addition, incentives for using the HPGR option could further reduce the energy unit price for the entire operation by Cdn$0.005/kWh. This is based on the 2012 estimate by WN Brazier Associates Inc (WN Brazier). This estimate indicates that the unit energy price is Cdn$0.049/kWh for HPGR option, and Cdn$0.054/kWh for SABC option.

The annual total electrical energy cost for the fine crushing and grinding circuits, and for the remaining production activities, are listed in Table 5.4.

Table 5.4 Total Electrical Energy Cost for SABC and HPGR Option

Description	Annual Electrical Power Consumption (kWh)	Annual Electrical Energy Cost (Cdn$'000)
Comminution Circuit Energy Cost		
SABC Option	820,742,674	44,320
HPGR Option	673,521,008	33,002
Savings Subtotal	147,221,666	11,318
Remaining Operation Energy Cost (Flotation/Leaching/Mining/Other)		
SABC Option	528,928,007	28,562
HPGR Option	528,928,007	25,917
Savings Subtotal		2,645
Savings, Total	**147,221,666**	**13,963**

Applying HPGR option in the future mine will produce a total electrical energy cost savings approximately Cdn$14.0 million per year as compared with SABC option. The electrical energy savings will include: 1) Cdn$11.3 million from the comminution circuit; and 2) further Cdn$2.6 million from the remaining operation due to the lower unit energy cost.

5.7 CAPITAL COSTS

The accuracy level of the capital and operating cost estimates is +25/-15% and values are provided in Canadian dollars.

The capital costs of the Treaty OPC facilities estimated for the study include stockpile, crushed ore conveyance, secondary crushing (if applicable), and primary grinding circuits. The primary crushing, flotation circuits and the remainder of the processing plant costs are not included.

Table 5.5 Capital Cost Summary Comparison

	Capital Cost (Cdn$'000)		
Description	**SABC Option**	**HPGR Option**	**HPGR vs. SABC**
Direct Works			
Plant Site	4,856	12,873	8,017
Crushing & Grinding	406,060	494,428	88,368
Other	9,685	12,565	2,880
Sub-total	**420,601**	**519,866**	**99,265**
Indirect Works			
Project Indirects	176,067	200,827	24,760
Contingency	82,244	99,138	16,894
Sub-total	**258,311**	**299,965**	**41,654**
Total Capital Costs	**678,912**	**819,831**	**140,919**

As indicated in Table 5.5, it is estimated that the total capital cost including equipment, building, installation and indirect costs for the SABC option is approximately Cdn$679 million, and for the HPGR option is approximately Cdn$820 million. The capital cost of the HPGR option is Cdn$141 million higher than the SABC option.

5.8 OPERATING COSTS

Operating costs were determined for both options and were based on budget estimates received from suppliers or from Tetra Tech's in-house database. As indicated in Section 5.6.3, the estimated electrical energy cost, is projected by WN Brazier at a unit price of Cdn$0.054/kWh for the SABC option and at an incentivized price of Cdn$0.049/kWh for the HPGR option.

Liner and grinding media consumption were calculated from Bond work index equations and quoted budget prices, or from Tetra Tech's database. Personnel salary levels were based on current labour rates in comparable operating mines in British Columbia. Maintenance supply costs were calculated based on major equipment capital costs.

The operating cost comparison between the two options is presented in Table 5.6.

Table 5.6 Comminution Circuit Operating Cost Comparison

Description	Unit Cost (Cdn$/t Milled)		
	SABC Option	**HPGR Option**	**HPGR vs. SABC**
Personnel			
Subtotal	**0.109**	**0.126**	**0.017**
Supplies			
Operating Supplies	0.003	0.003	0
Maintenance Supplies	0.245	0.262	0.017
Major Consumables	1.691	1.258	-0.433
Power Supply	0.934	0.696	-0.238
Sub-total	**2.873**	**2.218**	**-0.654**
Total Operating Costs	**2.981**	**2.344**	**-0.637**

As shown in Table 5.6, the estimated operating cost for the SABC grinding circuit including power consumption, manpower and steel consumption would be approximately Cdn$2.98/t milled or Cdn$141 million per year. The estimated operating cost for the HPGR option including power consumption, manpower, and steel consumption would be approximately Cdn$2.34/t milled or Cdn$111 million per year.

Compared with the SABC option, the HPGR option will save direct operating costs of approximately Cdn$30 million per year, including Cdn$11 million per year in electrical power savings, and non-power savings of Cdn$19 million per year. In addition, if energy-saving incentive pricing for the remaining project energy consumption is used, the additional cost saving would be approximately Cdn$3 million per year, the total operating cost savings of the HPGR option will further increase to about Cdn$33 million per year.

The detailed capital and operating cost estimates are presented in Appendix D and Appendix H for the SABC and HPGR options.

5.9 Simple Payback

The simple payback of HPGR option was calculated using the following equation as suggested by BC Hydro.

Simple Payback = (Project Capital Cost – Baseline Capital Cost) / Annual Electricity Savings

In the calculation, the SABC option was considered as the base case in the calculation. The energy consumption savings includes fine crushing and grinding circuits, and also, the remaining plant, incentive energy price reduction. The total energy cost savings per year is about Cdn$14 million (Section 5.6.3.) and the capital cost difference is about Cdn$141 million.

The calculated simple payback of the HPGR option is approximately 10 years. Furthermore, if considering all the operating cost savings by using the HPGR option instead of the SABC option, the simple payback will be significantly reduced to less than five years. This is based on Cdn$30 million savings in the total comminution circuit operating costs (energy, labor and consumables), plus Cdn$3 million energy cost savings in the remaining production activities (mining + plant) due to the lower incentive energy pricing for using the HPGR option.

5.10 SABC and HPGR Comparison

5.10.1 SABC Option

The key positive benefits of the SABC process are as follows:

- SABC circuit is a mature process and is more widely employed in mining industry than HPGR circuit options.
- There are many successful SABC operations in mining process plants for large capacity operations operating in cold and wet climates.
- The layout of a SABC circuit is considerably simpler and requires a smaller footprint than a comparable HPGR circuit.

A major downside of SABC circuits is the low efficiency in the utilization of energy. It has been reported that approximately 30% of the energy losses occur in the form of sound and heat in the tumbling SAG mill comminution process. Metal consumption associated with SAG mill grinding is also high, when compared to a HPGR circuit.

5.10.2 HPGR Option

The key positive benefits of the HPGR option are:

- lower operating costs, mainly due to the reduction in steel and energy consumption
- potential metallurgical benefits due to preferential mineral liberation and a reduction in ball mill power requirements.

The HPGR option may result in a lower BWi due to micro-cracking or micro-fracturing created during HPGR crushing. The particle reduction by HPGR is caused by the compressive force applied to the ore when it passes through the HPGR. The resulting high pressure causes micro-cracks at the weak interfaces in the ore. These weak interfaces normally occur around the grain boundaries between different minerals. This creates benefits in the form of preferential liberation between target minerals and gangue minerals.

The detrimental factors for using the HPGR circuit option are risks associated with relatively new technology and fewer in operation experiences. Only a few operations currently incorporate HPGR circuits in their ore comminution plants. Cerro Verde, in Peru, and Boddington, in Australia, are currently the only large mining operations in the world using the new HPGR circuits. However, other operations are currently planning to use HPGR circuits in their plant expansions.

The Treaty OPC layout is compact and, to the degree possible, takes advantage of the natural ground contours and shallow rock foundation depths. However, the HPGR option further complicates the layout of the Treaty OPC due to the restricted area available for the facilities.

It should be noted that an HGPR option may potentially require more intensive maintenance than a SAG circuit and, consequently, require a larger work force.

5.11 Proposed Metering

The power requirement for the HPGR option will be verified by actual field measurement.

Metering information (kilowatt hours and kilovolt amps reactive hours) will be provided by the microprocessor-based protective relays on the motor feeders. As most of the motors are fairly large, these relays will be at the 25 kV or 4 kV voltage level. The relays will be Multilin SR469 or Multilin 750 relays, or equivalent. The metering information in the relays will be polled by the plant-wide distributed control system (DCS) and correlated to production. The metering will not be revenue grade, but will certainly be accurate enough to verify the bulk differences in the power requirements.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This trade-off energy study compares the electrical energy demand and consumption, capital costs and operating costs for replacing a SABC grinding circuit with a HPGR fine crushing and grinding circuit for the KSM Project.

The current comparison indicates that the HPGR option would be able to reduce electrical energy consumption by approximately 147 GWh per year. This savings translates to approximately Cdn$11 million per year. Further energy cost savings are resulted from a lower incentive energy pricing in the remaining production activities due to using the HPGR circuits. This additional cost savings is about Cdn$3 million per year. In total, the energy cost savings is about Cdn$14 million per year.

Other major operating cost savings of the HPGR option include the savings in operation and maintenance, in particular, the grinding steel savings. The subtotal of the non-energy savings with the HPGR option is approximately Cdn$19 million per year.

The capital cost estimate of the HPGR option is higher than the SABC option by approximately Cdn$141 million per year.

Considering energy cost savings only, the simple payback of the HPGR option is about 10 years. However, the payback can be reduced to less than five years if the overall operating cost savings (energy, maintenance and consumables) are considered.

Compared with SABC processing option, a HPGR circuit can produce significant energy and operating cost savings. These economic and energy saving advantages indicate that the HPGR option should be used for the KSM Project.

APPENDIX A

SABC Option – Flowsheet

DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

CLIENT / PROJ.MAN. / PROJENG. / PROCESS / ELECTR. / INSTR. / PIPING / MECH. / STRUCT. / SERVICES / ARCH. / LAYOUT

		DATE
SECTION:	PROCESS	
SCALE:	NONE	
DESIGN. BY:	JH	10AUG12
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APP. BY:		

CLIENT: SEABRIDGE GOLD

BRITISH COLUMBIA, CANADA

WARDROP Engineering Inc.

TITLE KERR–SULPHURETS–MITCHELL ENERGY STUDIES

PROCESS FLOW DIAGRAM No.01 MITCHELL TREATY TUNNEL CONVEYOR AND TREATY COARSE ORE STOCKPILE SAG OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009004.DWG	10528801.00	A00–09–004	A

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DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

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TITLE
KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.02
PRIMARY GRINDING (TREATY SITE)
SHEET 1 OF 3
SAG OPTION

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DWG. NO.	REFERENCE DRAWINGS

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A	1	ISSUED FOR INFORMATION	10AUG12	AO

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SEABRIDGE GOLD
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WARDROP Engineering Inc.

TITLE
KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.03
PRIMARY GRINDING (TREATY SITE)
SHEET 2 OF 3
SAG OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
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KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.04
PRIMARY GRINDING (TREATY SITE)
SHEET 3 OF 3
SAG OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
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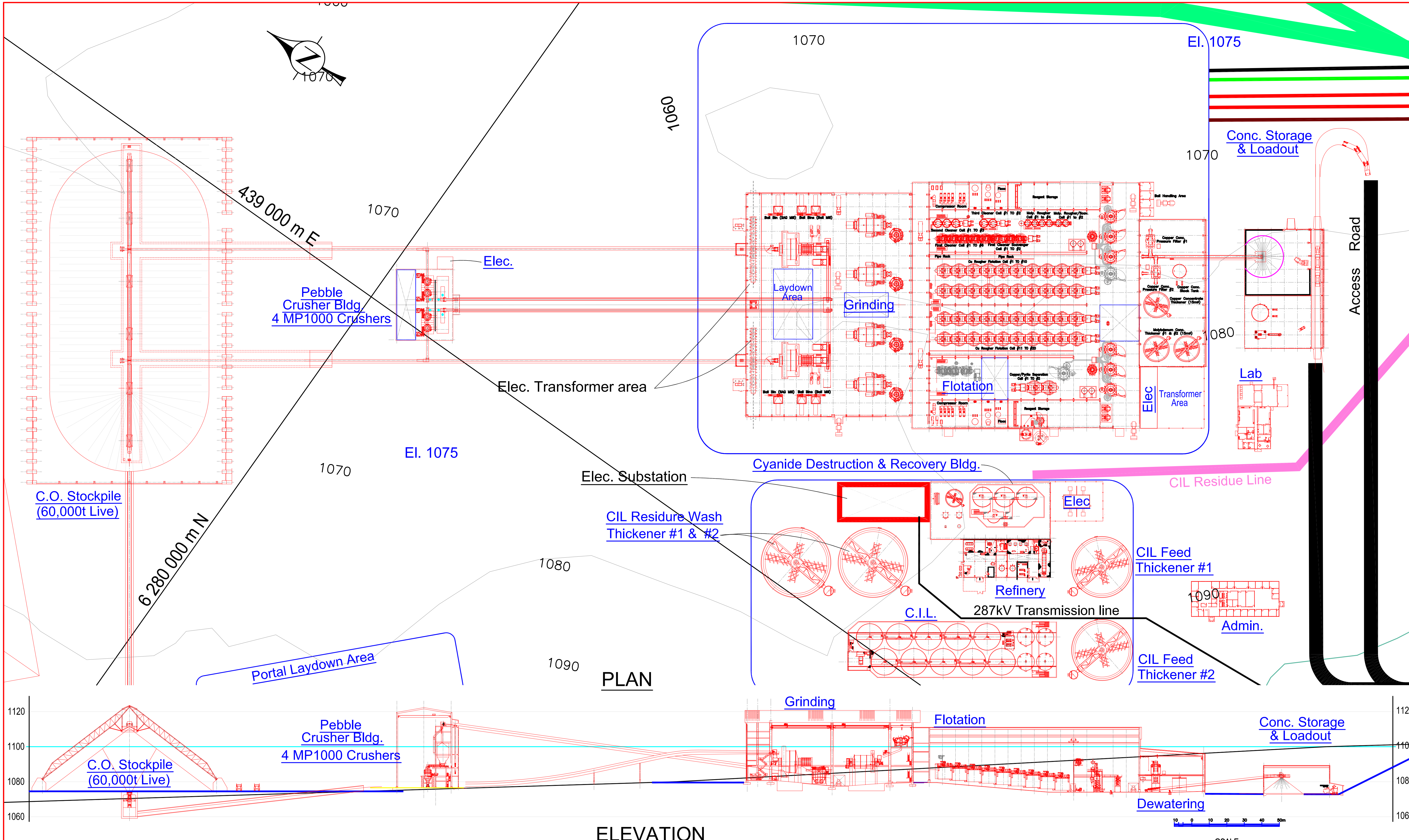
APPENDIX B

SABC Option – Layout



REV. No.	ISSUED FOR	REVISION DESCRIPTION	DR.	CHK.	APP.	DATE	REV. No.	ISSUED FOR	REVISION DESCRIPTION	DR.	CHK.	APP.	DATE	REFERENCE DRAWING	REF. DWG No.
							C		ISSUE FOR J. HUANG'S REPORT	BW		HB	2012/06/22		
							B		Elec room revised and E. Sub. relocated	BW		HB	2012/04/02		
							A		ISSUE FOR PFS UPDATE 2012	BW		HB	2012/02/10		

SCALE:	DATE:
DESIGNED: H. Bosche	Feb 10 2012
DRAWN: B. Wong	Feb 10 2012
CHECKED:	
APPROVED:	

CLIENT: KERR–SULPHURETS–MITCHELL

BOSCHE VENTURES LTD

TITLE: PFS UPDATE 2012 (SAG OPTION) PROCESS PLANT AT TREATY PLAN & SECTION

PROJECT No. | DRAWING No. 10–10–1759 | REV No. C

CADD FILE No.: S:\

APPENDIX C

SABC Option – Comminution Circuit Load List

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KSM ENERGY STUDY SABC OPTION LOAD LIST

Notes:

1. Motor Loading is defined as the average load divided by the installed Peak Load.
2. Motor efficiencies have been considered in the Electrical Load.
3. Utilization Factor is defined as the percent of time the motor actually runs in the summer or winter.
4. Utilization factors have been set in accordance with Process/Mech instructions.
5. Synchronous motors assumed for Ball Mills, running at leading 95% power factor.
6. Overall corrected power factor will be 97%.

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

EQM CODE	LOAD NAME	ELECTRICAL LOAD (kW)	OPERATING	STANDBY	FUTURE	MOTOR LOADING	SUMMER USE FACTOR (%)	WINTER USE FACTOR (%)	SUMMER KWH	WINTER KWH	ANNUAL KWH
E05-CNV-010	TREATY COARSE ORE STOCKPILE TRIPPER CONVEYOR	700.0	TRUE	FALSE	FALSE	0.74	94	94	2,132,965	2,132,965	4,265,930
E05-CNV-011	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.1	65.0	TRUE	FALSE	FALSE	0.74	94	94	198,061	198,061	396,122
E05-CNV-012	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.2	56.0	TRUE	FALSE	FALSE	0.74	94	94	170,637	170,637	341,274
E05-CNV-013	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.3	65.0	TRUE	FALSE	FALSE	0.74	94	94	198,061	198,061	396,122
E05-CNV-014	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.4	56.0	TRUE	FALSE	FALSE	0.74	94	94	170,637	170,637	341,274
E05-CNV-021	SAG MILL FEED CONVEYOR No.1	565.0	TRUE	FALSE	FALSE	0.74	94	94	1,721,608	1,721,608	3,443,215
E05-CNV-022	SAG MILL FEED CONVEYOR No.2	565.0	TRUE	FALSE	FALSE	0.74	94	94	1,721,608	1,721,608	3,443,215
E05-CNV-052	TREATY COARSE ORE RECLAIM DUST COLLECTOR SCREW CONVEYOR	3.7	TRUE	FALSE	FALSE	0.80	10	10	1,296	1,296	2,593
E05-COL-051	TREATY COARSE ORE RECLAIM DUST COLLECTOR WITH EXHAUST FAN	149.0	TRUE	FALSE	FALSE	0.80	94	94	490,770	490,770	981,540
E05-FAN-702	BUILDING SERVICES EXHAUST FAN - RECLAIM TUNNEL COARSE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E05-FAN-710	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN COARSE ORE STOCKPILE	78.0	TRUE	FALSE	FALSE	0.85	100	100	290,394	290,394	580,788
E05-FAN-717	BUILDING SERVICES AIR HANDLING UNIT - NO HEAT - RECLAIM COARSE ORE STOCKPILE	18.7	TRUE	FALSE	FALSE	0.85	100	100	69,620	69,620	139,240
E05-FDR-001	TREATY COARSE ORE RECLAIM APRON FEEDER No.1	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-002	TREATY COARSE ORE RECLAIM APRON FEEDER No.2	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-003	TREATY COARSE ORE RECLAIM APRON FEEDER No.3	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-004	TREATY COARSE ORE RECLAIM APRON FEEDER No.4	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-005	TREATY COARSE ORE RECLAIM APRON FEEDER No.5	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-006	TREATY COARSE ORE RECLAIM APRON FEEDER No.6	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-HOI-041	TREATY COARSE ORE STOCKPILE HOIST No.1	2.0	TRUE	FALSE	FALSE	0.80	10	10	701	701	1,402
E05-HOI-042	TREATY COARSE ORE STOCKPILE HOIST No.2	2.0	TRUE	FALSE	FALSE	0.80	10	10	701	701	1,402
E05-HTR-701	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-702	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-703	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-704	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-705	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-706	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-707	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-708	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-709	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-710	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-711	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-712	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-713	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-714	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-715	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-716	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-718	BUILDING SERVICES UNIT HEATER - FIRE VALVE ROOM COARSE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	0	100	0	13,775	13,775
E05-VLV-053	TREATY COARSE ORE RECLAIM DUST COLLECTOR ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E07-ACU-701	BUILDING SERVICES AIR CONDITIONING UNIT - ELECT ROOM PEBBLE CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	50	0	13,961	0	13,961
E07-ACU-702	BUILDING SERVICES AIR COOLED CONDENSING UNIT ELECTRICAL ROOM PEBBLE CRUSHING	18.7	TRUE	FALSE	FALSE	0.85	50	0	34,810	0	34,810
E07-CNV-541	SAG MILL SCREEN OVERSIZE CONVEYOR No.1	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-CNV-542	PEBBLE CRUSHER FEED CONVEYOR No.1	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E07-CNV-544	PEBBLE CRUSHER DISCHARGE CONVEYOR No.1	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-CNV-551	SAG MILL SCREEN OVERSIZE CONVEYOR No.2	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-CNV-552	PEBBLE CRUSHER FEED CONVEYOR No.2	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E07-CNV-554	PEBBLE CRUSHER DISCHARGE CONVEYOR No.2	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-CRN-020	PEBBLE CRUSHING CRANE	45.0	TRUE	FALSE	FALSE	0.80	10	10	15,768	15,768	31,536
E07-CRU-561	PEBBLE CRUSHER No.1	750.0	TRUE	FALSE	FALSE	0.63	94	94	1,958,846	1,958,846	3,917,691
E07-CRU-562	PEBBLE CRUSHER No.2	750.0	TRUE	TRUE	FALSE	0.63	94	94	1,958,846	1,958,846	3,917,691
E07-CRU-563	PEBBLE CRUSHER No.3	750.0	TRUE	FALSE	FALSE	0.63	94	94	1,958,846	1,958,846	3,917,691
E07-CRU-564	PEBBLE CRUSHER No.4	750.0	TRUE	TRUE	FALSE	0.63	94	94	1,958,846	1,958,846	3,917,691
E07-FAN-702	BUILDING SERVICES SUPPLY FAN / FILTER - (PRESSURIZATION) ELECTRICAL ROOM PEBBLE CRUSHING	5.5	TRUE	FALSE	FALSE	0.85	100	100	20,477	20,477	40,953
E07-FAN-703	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PEBBLE CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E07-FAN-704	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PEBBLE CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E07-FAN-705	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - LUBE ROOM PEBBLE CRUSHING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E07-FAN-706	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - LUBE ROOM PEBBLE CRUSHING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E07-FAN-710	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PEBBLE CRUSHING	250.0	TRUE	FALSE	FALSE	0.85	100	100	930,750	930,750	1,861,500
E07-FAN-711	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PEBBLE CRUSHING	200.0	TRUE	FALSE	FALSE	0.85	100	100	744,600	744,600	1,489,200
E07-FDR-543	PEBBLE CRUSHER BELT FEEDER No.1	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-FDR-553	PEBBLE CRUSHER BELT FEEDER No.2	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-FDR-557	PEBBLE CRUSHER BELT FEEDER No.3	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-FDR-558	PEBBLE CRUSHER BELT FEEDER No.4	15.0	TRUE	FALSE	FALSE	0.74	94	94	45,706	45,706	91,413
E07-HOI-190	PEBBLE CRUSHING HOIST	5.0	TRUE	FALSE	FALSE	0.80	5	5	876	876	1,752
E07-HTR-703	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PEBBLE CRUSHING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E07-HTR-704	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PEBBLE CRUSHING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E07-HTR-706	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-707	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-708	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-709	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-710	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-711	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-712	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-713	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-714	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-715	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-716	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-717	BUILDING SERVICES PROPANE UNIT HEATER PEBBLE CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-LUB-030	PEBBLE CRUSHER LUBE UNIT No.1	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E07-LUB-031	PEBBLE CRUSHER LUBE UNIT No.2	5.0	FALSE	TRUE	FALSE	0.80	94	94	0	0	0
E07-LUB-032	PEBBLE CRUSHER LUBE UNIT No.3	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E07-LUB-033	PEBBLE CRUSHER LUBE UNIT No.4	5.0	FALSE	TRUE	FALSE	0.80	94	94	0	0	0
E07-MED-185	PEBBLE CRUSHER FEED CONVEYOR METAL DETECTOR No.1	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881
E07-MED-186	PEBBLE CRUSHER FEED CONVEYOR METAL DETECTOR No.2	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881
E07-MGT-571	PEBBLE CRUSHER FEED SELF CLEANER MAGNET No.1	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E07-MGT-572	PEBBLE CRUSHER FEED SELF CLEANER MAGNET No.2	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E07-MGT-573	PEBBLE CRUSHER FEED SELF CLEANER MAGNET No.3	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E07-MGT-574	PEBBLE CRUSHER FEED SELF CLEANER MAGNET No.4	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E07-SCB-187	PEBBLE CRUSHER FEED CONVEYOR BELT SCALE No.1	0.5	TRUE	FALSE	FALSE	0.80	94	94	1,647	1,647	3,294
E07-SCB-188	PEBBLE CRUSHER FEED CONVEYOR BELT SCALE No.2	0.5	TRUE	FALSE	FALSE	0.80	94	94	1,647	1,647	3,294
E07-SYS-580	PEBBLE CRUSHER AREA FOGGING SYSTEM	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-ACU-001	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL MCC ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-002	BUILDING SERVICES AIR COOLED CONDENSING UNIT - MCC ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	50	0	27,736	0	27,736
E15-ACU-003	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL ELECT ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-004	BUILDING SERVICES AIR COOLED CONDENSING UNIT - ELECT ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	50	0	27,736	0	27,736
E15-ACU-005	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL OFFICES PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-006	BUILDING SERVICES AIR COOLED CONDENSING UNIT - OFFICES PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	50	0	20,849	0	20,849
E15-ACU-007	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL CONTROL ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-008	BUILDING SERVICES AIR COOLED CONDENSING UNIT - CONTROL ROOM PRIMARY GRINDING	15.0	TRUE	FALSE	FALSE	0.85	50	0	27,923	0	27,923
E15-ANA-003	PARTICLE SIZE ANALYZER No.1	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881
E15-ANA-004	PARTICLE SIZE ANALYZER No.2	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881
E15-BRK-191	SAG MILL BRAKE No.1	30.5	TRUE	FALSE	FALSE	0.80	10	10	10,687	10,687	21,374
E15-BRK-192	SAG MILL BRAKE No.2	30.5	TRUE	FALSE	FALSE	0.80	10	10	10,687	10,687	21,374
E15-CRN-005	PRIMARY GRINDING CRANE No.1	120.0	TRUE	FALSE	FALSE	0.80	10	10	42,048	42,048	84,096
E15-CRN-007	PRIMARY GRINDING CRANE No.2	75.0	TRUE	FALSE	FALSE	0.80	10	10	26,280	26,280	52,560
E15-CRN-008	PRIMARY GRINDING CRANE No.3	75.0	TRUE	FALSE	FALSE	0.80	10	10	26,280	26,280	52,560
E15-EQP-193	FEED CHUTE DRIVE SYSTEM HYDRAULIC UNIT No.1	7.5	TRUE	FALSE	FALSE	0.80	10	10	2,628	2,628	5,256

SEABRIDGE GOLD

KSM ENERGY STUDY SABC OPTION LOAD LIST

Notes:

1. Motor Loading is defined as the average load divided by the installed Peak Load.
2. Motor efficiencies have been considered in the Electrical Load.
3. Utilization Factor is defined as the percent of time the motor actually runs in the summer or winter.
4. Utilization factors have been set in accordance with Process/Mech instructions.
5. Synchronous motors assumed for Ball Mills, running at leading 95% power factor.
6. Overall corrected power factor will be 97%.

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

EQM CODE	LOAD NAME	ELECTRICAL LOAD (kW)	OPERATING	STANDBY	FUTURE	MOTOR LOADING	SUMMER USE FACTOR (%)	WINTER USE FACTOR (%)	SUMMER KWH	WINTER KWH	ANNUAL KWH
E15-EQP-194	FEED CHUTE DRIVE SYSTEM HYDRAULIC UNIT No.2	7.5	TRUE	FALSE	FALSE	0.80	10	10	2,628	2,628	5,256
E15-EQP-581	SAG MILL GMD CYCLOCONVERTER No.1	150.0	TRUE	FALSE	FALSE	0.70	94	94	432,306	432,306	864,612
E15-EQP-582	SAG MILL GMD CYCLOCONVERTER No.2	150.0	TRUE	FALSE	FALSE	0.70	94	94	432,306	432,306	864,612
E15-FAN-001	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-002	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-003	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-004	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-005	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-006	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-007	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-008	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-009	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-010	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-011	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-012	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-013	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-014	BUILDING SERVICES AIR HANDLING UNIT (no heat) - TRANSFORMER ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	100	100	55,473	55,473	110,945
E15-FAN-015	BUILDING SERVICES AIR HANDLING UNIT (no heat) - TRANSFORMER ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	100	100	55,473	55,473	110,945
E15-FAN-016	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - MCC ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-017	BUILDING SERVICES WALL SUPPLY FAN / FILTER UNIT - BALL MILL LUBE ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-018	BUILDING SERVICES WALL SUPPLY FAN / FILTER UNIT - BALL MILL LUBE ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-019	BUILDING SERVICES WALL SUPPLY FAN / FILTER UNIT - SAG MILL LUBE ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-020	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - ELECT ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-021	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - CONTROL ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-701	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E15-FAN-702	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E15-FAN-703	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-704	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-705	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-706	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-711	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E15-FAN-712	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	65.0	TRUE	FALSE	FALSE	0.85	100	100	241,995	241,995	483,990
E15-FAN-811	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	128.0	TRUE	FALSE	FALSE	0.85	100	100	476,544	476,544	953,088
E15-FAN-812	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E15-FDR-600	SAG MILL 125mm AUTOMATIC BALL CHARGING FEEDER	0.5	TRUE	FALSE	FALSE	0.74	94	94	1,524	1,524	3,047
E15-HAN-036	BALL MILL LINER HANDLER	80.0	TRUE	FALSE	FALSE	0.80	10	10	28,032	28,032	56,064
E15-HAN-509	SAG MILL LINER HANDLER	100.0	TRUE	FALSE	FALSE	0.80	10	10	35,040	35,040	70,080
E15-HOI-189	GRINDING AREA SUMP PUMP HOIST	25.0	TRUE	FALSE	FALSE	0.80	5	5	4,380	4,380	8,760
E15-HTR-001	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-002	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-003	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-004	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-005	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-006	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-007	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-008	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-009	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-012	BUILDING SERVICES PROPANE MAKE UP AIR UNIT PRIMARY GRINDING	18.7	TRUE	FALSE	FALSE	0.85	0	100	0	69,620	69,620
E15-HTR-013	BUILDING SERVICES PROPANE MAKE UP AIR UNIT PRIMARY GRINDING	18.7	TRUE	FALSE	FALSE	0.85	0	100	0	69,620	69,620
E15-HTR-016	BUILDING SERVICES ELECTRIC DUCT HEATER - ELECT ROOM PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-017	BUILDING SERVICES ELECTRIC DUCT HEATER - MCC PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-018	BUILDING SERVICES ELECTRIC DUCT HEATER - CONTROL ROOM PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-019	BUILDING SERVICES ELECTRIC DUCT HEATER - MCC PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-701	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PRIMARY GRINDING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E15-HTR-702	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PRIMARY GRINDING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E15-HTR-703	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-704	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-705	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-706	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-707	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-708	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-709	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-710	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-711	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-712	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-713	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-714	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-LUB-031	BALL MILL LUBE UNIT No.1	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-032	BALL MILL LUBE UNIT No.2	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-033	BALL MILL LUBE UNIT No.3	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-034	BALL MILL LUBE UNIT No.4	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-505	SAG MILL LUBE UNIT No.1	200.0	TRUE	FALSE	FALSE	0.80	94	94	658,752	658,752	1,317,504
E15-LUB-506	SAG MILL LUBE UNIT No.2	200.0	TRUE	FALSE	FALSE	0.80	94	94	658,752	658,752	1,317,504
E15-MIL-025	BALL MILL No.1	14000.0	TRUE	FALSE	FALSE	0.79	94	94	45,609,450	45,609,450	91,218,899
E15-MIL-026	BALL MILL No.2	14000.0	TRUE	FALSE	FALSE	0.79	94	94	45,609,450	45,609,450	91,218,899
E15-MIL-027	BALL MILL No.3	14000.0	TRUE	FALSE	FALSE	0.79	94	94	45,609,450	45,609,450	91,218,899
E15-MIL-028	BALL MILL No.4	14000.0	TRUE	FALSE	FALSE	0.79	94	94	45,609,450	45,609,450	91,218,899
E15-MIL-501	SAG MILL No.1	22500.0	TRUE	FALSE	FALSE	0.94	94	94	86,812,565	86,812,565	173,625,130
E15-MIL-502	SAG MILL No.2	22500.0	TRUE	FALSE	FALSE	0.94	94	94	86,812,565	86,812,565	173,625,130
E15-PPK-184	MILL INCHING HYDRAULIC POWER PACK	150.0	FALSE	FALSE	TRUE	0.80	5	5	0	0	0
E15-PSL-045	PRIMARY CYCLONE CLUSTER No.1 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-046	PRIMARY CYCLONE CLUSTER No.2 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-047	PRIMARY CYCLONE CLUSTER No.3 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-048	PRIMARY CYCLONE CLUSTER No.4 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-049	PRIMARY CYCLONE CLUSTER No.1 & 2 FEED PUMP (VFD) (BACK-UP)	1650.0	FALSE	TRUE	FALSE	0.85	94	94	0	0	0
E15-PSL-050	PRIMARY CYCLONE CLUSTER No.3 & 4 FEED PUMP (VFD) (BACK-UP)	1650.0	FALSE	TRUE	FALSE	0.85	94	94	0	0	0
E15-PSL-521	SAG MILL SCREEN UNDERSIZE PUMP No.1	500.0	TRUE	FALSE	FALSE	0.85	94	94	1,741,196	1,741,196	3,482,392
E15-PSL-529	SAG MILL SCREEN UNDERSIZE BACK-UP PUMP	500.0	FALSE	FALSE	FALSE	0.85	94	94	0	0	0
E15-PSL-531	SAG MILL SCREEN UNDERSIZE PUMP No.2	500.0	TRUE	FALSE	FALSE	0.85	94	94	1,741,196	1,741,196	3,482,392
E15-PSU-066	GRINDING AREA SUMP PUMP No.1	60.0	TRUE	FALSE	FALSE	0.80	10	10	21,024	21,024	42,048
E15-PSU-068	GRINDING AREA SUMP PUMP No.2	60.0	TRUE	FALSE	FALSE	0.80	10	10	21,024	21,024	42,048
E15-SCB-545	PEBBLE CRUSHER DISCHARGE SCALE No.1	1.0	TRUE	FALSE	FALSE	0.80	70	70	2,453	2,453	4,906
E15-SCB-555	PEBBLE CRUSHER DISCHARGE SCALE No.2	1.0	TRUE	FALSE	FALSE	0.80	70	70	2,453	2,453	4,906
E15-SCN-511	SAG MILL SCREEN No.1	45.0	TRUE	FALSE	FALSE	0.85	94	94	156,708	156,708	313,415
E15-SYS-511	MILL COOLING SYSTEM	750.0	TRUE	FALSE	FALSE	0.85	20	92	555,701	2,556,224	3,111,925
E15-SCN-512	SAG MILL SCREEN No.2	45.0	TRUE	FALSE	FALSE	0.85	94	94	156,708	156,708	313,415
E15-SMP-060	CYCLONE CLUSTER OVERFLOW No.1 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-061	CYCLONE CLUSTER OVERFLOW No.2 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-062	CYCLONE CLUSTER OVERFLOW No.3 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-063	CYCLONE CLUSTER OVERFLOW No.4 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
	TOTALS								408,806,483	411,936,192	820,742,674

APPENDIX D

SABC Option – Capital and Operating Cost Estimates

Project No: 0952880200-EST-R0001-02 | Kerr-Sulphurets-Mitchell Project | Report Date: 05-Jun-12

Client: Seabridge Gold Inc. | SABC Circuit Option - Major Summary | Rev E2

		Labour Manhour	Labour Cost	Material Cost	Construction Equipment Cost	Process Equipment Cost	Total Cost (CAD)
Direct Works							
A	Teigen Plansite	24,396	2,634,761	383,877	1,837,837	0	4,856,475
E0	Plantsite Crushing	555,254	59,967,388	59,290,856	3,960,684	40,259,293	163,478,221
E1	Plantsite Grinding	404,311	43,665,637	32,328,072	2,170,327	164,417,715	242,581,751
M1	Temporary Services	0	0	9,685,000	0	0	9,685,000
	Direct Works Subtotal	**983,961**	**106,267,787**	**101,687,805**	**7,968,847**	**204,677,008**	**420,601,447**
Indirects							
X	Project Indirects	210,290	24,082,252	151,909,638	75,000	0	176,066,890
Y	Owner's Costs	0	0	0	0	0	0
Z	Contingencies	0	0	82,244,000	0	0	82,244,000
	Indirects Subtotal	**210,290**	**24,082,252**	**234,153,638**	**75,000**	**0**	**258,310,890**
Option 6 (SAG+Conveyance) Total		**1,194,251**	**130,350,039**	**335,841,443**	**8,043,847**	**204,677,008**	**678,912,337**

Area		Labour Manhour	Labour Cost	Material Cost	Construction Eqpt Cost	Process Eqpt Cost	Total Cost (CAD)
A - Teigen Plansite		**24,396**	**2,634,761**	**383,877**	**1,837,837**	**0**	**4,856,475**
A10	*Plantsite and Roads*	*24,396*	*2,634,761*	*383,877*	*1,837,837*	*0*	*4,856,475*
E0 - Plantsite Crushing		**555,254**	**59,967,388**	**59,290,856**	**3,960,684**	**40,259,293**	**163,478,221**
E05	*Teigen Coarse Ore Stockpile*	*440,204*	*47,542,018*	*47,381,990*	*3,099,826*	*21,301,219*	*119,325,052*
E07	*Secondary Crushing*	*115,050*	*12,425,371*	*11,908,867*	*860,858*	*18,958,074*	*44,153,169*
E1 - Plantsite Grinding		**404,311**	**43,665,637**	**32,328,072**	**2,170,327**	**164,417,715**	**242,581,751**
E10	*Mill Building*	*278,278*	*30,054,056*	*29,817,328*	*1,881,641*	*2,047,060*	*63,800,085*
E15	*Primary & Secondary Grinding*	*126,033*	*13,611,581*	*2,510,745*	*288,685*	*162,370,655*	*178,781,665*
M1 - Temporary Services		**0**	**0**	**9,685,000**	**0**	**0**	**9,685,000**
M12	*Catering and Housekeeping*	*0*	*0*	*9,685,000*	*0*	*0*	*9,685,000*
X - Project Indirects		**210,290**	**24,082,252**	**151,909,638**	**75,000**	**0**	**176,066,890**
X10	*Construction Indirects*	*154,950*	*16,734,652*	*44,048,000*	*0*	*0*	*60,782,652*
X20	*Spares*	*0*	*0*	*13,720,000*	*0*	*0*	*13,720,000*
X30	*Initial Fills*	*0*	*0*	*9,522,821*	*0*	*0*	*9,522,821*
X40	*Freight And Logistic*	*0*	*0*	*13,734,000*	*0*	*0*	*13,734,000*
X50	*Commissioning and Pre-operational Startup*	*51,840*	*6,969,600*	*7,269,600*	*0*	*0*	*14,239,200*
X60	*EPCM*	*3,500*	*378,000*	*63,615,217*	*75,000*	*0*	*64,068,217*
Y - Owner's Costs		**0**	**0**	**0**	**0**	**0**	**0**
Y10	*Owner's Costs*	*0*	*0*	*0*	*0*	*0*	*0*
Z - Contingencies		**0**	**0**	**82,244,000**	**0**	**0**	**82,244,000**
Z10	*Contingency*	*0*	*0*	*82,244,000*	*0*	*0*	*82,244,000*

Area	Labour Manhour	Labour Cost	Material Cost	Construction Eqpt Cost	Process Eqpt Cost	Total Cost (CAD)
Option 6 (SAG+Conveyance) Total	**1,194,251**	**130,350,039**	**335,841,443**	**8,043,847**	**204,677,008**	**678,912,337**

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10 - Plantsite and Roads														
A10-10-8.00	Teigen Plantsite; Camp 6; Clear and grub	4.53 ha	93.60	424.00	108.00	45,792	0.00	0	4,560.00	20,656	0.00	0	14,668.80	66,448
A10-10-9.00	Teigen Plantsite; Camp 6; Excavate and remove top soil 300mm	12,783. m3	0.04	498.54	108.00	53,842	0.00	0	4.25	54,328	0.00	0	8.46	108,170
A10-10-10.00	Teigen Plantsite; Camp 6; Rock excavation - rippable rock	1,044. m3	0.04	40.72	108.00	4,397	0.00	0	5.50	5,742	0.00	0	9.71	10,139
A10-10-11.00	Teigen Plantsite; Camp 6; Rock excavation - drilll and blast	9,396. m3	0.10	977.18	108.00	105,536	3.00	28,188	4.50	42,282	0.00	0	18.73	176,006
A10-10-12.00	Teigen Plantsite; Camp 6; Excavate and remove unsuitable material	5,220. m3	0.04	203.58	108.00	21,987	0.00	0	4.25	22,185	0.00	0	8.46	44,172
A10-10-13.00	Teigen Plantsite; Camp 6; Excavate to temporary stockpile (not exceeding 2km haul)	4,230. m3	0.03	109.98	108.00	11,878	0.00	0	4.25	17,978	0.00	0	7.06	29,855
A10-10-14.00	Teigen Plantsite; 250 Person Permenent Camp; Clear and grub	1.22 ha	93.60	113.94	108.00	12,305	0.00	0	4,560.00	5,551	0.00	0	14,668.80	17,856
A10-10-15.00	Teigen Plantsite; 250 Person Permenent Camp; Excavate and remove top soil 300mm	3,160. m3	0.04	123.24	108.00	13,310	0.00	0	4.25	13,430	0.00	0	8.46	26,740
A10-10-16.00	Teigen Plantsite; 250 Person Permenent Camp; Rock excavation - rippable rock	436. m3	0.04	17.00	108.00	1,836	0.00	0	5.50	2,398	0.00	0	9.71	4,234
A10-10-17.00	Teigen Plantsite; 250 Person Permenent Camp; Rock excavation - drilll and blast	3,927. m3	0.10	408.41	108.00	44,108	3.00	11,781	4.50	17,672	0.00	0	18.73	73,561
A10-10-18.00	Teigen Plantsite; 250 Person Permenent Camp; Excavate and remove unsuitable material	2,182. m3	0.04	85.10	108.00	9,191	0.00	0	4.25	9,274	0.00	0	8.46	18,464
A10-10-19.00	Teigen Plantsite; 250 Person Permenent Camp; Compacted Fill from temporary stockpile (not exceeding 2km haul)	756. m3	0.03	19.66	108.00	2,123	0.00	0	4.75	3,591	0.00	0	7.56	5,714
A10-10-20.00	Teigen Plantsite; Portal Laydown Area; Clear and grub	1.08 ha	93.60	100.94	108.00	10,901	0.00	0	4,560.00	4,918	0.00	0	14,668.80	15,819
A10-10-21.00	Teigen Plantsite; Portal Laydown Area; Excavate and remove top soil 300mm	2,692. m3	0.04	104.99	108.00	11,339	0.00	0	4.25	11,441	0.00	0	8.46	22,780
A10-10-22.00	Teigen Plantsite; Portal Laydown Area; Rock excavation - rippable rock	411. m3	0.04	16.03	108.00	1,731	0.00	0	5.50	2,261	0.00	0	9.71	3,992
A10-10-23.00	Teigen Plantsite; Portal Laydown Area; Rock excavation - drilll and blast	3,703. m3	0.10	385.11	108.00	41,592	3.00	11,109	4.50	16,664	0.00	0	18.73	69,365

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-24.00	Teigen Plantsite; Portal Laydown Area; Excavate and remove unsuitable material	2,057. m3	0.04	80.22	108.00	8,664	0.00	0	4.25	8,742	0.00	0	8.46	17,406
A10-10-25.00	Teigen Plantsite; Portal Laydown Area; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,077. m3	0.03	54.00	108.00	5,832	0.00	0	4.75	9,866	0.00	0	7.56	15,698
A10-10-26.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Clear and grub	4.07 ha	93.60	381.28	108.00	41,178	0.00	0	4,560.00	18,575	0.00	0	14,668.80	59,753
A10-10-27.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate and remove top soil 300mm	10,027. m3	0.04	391.05	108.00	42,234	0.00	0	4.25	42,615	0.00	0	8.46	84,848
A10-10-28.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Rock excavation - rippable rock	4,305. m3	0.04	167.90	108.00	18,133	0.00	0	5.50	23,678	0.00	0	9.71	41,810
A10-10-29.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Rock excavation - drilll and blast	38,746. m3	0.10	4,029.58	108.00	435,195	3.00	116,238	4.50	174,357	0.00	0	18.73	725,790
A10-10-30.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate and remove unsuitable material	21,526. m3	0.04	839.51	108.00	90,668	0.00	0	4.25	91,486	0.00	0	8.46	182,153
A10-10-31.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate to fill, suitable material	11,499. m3	0.02	224.23	108.00	24,217	0.00	0	4.50	51,746	0.00	0	6.61	75,962
A10-10-32.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Compacted Fill from temporary stockpile (not exceeding 2km haul)	14,794. m3	0.03	384.64	108.00	41,542	0.00	0	4.75	70,272	0.00	0	7.56	111,813
A10-10-33.00	Teigen Plantsite; Grinding; Clear and grub	6.41 ha	93.60	600.02	108.00	64,802	0.00	0	4,560.00	29,232	0.00	0	14,668.80	94,034
A10-10-34.00	Teigen Plantsite; Grinding; Excavate and remove top soil 300mm	17,813. m3	0.04	694.71	108.00	75,028	0.00	0	4.25	75,705	0.00	0	8.46	150,734
A10-10-35.00	Teigen Plantsite; Grinding; Rock excavation - rippable rock	2,786. m3	0.04	108.65	108.00	11,735	0.00	0	5.50	15,323	0.00	0	9.71	27,058
A10-10-36.00	Teigen Plantsite; Grinding; Rock excavation - drilll and blast	25,072. m3	0.10	2,607.49	108.00	281,609	3.00	75,216	4.50	112,824	0.00	0	18.73	469,649
A10-10-37.00	Teigen Plantsite; Grinding; Excavate and remove unsuitable material	13,929. m3	0.04	543.23	108.00	58,669	0.00	0	4.25	59,198	0.00	0	8.46	117,867
A10-10-38.00	Teigen Plantsite; Grinding; Compacted Fill from temporary stockpile (not exceeding 2km haul)	20,140. m3	0.03	523.64	108.00	56,553	0.00	0	4.75	95,665	0.00	0	7.56	152,218
A10-10-39.00	Teigen Plantsite; Admin; Clear and grub	.57 ha	93.60	53.41	108.00	5,768	0.00	0	4,560.00	2,602	0.00	0	14,668.80	8,370

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-40.00	Teigen Plantsite; Admin; Excavate and remove top soil 300mm	1,316. m3	0.04	51.32	108.00	5,543	0.00	0	4.25	5,593	0.00	0	8.46	11,136
A10-10-41.00	Teigen Plantsite; Admin; Rock excavation - rippable rock	243. m3	0.04	9.48	108.00	1,024	0.00	0	5.50	1,337	0.00	0	9.71	2,360
A10-10-42.00	Teigen Plantsite; Admin; Rock excavation - drilll and blast	2,189. m3	0.10	227.66	108.00	24,587	3.00	6,567	4.50	9,851	0.00	0	18.73	41,004
A10-10-43.00	Teigen Plantsite; Admin; Excavate and remove unsuitable material	1,216. m3	0.04	47.42	108.00	5,122	0.00	0	4.25	5,168	0.00	0	8.46	10,290
A10-10-44.00	Teigen Plantsite; Admin; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,046. m3	0.03	105.20	108.00	11,361	0.00	0	4.75	19,219	0.00	0	7.56	30,580
A10-10-45.00	Teigen Plantsite; Temporary Muck Storage Pad; Clear and grub	1.32 ha	93.60	123.58	108.00	13,347	0.00	0	4,560.00	6,021	0.00	0	14,668.80	19,367
A10-10-46.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate and remove top soil 300mm	3,000. m3	0.04	117.00	108.00	12,636	0.00	0	4.25	12,750	0.00	0	8.46	25,386
A10-10-47.00	Teigen Plantsite; Temporary Muck Storage Pad; Rock excavation - rippable rock	823. m3	0.04	32.10	108.00	3,466	0.00	0	5.50	4,527	0.00	0	9.71	7,993
A10-10-48.00	Teigen Plantsite; Temporary Muck Storage Pad; Rock excavation - drilll and blast	7,404. m3	0.10	770.02	108.00	83,162	3.00	22,212	4.50	33,318	0.00	0	18.73	138,692
A10-10-49.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate and remove unsuitable material	4,113. m3	0.04	160.41	108.00	17,324	0.00	0	4.25	17,480	0.00	0	8.46	34,804
A10-10-50.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate to fill, suitable material	1,112. m3	0.02	21.68	108.00	2,342	0.00	0	4.50	5,004	0.00	0	6.61	7,346
A10-10-51.00	Teigen Plantsite; Temporary Muck Storage Pad; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,069. m3	0.03	105.79	108.00	11,426	0.00	0	4.75	19,328	0.00	0	7.56	30,754
A10-10-52.00	Teigen Plantsite; CN Destruction and Recovery; Clear and grub	3.21 ha	93.60	300.32	108.00	32,434	0.00	0	4,560.00	14,631	0.00	0	14,668.80	47,065
A10-10-53.00	Teigen Plantsite; CN Destruction and Recovery; Excavate and remove top soil 300mm	8,122. m3	0.04	316.76	108.00	34,210	0.00	0	4.25	34,519	0.00	0	8.46	68,728
A10-10-54.00	Teigen Plantsite; CN Destruction and Recovery; Rock excavation - rippable rock	2,599. m3	0.04	101.36	108.00	10,947	0.00	0	5.50	14,295	0.00	0	9.71	25,241
A10-10-55.00	Teigen Plantsite; CN Destruction and Recovery; Rock excavation - drilll and blast	23,393. m3	0.10	2,432.87	108.00	262,750	3.00	70,179	4.50	105,269	0.00	0	18.73	438,198

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-56.00	Teigen Plantsite; CN Destruction and Recovery; Excavate and remove unsuitable material	12,996. m3	0.04	506.84	108.00	54,739	0.00	0	4.25	55,233	0.00	0	8.46	109,972
A10-10-57.00	Teigen Plantsite; CN Destruction and Recovery; Excavate to fill, suitable material	4,874. m3	0.02	95.04	108.00	10,265	0.00	0	4.50	21,933	0.00	0	6.61	32,198
A10-10-58.00	Teigen Plantsite; CN Destruction and Recovery; Compacted Fill from temporary stockpile (not exceeding 2km haul)	13,278. m3	0.03	345.23	108.00	37,285	0.00	0	4.75	63,071	0.00	0	7.56	100,355
A10-10-59.00	Teigen Plantsite; Maintenance Shop; Clear and grub	1.11 ha	93.60	103.69	108.00	11,199	0.00	0	4,560.00	5,052	0.00	0	14,668.80	16,250
A10-10-60.00	Teigen Plantsite; Maintenance Shop; Excavate and remove top soil 300mm	2,810. m3	0.04	109.59	108.00	11,836	0.00	0	4.25	11,943	0.00	0	8.46	23,778
A10-10-61.00	Teigen Plantsite; Maintenance Shop; Rock excavation - rippable rock	465. m3	0.04	18.14	108.00	1,959	0.00	0	5.50	2,558	0.00	0	9.71	4,516
A10-10-62.00	Teigen Plantsite; Maintenance Shop; Rock excavation - drilll and blast	4,188. m3	0.10	435.55	108.00	47,040	3.00	12,564	4.50	18,846	0.00	0	18.73	78,450
A10-10-63.00	Teigen Plantsite; Maintenance Shop; Excavate and remove unsuitable material	2,327. m3	0.04	90.75	108.00	9,801	0.00	0	4.25	9,890	0.00	0	8.46	19,691
A10-10-64.00	Teigen Plantsite; Maintenance Shop; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,702. m3	0.03	70.25	108.00	7,587	0.00	0	4.75	12,835	0.00	0	7.56	20,422
A10-10-65.00	Teigen Plantsite; Container Storage Area; Clear and grub	1.09 ha	93.60	102.46	108.00	11,066	0.00	0	4,560.00	4,992	0.00	0	14,668.80	16,058
A10-10-66.00	Teigen Plantsite; Container Storage Area; Excavate and remove top soil 300mm	3,075. m3	0.04	119.93	108.00	12,952	0.00	0	4.25	13,069	0.00	0	8.46	26,021
A10-10-67.00	Teigen Plantsite; Container Storage Area; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,124. m3	0.03	107.22	108.00	11,580	0.00	0	4.75	19,589	0.00	0	7.56	31,169
A10-10-68.00	Teigen Plantsite; Construction Admin. Office; Clear and grub	.22 ha	93.60	20.58	108.00	2,223	0.00	0	4,560.00	1,003	0.00	0	14,668.80	3,226
A10-10-69.00	Teigen Plantsite; Construction Admin. Office; Excavate and remove top soil 300mm	529. m3	0.04	20.63	108.00	2,228	0.00	0	4.25	2,248	0.00	0	8.46	4,476
A10-10-70.00	Teigen Plantsite; Construction Admin. Office; Rock excavation - rippable rock	48. m3	0.04	1.87	108.00	202	0.00	0	5.50	264	0.00	0	9.71	466
A10-10-71.00	Teigen Plantsite; Construction Admin. Office; Rock excavation - drilll and blast	435. m3	0.10	45.24	108.00	4,886	3.00	1,305	4.50	1,958	0.00	0	18.73	8,148

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-72.00	Teigen Plantsite; Construction Admin. Office; Excavate and remove unsuitable material	242. m3	0.04	9.44	108.00	1,019	0.00	0	4.25	1,029	0.00	0	8.46	2,048
A10-10-73.00	Teigen Plantsite; Construction Admin. Office; Compacted Fill from temporary stockpile (not exceeding 2km haul)	273. m3	0.03	7.10	108.00	767	0.00	0	4.75	1,297	0.00	0	7.56	2,063
A10-10-74.00	Teigen Plantsite; Amb.; Clear and grub	.23 ha	93.60	21.70	108.00	2,343	0.00	0	4,560.00	1,057	0.00	0	14,668.80	3,400
A10-10-75.00	Teigen Plantsite; Amb.; Excavate and remove top soil 300mm	500. m3	0.04	19.50	108.00	2,106	0.00	0	4.25	2,125	0.00	0	8.46	4,231
A10-10-76.00	Teigen Plantsite; Amb.; Rock excavation - rippable rock	73. m3	0.04	2.85	108.00	307	0.00	0	5.50	402	0.00	0	9.71	709
A10-10-77.00	Teigen Plantsite; Amb.; Rock excavation - drilll and blast	658. m3	0.10	68.43	108.00	7,391	3.00	1,974	4.50	2,961	0.00	0	18.73	12,326
A10-10-78.00	Teigen Plantsite; Amb.; Excavate and remove unsuitable material	366. m3	0.04	14.27	108.00	1,542	0.00	0	4.25	1,556	0.00	0	8.46	3,097
A10-10-79.00	Teigen Plantsite; Amb.; Compacted Fill from temporary stockpile (not exceeding 2km haul)	390. m3	0.03	10.14	108.00	1,095	0.00	0	4.75	1,853	0.00	0	7.56	2,948
A10-10-80.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Clear and grub	.84 ha	93.60	78.62	108.00	8,491	0.00	0	4,560.00	3,830	0.00	0	14,668.80	12,322
A10-10-81.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate and remove top soil 300mm	1,842. m3	0.04	71.84	108.00	7,759	0.00	0	4.25	7,829	0.00	0	8.46	15,587
A10-10-82.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Rock excavation - rippable rock	470. m3	0.04	18.33	108.00	1,980	0.00	0	5.50	2,585	0.00	0	9.71	4,565
A10-10-83.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Rock excavation - drilll and blast	4,227. m3	0.10	439.61	108.00	47,478	3.00	12,681	4.50	19,022	0.00	0	18.73	79,180
A10-10-84.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate and remove unsuitable material	2,348. m3	0.04	91.57	108.00	9,890	0.00	0	4.25	9,979	0.00	0	8.46	19,869
A10-10-85.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate to fill, suitable material	506. m3	0.02	9.87	108.00	1,066	0.00	0	4.50	2,277	0.00	0	6.61	3,343
A10-10-86.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,903. m3	0.03	75.48	108.00	8,152	0.00	0	4.75	13,789	0.00	0	7.56	21,941
A10-10-87.00	Teigen Plantsite; Pre-construction Fuel Storage; Clear and grub	.49 ha	93.60	45.85	108.00	4,951	0.00	0	4,560.00	2,233	0.00	0	14,668.80	7,185

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-88.00	Teigen Plantsite; Pre-construction Fuel Storage; Excavate and remove top soil 300mm	1,087. m3	0.04	42.39	108.00	4,578	0.00	0	4.25	4,620	0.00	0	8.46	9,198
A10-10-89.00	Teigen Plantsite; Pre-construction Fuel Storage; Rock excavation - rippable rock	206. m3	0.04	8.03	108.00	868	0.00	0	5.50	1,133	0.00	0	9.71	2,001
A10-10-90.00	Teigen Plantsite; Pre-construction Fuel Storage; Rock excavation - drilll and blast	1,853. m3	0.10	192.71	108.00	20,813	3.00	5,559	4.50	8,339	0.00	0	18.73	34,710
A10-10-91.00	Teigen Plantsite; Pre-construction Fuel Storage; Excavate and remove unsuitable material	1,029. m3	0.04	40.13	108.00	4,334	0.00	0	4.25	4,373	0.00	0	8.46	8,707
A10-10-92.00	Teigen Plantsite; Pre-construction Fuel Storage; Compacted Fill from temporary stockpile (not exceeding 2km haul)	1,720. m3	0.03	44.72	108.00	4,830	0.00	0	4.75	8,170	0.00	0	7.56	13,000
A10-10-93.00	Teigen Plantsite; Pebble Crushers; Clear and grub	.58 ha	93.60	53.83	108.00	5,814	0.00	0	4,560.00	2,622	0.00	0	14,668.80	8,436
A10-10-94.00	Teigen Plantsite; Pebble Crushers; Excavate and remove top soil 300mm	1,452. m3	0.04	56.63	108.00	6,116	0.00	0	4.25	6,171	0.00	0	8.46	12,287
A10-10-95.00	Teigen Plantsite; Pebble Crushers; Rock excavation - rippable rock	153. m3	0.04	5.97	108.00	644	0.00	0	5.50	842	0.00	0	9.71	1,486
A10-10-96.00	Teigen Plantsite; Pebble Crushers; Rock excavation - drilll and blast	1,374. m3	0.10	142.90	108.00	15,433	3.00	4,122	4.50	6,183	0.00	0	18.73	25,738
A10-10-97.00	Teigen Plantsite; Pebble Crushers; Excavate and remove unsuitable material	763. m3	0.04	29.76	108.00	3,214	0.00	0	4.25	3,243	0.00	0	8.46	6,457
A10-10-98.00	Teigen Plantsite; Pebble Crushers; Compacted Fill from temporary stockpile (not exceeding 2km haul)	1,509. m3	0.03	39.23	108.00	4,237	0.00	0	4.75	7,168	0.00	0	7.56	11,405
A10-10-99.00	Teigen Plantsite; Process Water Tanks; Clear and grub	.54 ha	93.60	50.58	108.00	5,463	0.00	0	4,560.00	2,464	0.00	0	14,668.80	7,927
A10-10-100.00	Teigen Plantsite; Process Water Tanks; Excavate and remove top soil 300mm	1,452. m3	0.04	56.63	108.00	6,116	0.00	0	4.25	6,171	0.00	0	8.46	12,287
A10-10-101.00	Teigen Plantsite; Process Water Tanks; Rock excavation - rippable rock	155. m3	0.04	6.05	108.00	653	0.00	0	5.50	853	0.00	0	9.71	1,505
A10-10-102.00	Teigen Plantsite; Process Water Tanks; Rock excavation - drilll and blast	1,394. m3	0.10	144.98	108.00	15,657	3.00	4,182	4.50	6,273	0.00	0	18.73	26,112
A10-10-103.00	Teigen Plantsite; Process Water Tanks; Excavate and remove unsuitable material	774. m3	0.04	30.19	108.00	3,260	0.00	0	4.25	3,290	0.00	0	8.46	6,550

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-104.00	Teigen Plantsite; Process Water Tanks; Compacted Fill from temporary stockpile (not exceeding 2km haul)	1,487. m3	0.03	38.66	108.00	4,175	0.00	0	4.75	7,063	0.00	0	7.56	11,239
	A10 - Plantsite and Roads Subtotal			**24,395.94**		**2,634,761**		**383,877**		**1,837,837**		**0**		**4,856,475**

E05 - Teigen Coarse Ore Stockpile

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-13-108.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-13-109.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Detail Excavation	9,120. m3	0.08	711.36	108.00	76,827	0.00	0	3.75	34,200	0.00	0	12.17	111,027
E05-13-110.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Structural Backfill	5,880. m3	0.13	764.40	108.00	82,555	8.00	47,040	4.00	23,520	0.00	0	26.04	153,115
E05-20-111.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Concrete work	3,600. m3	8.45	30,420.00	108.00	3,285,360	765.00	2,754,000	25.00	90,000	0.00	0	1,702.60	6,129,360
E05-30-112.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Structural Steel	5,400. t	28.60	154,440.00	108.00	16,679,520	4,800.00	25,920,000	250.00	1,350,000	0.00	0	8,138.80	43,949,520
E05-40-113.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Wall cladding	6,050. m2	1.30	7,865.00	108.00	849,420	110.00	665,500	15.00	90,750	0.00	0	265.40	1,605,670
E05-40-114.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Roof cladding	31,115. m2	1.30	40,449.50	108.00	4,368,546	110.00	3,422,650	15.00	466,725	0.00	0	265.40	8,257,921
E05-40-115.00	Stockpile Reclaim - Main Tunnel	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-40-116.00	Stockpile Reclaim - Secondary Tunnel	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-13-117.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Detail Excavation	27,680. m3	0.08	2,159.04	108.00	233,176	0.00	0	3.75	103,800	0.00	0	12.17	336,976
E05-13-118.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Detail Excavation (Rock Excavation)	23,750. m3	0.13	3,087.50	108.00	333,450	0.00	0	5.50	130,625	0.00	0	19.54	464,075
E05-13-119.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Structural Backfill	13,080. m3	0.13	1,700.40	108.00	183,643	8.00	104,640	4.00	52,320	0.00	0	26.04	340,603
E05-20-120.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Concrete work	14,625. m3	8.45	123,581.25	108.00	13,346,775	765.00	11,188,125	25.00	365,625	0.00	0	1,702.60	24,900,525
E05-30-121.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Structural Steel	387. t	28.60	11,068.20	108.00	1,195,366	4,800.00	1,857,600	250.00	96,750	0.00	0	8,138.80	3,149,716

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-13-123.00	Conveyor; Detail Excavation	5,125. m3	0.08	399.75	108.00	43,173	0.00	0	3.75	19,219	0.00	0	12.17	62,392
E05-13-124.00	Conveyor; Structural Backfill	4,665. m3	0.13	606.45	108.00	65,497	8.00	37,320	4.00	18,660	0.00	0	26.04	121,477
E05-20-125.00	Conveyor; Concrete work	515. m3	8.45	4,351.75	108.00	469,989	765.00	393,975	25.00	12,875	0.00	0	1,702.60	876,839
E05-50-126.00	Teigen Coarse Ore Stockpile Tripper Conveyor, 1829 W x 300000 L [E05-CNV-010]	300. m	26.00	7,800.00	108.00	842,400	50.00	15,000	150.00	45,000	38,676.78	11,603,033	41,684.78	12,505,433
E05-55-127.00	Teigen Coarse Ore Stockpile Tripper Conveyor Head Chute	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E05-55-128.00	Teigen Coarse Ore Stockpile Tripper Conveyor Head Chute AR Liner	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E05-55-129.00	Teigen Coarse Ore Reclaim Apron Feeder Stockpile Inserts	6. ea	52.00	312.00	108.00	33,696	20,000.00	120,000	3,000.00	18,000	0.00	0	28,616.00	171,696
E05-55-130.00	Teigen Coarse Ore Reclaim Apron Feeder Feed Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632
E05-55-131.00	Teigen Coarse Ore Reclaim Apron Feeder Feed Chute AR Liners (6x)	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E05-50-132.00	Teigen Coarse Ore Reclaim Apron Feeder No.1, 1829 W x 8500 L [E05-FDR-001]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-133.00	Teigen Coarse Ore Reclaim Apron Feeder No.2, 1829 W x 8500 L [E05-FDR-002]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-134.00	Teigen Coarse Ore Reclaim Apron Feeder No.3, 1829 W x 8500 L [E05-FDR-003]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-135.00	Teigen Coarse Ore Reclaim Apron Feeder No.4, 1829 W x 8500 L [E05-FDR-004]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-136.00	Teigen Coarse Ore Reclaim Apron Feeder No.5, 1829 W x 8500 L [E05-FDR-005]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-137.00	Teigen Coarse Ore Reclaim Apron Feeder No.6, 1829 W x 8500 L [E05-FDR-006]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-55-138.00	Teigen Coarse Ore Reclaim Apron Feeder Dribbles Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-55-139.00	Teigen Coarse Ore Reclaim Apron Feeder Dribbles Chute AR Liners (6x)	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E05-55-140.00	Teigen Coarse Ore Reclaim Apron Feeder Discharge Chutes	6,120. kg	0.08	477.36	108.00	51,555	0.08	490	0.03	184	5.50	33,660	14.03	85,888
E05-55-141.00	Teigen Coarse Ore Reclaim Apron Feeder Discharge Chute AR Liners (6x)	5,040. kg	0.05	229.32	108.00	24,767	0.08	403	0.03	151	5.50	27,720	10.52	53,041
E05-50-142.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.1, 1372 W x 55000 L [E05-CNV-011]	55. m	23.40	1,287.00	108.00	138,996	50.00	2,750	150.00	8,250	6,051.64	332,840	8,778.84	482,836
E05-50-143.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.2, 1372 W x 20000 L [E05-CNV-012]	20. m	23.40	468.00	108.00	50,544	50.00	1,000	150.00	3,000	6,051.64	121,033	8,778.84	175,577
E05-55-144.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chutes (2x)	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E05-55-145.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chute AR Liners (2x)	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E05-50-146.00	SAG Mill Feed Conveyor No.1, 1524 W x 300000 L [E05-CNV-021]	300. m	28.60	8,580.00	108.00	926,640	50.00	15,000	150.00	45,000	8,048.01	2,414,403	11,336.81	3,401,043
E05-55-147.00	SAG Mill Feed Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E05-55-148.00	SAG Mill Feed Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E05-50-149.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.3, 1372 W x 85000 L [E05-CNV-013]	85. m	23.40	1,989.00	108.00	214,812	50.00	4,250	150.00	12,750	6,051.64	514,389	8,778.84	746,201
E05-50-150.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.4, 1372 W x 30000 L [E05-CNV-014]	30. m	23.40	702.00	108.00	75,816	50.00	1,500	150.00	4,500	6,051.64	181,549	8,778.84	263,365
E05-55-151.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chutes (2x)	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E05-55-152.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chute AR Liners (2x)	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E05-50-153.00	SAG Mill Feed Conveyor No.2, 1524 W x 300000 L [E05-CNV-022]	300. m	28.60	8,580.00	108.00	926,640	50.00	15,000	150.00	45,000	8,048.01	2,414,403	11,336.81	3,401,043
E05-55-154.00	SAG Mill Feed Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-55-155.00	SAG Mill Feed Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E05-50-156.00	Teigen Coarse Ore Stockpile Hoist No.1 (20m lift), 2T [E05-HOI-041]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791
E05-50-157.00	Teigen Coarse Ore Stockpile Hoist No.2 (20m lift), 2T [E05-HOI-042]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791
E05-50-158.00	Teigen Coarse Ore Reclaim Dust Collector Baghouse	1. lot	416.00	416.00	108.00	44,928	250.00	250	400.00	400	261,853.00	261,853	307,431.00	307,431
E05-50-159.00	Teigen Coarse Ore Reclaim Dust Collector With Exhaust Fan, included [E05-COL-051]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-160.00	Teigen Coarse Ore Reclaim Dust Collector Screw Conveyor, included [E05-CNV-052]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-161.00	Teigen Coarse Ore Reclaim Dust Collector Rotary Valve, included [E05-VLV-053]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-162.00	Teigen Coarse Ore Reclaim Dust Collector Dust Ducting, 25,000 CFM [E05-DUC-701]	1. lot	1,560.00	1,560.00	108.00	168,480	132,000.00	132,000	7,200.00	7,200	0.00	0	307,680.00	307,680
E05-58-163.00	Fire Protection; Auto Sprinklers @ Reclaim Tunnel Conveyor	252. ea	5.20	1,310.40	108.00	141,523	1,000.00	252,000	5.00	1,260	0.00	0	1,566.60	394,783
E05-58-164.00	Fire Protection; Auto Sprinklers @ Apron Feeders	168. ea	5.20	873.60	108.00	94,349	1,000.00	168,000	5.00	840	0.00	0	1,566.60	263,189
E05-58-165.00	Fire Protection; Fire Extinguishers	1. lot	5.20	5.20	108.00	562	400.00	400	5.00	5	0.00	0	966.60	967
E05-58-167.00	HVAC Allowance	1. lot	145.00	145.00	108.00	15,660	1,100.00	1,100	5,785.00	5,785	135,870.00	135,870	158,415.00	158,415
E05-60-187.00	Piping Allowance 1.00%	1. lot	546.89	546.89	108.00	59,064	213,666.92	213,667	2,308.79	2,309	0.00	0	275,039.37	275,039
E05-80-188.00	Field Instrumentation & Bulks Allowance	1. lot	1,029.60	1,029.60	108.00	111,197	24,630.00	24,630	3,680.00	3,680	130,000.00	130,000	269,506.80	269,507
E05-70-189.00	Electrical Motor Wiring, included in Area A20/A30	-	-	-	-	-	-	-	-	-	-	-	-	-
	E05 - Teigen Coarse Ore Stockpile Subtotal			**440,203.87**		**47,542,018**		**47,381,990**		**3,099,826**		**21,301,219**		**119,325,052**

E07 - Secondary Crushing

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-40-191.00	Pebble Crushing Building, 32m x 40m x 45m	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-13-192.00	Detail Excavation	3,330. m3	0.08	259.74	108.00	28,052	0.00	0	3.75	12,488	0.00	0	12.17	40,539
E07-13-193.00	Detail Excavation (Rock Excavation)	640. m3	0.13	83.20	108.00	8,986	0.00	0	5.50	3,520	0.00	0	19.54	12,506
E07-13-194.00	Structural Backfill	1,795. m3	0.13	233.35	108.00	25,202	8.00	14,360	4.00	7,180	0.00	0	26.04	46,742
E07-20-195.00	Concrete work	1,920. m3	8.45	16,224.00	108.00	1,752,192	765.00	1,468,800	25.00	48,000	0.00	0	1,702.60	3,268,992
E07-30-196.00	Structural Steel	1,730. t	28.60	49,478.00	108.00	5,343,624	4,800.00	8,304,000	250.00	432,500	0.00	0	8,138.80	14,080,124
E07-40-197.00	Wall cladding	6,480. m2	1.30	8,424.00	108.00	909,792	110.00	712,800	15.00	97,200	0.00	0	265.40	1,719,792
E07-40-198.00	Roof cladding	1,280. m2	1.30	1,664.00	108.00	179,712	110.00	140,800	15.00	19,200	0.00	0	265.40	339,712
E07-13-199.00	Conveyor; Detail Excavation	8,500. m3	0.08	663.00	108.00	71,604	0.00	0	3.75	31,875	0.00	0	12.17	103,479
E07-13-200.00	Conveyor; Structural Backfill	7,735. m3	0.13	1,005.55	108.00	108,599	8.00	61,880	4.00	30,940	0.00	0	26.04	201,419
E07-20-201.00	Conveyor; Concrete work	850. m3	8.45	7,182.50	108.00	775,710	765.00	650,250	25.00	21,250	0.00	0	1,702.60	1,447,210
E07-13-202.00	Transformer Station; Detail Excavation	165. m3	0.08	12.87	108.00	1,390	0.00	0	3.75	619	0.00	0	12.17	2,009
E07-13-203.00	Transformer Station; Structural Backfill	140. m3	0.13	18.20	108.00	1,966	8.00	1,120	4.00	560	0.00	0	26.04	3,646
E07-20-204.00	Transformer Station; Concrete work	32. m3	8.45	270.40	108.00	29,203	765.00	24,480	25.00	800	0.00	0	1,702.60	54,483
E07-50-205.00	SAG Mill Screen Oversize Conveyor No.1, 1220 W x 20600 L [E07-CNV-541]	20.6 m	32.50	669.50	108.00	72,306	50.00	1,030	150.00	3,090	13,999.03	288,380	17,709.03	364,806
E07-55-206.00	SAG Mill Screen Oversize Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-55-207.00	SAG Mill Screen Oversize Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-208.00	Pebble Crusher Feed Self Cleaner Magnet No.1 [E07-MGT-571]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-55-209.00	Tote Bin	500. kg	0.08	39.00	108.00	4,212	0.08	40	0.03	15	5.50	2,750	14.03	7,017
E07-50-210.00	Pebble Crusher Feed Self Cleaner Magnet No.2 [E07-MGT-572]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-55-211.00	Tote Bin	500. kg	0.08	39.00	108.00	4,212	0.08	40	0.03	15	5.50	2,750	14.03	7,017
E07-50-212.00	Pebble Crusher Feed Conveyor No.1, 1220 W x 185000 L [E07-CNV-542]	185. m	23.40	4,329.00	108.00	467,532	50.00	9,250	150.00	27,750	7,090.08	1,311,665	9,817.28	1,816,197
E07-55-213.00	Pebble Crusher Feed Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-214.00	Pebble Crusher Feed Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-215.00	Pebble Crusher Feed Conveyor Belt Scale No.1 [E07-SCB-187]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545
E07-50-216.00	Pebble Crusher Feed Conveyor Metal Detector No.1 [E07-MED-185]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E07-50-217.00	Pebble Crusher Feeder By-Pass Chute No.1 [E07-CHU-545]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E07-50-218.00	Pebble Crusher Feed Bin No.1, 165 m³ [E07-BIN-549]	1. ea	390.00	390.00	108.00	42,120	75.00	75	5,000.00	5,000	175,000.00	175,000	222,195.00	222,195
E07-50-219.00	Pebble Crusher Belt Feeder No.1, 1500 W x 7700 L [E07-FDR-543]	1. ea	520.00	520.00	108.00	56,160	150.00	150	3,000.00	3,000	237,000.00	237,000	296,310.00	296,310
E07-55-220.00	Pebble Crusher Belt Feeder No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-221.00	Pebble Crusher Belt Feeder No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-222.00	Pebble Crusher Belt Feeder No.2, 1500 W x 7700 L [E07-FDR-553]	1. ea	520.00	520.00	108.00	56,160	150.00	150	3,000.00	3,000	237,000.00	237,000	296,310.00	296,310

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-55-223.00	Pebble Crusher Belt Feeder No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-224.00	Pebble Crusher Belt Feeder No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-225.00	Pebble Crusher No.1 c/w Driver Motor, Crusher Automation, Startup Support and Feed Monitoring, MP800 [E07-CRU-561]	1. ea	1,092.00	1,092.00	108.00	117,936	1,000.00	1,000	2,000.00	2,000	2,922,041.67	2,922,042	3,042,977.67	3,042,978
E07-50-226.00	Pebble Crusher Lube Unit No.1, included [E07-LUB-030]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-227.00	Pebble Crusher No.2 c/w Driver Motor, Crusher Automation, Startup Support and Feed Monitoring, MP800 [E07-CRU-562]	1. ea	1,092.00	1,092.00	108.00	117,936	1,000.00	1,000	2,000.00	2,000	2,922,041.67	2,922,042	3,042,977.67	3,042,978
E07-50-228.00	Pebble Crusher Lube Unit No.2, included [E07-LUB-031]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-229.00	Pebble Crusher Discharge Conveyor No.1, 1220 W x 22000 L [E07-CNV-544]	22. m	32.50	715.00	108.00	77,220	50.00	1,100	150.00	3,300	10,595.91	233,110	14,305.91	314,730
E07-55-230.00	Pebble Crusher Discharge Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-231.00	Pebble Crusher Discharge Conveyor No.1 Head Chute	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-232.00	SAG Mill Screen Oversize Conveyor No.2, 1220 W x 20600 L [E07-CNV-551]	20.6 m	32.50	669.50	108.00	72,306	50.00	1,030	150.00	3,090	13,999.03	288,380	17,709.03	364,806
E07-55-233.00	SAG Mill Screen Oversize Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-234.00	SAG Mill Screen Oversize Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-235.00	Pebble Crusher Feed Self Cleaner Magnet No.3 [E07-MGT-573]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-55-236.00	Tote Bin	500. kg	0.08	39.00	108.00	4,212	0.08	40	0.03	15	5.50	2,750	14.03	7,017
E07-50-237.00	Pebble Crusher Feed Self Cleaner Magnet No.4 [E07-MGT-574]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-55-238.00	Tote Bin	500. kg	0.08	39.00	108.00	4,212	0.08	40	0.03	15	5.50	2,750	14.03	7,017

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-50-239.00	Pebble Crusher Feed Conveyor No.2, 1220 W x 185000 L [E07-CNV-552]	185. m	23.40	4,329.00	108.00	467,532	50.00	9,250	150.00	27,750	7,090.08	1,311,665	9,817.28	1,816,197
E07-55-240.00	Pebble Crusher Feed Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-241.00	Pebble Crusher Feed Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-242.00	Pebble Crusher Feed Conveyor Belt Scale No.2 [E07-SCB-188]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545
E07-50-243.00	Pebble Crusher Feed Conveyor Metal Detector No.2 [E07-MED-186]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E07-50-244.00	Pebble Crusher Feeder By-Pass Chute No.2 c/w Liner [E07-CHU-555]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E07-50-245.00	Pebble Crusher Feed Bin No.2, 165 m³ [E07-BIN-559]	1. ea	390.00	390.00	108.00	42,120	75.00	75	5,000.00	5,000	175,000.00	175,000	222,195.00	222,195
E07-50-246.00	Pebble Crusher Belt Feeder No.3, 1500 W x 7700 L [E07-FDR-557]	1. ea	520.00	520.00	108.00	56,160	150.00	150	3,000.00	3,000	237,000.00	237,000	296,310.00	296,310
E07-55-247.00	Pebble Crusher Belt Feeder No.3 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-248.00	Pebble Crusher Belt Feeder No.3 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-249.00	Pebble Crusher Belt Feeder No.4, 1500 W x 7700 L [E07-FDR-558]	1. ea	520.00	520.00	108.00	56,160	150.00	150	3,000.00	3,000	237,000.00	237,000	296,310.00	296,310
E07-55-250.00	Pebble Crusher Belt Feeder No.4 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-251.00	Pebble Crusher Belt Feeder No.4 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-252.00	Pebble Crusher No.3 c/w Driver Motor, Crusher Automation, Startup Support and Feed Monitoring, MP800 [E07-CRU-563]	1. ea	1,092.00	1,092.00	108.00	117,936	1,000.00	1,000	2,000.00	2,000	2,922,041.67	2,922,042	3,042,977.67	3,042,978
E07-50-253.00	Pebble Crusher Lube Unit No.3, included [E07-LUB-032]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-254.00	Pebble Crusher No.4 c/w Driver Motor, Crusher Automation, Startup Support and Feed Monitoring, MP800 [E07-CRU-564]	1. ea	1,092.00	1,092.00	108.00	117,936	1,000.00	1,000	2,000.00	2,000	2,922,041.67	2,922,042	3,042,977.67	3,042,978

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-50-255.00	Pebble Crusher Lube Unit No.4, included [E07-LUB-033]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-256.00	Pebble Crusher Discharge Conveyor No.2, 1220 W x 22000 L [E07-CNV-554]	22. m	32.50	715.00	108.00	77,220	50.00	1,100	150.00	3,300	10,595.91	233,110	14,305.91	314,730
E07-55-257.00	Pebble Crusher Discharge Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-258.00	Pebble Crusher Discharge Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-259.00	Pebble Crusher Area Fogging System [E07-SYS-580]	1. ea	585.00	585.00	108.00	63,180	200.00	200	3,000.00	3,000	180,000.00	180,000	246,380.00	246,380
E07-50-260.00	Pebble Crushing Crane (30m span, 40m lift)), 30T/5T [E07-CRN-020]	1. ea	260.00	260.00	108.00	28,080	300.00	300	2,000.00	2,000	275,000.00	275,000	305,380.00	305,380
E07-50-261.00	Pebble Crushing Hoist (20m lift), 5T [E07-HOI-190]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	35,000.00	35,000	40,791.00	40,791
E07-58-262.00	Pebble Crushing Dust Collector Exhaust Fan, 89,000 CFM [E07-FAN-710]	1. ea	416.00	416.00	108.00	44,928	250.00	250	400.00	400	362,714.10	362,714	408,292.10	408,292
E07-58-263.00	Pebble Crushing Dust Ducting, 89,000 CFM [E07-DUC-702]	1. lot	1,690.00	1,690.00	108.00	182,520	144,000.00	144,000	8,000.00	8,000	0.00	0	334,520.00	334,520
E07-58-264.00	Pebble Crushing Dust Collector Exhaust Fan, 63,000 CFM [E07-FAN-711]	1. ea	416.00	416.00	108.00	44,928	275.00	275	350.00	350	259,023.45	259,023	304,576.45	304,576
E07-58-265.00	Pebble Crushing Dust Ducting, 63,000 CFM [E07-DUC-701]	1. lot	1,560.00	1,560.00	108.00	168,480	132,000.00	132,000	7,200.00	7,200	0.00	0	307,680.00	307,680
E07-58-266.00	HVAC Allowance	1. lot	415.00	415.00	108.00	44,820	785.00	785	22,400.00	22,400	462,560.00	462,560	530,565.00	530,565
E07-60-288.00	Piping Allowance 1.00%	1. lot	227.32	227.32	108.00	24,550	176,353.60	176,354	1,078.48	1,078	0.00	0	201,982.42	201,982
E07-80-289.00	Field Instrumentation & Bulks Allowance	1. lot	2,074.80	2,074.80	108.00	224,078	45,130.00	45,130	7,450.00	7,450	270,000.00	270,000	546,658.40	546,658
E07-70-290.00	Electrical Motor Wiring, included in Area A20/A30	-	-	-	-	-	-	-	-	-	-	-	-	-
	E07 - Secondary Crushing Subtotal			**115,049.73**		**12,425,371**		**11,908,867**		**860,858**		**18,958,074**		**44,153,169**

E10 - Mill Building

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E10-40-292.00	Grinding Area;, 96m x 130m x 40m	-	-	-	-	-	-	-	-	-	-	-	-	-
E10-13-293.00	Grinding Area; Detail Excavation	25,870. m3	0.08	2,017.86	108.00	217,929	0.00	0	3.75	97,013	0.00	0	12.17	314,941
E10-13-294.00	Grinding Area; Detail Excavation (Rock Excavation)	8,940. m3	0.13	1,162.20	108.00	125,518	0.00	0	5.50	49,170	0.00	0	19.54	174,688
E10-13-295.00	Grinding Area; Structural Backfill	13,355. m3	0.13	1,736.15	108.00	187,504	8.00	106,840	4.00	53,420	0.00	0	26.04	347,764
E10-20-296.00	Grinding Area; Concrete work	17,880. m3	8.45	151,086.00	108.00	16,317,288	765.00	13,678,200	25.00	447,000	0.00	0	1,702.60	30,442,488
E10-30-297.00	Grinding Area; Structural Steel	2,495. t	28.60	71,357.00	108.00	7,706,556	4,800.00	11,976,000	250.00	623,750	0.00	0	8,138.80	20,306,306
E10-40-298.00	Grinding Area; Wall cladding	12,880. m2	1.30	16,744.00	108.00	1,808,352	110.00	1,416,800	15.00	193,200	0.00	0	265.40	3,418,352
E10-40-299.00	Grinding Area; Roof cladding	12,480. m2	1.30	16,224.00	108.00	1,752,192	110.00	1,372,800	15.00	187,200	0.00	0	265.40	3,312,192
E10-40-300.00	Grinding Area; Fire Protection; Auto Sprinklers @ Control Room	6. ea	5.20	31.20	108.00	3,370	500.00	3,000	5.00	30	0.00	0	1,066.60	6,400
E10-40-301.00	Grinding Area; Fire Protection; Fire Extinguishers	12. ea	5.20	62.40	108.00	6,739	400.00	4,800	5.00	60	0.00	0	966.60	11,599
E10-40-302.00	Grinding Area; Fire Protection; Fire Hose System	9. ea	10.40	93.60	108.00	10,109	2,000.00	18,000	20.00	180	0.00	0	3,143.20	28,289
E10-13-303.00	Grinding Area Conveyor; Detail Excavation	12,000. m3	0.08	936.00	108.00	101,088	0.00	0	3.75	45,000	0.00	0	12.17	146,088
E10-13-304.00	Grinding Area Conveyor; Structural Backfill	10,920. m3	0.13	1,419.60	108.00	153,317	8.00	87,360	4.00	43,680	0.00	0	26.04	284,357
E10-20-305.00	Grinding Area Conveyor; Concrete work	1,200. m3	8.45	10,140.00	108.00	1,095,120	765.00	918,000	25.00	30,000	0.00	0	1,702.60	2,043,120
E10-13-306.00	Transformer Station; Detail Excavation	1,505. m3	0.08	117.39	108.00	12,678	0.00	0	3.75	5,644	0.00	0	12.17	18,322
E10-13-307.00	Transformer Station; Structural Backfill	1,315. m3	0.13	170.95	108.00	18,463	8.00	10,520	4.00	5,260	0.00	0	26.04	34,243

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E10-20-308.00	Transformer Station; Concrete work	275. m3	8.45	2,323.75	108.00	250,965	765.00	210,375	25.00	6,875	0.00	0	1,702.60	468,215
E10-80-309.00	Field Instrumentation & Bulks Allowance	1. lot	421.20	421.20	108.00	45,490	9,102.50	9,103	1,500.00	1,500	55,000.00	55,000	111,092.10	111,092
E10-58-310.00	HVAC Allowance	1. lot	2,235.00	2,235.00	108.00	241,380	5,530.00	5,530	92,660.00	92,660	1,992,060.00	1,992,060	2,331,630.00	2,331,630
E10-50-420.00	Process Equipment Replacement Cost, (Sustaining Capital CAD$20,000,000)	-	-	-	-	-	-	-	-	-	-	-	-	-
E10-50-421.00	Process Equipment Replacement Cost, (Sustaining Capital CAD$20,000,000)	-	-	-	-	-	-	-	-	-	-	-	-	-
	E10 - Mill Building Subtotal			**278,278.30**		**30,054,056**		**29,817,328**		**1,881,641**		**2,047,060**		**63,800,085**

E15 - Primary & Secondary Grinding

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-55-423.00	SAG Mill No.1 Trommel Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-424.00	SAG Mill No.1 Trommel Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-425.00	SAG Mill No.1, 12200 D x 6700 [E15-MIL-501]	1. ea	20,150.00	20,150.00	108.00	2,176,200	12,500.00	12,500	20,000.00	20,000	15,518,750.00	15,518,750	17,727,450.00	17,727,450
E15-50-426.00	SAG Mill No.1 Gearless Motor No.1 (Supply only, installation included in SAG Mill)	1. ea	0.00	0.00	108.00	0	0.00	0	0.00	0	19,150,000.00	19,150,000	19,150,000.00	19,150,000
E15-50-427.00	SAG Mill Harmonic Filter No.1 (Supply only, installation included in SAG Mill)	1. ea	0.00	0.00	108.00	0	0.00	0	0.00	0	2,750,000.00	2,750,000	2,750,000.00	2,750,000
E15-50-428.00	SAG Mill GMD No.1, included [E15-EQP-581]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-429.00	SAG Mill Brake No.1, included [E15-BRK-191]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-430.00	SAG Mill Lube Unit No.1, included [E15-LUB-505]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-431.00	SAG Mill Cradle No.1, included [E15-EQP-181]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-432.00	Feed Chute Drive System Hydraulic Unit No.1, included [E15-EQP-193]	-	-	-	-	-	-	-	-	-	-	-	-	-

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-55-433.00	SAG Mill No.1 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-434.00	SAG Mill No.1 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-435.00	SAG Mill Screen No.1, 4000 W x 8000 L [E15-SCN-511]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-436.00	SAG Mill Screen No.1 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-55-437.00	SAG Mill Screen No.1 Undersize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-50-438.00	SAG Mill No.1 Back-Up Screen (No installation), 4000 W x 8000 L [E15-SCN-515]	1. ea	0.00	0.00	108.00	0	0.00	0	500.00	500	639,736.46	639,736	640,236.46	640,236
E15-50-439.00	SAG Mill Screen Undersize Pumpbox No.1 c/w Rubber Liner [E15-PBX-520]	5,265. kg	0.10	547.56	108.00	59,136	0.10	527	0.03	158	6.00	31,590	17.36	91,411
E15-50-440.00	SAG Mill Screen Undersize Pump No.1 c/w motor 500kW (VFD), 600 x 550 [E15-PSL-521]	1. ea	403.00	403.00	108.00	43,524	2,500.00	2,500	5,000.00	5,000	215,775.00	215,775	266,799.00	266,799
E15-50-441.00	Ball Mill Feed Distributor No.1 [E15-DIS-571]	1. ea	65.00	65.00	108.00	7,020	100.00	100	500.00	500	25,000.00	25,000	32,620.00	32,620
E15-50-442.00	Cyclone Cluster Feed Pumpbox No.1 c/w Rubber Liner [E15-PBX-052]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-443.00	Primary Cyclone Cluster No.1 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-045]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-444.00	Primary Grinding Cyclone Cluster No.1 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-020]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-445.00	Cyclone Cluster Overflow No.1 Sampler [E15-SMP-060]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-446.00	Ball Mill No.1 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-447.00	Ball Mill No.1 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-448.00	Ball Mill No.1, 7320 D x 12500 [E15-MIL-025]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-449.00	Ball Mill Cradle No.1, included [E15-EQP-181]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-450.00	Ball Mill Lube Unit No.1, included [E15-LUB-031]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-451.00	Ball Mill No.1 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-452.00	Ball Mill No.1 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-453.00	Grinding Area Sump Pump No.1 c/w motor 60kW, 250 [E15-PSU-066]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	52,000.00	52,000	66,190.00	66,190
E15-50-454.00	Cyclone Cluster Feed Pumpbox No.2 c/w Rubber Liner [E15-PBX-053]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-455.00	Primary Cyclone Cluster No.2 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-046]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-456.00	Primary Cyclone Cluster No.1 & 2 Feed Pump (VFD) (Back-Up) c/w motor 1650kW, 700 x 650 [E15-PSL-049]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-457.00	Primary Grinding Cyclone Cluster No.2 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-021]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-458.00	Cyclone Cluster Overflow No.2 Sampler [E15-SMP-061]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-459.00	Ball Mill No.2 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-460.00	Ball Mill No.2 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-461.00	Ball Mill No.2, 7320 D x 12500 [E15-MIL-026]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-462.00	Ball Mill Cradle No.2, included [E15-EQP-182]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-463.00	Ball Mill Lube Unit No.2, included [E15-LUB-032]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-464.00	Ball Mill No.2 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-55-465.00	Ball Mill No.2 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-55-466.00	SAG Mill No.2 Trommel Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-467.00	SAG Mill No.2 Trommel Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-468.00	SAG Mill No.2, 12200 D x 6700 [E15-MIL-502]	1. ea	20,150.00	20,150.00	108.00	2,176,200	12,500.00	12,500	20,000.00	20,000	15,518,750.00	15,518,750	17,727,450.00	17,727,450
E15-50-469.00	SAG Mill No.2 Gearless Motor No.2 (Supply only, installation included in SAG Mill)	1. ea	0.00	0.00	108.00	0	0.00	0	0.00	0	19,150,000.00	19,150,000	19,150,000.00	19,150,000
E15-50-470.00	SAG Mill Harmonic Filter No.2 (Supply only, installation included in SAG Mill)	1. ea	0.00	0.00	108.00	0	0.00	0	0.00	0	2,750,000.00	2,750,000	2,750,000.00	2,750,000
E15-50-471.00	SAG Mill GMD Cycloconverter No.2, included [E15-EQP-582]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-472.00	SAG Mill Brake No.2, included [E15-BRK-192]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-473.00	SAG Mill Lube Unit No.2, included [E15-LUB-506]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-474.00	SAG Mill Cradle No.2, included [E15-EQP-182]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-475.00	Feed Chute Drive System Hydraulic Unit No.2, included [E15-EQP-194]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-476.00	SAG Mill No.2 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-477.00	SAG Mill No.2 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-478.00	SAG Mill Screen No.2, 4000 W x 8000 L [E15-SCN-512]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-479.00	SAG Mill Screen No.2 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-55-480.00	SAG Mill Screen No.2 Undersize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-481.00	SAG Mill No.2 Back-Up Screen (No installation), 4000 W x 8000 L [E15-SCN-516]	1. ea	0.00	0.00	108.00	0	0.00	0	500.00	500	639,736.46	639,736	640,236.46	640,236
E15-50-482.00	SAG Mill Screen Undersize Pumpbox No.2 c/w Rubber Liner [E15-PBX-530]	5,265. kg	0.10	547.56	108.00	59,136	0.10	527	0.03	158	6.00	31,590	17.36	91,411
E15-50-483.00	SAG Mill Screen Undersize Pump No.2 c/w motor 500kW (VFD), 600 x 550 [E15-PSL-531]	1. ea	403.00	403.00	108.00	43,524	2,500.00	2,500	5,000.00	5,000	215,775.00	215,775	266,799.00	266,799
E15-50-484.00	SAG Mill Screen Undersize Back-Up Pump c/w motor 500kW (VFD), 600 x 550 [E15-PSL-529]	1. ea	403.00	403.00	108.00	43,524	2,500.00	2,500	5,000.00	5,000	215,775.00	215,775	266,799.00	266,799
E15-50-485.00	Ball Mill Feed Distributor No.2 [E15-DIS-572]	1. ea	65.00	65.00	108.00	7,020	100.00	100	500.00	500	25,000.00	25,000	32,620.00	32,620
E15-50-486.00	Cyclone Cluster Feed Pumpbox No.3 c/w Rubber Liner [E15-PBX-054]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-487.00	Primary Cyclone Cluster No.3 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-047]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-488.00	Primary Grinding Cyclone Cluster No.3 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-022]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-489.00	Cyclone Cluster Overflow No.3 Sampler [E15-SMP-062]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-490.00	Ball Mill No.3 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-491.00	Ball Mill No.3 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-492.00	Ball Mill No.3, 7320 D x 12500 [E15-MIL-025]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-493.00	Ball Mill Cradle No.3, included [E15-EQP-181]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-494.00	Ball Mill Lube Unit No.3, included [E15-LUB-031]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-495.00	Ball Mill No.3 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-496.00	Ball Mill No.3 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-497.00	Grinding Area Sump Pump No.2 c/w motor 60kW, 250 [E15-PSU-068]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	52,000.00	52,000	66,190.00	66,190
E15-50-498.00	Cyclone Cluster Feed Pumpbox No.4 c/w Rubber Liner [E15-PBX-055]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-499.00	Primary Cyclone Cluster No.4 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-048]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-500.00	Primary Cyclone Cluster No.3 & 4 Feed Pump (VFD) (Back-Up) c/w motor 1650kW, 700 x 650 [E15-PSL-050]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-501.00	Primary Grinding Cyclone Cluster No.4 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-023]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-502.00	Cyclone Cluster Overflow No.4 Sampler [E15-SMP-063]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-503.00	Ball Mill No.4 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-504.00	Ball Mill No.4 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-505.00	Ball Mill No.4, 7320 D x 12500 [E15-MIL-028]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-506.00	Ball Mill Cradle No.4, included [E15-EQP-186]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-507.00	Ball Mill Lube Unit No.4, included [E15-LUB-034]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-508.00	Ball Mill Inching Drive, included [E15-DRV-035]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-509.00	Ball Mill Ball Charging System, included [E15-EQP-183]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-510.00	Ball Mill No.4 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-511.00	Ball Mill No.4 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-512.00	Cooling Water Filter [E15-FIL-197]	1. ea	26.00	26.00	108.00	2,808	25.00	25	50.00	50	5,000.00	5,000	7,883.00	7,883

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-513.00	Mill Cooling System [E15-SCN-511]	1. ea	1,300.00	1,300.00	108.00	140,400	750.00	750	1,000.00	1,000	1,000,000.00	1,000,000	1,142,150.00	1,142,150
E15-50-514.00	SAG Mill 125mm Automatic Ball Charging Feeder [E15-FDR-600]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	75,000.00	75,000	89,190.00	89,190
E15-50-515.00	Mill Inching Hydraulic Power Pack [E15-PPK-184]	1. ea	195.00	195.00	108.00	21,060	100.00	100	2,500.00	2,500	200,000.00	200,000	223,660.00	223,660
E15-50-516.00	SAG Mill Liner Handler [E15-HAN-509]	1. lot	260.00	260.00	108.00	28,080	100.00	100	3,500.00	3,500	1,951,303.54	1,951,304	1,982,983.54	1,982,984
E15-50-517.00	Ball Mill Liner Handler [E15-HAN-036]	1. lot	260.00	260.00	108.00	28,080	100.00	100	3,500.00	3,500	1,951,303.54	1,951,304	1,982,983.54	1,982,984
E15-50-518.00	Particle Size Analyzer No.1 [E15-ANA-003]	1. ea	260.00	260.00	108.00	28,080	200.00	200	2,000.00	2,000	350,000.00	350,000	380,280.00	380,280
E15-50-519.00	Particle Size Analyzer No.2 [E15-ANA-004]	1. ea	260.00	260.00	108.00	28,080	200.00	200	2,000.00	2,000	350,000.00	350,000	380,280.00	380,280
E15-50-520.00	Pebble Crusher Discharge Scale No.1 [E15-SCB-545]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545
E15-50-521.00	Pebble Crusher Discharge Scale No.2 [E15-SCB-555]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545
E15-50-522.00	Primary Grinding Crane No.1 (35m span, 30m lift)), 110/20T [E15-CRN-005]	1. ea	487.50	487.50	108.00	52,650	1,000.00	1,000	5,000.00	5,000	900,000.00	900,000	958,650.00	958,650
E15-50-523.00	Primary Grinding Crane No.2 (33m span, 30m lift), 50/10T [E15-CRN-007]	1. ea	325.00	325.00	108.00	35,100	300.00	300	2,000.00	2,000	400,000.00	400,000	437,400.00	437,400
E15-50-524.00	Primary Grinding Crane No.3 (33m span, 30m lift), 50/10T [E15-CRN-008]	1. ea	325.00	325.00	108.00	35,100	300.00	300	2,000.00	2,000	400,000.00	400,000	437,400.00	437,400
E15-50-525.00	Grinding Area Sump Pump Hoist, 15T [E15-HOI-189]	1. ea	104.00	104.00	108.00	11,232	125.00	125	75.00	75	57,500.00	57,500	68,932.00	68,932
E15-58-526.00	Fire Protection; Auto Sprinklers @ SAG Mill Lube Unit No.1	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-527.00	Fire Protection; Auto Sprinklers @ SAG Mill Lube Unit No.2	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-528.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.1	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-58-529.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.2	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-530.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.3	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-531.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.4	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-532.00	HVAC Allowance, included in Area E10 - Mill Building	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-60-533.00	Piping Allowance 1.25%	1. lot	1,359.91	1,359.91	108.00	146,870	2,005,552.30	2,005,552	2,881.67	2,882	0.00	0	2,155,303.78	2,155,304
E15-80-534.00	Field Instrumentation & Bulks Allowance	1. lot	15,600.00	15,600.00	108.00	1,684,800	332,662.50	332,663	55,000.00	55,000	2,045,000.00	2,045,000	4,117,462.50	4,117,463
E15-70-535.00	Electrical Motor Wiring, included in Area A20/A30	-	-	-	-	-	-	-	-	-	-	-	-	-
	E15 - Primary & Secondary Grinding Subtotal			**126,033.16**		**13,611,581**		**2,510,745**		**288,685**		**162,370,655**		**178,781,665**

M12 - Catering and Housekeeping

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
M12-40-537.00	Catering and Housekeeping (based on 149,000 mandays @ $65/day)	1. lot	0.00	0.00	108.00	0	9,685,000.00	9,685,000	0.00	0	0.00	0	9,685,000.00	9,685,000
	M12 - Catering and Housekeeping Subtotal			**0.00**		**0**		**9,685,000**		**0**		**0**		**9,685,000**

X10 - Construction Indirects

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
X10-91-540.00	Construction Indirects	1. lot	140,200.48	140,200.48	108.00	15,141,652	35,331,000.00	35,331,000	0.00	0	0.00	0	50,472,652.10	50,472,652
X10-91-541.00	Construction Indirects (Open Pit - Pre-Production)	1. lot	14,750.00	14,750.00	108.00	1,593,000	3,717,000.00	3,717,000	0.00	0	0.00	0	5,310,000.00	5,310,000
X10-91-542.00	Helicopter Costs Additional Cost	1. sum	0.00	0.00	108.00	0	5,000,000.00	5,000,000	0.00	0	0.00	0	5,000,000.00	5,000,000
	X10 - Construction Indirects Subtotal			**154,950.48**		**16,734,652**		**44,048,000**		**0**		**0**		**60,782,652**

X20 - Spares

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
X20-92-544.00	Construction and Commission Spares	1. lot	0.00	0.00	108.00	0	13,720,000.00	13,720,000	0.00	0	0.00	0	13,720,000.00	13,720,000
	X20 - Spares Subtotal			**0.00**		**0**		**13,720,000**		**0**		**0**		**13,720,000**

X30 - Initial Fills

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
X30-93-547.00	Initial Fills Process (includes grinding media, warehouse inventory, lubricants, etc)													
		1. lot	0.00	0.00	108.00	0	9,522,821.00	9,522,821	0.00	0	0.00	0	9,522,821.00	9,522,821
	X30 - Initial Fills Subtotal			**0.00**		**0**		**9,522,821**		**0**		**0**		**9,522,821**
X40 - Freight And Logistic														
X40-94-549.00	Freight And Logistic													
		1. lot	0.00	0.00	108.00	0	13,634,000.00	13,634,000	0.00	0	0.00	0	13,634,000.00	13,634,000
X40-94-550.00	Air Freight - Minimal Allowance													
		1. sum	0.00	0.00	108.00	0	100,000.00	100,000	0.00	0	0.00	0	100,000.00	100,000
X40-94-551.00	Bonds/Insurances By owner													
		-	-	-	-	-	-	-	-	-	-	-	-	-
	X40 - Freight And Logistic Subtotal			**0.00**		**0**		**13,734,000**		**0**		**0**		**13,734,000**
X50 - Commissioning and Pre-operational Startup														
X50-95-553.00	Commissioning And Startup Construction Forces allow 24men for 4mths @ $125/hr (including travel and expenses)													
		1. lot	34,560.00	34,560.00	125.00	4,320,000	4,320,000.00	4,320,000	0.00	0	0.00	0	8,640,000.00	8,640,000
X50-95-554.00	Commissioning And Startup CM Forces allow 8men for 4mths @ $150/hr (including travel and expenses)													
		1. lot	11,520.00	11,520.00	150.00	1,728,000	1,728,000.00	1,728,000	0.00	0	0.00	0	3,456,000.00	3,456,000
X50-95-555.00	Commissioning And Startup Vendors allow 8men for 2mths @ $160/hr (including travel and expenses)													
		1. lot	5,760.00	5,760.00	160.00	921,600	921,600.00	921,600	0.00	0	0.00	0	1,843,200.00	1,843,200
X50-95-556.00	Commissioning And Startup Operator training by vendors (Included in Owners Costs)													
		-	-	-	-	-	-	-	-	-	-	-	-	-
X50-95-557.00	Commissioning And Startup DCS Programming Allow 2000 hrs @ $150/hr													
		1. lot	0.00	0.00	108.00	0	300,000.00	300,000	0.00	0	0.00	0	300,000.00	300,000
	X50 - Commissioning and Pre-operational Startup Subtotal			**51,840.00**		**6,969,600**		**7,269,600**		**0**		**0**		**14,239,200**
X60 - EPCM														
X60-96-559.00	Engineering and Procuement (Wardrop) 8% of Direct Costs													
		1. lot	0.00	0.00	108.00	0	33,648,115.77	33,648,116	0.00	0	0.00	0	33,648,115.77	33,648,116
X60-96-560.00	Construction Management (Wardrop) 7% of Direct Costs													
		1. lot	0.00	0.00	108.00	0	29,442,101.30	29,442,101	0.00	0	0.00	0	29,442,101.30	29,442,101
X60-96-561.00	Construction Management - Vendor support (Allowance)													
		1. lot	2,500.00	2,500.00	108.00	270,000	375,000.00	375,000	50,000.00	50,000	0.00	0	695,000.00	695,000
X60-96-562.00	Construction Management - Consultants (Allowance)													
		1. lot	1,000.00	1,000.00	108.00	108,000	150,000.00	150,000	25,000.00	25,000	0.00	0	283,000.00	283,000
	X60 - EPCM Subtotal			**3,500.00**		**378,000**		**63,615,217**		**75,000**		**0**		**64,068,217**

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
Y10 - Owner's Costs														
Y10-98-566.00	Owner's Costs (not included)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Y10 - Owner's Costs Subtotal			**0.00**		**0**		**0**		**0**		**0**		**0**
Z10 - Contingency														
Z10-99-571.00	Contingency 14.0%	1. lot	0.00	0.00	108.00	0	82,244,000.00	82,244,000	0.00	0	0.00	0	82,244,000.00	82,244,000
	Z10 - Contingency Subtotal			**0.00**		**0**		**82,244,000**		**0**		**0**		**82,244,000**
Option 6 (SAG+Conveyance) Total				**1,194,251.47**		**130,350,039**		**335,841,443**		**8,043,847**		**204,677,008**		**678,912,337**

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE SABC COMMINUTION CIRCUIT

PROCESSING OPERATING COSTS SUMMARY

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

OPERATING COST SUMMARY - BLENDED ORE SABC

DESCRIPTION	MANPOWER	ANNUAL COST (CDN$)	UNIT COST (CDN$/t ore)
HUMAN POWER			
TREATY OPERATING LABOUR	20	$1,890,000	$0.040
TREATY MAINTENANCE LABOUR	30	$3,266,854	$0.069
SUB-TOTAL MANPOWER	50	$5,156,854	$0.109
SUPPLIES			
METAL CONSUMABLES			
TREATY SITE (SAG & BALL MILL)		$80,217,990	$1.691
SUB-TOTAL METAL CONSUMBLES			
MAINTENANCE SUPPLIES			
TREATY SITE (SAG & BALL MILL)		$11,612,680	$0.245
SUB-TOTALMAINTENANCE SUPPLIES			
OPERATING SUPPLIES			
TREATY SITE (SAG & BALL MILLL)		$150,000	$0.003
SUB-TOTALOPERATING SUPPLIES			
POWER SUPPLY			
TREATY SITE (SAG & BALL MILL)		$44,320,104	$0.934
SUB-TOTALPOWER SUPPLIES			
SUB-TOTAL SUPPLIES		$136,300,774	$2.873
TOTAL	50	$141,457,628	$2.981

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE SABC COMMINUTION CIRCUIT

TREATY SITE MANPOWER COSTS

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

TREATY OPERATION MANPOWER

DESCRIPTION	MANPOWER	BASE SALARY (CDN$)	LOADED SALARY (CDN$)	ANNUAL COST (CDN$)
HOURLY				
Grinding Operators	8	$76,680	$103,518	$828,144
Control Room	4	$80,000	$108,000	$432,000
Helpers	8	$58,320	$78,732	$629,856
SUB-TOTAL HOURLY	**20**			**$1,890,000**
TOTAL TREATY SITE OPERATION MANPOWER	**20**			**$1,890,000**

TREATY MAINTENANCE MANPOWER

DESCRIPTION	MANPOWER	BASE SALARY (CDN$)	LOADED SALARY (CDN$)	ANNUAL COST (CDN$)
HOURLY				
Mechanics	8	$85,320	$115,182	$921,456
Electrician	4	$88,560	$119,556	$478,224
Electrician Apprentices	2	$76,680	$103,518	$207,036
Instrument Technicians	4	$90,720	$122,472	$489,888
Welders	4	$85,320	$115,182	$460,728
Welder Apprentices	2	$76,680	$103,518	$207,036
Crane / Equipment Operators	2	$69,466	$93,779	$187,558
Helpers	4	$58,320	$78,732	$314,928
SUB-TOTAL HOURLY	**30**			**$3,266,854**
TOTAL TREATY SITE OPERATION MAINTENANCE MANPOWER	**30**			**$3,266,854**

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE SABC COMMINUTION CIRCUIT

TREATY SITE SUPPLIES OPERATING COSTS

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

POWER SUPPLY - BLENDED ORE

Treaty Operation Power Drawn	kW	100,600

POWER SUPPLIES	KWH	UNIT COST	TOTAL COST	UNIT COST
Treaty Operation Power Consumption	820,742,674	$0.054	$44,320,104	$0.934
TOTAL POWER SUPPLY	**820,742,674**	**$0.054**	**44,320,104**	**$0.934**

MAINTENANCE SUPPLIES

AREA		TOTAL COST (CDN$/year)	UNIT COST (CDN$/t ore)
MAINTENANCE SUPPLIES			
Coarse Ore Stockpile	allowance	$596,625	$0.013
SAG/Ball Mill Grinding	allowance	$9,832,992	$0.207
Pebble Crushing	allowance	$883,063	$0.019
Misc. Building Complex Supplies	allowance	$300,000	$0.006
SUB-TOTAL MTCE. SUPPLIES		**$11,612,680**	**0.245**
OPERATING SUPPLIES			
Miscellaneous		$150,000	$0.003
SUB-TOTAL OPERATING SUPPLIES		**$150,000**	**$0.002**

MAJOR CONSUMABLE - BLENDED ORE

SUPPLIES	CONSUMPTION (kg/t ore)	SOURCE	UNIT COST (CDN$/kg)	SOURCE	UNIT COST FOB POINT	TOTAL COST (CDN$/year)	UNIT COST (CDN$/t ore)
METAL CONSUMABLES							
LINERS							
SAG Mill Liners	0.037	Calculation	$3.494	GE Globe	minesite	$6,121,760	$0.13
Primary Grinding - Ball Mill Liners	0.048	Calculation	$3.301	ME/Metso	minesite	$7,564,432	$0.16
Pebble Crusher Liners	-	Calculation	-	Metso	minesite	$353,682	$0.007
BALLS							
SAG Mill Balls	0.405	Calculation	$1.468	Moly-Cop	minesite	$28,228,250	$0.59
Primary Grinding - Ball Mill Balls	0.585	Calculation	$1.368	Moly-Cop	minesite	$37,949,866	$0.80
SUB-TOTAL METALS						**$80,217,990**	**$1.691**
TOTAL OPERATING SUPPLIES						**80,217,990**	**$1.691**

APPENDIX E

HPGR Option – Flowsheet

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DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

CLIENT | PROJ.MAN. | PROJ.ENG. | PROCESS | ELECTR. | INSTR. | PIPING | MECH. | STRUCT. | SERVICES | ARCH. | LAYOUT

SECTION: PROCESS
SCALE: NONE
DESIGN. BY: JH 10AUG12
DRAWN BY: AO 10AUG12
CHECK. BY:
APP. BY:

CLIENT: SEABRIDGE GOLD
BRITISH COLUMBIA, CANADA
WARDROP Engineering Inc.

TITLE KERR–SULPHURETS–MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.01
MITCHELL TREATY TUNNEL CONVEYOR AND TREATY COARSE ORE STOCKPILE HPGR OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009604.DWG	10528801.00	A00–09–604	A

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12/08/16 09:49

DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

CLIENT / PROJ.ENG. / PROCESS / ELECTR. / INSTR. / PIPING / MECH. / STRUCT. / SERVICES / ARCH. / LAYOUT

SECTION: PROCESS
SCALE: NONE
DESIGN. BY: JH — 10AUG12
DRAWN BY: AO — 10AUG12
CHECK. BY:
APP. BY:

CLIENT: SEABRIDGE GOLD
BRITISH COLUMBIA, CANADA

WARDROP Engineering Inc.

TITLE: KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.02
SECONDARY CRUSHING (TREATY SITE)
HPGR OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009605.DWG	10528801.00	A00-09-605	A

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DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

CLIENT PROJ.MAN. PROJ.ENG. PROCESS ELECTR. INSTR. PIPING MECH. STRUCT. SERVICES ARCH. LAYOUT

		DATE
SECTION:	PROCESS	
SCALE:	NONE	
DESIGN. BY:	JH	10AUG12
DRAWN BY:	AO	10AUG12
CHECK. BY:		
APP. BY:		

CLIENT:

SEABRIDGE GOLD

BRITISH COLUMBIA, CANADA

WARDROP Engineering Inc.

TITLE

KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.03 FINE ORE STOCKPILE AND TERTIARY CRUSHING (HPGR) HPGR OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009606.DWG	10528801.00	A00-09-606	A

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DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
A	1	ISSUED FOR INFORMATION	10AUG12	AO

SECTION:	PROCESS	
SCALE:	NONE	DATE
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BRITISH COLUMBIA, CANADA

WARDROP Engineering Inc.

TITLE KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.04
PRIMARY GRINDING (TREATY SITE)
SHEET 1 OF 2
HPGR OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009607.DWG	10528801.00	A00-09-607	A

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DWG. NO.	REFERENCE DRAWINGS

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A	1	ISSUED FOR INFORMATION	10AUG12	AO

SECTION: PROCESS
SCALE: NONE
DESIGN. BY: JH 10AUG12
DRAWN BY: AO 10AUG12
CHECK. BY:
APP. BY:

CLIENT: SEABRIDGE GOLD
BRITISH COLUMBIA, CANADA
WARDROP Engineering Inc.

TITLE KERR-SULPHURETS-MITCHELL ENERGY STUDIES
PROCESS FLOW DIAGRAM No.05
PRIMARY GRINDING (TREATY SITE)
SHEET 2 OF 2
HPGR OPTION

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009608.DWG	10528801.00	A00-09-608	A

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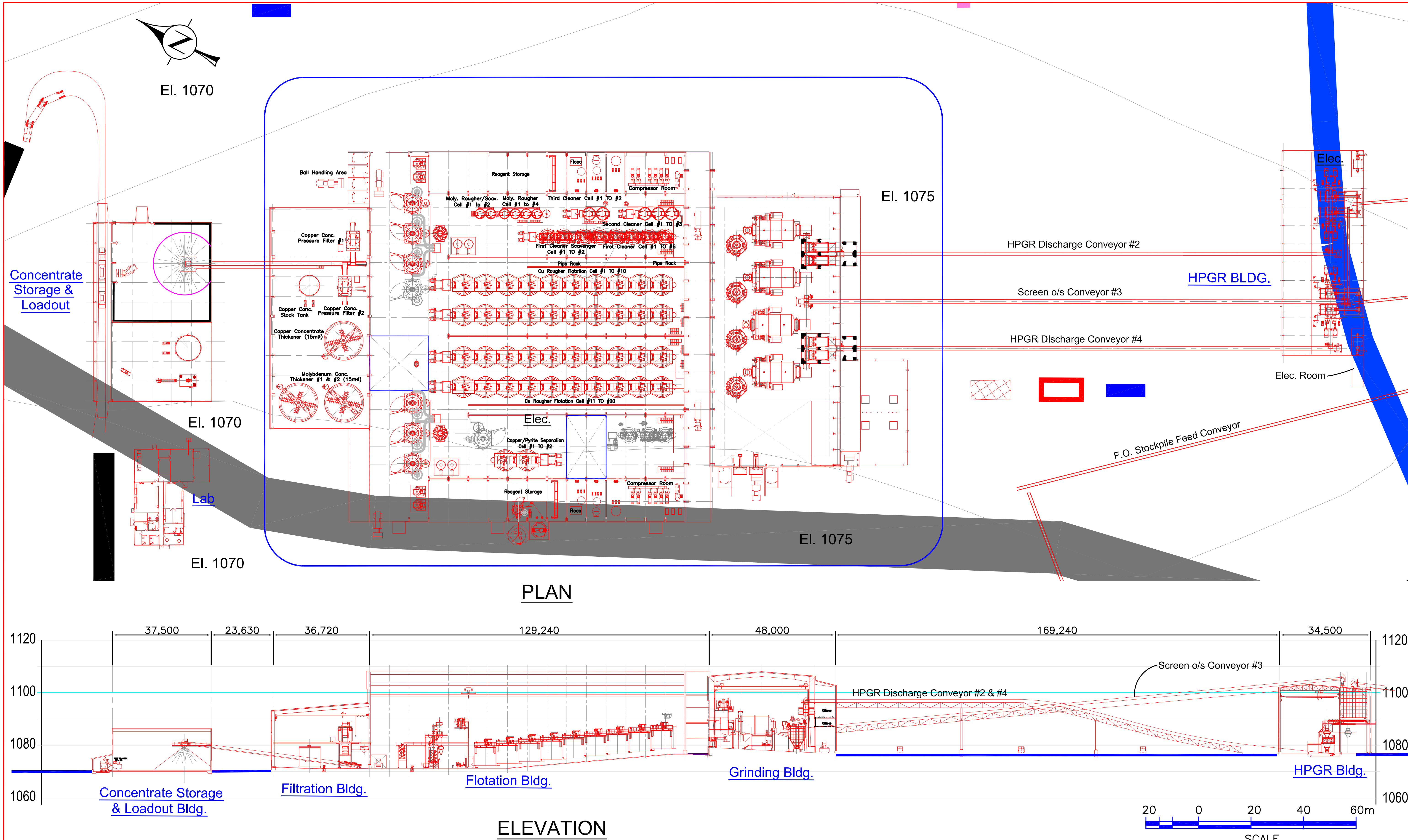
APPENDIX F

HPGR Option – Layout



REV. No.	ISSUED FOR	REVISION DESCRIPTION	DR.	CHK.	APP.	DATE
B		ISSUE FOR J. HUANG'S REPORT	BW		HB	2012-06-22
A		ISSUE FOR PFS UPDATE 2012	BW		HB	2012-04-02

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SCALE: — DATE:
DESIGNED: H. Bosche — Mar 17 2012
DRAWN: B. Wong — Mar 17 2012
CHECKED:
APPROVED:

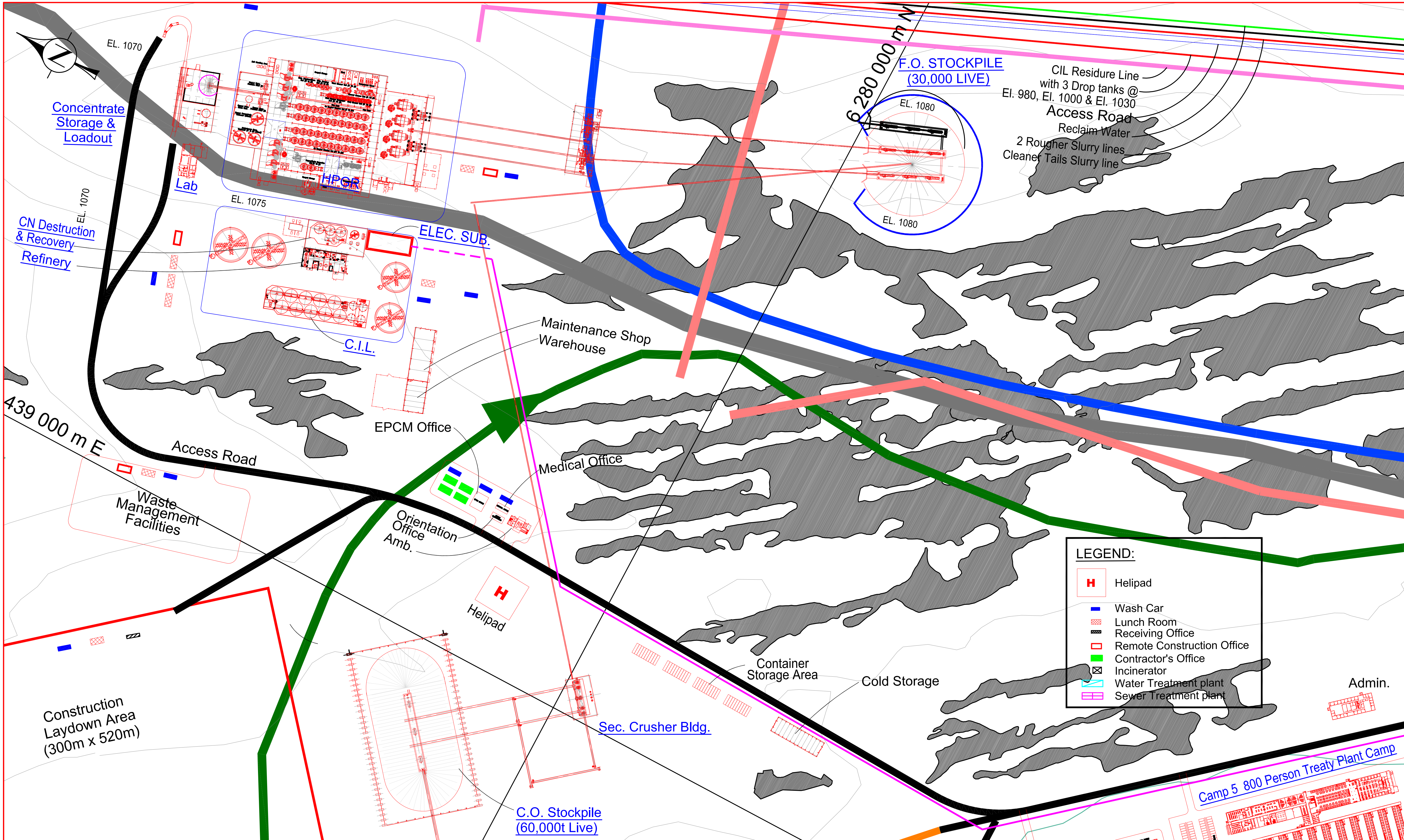
CLIENT: KERR-SULPHURETS-MITCHELL

BOSCHE VENTURES LTD

TITLE: PFS UPDATE 2012 HPGR OPTION HPGR PLANTSITE AT TREATY PLAN AND SECTION

PROJECT No. — DRAWING No. 10-10-1619 — REV No. B

CADD FILE No.: S:\



REV. No.	ISSUED FOR	REVISION DESCRIPTION	DR.	CHK.	APP.	DATE
A	ISSUE FOR J. HUANG'S REPORT		BW		HB	2012-06-22

REFERENCE DRAWING | REF. DWG No.

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		DATE:
SCALE:		
DESIGNED:	H. Bosche	Mar 17 2012
DRAWN:	B. Wong	Mar 17 2012
CHECKED:		
APPROVED:		

CLIENT: KERR–SULPHURETS–MITCHELL

BOSCHE VENTURES LTD

TITLE: PFS UPDATE 2012 HPGR OPTION HPGR PROCESS PLANTAT TREATY PLAN

PROJECT No. | DRAWING No. 10–10–1622 | REV No. A

CADD FILE No.: S:\

APPENDIX G

HPGR Option – Comminution Circuit Load List

Seabridge Gold

KSM ENERGY STUDY HPGR OPTION LOAD LIST

Notes

1. Motor loading is defined as the average load divided by the installed Peak Load.
2. Motor efficiencies have been considered in the Electrical Load.
3. Utilization Factor is defined as the percent of time the motor actually runs in the summer or winter.
4. Utilization factors have been set in accordance with Process/Mech instructions.
5. Synchronous motors assumed for Ball Mills, running at leading 95% power factor.
6. Overall corrected power factor will be 97%.

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

EQM Code	LOAD NAME	ELECTRICAL LOAD (kW)	OPERATING	STANDBY	FUTURE	MOTOR LOADING	SUMMER USE FACTOR (%)	WINTER USE FACTOR (%)	SUMMER KWH	WINTER KWH	ANNUAL KWH
E05-CNV-010	TREATY COARSE ORE STOCKPILE TRIPPER CONVEYOR	700.0	TRUE	FALSE	FALSE	0.74	94	94	2,132,965	2,132,965	4,265,930
E05-CNV-011	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.1	65.0	TRUE	FALSE	FALSE	0.74	94	94	198,061	198,061	396,122
E05-CNV-012	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.2	56.0	TRUE	FALSE	FALSE	0.74	94	94	170,637	170,637	341,274
E05-CNV-013	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.3	65.0	TRUE	FALSE	FALSE	0.74	94	94	198,061	198,061	396,122
E05-CNV-014	TREATY COARSE ORE STOCKPILE APRON FEEDER DISCHARGE CONVEYOR No.4	56.0	TRUE	FALSE	FALSE	0.74	94	94	170,637	170,637	341,274
E05-CNV-052	TREATY COARSE ORE RECLAIM DUST COLLECTOR SCREW CONVEYOR	3.7	TRUE	FALSE	FALSE	0.80	10	10	1,296	1,296	2,593
E05-COL-051	TREATY COARSE ORE RECLAIM DUST COLLECTOR WITH EXHAUST FAN	149.0	TRUE	FALSE	FALSE	0.80	94	94	490,770	490,770	981,540
E05-FAN-702	BUILDING SERVICES EXHAUST FAN - RECLAIM TUNNEL COARSE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E05-FAN-710	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN COARSE ORE STOCKPILE	78.0	TRUE	FALSE	FALSE	0.85	100	100	290,394	290,394	580,788
E05-FAN-717	BUILDING SERVICES AIR HANDLING UNIT - NO HEAT - RECLAIM COARSE ORE STOCKPILE	18.7	TRUE	FALSE	FALSE	0.85	100	100	69,620	69,620	139,240
E05-FDR-001	TREATY COARSE ORE RECLAIM APRON FEEDER No.1	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-002	TREATY COARSE ORE RECLAIM APRON FEEDER No.2	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-003	TREATY COARSE ORE RECLAIM APRON FEEDER No.3	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-004	TREATY COARSE ORE RECLAIM APRON FEEDER No.4	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-005	TREATY COARSE ORE RECLAIM APRON FEEDER No.5	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-FDR-006	TREATY COARSE ORE RECLAIM APRON FEEDER No.6	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E05-HOI-041	TREATY COARSE ORE STOCKPILE HOIST No.1	2.0	TRUE	FALSE	FALSE	0.80	10	10	701	701	1,402
E05-HOI-042	TREATY COARSE ORE STOCKPILE HOIST No.2	2.0	TRUE	FALSE	FALSE	0.80	10	10	701	701	1,402
E05-HTR-701	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-702	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-703	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-704	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-705	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-706	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-707	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-708	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-709	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-710	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-711	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-712	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-713	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-714	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-715	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-716	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM COARSE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E05-HTR-718	BUILDING SERVICES UNIT HEATER - FIRE VALVE ROOM COARSE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	0	100	0	13,775	13,775
E05-VLV-053	TREATY COARSE ORE RECLAIM DUST COLLECTOR ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E07-MED-631	CONE CRUSHER FEED CONVEYOR No.1 METAL DETECTOR	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-MED-632	CONE CRUSHER FEED CONVEYOR No.2 METAL DETECTOR	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-MGT-627	CONE CRUSHER FEED CONVEYOR No.1 SELF CLEANER MAGNET No. 1	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-MGT-628	CONE CRUSHER FEED CONVEYOR No.2 SELF CLEANER MAGNET No. 1	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-MGT-633	CONE CRUSHER FEED CONVEYOR No.1 SELF CLEANER MAGNET No. 2	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-MGT-634	CONE CRUSHER FEED CONVEYOR No.2 SELF CLEANER MAGNET No. 2	10.0	TRUE	FALSE	FALSE	0.80	85	85	29,784	29,784	59,568
E07-ACU-701	BUILDING SERVICES AIR CONDITIONING UNIT - SEC CRUSHING ELECT ROOM SEC CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	100	0	27,923	0	27,923
E07-ACU-702	BUILDING SERVICES AIR COOLED CONDENSING UNIT SEC CRUSHING ELECTRICAL ROOM SEC CRUSHING	18.7	TRUE	FALSE	FALSE	0.85	100	0	69,620	0	69,620
E07-CNV-615	CONE CRUSHER DISCHARGE CONVEYOR No.1	145.0	TRUE	FALSE	FALSE	0.74	85	85	399,526	399,526	799,052
E07-CNV-616	CONE CRUSHER DISCHARGE CONVEYOR No.2	440.0	TRUE	FALSE	FALSE	0.74	85	85	1,212,354	1,212,354	2,424,708
E07-CNV-614	CONE CRUSHER DISCHARGE CONVEYOR No.3	12.0	TRUE	FALSE	FALSE	0.74	85	85	33,064	33,064	66,128
E07-CNV-621	CONE CRUSHER FEED CONVEYOR No.1	800.0	TRUE	FALSE	FALSE	0.74	85	85	2,204,280	2,204,280	4,408,560
E07-CNV-622	CONE CRUSHER FEED CONVEYOR No.2	800.0	TRUE	FALSE	FALSE	0.74	85	85	2,204,280	2,204,280	4,408,560
E07-CNV-618	CONE CRUSHER BY PASS CONVEYOR No.1	9.0	TRUE	FALSE	FALSE	0.74	85	85	24,798	24,798	49,596
E07-CNV-619	CONE CRUSHER BY PASS CONVEYOR No.2	9.0	TRUE	FALSE	FALSE	0.74	85	85	24,798	24,798	49,596
E07-CNV-623	CONE CRUSHING SCREEN OVERSIZE TRANSFER CONVEYOR	12.0	TRUE	FALSE	FALSE	0.74	85	85	33,064	33,064	66,128
E07-CNV-617	CONE CRUSHING SCREEN UNDERSIZE CONVEYOR	75.0	TRUE	FALSE	FALSE	0.74	85	85	206,651	206,651	413,303
E07-CNV-636	FINE ORE STOCKPILE FEED CONVEYOR	1360.0	TRUE	FALSE	FALSE	0.74	85	85	3,747,276	3,747,276	7,494,552
E07-CNV-652	CONE CRUSHING BUILDING DUST COLLECTOR No.1 SCREW CONVEYOR	5.5	TRUE	FALSE	FALSE	0.80	10	10	1,927	1,927	3,854
E07-CNV-662	CONE CRUSHING BUILDING DUST COLLECTOR No.2 SCREW CONVEYOR	5.5	TRUE	FALSE	FALSE	0.80	10	10	1,927	1,927	3,854
E07-COL-651	CONE CRUSHING BUILDING DUST COLLECTOR No.1 WITH EXHAUST FAN	223.5	TRUE	FALSE	FALSE	0.80	85	85	665,672	665,672	1,331,345
E07-COL-661	CONE CRUSHING BUILDING DUST COLLECTOR No.2 WITH EXHAUST FAN	186.3	TRUE	FALSE	FALSE	0.80	85	85	554,876	554,876	1,109,752
E07-CRN-620	SECONDARY CRUSHING CRANE	45.0	TRUE	FALSE	FALSE	0.80	20	20	31,536	31,536	63,072
E07-CRU-610	CONE CRUSHER No.5	750.0	FALSE	TRUE	FALSE	0.90	85	85	0	0	0
E07-CRU-611	CONE CRUSHER No.1	750.0	TRUE	FALSE	FALSE	0.90	85	85	2,514,087	2,514,087	5,028,173
E07-CRU-612	CONE CRUSHER No.2	750.0	TRUE	FALSE	FALSE	0.90	85	85	2,514,087	2,514,087	5,028,173
E07-CRU-613	CONE CRUSHER No.3	750.0	TRUE	FALSE	FALSE	0.90	85	85	2,514,087	2,514,087	5,028,173
E07-CRU-614	CONE CRUSHER No.4	750.0	TRUE	FALSE	FALSE	0.90	85	85	2,514,087	2,514,087	5,028,173
E07-FAN-702	BUILDING SERVICES SUPPLY FAN / FILTER - (PRESSURIZATION) ELECTRICAL ROOM SEC CRUSHING	5.5	TRUE	FALSE	FALSE	0.85	100	100	20,477	20,477	40,953
E07-FAN-703	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN - SEC CRUSHING SEC CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E07-FAN-704	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN - SEC CRUSHING SEC CRUSHING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E07-FAN-705	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - BALL MILL #1 LUBE ROOM SEC CRUSHING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E07-FAN-706	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - BALL MILL #2 LUBE ROOM SEC CRUSHING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E07-FAN-710	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN SECONDARY CRUSHING	250.0	TRUE	FALSE	FALSE	0.85	100	100	930,750	930,750	1,861,500
E07-FAN-711	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN SECONDARY CRUSHING	200.0	TRUE	FALSE	FALSE	0.85	100	100	744,600	744,600	1,489,200
E07-HTR-703	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT - SEC CRUSHING SEC CRUSHING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E07-HTR-704	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT - SEC CRUSHING SEC CRUSHING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E07-HTR-706	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-707	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-708	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-709	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-710	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-711	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-712	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-713	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-714	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-715	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-716	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-HTR-717	BUILDING SERVICES PROPANE UNIT HEATER - SEC CRUSHING SEC CRUSHING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E07-LUB-630	CONE CRUSHER LUBE UNIT No.1	5.0	TRUE	FALSE	FALSE	0.80	85	85	14,892	14,892	29,784
E07-LUB-631	CONE CRUSHER LUBE UNIT No.2	5.0	TRUE	FALSE	FALSE	0.80	85	85	14,892	14,892	29,784
E07-LUB-632	CONE CRUSHER LUBE UNIT No.3	5.0	TRUE	FALSE	FALSE	0.80	85	85	14,892	14,892	29,784
E07-LUB-633	CONE CRUSHER LUBE UNIT No.4	5.0	TRUE	FALSE	FALSE	0.80	85	85	14,892	14,892	29,784
E07-SCN-603	CONE CRUSHING SCREEN No.1	75.0	TRUE	FALSE	FALSE	0.85	85	85	236,846	236,846	473,692
E07-SCN-604	CONE CRUSHING SCREEN No.2	75.0	TRUE	FALSE	FALSE	0.85	85	85	236,846	236,846	473,692
E07-SCN-605	CONE CRUSHING SCREEN No.3	75.0	TRUE	FALSE	FALSE	0.85	85	85	236,846	236,846	473,692
E07-SCN-606	CONE CRUSHING SCREEN No.4	75.0	TRUE	FALSE	FALSE	0.85	85	85	236,846	236,846	473,692
E07-SCN-619	CONE CRUSHING SCREEN (SPARE) No.5	0.0	TRUE	FALSE	FALSE	0.85	85	85	0	0	0
E07-VLV-653	CONE CRUSHING BUILDING DUST COLLECTOR No.1 ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E07-VLV-663	CONE CRUSHING BUILDING DUST COLLECTOR No.2 ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E08-AIC-711	FINE ORE STOCKPILE AIR COMPRESSOR No.1	37.0	TRUE	FALSE	FALSE	0.80	30	30	38,894	38,894	77,789
E08-AIC-712	FINE ORE STOCKPILE AIR COMPRESSOR No.2	37.0	TRUE	FALSE	FALSE	0.80	30	30	38,894	38,894	77,789
E08-CNV-621	HPGR FEED CONVEYOR No.1	600.0	TRUE	FALSE	FALSE	0.74	94	94	1,828,256	1,828,256	3,656,512
E08-CNV-622	HPGR FEED CONVEYOR No.2	600.0	TRUE	FALSE	FALSE	0.74	94	94	1,828,256	1,828,256	3,656,512
E08-CNV-652	FINE ORE STOCKPILE DUST COLLECTOR SCREW CONVEYOR	3.7	TRUE	FALSE	FALSE	0.80	10	10	1,296	1,296	2,593
E08-COL-651	FINE ORE STOCKPILE DUST COLLECTOR WITH EXHAUST FAN	55.9	TRUE	FALSE	FALSE	0.80	94	92	184,055	180,139	364,195
E08-FAN-850	BUILDING SERVICES EXHAUST FAN - RECLAIM TUNNEL FINE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550

SEABRIDGE GOLD

KSM ENERGY STUDY HPGR OPTION LOAD LIST

Notes
1. Motor loading is defined as the average load divided by the installed Peak Load.
2. Motor efficiencies have been considered in the Electrical Load.
3. Utilization Factor is defined as the percent of time the motor actually runs in the summer or winter.
4. Utilization factors have been set in accordance with Process/Mech instructions.
5. Synchronous motors assumed for Ball Mills, running at leading 95% power factor.
6. Overall corrected power factor will be 97%.

Version Final
Date August 14, 2012
Prepared by T. L. Tetra Tech WEI
Reviewed by J. H. Tetra Tech WEI

EQM Code	LOAD NAME	ELECTRICAL LOAD (kW)	OPERATING	STANDBY	FUTURE	MOTOR LOADING	SUMMER USE FACTOR (%)	WINTER USE FACTOR (%)	SUMMER KWH	WINTER KWH	ANNUAL KWH
E08-FAN-851	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN FINE ORE STOCKPILE	78.0	TRUE	FALSE	FALSE	0.85	100	100	290,394	290,394	580,788
E08-FAN-852	BUILDING SERVICES AIR HANDLING UNIT - NO HEAT - RECLAIM FINE ORE STOCKPILE	18.7	TRUE	FALSE	FALSE	0.85	100	100	69,620	69,620	139,240
E08-FDR-601	FINE ORE RECLAIM APRON FEEDER No.1	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-FDR-602	FINE ORE RECLAIM APRON FEEDER No.2	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-FDR-603	FINE ORE RECLAIM APRON FEEDER No.3	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-FDR-604	FINE ORE RECLAIM APRON FEEDER No.4	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-FDR-605	FINE ORE RECLAIM APRON FEEDER No.5	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-FDR-606	FINE ORE RECLAIM APRON FEEDER No.6	112.0	TRUE	FALSE	FALSE	0.74	94	94	341,274	341,274	682,549
E08-HOI-641	FINE ORE STOCKPILE HOIST No.1	2.0	TRUE	FALSE	FALSE	0.80	5	5	350	350	701
E08-HOI-642	FINE ORE STOCKPILE HOIST No.2	2.0	TRUE	FALSE	FALSE	0.80	5	5	350	350	701
E08-HTR-801	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-802	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-803	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-804	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-805	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-806	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-807	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-808	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-809	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-810	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-811	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-812	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-813	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-814	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-815	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-816	BUILDING SERVICES ELECTRIC RADIANT HEATERS - RECLAIM FINE ORE STOCKPILE	2.0	TRUE	FALSE	FALSE	0.85	0	100	0	7,446	7,446
E08-HTR-817	BUILDING SERVICES UNIT HEATER - FIRE VALVE ROOM FINE ORE STOCKPILE	3.7	TRUE	FALSE	FALSE	0.85	0	100	0	13,775	13,775
E08-MED-625	HPGR FEED CONVEYOR No.1 METAL DETECTOR	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E08-MED-626	HPGR FEED CONVEYOR No.2 METAL DETECTOR	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E08-MGT-627	HPGR FEED CONVEYOR No.1 SELF CLEANER MAGNET	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E08-MGT-628	HPGR FEED CONVEYOR No.2 SELF CLEANER MAGNET	10.0	TRUE	FALSE	FALSE	0.80	94	94	32,938	32,938	65,875
E08-PSU-610	FINE ORE STOCKPILE AREA SUMP PUMP	15.0	TRUE	FALSE	FALSE	0.80	10	10	5,256	5,256	10,512
E08-VLV-653	FINE ORE STOCKPILE DUST COLLECTOR ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E09-CNV-650	HPGR CRUSHER DISCHARGE CONVEYOR No.1	50.0	TRUE	FALSE	FALSE	0.74	94	94	152,355	152,355	304,709
E09-CNV-651	HPGR CRUSHER DISCHARGE CONVEYOR No.2	440.0	TRUE	FALSE	FALSE	0.74	94	94	1,340,721	1,340,721	2,681,442
E09-CNV-652	HPGR CRUSHER DISCHARGE CONVEYOR No.3	50.0	TRUE	FALSE	FALSE	0.74	94	94	152,355	152,355	304,709
E09-CNV-653	HPGR CRUSHER DISCHARGE CONVEYOR No.4	440.0	TRUE	FALSE	FALSE	0.74	94	94	1,340,721	1,340,721	2,681,442
E09-CNV-662	HPGR DUST COLLECTOR No.1 SCREW CONVEYOR	3.7	TRUE	FALSE	FALSE	0.80	10	10	1,296	1,296	2,593
E09-CNV-672	HPGR DUST COLLECTOR No.2 SCREW CONVEYOR	3.7	TRUE	FALSE	FALSE	0.80	10	10	1,296	1,296	2,593
E09-COL-661	HPGR DUST COLLECTOR No.1 WITH EXHAUST FAN	74.5	TRUE	FALSE	FALSE	0.80	94	94	245,385	245,385	490,770
E09-COL-671	HPGR DUST COLLECTOR No.2 WITH EXHAUST FAN	74.5	TRUE	FALSE	FALSE	0.80	94	94	245,385	245,385	490,770
E09-COO-645	HPGR CRUSHER No.1 LUBRICATION COOLER	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E09-COO-646	HPGR CRUSHER No.2 LUBRICATION COOLER	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E09-COO-647	HPGR CRUSHER No.3 LUBRICATION COOLER	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E09-COO-648	HPGR CRUSHER No.4 LUBRICATION COOLER	5.0	TRUE	FALSE	FALSE	0.80	94	94	16,469	16,469	32,938
E09-CRN-610	HPGR BUILDING AREA CRANE	130.0	TRUE	FALSE	FALSE	0.80	20	94	91,104	428,189	519,293
E09-CRU-620	HIGH PRESSURE GRINDING ROLL No.1	5800.0	TRUE	FALSE	FALSE	0.81	94	94	19,414,615	19,414,615	38,829,231
E09-CRU-625	HIGH PRESSURE GRINDING ROLL No.2	5800.0	TRUE	FALSE	FALSE	0.81	94	94	19,414,615	19,414,615	38,829,231
E09-CRU-630	HIGH PRESSURE GRINDING ROLL No.3	5800.0	TRUE	FALSE	FALSE	0.81	94	94	19,414,615	19,414,615	38,829,231
E09-CRU-635	HIGH PRESSURE GRINDING ROLL No.4	5800.0	TRUE	FALSE	FALSE	0.81	94	94	19,414,615	19,414,615	38,829,231
E09-EQP-605	HPGR SURGE BIN No.1 VENT	1.0	TRUE	FALSE	FALSE	0.80	94	94	3,287	3,287	6,574
E09-EQP-606	HPGR SURGE BIN No.2 VENT	1.0	TRUE	FALSE	FALSE	0.80	94	94	3,287	3,287	6,574
E09-FAN-835	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN TERTIARY CRUSHING (HPGR)	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E09-FAN-836	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN TERTIARY CRUSHING (HPGR)	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E09-FAN-837	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - HPGR #1 LUBE ROOM TERTIARY CRUSHING (HPGR)	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E09-FAN-838	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - HPGR #2 LUBE ROOM TERTIARY CRUSHING (HPGR)	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E09-FAN-839	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - HPGR #3 LUBE ROOM TERTIARY CRUSHING (HPGR)	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E09-FAN-840	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - HPGR #4 LUBE ROOM TERTIARY CRUSHING (HPGR)	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E09-FAN-841	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN HPGR SURGE BIN	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E09-FAN-842	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN TERTIARY CRUSHING (HPGR)	65.0	TRUE	FALSE	FALSE	0.85	100	100	241,995	241,995	483,990
E09-FAN-843	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN TERTIARY CRUSHING (HPGR)	128.0	TRUE	FALSE	FALSE	0.85	100	100	476,544	476,544	953,088
E09-FAN-844	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN HPGR SURGE BIN	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E09-FDR-615	HPGR BELT FEEDER No. 1 (RAIL MOUNTED)	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E09-FDR-616	HPGR BELT FEEDER No. 2 (RAIL MOUNTED)	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E09-FDR-617	HPGR BELT FEEDER No. 3 (RAIL MOUNTED)	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E09-FDR-618	HPGR BELT FEEDER No. 4 (RAIL MOUNTED)	80.0	TRUE	FALSE	FALSE	0.74	94	94	243,767	243,767	487,535
E09-THR-820	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT - TERT CRUSHING TERTIARY CRUSHING (HPGR)	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E09-THR-821	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT - TERT CRUSHING TERTIARY CRUSHING (HPGR)	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E09-THR-822	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-823	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-824	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-825	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-826	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-827	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-828	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-829	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-830	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-831	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-832	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-THR-833	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING TERTIARY CRUSHING (HPGR)	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E09-LUB-640	HPGR CRUSHER No.1 LUBE UNIT	22.0	TRUE	FALSE	FALSE	0.80	94	94	72,463	72,463	144,925
E09-LUB-641	HPGR CRUSHER No.2 LUBE UNIT	22.0	TRUE	FALSE	FALSE	0.80	94	94	72,463	72,463	144,925
E09-LUB-642	HPGR CRUSHER No.3 LUBE UNIT	22.0	TRUE	FALSE	FALSE	0.80	94	94	72,463	72,463	144,925
E09-LUB-643	HPGR CRUSHER No.4 LUBE UNIT	22.0	TRUE	FALSE	FALSE	0.80	94	94	72,463	72,463	144,925
E09-VLV-663	HPGR DUST COLLECTOR No.1 ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E09-VLV-673	HPGR DUST COLLECTOR No.2 ROTARY VALVE	0.7	TRUE	FALSE	FALSE	0.80	10	10	245	245	491
E15-CNV-615	HPGR SCREEN OVERSIZE CONVEYOR No.1	30.0	TRUE	FALSE	FALSE	0.74	94	94	91,413	91,413	182,826
E15-CNV-616	HPGR SCREEN OVERSIZE CONVEYOR No.2	30.0	TRUE	FALSE	FALSE	0.74	94	94	91,413	91,413	182,826
E15-CNV-617	HPGR SCREEN OVERSIZE CONVEYOR No.3	280.0	TRUE	FALSE	FALSE	0.74	94	94	853,186	853,186	1,706,372
E15-SCN-610	HPGR SCREEN No.1	75.0	TRUE	FALSE	FALSE	0.85	94	94	261,924	261,924	523,848
E15-SCN-611	HPGR SCREEN No.2	75.0	TRUE	FALSE	FALSE	0.85	94	94	261,924	261,924	523,848
E15-SCN-612	HPGR SCREEN No.3	75.0	TRUE	FALSE	FALSE	0.85	94	94	261,924	261,924	523,848
E15-SCN-613	HPGR SCREEN No.4	75.0	TRUE	FALSE	FALSE	0.85	94	94	261,924	261,924	523,848
E15-SCN-614	HPGR SCREEN No.5 (SPARE)	75.0	FALSE	TRUE	FALSE	0.85	94	94	0	0	0
E15-ACU-001	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL MCC ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-002	BUILDING SERVICES AIR COOLED CONDENSING UNIT - MCC ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	50	0	27,736	0	27,736
E15-ACU-003	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL ELECT ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-004	BUILDING SERVICES AIR COOLED CONDENSING UNIT - ELECT ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	50	0	27,736	0	27,736
E15-ACU-005	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL OFFICES PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-006	BUILDING SERVICES AIR COOLED CONDENSING UNIT - OFFICES PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	50	0	20,849	0	20,849
E15-ACU-007	BUILDING SERVICES AIR CONDITIONING UNIT - FAN COIL CONTROL ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	50	0	6,888	0	6,888
E15-ACU-008	BUILDING SERVICES AIR COOLED CONDENSING UNIT - CONTROL ROOM PRIMARY GRINDING	15.0	TRUE	FALSE	FALSE	0.85	50	0	27,923	0	27,923
E15-ANA-003	PARTICLE SIZE ANALYZER No.1	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881

SEABRIDGE GOLD

KSM ENERGY STUDY HPGR OPTION LOAD LIST

Notes
1. Motor loading is defined as the average load divided by the installed Peak Load.
2. Motor efficiencies have been considered in the Electrical Load.
3. Utilization Factor is defined as the percent of time the motor actually runs in the summer or winter.
4. Utilization factors have been set in accordance with Process/Mech instructions.
5. Synchronous motors assumed for Ball Mills, running at leading 95% power factor.
6. Overall corrected power factor will be 97%.

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

EQM Code	LOAD NAME	ELECTRICAL LOAD (kW)	OPERATING	STANDBY	FUTURE	MOTOR LOADING	SUMMER USE FACTOR (%)	WINTER USE FACTOR (%)	SUMMER KWH	WINTER KWH	ANNUAL KWH
E15-ANA-004	PARTICLE SIZE ANALYZER No.2	1.5	TRUE	FALSE	FALSE	0.80	94	94	4,941	4,941	9,881
E15-CRN-007	PRIMARY GRINDING CRANE No.1	75.0	TRUE	FALSE	FALSE	0.80	10	10	26,280	26,280	52,560
E15-CRN-008	PRIMARY GRINDING CRANE No.2	75.0	TRUE	FALSE	FALSE	0.80	10	10	26,280	26,280	52,560
E15-FAN-001	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-002	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-003	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-004	BUILDING SERVICES FAN - HEAT RECOVERY PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	0	100	0	27,923	27,923
E15-FAN-005	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-006	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-007	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-008	BUILDING SERVICES EXHAUST FAN - COMPRESSOR /BLOWER ROOM PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,923	27,923	55,845
E15-FAN-009	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-010	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-011	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-012	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-013	BUILDING SERVICES ROOF UPBLAST EXHAUST FAN PRIMARY GRINDING	11.2	TRUE	FALSE	FALSE	0.85	100	100	41,698	41,698	83,395
E15-FAN-014	BUILDING SERVICES AIR HANDLING UNIT (no heat) - TRANSFORMER ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	100	100	55,473	55,473	110,945
E15-FAN-015	BUILDING SERVICES AIR HANDLING UNIT (no heat) - TRANSFORMER ROOM PRIMARY GRINDING	14.9	TRUE	FALSE	FALSE	0.85	100	100	55,473	55,473	110,945
E15-FAN-016	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - MCC ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-017	BUILDING SERVICES WALL SUPPLY FAN / FILTER UNIT - BALL MILL LUBE ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-018	BUILDING SERVICES WALL SUPPLY FAN / FILTER UNIT - BALL MILL LUBE ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-020	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - ELECT ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-021	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) - CONTROL ROOM PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-701	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E15-FAN-702	BUILDING SERVICES UPBLAST ROOF EXHAUST FAN PRIMARY GRINDING	7.5	TRUE	FALSE	FALSE	0.85	100	100	27,774	27,774	55,547
E15-FAN-703	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-704	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-705	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-706	BUILDING SERVICES SUPPLY FAN / FILTER UNIT (PRESSURIZATION) PRIMARY GRINDING	3.7	TRUE	FALSE	FALSE	0.85	100	100	13,775	13,775	27,550
E15-FAN-711	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E15-FAN-712	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	65.0	TRUE	FALSE	FALSE	0.85	100	100	241,995	241,995	483,990
E15-FAN-811	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	128.0	TRUE	FALSE	FALSE	0.85	100	100	476,544	476,544	953,088
E15-FAN-812	BUILDING SERVICES DUST COLLECTOR EXHAUST FAN PRIMARY GRINDING	11.1	TRUE	FALSE	FALSE	0.85	100	100	41,325	41,325	82,651
E15-HAN-036	BALL MILL LINER HANDLER	80.0	TRUE	FALSE	FALSE	0.80	10	10	28,032	28,032	56,064
E15-HOI-189	GRINDING AREA SUMP PUMP HOIST	25.0	TRUE	FALSE	FALSE	0.80	5	5	4,380	4,380	8,760
E15-HTR-001	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-002	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-003	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-004	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-005	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-006	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-007	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-008	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-009	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-012	BUILDING SERVICES PROPANE MAKE UP AIR UNIT PRIMARY GRINDING	18.7	TRUE	FALSE	FALSE	0.85	0	100	0	69,620	69,620
E15-HTR-013	BUILDING SERVICES PROPANE MAKE UP AIR UNIT PRIMARY GRINDING	18.7	TRUE	FALSE	FALSE	0.85	0	100	0	69,620	69,620
E15-HTR-016	BUILDING SERVICES ELECTRIC DUCT HEATER - ELECT ROOM PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-017	BUILDING SERVICES ELECTRIC DUCT HEATER - MCC PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-018	BUILDING SERVICES ELECTRIC DUCT HEATER - CONTROL ROOM PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-019	BUILDING SERVICES ELECTRIC DUCT HEATER - MCC PRIMARY GRINDING	34.0	TRUE	FALSE	FALSE	0.85	0	100	0	126,582	126,582
E15-HTR-701	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PRIMARY GRINDING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E15-HTR-702	BUILDING SERVICES PROPANE MAKE-UP AIR UNIT PRIMARY GRINDING	22.4	TRUE	FALSE	FALSE	0.85	0	100	0	83,395	83,395
E15-HTR-703	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-704	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-705	BUILDING SERVICES PROPANE UNIT HEATER - TERT CRUSHING PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-706	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-707	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-708	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-709	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-710	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-711	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-712	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-713	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-HTR-714	BUILDING SERVICES PROPANE UNIT HEATER PRIMARY GRINDING	0.7	TRUE	FALSE	FALSE	0.85	0	100	0	2,606	2,606
E15-LUB-031	BALL MILL LUBE UNIT No.1	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-032	BALL MILL LUBE UNIT No.2	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-033	BALL MILL LUBE UNIT No.3	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-LUB-034	BALL MILL LUBE UNIT No.4	110.0	TRUE	FALSE	FALSE	0.80	94	94	362,314	362,314	724,627
E15-MIL-025	BALL MILL No.1	14000.0	TRUE	FALSE	FALSE	0.81	94	94	46,708,473	46,708,473	93,416,945
E15-MIL-026	BALL MILL No.2	14000.0	TRUE	FALSE	FALSE	0.81	94	94	46,708,473	46,708,473	93,416,945
E15-MIL-027	BALL MILL No.3	14000.0	TRUE	FALSE	FALSE	0.81	94	94	46,708,473	46,708,473	93,416,945
E15-MIL-028	BALL MILL No.4	14000.0	TRUE	FALSE	FALSE	0.81	94	94	46,708,473	46,708,473	93,416,945
E15-PPK-184	MILL INCHING HYDRAULIC POWER PACK	150.0	FALSE	FALSE	TRUE	0.80	5	5	0	0	0
E15-PSL-045	PRIMARY CYCLONE CLUSTER No.1 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-046	PRIMARY CYCLONE CLUSTER No.2 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-047	PRIMARY CYCLONE CLUSTER No.3 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-048	PRIMARY CYCLONE CLUSTER No.4 FEED PUMP (VFD)	1650.0	TRUE	FALSE	FALSE	0.85	94	94	5,745,947	5,745,947	11,491,894
E15-PSL-049	PRIMARY CYCLONE CLUSTER No.1 & 2 FEED PUMP (VFD) (BACK-UP)	1650.0	FALSE	TRUE	FALSE	0.85	94	94	0	0	0
E15-PSL-050	PRIMARY CYCLONE CLUSTER No.3 & 4 FEED PUMP (VFD) (BACK-UP)	1650.0	FALSE	TRUE	FALSE	0.85	94	94	0	0	0
E15-PSU-066	GRINDING AREA SUMP PUMP No.1	60.0	TRUE	FALSE	FALSE	0.80	10	10	21,024	21,024	42,048
E15-PSU-068	GRINDING AREA SUMP PUMP No.2	60.0	TRUE	FALSE	FALSE	0.80	10	10	21,024	21,024	42,048
E15-SYC-511	MILL COOLING SYSTEM	300.0	TRUE	FALSE	FALSE	0.85	20	92	222,280	1,022,490	1,244,770
E15-SMP-060	CYCLONE CLUSTER OVERFLOW No.1 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-061	CYCLONE CLUSTER OVERFLOW No.2 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-062	CYCLONE CLUSTER OVERFLOW No.3 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
E15-SMP-063	CYCLONE CLUSTER OVERFLOW No.4 SAMPLER	2.0	TRUE	FALSE	FALSE	0.80	94	94	6,588	6,588	13,175
	TOTALS								**335,488,121**	**338,032,888**	**673,521,008**

APPENDIX H

HPGR Option – Capital and Operating Cost Estimates

Project No: 0952880200-EST-R0001-02 **Kerr-Sulphurets-Mitchell Project** **Report Date: 01-Jun-12**

Client: Seabridge Gold Inc. **HPGR Circuit Option - Major Summary** **Rev E2**

			Labour Manhour	Labour Cost	Material Cost	Construction Equipment Cost	Process Equipment Cost	Total Cost (CAD)
Direct Works								
A	Teigen Plansite		63,924	6,903,756	1,164,162	4,805,102	0	12,873,020
E0	Plantsite Crushing		1,026,739	110,887,814	97,151,916	6,942,918	148,245,260	363,227,908
E1	Plantsite Grinding		220,342	23,796,956	15,039,891	1,194,924	91,168,783	131,200,554
M1	Temporary Services		0	0	12,565,073	0	0	12,565,073
		Direct Works Subtotal	**1,311,005**	**141,588,526**	**125,921,041**	**12,942,945**	**239,414,043**	**519,866,555**
Indirects								
X	Project Indirects		243,379	26,284,916	174,466,941	75,000	0	200,826,857
Y	Owner's Costs		0	0	0	0	0	0
Z	Contingencies		0	0	99,138,000	0	0	99,138,000
		Indirects Subtotal	**243,379**	**26,284,916**	**273,604,941**	**75,000**	**0**	**299,964,857**
Option 5 (HPGR+Conveyance) Total			**1,554,384**	**167,873,442**	**399,525,982**	**13,017,945**	**239,414,043**	**819,831,412**

WARDROP
A TETRA TECH COMPANY

SEABRIDGE GOLD

Project No: 0952880200-EST-R0001-02 **Kerr-Sulphurets-Mitchell Project** **Report Date: 01-Jun-12**

Client: Seabridge Gold Inc. **HPGR Circuit Option - Area Summary** **Rev E2**

Area		Labour Manhour	Labour Cost	Material Cost	Construction Eqpt Cost	Process Eqpt Cost	Total Cost (CAD)
A - Teigen Plansite		**63,924**	**6,903,756**	**1,164,162**	**4,805,102**	**0**	**12,873,020**
A10	*Plantsite and Roads*	*63,924*	*6,903,756*	*1,164,162*	*4,805,102*	*0*	*12,873,020*
E0 - Plantsite Crushing		**1,026,739**	**110,887,814**	**97,151,916**	**6,942,918**	**148,245,260**	**363,227,908**
E05	*Teigen Coarse Ore Stockpile*	*419,679*	*45,325,281*	*47,289,624*	*2,991,278*	*15,735,555*	*111,341,738*
E07	*Secondary Crushing*	*130,486*	*14,092,504*	*8,812,169*	*773,761*	*37,660,090*	*61,338,524*
E08	*Fine Ore Stockpile*	*266,674*	*28,800,833*	*23,058,370*	*1,927,738*	*14,294,715*	*68,081,656*
E09	*Tertiary Crushing (HPGR)*	*209,900*	*22,669,196*	*17,991,753*	*1,250,141*	*80,554,900*	*122,465,990*
E1 - Plantsite Grinding		**220,342**	**23,796,956**	**15,039,891**	**1,194,924**	**91,168,783**	**131,200,554**
E10	*Mill Building*	*131,255*	*14,175,504*	*13,529,734*	*927,858*	*2,047,060*	*30,680,156*
E15	*Primary & Secondary Grinding*	*89,088*	*9,621,451*	*1,510,157*	*267,066*	*89,121,723*	*100,520,398*
M1 - Temporary Services		**0**	**0**	**12,565,073**	**0**	**0**	**12,565,073**
M12	*Catering and Housekeeping*	*0*	*0*	*12,565,073*	*0*	*0*	*12,565,073*
X - Project Indirects		**243,379**	**26,284,916**	**174,466,941**	**75,000**	**0**	**200,826,857**
X10	*Construction Indirects*	*188,039*	*20,308,196*	*52,386,000*	*0*	*0*	*72,694,196*
X20	*Spares*	*0*	*0*	*10,785,000*	*0*	*0*	*10,785,000*
X30	*Initial Fills*	*0*	*0*	*7,733,341*	*0*	*0*	*7,733,341*
X40	*Freight And Logistic*	*0*	*0*	*17,787,000*	*0*	*0*	*17,787,000*
X50	*Commissioning and Pre-operational Startup*	*51,840*	*5,598,720*	*7,269,600*	*0*	*0*	*12,868,320*
X60	*EPCM*	*3,500*	*378,000*	*78,506,000*	*75,000*	*0*	*78,959,000*
Y - Owner's Costs		**0**	**0**	**0**	**0**	**0**	**0**
Y10	*Owner's Costs*	*0*	*0*	*0*	*0*	*0*	*0*

Area	Labour Manhour	Labour Cost	Material Cost	Construction Eqpt Cost	Process Eqpt Cost	Total Cost (CAD)
Z - Contingencies	**0**	**0**	**99,138,000**	**0**	**0**	**99,138,000**
Z10 Contingency	*0*	*0*	*99,138,000*	*0*	*0*	*99,138,000*
Option 5 (HPGR+Conveyance) Total	**1,554,384**	**167,873,442**	**399,525,982**	**13,017,945**	**239,414,043**	**819,831,412**

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10 - Plantsite and Roads														
A10-10-8.00	Teigen Plantsite; Camp 6; Clear and grub	5.14 ha	93.60	481.10	108.00	51,959	0.00	0	4,560.00	23,438	0.00	0	14,668.80	75,398
A10-10-9.00	Teigen Plantsite; Camp 6; Excavate and remove top soil 300mm	12,204. m3	0.04	475.96	108.00	51,403	0.00	0	4.25	51,867	0.00	0	8.46	103,270
A10-10-10.00	Teigen Plantsite; Camp 6; Rock excavation - rippable rock	4,339. m3	0.04	169.22	108.00	18,276	0.00	0	5.50	23,865	0.00	0	9.71	42,140
A10-10-11.00	Teigen Plantsite; Camp 6; Rock excavation - drilll and blast	39,051. m3	0.10	4,061.30	108.00	438,621	3.00	117,153	4.50	175,730	0.00	0	18.73	731,503
A10-10-12.00	Teigen Plantsite; Camp 6; Excavate and remove unsuitable material	21,695. m3	0.04	846.11	108.00	91,379	0.00	0	4.25	92,204	0.00	0	8.46	183,583
A10-10-13.00	Teigen Plantsite; Camp 6; Excavate to fill, suitable material	9,491. m3	0.02	185.07	108.00	19,988	0.00	0	4.50	42,710	0.00	0	6.61	62,698
A10-10-14.00	Teigen Plantsite; Camp 6; Compacted Fill from temporary stockpile (not exceeding 2km haul)	26,195. m3	0.03	681.07	108.00	73,556	0.00	0	4.75	124,426	0.00	0	7.56	197,982
A10-10-15.00	Teigen Plantsite; 170 Person Permenent Camp; Clear and grub	.98 ha	93.60	91.76	108.00	9,910	0.00	0	4,560.00	4,470	0.00	0	14,668.80	14,380
A10-10-16.00	Teigen Plantsite; 170 Person Permenent Camp; Excavate and remove top soil 300mm	2,515. m3	0.04	98.09	108.00	10,593	0.00	0	4.25	10,689	0.00	0	8.46	21,282
A10-10-17.00	Teigen Plantsite; 170 Person Permenent Camp; Rock excavation - rippable rock	318. m3	0.04	12.40	108.00	1,339	0.00	0	5.50	1,749	0.00	0	9.71	3,088
A10-10-18.00	Teigen Plantsite; 170 Person Permenent Camp; Rock excavation - drilll and blast	2,858. m3	0.10	297.23	108.00	32,101	3.00	8,574	4.50	12,861	0.00	0	18.73	53,536
A10-10-19.00	Teigen Plantsite; 170 Person Permenent Camp; Excavate and remove unsuitable material	1,588. m3	0.04	61.93	108.00	6,689	0.00	0	4.25	6,749	0.00	0	8.46	13,438
A10-10-20.00	Teigen Plantsite; 170 Person Permenent Camp; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,033. m3	0.03	52.86	108.00	5,709	0.00	0	4.75	9,657	0.00	0	7.56	15,365
A10-10-21.00	Teigen Plantsite; Portal Laydown Area; Clear and grub	1.08 ha	93.60	100.94	108.00	10,901	0.00	0	4,560.00	4,918	0.00	0	14,668.80	15,819
A10-10-22.00	Teigen Plantsite; Portal Laydown Area; Excavate and remove top soil 300mm	2,692. m3	0.04	104.99	108.00	11,339	0.00	0	4.25	11,441	0.00	0	8.46	22,780
A10-10-23.00	Teigen Plantsite; Portal Laydown Area; Rock excavation - rippable rock	411. m3	0.04	16.03	108.00	1,731	0.00	0	5.50	2,261	0.00	0	9.71	3,992

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A10-10-24.00	Teigen Plantsite; Portal Laydown Area; Rock excavation - drilll and blast	3,703. m3	0.10	385.11	108.00	41,592	3.00	11,109	4.50	16,664	0.00	0	18.73	69,365
A10-10-25.00	Teigen Plantsite; Portal Laydown Area; Excavate and remove unsuitable material	2,057. m3	0.04	80.22	108.00	8,664	0.00	0	4.25	8,742	0.00	0	8.46	17,406
A10-10-26.00	Teigen Plantsite; Portal Laydown Area; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,077. m3	0.03	54.00	108.00	5,832	0.00	0	4.75	9,866	0.00	0	7.56	15,698
A10-10-27.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Clear and grub	4.1 ha	93.60	383.38	108.00	41,405	0.00	0	4,560.00	18,677	0.00	0	14,668.80	60,082
A10-10-28.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate and remove top soil 300mm	9,804. m3	0.04	382.36	108.00	41,294	0.00	0	4.25	41,667	0.00	0	8.46	82,961
A10-10-29.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Rock excavation - rippable rock	4,334. m3	0.04	169.03	108.00	18,255	0.00	0	5.50	23,837	0.00	0	9.71	42,092
A10-10-30.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Rock excavation - drilll and blast	39,002. m3	0.10	4,056.21	108.00	438,070	3.00	117,006	4.50	175,509	0.00	0	18.73	730,585
A10-10-31.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate and remove unsuitable material	21,668. m3	0.04	845.05	108.00	91,266	0.00	0	4.25	92,089	0.00	0	8.46	183,355
A10-10-32.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Excavate to fill, suitable material	11,862. m3	0.02	231.31	108.00	24,981	0.00	0	4.50	53,379	0.00	0	6.61	78,360
A10-10-33.00	Teigen Plantsite; C.O. Stockpile (60000t Live); Compacted Fill from temporary stockpile (not exceeding 2km haul)	25,208. m3	0.03	655.41	108.00	70,784	0.00	0	4.75	119,738	0.00	0	7.56	190,522
A10-10-34.00	Teigen Plantsite; Concentrate Loadout; Clear and grub	1.55 ha	93.60	145.29	108.00	15,691	0.00	0	4,560.00	7,078	0.00	0	14,668.80	22,769
A10-10-35.00	Teigen Plantsite; Concentrate Loadout; Excavate and remove top soil 300mm	2,576. m3	0.04	100.46	108.00	10,850	0.00	0	4.25	10,948	0.00	0	8.46	21,798
A10-10-36.00	Teigen Plantsite; Concentrate Loadout; Rock excavation - rippable rock	1,889. m3	0.04	73.67	108.00	7,956	0.00	0	5.50	10,390	0.00	0	9.71	18,346
A10-10-37.00	Teigen Plantsite; Concentrate Loadout; Rock excavation - drilll and blast	16,997. m3	0.10	1,767.69	108.00	190,910	3.00	50,991	4.50	76,487	0.00	0	18.73	318,388
A10-10-38.00	Teigen Plantsite; Concentrate Loadout; Excavate and remove unsuitable material	9,443. m3	0.04	368.28	108.00	39,774	0.00	0	4.25	40,133	0.00	0	8.46	79,907
A10-10-39.00	Teigen Plantsite; Concentrate Loadout; Excavate to fill, suitable material	6,865. m3	0.02	133.87	108.00	14,458	0.00	0	4.50	30,893	0.00	0	6.61	45,350

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A10-10-40.00	Teigen Plantsite; Concentrate Loadout; Compacted Fill from temporary stockpile (not exceeding 2km haul)	3,585. m3	0.03	93.21	108.00	10,067	0.00	0	4.75	17,029	0.00	0	7.56	27,095
A10-10-41.00	Teigen Plantsite; Process Plant; Clear and grub	5.83 ha	93.60	546.03	108.00	58,972	0.00	0	4,560.00	26,602	0.00	0	14,668.80	85,573
A10-10-42.00	Teigen Plantsite; Process Plant; Excavate and remove top soil 300mm	12,825. m3	0.04	500.18	108.00	54,019	0.00	0	4.25	54,506	0.00	0	8.46	108,525
A10-10-43.00	Teigen Plantsite; Process Plant; Rock excavation - rippable rock	10,056. m3	0.04	392.18	108.00	42,356	0.00	0	5.50	55,308	0.00	0	9.71	97,664
A10-10-44.00	Teigen Plantsite; Process Plant; Rock excavation - drilll and blast	90,508. m3	0.10	9,412.83	108.00	1,016,586	3.00	271,524	4.50	407,286	0.00	0	18.73	1,695,396
A10-10-45.00	Teigen Plantsite; Process Plant; Excavate and remove unsuitable material	50,282. m3	0.04	1,961.00	108.00	211,788	0.00	0	4.25	213,699	0.00	0	8.46	425,486
A10-10-46.00	Teigen Plantsite; Process Plant; Excavate to fill, suitable material	37,458. m3	0.02	730.43	108.00	78,887	0.00	0	4.50	168,561	0.00	0	6.61	247,448
A10-10-47.00	Teigen Plantsite; Process Plant; Compacted Fill from temporary stockpile (not exceeding 2km haul)	25,244. m3	0.03	656.34	108.00	70,885	0.00	0	4.75	119,909	0.00	0	7.56	190,794
A10-10-48.00	Teigen Plantsite; HPGR; Clear and grub	1.02 ha	93.60	95.04	108.00	10,264	0.00	0	4,560.00	4,630	0.00	0	14,668.80	14,895
A10-10-49.00	Teigen Plantsite; HPGR; Excavate and remove top soil 300mm	1,975. m3	0.04	77.03	108.00	8,319	0.00	0	4.25	8,394	0.00	0	8.46	16,712
A10-10-50.00	Teigen Plantsite; HPGR; Rock excavation - rippable rock	668. m3	0.04	26.05	108.00	2,814	0.00	0	5.50	3,674	0.00	0	9.71	6,488
A10-10-51.00	Teigen Plantsite; HPGR; Rock excavation - drilll and blast	6,015. m3	0.10	625.56	108.00	67,560	3.00	18,045	4.50	27,068	0.00	0	18.73	112,673
A10-10-52.00	Teigen Plantsite; HPGR; Excavate and remove unsuitable material	3,342. m3	0.04	130.34	108.00	14,077	0.00	0	4.25	14,204	0.00	0	8.46	28,280
A10-10-53.00	Teigen Plantsite; HPGR; Excavate to fill, suitable material	1,367. m3	0.02	26.66	108.00	2,879	0.00	0	4.50	6,152	0.00	0	6.61	9,030
A10-10-54.00	Teigen Plantsite; HPGR; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,145. m3	0.03	107.77	108.00	11,639	0.00	0	4.75	19,689	0.00	0	7.56	31,328
A10-10-55.00	Teigen Plantsite; Secondary Crushing Building; Clear and grub	.38 ha	93.60	35.39	108.00	3,822	0.00	0	4,560.00	1,724	0.00	0	14,668.80	5,546

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A10-10-56.00	Teigen Plantsite; Secondary Crushing Building; Excavate and remove top soil 300mm	959. m3	0.04	37.40	108.00	4,039	0.00	0	4.25	4,076	0.00	0	8.46	8,115
A10-10-57.00	Teigen Plantsite; Secondary Crushing Building; Rock excavation - rippable rock	85. m3	0.04	3.32	108.00	358	0.00	0	5.50	468	0.00	0	9.71	826
A10-10-58.00	Teigen Plantsite; Secondary Crushing Building; Rock excavation - drilll and blast	763. m3	0.10	79.35	108.00	8,570	3.00	2,289	4.50	3,434	0.00	0	18.73	14,293
A10-10-59.00	Teigen Plantsite; Secondary Crushing Building; Excavate and remove unsuitable material	424. m3	0.04	16.54	108.00	1,786	0.00	0	4.25	1,802	0.00	0	8.46	3,588
A10-10-60.00	Teigen Plantsite; Secondary Crushing Building; Compacted Fill from temporary stockpile (not exceeding 2km haul)	672. m3	0.03	17.47	108.00	1,887	0.00	0	4.75	3,192	0.00	0	7.56	5,079
A10-10-61.00	Teigen Plantsite; Admin; Clear and grub	.36 ha	93.60	33.64	108.00	3,633	0.00	0	4,560.00	1,639	0.00	0	14,668.80	5,272
A10-10-62.00	Teigen Plantsite; Admin; Excavate and remove top soil 300mm	839. m3	0.04	32.72	108.00	3,534	0.00	0	4.25	3,566	0.00	0	8.46	7,100
A10-10-63.00	Teigen Plantsite; Admin; Rock excavation - rippable rock	111. m3	0.04	4.33	108.00	468	0.00	0	5.50	611	0.00	0	9.71	1,078
A10-10-64.00	Teigen Plantsite; Admin; Rock excavation - drilll and blast	997. m3	0.10	103.69	108.00	11,198	3.00	2,991	4.50	4,487	0.00	0	18.73	18,676
A10-10-65.00	Teigen Plantsite; Admin; Excavate and remove unsuitable material	554. m3	0.04	21.61	108.00	2,333	0.00	0	4.25	2,355	0.00	0	8.46	4,688
A10-10-66.00	Teigen Plantsite; Admin; Compacted Fill from temporary stockpile (not exceeding 2km haul)	1,703. m3	0.03	44.28	108.00	4,782	0.00	0	4.75	8,089	0.00	0	7.56	12,871
A10-10-67.00	Teigen Plantsite; Temporary Muck Storage Pad; Clear and grub	1.32 ha	93.60	123.58	108.00	13,347	0.00	0	4,560.00	6,021	0.00	0	14,668.80	19,367
A10-10-68.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate and remove top soil 300mm	3,000. m3	0.04	117.00	108.00	12,636	0.00	0	4.25	12,750	0.00	0	8.46	25,386
A10-10-69.00	Teigen Plantsite; Temporary Muck Storage Pad; Rock excavation - rippable rock	823. m3	0.04	32.10	108.00	3,466	0.00	0	5.50	4,527	0.00	0	9.71	7,993
A10-10-70.00	Teigen Plantsite; Temporary Muck Storage Pad; Rock excavation - drilll and blast	7,404. m3	0.10	770.02	108.00	83,162	3.00	22,212	4.50	33,318	0.00	0	18.73	138,692
A10-10-71.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate and remove unsuitable material	4,113. m3	0.04	160.41	108.00	17,324	0.00	0	4.25	17,480	0.00	0	8.46	34,804

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A10-10-72.00	Teigen Plantsite; Temporary Muck Storage Pad; Excavate to fill, suitable material	1,112. m3	0.02	21.68	108.00	2,342	0.00	0	4.50	5,004	0.00	0	6.61	7,346
A10-10-73.00	Teigen Plantsite; Temporary Muck Storage Pad; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,069. m3	0.03	105.79	108.00	11,426	0.00	0	4.75	19,328	0.00	0	7.56	30,754
A10-10-74.00	Teigen Plantsite; CN Destruction and Recovery; Clear and grub	5.07 ha	93.60	474.63	108.00	51,260	0.00	0	4,560.00	23,123	0.00	0	14,668.80	74,383
A10-10-75.00	Teigen Plantsite; CN Destruction and Recovery; Excavate and remove top soil 300mm	10,201. m3	0.04	397.84	108.00	42,967	0.00	0	4.25	43,354	0.00	0	8.46	86,321
A10-10-76.00	Teigen Plantsite; CN Destruction and Recovery; Rock excavation - rippable rock	7,989. m3	0.04	311.57	108.00	33,650	0.00	0	5.50	43,940	0.00	0	9.71	77,589
A10-10-77.00	Teigen Plantsite; CN Destruction and Recovery; Rock excavation - drilll and blast	71,905. m3	0.10	7,478.12	108.00	807,637	3.00	215,715	4.50	323,573	0.00	0	18.73	1,346,924
A10-10-78.00	Teigen Plantsite; CN Destruction and Recovery; Excavate and remove unsuitable material	39,947. m3	0.04	1,557.93	108.00	168,257	0.00	0	4.25	169,775	0.00	0	8.46	338,032
A10-10-79.00	Teigen Plantsite; CN Destruction and Recovery; Excavate to fill, suitable material	29,747. m3	0.02	580.07	108.00	62,647	0.00	0	4.50	133,862	0.00	0	6.61	196,509
A10-10-80.00	Teigen Plantsite; CN Destruction and Recovery; Excavate to temporary stockpile (not exceeding 2km haul)	18,009. m3	0.03	468.23	108.00	50,569	0.00	0	4.25	76,538	0.00	0	7.06	127,108
A10-10-81.00	Teigen Plantsite; Maintenance Shop; Clear and grub	1.04 ha	93.60	97.41	108.00	10,520	0.00	0	4,560.00	4,746	0.00	0	14,668.80	15,266
A10-10-82.00	Teigen Plantsite; Maintenance Shop; Excavate and remove top soil 300mm	2,125. m3	0.04	82.88	108.00	8,951	0.00	0	4.25	9,031	0.00	0	8.46	17,982
A10-10-83.00	Teigen Plantsite; Maintenance Shop; Rock excavation - rippable rock	776. m3	0.04	30.26	108.00	3,269	0.00	0	5.50	4,268	0.00	0	9.71	7,537
A10-10-84.00	Teigen Plantsite; Maintenance Shop; Rock excavation - drilll and blast	6,986. m3	0.10	726.54	108.00	78,467	3.00	20,958	4.50	31,437	0.00	0	18.73	130,862
A10-10-85.00	Teigen Plantsite; Maintenance Shop; Excavate and remove unsuitable material	3,881. m3	0.04	151.36	108.00	16,347	0.00	0	4.25	16,494	0.00	0	8.46	32,841
A10-10-86.00	Teigen Plantsite; Maintenance Shop; Excavate to fill, suitable material	1,756. m3	0.02	34.24	108.00	3,698	0.00	0	4.50	7,902	0.00	0	6.61	11,600
A10-10-87.00	Teigen Plantsite; Maintenance Shop; Compacted Fill from temporary stockpile (not exceeding 2km haul)	5,201. m3	0.03	135.23	108.00	14,604	0.00	0	4.75	24,705	0.00	0	7.56	39,309

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A10-10-88.00	Teigen Plantsite; Container Storage Area; Clear and grub	1.09 ha	93.60	102.46	108.00	11,066	0.00	0	4,560.00	4,992	0.00	0	14,668.80	16,058
A10-10-89.00	Teigen Plantsite; Container Storage Area; Excavate and remove top soil 300mm	3,075. m3	0.04	119.93	108.00	12,952	0.00	0	4.25	13,069	0.00	0	8.46	26,021
A10-10-90.00	Teigen Plantsite; Container Storage Area; Compacted Fill from temporary stockpile (not exceeding 2km haul)	4,124. m3	0.03	107.22	108.00	11,580	0.00	0	4.75	19,589	0.00	0	7.56	31,169
A10-10-91.00	Teigen Plantsite; Construction Admin. Office; Clear and grub	.22 ha	93.60	20.58	108.00	2,223	0.00	0	4,560.00	1,003	0.00	0	14,668.80	3,226
A10-10-92.00	Teigen Plantsite; Construction Admin. Office; Excavate and remove top soil 300mm	529. m3	0.04	20.63	108.00	2,228	0.00	0	4.25	2,248	0.00	0	8.46	4,476
A10-10-93.00	Teigen Plantsite; Construction Admin. Office; Rock excavation - rippable rock	48. m3	0.04	1.87	108.00	202	0.00	0	5.50	264	0.00	0	9.71	466
A10-10-94.00	Teigen Plantsite; Construction Admin. Office; Rock excavation - drilll and blast	435. m3	0.10	45.24	108.00	4,886	3.00	1,305	4.50	1,958	0.00	0	18.73	8,148
A10-10-95.00	Teigen Plantsite; Construction Admin. Office; Excavate and remove unsuitable material	242. m3	0.04	9.44	108.00	1,019	0.00	0	4.25	1,029	0.00	0	8.46	2,048
A10-10-96.00	Teigen Plantsite; Construction Admin. Office; Compacted Fill from temporary stockpile (not exceeding 2km haul)	273. m3	0.03	7.10	108.00	767	0.00	0	4.75	1,297	0.00	0	7.56	2,063
A10-10-97.00	Teigen Plantsite; Amb.; Clear and grub	.23 ha	93.60	21.70	108.00	2,343	0.00	0	4,560.00	1,057	0.00	0	14,668.80	3,400
A10-10-98.00	Teigen Plantsite; Amb.; Excavate and remove top soil 300mm	500. m3	0.04	19.50	108.00	2,106	0.00	0	4.25	2,125	0.00	0	8.46	4,231
A10-10-99.00	Teigen Plantsite; Amb.; Rock excavation - rippable rock	73. m3	0.04	2.85	108.00	307	0.00	0	5.50	402	0.00	0	9.71	709
A10-10-100.00	Teigen Plantsite; Amb.; Rock excavation - drilll and blast	658. m3	0.10	68.43	108.00	7,391	3.00	1,974	4.50	2,961	0.00	0	18.73	12,326
A10-10-101.00	Teigen Plantsite; Amb.; Excavate and remove unsuitable material	366. m3	0.04	14.27	108.00	1,542	0.00	0	4.25	1,556	0.00	0	8.46	3,097
A10-10-102.00	Teigen Plantsite; Amb.; Compacted Fill from temporary stockpile (not exceeding 2km haul)	390. m3	0.03	10.14	108.00	1,095	0.00	0	4.75	1,853	0.00	0	7.56	2,948
A10-10-103.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Clear and grub	.72 ha	93.60	67.11	108.00	7,248	0.00	0	4,560.00	3,270	0.00	0	14,668.80	10,518

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A10-10-104.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate and remove top soil 300mm	1,458. m3	0.04	56.86	108.00	6,141	0.00	0	4.25	6,197	0.00	0	8.46	12,338
A10-10-105.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Rock excavation - rippable rock	388. m3	0.04	15.13	108.00	1,634	0.00	0	5.50	2,134	0.00	0	9.71	3,768
A10-10-106.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Rock excavation - drilll and blast	3,495. m3	0.10	363.48	108.00	39,256	3.00	10,485	4.50	15,728	0.00	0	18.73	65,468
A10-10-107.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate and remove unsuitable material	1,942. m3	0.04	75.74	108.00	8,180	0.00	0	4.25	8,254	0.00	0	8.46	16,433
A10-10-108.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Excavate to fill, suitable material	483. m3	0.02	9.42	108.00	1,017	0.00	0	4.50	2,174	0.00	0	6.61	3,191
A10-10-109.00	Teigen Plantsite; Fuel Unloading / Pumping Station; Compacted Fill from temporary stockpile (not exceeding 2km haul)	2,629. m3	0.03	68.35	108.00	7,382	0.00	0	4.75	12,488	0.00	0	7.56	19,870
A10-10-110.00	Teigen Plantsite; Pre-construction Fuel Storage; Clear and grub	.29 ha	93.60	27.50	108.00	2,970	0.00	0	4,560.00	1,340	0.00	0	14,668.80	4,310
A10-10-111.00	Teigen Plantsite; Pre-construction Fuel Storage; Excavate and remove top soil 300mm	750. m3	0.04	29.25	108.00	3,159	0.00	0	4.25	3,188	0.00	0	8.46	6,347
A10-10-112.00	Teigen Plantsite; Pre-construction Fuel Storage; Rock excavation - rippable rock	40. m3	0.04	1.56	108.00	168	0.00	0	5.50	220	0.00	0	9.71	388
A10-10-113.00	Teigen Plantsite; Pre-construction Fuel Storage; Rock excavation - drilll and blast	363. m3	0.10	37.75	108.00	4,077	3.00	1,089	4.50	1,634	0.00	0	18.73	6,800
A10-10-114.00	Teigen Plantsite; Pre-construction Fuel Storage; Excavate and remove unsuitable material	202. m3	0.04	7.88	108.00	851	0.00	0	4.25	859	0.00	0	8.46	1,709
A10-10-115.00	Teigen Plantsite; Pre-construction Fuel Storage; Compacted Fill from temporary stockpile (not exceeding 2km haul)	260. m3	0.03	6.76	108.00	730	0.00	0	4.75	1,235	0.00	0	7.56	1,965
A10-10-116.00	Teigen Plantsite; Construction Laydown Area; Clear and grub	.11 ha	93.60	9.92	108.00	1,072	0.00	0	4,560.00	483	0.00	0	14,668.80	1,555
A10-10-117.00	Teigen Plantsite; Construction Laydown Area; Excavate and remove top soil 300mm	26,721. m3	0.04	1,042.12	108.00	112,549	0.00	0	4.25	113,564	0.00	0	8.46	226,113
A10-10-118.00	Teigen Plantsite; Construction Laydown Area; Rock excavation - rippable rock	10,613. m3	0.04	413.91	108.00	44,702	0.00	0	5.50	58,372	0.00	0	9.71	103,073
A10-10-119.00	Teigen Plantsite; Construction Laydown Area; Rock excavation - drilll and blast	95,520. m3	0.10	9,934.08	108.00	1,072,881	3.00	286,560	4.50	429,840	0.00	0	18.73	1,789,281

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
A10-10-120.00	Teigen Plantsite; Construction Laydown Area; Excavate and remove unsuitable material	53,067. m3	0.04	2,069.61	108.00	223,518	0.00	0	4.25	225,535	0.00	0	8.46	449,053
A10-10-121.00	Teigen Plantsite; Construction Laydown Area; Excavate to fill, suitable material	26,345. m3	0.02	513.73	108.00	55,483	0.00	0	4.50	118,553	0.00	0	6.61	174,035
A10-10-122.00	Teigen Plantsite; Construction Laydown Area; Compacted Fill from temporary stockpile (not exceeding 2km haul)	40,016. m3	0.03	1,040.42	108.00	112,365	0.00	0	4.75	190,076	0.00	0	7.56	302,441
A10-10-123.00	Teigen Plantsite; Process Water Tanks; Clear and grub	.54 ha	93.60	50.58	108.00	5,463	0.00	0	4,560.00	2,464	0.00	0	14,668.80	7,927
A10-10-124.00	Teigen Plantsite; Process Water Tanks; Excavate and remove top soil 300mm	1,452. m3	0.04	56.63	108.00	6,116	0.00	0	4.25	6,171	0.00	0	8.46	12,287
A10-10-125.00	Teigen Plantsite; Process Water Tanks; Rock excavation - rippable rock	155. m3	0.04	6.05	108.00	653	0.00	0	5.50	853	0.00	0	9.71	1,505
A10-10-126.00	Teigen Plantsite; Process Water Tanks; Rock excavation - drilll and blast	1,394. m3	0.10	144.98	108.00	15,657	3.00	4,182	4.50	6,273	0.00	0	18.73	26,112
A10-10-127.00	Teigen Plantsite; Process Water Tanks; Excavate and remove unsuitable material	774. m3	0.04	30.19	108.00	3,260	0.00	0	4.25	3,290	0.00	0	8.46	6,550
A10-10-128.00	Teigen Plantsite; Process Water Tanks; Compacted Fill from temporary stockpile (not exceeding 2km haul)	1,487. m3	0.03	38.66	108.00	4,175	0.00	0	4.75	7,063	0.00	0	7.56	11,239
	A10 - Plantsite and Roads Subtotal			**63,923.67**		**6,903,756**		**1,164,162**		**4,805,102**		**0**		**12,873,020**

E05 - Teigen Coarse Ore Stockpile

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-40-132.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-13-133.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Detail Excavation	9,120. m3	0.08	711.36	108.00	76,827	0.00	0	3.75	34,200	0.00	0	12.17	111,027
E05-13-134.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Structural Backfill	5,880. m3	0.13	764.40	108.00	82,555	8.00	47,040	4.00	23,520	0.00	0	26.04	153,115
E05-20-135.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Concrete work	3,600. m3	8.45	30,420.00	108.00	3,285,360	765.00	2,754,000	25.00	90,000	0.00	0	1,702.60	6,129,360
E05-30-136.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Structural Steel	5,400. t	28.60	154,440.00	108.00	16,679,520	4,800.00	25,920,000	250.00	1,350,000	0.00	0	8,138.80	43,949,520
E05-40-137.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Wall cladding	6,050. m2	1.30	7,865.00	108.00	849,420	110.00	665,500	15.00	90,750	0.00	0	265.40	1,605,670

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-40-138.00	Stockpile Reclaim A-frame Enclousre and Overall Site Plan; Roof cladding	31,115. m2	1.30	40,449.50	108.00	4,368,546	110.00	3,422,650	15.00	466,725	0.00	0	265.40	8,257,921
E05-40-139.00	Stockpile Reclaim - Main Tunnel	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-40-140.00	Stockpile Reclaim - Secondary Tunnel	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-13-141.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Detail Excavation	27,680. m3	0.08	2,159.04	108.00	233,176	0.00	0	3.75	103,800	0.00	0	12.17	336,976
E05-13-142.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Detail Excavation (Rock Excavation)	23,750. m3	0.13	3,087.50	108.00	333,450	0.00	0	5.50	130,625	0.00	0	19.54	464,075
E05-13-143.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Structural Backfill	13,080. m3	0.13	1,700.40	108.00	183,643	8.00	104,640	4.00	52,320	0.00	0	26.04	340,603
E05-20-144.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Concrete work	14,625. m3	8.45	123,581.25	108.00	13,346,775	765.00	11,188,125	25.00	365,625	0.00	0	1,702.60	24,900,525
E05-30-145.00	Stockpile Reclaim - Main Tunnel and Secondary Tunnel; Structural Steel	387. t	28.60	11,068.20	108.00	1,195,366	4,800.00	1,857,600	250.00	96,750	0.00	0	8,138.80	3,149,716
E05-13-147.00	Conveyor; Detail Excavation	5,125. m3	0.08	399.75	108.00	43,173	0.00	0	3.75	19,219	0.00	0	12.17	62,392
E05-13-148.00	Conveyor; Structural Backfill	4,665. m3	0.13	606.45	108.00	65,497	8.00	37,320	4.00	18,660	0.00	0	26.04	121,477
E05-20-149.00	Conveyor; Concrete work	515. m3	8.45	4,351.75	108.00	469,989	765.00	393,975	25.00	12,875	0.00	0	1,702.60	876,839
E05-50-150.00	Teigen Coarse Ore Stockpile Tripper Conveyor, 1829 W x 300000 L [E05-CNV-010]	300. m	26.00	7,800.00	108.00	842,400	50.00	15,000	150.00	45,000	38,676.78	11,603,033	41,684.78	12,505,433
E05-55-151.00	Teigen Coarse Ore Stockpile Tripper Conveyor Head Chute	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E05-55-152.00	Teigen Coarse Ore Stockpile Tripper Conveyor Head Chute AR Liner	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E05-55-153.00	Teigen Coarse Ore Reclaim Apron Feeder Stockpile Inserts	6. ea	52.00	312.00	108.00	33,696	20,000.00	120,000	3,000.00	18,000	0.00	0	28,616.00	171,696
E05-55-154.00	Teigen Coarse Ore Reclaim Apron Feeder Feed Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-55-155.00	Teigen Coarse Ore Reclaim Apron Feeder Feed Chute AR Liners (6x)	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E05-50-156.00	Teigen Coarse Ore Reclaim Apron Feeder No.1, 1829 W x 8500 L [E05-FDR-001]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-157.00	Teigen Coarse Ore Reclaim Apron Feeder No.2, 1829 W x 8500 L [E05-FDR-002]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-158.00	Teigen Coarse Ore Reclaim Apron Feeder No.3, 1829 W x 8500 L [E05-FDR-003]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-159.00	Teigen Coarse Ore Reclaim Apron Feeder No.4, 1829 W x 8500 L [E05-FDR-004]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-160.00	Teigen Coarse Ore Reclaim Apron Feeder No.5, 1829 W x 8500 L [E05-FDR-005]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-50-161.00	Teigen Coarse Ore Reclaim Apron Feeder No.6, 1829 W x 8500 L [E05-FDR-006]	1. ea	812.50	812.50	108.00	87,750	200.00	200	5,500.00	5,500	258,464.00	258,464	351,914.00	351,914
E05-55-162.00	Teigen Coarse Ore Reclaim Apron Feeder Dribbles Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632
E05-55-163.00	Teigen Coarse Ore Reclaim Apron Feeder Dribbles Chute AR Liners (6x)	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E05-55-164.00	Teigen Coarse Ore Reclaim Apron Feeder Discharge Chutes	6,120. kg	0.08	477.36	108.00	51,555	0.08	490	0.03	184	5.50	33,660	14.03	85,888
E05-55-165.00	Teigen Coarse Ore Reclaim Apron Feeder Discharge Chute AR Liners (6x)	5,040. kg	0.05	229.32	108.00	24,767	0.08	403	0.03	151	5.50	27,720	10.52	53,041
E05-50-166.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.1, 1372 W x 55000 L [E05-CNV-011]	55. m	23.40	1,287.00	108.00	138,996	50.00	2,750	150.00	8,250	6,051.64	332,840	8,778.84	482,836
E05-50-167.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor No.2, 1372 W x 20000 L [E05-CNV-012]	20. m	23.40	468.00	108.00	50,544	50.00	1,000	150.00	3,000	6,051.64	121,033	8,778.84	175,577
E05-55-168.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chutes (2x)	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E05-55-169.00	Teigen Coarse Ore Stockpile Apron Feeder Discharge Conveyor Head Chute AR Liners (2x)	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E05-50-170.00	Teigen Coarse Ore Stockpile Hoist No.1 (20m lift), 2T [E05-HOI-041]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E05-50-171.00	Teigen Coarse Ore Stockpile Hoist No.2 (20m lift), 2T [E05-HOI-042]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791
E05-50-172.00	Teigen Coarse Ore Reclaim Dust Collector Baghouse	1. lot	416.00	416.00	108.00	44,928	250.00	250	400.00	400	261,853.00	261,853	307,431.00	307,431
E05-50-173.00	Teigen Coarse Ore Reclaim Dust Collector With Exhaust Fan, included [E05-COL-051]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-174.00	Teigen Coarse Ore Reclaim Dust Collector Screw Conveyor, included [E05-CNV-052]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-175.00	Teigen Coarse Ore Reclaim Dust Collector Rotary Valve, included [E05-VLV-053]	-	-	-	-	-	-	-	-	-	-	-	-	-
E05-50-176.00	Teigen Coarse Ore Reclaim Dust Collector Dust Ducting, 25,000 CFM [E05-DUC-701]	1. lot	1,560.00	1,560.00	108.00	168,480	132,000.00	132,000	7,200.00	7,200	0.00	0	307,680.00	307,680
E05-58-177.00	Fire Protection; Auto Sprinklers @ Reclaim Tunnel Conveyor	252. ea	5.20	1,310.40	108.00	141,523	1,000.00	252,000	5.00	1,260	0.00	0	1,566.60	394,783
E05-58-178.00	Fire Protection; Auto Sprinklers @ Apron Feeders	168. ea	5.20	873.60	108.00	94,349	1,000.00	168,000	5.00	840	0.00	0	1,566.60	263,189
E05-58-179.00	Fire Protection; Fire Extinguishers	1. lot	5.20	5.20	108.00	562	400.00	400	5.00	5	0.00	0	966.60	967
E05-58-181.00	HVAC Allowance	1. lot	145.00	145.00	108.00	15,660	1,100.00	1,100	5,785.00	5,785	135,870.00	135,870	158,415.00	158,415
E05-60-201.00	Piping Allowance 1.00%	1. lot	343.66	343.66	108.00	37,116	157,646.82	157,647	1,234.05	1,234	0.00	0	195,996.65	195,997
E05-80-202.00	Field Instrumentation & Bulks Allowance	1. lot	1,029.60	1,029.60	108.00	111,197	24,630.00	24,630	3,680.00	3,680	130,000.00	130,000	269,506.80	269,507
E05-70-203.00	Electrical Motor Wiring Allowance, Not included	-	-	-	-	-	-	-	-	-	-	-	-	-
	E05 - Teigen Coarse Ore Stockpile Subtotal			**419,678.53**		**45,325,281**		**47,289,624**		**2,991,278**		**15,735,555**		**111,341,738**

E07 - Secondary Crushing

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-40-205.00	Secondary Crushing, 28m x 48m x 38	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-13-206.00	Detail Excavation	3,330. m3	0.08	259.74	108.00	28,052	0.00	0	3.75	12,488	0.00	0	12.17	40,539

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-13-207.00	Detail Excavation (Rock Excavation)	670. m3	0.13	87.10	108.00	9,407	0.00	0	5.50	3,685	0.00	0	19.54	13,092
E07-13-208.00	Structural Backfill	2,040. m3	0.13	265.20	108.00	28,642	8.00	16,320	4.00	8,160	0.00	0	26.04	53,122
E07-20-209.00	Concrete work	1,615. m3	8.45	13,646.75	108.00	1,473,849	765.00	1,235,475	25.00	40,375	0.00	0	1,702.60	2,749,699
E07-30-210.00	Structural Steel	1,345. t	28.60	38,467.00	108.00	4,154,436	4,800.00	6,456,000	250.00	336,250	0.00	0	8,138.80	10,946,686
E07-40-211.00	Wall cladding	5,775. m2	1.24	7,132.13	108.00	770,269	85.00	490,875	15.00	86,625	0.00	0	233.38	1,347,770
E07-40-212.00	Roof cladding	1,345. m2	1.24	1,661.08	108.00	179,396	85.00	114,325	15.00	20,175	0.00	0	233.38	313,896
E07-50-216.00	Cone Crusher Feed Conveyor No.1, 2134 W x 296000 L [E07-CNV-621]	296. m	23.40	6,926.40	108.00	748,051	50.00	14,800	200.00	59,200	18,752.27	5,550,673	21,529.47	6,372,724
E07-55-217.00	Cone Crusher Feed Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-218.00	Cone Crusher Feed Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-219.00	Cone Crusher Feed Conveyor No.1 Self Cleaner Magnet No. 2 [E07-MGT-633]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-50-220.00	Cone Crusher Feed Conveyor No.1 Metal Detector [E07-MED-631]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E07-50-221.00	Cone Crushing Screen Splitter Chute No.1 [E07-CHU-601]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E07-50-222.00	Cone Crushing Screen No.1, 3700 W x 7300 L [E07-SCN-603]	1. ea	279.50	279.50	108.00	30,186	250.00	250	1,750.00	1,750	577,864.30	577,864	610,050.30	610,050
E07-55-223.00	Cone Crushing Screen No.1 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E07-55-224.00	Cone Crushing Screen No.1 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E07-50-225.00	Cone Crushing Screen No.2, 3700 W x 7300 L [E07-SCN-604]	1. ea	279.50	279.50	108.00	30,186	250.00	250	1,750.00	1,750	577,864.30	577,864	610,050.30	610,050

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-55-226.00	Cone Crushing Screen No.2 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E07-55-227.00	Cone Crushing Screen No.2 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E07-55-228.00	Cone Crusher Feed Chutes	5,000. kg	0.05	227.50	108.00	24,570	0.08	400	0.03	150	5.50	27,500	10.52	52,620
E07-55-229.00	Cone Crusher Feed Chute AR Liners	4,000. kg	0.05	182.00	108.00	19,656	0.08	320	0.03	120	5.50	22,000	10.52	42,096
E07-50-230.00	Cone Crusher No.1 (c/w Drive Motor, Drive Guard, Crusher Automation, etc.), MP 1000 [E07-CRU-611]	1. ea	5,200.00	5,200.00	108.00	561,600	1,000.00	1,000	500.00	500	3,712,265.63	3,712,266	4,275,365.63	4,275,366
E07-50-231.00	Cone Crusher Lube Unit No.1, included [E07-LUB-630]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-232.00	Cone Crusher No.2 (c/w Drive Motor, Drive Guard, Crusher Automation, etc.), MP 1000 [E07-CRU-612]	1. ea	5,200.00	5,200.00	108.00	561,600	1,000.00	1,000	500.00	500	3,712,265.63	3,712,266	4,275,365.63	4,275,366
E07-50-233.00	Cone Crusher Lube Unit No.2, included [E07-LUB-631]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-55-234.00	Cone Crusher Discharge Chutes	2,040. kg	0.08	159.12	108.00	17,185	0.08	163	0.03	61	5.50	11,220	14.03	28,629
E07-55-235.00	Cone Crusher Discharge Chutes AR Liner	1,680. kg	0.05	76.44	108.00	8,256	0.08	134	0.03	50	5.50	9,240	10.52	17,680
E07-50-236.00	Cone Crusher Discharge Conveyor No.1, 1829 W x 65500 L [E07-CNV-615]	65.5 m	29.90	1,958.45	108.00	211,513	50.00	3,275	150.00	9,825	17,107.83	1,120,563	20,537.03	1,345,175
E07-55-237.00	Cone Crusher Discharge Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-238.00	Cone Crusher Discharge Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-239.00	Cone Crusher Discharge Conveyor No.2, 1829 W x 175000 L [E07-CNV-616]	175. m	26.00	4,550.00	108.00	491,400	50.00	8,750	150.00	26,250	38,676.78	6,768,436	41,684.78	7,294,836
E07-55-240.00	Cone Crusher Discharge Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-241.00	Cone Crusher Discharge Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-50-242.00	Cone Crusher Discharge Conveyor No.3, 1829 W X 33000 L [E07-CNV-614]	33. m	29.90	986.70	108.00	106,564	50.00	1,650	150.00	4,950	17,107.83	564,558	20,537.02	677,722
E07-55-243.00	Cone Crusher Discharge Conveyor No.3 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-244.00	Cone Crusher Discharge Conveyor No.3 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-245.00	Cone Crushing Screen Oversize Splitter Chute [E07-CHU-624]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E07-50-246.00	Cone Crushing Screen Oversize Transfer Conveyor, 1372 W x 33000 L [E07-CNV-623]	33. m	23.40	772.20	108.00	83,398	50.00	1,650	150.00	4,950	6,051.64	199,704	8,778.84	289,702
E07-55-247.00	Cone Crushing Screen Oversize Transfer Conveyor Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-248.00	Cone Crushing Screen Oversize Transfer Conveyor Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-249.00	Cone Crusher Feed Conveyor No.2, 2134 W x 192000 L [E07-CNV-622]	192. m	23.40	4,492.80	108.00	485,222	50.00	9,600	200.00	38,400		0	2,777.20	533,222
E07-55-250.00	Cone Crusher Feed Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-251.00	Cone Crusher Feed Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-252.00	Cone Crusher Feed Conveyor No.2 Self Cleaner Magnet No. 2 [E07-MGT-634]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E07-50-253.00	Cone Crusher Feed Conveyor No.2 Metal Detector [E07-MED-632]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E07-50-254.00	Cone Crushing Screen Splitter Chute No.2 [E07-CHU-602]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E07-50-255.00	Cone Crushing Screen No.3, 3700 W x 7300 L [E07-SCN-605]	1. ea	279.50	279.50	108.00	30,186	250.00	250	1,750.00	1,750	577,864.30	577,864	610,050.30	610,050
E07-55-256.00	Cone Crushing Screen No.3 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E07-55-257.00	Cone Crushing Screen No.3 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-50-258.00	Cone Crushing Screen No.4, 3700 W x 7300 L [E07-SCN-606]	1. ea	279.50	279.50	108.00	30,186	250.00	250	1,750.00	1,750	577,864.30	577,864	610,050.30	610,050
E07-55-259.00	Cone Crushing Screen No.4 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E07-55-260.00	Cone Crushing Screen No.4 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E07-50-261.00	Cone Crushing Screen (Spare) No.5 (No installation), 3700 W x 7300L [E07-SCN-619]	1. ea	0.00	0.00	108.00	0	0.00	0	500.00	500	577,864.30	577,864	578,364.30	578,364
E07-50-262.00	Cone Crusher By Pass Conveyor No.1, 1372 W x 18000 L [E07-CNV-618]	18. m	23.40	421.20	108.00	45,490	50.00	900	150.00	2,700	6,051.64	108,929	8,778.84	158,019
E07-55-263.00	Cone Crusher By Pass Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-264.00	Cone Crusher By Pass Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-265.00	Cone Crusher By Pass Conveyor No.2, 1372 W x 18000 L [E07-CNV-619]	18. m	23.40	421.20	108.00	45,490	50.00	900	150.00	2,700	6,051.64	108,929	8,778.84	158,019
E07-55-266.00	Cone Crusher By Pass Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-267.00	Cone Crusher By Pass Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-55-268.00	Cone Crusher Feed Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E07-55-269.00	Cone Crusher Feed Chutes AR Liner	2,000. kg	0.05	91.00	108.00	9,828	0.08	160	0.03	60	5.50	11,000	10.52	21,048
E07-50-270.00	Cone Crusher No.5 (c/w Drive Motor, Drive Guard, Crusher Automation, etc.), MP 1000 [E07-CRU-610]	1. ea	5,200.00	5,200.00	108.00	561,600	1,000.00	1,000	500.00	500	3,712,265.63	3,712,266	4,275,365.63	4,275,366
E07-55-271.00	Cone Crusher No.5 Discharge Chute	2,000. kg	0.08	156.00	108.00	16,848	0.08	160	0.03	60	5.50	11,000	14.03	28,068
E07-55-272.00	Cone Crusher No.5 Discharge Chute AR Liner	1,600. kg	0.05	72.80	108.00	7,862	0.08	128	0.03	48	5.50	8,800	10.52	16,838
E07-55-273.00	Cone Crusher Feed Chutes	5,000. kg	0.05	227.50	108.00	24,570	0.08	400	0.03	150	5.50	27,500	10.52	52,620

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-55-274.00	Cone Crusher Feed Chute AR Liners	4,000. kg	0.05	182.00	108.00	19,656	0.08	320	0.03	120	5.50	22,000	10.52	42,096
E07-50-275.00	Cone Crusher No.3 (c/w Drive Motor, Drive Guard, Crusher Automation, etc.), MP 1000 [E07-CRU-613]	1. ea	5,200.00	5,200.00	108.00	561,600	1,000.00	1,000	500.00	500	3,712,265.63	3,712,266	4,275,365.63	4,275,366
E07-50-276.00	Cone Crusher Lube Unit No.3, included [E07-LUB-632]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-277.00	Cone Crusher No.4 (c/w Drive Motor, Drive Guard, Crusher Automation, etc.), MP 1000 [E07-CRU-614]	1. ea	5,200.00	5,200.00	108.00	561,600	1,000.00	1,000	500.00	500	3,712,265.63	3,712,266	4,275,365.63	4,275,366
E07-50-278.00	Cone Crusher Lube Unit No.4, included [E07-LUB-633]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-55-279.00	Cone Crusher Discharge Chutes	4,000. kg	0.08	312.00	108.00	33,696	0.08	320	0.03	120	5.50	22,000	14.03	56,136
E07-55-280.00	Cone Crusher Discharge Chutes AR Liner	3,200. kg	0.05	145.60	108.00	15,725	0.08	256	0.03	96	5.50	17,600	10.52	33,677
E07-50-281.00	Cone Crushing Screen Undersize Conveyor, 2134 W x 80000 L [E07-CNV-617]	80. m	26.00	2,080.00	108.00	224,640	50.00	4,000	200.00	16,000		0	3,058.00	244,640
E07-55-282.00	Cone Crushing Screen Undersize Conveyor Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-283.00	Cone Crushing Screen Undersize Conveyor Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-284.00	Fine Ore Stockpile Feed Conveyor, 2134 W x 369000 L [E07-CNV-636]	369. m	23.40	8,634.60	108.00	932,537	50.00	18,450	200.00	73,800		0	2,777.20	1,024,787
E07-55-285.00	Fine Ore Stockpile Feed Conveyor Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E07-55-286.00	Fine Ore Stockpile Feed Conveyor Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E07-50-287.00	Secondary Crushing Crane, 35t [E07-CRN-620]	1. ea	234.00	234.00	108.00	25,272	300.00	300	2,000.00	2,000	215,000.00	215,000	242,572.00	242,572
E07-50-288.00	Cone Crushing Building Dust Collector No.1 Baghouse, 89,000 CFM	1. lot	416.00	416.00	108.00	44,928	250.00	250	400.00	400	362,714.10	362,714	408,292.10	408,292
E07-50-289.00	Cone Crushing Building Dust Collector No.1 With Exhaust Fan, 89,000 CFM, included [E07-COL-651]	-	-	-	-	-	-	-	-	-	-	-	-	-

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E07-50-290.00	Cone Crushing Building Dust Collector No.1 Screw Conveyor, included [E07-CNV-652]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-291.00	Cone Crushing Building Dust Collector No.1 Rotary Valve, included [E07-VLV-653]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-292.00	Cone Crushing Building Dust Collector No.2 Baghouse, 63,000 CFM	1. lot	416.00	416.00	108.00	44,928	275.00	275	350.00	350	259,023.45	259,023	304,576.45	304,576
E07-50-293.00	Cone Crushing Building Dust Collector No.2 With Exhaust Fan, 63,000 CFM, included [E07-COL-661]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-294.00	Cone Crushing Building Dust Collector No.2 Rotary Valve, included [E07-VLV-663]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-50-295.00	Cone Crushing Building Dust Collector No.2 Screw Conveyor, included [E07-CNV-662]	-	-	-	-	-	-	-	-	-	-	-	-	-
E07-60-317.00	Piping Allowance 1.00%	1. lot	662.30	662.30	108.00	71,528	374,694.39	374,694	2,559.94	2,560	0.00	0	448,782.80	448,783
E07-80-318.00	Field Instrumentation & Bulks Allowance	1. lot	2,074.80	2,074.80	108.00	224,078	45,130.00	45,130	7,450.00	7,450	270,000.00	270,000	546,658.40	546,658
E07-70-319.00	Electrical Motor Wiring Allowance, Not included	-	-	-	-	-	-	-	-	-	-	-	-	-
	E07 - Secondary Crushing Subtotal			**130,486.15**		**14,092,504**		**8,812,169**		**773,761**		**37,660,090**		**61,338,524**

E08 - Fine Ore Stockpile

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E08-13-321.00	Stockpile Reclaim A-frame Enclousre and Overall Site	-	-	-	-	-	-	-	-	-	-	-	-	-
E08-13-322.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Detail Excavation	16,000. m3	0.08	1,248.00	108.00	134,784	0.00	0	3.75	60,000	0.00	0	12.17	194,784
E08-13-323.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Structural Backfill	14,200. m3	0.13	1,846.00	108.00	199,368	8.00	113,600	4.00	56,800	0.00	0	26.04	369,768
E08-20-324.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Concrete work	2,000. m3	8.45	16,900.00	108.00	1,825,200	765.00	1,530,000	25.00	50,000	0.00	0	1,702.60	3,405,200
E08-30-325.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Structural Steel	1,750. t	28.60	50,050.00	108.00	5,405,400	4,800.00	8,400,000	250.00	437,500	0.00	0	8,138.80	14,242,900
E08-40-326.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Wall cladding	3,500. m2	1.24	4,322.50	108.00	466,830	85.00	297,500	15.00	52,500	0.00	0	233.38	816,830

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E08-40-327.00	Stockpile Reclaim A-frame Enclousre and Overall Site; Roof cladding	12,205. m2	1.24	15,073.18	108.00	1,627,903	85.00	1,037,425	15.00	183,075	0.00	0	233.38	2,848,403
E08-13-328.00	Stockpile Reclaim - Tunnels and Retaining Wall	-	-	-	-	-	-	-	-	-	-	-	-	-
E08-13-330.00	Stockpile Reclaim - Tunnels and Retaining Wall; Detail Excavation (Rock Excavation)	23,290. m3	0.13	3,027.70	108.00	326,992	0.00	0	5.50	128,095	0.00	0	19.54	455,087
E08-13-331.00	Stockpile Reclaim - Tunnels and Retaining Wall; Structural Backfill	32,615. m3	0.13	4,239.95	108.00	457,915	8.00	260,920	4.00	130,460	0.00	0	26.04	849,295
E08-20-332.00	Stockpile Reclaim - Tunnels and Retaining Wall; Concrete work	9,850. m3	8.45	83,232.50	108.00	8,989,110	765.00	7,535,250	25.00	246,250	0.00	0	1,702.60	16,770,610
E08-30-333.00	Stockpile Reclaim - Tunnels and Retaining Wall; Structural Steel	245. t	28.60	7,007.00	108.00	756,756	4,800.00	1,176,000	250.00	61,250	0.00	0	8,138.80	1,994,006
E08-40-334.00	Stockpile Reclaim - Tunnels and Retaining Wall; Armco Tunnel (4.5m D)	20. m	5.85	117.00	108.00	12,636	5,700.00	114,000	50.00	1,000	0.00	0	6,381.80	127,636
E08-13-335.00	Conveyor; Detail Excavation	26,250. m3	0.08	2,047.50	108.00	221,130	0.00	0	3.75	98,438	0.00	0	12.17	319,568
E08-13-336.00	Conveyor; Structural Backfill	23,890. m3	0.13	3,105.70	108.00	335,416	8.00	191,120	4.00	95,560	0.00	0	26.04	622,096
E08-20-337.00	Conveyor; Concrete work	2,625. m3	8.45	22,181.25	108.00	2,395,575	765.00	2,008,125	25.00	65,625	0.00	0	1,702.60	4,469,325
E08-50-338.00	Fine Ore Stockpile Sump Pump c/w motor 15kW [E14-PSU-601]	1. ea	78.00	78.00	108.00	8,424	50.00	50	25.00	25	30,000.00	30,000	38,499.00	38,499
E08-55-339.00	Fine Ore Reclaim Apron Feeder Inserts	6. ea	52.00	312.00	108.00	33,696	20,000.00	120,000	3,000.00	18,000	0.00	0	28,616.00	171,696
E08-55-340.00	Fine Ore Reclaim Apron Feeder Feed Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632
E08-55-341.00	Fine Ore Reclaim Apron Feeder Feed Chutes AR Liners	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E08-50-342.00	Fine Ore Reclaim Apron Feeder No.1, 1524 W x 7600 L [E14-FDR-601]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390
E08-50-343.00	Fine Ore Reclaim Apron Feeder No.2, 1524 W x 7600 L [E14-FDR-602]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E08-50-344.00	Fine Ore Reclaim Apron Feeder No.3, 1524 W x 7600 L [E14-FDR-603]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390
E08-50-345.00	Fine Ore Reclaim Apron Feeder No.4, 1524 W x 7600 L [E14-FDR-604]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390
E08-50-346.00	Fine Ore Reclaim Apron Feeder No.5, 1524 W x 7600 L [E14-FDR-605]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390
E08-50-347.00	Fine Ore Reclaim Apron Feeder No.6, 1524 W x 7600 L [E14-FDR-606]	1. ea	780.00	780.00	108.00	84,240	150.00	150	5,000.00	5,000	300,000.00	300,000	389,390.00	389,390
E08-55-348.00	Fine Ore Reclaim Apron Feeder Dribbles Chutes	67,524. kg	0.08	5,266.87	108.00	568,822	0.08	5,402	0.03	2,026	5.50	371,382	14.03	947,632
E08-55-349.00	Fine Ore Reclaim Apron Feeder Dribbles Chutes AR Liners	64,098. kg	0.05	2,916.46	108.00	314,978	0.08	5,128	0.03	1,923	5.50	352,539	10.52	674,567
E08-55-350.00	Fine Ore Reclaim Apron Feeder Discharge Chutes	6,120. kg	0.08	477.36	108.00	51,555	0.08	490	0.03	184	5.50	33,660	14.03	85,888
E08-55-351.00	Fine Ore Reclaim Apron Feeder Discharge Chutes AR Liners	5,040. kg	0.05	229.32	108.00	24,767	0.08	403	0.03	151	5.50	27,720	10.52	53,041
E08-50-352.00	HPGR Feed Conveyor No.1, 1372 W x 645000 L [E14-CNV-621]	645. m	20.80	13,416.00	108.00	1,448,928	50.00	32,250	150.00	96,750	8,048.01	5,190,966	10,494.41	6,768,894
E08-55-353.00	HPGR Feed Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E08-55-354.00	HPGR Feed Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E08-50-355.00	HPGR Feed Conveyor No.1 Self Cleaner Magnet [E14-MGT-627]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E08-50-356.00	HPGR Feed Conveyor No.1 Metal Detector [E14-MED-625]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E08-50-357.00	HPGR Feed Conveyor No.2, 1372 W x 645000 L [E14-CNV-622]	645. m	20.80	13,416.00	108.00	1,448,928	50.00	32,250	150.00	96,750	8,048.01	5,190,966	10,494.41	6,768,894
E08-55-358.00	HPGR Feed Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E08-55-359.00	HPGR Feed Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E08-50-360.00	HPGR Feed Conveyor No.2 Self Cleaner Magnet [E14-MGT-628]	1. ea	26.00	26.00	108.00	2,808	25.00	25	500.00	500	30,000.00	30,000	33,333.00	33,333
E08-50-361.00	HPGR Feed Conveyor No.2 Metal Detector [E14-MED-626]	1. ea	26.00	26.00	108.00	2,808	25.00	25	150.00	150	20,000.00	20,000	22,983.00	22,983
E08-50-362.00	Fine Ore Stockpile Hoist No.1, 2t [E14-HOI-641]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791
E08-50-363.00	Fine Ore Stockpile Hoist No.2, 2t [E14-HOI-642]	1. ea	52.00	52.00	108.00	5,616	125.00	125	50.00	50	25,000.00	25,000	30,791.00	30,791
E08-50-364.00	Fine Ore Stockpile Dust Collector Baghouse	1. lot	416.00	416.00	108.00	44,928	250.00	250	400.00	400	153,100.00	153,100	198,678.00	198,678
E08-50-365.00	Fine Ore Stockpile Dust Collector With Exhaust Fan, 25,000 CFM, included [E14-COL-651]	-	-	-	-	-	-	-	-	-	-	-	-	-
E08-50-366.00	Fine Ore Stockpile Dust Collector Screw Conveyor, included [E14-CNV-652]	-	-	-	-	-	-	-	-	-	-	-	-	-
E08-50-367.00	Fine Ore Stockpile Dust Collector Rotary Valve, included [E14-VLV-653]	-	-	-	-	-	-	-	-	-	-	-	-	-
E08-60-368.00	Piping allowance 1.00%	1. lot	499.00	499.00	108.00	53,892	142,530.15	142,530	2,516.69	2,517	0.00	0	198,938.84	198,939
E08-80-369.00	Field Instrumentation & Bulks Allowance	1. lot	1,942.20	1,942.20	108.00	209,758	43,600.00	43,600	7,000.00	7,000	250,000.00	250,000	510,357.60	510,358
E08-70-370.00	Electrical Motor Wiring, Not included	-	-	-	-	-	-	-	-	-	-	-	-	-
	E08 - Fine Ore Stockpile Subtotal			**266,674.38**		**28,800,833**		**23,058,370**		**1,927,738**		**14,294,715**		**68,081,656**

E09 - Tertiary Crushing (HPGR)

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-40-372.00	HPGR Building, 31m x 80m x 27m	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-13-373.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Detail Excavation	5,772. m3	0.08	450.22	108.00	48,623	0.00	0	3.75	21,645	0.00	0	12.17	70,268
E09-13-374.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Detail Excavation (Rock Excavation)	1,240. m3	0.13	161.20	108.00	17,410	0.00	0	5.50	6,820	0.00	0	19.54	24,230
E09-13-375.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Structural Backfill	3,130. m3	0.13	406.90	108.00	43,945	8.00	25,040	4.00	12,520	0.00	0	26.04	81,505

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-20-376.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Concrete work	3,300. m3	8.45	27,885.00	108.00	3,011,580	765.00	2,524,500	25.00	82,500	0.00	0	1,702.60	5,618,580
E09-30-377.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Structural Steel	2,365. t	28.60	67,639.00	108.00	7,305,012	4,800.00	11,352,000	250.00	591,250	0.00	0	8,138.80	19,248,262
E09-40-378.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Wall cladding	5,995. m2	1.30	7,793.50	108.00	841,698	110.00	659,450	15.00	89,925	0.00	0	265.40	1,591,073
E09-40-379.00	HPGR Building (including 400T Bins x 2 and Dust Collection); Roof cladding	2,480. m2	1.30	3,224.00	108.00	348,192	110.00	272,800	15.00	37,200	0.00	0	265.40	658,192
E09-13-380.00	Conveyor; Detail Excavation	15,450. m3	0.08	1,205.10	108.00	130,151	0.00	0	3.75	57,938	0.00	0	12.17	188,088
E09-13-381.00	Conveyor; Structural Backfill	14,060. m3	0.13	1,827.80	108.00	197,402	8.00	112,480	4.00	56,240	0.00	0	26.04	366,122
E09-20-382.00	Conveyor; Concrete work	1,545. m3	8.45	13,055.25	108.00	1,409,967	765.00	1,181,925	25.00	38,625	0.00	0	1,702.60	2,630,517
E09-58-383.00	Building Services; Water Lines	1. lot	130.00	130.00	108.00	14,040	50,000.00	50,000	3,000.00	3,000	0.00	0	67,040.00	67,040
E09-58-384.00	Building Services; Air Lines	1. lot	130.00	130.00	108.00	14,040	40,000.00	40,000	1,500.00	1,500	0.00	0	55,540.00	55,540
E09-58-385.00	Building Services; Glycol System	1. lot	650.00	650.00	108.00	70,200	450,000.00	450,000	8,000.00	8,000	0.00	0	528,200.00	528,200
E09-40-386.00	Louvers and snow canopies	1. lot	260.00	260.00	108.00	28,080	90,000.00	90,000	6,000.00	6,000	0.00	0	124,080.00	124,080
E09-40-387.00	Finishes	1. lot	234.00	234.00	108.00	25,272	100,000.00	100,000	2,000.00	2,000	0.00	0	127,272.00	127,272
E09-40-388.00	Offices/Washrooms	1. lot	156.00	156.00	108.00	16,848	60,000.00	60,000	3,000.00	3,000	0.00	0	79,848.00	79,848
E09-40-389.00	Computers & Equipment	1. lot	104.00	104.00	108.00	11,232	50,000.00	50,000	200.00	200	0.00	0	61,432.00	61,432
E09-40-390.00	Furniture	1. lot	162.50	162.50	108.00	17,550	80,000.00	80,000	750.00	750	0.00	0	98,300.00	98,300
E09-50-391.00	HPGR Oversize Conveyor No.3 Splitter Chute [E16-CHU-617]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-50-392.00	HPGR Surge Bin No.1, 400t, (included in Structural Steel) [E16-BIN-603]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-393.00	HPGR Surge Bin No.1 Vent, 8000 CFM [E16-EQP-605]	1. ea	31.20	31.20	108.00	3,370	50.00	50	25.00	25	12,500.00	12,500	15,944.60	15,945
E09-50-394.00	HPGR Belt Feeder No. 1 (Rail Mounted), 1524 W x 10000 L [E16-FDR-615]	10. m	520.00	5,200.00	108.00	561,600	150.00	1,500	3,000.00	30,000	277,000.00	2,770,000	336,310.00	3,363,100
E09-55-395.00	HPGR Belt Feeder No. 1 (Rail Mounted) Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-396.00	HPGR Belt Feeder No. 1 (Rail Mounted) Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-397.00	HPGR Belt Feeder No. 2 (Rail Mounted), 1524 W x 10000 L [E16-FDR-616]	10. m	520.00	5,200.00	108.00	561,600	150.00	1,500	3,000.00	30,000	277,000.00	2,770,000	336,310.00	3,363,100
E09-55-398.00	HPGR Belt Feeder No. 2 (Rail Mounted) Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-399.00	HPGR Belt Feeder No. 2 (Rail Mounted) Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-400.00	High Pressure Grinding Roll No.1 c/w PLC Control System [E16-CRU-620]	1. ea	8,775.00	8,775.00	108.00	947,700	1,000.00	1,000	1,500.00	1,500	11,261,554.29	11,261,554	12,211,754.29	12,211,754
E09-50-401.00	High Pressure Grinding Roll No.1 Motor No.1, included [E16-MOT-621]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-402.00	High Pressure Grinding Roll No.1 Motor No.2, included [E16-MOT-622]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-403.00	HPGR Crusher No.1 Lube Unit, included [E16-LUB-640]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-404.00	HPGR Crusher No.1 Lubrication Cooler, included [E16-COO-645]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-405.00	High Pressure Grinding Roll No.2 c/w PLC Control System [E16-CRU-625]	1. ea	8,775.00	8,775.00	108.00	947,700	1,000.00	1,000	1,500.00	1,500	11,261,554.29	11,261,554	12,211,754.29	12,211,754
E09-50-406.00	High Pressure Grinding Roll No.2 Motor No.1, included [E16-MOT-626]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-407.00	High Pressure Grinding Roll No.2 Motor No.2, included [E16-MOT-627]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-50-408.00	HPGR Crusher No.2 Lube Unit, included [E16-LUB-641]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-409.00	HPGR Crusher No.2 Lubrication Cooler, included [E16-COO-646]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-410.00	HPGR Crusher Discharge Conveyor No.1, 1829 W x 25600 L [E16-CNV-650]	25.6 m	29.90	765.44	108.00	82,668	50.00	1,280	150.00	3,840	17,107.83	437,960	20,537.03	525,748
E09-55-411.00	HPGR Crusher Discharge Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-412.00	HPGR Crusher Discharge Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-413.00	HPGR Screen Feed Conveyor No.1, 1829 W x 205000 L [E16-CNV-652]	205. m	26.00	5,330.00	108.00	575,640	50.00	10,250	150.00	30,750	38,676.78	7,928,739	41,684.78	8,545,379
E09-55-414.00	HPGR Screen Feed Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-415.00	HPGR Screen Feed Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-416.00	HPGR Screen Oversize Conveyor No.3, 1372 W x 60000 L [E16-CNV-654]	60. m	23.40	1,404.00	108.00	151,632	50.00	3,000	150.00	9,000	6,051.64	363,098	8,778.84	526,730
E09-55-417.00	HPGR Screen Oversize Conveyor No.3 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-418.00	HPGR Screen Oversize Conveyor No.3 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-419.00	HPGR Surge Bin No.2, 400t, (included in Structural Steel) [E16-BIN-604]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-420.00	HPGR Surge Bin No.2 Vent, 8000 CFM [E16-EQP-606]	1. ea	31.20	31.20	108.00	3,370	50.00	50	25.00	25	12,500.00	12,500	15,944.60	15,945
E09-50-421.00	HPGR Belt Feeder No. 3 (Rail Mounted), 1524 W x 10000 L [E16-FDR-617]	10. m	520.00	5,200.00	108.00	561,600	150.00	1,500	3,000.00	30,000	277,000.00	2,770,000	336,310.00	3,363,100
E09-55-422.00	HPGR Belt Feeder No. 3 (Rail Mounted) Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-423.00	HPGR Belt Feeder No. 3 (Rail Mounted) Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-50-424.00	HPGR Belt Feeder No. 4 (Rail Mounted), 1524 W x 10000 L [E16-FDR-618]	10. m	520.00	5,200.00	108.00	561,600	150.00	1,500	3,000.00	30,000	277,000.00	2,770,000	336,310.00	3,363,100
E09-55-425.00	HPGR Belt Feeder No. 4 (Rail Mounted) Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-426.00	HPGR Belt Feeder No. 4 (Rail Mounted) Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-427.00	High Pressure Grinding Roll No.3 c/w PLC Control System [E16-CRU-630]	1. ea	8,775.00	8,775.00	108.00	947,700	1,000.00	1,000	1,500.00	1,500	11,261,554.29	11,261,554	12,211,754.29	12,211,754
E09-50-428.00	High Pressure Grinding Roll No.3 Motor No.1, (installed only) [E16-MOT-631]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-429.00	High Pressure Grinding Roll No.3 Motor No.2, (installed only) [E16-MOT-632]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-430.00	HPGR Crusher No.3 Lubrication Cooler, included [E16-COO-647]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-431.00	HPGR Crusher No.3 Lube Unit, included [E16-LUB-642]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-432.00	High Pressure Grinding Roll No.4 c/w PLC Control System [E16-CRU-635]	1. ea	8,775.00	8,775.00	108.00	947,700	1,000.00	1,000	1,500.00	1,500	11,261,554.29	11,261,554	12,211,754.29	12,211,754
E09-50-433.00	High Pressure Grinding Roll No.4 Motor No.1, included [E16-MOT-636]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-434.00	High Pressure Grinding Roll No.4 Motor No.2, included [E16-MOT-637]	1. ea	975.00	975.00	108.00	105,300	200.00	200	150.00	150	0.00	0	105,650.00	105,650
E09-50-435.00	HPGR Crusher No.4 Lubrication Cooler, included [E16-COO-648]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-436.00	HPGR Crusher No.4 Lube Unit, included [E16-LUB-643]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-437.00	HPGR Crusher Discharge Conveyor No.2, 1829 W x 25600 L [E16-CNV-651]	25.6 m	29.90	765.44	108.00	82,668	50.00	1,280	150.00	3,840	17,107.83	437,960	20,537.03	525,748
E09-55-438.00	HPGR Crusher Discharge Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-439.00	HPGR Crusher Discharge Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-50-440.00	HPGR Spare Roller Set (No installation) [E16-ROL-681]	1. ea	0.00	0.00	108.00	0	0.00	0	0.00	0	5,845,714.29	5,845,714	5,845,714.29	5,845,714
E09-50-441.00	HPGR Screen Feed Conveyor No.2, 1829 W x 205000 L [E16-CNV-653]	205. m	26.00	5,330.00	108.00	575,640	50.00	10,250	150.00	30,750	38,676.78	7,928,739	41,684.78	8,545,379
E09-55-442.00	HPGR Screen Feed Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E09-55-443.00	HPGR Screen Feed Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E09-50-444.00	HPGR Building Area Crane, 50t [E16-CRN-610]	1. ea	260.00	260.00	108.00	28,080	300.00	300	2,000.00	2,000	265,000.00	265,000	295,380.00	295,380
E09-50-445.00	HPGR Dust Collector No.1 Baghouse, 27,000 CFM	1. lot	416.00	416.00	108.00	44,928	250.00	250	400.00	400	153,100.00	153,100	198,678.00	198,678
E09-50-446.00	HPGR Dust Collector No.1 With Exhaust Fan, 27,000 CFM, included [E16-COL-661]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-447.00	HPGR Dust Collector No.1 Screw Conveyor, included [E16-CNV-662]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-448.00	HPGR Dust Collector No.1 Rotary Valve, included [E16-VLV-663]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-449.00	HPGR Dust Collector No.2 Baghouse, 52,000 CFM	1. lot	416.00	416.00	108.00	44,928	275.00	275	350.00	350	259,023.45	259,023	304,576.45	304,576
E09-50-450.00	HPGR Dust Collector No.2 With Exhaust Fan, 52,000 CFM, included [E16-COL-671]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-451.00	HPGR Dust Collector No.2 Screw Conveyor, included [E16-CNV-672]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-50-452.00	HPGR Dust Collector No.2 Rotary Valve, included [E16-VLV-673]	-	-	-	-	-	-	-	-	-	-	-	-	-
E09-58-453.00	Fire Protection; Auto Sprinklers @ HPGR Lube Unit No.1	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E09-58-454.00	Fire Protection; Auto Sprinklers @ HPGR Lube Unit No.2	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E09-58-455.00	Fire Protection; Auto Sprinklers @ HPGR Lube Unit No.3	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E09-58-456.00	Fire Protection; Auto Sprinklers @ HPGR Lube Unit No.4	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E09-58-457.00	Fire Protection; Auto Sprinklers @ Conveyor within Structure	10. ea	5.20	52.00	108.00	5,616	1,000.00	10,000	5.00	50	0.00	0	1,566.60	15,666
E09-58-458.00	HVAC (includes Propane Make-Up Air Unit, Propane Unit Heater, Echaust Fan, Supply Fan/Filter, etc.)	1. lot	364.00	364.00	108.00	39,312	340.00	340	9,976.68	9,977	277,278.00	277,278	326,906.68	326,907
E09-60-459.00	Piping allowance 1.00%	1. lot	803.00	803.00	108.00	86,724	799,583.46	799,583	2,089.82	2,090	0.00	0	888,397.29	888,397
E09-80-460.00	Field Instrumentation & Bulks Allowance	1. lot	2,730.00	2,730.00	108.00	294,840	56,910.00	56,910	9,750.00	9,750	360,000.00	360,000	721,500.00	721,500
E09-70-461.00	Electrical Motor Wiring, Not included	-	-	-	-	-	-	-	-	-	-	-	-	-
	E09 - Tertiary Crushing (HPGR) Subtotal			**209,899.97**		**22,669,196**		**17,991,753**		**1,250,141**		**80,554,900**		**122,465,990**

E10 - Mill Building

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E10-40-463.00	Grinding Building	-	-	-	-	-	-	-	-	-	-	-	-	-
E10-13-464.00	Grinding Building; Detail Excavation	10,700. m3	0.08	834.60	108.00	90,137	0.00	0	3.75	40,125	0.00	0	12.17	130,262
E10-13-465.00	Grinding Building; Detail Excavation (Rock Excavation)	4,020. m3	0.13	522.60	108.00	56,441	0.00	0	5.50	22,110	0.00	0	19.54	78,551
E10-13-466.00	Grinding Building; Structural Backfill	5,072. m3	0.13	659.36	108.00	71,211	8.00	40,576	4.00	20,288	0.00	0	26.04	132,075
E10-20-467.00	Grinding Building; Concrete work	8,040. m3	8.45	67,938.00	108.00	7,337,304	765.00	6,150,600	25.00	201,000	0.00	0	1,702.60	13,688,904
E10-30-468.00	Grinding Building; Structural Steel	1,010. t	28.60	28,886.00	108.00	3,119,688	4,800.00	4,848,000	250.00	252,500	0.00	0	8,138.80	8,220,188
E10-40-469.00	Grinding Building; Wall cladding	6,030. m2	1.30	7,839.00	108.00	846,612	110.00	663,300	15.00	90,450	0.00	0	265.40	1,600,362
E10-40-470.00	Grinding Building; Roof cladding	5,040. m2	1.30	6,552.00	108.00	707,616	110.00	554,400	15.00	75,600	0.00	0	265.40	1,337,616
E10-13-471.00	Conveyor; Detail Excavation	10,000. m3	0.08	780.00	108.00	84,240	0.00	0	3.75	37,500	0.00	0	12.17	121,740

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E10-13-472.00	Conveyor; Structural Backfill	9,100. m3	0.13	1,183.00	108.00	127,764	8.00	72,800	4.00	36,400	0.00	0	26.04	236,964
E10-20-473.00	Conveyor; Concrete work	1,000. m3	8.45	8,450.00	108.00	912,600	765.00	765,000	25.00	25,000	0.00	0	1,702.60	1,702,600
E10-13-474.00	Transformer Station (HPGR); Detail Excavation	1,215. m3	0.08	94.77	108.00	10,235	0.00	0	3.75	4,556	0.00	0	12.17	14,791
E10-13-475.00	Transformer Station (HPGR); Structural Backfill	1,035. m3	0.13	134.55	108.00	14,531	8.00	8,280	4.00	4,140	0.00	0	26.04	26,951
E10-20-476.00	Transformer Station (HPGR); Concrete work	250. m3	8.45	2,112.50	108.00	228,150	765.00	191,250	25.00	6,250	0.00	0	1,702.60	425,650
E10-13-477.00	Transformer Station; Detail Excavation	1,505. m3	0.08	117.39	108.00	12,678	0.00	0	3.75	5,644	0.00	0	12.17	18,322
E10-13-478.00	Transformer Station; Structural Backfill	1,315. m3	0.13	170.95	108.00	18,463	8.00	10,520	4.00	5,260	0.00	0	26.04	34,243
E10-20-479.00	Transformer Station; Concrete work	275. m3	8.45	2,323.75	108.00	250,965	765.00	210,375	25.00	6,875	0.00	0	1,702.60	468,215
E10-80-480.00	Field Instrumentation & Bulks Allowance	1. lot	421.20	421.20	108.00	45,490	9,102.50	9,103	1,500.00	1,500	55,000.00	55,000	111,092.10	111,092
E10-58-481.00	HVAC Allowance	1. lot	2,235.00	2,235.00	108.00	241,380	5,530.00	5,530	92,660.00	92,660	1,992,060.00	1,992,060	2,331,630.00	2,331,630
E10-50-591.00	Process Equipment Replacement Cost, (Sustaining Capital CAD$20,000,000)	-	-	-	-	-	-	-	-	-	-	-	-	-
E10-50-592.00	Process Equipment Replacement Cost, (Sustaining Capital CAD$20,000,000)	-	-	-	-	-	-	-	-	-	-	-	-	-
		E10 - Mill Building Subtotal		**131,254.67**		**14,175,504**		**13,529,734**		**927,858**		**2,047,060**		**30,680,156**

E15 - Primary & Secondary Grinding

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-594.00	HPGR Screen Splitter Chute No.1 [E15-CHU-601]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E15-50-595.00	HPGR Screen No.1, 4000 W x 8000 L [E15-SCN-610]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-596.00	HPGR Screen No.1 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-55-597.00	HPGR Screen No.1 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E15-50-598.00	HPGR Screen No.2, 4000 W x 8000 L [E15-SCN-611]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-599.00	HPGR Screen No.2 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-55-600.00	HPGR Screen No.2 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E15-50-601.00	HPGR Screen Oversize Conveyor No.1, 1372 W x 25000 L [E15-CNV-615]	25. m	23.40	585.00	108.00	63,180	50.00	1,250	150.00	3,750	6,051.64	151,291	8,778.84	219,471
E15-55-602.00	HPGR Screen Oversize Conveyor No.1 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E15-55-603.00	HPGR Screen Oversize Conveyor No.1 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E15-50-604.00	HPGR Screen Splitter Chute No.2 [E15-CHU-602]	10,000. kg	0.08	780.00	108.00	84,240	0.08	800	0.03	300	5.50	55,000	14.03	140,340
E15-50-605.00	HPGR Screen No.3, 4000 W x 8000 L [E15-SCN-612]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-606.00	HPGR Screen No.3 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-55-607.00	HPGR Screen No.3 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E15-50-608.00	HPGR Screen No.4, 4000 W x 8000 L [E15-SCN-613]	1. ea	299.00	299.00	108.00	32,292	250.00	250	1,750.00	1,750	639,736.46	639,736	674,028.46	674,028
E15-55-609.00	HPGR Screen No.4 Oversize Chute	2,500. kg	0.08	195.00	108.00	21,060	0.08	200	0.03	75	5.50	13,750	14.03	35,085
E15-55-610.00	HPGR Screen No.4 Undersize Chute	2,500. kg	0.05	113.75	108.00	12,285	0.08	200	0.03	75	5.50	13,750	10.52	26,310
E15-50-611.00	HPGR Screen No.5 (Spare) (No installation), 4000 W x 8000 L [E15-SCN-614]	1. ea	0.00	0.00	108.00	0	0.00	0	500.00	500	639,736.46	639,736	640,236.46	640,236
E15-50-612.00	HPGR Screen Oversize Conveyor No.2, 1372 W x 25000 L [E15-CNV-616]	25. m	23.40	585.00	108.00	63,180	50.00	1,250	150.00	3,750	6,051.64	151,291	8,778.84	219,471

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-55-613.00	HPGR Screen Oversize Conveyor No.2 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E15-55-614.00	HPGR Screen Oversize Conveyor No.2 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E15-50-615.00	HPGR Screen Oversize Conveyor No.3, 1372 W x 163000 L [E15-CNV-617]	163. m	20.80	3,390.40	108.00	366,163	50.00	8,150	150.00	24,450	8,048.01	1,311,826	10,494.41	1,710,589
E15-55-616.00	HPGR Screen Oversize Conveyor No.3 Head Chute	1,020. kg	0.08	79.56	108.00	8,592	0.08	82	0.03	31	5.50	5,610	14.03	14,315
E15-55-617.00	HPGR Screen Oversize Conveyor No.3 Head Chute AR Liner	840. kg	0.05	38.22	108.00	4,128	0.08	67	0.03	25	5.50	4,620	10.52	8,840
E15-50-618.00	Cyclone Cluster Feed Pumpbox No.1 c/w Rubber Liner [E15-PBX-052]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-619.00	Primary Cyclone Cluster No.1 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-045]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-620.00	Primary Grinding Cyclone Cluster No.1 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-020]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-621.00	Cyclone Cluster Overflow No.1 Sampler [E15-SMP-060]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-622.00	Ball Mill No.1 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-623.00	Ball Mill No.1 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-624.00	Ball Mill No.1, 7320 D x 12500 [E15-MIL-025]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-625.00	Ball Mill Cradle No.1, included [E15-EQP-181]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-626.00	Ball Mill Lube Unit No.1, included [E15-LUB-031]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-627.00	Ball Mill No.1 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-628.00	Ball Mill No.1 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-629.00	Grinding Area Sump Pump No.1 c/w motor 60kW, 250 [E15-PSU-066]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	52,000.00	52,000	66,190.00	66,190
E15-50-630.00	Cyclone Cluster Feed Pumpbox No.2 c/w Rubber Liner [E15-PBX-053]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-631.00	Primary Cyclone Cluster No.2 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-046]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-632.00	Primary Cyclone Cluster No.1 & 2 Feed Pump (VFD) (Back-Up) c/w motor 1650kW, 700 x 650 [E15-PSL-049]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-633.00	Primary Grinding Cyclone Cluster No.2 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-021]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-634.00	Cyclone Cluster Overflow No.2 Sampler [E15-SMP-061]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-635.00	Ball Mill No.2 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-636.00	Ball Mill No.2 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-637.00	Ball Mill No.2, 7320 D x 12500 [E15-MIL-026]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-638.00	Ball Mill Cradle No.2, included [E15-EQP-182]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-639.00	Ball Mill Lube Unit No.2, included [E15-LUB-032]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-640.00	Ball Mill No.2 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-641.00	Ball Mill No.2 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-642.00	Cyclone Cluster Feed Pumpbox No.3 c/w Rubber Liner [E15-PBX-054]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-643.00	Primary Cyclone Cluster No.3 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-047]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-644.00	Primary Grinding Cyclone Cluster No.3 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-022]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-645.00	Cyclone Cluster Overflow No.3 Sampler [E15-SMP-062]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-646.00	Ball Mill No.3 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-647.00	Ball Mill No.3 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046
E15-50-648.00	Ball Mill No.3, 7320 D x 12500 [E15-MIL-025]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-649.00	Ball Mill Cradle No.3, included [E15-EQP-181]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-650.00	Ball Mill Lube Unit No.3, included [E15-LUB-031]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-651.00	Ball Mill No.3 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-652.00	Ball Mill No.3 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-653.00	Grinding Area Sump Pump No.2 c/w motor 60kW, 250 [E15-PSU-068]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	52,000.00	52,000	66,190.00	66,190
E15-50-654.00	Cyclone Cluster Feed Pumpbox No.4 c/w Rubber Liner [E15-PBX-055]	6,200. kg	0.10	644.80	108.00	69,638	0.10	620	0.03	186	6.00	37,200	17.36	107,644
E15-50-655.00	Primary Cyclone Cluster No.4 Feed Pump (VFD) c/w motor 1650kW, 700 x 650 [E15-PSL-048]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-656.00	Primary Cyclone Cluster No.3 & 4 Feed Pump (VFD) (Back-Up) c/w motor 1650kW, 700 x 650 [E15-PSL-050]	1. ea	663.00	663.00	108.00	71,604	5,000.00	5,000	7,000.00	7,000	377,250.00	377,250	460,854.00	460,854
E15-50-657.00	Primary Grinding Cyclone Cluster No.4 (11 Operating / 1 Standby), 12 x 710 [E15-CYC-023]	1. ea	845.00	845.00	108.00	91,260	750.00	750	5,000.00	5,000	552,900.00	552,900	649,910.00	649,910
E15-50-658.00	Cyclone Cluster Overflow No.4 Sampler [E15-SMP-063]	1. ea	26.00	26.00	108.00	2,808	50.00	50	25.00	25	45,000.00	45,000	47,883.00	47,883
E15-55-659.00	Ball Mill No.4 Feed Chute	3,710. kg	0.08	289.38	108.00	31,253	0.08	297	0.03	111	5.50	20,405	14.03	52,066
E15-55-660.00	Ball Mill No.4 Feed Chute AR Liner	2,950. kg	0.05	134.23	108.00	14,496	0.08	236	0.03	89	5.50	16,225	10.52	31,046

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-661.00	Ball Mill No.4, 7320 D x 12500 [E15-MIL-028]	1. ea	11,700.00	11,700.00	108.00	1,263,600	10,000.00	10,000	20,000.00	20,000	17,296,354.17	17,296,354	18,589,954.17	18,589,954
E15-50-662.00	Ball Mill Cradle No.4, included [E15-EQP-186]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-663.00	Ball Mill Lube Unit No.4, included [E15-LUB-034]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-664.00	Ball Mill Inching Drive, included [E15-DRV-035]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-50-665.00	Ball Mill Ball Charging System, included [E15-EQP-183]	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-55-666.00	Ball Mill No.4 Discharge Chute	1,500. kg	0.08	117.00	108.00	12,636	0.08	120	0.03	45	5.50	8,250	14.03	21,051
E15-55-667.00	Ball Mill No.4 Discharge Chute AR Liner	1,000. kg	0.05	45.50	108.00	4,914	0.08	80	0.03	30	5.50	5,500	10.52	10,524
E15-50-668.00	Cooling Water Filter [E15-FIL-197]	1. ea	26.00	26.00	108.00	2,808	25.00	25	50.00	50	5,000.00	5,000	7,883.00	7,883
E15-50-669.00	Mill Cooling System [E15-SCN-511]	1. ea	1,300.00	1,300.00	108.00	140,400	750.00	750	1,000.00	1,000	1,000,000.00	1,000,000	1,142,150.00	1,142,150
E15-50-670.00	SAG Mill 125mm Automatic Ball Charging Feeder [E15-FDR-600]	1. ea	130.00	130.00	108.00	14,040	50.00	50	100.00	100	75,000.00	75,000	89,190.00	89,190
E15-50-671.00	Mill Inching Hydraulic Power Pack [E15-PPK-184]	1. ea	195.00	195.00	108.00	21,060	100.00	100	2,500.00	2,500	200,000.00	200,000	223,660.00	223,660
E15-50-672.00	SAG Mill Liner Handler [E15-HAN-509]	1. lot	260.00	260.00	108.00	28,080	100.00	100	3,500.00	3,500	1,951,303.54	1,951,304	1,982,983.54	1,982,984
E15-50-673.00	Ball Mill Liner Handler [E15-HAN-036]	1. lot	260.00	260.00	108.00	28,080	100.00	100	3,500.00	3,500	1,951,303.54	1,951,304	1,982,983.54	1,982,984
E15-50-674.00	Particle Size Analyzer No.1 [E15-ANA-003]	1. ea	260.00	260.00	108.00	28,080	200.00	200	2,000.00	2,000	350,000.00	350,000	380,280.00	380,280
E15-50-675.00	Particle Size Analyzer No.2 [E15-ANA-004]	1. ea	260.00	260.00	108.00	28,080	200.00	200	2,000.00	2,000	350,000.00	350,000	380,280.00	380,280
E15-50-676.00	Pebble Crusher Discharge Scale No.1 [E15-SCB-545]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
E15-50-677.00	Pebble Crusher Discharge Scale No.2 [E15-SCB-555]	1. ea	65.00	65.00	108.00	7,020	25.00	25	500.00	500	39,000.00	39,000	46,545.00	46,545
E15-50-678.00	Primary Grinding Crane No.1 (35m span, 30m lift)), 110/20T [E15-CRN-005]	1. ea	487.50	487.50	108.00	52,650	1,000.00	1,000	5,000.00	5,000	900,000.00	900,000	958,650.00	958,650
E15-50-679.00	Primary Grinding Crane No.2 (33m span, 30m lift), 50/10T [E15-CRN-007]	1. ea	325.00	325.00	108.00	35,100	300.00	300	2,000.00	2,000	400,000.00	400,000	437,400.00	437,400
E15-50-680.00	Primary Grinding Crane No.3 (33m span, 30m lift), 50/10T [E15-CRN-008]	1. ea	325.00	325.00	108.00	35,100	300.00	300	2,000.00	2,000	400,000.00	400,000	437,400.00	437,400
E15-50-681.00	Grinding Area Sump Pump Hoist, 15T [E15-HOI-189]	1. ea	104.00	104.00	108.00	11,232	125.00	125	75.00	75	57,500.00	57,500	68,932.00	68,932
E15-58-682.00	Fire Protection; Auto Sprinklers @ SAG Mill Lube Unit No.1	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-683.00	Fire Protection; Auto Sprinklers @ SAG Mill Lube Unit No.2	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-684.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.1	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-685.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.2	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-686.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.3	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-687.00	Fire Protection; Auto Sprinklers @ Ball Mill Lube Unit No.4	9. ea	5.20	46.80	108.00	5,054	1,000.00	9,000	5.00	45	0.00	0	1,566.60	14,099
E15-58-688.00	HVAC Allowance, included in Area E10 - Mill Building	-	-	-	-	-	-	-	-	-	-	-	-	-
E15-60-689.00	Piping Allowance 1.25%	1. lot	793.85	793.85	108.00	85,736	1,026,186.94	1,026,187	2,110.85	2,111	0.00	0	1,114,033.75	1,114,034
E15-80-690.00	Field Instrumentation & Bulks Allowance	1. lot	15,600.00	15,600.00	108.00	1,684,800	332,662.50	332,663	55,000.00	55,000	2,045,000.00	2,045,000	4,117,462.50	4,117,463
E15-70-691.00	Electrical Motor Wiring, Not included	-	-	-	-	-	-	-	-	-	-	-	-	-
	E15 - Primary & Secondary Grinding Subtotal			**89,087.51**		**9,621,451**		**1,510,157**		**267,066**		**89,121,723**		**100,520,398**

M12 - Catering and Housekeeping

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
M12-40-693.00	Catering and Housekeeping (based on 194,000 mandays @ $65/day)													
		1. lot	0.00	0.00	108.00	0	12,565,072.79	12,565,073	0.00	0	0.00	0	12,565,072.79	12,565,073
	M12 - Catering and Housekeeping Subtotal			**0.00**		**0**		**12,565,073**		**0**		**0**		**12,565,073**
X10 - Construction Indirects														
X10-91-696.00	Construction Indirects													
		1. lot	173,288.85	173,288.85	108.00	18,715,196	43,669,000.00	43,669,000	0.00	0	0.00	0	62,384,195.99	62,384,196
X10-91-697.00	Construction Indirects (Open Pit - Pre-Production)													
		1. lot	14,750.00	14,750.00	108.00	1,593,000	3,717,000.00	3,717,000	0.00	0	0.00	0	5,310,000.00	5,310,000
X10-91-698.00	Helicopter Costs Additional Cost													
		1. sum	0.00	0.00	108.00	0	5,000,000.00	5,000,000	0.00	0	0.00	0	5,000,000.00	5,000,000
	X10 - Construction Indirects Subtotal			**188,038.85**		**20,308,196**		**52,386,000**		**0**		**0**		**72,694,196**
X20 - Spares														
X20-92-700.00	Construction and Commission Spares													
		1. lot	0.00	0.00	108.00	0	10,785,000.00	10,785,000	0.00	0	0.00	0	10,785,000.00	10,785,000
	X20 - Spares Subtotal			**0.00**		**0**		**10,785,000**		**0**		**0**		**10,785,000**
X30 - Initial Fills														
X30-93-703.00	Initial Fills Process (includes grinding media, warehouse inventory, lubricants, etc)													
		1. lot	0.00	0.00	108.00	0	7,733,341.00	7,733,341	0.00	0	0.00	0	7,733,341.00	7,733,341
	X30 - Initial Fills Subtotal			**0.00**		**0**		**7,733,341**		**0**		**0**		**7,733,341**
X40 - Freight And Logistic														
X40-94-705.00	Freight And Logistics for main bulks and major equipment (Generally 8% and 6% for mobile equipment)													
		1. lot	0.00	0.00	108.00	0	17,687,000.00	17,687,000	0.00	0	0.00	0	17,687,000.00	17,687,000
X40-94-706.00	Air Freight - Minimal Allowance													
		1. sum	0.00	0.00	108.00	0	100,000.00	100,000	0.00	0	0.00	0	100,000.00	100,000
X40-94-707.00	Bonds/Insurances By owner													
		-	-	-	-	-	-	-	-	-	-	-	-	-
	X40 - Freight And Logistic Subtotal			**0.00**		**0**		**17,787,000**		**0**		**0**		**17,787,000**
X50 - Commissioning and Pre-operational Startup														
X50-95-709.00	Commissioning And Startup Construction Forces allow 24men for 4mths @ $125/hr (including travel and expenses)													
		1. lot	34,560.00	34,560.00	108.00	3,732,480	4,320,000.00	4,320,000	0.00	0	0.00	0	8,052,480.00	8,052,480
X50-95-710.00	Commissioning And Startup CM Forces allow 8men for 4mths @ $150/hr (including travel and expenses)													
		1. lot	11,520.00	11,520.00	108.00	1,244,160	1,728,000.00	1,728,000	0.00	0	0.00	0	2,972,160.00	2,972,160

Area-Sec-Seq	Description	Qty	Labour Unit Mhr	Labour Manhour	Labour Rate	Labour Cost	Material Unit Cost	Material Cost	Const Eqt Unit Cost	Const Eqt Cost	Process Eqpt Unit Cost	Process Eqpt Cost	Total Unit Cost	Total Cost (CAD)
X50-95-711.00	Commissioning And Startup Vendors allow 8men for 2mths @ $160/hr (including travel and expenses)	1. lot	5,760.00	5,760.00	108.00	622,080	921,600.00	921,600	0.00	0	0.00	0	1,543,680.00	1,543,680
X50-95-712.00	Commissioning And Startup Operator training by vendors (Included in Owners Costs)	-	-	-	-	-	-	-	-	-	-	-	-	-
X50-95-713.00	Commissioning And Startup DCS Programming Allow 2000 hrs @ $150/hr	1. lot	0.00	0.00	108.00	0	300,000.00	300,000	0.00	0	0.00	0	300,000.00	300,000
	X50 - Commissioning and Pre-operational Startup Subtotal			**51,840.00**		**5,598,720**		**7,269,600**		**0**		**0**		**12,868,320**
X60 - EPCM														
X60-96-716.00	Engineering and Procurement - Process (Allowance) 8% of Direct Costs	1. lot	0.00	0.00	108.00	0	41,590,000.00	41,590,000	0.00	0	0.00	0	41,590,000.00	41,590,000
X60-96-717.00	Construction Management - Process (Allowance) 7% of Direct Costs	1. lot	0.00	0.00	108.00	0	36,391,000.00	36,391,000	0.00	0	0.00	0	36,391,000.00	36,391,000
X60-96-718.00	Construction Management - Vendor support (Allowance)	1. lot	2,500.00	2,500.00	108.00	270,000	375,000.00	375,000	50,000.00	50,000	0.00	0	695,000.00	695,000
X60-96-719.00	Construction Management - Consultants (Allowance)	1. lot	1,000.00	1,000.00	108.00	108,000	150,000.00	150,000	25,000.00	25,000	0.00	0	283,000.00	283,000
	X60 - EPCM Subtotal			**3,500.00**		**378,000**		**78,506,000**		**75,000**		**0**		**78,959,000**
Y10 - Owner's Costs														
Y10-98-727.00	Owners Costs (not included)	-	-	-	-	-	-	-	-	-	-	-	-	-
	Y10 - Owner's Costs Subtotal			**0.00**		**0**		**0**		**0**		**0**		**0**
Z10 - Contingency														
Z10-99-729.00	Contingency@14.0%	1. lot	0.00	0.00	108.00	0	99,138,000.00	99,138,000	0.00	0	0.00	0	99,138,000.00	99,138,000
	Z10 - Contingency Subtotal			**0.00**		**0**		**99,138,000**		**0**		**0**		**99,138,000**
Option 5 (HPGR+Conveyance) Total				**1,554,383.72**		**167,873,442**		**399,525,982**		**13,017,945**		**239,414,043**		**819,831,412**

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE HPGR COMMINUTION CIRCUIT

PROCESSING OPERATING COSTS SUMMARY

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

OPERATING COST SUMMARY - BLENDED ORE HPGR

DESCRIPTION	MANPOWER	ANNUAL COST (CDN$)	UNIT COST (CDN$/t ore)
HUMAN POWER			
TREATY OPERATING LABOUR	28	$2,694,816	$0.057
TREATY MAINTENANCE LABOUR	30	$3,266,854	$0.069
SUB-TOTAL MANPOWER	58	$5,961,670	$0.126
SUPPLIES			
METAL CONSUMABLES			
TREATY SITE (HPGR & BALL MILL)		$59,702,889	$1.258
SUB-TOTAL METAL CONSUMBLES			
MAINTENANCE SUPPLIES			
TREATY SITE (HPGR & BALL MILL)		$12,411,328	$0.262
SUB-TOTALMAINTENANCE SUPPLIES			
OPERATING SUPPLIES			
TREATY SITE (HPGR & BALL MILL)		$150,000	$0.003
SUB-TOTALOPERATING SUPPLIES			
POWER SUPPLY			
TREATY SITE (HPGR & BALL MILL)		$33,002,529	$0.696
SUB-TOTALPOWER SUPPLIES			
SUB-TOTAL SUPPLIES		$105,266,747	$2.218
TOTAL	58	$111,228,417	$2.344

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE HPGR COMMINUTION CIRCUIT

TREATYSITE SITE MANPOWER COSTS

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

TREATY OPERATION MANPOWER

DESCRIPTION	MANPOWER	BASE SALARY (CDN$)	LOADED SALARY (CDN$)	ANNUAL COST (CDN$)
HOURLY				
Secondary Crusher Operators	4	$74,520	$100,602	$402,408
HPGR Crusher Operators	4	$74,520	$100,602	$402,408
Grinding Operators	8	$76,680	$103,518	$828,144
Control Room	4	$80,000	$108,000	$432,000
Helpers	8	$58,320	$78,732	$629,856
SUB-TOTAL HOURLY	**28**			**$2,694,816**
TOTAL TREATY OPERATION MANPOWER	**28**			**$2,694,816**

TREATY MAINTENANCE MANPOWER

DESCRIPTION	MANPOWER	BASE SALARY (CDN$)	LOADED SALARY (CDN$)	ANNUAL COST (CDN$)
HOURLY				
Mechanics	8	$85,320	$115,182	$921,456
Electrician	4	$88,560	$119,556	$478,224
Electrician Apprentices	2	$76,680	$103,518	$207,036
Instrument Technicians	4	$90,720	$122,472	$489,888
Welders	4	$85,320	$115,182	$460,728
Welder Apprentices	2	$76,680	$103,518	$207,036
Crane / Equipment Operators	2	$69,466	$93,779	$187,558
Helpers	4	$58,320	$78,732	$314,928
SUB-TOTAL HOURLY	**30**			**$3,266,854**
TOTAL TREATY MAINTENANCE MANPOWER	**30**			**$3,266,854**

SEABRIDGE GOLD

KERR-SULPHURETS-MITCHELL ENERGY STUDIES

BLENDED ORE HPGR COMMINUTION CIRCUIT

TREATY SITE SUPPLIES OPERATING COSTS

Version	Final	
Date	August 14, 2012	
Prepared by	T. L.	Tetra Tech WEI
Reviewed by	J. H.	Tetra Tech WEI

TREATY SITE POWER SUPPLY - BLENDED ORE

Treaty Operation Power Drawn	kW	83,063

POWER SUPPLIES	KWH	UNIT COST	TOTAL COST	UNIT COST
Treaty Operation Power Consumption	673,521,008	$0.049	33,002,529	$0.696
TOTAL POWER SUPPLY *	**673,521,008**	**$0.049**	**33,002,529**	**$0.696**

* including slurry holding tank agitators, pumps and others

TREATY SITE MAINTENANCE SUPPLIES

AREA		TOTAL COST (CDN$/year)	UNIT COST (CDN$/t ore)
MAINTENANCE SUPPLIES			
Coarse & Fine Ore Stockpiles	allowance	$760,954	$0.016
Cone Crushing	allowance	$613,385	$0.013
HPGR Crushing	allowance	$5,510,970	$0.116
Ball Mill Grinding	allowance	$5,026,020	$0.106
Misc. Building Complex Supplies	allowance	$500,000	$0.011
SUB-TOTAL MTCE. SUPPLIES		**$12,411,328**	**$0.262**
OPERATING SUPPLIES			
Miscellaneous		$150,000	$0.003
SUB-TOTAL OPERATING SUPPLIES		**$150,000**	**$0.003**

TREATY SITE MAJOR CONSUMABLE - BLENDED ORE

SUPPLIES	CONSUMPTION (kg/t ore)	SOURCE	UNIT COST (CDN$/kg)	SOURCE	UNIT COST FOB POINT	TOTAL COST (CDN$/year)	UNIT COST (CDN$/t ore)
METAL CONSUMABLES							
LINERS							
Cone Crusher Liners		Calculation	-	Metso/ME	minesite	$796,983	$0.017
HPGR Liners		Estimate	-	Estimate	minesite	$12,294,879	$0.259
Primary Grinding - Ball Mill Liners	0.049	Calculation	$3.301	ME/Metso	minesite	$7,746,707	$0.163
BALLS							
Primary Grinding - Ball Mill Balls	0.599	Calculation	$1.368	Moly-Cop	minesite	$38,864,321	$0.819
SUB-TOTAL METALS						**$59,702,889**	**$1.258**
TOTAL OPERATING SUPPLIES						**$59,702,889**	**$1.258**

APPENDIX I

SGS HPGR and Koeppern HPGR Test Reports

An Investigation into

THE GRINDABILITY AND FLOTATION CHARACTERISTICS OF TWO SAMPLES FROM THE KSM DEPOSIT

prepared for

SEABRIDGE GOLD INC.

Project 12248-001 – Final Report
February 03, 2010

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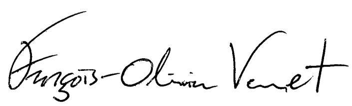
Introduction

Mr. Jim Smolik from Seabridge Gold Inc., on March 9, 2009, requested that SGS Minerals Services (SGS) perform grindability and flotation testing on two samples from the KSM deposit, located in British Columbia, Canada.

This report presents the test results.

Author:



Francois Verret, M.Sc.
Project Metallurgist, Metallurgical Operations

Reviewer:

Dominique Lascelles
Technical Leader, Mineral Processing

Experimental work by Thomas Davies, John Patsias and Francois Verret
Report preparation by: Thomas Davies, Francois Verret, Dominique Lascelles and Su McKenzie
Reviewed by: Dominique Lascelles and Andre McKen

Executive Summary

Two samples were received at the SGS Lakefield site and were submitted for the Bond ball mill grindability test and the Bond abrasion test. The results are summarised in Table 1 and the test details are discussed in Section 2 of the Discussion. The Mitchell sample was categorised as medium and as being abrasive, while the Sulphurets sample was categorised as hard and as being moderately abrasive. The proposed grinding circuit design based on the design criteria provided by the client, which is presented in Table 11, is summarised in Table 2.

Table 1: Grindability Test Summary

Sample Name	HPGR LCT Net Specific Energy Requirement (kWh/t)	BWI (kWh/t)	AI (g)
Mitchell	2.3	13.8	0.293
Mitchell HPGR Prod.	-	14.0	-
Sulphurets	3.1	19.1	0.233
Sulphurets HPGR Prod.	-	19.5	-

Table 2: Grinding Circuit Design Summary

Ore Type	**Sulphurets**			**Mitchell**		
Mill Dimensions	**Crusher**	**HPGR**	**Ball Mill**	**Crusher**	**HPGR**	**Ball Mill**
Number in Parallel	-	5	5	-	4	4
Nominal Dimension	-	7.9' x 5.4'	23.5' x 40'	-	7.9' x 5.4'	23.5' x 40'
Inside Liner Dimension (metre)	-	2.40 x 1.65	6.96 x 11.99	-	2.40 x 1.65	6.96 x 11.99
Mill Speed (RPM)	-	15.9	12.0	-	16.9	12.0
% of Critical Speed (%)	-	-	75	-	-	75
Cone Angle (degree)	-	-	0	-	-	0
Grinding Steel						
Diameter Recommended (inch)	-	-	38	-	-	38
Design Ball Charge (%Vol.)	-	-	33	-	-	29
Maximum Ball Charge (%)	-	-	34	-	-	34
Motor						
Design Power (kW)	2,189	23,465	57,293	1,030	15,816	40,759
Total Installed Power (kW)	-	28,000	59,680	-	22,400	47,744
Total Installed Power (HP)	-	37,534	80,000	-	30,027	64,000
Installed Power (HP) per Mill	-	7,507	16,000	-	7,507	16,000
Classification						
Type	-	Screens	Hydrocyclones	-	Screens	Hydrocyclones
Circuit Performance						
Daily Dry Throughput Rate (mtpd)		120,000			120,000	
Availability (%)	-	92	92	-	92	92
Net Dry Throughput Rate (t/h)	-	5,435	5,435	-	5,435	5,435
F_{80} (microns)	150,000	45,000	2,220	150,000	45,000	1,988
P_{80} (microns)	45,000	2,220	180	45,000	1,988	180
Ind. Specific Power Req. (kWh/t)	0.4	4.3	10.5	0.2	2.9	7.5
Total Designed Power (kW)		82,946			57,605	
Total Specific Power Req. (kWh/t)		15.3			10.6	

The Sulphurets ore was harder and required one more HPGR and one more ball mill than the Mitchell ore. Given the very different nature of the two ores, it is recommended that the design criteria (throughput and grind for the two ores) and/ore the mine plan be revisited to better utilise the grinding circuits.

The two samples were also submitted to flotation and cyanidation testwork. The metallurgical projection summary for the combined locked-cycle flotation and cyanide leach are presented in Table 3. The results for the Mitchell and Sulphurets samples were similar. About 85.7 to 89.0% of the Cu and about 59.6 to 66.6% of the Mo was recovered in the 3rd cleaner flotation concentrate for the Mitchell and Sulphurets samples, respectively. The sulphide concentrates, produced from the combination of the 1st cleaner tails and the rougher pyrite concentrate of both samples, were leached with cyanide to investigate the potential gold extraction rates. The overall combined (flotation/cyanidation) gold recovery was 78-80%.

Table 3: Metallurgical Projection Summary

Sample Name	Head Assay			Total Recovery (%)		
	Au (g/t)	Cu (%)	Mo (%)	Au	Cu	Mo
Mitchell	0.80	0.21	0.0061	78.3	89.0	59.6
Sulphurets	0.69	0.20	0.0077	80.3	85.7	66.6

Discussion

1. Sample Preparation

Two skids of rice bags, and representing the KSM deposit, were received at the SGS Lakefield site on July 30th, 2009. The shipment weighed approximately 890 kg and was given our receipt number 0316-JUL09. The pails represented two samples labelled as Mitchell and Sulphurets. The characterisation of the samples included the following:

- Cu, Fe, Au, S, $S^=$ and Mo analyses
- Bond ball mill grindability test
- Bond abrasion test
- HPGR testing
- Flotation testing

The bags representing each ore type were blended and prepared as depicted in Figure 1.

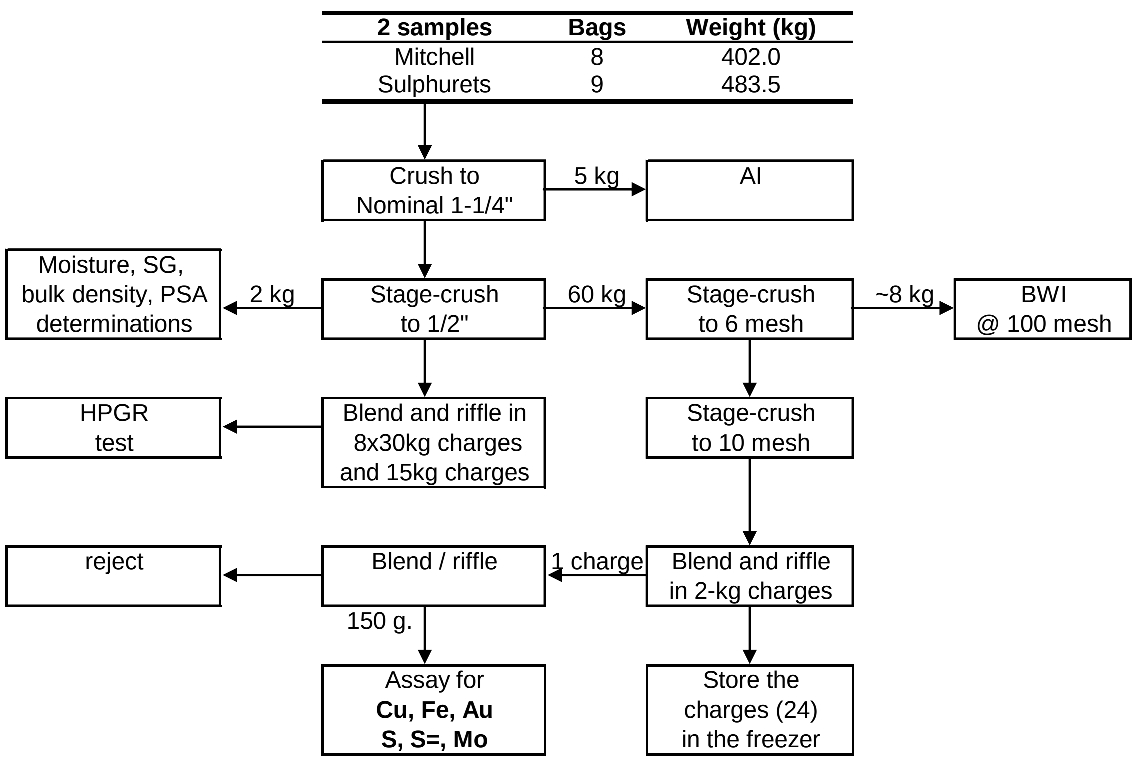


Figure 1: Sample Preparation Diagram

2. Head Assays

A head sample was riffled and submitted for selected analyses for both Mitchell and Sulphurets samples. The results are presented in Table 4.

Table 4: Head Assay Results

Sample Name	Cu (%)	Au (g/t)	Fe (%)	S (%)	S= (%)	Mo (%)
Mitchell	0.21	0.80	4.86	3.68	3.17	0.0061
Sulphurets	0.20	0.69	4.87	2.99	2.92	0.0077

3. Grindability Testing

3.1. Bond Ball Mill Grindability Test

The Bond ball mill grindability test was performed at 100 mesh of grind (150 microns) on the two samples. The test results are summarized in Table 5 and compared to our database in Figure 2. The test details are appended (Appendix A). The Mitchell sample was categorised as medium with a ball mill work index (BWI) of 13.8 kWh/t, while the Sulphurets sample was categorised as hard, with a BWI of 19.1 kWh/t.

Table 5: Bond Ball Mill Grindability Test Results

Sample Name	Mesh of Grind	F_{80} (µm)	P_{80} (µm)	Gram per Revolution	Work Index (kWh/t)	Hardness Percentile
Mitchell	100	2,281	119	1.76	13.8	42
Sulphurets	100	2,590	117	1.14	19.1	87

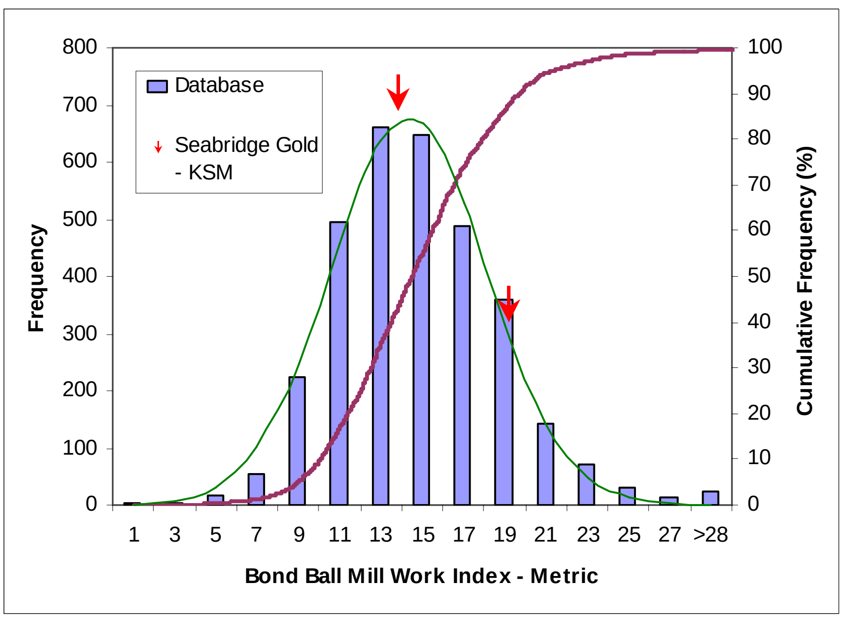


Figure 2: Bond Ball Mill Work Index Database

3.2. Bond Abrasion Test

The two samples were submitted for the Bond abrasion test. The test details are appended (Appendix B) and the results are summarised in Table 6. Comparison to our database is depicted in Figure 3. With an abrasion index (AI) of 0.293 g, the Mitchell sample fell in the moderately abrasive range, while the Sulphurets sample was slightly milder and fell in the medium range (AI of 0.233 g).

Table 6: Bond Abrasion Test Results

Sample Name	AI (g)	Percentile of Abrasivity
Mitchell	0.293	63
Sulphurets	0.233	50

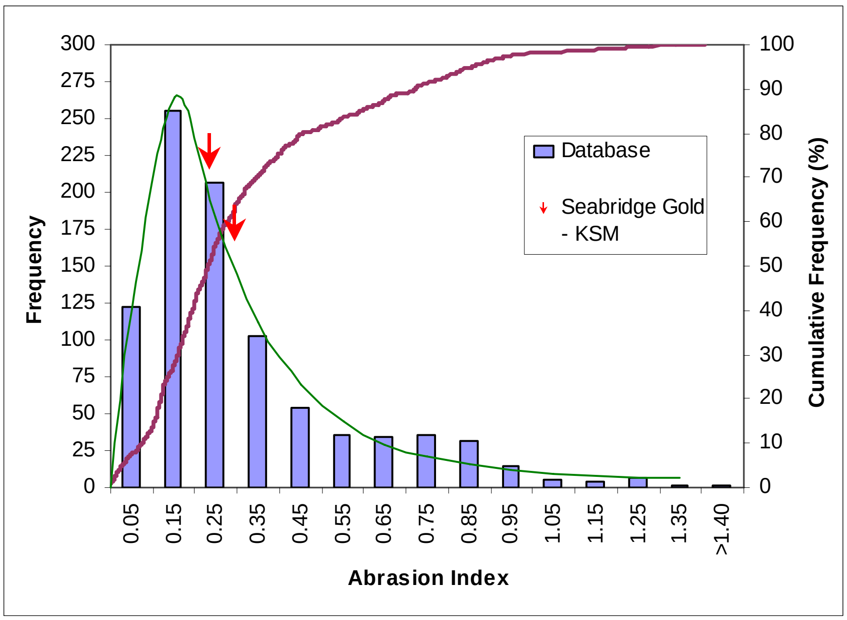


Figure 3: Bond Abrasion Index Database

3.3. HPGR Investigation

The HPGR investigation was performed in two steps. First, the samples were submitted for a series of batch LABWAL tests, which investigated the effect of pressure and moisture content on HPGR performance. Then a locked-cycle test was performed to determine closed-circuit power requirements on each of the samples. The locked-cycle tests were performed using the best operating parameters determined in the first series of tests conducted on each sample.

3.3.1. Feed Characteristics

A head sample was withdrawn for both samples for specific gravity (S.G.), bulk density, particle size analysis (PSA) and 'as received' moisture determinations. The S.G. was measured using a gas pycnometer, while the bulk density was measured by vibrating the sample for five minutes in a 1-L graduated cylinder, and recording the volume. The HPGR feed characteristics are summarised in Table 7.

Table 7: HPGR Feed Characteristics

Feed Characteristics	Mitchell	Sulphurets
$F_{50,}$ (microns)	7,024	4,914
F_{80}, (microns)	9,651	8,624
Percent Passing 100 mesh	5.7	5.8
Percent Passing 6 mesh	26.5	39.3
Specific Gravity (kg/L)	2.63	2.69
Wet Bulk Density (kg/L)	1.82	1.69
Moisture 'as received' (%H_2O)	0.1	0.2
Ball Mill Work Index (kWh/t)	13.8	19.1

3.3.2. LABWAL Characteristics and Test Procedure

The HPGR tests were run in the LABWAL unit, which is equipped with solid roll tires that are protected against wear by tungsten-carbide studs. The principal characteristics of the unit are presented below.

Diameter of rolls	0.25 m
Width of rolls	0.10 m
Speed of rolls	0.57 rotation/second

The unit pressure and power draw were measured every second by our Bailey DCS system and were trended over the test period. The HPGR was choke-fed. For each cycle, the following data was recorded and reported:

- Zero gap
- Moisture content
- Throughput rate
- Specific throughput rate
- Flake thickness (if present)
- Flake density (if present)
- Ore specific gravity (S.G)
- Ore bulk density
- Preset nitrogen pressure
- Initial hydraulic pressure
- Operating hydraulic pressure
- Gross, no-load and net power
- Specific energy input
- Feed and product particle size analyses

In the batch test procedure, a 10-kg test charge was repeatedly processed (three times) through the HPGR to clean the roll and apply an autogenous layer on the tungsten-carbide studs. Seven 30-kg tests were then carried out at different pressure settings and moisture contents. The moisture content was adjusted by adding the proportion of water required to the sample and mixing it in a cement mixer.

For each test, the initial nitrogen and hydraulic pressures were recorded, as well as the feed sample wet weight. The sample was fed to the HPGR and the test duration was recorded with a stopwatch. The power draw and pressures of operation were also recorded through our Bailey system. The HPGR discharge was sampled with a sampling pan after about 10 seconds of operation (three cuts) to allow stabilization, and the flake thickness was measured with a ruler and recorded. The product was submitted for moisture content and particle size analysis (PSA) determinations.

The locked-cycle test was performed at the optimum moisture and pressure settings determined in the batch test. For each cycle, the initial nitrogen and hydraulic pressures were adjusted and recorded. The test charges were set at the optimal moisture prior to each cycle. Once processed through the HPGR, the product was discharged on a 6 mesh screen and the oversize was combined with the fresh feed for the next cycle. This procedure was then repeated until the amount of oversize produced was stabilized for at least 3 cycles. For the Mitchell sample, 30-kg charges were used for the locked-cycle test; while 25-kg charges were used for the Sulphurets sample, due to lower sample availability.

The screen undersize products for the last three cycles were combined and represented the HPGR circuit product (LC Blend). The HPGR circuit product was sub-sampled and submitted for moisture content and particle size analysis (PSA) determinations. A 10-kg sample was withdrawn and submitted for BWI determination. During testing, flakes from the HPGR product were collected and their thickness was measured with a ruler and recorded. Some flakes were also submitted for bulk density determination, using the waxing method. The wax protects the sample from breaking up when immersed in water and prevents the water from filling the voids in the flake. The flake specimens were weighed before and after coating with wax, prior to S.G. determination, using the water displacement technique. The weight and volume of the wax are known, so the actual bulk density of the flakes can be calculated.

3.3.3. Mitchell Test Results

Seven batch tests were performed to optimise the pressure of operation and moisture content, this was followed by a locked-cycle test to establish closed-circuit performance and produce material for ball mill grindability testing. The test results are summarised in Table 8, and are discussed in the following sub-sections. The HPGR test details are appended (Appendix C). The moisture contents presented on the graphs were rounded to 1, 2, and 4% moisture, for simplicity sake, but the actual values are presented in the summary table. The locked-cycle test conditions were 2% moisture with nitrogen and hydraulic pressures of 38 and 56 bars, respectively.

Table 8: Mitchell HPGR Test Results

	Batch Tests							Locked-cycle			
Test Number	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**LC5**	**LC6**	**LC7**	**AVG**
Date:	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	08/09/09	08/09/09	08/09/09	-
Operation											
Initial Nitrogen Pressure (bar)	15	38	15	30	38	15	38	38	38	38	38
Initial Hydraulic Pressure (bar)	24	56	24	45	56	24	56	56	56	56	56
Ratio Hydraulic/Nitrogen	1.6	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5
Pressure of Operation (bar)	34	67	36	53	68	34	67	65	65	65	65
Moisture (%H_2O)	1.2	1.3	2.3	2.1	2.2	4.0	4.0	-	-	-	1.8
Dry Net Throughput (t/h)	3.1	2.7	2.6	2.7	2.6	2.5	2.4	1.8	2.0	1.9	1.9
Circulating Load (%)	-	-	-	-	-	-	-	35.1	33.9	35.1	34.7
Gross Power (kW)	4.1	6.2	4.3	5.3	6.1	4.1	6.2	5.7	5.6	5.6	5.6
No-Load Power (kW)	1.5	1.5	1.4	1.4	1.5	1.5	1.5	1.2	1.2	1.2	1.2
Net Power (kW)	2.6	4.7	2.9	3.9	4.7	2.7	4.7	4.4	4.4	4.5	4.4
Gross Specific Energy Requirement (kWh/t)	1.32	2.25	1.63	1.95	2.41	1.64	2.54	3.09	2.82	2.98	2.96
Net Specific Energy Requirement (kWh/t)	0.84	1.72	1.09	1.43	1.84	1.06	1.93	2.42	2.22	2.36	2.33
HPGR Product Analysis											
P_{50} (µm)	1,515	1,131	1,650	1,230	1,162	1,838	1,165	-	-	-	694
P_{80} (µm)	4,156	3,298	4,205	3,341	3,320	4,414	3,416	-	-	-	1,988
Percent Passing 100 mesh	18.1	20.2	17.2	19.4	21.8	17.1	21.0	-	-	-	25.3
Percent Passing 6 mesh	73.0	80.6	72.7	80.1	80.3	69.7	79.5	-	-	-	100
Flake Thickeness (mm)	7.0	6.0	7.0	7.0	7.0	7.0	6.0	6.0	6.0	6.0	6.0
Performance Indicators											
Specific Grinding Force (N/mm^2)	1.70	3.32	1.78	2.65	3.38	1.71	3.34	3.22	3.27	3.24	3.24
Specific Throughput (ts/hm^3)-(m_f)	278	243	232	241	227	223	216	219	234	226	226
Specific Throughput Rate (ts/hm^3)-(m_c)	228	195	228	228	228	228	195	195	195	195	195
Ratio m_c/m_f	0.82	0.81	0.98	0.95	1.00	1.02	0.91	0.89	0.84	0.87	0.86
Specific Power (kWs/m^3)	234	417	254	344	417	237	417	530	520	533	528
New minus 100 Mesh Produced (%)	12.4	14.5	11.5	13.7	16.1	11.5	15.3	-	-	-	19.6
% Increase in -100 mesh	218	255	202	241	283	201	268	-	-	-	344
New minus 6 Mesh Produced (%)	46.5	54.1	46.2	53.6	53.8	43.2	53.0	-	-	-	73.5
% Increase in -6 mesh	175	204	174	202	203	163	200	-	-	-	277

* Based on the largest movement of the rolls

3.3.3.1. Particle Size Analyses

The feed and product PSAs are presented in Figure 4. The solid lines represent the batch tests, while the dotted lines represent the locked-cycle tests.

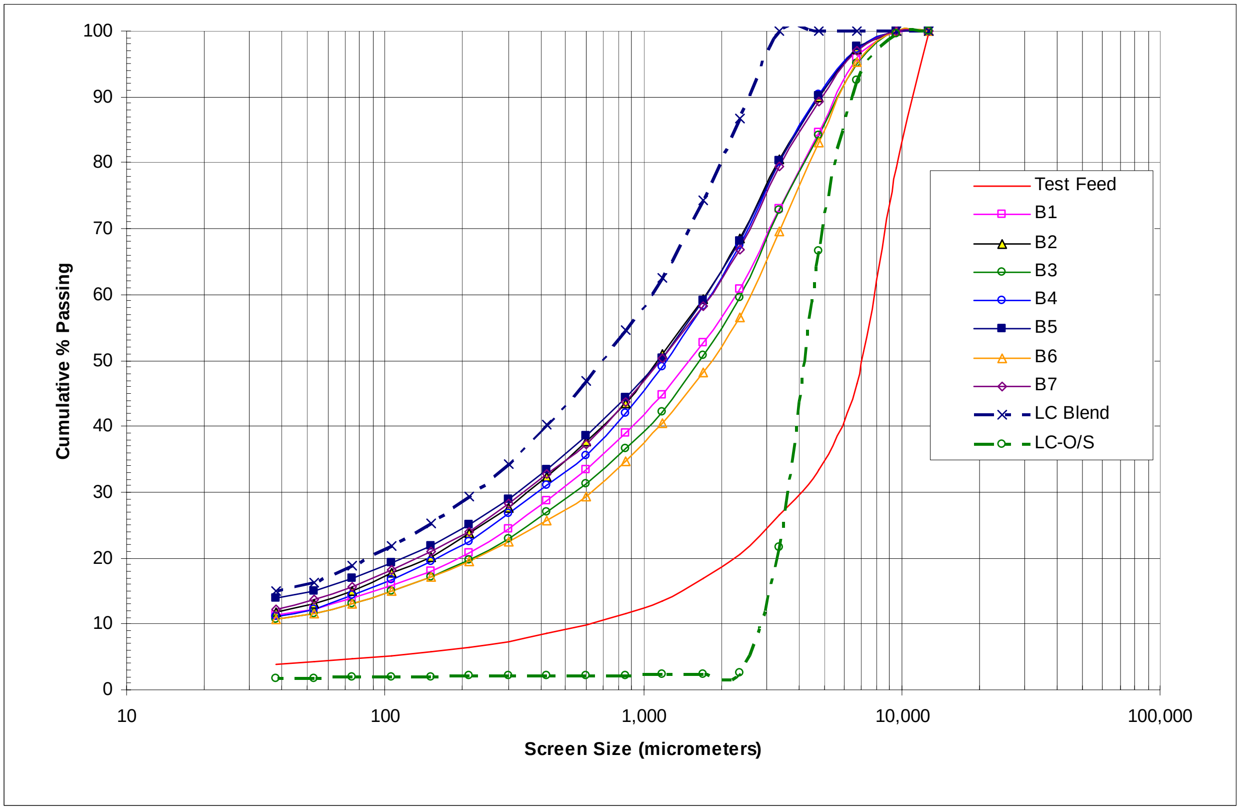


Figure 4: Mitchell HPGR Feed and Product Particle Size Distributions

3.3.3.2. Specific Grinding Force

The specific grinding force corresponds to the hydraulic force between the rolls per unit of area and is expressed in N/mm^2. For a given HPGR unit, it is directly related to the hydraulic pressure, as presented in Figure 5. Higher forces normally result in higher power draw and increased size reduction up to a certain point.

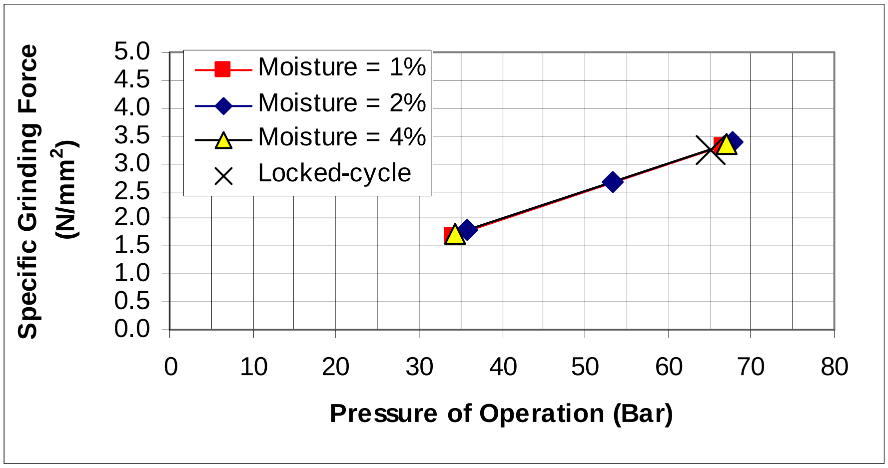


Figure 5: Mitchell Relationship between Hydraulic Pressure and Specific Grinding Force

3.3.3.3. Specific Throughput Rate

The specific throughput rate corresponds to the throughput of the HPGR unit per unit of roll area and speed. It is normalised to a 1 m x 1 m HPGR (Diameter x Width) operated at 1 m/s. This normalised throughput is ore-dependant and varies with operating conditions, but is essentially independent of the rolls geometry and speed, and can therefore be used for scale-up to industrial size. The relationship between the specific grinding force and the specific throughput is presented in Figure 6. Specific throughput decreased with higher pressure and moisture content which is typical.

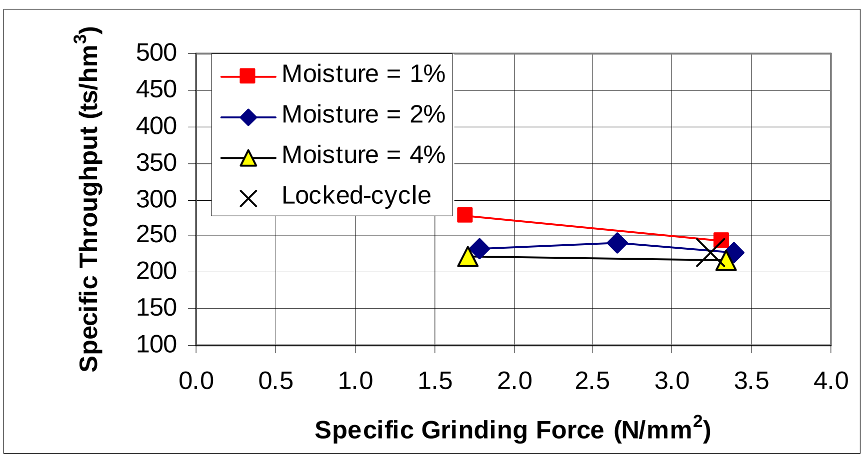


Figure 6: Mitchell Specific Throughput Rate as a Function of Specific Grinding Force

3.3.3.4. Product Size

The LABWAL product sizes, as percent passing 6 and 100 mesh, are presented based on the specific grinding force and the specific energy input in Figure 7 and Figure 8. Higher grinding forces and specific energy inputs slightly increased fineness. The moisture content had a negligible effect on the fineness. The locked cycle test achieved a higher specific energy input, which is the effect of the additional power required to achieve a 100% passing 6-mesh product.

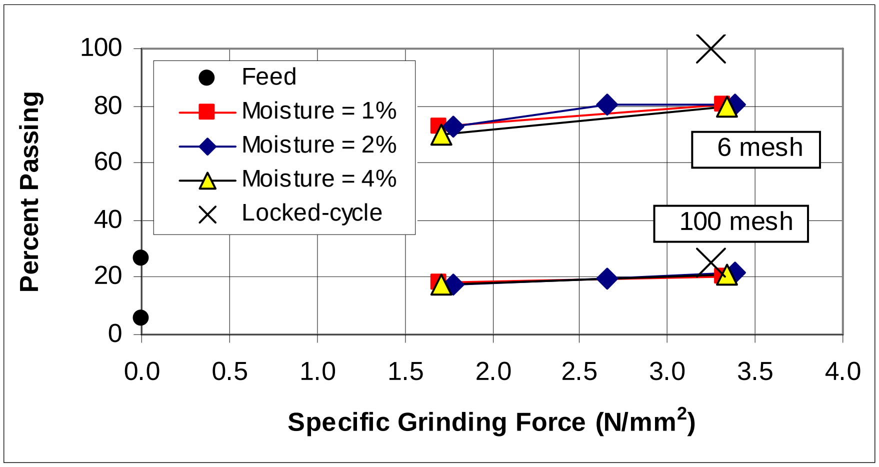


Figure 7: Mitchell Effect of Specific Grinding Force on HPGR Product

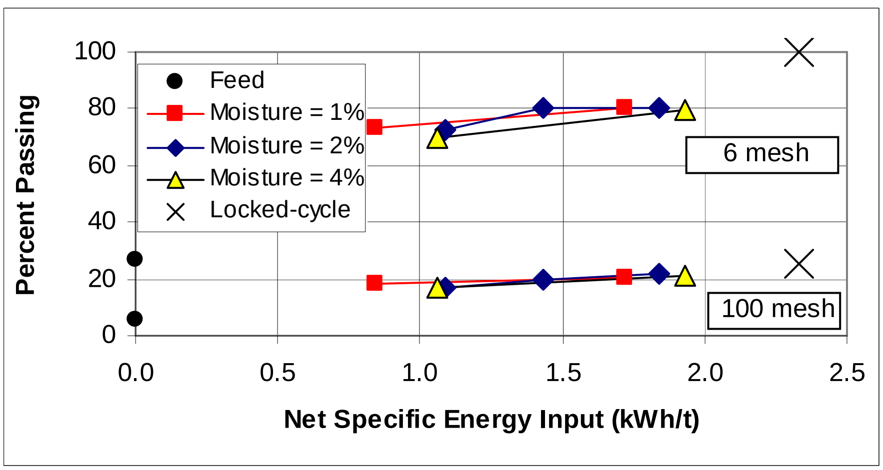


Figure 8: Mitchell Effect of Net Specific Energy Input on HPGR Product

3.3.3.5. Net Power Draw and Net Specific Power

The net power draw is defined as the energy of comminution; i.e. the gross power requirement as measured by the Bailey system less the power required to drive the rolls empty (no-load power). The additional power applied is that which actually achieves comminution. The effect of the specific grinding force of the LABWAL net power is presented in Figure 9.

The net specific power requirement, in kWh/t, corresponds to the net power divided by the actual throughput rate. It is plotted against the specific grinding force in Figure 10. Power requirement increased with higher grinding force. The power requirement for the locked-cycle test was significantly higher. The batch sample tested at 2% moisture and with nitrogen and hydraulic pressures of 38 and 56 bars, respectively, required 1.8 kWh/t net, while about 2.3 kWh/t was required for the locked-cycle test as a result of the circulating load and finer product.

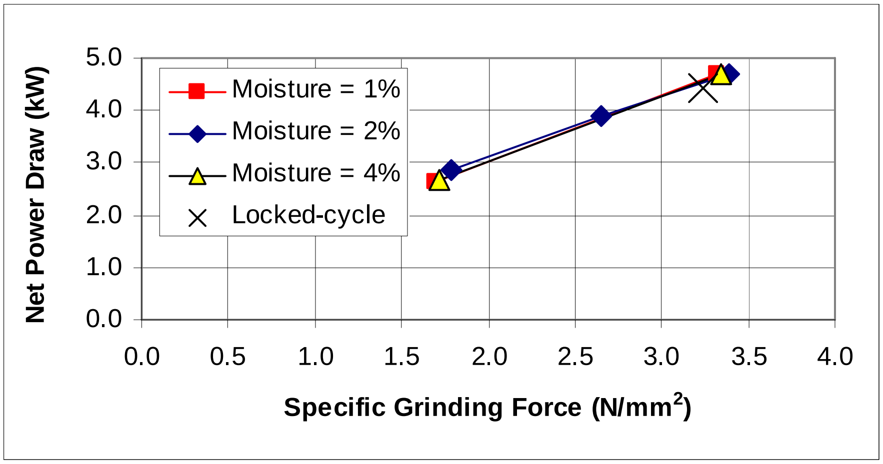


Figure 9: Mitchell Effect of Specific Grinding Force on the LABWAL Net Power

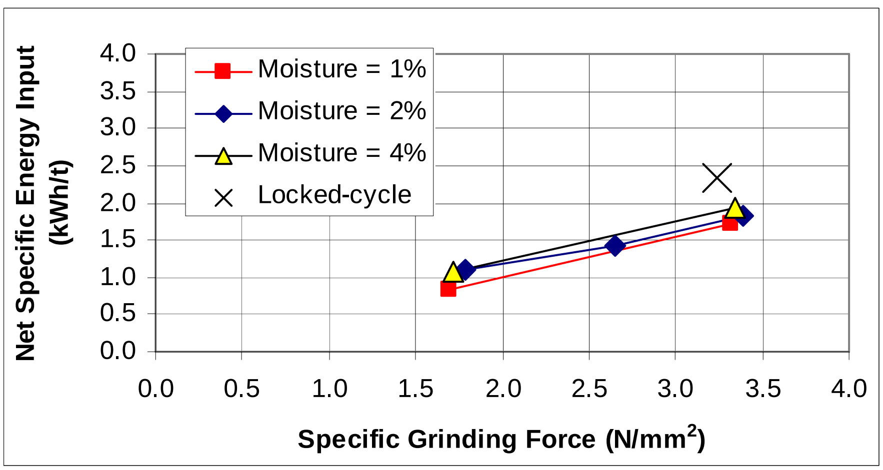


Figure 10: Mitchell Net Specific Power Input as a Function of Specific Grinding Force

3.3.4. Sulphurets Test Results

Seven batch tests were performed to optimise the pressure of operation and moisture content, this was followed by a locked-cycle test to establish closed-circuit performance and produce material for ball mill grindability testing. The test results are summarised in Table 9, and are discussed in the following sub-sections. The HPGR test details are appended (Appendix C). The moisture contents presented on the graphs were rounded off to 1, 2, and 4% moisture, for simplicity sake, but the actual values are presented in the summary table. The locked-cycle test conditions were the same as for the Mitchell sample, at 2% moisture and nitrogen and hydraulic pressures of 38 and 56 bars, respectively.

3.3.4.1. Particle Size Analyses

The feed and product PSA's are presented in Figure 11.

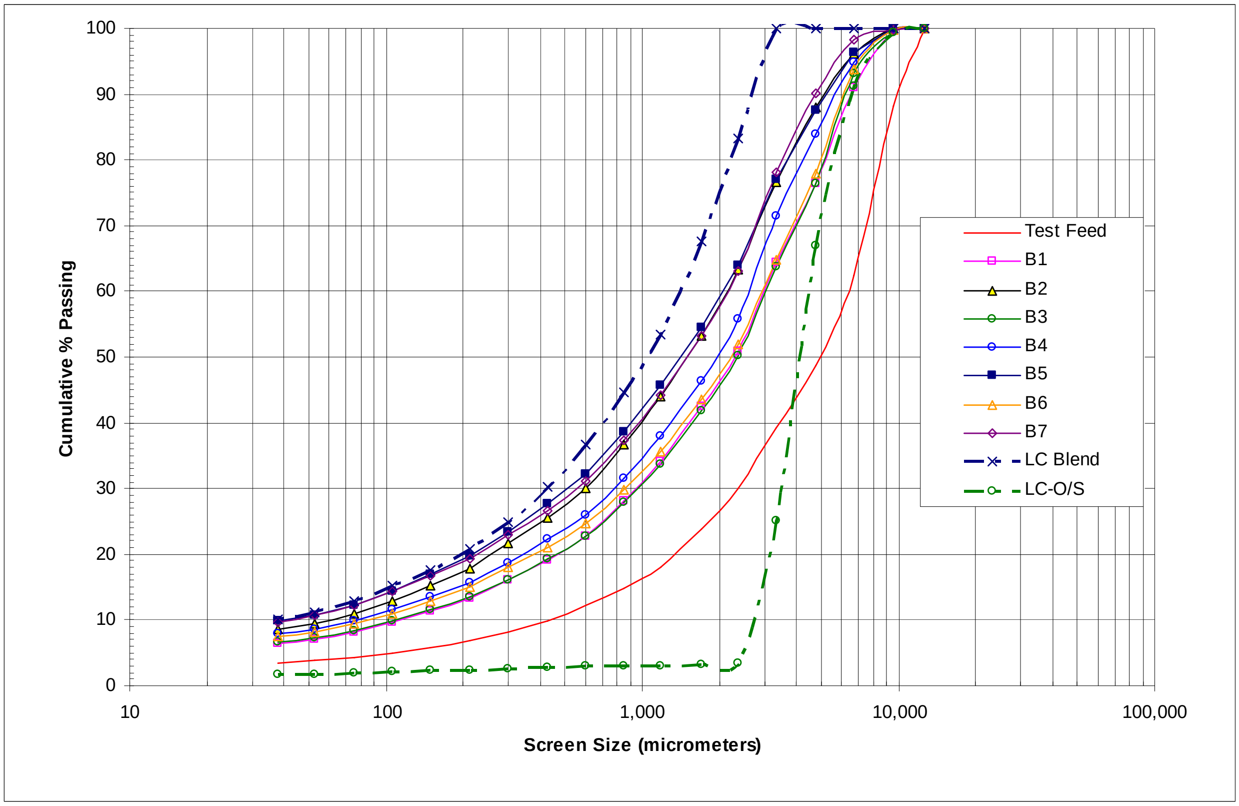


Figure 11: Sulphurets HPGR Feed and Product Particle Size Distributions

Table 9: Sulphurets HPGR Test Results

	Batch Tests							Locked-cycle			
Test Number	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**LC3**	**LC4**	**LC5**	**AVG**
Date:	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	09/09/09	09/09/09	09/09/09	-
Operation											
Initial Nitrogen Pressure (bar)	15	38	15	30	38	15	38	38	38	38	38
Initial Hydraulic Pressure (bar)	24	56	24	45	56	24	56	56	56	56	56
Ratio Hydraulic/Nitrogen	1.6	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5
Pressure of Operation (bar)	34	68	35	55	69	39	72	66	67	67	66
Moisture (%H_2O)	1.2	1.3	2.0	2.1	2.2	3.8	3.8	-	-	-	1.7
Dry Net Throughput (t/h)	2.9	2.7	2.6	2.5	2.5	2.4	2.4	1.6	1.6	1.7	1.6
Circulating Load (%)	-	-	-	-	-	-	-	47.1	47.1	47.1	47.1
Gross Power (kW)	4.5	6.6	4.5	5.9	6.7	4.6	7.0	6.2	6.3	6.1	6.2
No-Load Power (kW)	1.5	1.5	1.4	1.5	1.6	1.5	1.5	1.2	1.2	1.1	1.2
Net Power (kW)	2.9	5.1	3.1	4.4	5.1	3.1	5.5	5.1	5.1	5.0	5.1
Gross Specific Energy Requirement (kWh/t)	1.53	2.47	1.71	2.34	2.69	1.90	2.91	3.83	3.91	3.66	3.80
Net Specific Energy Requirement (kWh/t)	1.00	1.90	1.18	1.73	2.07	1.29	2.29	3.11	3.17	2.97	3.08
HPGR Product Analysis											
P_{50} (µm)	2,284	1,506	2,341	1,937	1,424	2,195	1,508	-	-	-	1,046
P_{80} (µm)	5,203	3,734	5,139	4,291	3,715	4,996	3,557	-	-	-	2,220
Percent Passing 100 mesh	11.3	15.2	11.5	13.5	16.9	12.9	16.7	-	-	-	17.7
Percent Passing 6 mesh	64.3	76.7	63.7	71.4	77.0	64.8	78.1	-	-	-	100
Flake Thickeness (mm)	6.0	7.0	8.0	6.0	6.0	7.0	6.0	6.0	5.5	6.0	5.8
Performance Indicators											
Specific Grinding Force (N/mm^2)	1.71	3.39	1.75	2.72	3.42	1.92	3.61	3.30	3.32	3.32	3.31
Specific Throughput (ts/hm^3)-(m_f)	260	239	233	224	221	216	213	212	210	218	213
Specific Throughput Rate (ts/hm^3)-(m_c)	192	224	256	192	192	224	192	192	176	192	187
Ratio m_c/m_f	0.74	0.94	1.10	0.86	0.87	1.04	0.90	0.91	0.84	0.88	0.88
Specific Power (kWs/m^3)	261	455	274	388	457	280	487	659	664	649	657
New minus 100 Mesh Produced (%)	5.5	9.4	5.7	7.7	11.1	7.1	10.9	-	-	-	11.9
% Increase in -100 mesh	95	163	99	133	192	122	188	-	-	-	205
New minus 6 Mesh Produced (%)	24.9	37.3	24.3	32.0	37.7	25.4	38.7	-	-	-	60.6
% Increase in -6 mesh	63	95	62	81	96	65	98	-	-	-	154

* Based on the largest movement of the rolls

3.3.4.2. Specific Grinding Force

The relationship between the hydraulic pressure and the specific grinding force for the Sulphurets sample is presented in Figure 12.

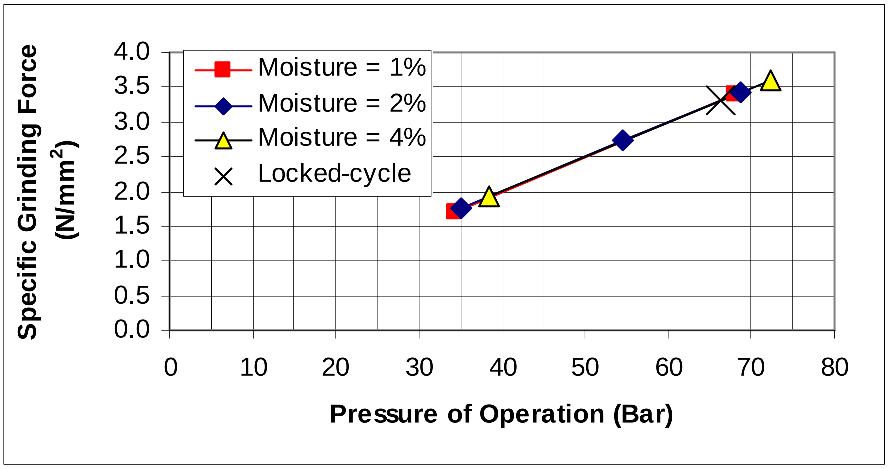


Figure 12: Sulphurets Relationship between Hydraulic Pressure and Specific Grinding Force

3.3.4.3. Specific Throughput Rate

The relationship between the specific grinding force and the specific throughput is presented in Figure 13. Specific throughput decreased with higher pressure and moisture content which is typical.

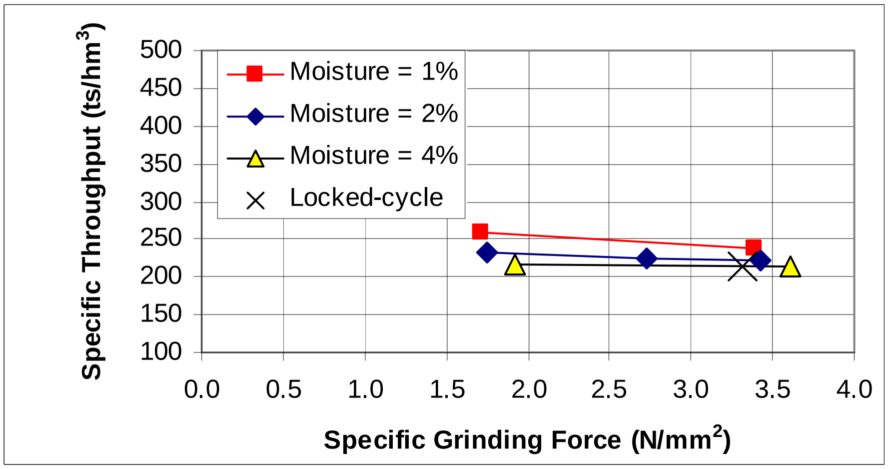


Figure 13: Sulphurets Specific Throughput Rate as a Function of Specific Grinding Force

3.3.4.4. Product Size

The LABWAL product sizes, as percent passing 6 and 100 mesh, are presented based on the specific grinding force and the specific energy input in Figure 14 and Figure 15. The moisture content had a negligible effect on the fineness.

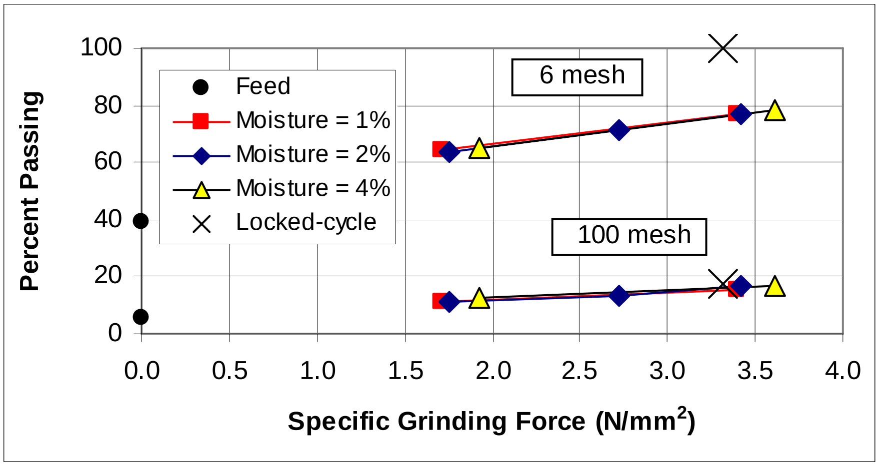


Figure 14: Sulphurets Effect of Specific Grinding Force on HPGR Product

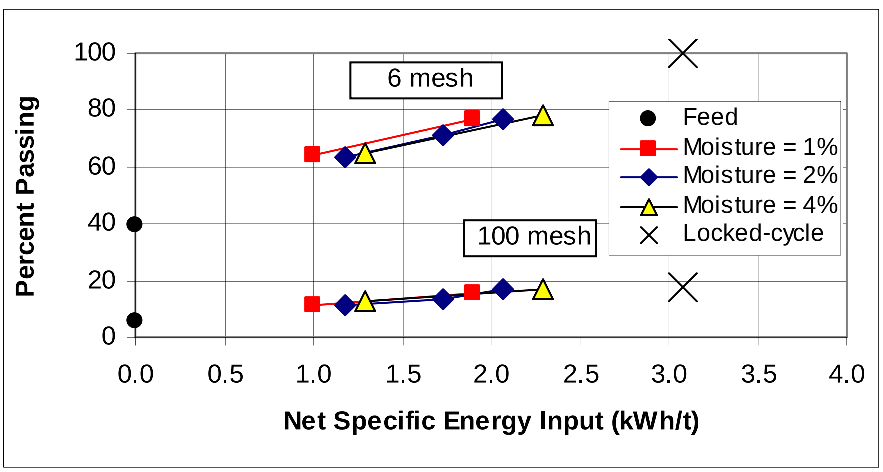


Figure 15: Sulphurets Effect of Net Specific Energy Input on HPGR Product

3.3.4.5. Net Power Draw and Net Specific Power

The effect of the specific grinding force on the LABWAL net power is presented in Figure 16, and the specific power requirement, in kWh/t, is plotted against the specific grinding force in Figure 17. The Power requirement increased with higher pressure and slightly increased with higher moisture content.

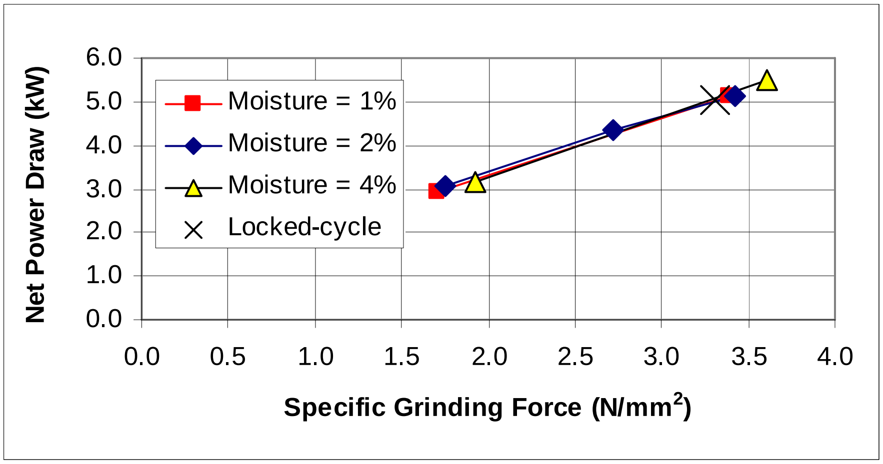


Figure 16: Sulphurets Effect of Specific Grinding Force on the LABWAL Net Power

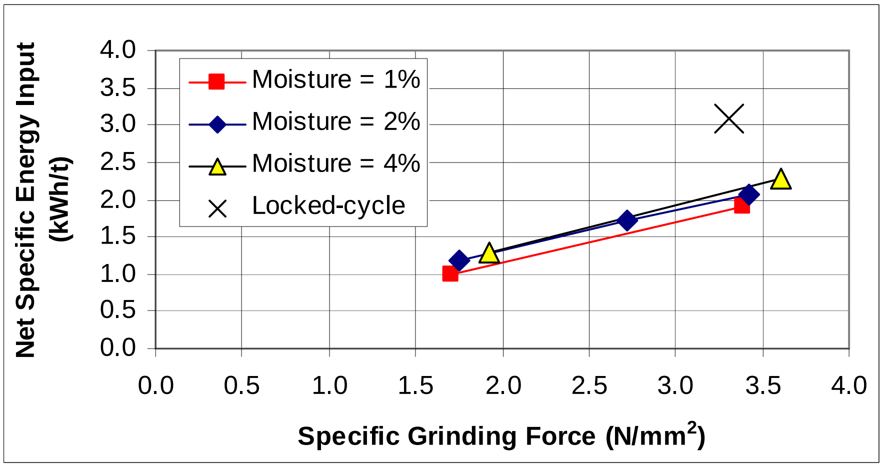


Figure 17: Sulphurets Net Specific Power Input as a Function of Specific Grinding Force

3.4. Bond Ball Mill Grindability Testing on HPGR Products

Of interest in HPGR grinding is the relatively high quantity of new final product (-100 mesh), which is created for a given product size. This makes the data analysis more challenging. The calculation of a work index, which is based strictly on K_{80}'s, ignores this important feature, and is therefore biased. The proper way to deal with this would be to actually measure the ball mill power requirement on an HPGR-prepared material at pilot scale. SGS Minerals Services developed an alternative methodology, which is based on the well-known (locked-cycle) Bond ball mill grindability test. The ball mill power requirements are calculated using a proprietary procedure, which uses the overall grams per revolution of the test, rather than the index itself which is biased.

The locked-cycle HPGR products were submitted for BWI determinations at 100 mesh (150 microns) of grind. The results of the tests are presented in Table 10 and the details are appended (Appendix A).

Small increases in BWI's (1.5 to 1.6%) were measured between the conventional and HPGR-prepared materials.

Table 10: Bond Ball Mill Grindability Test Results – HPGR Products

Sample Name	Mesh of Grind	F_{80} (μm)	P_{80} (μm)	Gram per Revolution	Work Index (kWh/t)	% Reduction in Hardness	Hardness Percentile
Mitchell	100	2,281	119	1.76	13.8	-	42
Mitchell HPGR Prod.	100	2,036	115	1.72	14.0	-1.5	45
Sulphurets	100	2,590	117	1.14	19.1	-	87
Sulphurets HPGR Prod.	100	2,192	113	1.12	19.5	-1.6	89

4. Preliminary HPGR-BM Design

Mr. Jim Smolik requested that SGS design an HPGR-ball mill circuit using the grindability data obtained in this program. The design criteria, as provided by the client, are summarized in Table 11. The objective was to develop an HPGR/BM circuit capable of treating 120,000 t/d (or 5,435 t/h at 92% availability) to a ball mill product size P_{80} of 180 microns. A third stage of grinding, using regrinding technologies such as vertimills, will be required to obtain a final grinding circuit P_{80} of 120 microns. The equipment design for the third stage of grinding is not covered in this report. The client requested that the study investigates two primary crushing product sizes, with K_{80}'s of 120 and 150 mm.

Table 11: Design Criteria

Daily throughput rate:	120,000	dry metric tons per day
Equipment availability:	92%	
Throughput rate:	5,435	dry metric tons per hour
Fine primary crushing P_{80}:	120	mm
Coarse primary crushing P_{80}:	150	mm
Secondary crushing P_{80}:	45	mm
Final product size P_{80}:	180	microns

Only the coarse primary crushing P_{80} (150 mm) was investigated in this study, as the secondary crushing product P_{80} was fixed to 45 mm, and as such would not affect the HPGR and ball mill power requirements. The variation in primary crushing P_{80} would only affect the design of the secondary crusher, which was not covered in this report.

4.1. HPGR Benefits in Ball Mill Power Requirements

The work index is the industry standard to measure ore hardness in ball milling applications. The test measures the net gram per revolution produced, when grinding the sample from a F_{80} to a P_{80}, using the following equation:

$$BWI = \frac{44.5}{P1^{0.23} \times Grp^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

Where: P1 is the closing screen size in microns

Grp is the net gram per revolution

P and F are the product and feed K_{80}'s

This net gram per revolution (Grp) is strictly based on the fraction of the feed that is coarser than the closing screen (100 mesh). Therefore, it overlooks the benefit of having more fines in the feed particle size distribution. This is because the Bond ball mill grindability test is meant to measure the ore hardness as an index, independent from the feed PSA. In the case of an HPGR product, the additional fines that are generated would also benefit the ball mill, resulting in additional capacity. This must be taken into consideration.

The gross (or overall) grams per revolution were calculated on the standard and locked-cycle product samples, and are presented in Table 12. These are based on the actual feed to the Bond mill rather than the oversize only. As one mill revolution draws a constant power, the overall gram per revolution is directly proportional to the power required to grind the material to the final product size. This can be compared to the power requirement for the head sample, and the effect of having more fines is then taken into consideration. This exercise shows that the HPGR product, for both the Mitchell and Sulphurets samples, required about 6% less power (compared to a standard feed) to grind from 100% passing 6 mesh to 100% passing 100 mesh, at a finer P_{80}.

Table 12: Quantifying the Benefit of Fines using the BWI Data

Sample Name	BWI Balance, % weight			Work Index	gram per revolution		kWh/t*
	Feed	%U/S	to be Ground	kWh/t	Net	Gross (O'all)	% Reduction
Mitchell	100	12.2	87.8	13.8	1.76	2.00	-
Mitchell HPGR Prod.	100	18.8	81.2	14.0	1.72	2.12	6
Sulphurets	100	5.7	94.3	19.1	1.14	1.20	-
Sulphurets HPGR Prod.	100	13.0	87.0	19.5	1.12	1.28	6

* kWh/t reduction based on [gross gram per revolution] $^{-1}$

4.2. Preliminary HPGR-BM Design

A preliminary HPGR design was based on the same production rate assumptions, using the scale-up methodology presented in the SME "Mineral Processing Plant Design, Practice, and Control". The scale-up for feed top size from bench-scale to industrial-scale was performed using the CWI, which is a reasonable assumption, but pilot-scale HPGR confirmation tests should be carried out. The secondary crusher power was also included in the calculations. The HPGR circuit flowsheet is presented in Figure 18.

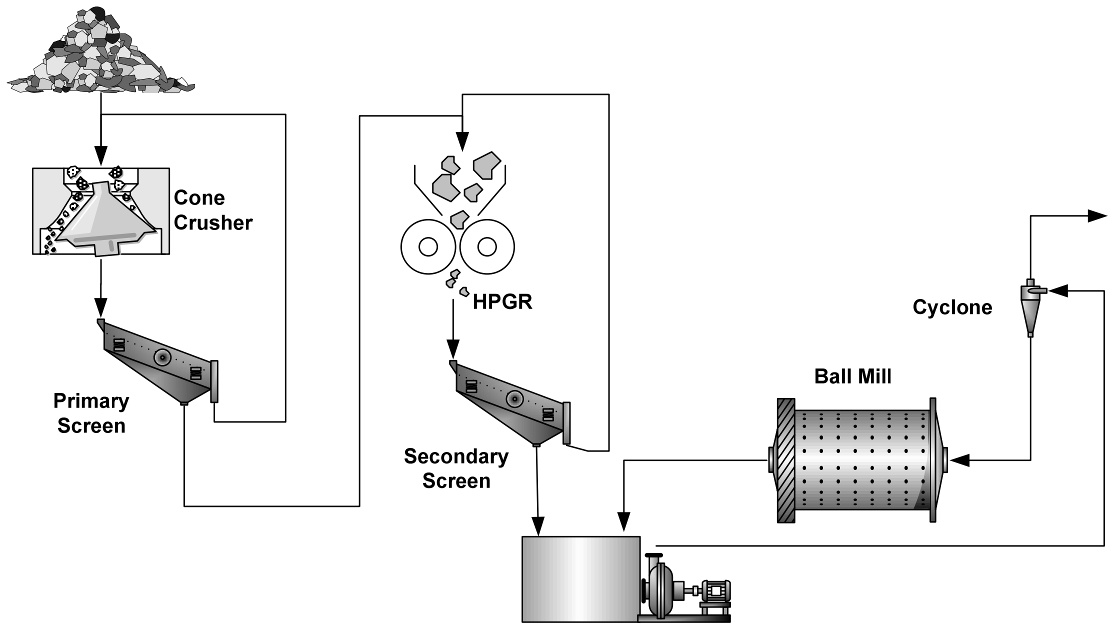


Figure 18: HPGR Circuit Flowsheet

The preliminary circuit design is presented Table 13. The sizes of the rolls, selected from a list available at Polysius, were chosen to handle both ores by changing the roll speed. Bond crusher work indices (CWI) of 8 and 17 kWh/t were assumed for the Mitchell and Sulphurets samples, respectively, based on the relative hardness of the BWI values. The CWI values were used to estimate the secondary crusher power requirements and to do the scale up for feed top size from bench-scale to industrial-scale.

The specific throughput rate (m_f) and the specific grinding force were used for the scale-up. The circulating load of the bench-scale HPGR locked-cycle test was increased by about 15% for the design to account for the coarser feed, but edge-effect on industrial units is lower, so this should be conservative. Preliminary HPGR design indicates that four or five 24/17-8 units based on the Mitchell and Sulphurets ores, respectively, would be required. Each unit consists of rolls of 2.40 m x 1.65 m (diameter x length) fitted with two 2,800 kW motors. The resulting net power requirements were 2.77 and 4.11 kWh/t for the Mitchell and Sulphurets ores, respectively. This can be confirmed at pilot-scale with coarser/larger samples. The final design must be confirmed with the supplier, who will likely require pilot testing to guarantee the design, especially for such high throughput. Piloting should be performed at least on the Sulphurets ore, as it was the hardest, or on a blend if the mining plan allows it. The feed to the HPGR would require secondary crushing to passing ~50 mm. A conservative HPGR availability of 92% was used for the design. Equipment availability in the range of 95% is common for HPGRs.

Table 13: Preliminary HPGR Design

Preliminary Proposed Design Based on LABWAL Experiments		**LABWAL Locked-cycle** Mitchell	Sulphurets	**Industrial Design** Mitchell Size Unit #8*	Sulphurets Size Unit #8*
Secondary Crusher					
Crusher work index	kWh/t	*8*	*17*	*8*	*17*
F_{80}	microns	150,000	150,000	150,000	150,000
P_{80}	microns	9,651	8,624	45,000	45,000
Net Specific Energy Input	kWh/t	0.61	1.39	0.17	0.36
Gross Power	kWh/t	0.68	1.55	0.19	0.40
HPGR					
F_{80}	microns	9,651	8,624	45,000	45,000
P_{80}	microns	1,988	2,220	1,988	2,220
Max feed size	mm	13	13	65	65
Roll Diameter	m	0.25	0.25	2.40	2.40
Roll Length	m	0.10	0.10	1.65	1.65
Ratio L/D	-	0.40	0.40	0.69	0.69
Circumferential Roll Speed	m/s	0.45	0.45	2.1	2.0
Roll Speed	RPM	34.4	34.4	16.9	15.9
Ore Density	g/cm^3	2.63	2.69	2.63	2.69
Flake Density	g/cm^3	2.26	2.22	2.26	2.22
Specific Throughput Rate - mf	ts/hm^3	226	213	226	213
Total Net Dry Throughput	t/d	-	-	120,000	120,000
Number of HPGR Unit	-	-	-	4	5
Net Dry Throughput per Unit	t/d	-	-	30,000	24,000
Availability	%	-	-	92	92
Net Dry Throughput	t/h	1.90	1.64	1,359	1,087
Total Dry Throughput	t/h	2.54	2.40	1,902	1,685
Circulating Load	%	35	47	40	55
Specific Grinding Force	N/mm^2	3.24	3.31	3.24	3.31
Grinding Force	kN	81	83	12,845	13,117
Net Specific Energy Input	kWh/t	2.33	3.08	2.77	4.11
Gross Power	kWh/t	2.45	3.24	2.91	4.32
Required Power Motor (total)	kW	-		3,954	4,693
Power Motor (each)	kW	-		2,185	2,593
Primary Ball Mill					
Ball Mill Work Index	kWh/t	14.0	19.5	-	-
Primary Grind	microns	-	-	180	180
Primary BM Gross Power	kWh/t	-	-	7.5	10.5
Overall					
Gross Power	kWh/t	-	-	10.6	15.3

*as per Polysius technical data sheet
The CWI was estimated from similar ore hardness

The ball mill power calculations were based on Bond's third theory of comminution, along with the appropriate efficiency factors and the SGS methodology to analyse HPGRs. An efficiency drive of 95% was assumed in the Bond calculations to transform pinion power into gross power.

The ball mill power requirements were calculated from the BWI results and the net throughput rate (5,435 t/h), equivalent to 7.5 and 10.5 kWh/t for the Mitchell and Sulphurets ore, respectively. The results of the Bond ball mill grindability tests performed on the HPGR feed materials were used for the design, along with the third theory of comminution and SGS proprietary procedure to correct for the effect of HPGR on hardness and fineness. Four to five 23.5' x 40.0' ball mills, with internal dimension of 6.96 x 11.99 m and 0^o cone angles (assumed square mill) would be required to achieve the design criteria, depending on which ore is being processed. Each ball mill should be fitted with a 16,000-HP motor power (11.9 MW). This circuit would have extra capacity for the Mitchell ore, even with 4 lines, so we recommend that blending or different throughput options be considered for the two ores. Table 14 presents the ball mill details.

Table 14: HPGR Ball Mill Details

Mill Dimensions	**Ball Mill**	**Ball Mill**
Ore Type	Mitchell	Sulphurets
Number in Parallel	4	5
Nominal Dimension	23.5' x 40'	23.5' x 40'
Inside Liner Dimension (metre)	6.96 x 11.99	6.96 x 11.99
Mill Speed (RPM)	12.0	12.0
% of Critical Speed (%)	75	75
Cone Angle (degree)	0	0
Grinding Steel		
Diameter Recommended (inch)	38	38
Design Ball Charge (%Vol.)	28	33
Maximum Ball Charge (%)	34	34
Motor		
Design Power (kW)	40,759	57,293
Total Installed Power (kW)	47,744	59,680
Total Installed Power (HP)	64,000	80,000
Installed Power (HP) per Mill	16,000	16,000
Classification		
Type	Hydrocyclones	Hydrocyclones

5. Flotation Testing

Flotation testing was conducted on both the Mitchell and Sulphurets samples. A total of ten batch flotation tests and two locked-cycle tests were performed. The objectives of the study were to:

1. Confirm G&T flotation test results;
2. Recover at least 90% of the gold in the Cu and pyrite concentrates;
3. Obtain a Cu grade above 24% in the Cu concentrate.

5.1. Grind Curve Establishment

For each sample, three 2-kg charges were wet ground in a laboratory rod mill at different times to establish a grind curve that would be used to estimate the grinding time required to achieve the specified grind target.

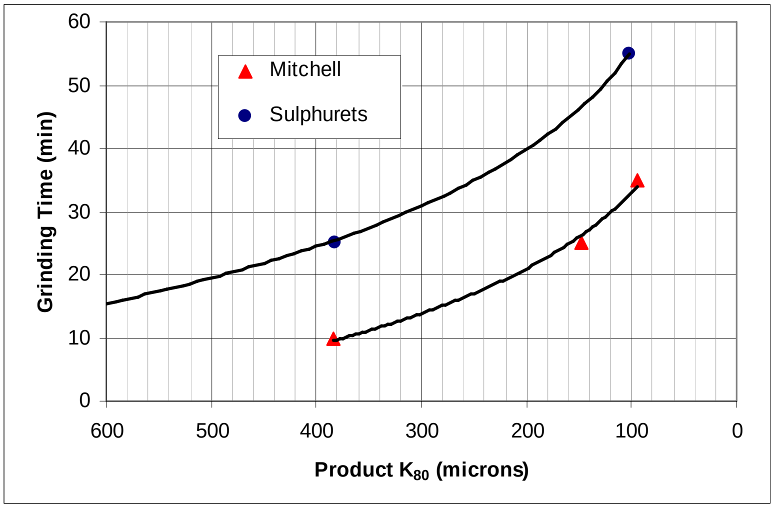


Figure 19: Grind Curve Establishment

5.2. Flotation Batch Test Results

The initial flotation conditions for the batch tests were set by the client and are summarised below:

- 3-stage cleaning
- Rougher pH at 9.5
- Final stage cleaner at pH 12.0-12.5
- Use of reagents 3418A, 208 and MIBC at the Cu rougher stage
- Use of reagents 208, PAX, and MIBC at the Pyrite rougher stage

The amounts of reagents used are summarised in Table 15.

The flowsheet for the batch test is presented in Figure 20. The flotation batch test results are summarized in Table 16 and the test details are presented in Appendix D.

Table 15: Reagents Consumption

Stages				Reagents added, grams per tonne				Time (minutes)	
	Lime	3418A	AERO 208	PAX	MIBC	CMC	Fuel Oil	Cond.	Froth
Grind	350 to 450	-	-	-	-	-	-	-	-
Rougher Circuit									
Rougher 1	-	5	5	-	7.5 or 15	-		1	3
Rougher 2	-	5	5	-	5	-		1	4
Cleaner Circuit - Rougher Conc 1-2									
Regrind (Comb Conc)	250 to 500	-	-	-	-	-	0 or 2.5		
Cu 1st Cleaner	<50	2.5	2.5	-	0 or 1.25	<5	-	1	5
Cu 2nd Cleaner	<37.5	1.25	1.25	-	0 or 1.25	-	-	1	4
Cu 3rd Cleaner	<100	-	-	-	0 or 1.25	<5	0 or 2.5	1	3
Pyrite Rougher - on Rougher Tail									
Pyrite Ro 1		-	30	30	5	-		1	4
Pyrite Ro 2		-	30	30	7.5	-		1	4
Total	770 to 995	14	74	60	< 33	< 11	0 or 5	-	-

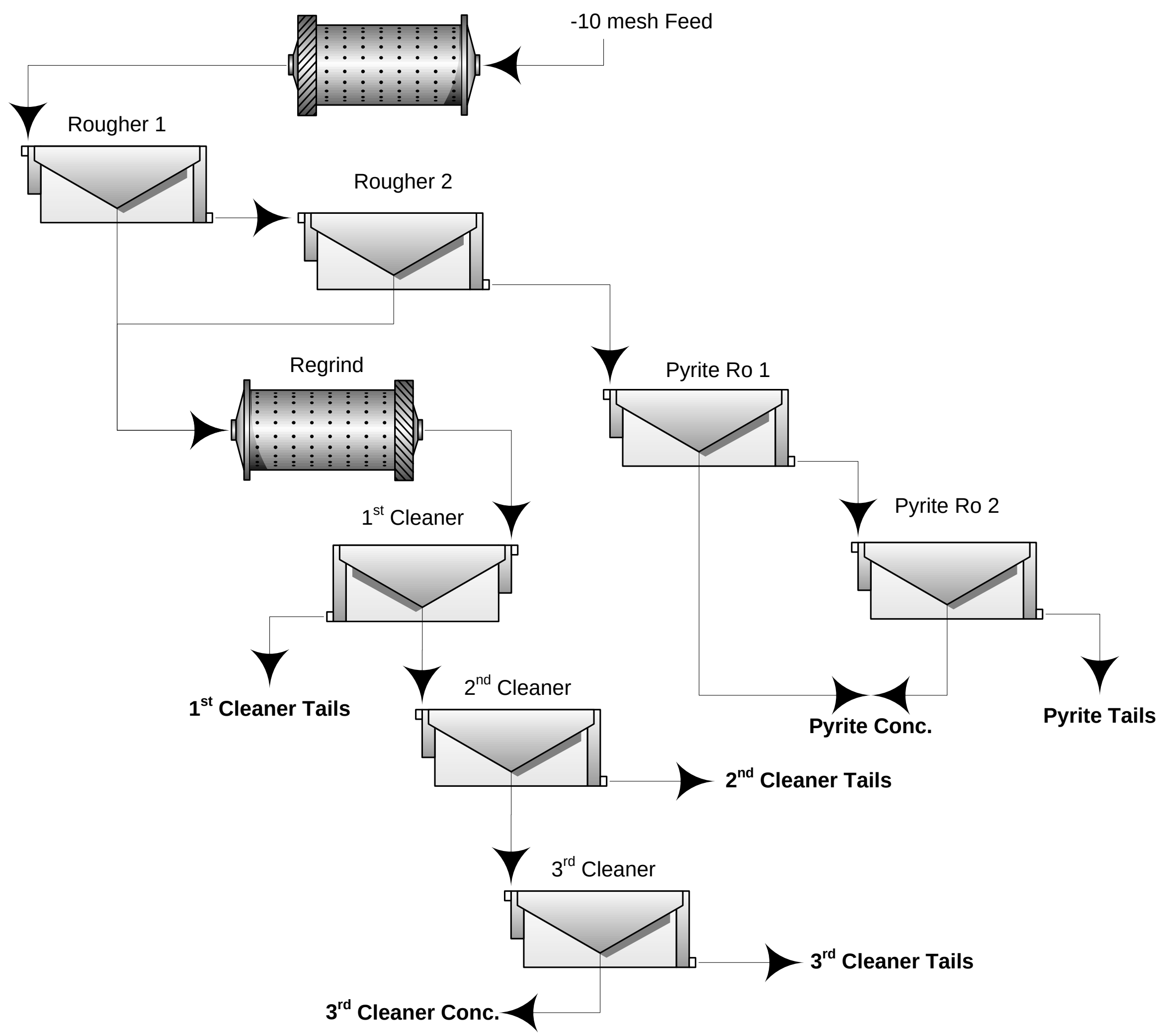


Figure 20: Batch Flotation Flowsheet

Table 16: Overall Batch Flotation Results

Test		Product	pH	Weight	Assays %, g/t			% Distribution		
				%	Cu	Au	Mo	Cu	Au	Mo
F1		Cu 3rd Cl Conc	12.0	0.67	26.7	56.6	0.22	85.2	53.2	20.6
Mitchell		Cu 2nd Cl Conc	11.6	0.96	19.3	43.4	0.21	88.1	58.4	28.7
K80	91 µm	Cu 1st Cl Conc	12.0	1.40	13.4	31.0	0.19	89.0	60.7	37.3
MIBC	29 g/t	Cu/Mo Ro Conc	9.3	7.93	2.43	6.84	0.04	91.2	75.7	46.3
CMC	3 g/t	Pyrite Conc	8.6	5.81	0.08	1.21	0.05	2.26	9.81	38.0
Fuel Oil	0 g/t	Sulphide Conc	-	12.3	0.08	1.44	0.03	4.48	24.8	47.1
		Pyrite Tail	-	86.3	0.02	0.12	0.00	6.54	14.5	15.6
F2		Cu 3rd Cl Conc	12.0	0.64	25.6	53.2	0.29	83.2	51.2	23.9
Sulphurets		Cu 2nd Cl Conc	11.5	0.85	19.9	43.5	0.37	85.0	55.0	40.5
K80	92 µm	Cu 1st Cl Conc	11.5	1.10	15.4	34.3	0.32	85.6	56.5	45.2
MIBC	33 g/t	Cu/Mo Ro Conc	9.7	8.54	2.07	6.44	0.06	89.3	82.2	68.0
CMC	5 g/t	Pyrite Conc	9.3	5.21	0.11	0.97	0.03	2.89	7.55	18.7
Fuel Oil	0 g/t	Sulphide Conc	-	12.7	0.10	1.76	0.03	6.53	33.2	41.6
		Pyrite Tail	-	86.2	0.02	0.08	0.00	7.83	10.3	13.3
F3		Cu 3rd Cl Conc	12.0	0.70	25.4	57.9	0.12	88.0	56.4	11.3
Mitchell		Cu 2nd Cl Conc	11.5	1.00	18.1	44.0	0.27	90.1	61.5	36.7
K80	120 µm	Cu 1st Cl Conc	11.5	1.25	14.7	36.0	0.24	90.5	62.5	40.3
MIBC	29 g/t	Cu/Mo Ro Conc	9.3	9.28	2.01	6.13	0.04	92.6	79.2	52.2
CMC	9 g/t	Pyrite Conc	8.5	6.57	0.10	0.61	0.04	3.25	5.58	35.3
Fuel Oil	0 g/t	Sulphide Conc	-	14.6	0.07	1.09	0.02	5.32	22.3	47.3
		Pyrite Tail	-	84.2	0.01	0.13	0.00	4.17	15.2	12.5
F4		Cu 3rd Cl Conc	12.0	0.64	27.9	56.5	0.03	86.4	53.1	2.59
Mitchell		Cu 2nd Cl Conc	11.5	0.88	21.0	46.2	0.22	89.7	60.0	26.0
K80	104 µm	Cu 1st Cl Conc	11.7	1.05	17.8	39.7	0.21	90.2	61.1	30.0
MIBC	29 g/t	Cu/Mo Ro Conc	9.3	9.00	2.13	6.06	0.04	92.5	80.0	45.1
CMC	9 g/t	Pyrite Conc	8.7	5.69	0.08	0.59	0.05	2.12	4.93	35.4
Fuel Oil	0 g/t	Sulphide Conc	-	13.6	0.07	1.19	0.03	4.47	23.8	50.4
		Pyrite Tail	-	85.3	0.01	0.12	0.00	5.36	15.0	19.6
F5		Cu 3rd Cl Conc	12.0	0.65	25.3	51.6	0.28	85.0	52.4	24.2
Sulphurets		Cu 2nd Cl Conc	11.5	0.82	20.4	43.5	0.46	86.4	55.7	50.1
K80	121 µm	Cu 1st Cl Conc	11.5	1.06	15.8	34.5	0.39	87.3	57.6	55.1
MIBC	33 g/t	Cu/Mo Ro Conc	9.7	9.78	1.77	5.55	0.05	89.8	85.2	69.1
CMC	9 g/t	Pyrite Conc	9.3	6.40	0.10	0.56	0.02	3.29	5.62	19.7
Fuel Oil	0 g/t	Sulphide Conc	-	15.1	0.07	1.40	0.02	5.78	33.2	33.7
		Pyrite Tail	-	83.8	0.02	0.07	0.00	6.96	9.20	11.2
F6		Cu 3rd Cl Conc	12.0	0.72	24.2	49.0	0.39	85.3	52.5	36.5
Sulphurets		Cu 2nd Cl Conc	11.5	1.08	16.5	35.8	0.45	87.4	57.7	63.5
K80	123 µm	Cu 1st Cl Conc	11.5	1.37	13.0	28.9	0.37	88.0	59.4	65.6
MIBC	33 g/t	Cu/Mo Ro Conc	9.4	9.86	1.85	5.63	0.06	89.6	83.0	72.3
CMC	9 g/t	Pyrite Conc	9.2	6.42	0.12	0.73	0.02	3.79	7.00	16.8
Fuel Oil	0 g/t	Sulphide Conc	-	14.9	0.07	1.37	0.01	5.38	30.6	23.4
		Pyrite Tail	-	83.7	0.02	0.08	0.00	6.59	10.0	10.9
F7		Cu 3rd Cl Conc	12.0	0.69	26.2	62.2	0.12	89.6	58.6	11.4
Mitchell		Cu 2nd Cl Conc	11.5	0.98	18.7	47.1	0.45	91.4	63.4	61.4
K80	93 µm	Cu 1st Cl Conc	11.5	1.23	15.0	38.3	0.38	91.8	64.7	65.6
MIBC	29 g/t	Cu/Mo Ro Conc	9.3	8.67	2.17	6.75	0.06	93.6	80.4	70.8
CMC	10 g/t	Pyrite Conc	8.6	5.70	0.06	0.71	0.02	1.67	5.55	17.4
Fuel Oil	10 g/t	Sulphide Conc	-	13.1	0.05	1.17	0.01	3.49	21.2	22.5
		Pyrite Tail	-	85.6	0.01	0.12	0.00	4.69	14.1	11.9
F8		Cu 3rd Cl Conc	12.0	0.62	26.9	54.6	0.27	85.7	52.7	22.4
Sulphurets		Cu 2nd Cl Conc	11.5	0.86	19.9	43.1	0.60	87.8	57.6	69.1
K80	90 µm	Cu 1st Cl Conc	11.5	1.25	13.8	30.9	0.44	88.6	60.2	72.8
MIBC	33 g/t	Cu/Mo Ro Conc	9.6	9.71	1.83	5.69	0.06	91.6	86.2	79.6
CMC	11 g/t	Pyrite Conc	9.3	5.66	0.07	0.52	0.01	1.89	4.59	9.10
Fuel Oil	10 g/t	Sulphide Conc	-	14.1	0.07	1.39	0.01	4.81	30.6	15.9
		Pyrite Tail	-	84.6	0.02	0.07	0.00	6.54	9.24	11.3
F9		Cu 3rd Cl Conc	12.0	0.67	25.4	58.6	0.06	82.7	52.0	6.17
Mitchell		Cu 2nd Cl Conc	11.5	0.97	18.0	44.3	0.22	85.0	57.0	31.6
K80	140 µm	Cu 1st Cl Conc	11.5	1.19	14.8	36.8	0.20	85.3	57.9	35.9
MIBC	29 g/t	Cu/Mo Ro Conc	9.3	9.47	1.93	6.13	0.03	88.7	76.8	47.1
CMC	9 g/t	Pyrite Conc	8.5	6.36	0.14	0.90	0.04	4.32	7.57	40.2
Fuel Oil	0 g/t	Sulphide Conc	-	14.6	0.11	1.37	0.02	7.74	26.5	51.5
		Pyrite Tail	-	84.2	0.02	0.14	0.00	6.95	15.6	12.7
F10		Cu 3rd Cl Conc	12.0	0.60	25.8	54.0	0.25	78.3	51.4	18.2
Sulphurets		Cu 2nd Cl Conc	11.5	0.82	19.3	42.9	0.45	80.1	55.9	44.6
K80	149 µm	Cu 1st Cl Conc	11.5	1.15	13.9	32.0	0.36	80.9	58.4	49.8
MIBC	33 g/t	Cu/Mo Ro Conc	9.3	9.40	1.78	5.52	0.05	84.0	81.9	60.8
CMC	9 g/t	Pyrite Conc	8.9	7.49	0.19	0.75	0.02	7.17	8.87	19.0
Fuel Oil	0 g/t	Sulphide Conc	-	15.7	0.13	1.31	0.02	10.3	32.4	30.0
		Pyrite Tail	-	83.1	0.02	0.07	0.00	8.8	9.19	20.1

CMC (2.5-5g/t) was added to the cleaner circuit to depress the obvious clay minerals that were sliming the chalcopyrite. Tests F7 and F8 were repeats of tests F1 and F2, but with the use of fuel oil, in an attempt to increase the Mo recovery in the Cu concentrate. The 3rd cleaner concentrate Cu grade, as well as Cu, Au, and Mo recoveries are presented in Figure 21, Figure 22, and Figure 23, against Cu recovery.

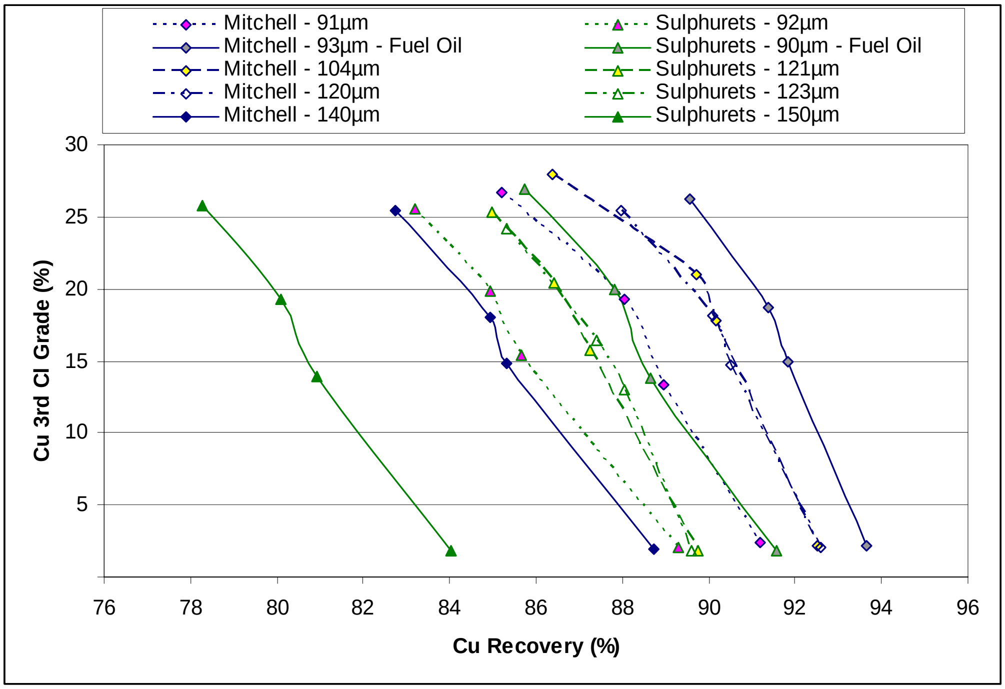


Figure 21: Batch Flotation 3rd Cu Cl. Conc Grade vs. Recovery

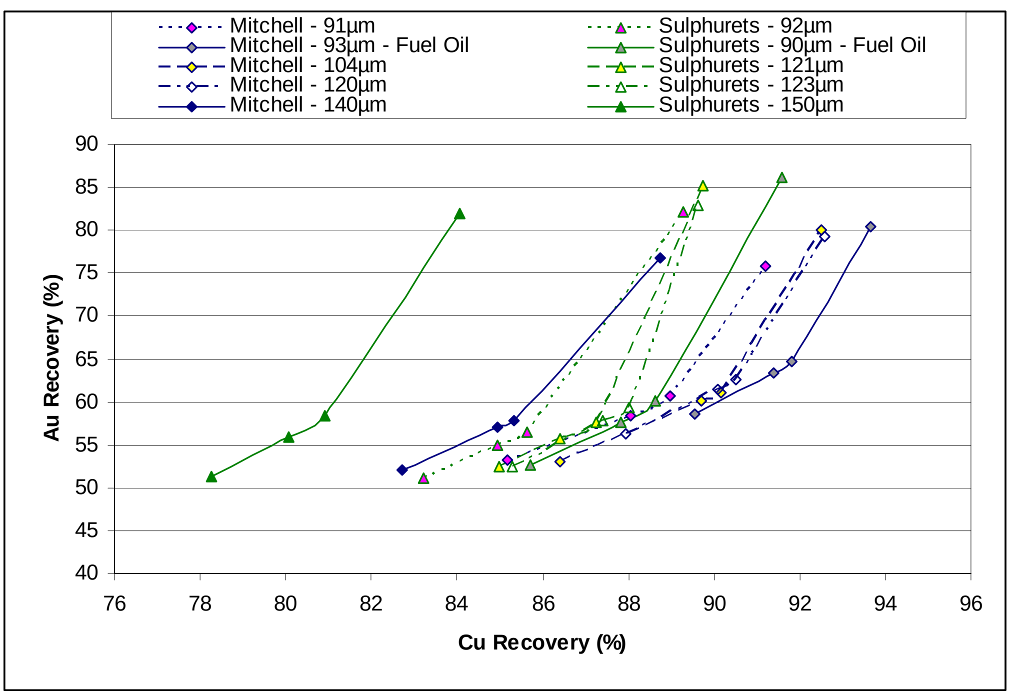


Figure 22: Batch Flotation Au Recovery vs. Cu Recovery

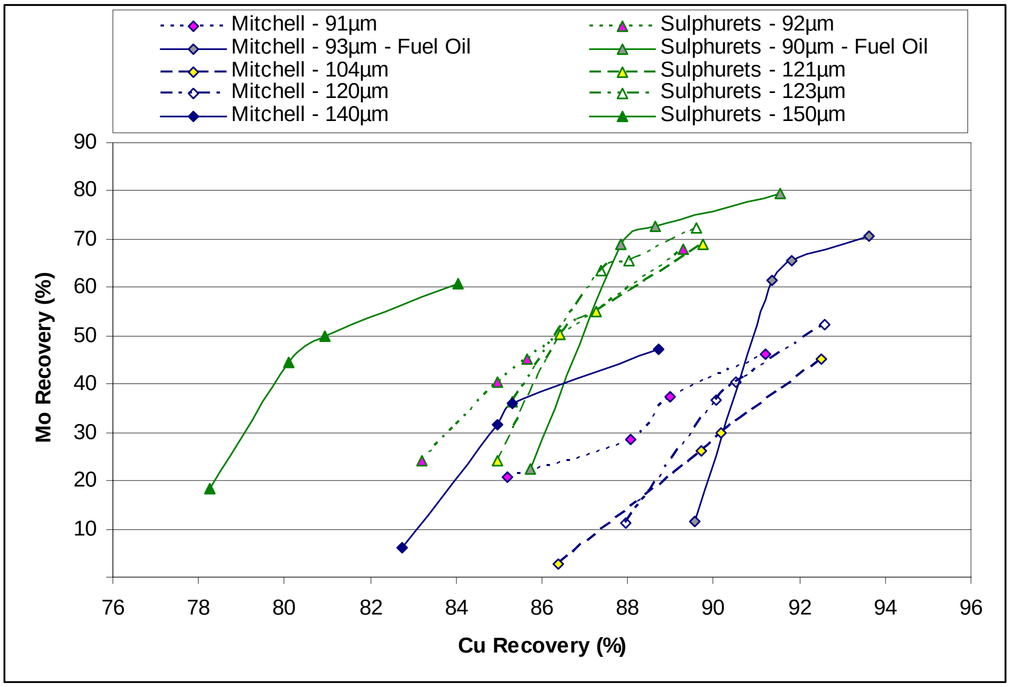


Figure 23: Batch Flotation Mo Recovery vs. Cu Recovery

5.3. Locked-cycle Flotation Test Results

Two locked cycle tests, LCT1 and LCT2, were conducted on the Mitchell and on the Sulphurets composites, respectively. The two tests were conducted using the flowsheet with recirculating streams, as indicated in Figure 24. The conditions and reagents used for tests LCT1 and LCT2 corresponded to the conditions used in batch tests F3 and F5, respectively. The metallurgical projections (cycles D to F) are presented in Table 17.

Table 17: Flotation Metallurgical Projections

Test	Combined Products (from cycles D to F)	Weight %	Assays %, g/t Cu	Au	Mo	% Distribution Cu	Au	Mo
LCT1 Mitchell	3rd Cleaner Conc	0.80	23.1	53.7	0.41	89.0	59.6	59.6
	Sulphide Conc	15.1	0.07	1.25	0.01	5.22	26.3	29.1
	Pyrite Rougher Tail	84.1	0.01	0.12	0.00	5.82	14.1	11.3
	Head	100	0.21	0.72	0.01	100	100	100
LCT2 Sulphurets	3rd Cleaner Conc	0.75	22.7	49.1	0.63	85.7	56.1	66.6
	Sulphide Conc	17.3	0.08	1.31	0.01	6.73	34.3	20.3
	Pyrite Rougher Tail	82.0	0.02	0.08	0.00	7.56	9.61	13.2
	Head	100	0.20	0.66	0.01	100	100	100

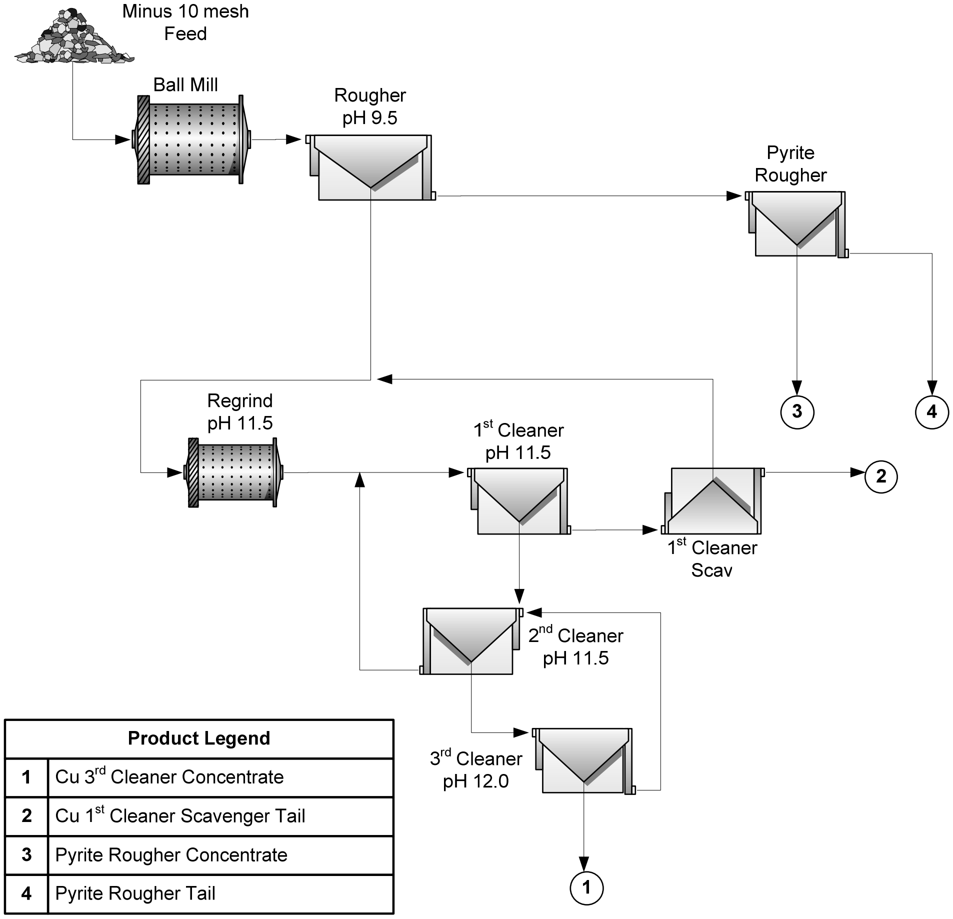


Figure 24: Locked-cycle Flotation Flowsheet

The locked cycle test results were similar to those obtained in the corresponding batch flotation test. The main differences were: 1) lower Cu grade in the 3rd cleaner concentrate for the LCT, and 2) higher Mo recovery in the 3rd cleaner concentrate for the LCT.

The metallurgical projections showed that a Cu concentrate grading about 23% Cu for both samples can be achieved, and that 85.7% and 89.0% Cu can be recovered for the Sulphurets and Mitchell composites, respectively. The Cu concentrate also recovered 56-60% of the Au, and as well as 60-67% of the Mo.

The pyrite rougher tails represents the flotation rejects. About 5.8 to 7.6% of the Cu would be lost, as well as 10 to 14% of the Au and 11 to 13% of the Mo.

The sulphide concentrates, which consisted of the pyrite rougher concentrate and the 1st cleaner tails, carried 5.2 to 6.7% of the Cu, 26 to 34% of the Au and 20 to 29% of the Mo.

5.4. Flotation Concentrate Cyanidation

In order to investigate the recovery of gold in the flotation sulphide concentrate, the combined products from the locked-cycle for both ores were submitted for gold cyanidation extraction. First, a cyanidation test was performed on each sulphide concentrate (CN1 and CN2), and low extractions rates were achieved (52-59%). After reviewing the results, in order to establish whether or not the refractoriness exhibited by the concentrate might be partly related to the preg-robbing effect, 20 g/L pre-attritioned carbon was added to the leach tests CIL3 and CIL4, performed for the Mitchell and Sulphurets composites, respectively. Table 18 presents the conditions used for the four cyanide leach tests.

Table 18: Cyanidation Conditions Applied

Test	Ore	Pulp Density %	Pre-aeration with air[1] h	Ret. Time h	Lead Nitrate kg/t	NaCN Conc. start g/L	NaCN Conc. end g/L	Carbon Conc.[2] g/L
CN1	Mitchell	40	5	24	…	2.00	1.36	…
CN2	Sulphurets	40	5	24	…	2.00	1.09	…
CIL3	Mitchell	40	5	24	…	2.00	1.33	20
CIL4	Sulphurets	40	5	24	…	2.00	1.25	20

[1] Air was sparged during pre-aeration only.

[2] Carbon was soaked in 1 g/L cyanide solution overnight.

The cyanide leach results are summarized in Table 19, and test details in Appendix F. The gold extraction rates for the cyanidation tests were 59.1 and 51.5% for the Mitchell and Sulphurets flotation sulphide concentrates, respectively. The carbon-in-pulp (CIL) method increased gold extractions by 12 to 19%. The gold residues were measured at 0.40 g/t (in triplicate). The overall gold distribution within the entire flowsheet is summarised in Table 20.

Table 19: Leach Test Results

Test No.	Feed ($S^=$ Conc)	K_{80} µm	Reag. Add'n NaCN kg/t	Reag. Add'n CaO kg/t	Reag. Cons. NaCN kg/t	Reag. Cons. CaO kg/t	Extraction Au %	Extraction Cu %	PLS Assay Au mg/L	PLS Assay Cu mg/L	Loaded Carbon Au g/t	Loaded Carbon Cu %	Residue Au g/t	Residue Cu %	CN Feed(calc) Au g/t	CN Feed(calc) Cu %
CN1	LCT1 - F	15.5	3.08	1.24	0.99	1.19	59.1	33.0	0.34	119	…	…	0.39	0.040	0.95	0.060
CIL3	LCT1 - E	*15.5*	3.06	4.58	1.02	4.39	71.0	34.9	<0.01	116	30.2	0.10	0.40	0.043	1.38	0.066
CN2	LCT2 - F	14.8	3.07	1.57	1.39	1.55	51.5	30.1	0.50	131	…	…	0.78	0.050	1.60	0.072
CIL4	LCT2 - E	*14.8*	3.12	4.84	1.16	4.67	70.5	32.4	<0.01	107	28.3	0.10	0.40	0.045	1.34	0.067

Table 20: Global Gold Recovery

	Flotation Au Distribution (%) 3rd Cleaner Conc	Flotation Au Distribution (%) Sulphide Conc	Cyanide Au Extraction (%)	**Total Au Recovery (%)**
Mitchell	59.6	26.3	71.0	**78.3**
Sulphurets	56.1	34.3	70.5	**80.3**

Appendix A – Bond Ball Mill Grindability Test Details

Standard Bond Ball Mill Grindability Test

Project No.:	12248-001 Product: Minus 6 Mesh Date: Aug 20 2009		
Sample.:	Mitchell		
Purpose:	To determine the ball mill grindability of the sample in terms of a Bond work index number.		
Procedure:	The equipment and procedure duplicate the Bond method for determining ball mill work indices.		
Test Conditions:	Mesh of grind:	100	mesh
	Test feed weight (700 mL):	1335	grams
	Equivalent to : 1907 kg/m³ at Minus 6 mesh		
	Weight % of the undersize material in the ball mill feed:	12.2	%
	Weight of undersize product for 250% circulating load:	381	grams
Results:	Average for Last Three Stages = **1.76g.**	**246%**	Circulation load

CALCULATION OF A BOND WORK INDEX

$$BWI = \frac{44.5}{P1^{0.23} \times Grp^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

P1 = 100% passing size of the product	150	microns
Grp = Grams per revolution	1.76	grams
P80 = 80% passing size of product	119	microns
F80 = 80% passing size of the feed	2281	microns

BWI = **12.5** (imperial)

BWI = **13.8** (metric)

Stage No.	Revs	New Feed (grams)	Undersize In Feed (grams)	Undersize To Be Ground (grams)	U'Size In Product (grams)	Undersize Product Total (grams)	Undersize Product Per Mill Rev (grams)
1	100	1,335	164	218	310	146	1.46
2	200	310	38	343	356	318	1.59
3	212	356	44	338	383	339	1.60
4	209	383	47	335	398	351	1.68
5	198	398	49	333	395	346	1.75
6	190	395	48	333	385	337	1.77
7	189	385	47	334	378	331	1.75

Average for Last Three Stages = 386g. 1.76g.

Feed K80

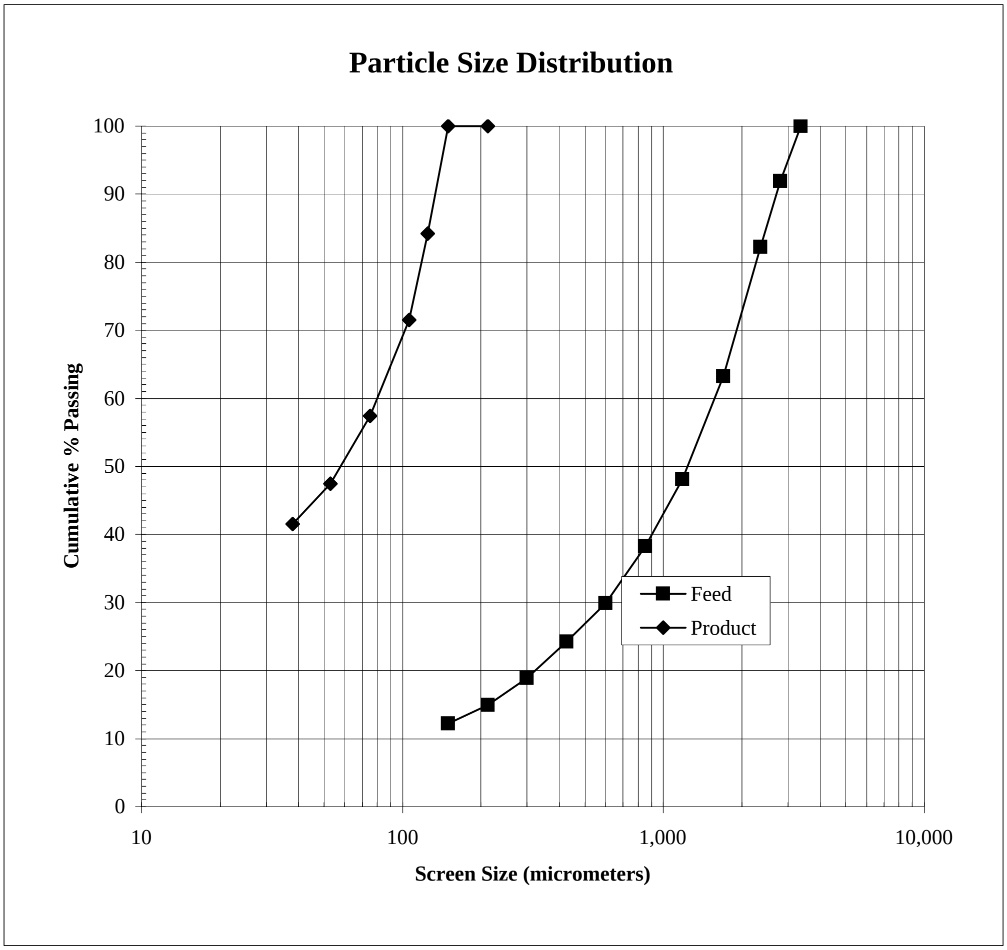
Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
6	3,360	0.0	0.0	0.0	100.0
7	2,800	56.9	8.1	8.1	91.9
8	2,360	67.7	9.7	17.8	82.2
10	1,700	132.9	19.0	36.8	63.2
14	1,180	105.9	15.1	51.9	48.1
20	850	69.4	9.9	61.8	38.2
28	600	58.2	8.3	70.1	29.9
35	425	39.8	5.7	75.8	24.2
48	300	37.2	5.3	81.1	18.9
65	212	27.6	3.9	85.0	15.0
100	150	19.1	2.7	87.8	12.2
Pan	-150	85.8	12.2	100.0	0.0
Total	**-**	**700.5**	**100.0**	**-**	**-**

K80 **2,281**

Product K80

Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
65	212	0.0	0.0	0.0	100.0
100	150	0.0	0.0	0.0	100.0
115	125	24.1	15.8	15.8	84.2
150	106	19.4	12.7	28.5	71.5
200	75	21.5	14.1	42.6	57.4
270	53	15.2	10.0	52.5	47.5
400	38	9.0	5.9	58.4	41.6
Pan	-38	63.5	41.6	100.0	0.0
Total	**-**	152.7	**100.0**	**-**	**-**

K80 **119**


Particle Size Distribution
Cumulative % Passing
100
90
80
70
60
50
40
30
20
10
0
10
100
1,000
10,000
Screen Size (micrometers)
Feed
Product

Standard Bond Ball Mill Grindability Test

Project No.:	12248-001	Product: Minus 6 Mesh	Date: Sept 13th		
Sample.:	Mitchell HPGR Prod.				
Purpose:	To determine the ball mill grindability of the sample in terms of a Bond work index number.				
Procedure:	The equipment and procedure duplicate the Bond method for determining ball mill work indices.				
Test Conditions:	Mesh of grind:			100	mesh
	Test feed weight (700 mL):			1267	grams
	Equivalent to :	1810	kg/m³ at Minus 6 mesh		
	Weight % of the undersize material in the ball mill feed:			18.8	%
	Weight of undersize product for 250% circulating load:			362	grams
Results:	Average for Last Three Stages =	**1.72g.**		**248%**	Circulation load

CALCULATION OF A BOND WORK INDEX

$$BWI = \frac{44.5}{P1^{0.23} \times Grp^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

P1 = 100% passing size of the product	150	microns
Grp = Grams per revolution	1.72	grams
P80 = 80% passing size of product	115	microns
F80 = 80% passing size of the feed	2036	microns

BWI = **12.7** (imperial)

BWI = **14.0** (metric)

Stage No.	Revs	New Feed (grams)	Undersize In Feed (grams)	Undersize To Be Ground (grams)	U'Size In Product (grams)	Undersize Product Total (grams)	Undersize Product Per Mill Rev (grams)
1	100	1,267	238	124	417	179	1.79
2	158	417	78	284	328	250	1.58
3	190	328	62	300	365	303	1.60
4	184	365	68	294	377	309	1.68
5	174	377	71	291	370	299	1.72
6	170	370	69	293	364	295	1.73
7	169	364	68	294	359	291	1.72

Average for Last Three Stages = 364g. 1.72g.

Feed K80

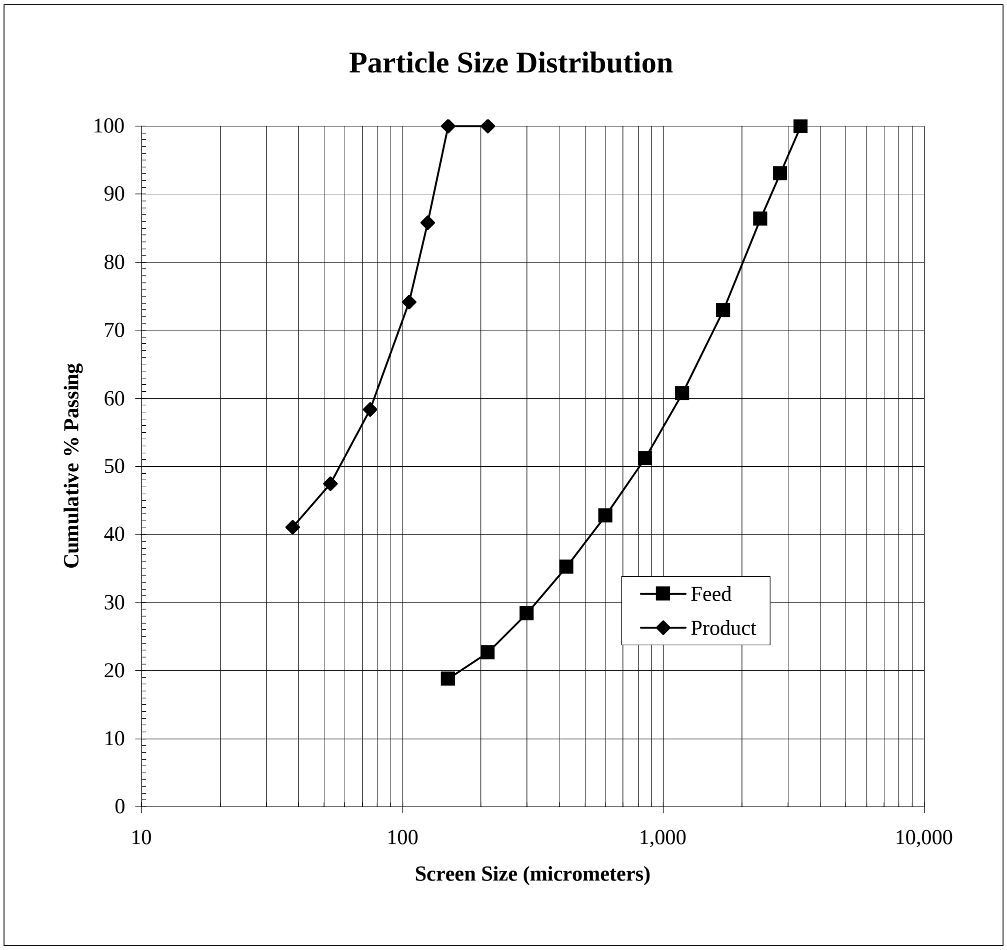
Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
6	3,360	0.0	0.0	0.0	100.0
7	2,800	41.8	7.0	7.0	93.0
8	2,360	40.3	6.7	13.7	86.3
10	1,700	80.6	13.4	27.1	72.9
14	1,180	73.1	12.2	39.3	60.7
20	850	57.3	9.5	48.8	51.2
28	600	50.8	8.5	57.3	42.7
35	425	44.8	7.5	64.7	35.3
48	300	41.2	6.9	71.6	28.4
65	212	34.9	5.8	77.4	22.6
100	150	23.1	3.8	81.2	18.8
Pan	-150	112.7	18.8	100.0	0.0
Total	**-**	**600.6**	**100.0**	**-**	**-**

K80 **2,036**

Product K80

Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
65	212	0.0	0.0	0.0	100.0
100	150	0.0	0.0	0.0	100.0
115	125	25.2	14.2	14.2	85.8
150	106	20.5	11.6	25.8	74.2
200	75	28.1	15.9	41.7	58.3
270	53	19.2	10.8	52.5	47.5
400	38	11.4	6.4	58.9	41.1
Pan	-38	72.7	41.1	100.0	0.0
Total	**-**	177.1	**100.0**	**-**	**-**

K80 **115**


Particle Size Distribution
Cumulative % Passing
100
90
80
70
60
50
40
30
20
10
0
10
100
1,000
10,000
Screen Size (micrometers)
Feed
Product

Standard Bond Ball Mill Grindability Test

Project No.:	12248-001 Product: Minus 6 Mesh Date: Aug 20 2009	
Sample.:	Sulphurets	
Purpose:	To determine the ball mill grindability of the sample in terms of a Bond work index number.	
Procedure:	The equipment and procedure duplicate the Bond method for determining ball mill work indices.	
Test Conditions:	Mesh of grind:	100 mesh
	Test feed weight (700 mL):	1261 grams
	Equivalent to : 1801 kg/m³ at Minus 6 mesh	
	Weight % of the undersize material in the ball mill feed:	5.7 %
	Weight of undersize product for 250% circulating load:	360 grams
Results:	Average for Last Three Stages = **1.14g.**	**247%** Circulation load

CALCULATION OF A BOND WORK INDEX

$$BWI = \frac{44.5}{P1^{0.23} \times Grp^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

P1 = 100% passing size of the product	150 microns
Grp = Grams per revolution	1.14 grams
P80 = 80% passing size of product	117 microns
F80 = 80% passing size of the feed	2590 microns

BWI = **17.4** (imperial)

BWI = **19.1** (metric)

Stage No.	Revs	New Feed (grams)	Undersize In Feed (grams)	Undersize To Be Ground (grams)	U'Size In Product (grams)	Undersize Product Total (grams)	Undersize Product Per Mill Rev (grams)
1	100	1,261	72	288	180	108	1.08
2	325	180	10	350	327	317	0.97
3	351	327	19	342	385	366	1.04
4	324	385	22	338	376	354	1.09
5	310	376	22	339	375	353	1.14
6	297	375	21	339	361	340	1.14
7	297	361	21	340	354	333	1.12

Average for Last Three Stages = 363g. 1.14g.

Feed K80

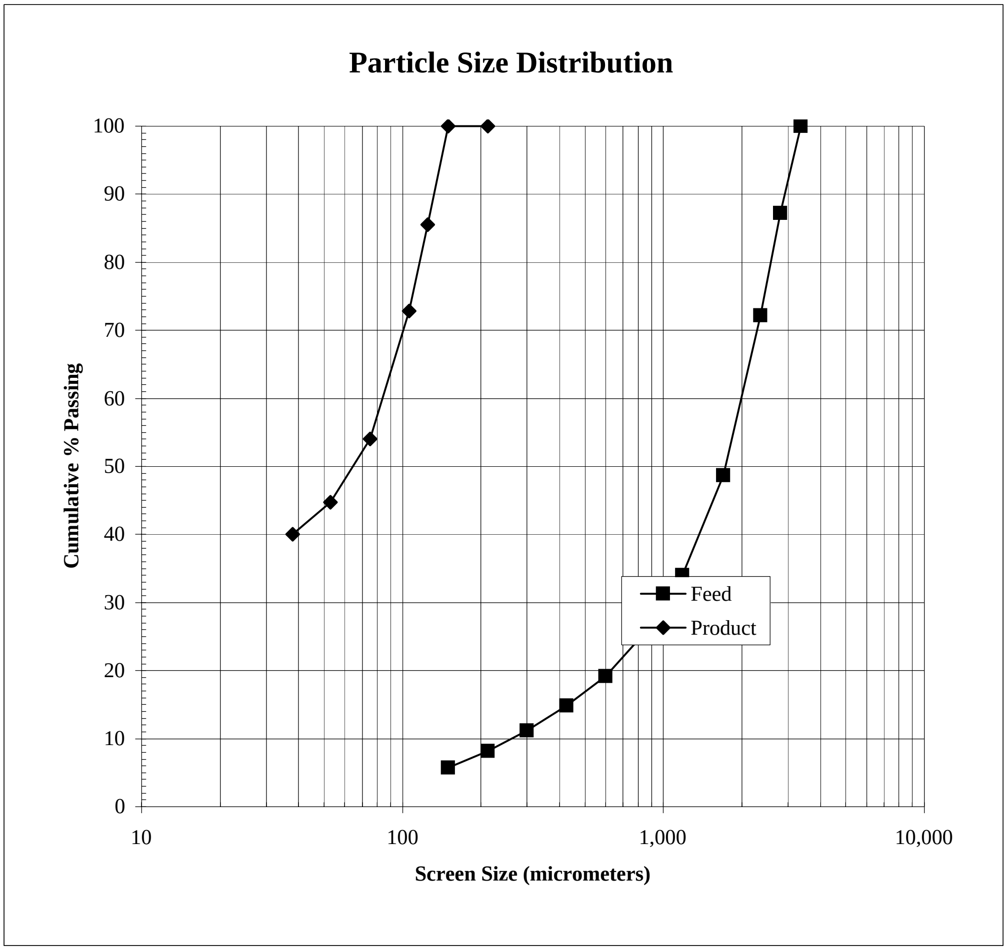
Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
6	3,360	0.0	0.0	0.0	100.0
7	2,800	87.0	12.8	12.8	87.2
8	2,360	101.5	15.0	27.8	72.2
10	1,700	160.0	23.6	51.3	48.7
14	1,180	99.6	14.7	66.0	34.0
20	850	56.2	8.3	74.3	25.7
28	600	44.3	6.5	80.8	19.2
35	425	29.2	4.3	85.1	14.9
48	300	25.1	3.7	88.8	11.2
65	212	20.1	3.0	91.8	8.2
100	150	16.8	2.5	94.3	5.7
Pan	-150	38.9	5.7	100.0	0.0
Total	**-**	**678.7**	**100.0**	**-**	**-**

K80 **2,590**

Product K80

Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
65	212	0.0	0.0	0.0	100.0
100	150	0.0	0.0	0.0	100.0
115	125	21.3	14.4	14.4	85.6
150	106	18.7	12.7	27.1	72.9
200	75	27.8	18.8	46.0	54.0
270	53	13.7	9.3	55.3	44.7
400	38	7.0	4.7	60.0	40.0
Pan	-38	59.0	40.0	100.0	0.0
Total	**-**	147.5	**100.0**	**-**	**-**

K80 **117**


Particle Size Distribution
Cumulative % Passing
Screen Size (micrometers)
0
10
20
30
40
50
60
70
80
90
100
10
100
1,000
10,000
Feed
Product

Standard Bond Ball Mill Grindability Test

Project No.:	12248-001	Product: Minus 6 Mesh	Date: Sept 13th	
Sample.:	Sulphurets HPGR Prod.			
Purpose:	To determine the ball mill grindability of the sample in terms of a Bond work index number.			
Procedure:	The equipment and procedure duplicate the Bond method for determining ball mill work indices.			
Test Conditions:	Mesh of grind:		100	mesh
	Test feed weight (700 mL):		1280	grams
	Equivalent to : 1829 kg/m³ at Minus 6 mesh			
	Weight % of the undersize material in the ball mill feed:		13.0	%
	Weight of undersize product for 250% circulating load:		366	grams
Results:	Average for Last Three Stages =	**1.12g.**	**244%**	Circulation load

CALCULATION OF A BOND WORK INDEX

$$BWI = \frac{44.5}{P1^{0.23} \times Grp^{0.82} \times \left\{ \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right\}}$$

P1 = 100% passing size of the product	150	microns
Grp = Grams per revolution	1.12	grams
P80 = 80% passing size of product	113	microns
F80 = 80% passing size of the feed	2192	microns

BWI = **17.6** (imperial)

BWI = **19.5** (metric)

Stage No.	Revs	New Feed (grams)	Undersize In Feed (grams)	Undersize To Be Ground (grams)	U'Size In Product (grams)	Undersize Product Total (grams)	Undersize Product Per Mill Rev (grams)
1	100	1,280	166	200	310	144	1.44
2	226	310	40	325	266	226	1.00
3	332	266	35	331	372	337	1.02
4	312	372	48	317	376	328	1.05
5	302	376	49	317	387	338	1.12
6	282	387	50	315	364	314	1.11
7	286	364	47	318	366	319	1.11

Average for Last Three Stages = 372g. 1.12g.

Feed K80

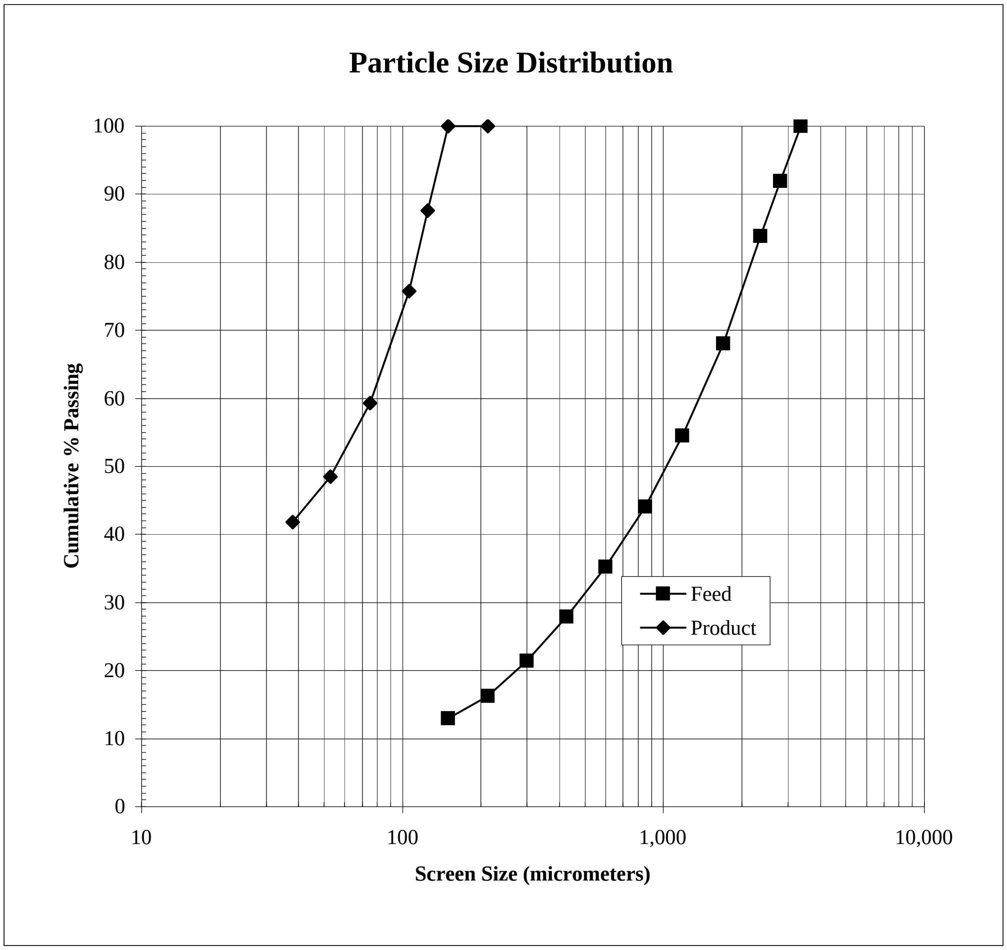
Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
6	3,360	0.0	0.0	0.0	100.0
7	2,800	46.8	8.1	8.1	91.9
8	2,360	47.1	8.1	16.2	83.8
10	1,700	91.5	15.8	31.9	68.1
14	1,180	78.8	13.6	45.5	54.5
20	850	60.4	10.4	55.9	44.1
28	600	51.4	8.8	64.7	35.3
35	425	42.5	7.3	72.1	27.9
48	300	37.6	6.5	78.5	21.5
65	212	30.0	5.2	83.7	16.3
100	150	19.3	3.3	87.0	13.0
Pan	-150	75.4	13.0	100.0	0.0
Total	**-**	**580.8**	**100.0**	**-**	**-**

K80 **2,192**

Product K80

Size Mesh	Size µm	Weight grams	% Retained Individual	% Retained Cumulative	% Passing Cumulative
65	212	0.0	0.0	0.0	100.0
100	150	0.0	0.0	0.0	100.0
115	125	19.1	12.4	12.4	87.6
150	106	18.1	11.8	24.2	75.8
200	75	25.3	16.5	40.7	59.3
270	53	16.6	10.8	51.5	48.5
400	38	10.3	6.7	58.2	41.8
Pan	-38	64.2	41.8	100.0	0.0
Total	**-**	153.6	**100.0**	**-**	**-**

K80 **113**


Particle Size Distribution
Cumulative % Passing
100
90
80
70
60
50
40
30
20
10
0
10
100
1,000
10,000
Screen Size (micrometers)
Feed
Product

Appendix B – Bond Abrasion Test Details

SGS Minerals Services

STANDARD BOND ABRASION TEST

Project No.: 12248-001 Test : Abrasion

Sample: Mitchell

Purpose: To determine the Abrasion Index of the sample

Procedure: The equipment and procedure duplicate the Bond method for determining an abrasion index.

Feed: 1600 grams minus 3/4 inch plus 1/2 inch fraction

Results:	Original paddle weight, grams:	94.4213
	Final paddle weight, grams:	94.1279
	Abrasion Index, Ai:	**0.2934**

Predicted Wear Rates:

		lb/kwh	kg/kwh
Wet rod mill, rods:	0.35*(Ai-0.020)^0.20	0.27	0.12
Wet rod mill, liners:	0.035*(Ai-0.015)^0.30	0.024	0.011
Wet ball mill, balls: (1)	0.35*(Ai-0.015)^0.33	0.23	0.104
Wet ball mill, liners: (1)	0.026*(Ai-0.015)^0.30	0.018	0.0080
Dry ball mill, balls: (2)	0.05*(Ai)^0.5	0.027	0.012
Dry ball mill, liners: (2)	0.005*(Ai)^0.5	0.0027	0.0012
Crusher, liners: (3)	(Ai+0.22)/11	0.047	0.021
Roll crusher, shells:	(Ai/10)^0.67	0.094	0.043

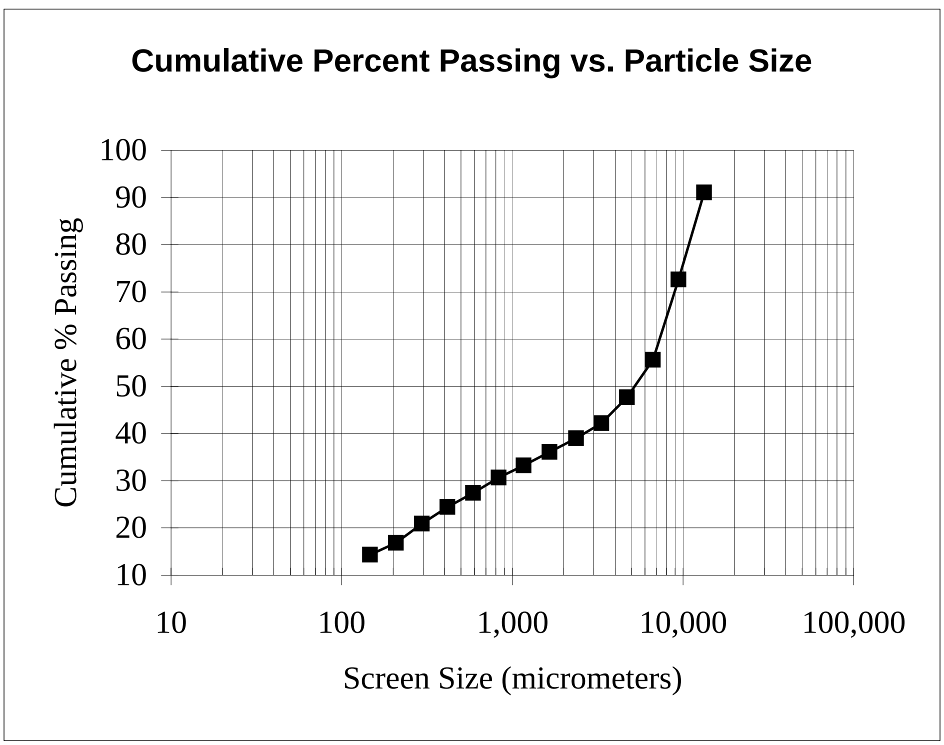
(1) overflow and grate discharge types
(2) grate discharge type
(3) gyratory, jaw, cone

STANDARD BOND ABRASION TEST

Final Product Test : Abrasion

Sample: Mitchell

Microns	Mesh	Weight	% Weight		
		Grams	Ind.	Cum.	Passing
13,330	1/2 in	70.9	9.0	9.0	91.0
9,423	3/8 in	145.8	18.4	27.4	72.6
6,680	3	134.5	17.0	44.4	55.6
4,699	4	62.6	7.9	52.3	47.7
3,327	6	43.5	5.5	57.8	42.2
2,362	8	25.2	3.2	61.0	39.0
1,651	10	23.0	2.9	63.9	36.1
1,168	14	22.4	2.8	66.7	33.3
833	20	20.5	2.6	69.3	30.7
589	28	25.7	3.2	72.6	27.4
417	35	23.7	3.0	75.6	24.4
295	48	27.7	3.5	79.1	20.9
208	65	32.1	4.1	83.1	16.9
147	100	20.0	2.5	85.7	14.3
-147	-100	113.3	14.3	100.0	-
	Total	790.9	100.0	-	-



SGS Minerals Services

STANDARD BOND ABRASION TEST

Project No.: 12248-001 Test : Abrasion

Sample: Sulphurets

Purpose: To determine the Abrasion Index of the sample

Procedure: The equipment and procedure duplicate the Bond method for determining an abrasion index.

Feed: 1600 grams minus 3/4 inch plus 1/2 inch fraction

Results:	Original paddle weight, grams:	93.8781
	Final paddle weight, grams:	93.6450
	Abrasion Index, Ai:	**0.2331**

Predicted Wear Rates:

		lb/kwh	kg/kwh
Wet rod mill, rods:	0.35*(Ai-0.020)^0.20	0.26	0.12
Wet rod mill, liners:	0.035*(Ai-0.015)^0.30	0.022	0.010
Wet ball mill, balls: (1)	0.35*(Ai-0.015)^0.33	0.21	0.096
Wet ball mill, liners: (1)	0.026*(Ai-0.015)^0.30	0.016	0.0075
Dry ball mill, balls: (2)	0.05*(Ai)^0.5	0.024	0.011
Dry ball mill, liners: (2)	0.005*(Ai)^0.5	0.0024	0.0011
Crusher, liners: (3)	(Ai+0.22)/11	0.041	0.019
Roll crusher, shells:	(Ai/10)^0.67	0.081	0.037

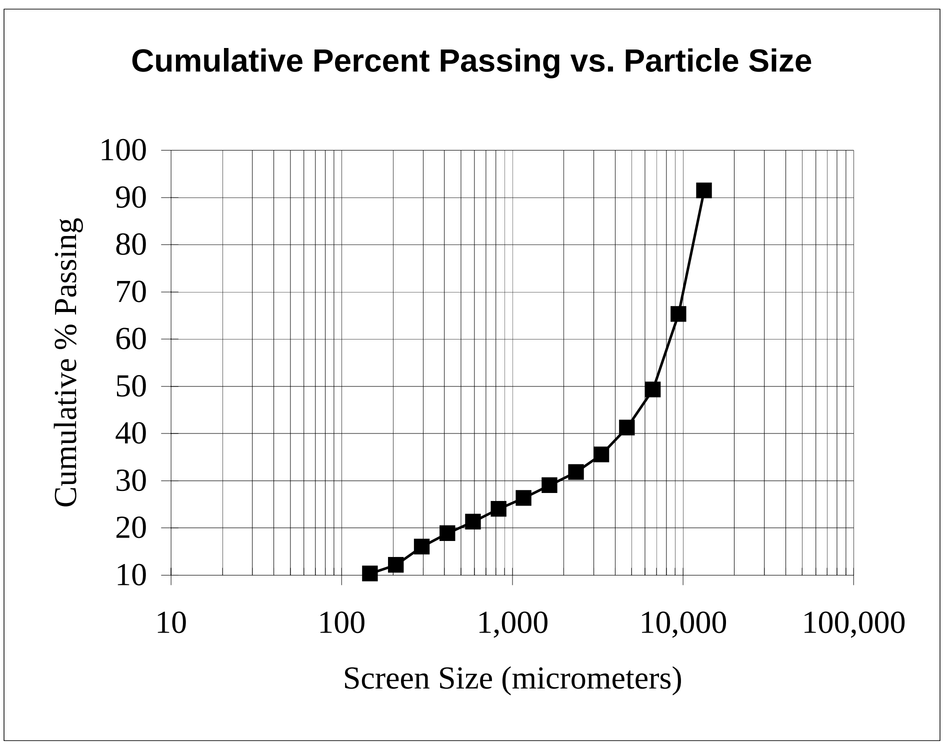
(1) overflow and grate discharge types
(2) grate discharge type
(3) gyratory, jaw, cone

STANDARD BOND ABRASION TEST

Final Product　　　　　　　　Test : Abrasion

Sample: Sulphurets

Microns	Mesh	Weight Grams	% Weight Ind.	% Weight Cum.	% Weight Passing
13,330	1/2 in	73.4	8.6	8.6	91.4
9,423	3/8 in	224.0	26.1	34.7	65.3
6,680	3	137.7	16.1	50.7	49.3
4,699	4	69.2	8.1	58.8	41.2
3,327	6	48.4	5.6	64.4	35.6
2,362	8	32.0	3.7	68.2	31.8
1,651	10	24.1	2.8	71.0	29.0
1,168	14	23.4	2.7	73.7	26.3
833	20	19.4	2.3	76.0	24.0
589	28	23.6	2.8	78.7	21.3
417	35	21.0	2.4	81.2	18.8
295	48	24.3	2.8	84.0	16.0
208	65	33.0	3.8	87.8	12.2
147	100	15.9	1.9	89.7	10.3
-147	-100	88.5	10.3	100.0	-
	Total	857.9	100.0	-	-



Appendix C – HPGR Test Details

LABWAL Test Summary - Mitchell

Feed Characteristics	
$F_{50,}$ (microns)	7,024
F_{80}, (microns)	9,651
Percent Passing 100 mesh	5.7
Percent Passing 6 mesh	26.5
Specific Gravity (kg/L)	2.63
Wet Bulk Density (kg/L)	1.82
Moisture 'as received' (%H_2O)	0.1
Ball Mill Work Index (kWh/t)	13.8

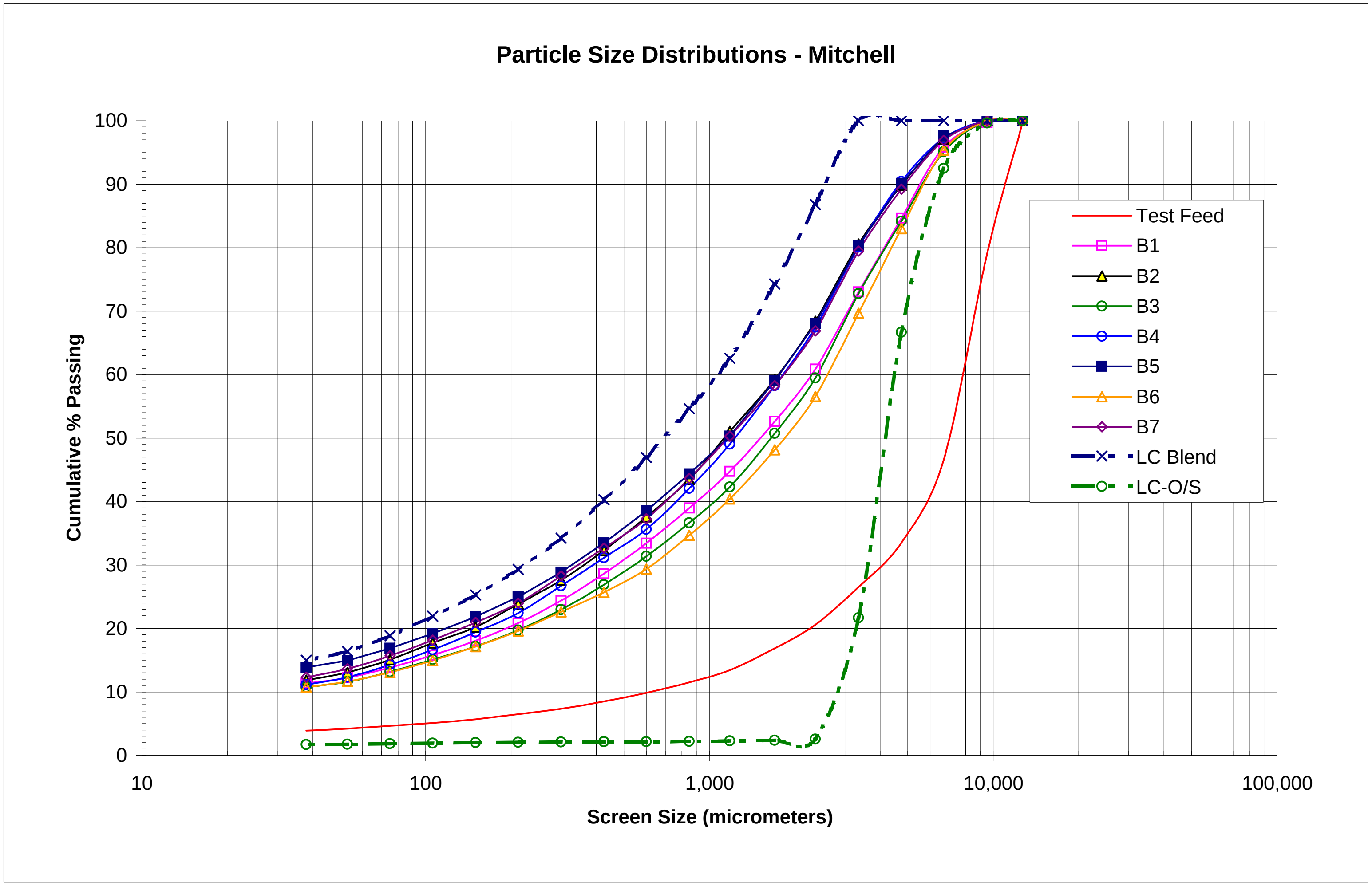
Test Results Summary

	Batch Tests							Locked-cycle			
Test Number	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**LC5**	**LC6**	**LC7**	**AVG**
Date:	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	26/08/09	08/09/09	08/09/09	08/09/09	-
Operation											
Initial Nitrogen Pressure (bar)	15	38	15	30	38	15	38	38	38	38	38
Initial Hydraulic Pressure (bar)	24	56	24	45	56	24	56	56	56	56	56
Ratio Hydraulic/Nitrogen	1.6	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5
Pressure of Operation (bar)	34	67	36	53	68	34	67	65	65	65	65
Moisture (%H_2O)	1.2	1.3	2.3	2.1	2.2	4.0	4.0	-	-	-	1.8
Dry Net Throughput (t/h)	3.1	2.7	2.6	2.7	2.6	2.5	2.4	1.8	2.0	1.9	1.9
Circulating Load (%)	-	-	-	-	-	-	-	35.1	33.9	35.1	34.7
Gross Power (kW)	4.1	6.2	4.3	5.3	6.1	4.1	6.2	5.7	5.6	5.6	5.6
No-Load Power (kW)	1.5	1.5	1.4	1.4	1.5	1.5	1.5	1.2	1.2	1.2	1.2
Net Power (kW)	2.6	4.7	2.9	3.9	4.7	2.7	4.7	4.4	4.4	4.5	4.4
Gross Specific Energy Requirement (kWh/t)	1.3	2.3	1.6	2.0	2.4	1.6	2.5	3.1	2.8	3.0	3.0
Net Specific Energy Requirement (kWh/t)	0.8	1.7	1.1	1.4	1.8	1.1	1.9	2.4	2.2	2.4	2.3
HPGR Product Analysis											
P_{50} (µm)	1,515	1,131	1,650	1,230	1,162	1,838	1,165	-	-	-	694
P_{80} (µm)	4,156	3,298	4,205	3,341	3,320	4,414	3,416	-	-	-	1,988
Percent Passing 100 mesh	18.1	20.2	17.2	19.4	21.8	17.1	21.0	-	-	-	25.3
Percent Passing 6 mesh	73.0	80.6	72.7	80.1	80.3	69.7	79.5	-	-	-	100
Flake Thickeness (mm)	7.0	6.0	7.0	7.0	7.0	7.0	6.0	6.0	6.0	6.0	6.0
Performance Indicators											
Specific Grinding Force (N/mm^2)	1.70	3.32	1.78	2.65	3.38	1.71	3.34	3.22	3.27	3.24	3.24
Specific Throughput (ts/hm^3)-(m_f)	278	243	232	241	227	223	216	219	234	226	226
Specific Throughput Rate (ts/hm^3)-(m_c)	65	65	65	65	65	65	65	65	65	65	65
Ratio m_c/m_f	0.23	0.27	0.28	0.27	0.29	0.29	0.30	0.30	0.28	0.29	0.29
Specific Power (kWs/m^3)	234	417	254	344	417	237	417	530	520	533	528
New minus 100 Mesh Produced (%)	12.4	14.5	11.5	13.7	16.1	11.5	15.3	-	-	-	19.6
% Increase in -100 mesh	218	255	202	241	283	201	268	-	-	-	344
New minus 6 Mesh Produced (%)	46.5	54.1	46.2	53.6	53.8	43.2	53.0	-	-	-	73.5
% Increase in -6 mesh	175	204	174	202	203	163	200	-	-	-	277

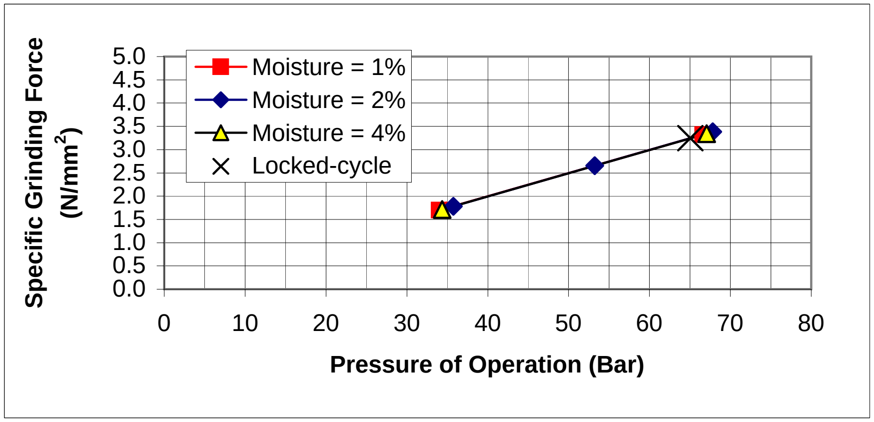
Particle Size Distributions - Mitchell

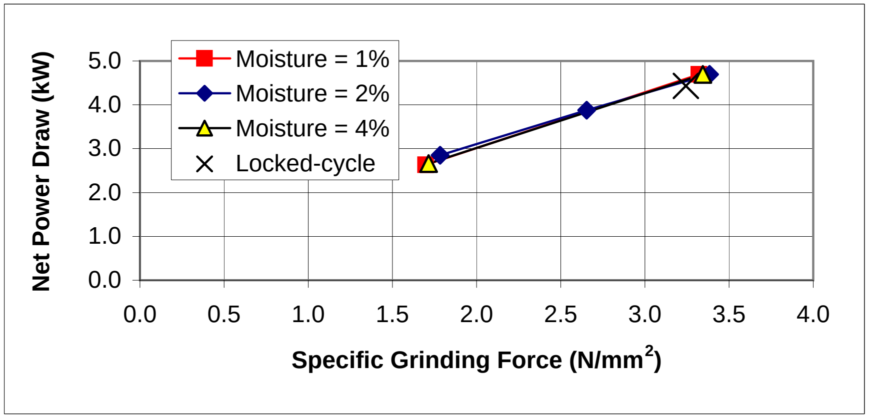
Size		**Test Feed**		**B1**		**B2**		**B3**		**B4**		**B5**		**B6**		**B7**		**LC Blend**		**LC-O/S**	
Inch / Mesh	**μm**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**	**%Ret**	**% C. Pass.**
1/2"	12,700	0.2	99.8	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
3/8"	9,525	20.6	79.2	0.3	99.7	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.4	99.6
3	6,700	32.6	46.6	3.9	95.8	2.9	97.1	4.9	95.1	2.7	97.3	2.4	97.6	4.6	95.4	3.1	96.9	0.0	100.0	7.2	92.5
4	4,750	13.1	33.5	11.2	84.7	7.3	89.8	11.0	84.2	6.9	90.4	7.5	90.1	12.4	83.0	7.7	89.2	0.0	100.0	25.8	66.7
6	3,350	7.0	26.5	11.6	73.0	9.2	80.6	11.4	72.7	10.3	80.1	9.8	80.3	13.3	69.7	9.7	79.5	0.0	100.0	45.0	21.7
8	2,360	6.0	20.6	12.2	60.8	12.2	68.4	13.3	59.5	12.6	67.5	12.3	68.0	13.1	56.5	12.6	66.9	13.2	86.8	19.1	2.5
10	1,700	3.7	16.9	8.2	52.6	9.2	59.3	8.7	50.8	9.3	58.2	9.0	59.0	8.4	48.1	8.7	58.2	12.5	74.3	0.2	2.4
14	1,180	3.4	13.4	7.9	44.7	8.2	51.1	8.5	42.3	9.2	49.0	8.7	50.3	7.7	40.4	8.0	50.3	11.7	62.5	0.1	2.3
20	850	1.9	11.5	5.7	39.0	7.6	43.5	5.6	36.7	7.0	42.1	6.0	44.3	5.7	34.7	6.7	43.6	7.9	54.6	0.1	2.2
28	600	1.6	9.8	5.6	33.4	5.9	37.6	5.3	31.4	6.4	35.6	5.8	38.5	5.3	29.3	6.4	37.3	7.7	46.9	0.0	2.2
35	425	1.4	8.5	4.8	28.7	5.3	32.3	4.5	26.9	4.5	31.1	5.0	33.5	3.7	25.7	4.6	32.7	6.7	40.3	0.0	2.1
48	300	1.1	7.4	4.3	24.4	4.7	27.6	3.9	23.0	4.4	26.7	4.6	28.9	3.1	22.6	4.4	28.3	6.0	34.2	0.0	2.1
65	212	0.9	6.5	3.5	20.9	3.8	23.8	3.2	19.7	4.3	22.4	3.9	25.0	3.0	19.6	4.3	24.0	4.9	29.3	0.0	2.1
100	150	0.8	5.7	2.8	18.1	3.6	20.2	2.6	17.2	3.0	19.4	3.2	21.8	2.4	17.1	3.0	21.0	4.1	25.3	0.1	2.0
150	106	0.6	5.1	2.3	15.8	2.5	17.7	2.1	15.1	2.7	16.7	2.6	19.2	2.2	14.9	2.8	18.2	3.4	21.9	0.1	1.9
200	75	0.5	4.7	2.0	13.8	2.6	15.1	1.9	13.2	2.4	14.3	2.3	16.9	1.9	13.1	2.5	15.7	3.1	18.8	0.1	1.8
270	53	0.4	4.2	1.6	12.2	2.0	13.1	1.6	11.6	2.0	12.3	1.9	14.9	1.4	11.6	2.1	13.6	2.4	16.4	0.1	1.8
400	38	0.3	3.9	0.9	11.3	1.2	11.8	0.8	10.7	1.1	11.2	1.1	13.9	0.9	10.8	1.3	12.3	1.4	15.0	0.1	1.7
Pan	-38	3.9	-	11.3	-	11.8	-	10.7	-	11.2	-	13.9	-	10.8	-	12.3	-	15.0	-	1.7	-
Total	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-
K50		*7,024*		*1,515*		*1,131*		*1,650*		*1,230*		*1,162*		*1,838*		*1,165*		*694*		*4,344*	
K80		*9,651*		*4,156*		*3,298*		*4,205*		*3,341*		*3,320*		*4,414*		*3,416*		*1,988*		*5,754*	
K85		*10,407*		*4,804*		*3,976*		*4,882*		*3,975*		*3,977*		*5,040*		*4,103*		*2,259*		*6,133*	
%, -1 mm		*12.4*		*41.6*		*46.9*		*39.2*		*45.2*		*47.0*		*37.3*		*46.6*		*58.2*		*2.2*	
%, -250 microns		*6.9*		*22.4*		*25.5*		*21.1*		*24.3*		*26.7*		*20.9*		*25.8*		*31.4*		*2.1*	

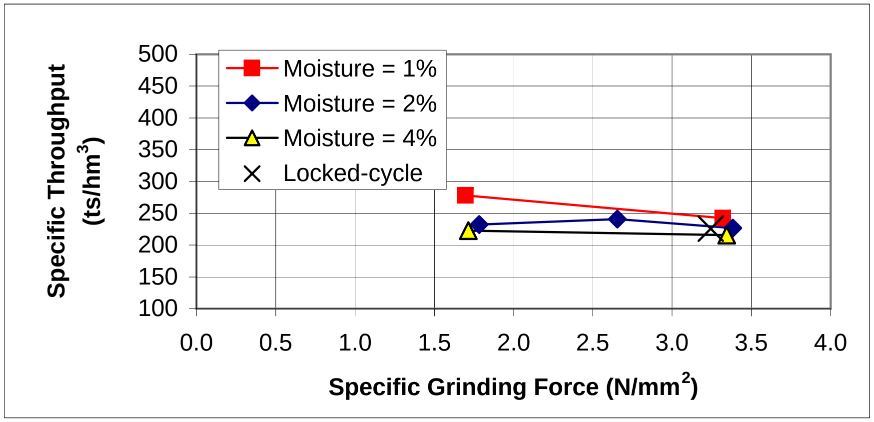
Particle Size Distributions - Mitchell

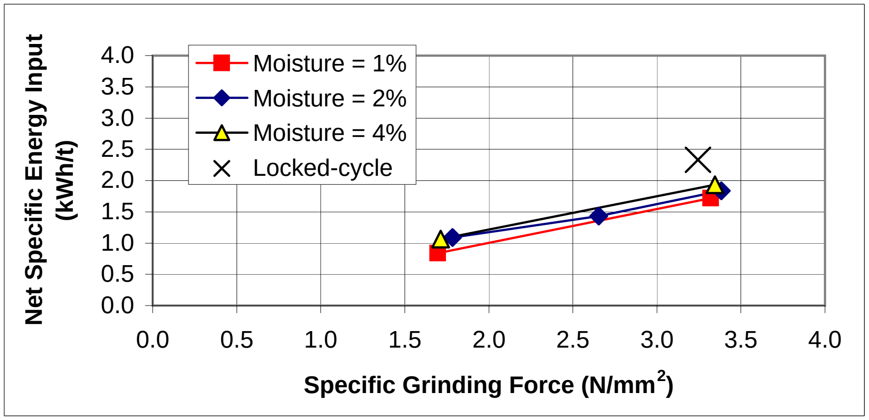


LABWAL Performance Graphs - Mitchell

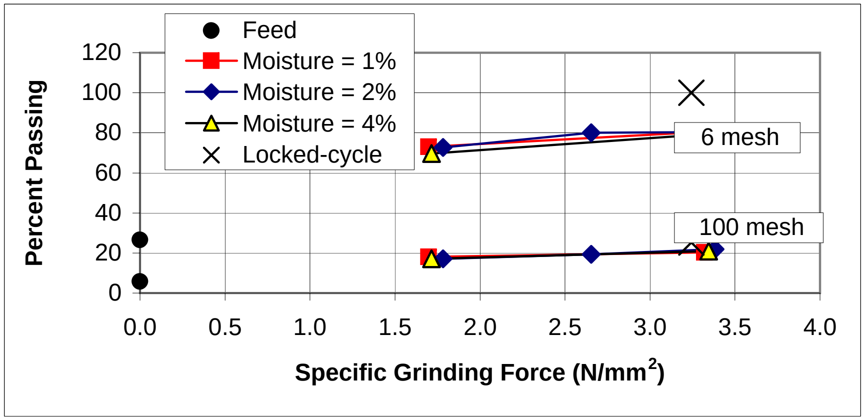


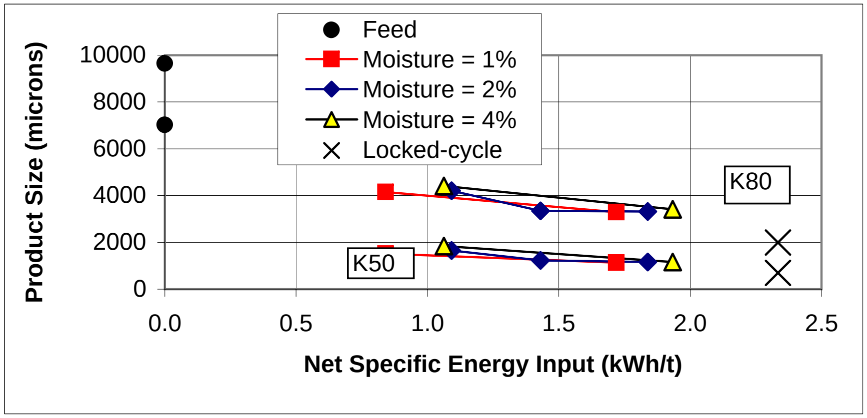


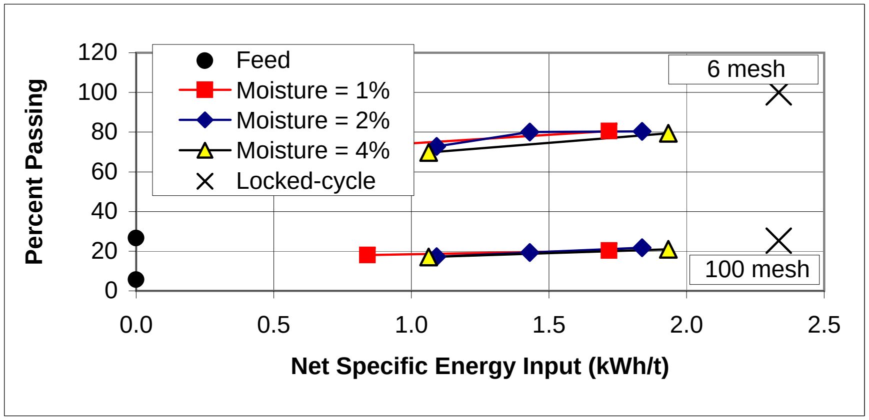


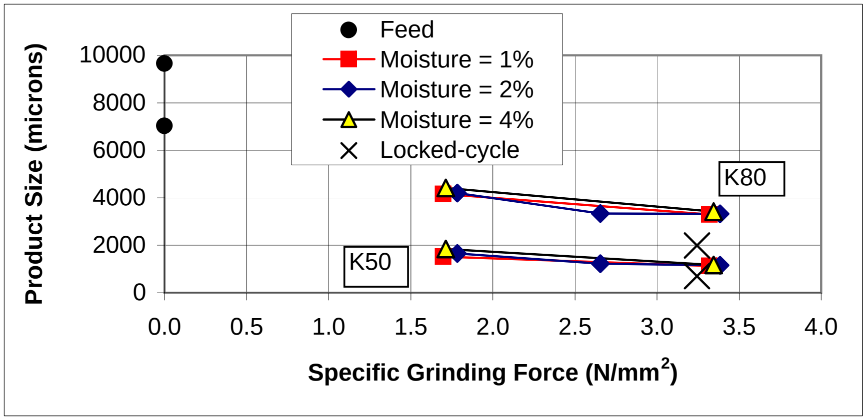


LABWAL Performance Graphs - Mitchell









Seabridge Gold Inc. **Project Number: 12248-001**
KSM
LABWAL Test Summary - Sulphurets

Feed Characteristics	
$F_{50,}$ (microns)	4,914
F_{80}, (microns)	8,624
Percent Passing 100 mesh	5.8
Percent Passing 6 mesh	39.3
Specific Gravity (kg/L)	2.69
Wet Bulk Density (kg/L)	1.69
Moisture 'as received' (%H_2O)	0.2
Ball Mill Work Index (kWh/t)	19.1

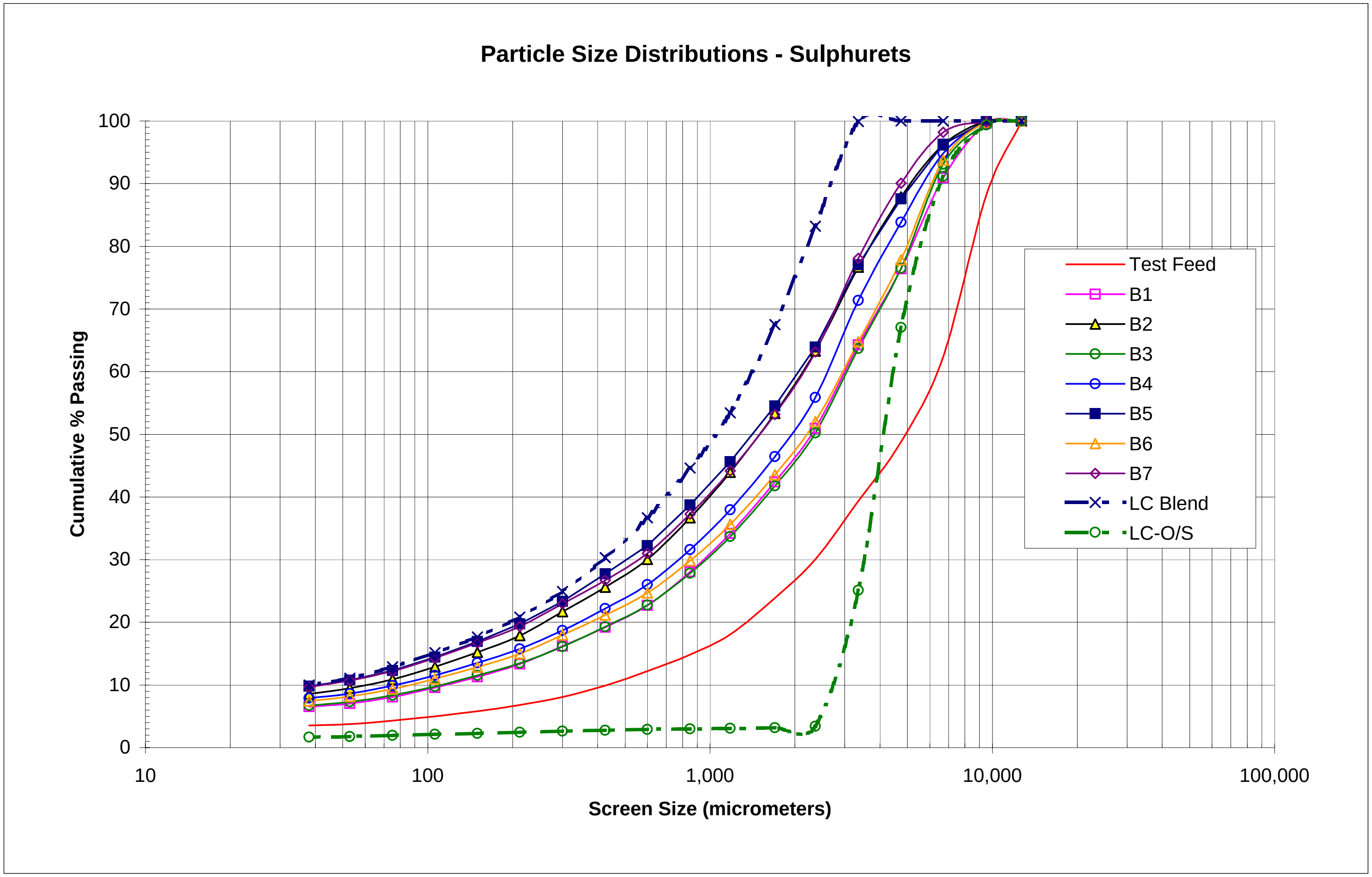
Test Results Summary

	Batch Tests							Locked-cycle			
Test Number	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**LC3**	**LC4**	**LC5**	**AVG**
Date:	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	27/08/09	09/09/09	09/09/09	09/09/09	-
Operation											
Initial Nitrogen Pressure (bar)	15	38	15	30	38	15	38	38	38	38	38
Initial Hydraulic Pressure (bar)	24	56	24	45	56	24	56	56	56	56	56
Ratio Hydraulic/Nitrogen	1.6	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.5	1.5	1.5
Pressure of Operation (bar)	34	68	35	55	69	39	72	66	67	67	66
Moisture (%H_2O)	1.2	1.3	2.0	2.1	2.2	3.8	3.8	-	-	-	1.7
Dry Net Throughput (t/h)	2.9	2.7	2.6	2.5	2.5	2.4	2.4	1.6	1.6	1.7	1.6
Circulating Load (%)	-	-	-	-	-	-	-	47.1	47.1	47.1	47.1
Gross Power (kW)	4.5	6.6	4.5	5.9	6.7	4.6	7.0	6.2	6.3	6.1	6.2
No-Load Power (kW)	1.5	1.5	1.4	1.5	1.6	1.5	1.5	1.2	1.2	1.1	1.2
Net Power (kW)	2.9	5.1	3.1	4.4	5.1	3.1	5.5	5.1	5.1	5.0	5.1
Gross Specific Energy Requirement (kWh/t)	1.53	2.47	1.71	2.34	2.69	1.90	2.91	3.83	3.91	3.66	3.80
Net Specific Energy Requirement (kWh/t)	1.00	1.90	1.18	1.73	2.07	1.29	2.29	3.11	3.17	2.97	3.08
HPGR Product Analysis											
P_{50} (µm)	2,284	1,506	2,341	1,937	1,424	2,195	1,508	-	-	-	1,046
P_{80} (µm)	5,203	3,734	5,139	4,291	3,715	4,996	3,557	-	-	-	2,220
Percent Passing 100 mesh	11.3	15.2	11.5	13.5	16.9	12.9	16.7	-	-	-	17.7
Percent Passing 6 mesh	64.3	76.7	63.7	71.4	77.0	64.8	78.1	-	-	-	100
Flake Thickeness (mm)	6.0	7.0	8.0	6.0	6.0	7.0	6.0	6.0	5.5	6.0	5.8
Performance Indicators											
Specific Grinding Force (N/mm^2)	1.71	3.39	1.75	2.72	3.42	1.92	3.61	3.30	3.32	3.32	3.31
Specific Throughput (ts/hm^3)-(m_f)	260	239	233	224	221	216	213	212	210	218	213
Specific Throughput Rate (ts/hm^3)-(m_c)	64	64	64	64	64	64	64	64	64	64	64
Ratio m_c/m_f	0.25	0.27	0.27	0.29	0.29	0.30	0.30	0.30	0.31	0.29	0.30
Specific Power (kWs/m^3)	261	455	274	388	457	280	487	659	664	649	657
New minus 100 Mesh Produced (%)	5.5	9.4	5.7	7.7	11.1	7.1	10.9	-	-	-	11.9
% Increase in -100 mesh	95	163	99	133	192	122	188	-	-	-	205
New minus 6 Mesh Produced (%)	24.9	37.3	24.3	32.0	37.7	25.4	38.7	-	-	-	60.6
% Increase in -6 mesh	63	95	62	81	96	65	98	-	-	-	154

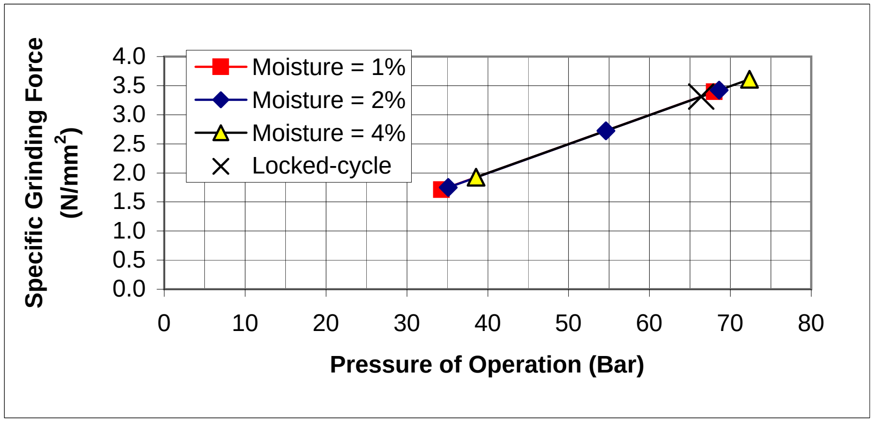
Particle Size Distributions - Sulphurets

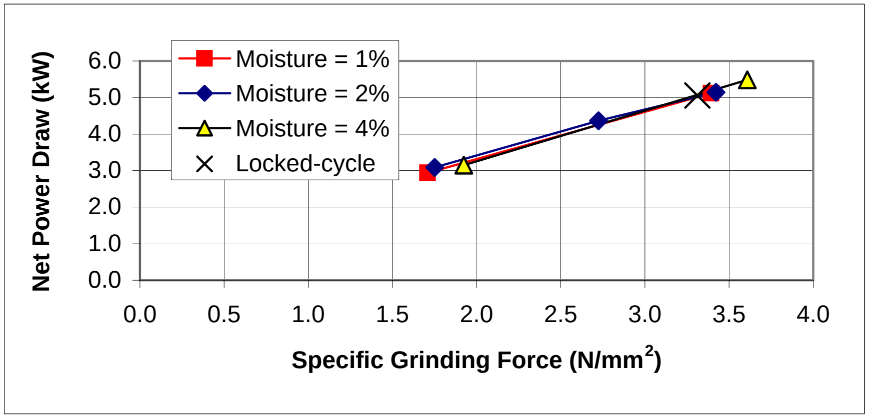
Size		Test Feed		B1		B2		B3		B4		B5		B6		B7		LC Blend		LC-O/S	
Inch / Mesh	μm	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.	%Ret	% C. Pass.
1/2"	12,700	0.1	99.9	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0	0.0	100.0
3/8"	9,525	11.6	88.2	0.4	99.6	0.0	100.0	0.6	99.4	0.2	99.8	0.0	100.0	0.2	99.8	0.1	99.9	0.0	100.0	0.6	99.4
3	6,700	25.9	62.4	8.7	90.9	3.8	96.2	6.3	93.1	5.0	94.8	3.7	96.3	6.1	93.8	1.7	98.2	0.0	100.0	8.3	91.1
4	4,750	13.6	48.8	14.5	76.4	8.3	87.9	16.6	76.5	11.0	83.8	8.7	87.5	15.9	77.8	8.1	90.1	0.0	100.0	24.1	67.0
6	3,350	9.5	39.3	12.1	64.3	11.2	76.7	12.8	63.7	12.5	71.4	10.5	77.0	13.1	64.8	12.0	78.1	0.1	99.9	41.9	25.1
8	2,360	9.3	30.0	13.4	50.9	13.4	63.3	13.5	50.2	15.5	55.9	13.1	63.9	12.8	52.0	14.9	63.1	16.7	83.2	21.7	3.4
10	1,700	6.2	23.9	8.5	42.4	9.9	53.3	8.5	41.8	9.4	46.4	9.4	54.5	8.5	43.5	10.0	53.1	15.7	67.5	0.2	3.2
14	1,180	5.8	18.1	8.2	34.2	9.4	44.0	8.1	33.7	8.5	37.9	8.9	45.6	7.9	35.6	9.0	44.2	14.1	53.4	0.1	3.1
20	850	3.2	14.8	6.1	28.1	7.3	36.7	5.8	27.8	6.4	31.6	6.9	38.7	5.8	29.8	6.9	37.3	8.8	44.6	0.1	3.0
28	600	2.6	12.2	5.4	22.7	6.6	30.1	5.1	22.8	5.6	26.0	6.5	32.2	5.1	24.7	6.3	31.0	7.9	36.7	0.1	2.9
35	425	2.3	9.9	3.5	19.2	4.5	25.6	3.5	19.3	3.8	22.2	4.5	27.7	3.5	21.1	4.3	26.7	6.4	30.3	0.1	2.8
48	300	1.8	8.1	3.0	16.2	3.9	21.7	3.2	16.1	3.5	18.7	4.4	23.3	3.2	18.0	3.8	23.0	5.4	24.9	0.1	2.6
65	212	1.3	6.8	2.9	13.3	3.8	17.9	2.6	13.5	3.0	15.8	3.6	19.7	3.0	15.0	3.6	19.4	4.1	20.8	0.2	2.5
100	150	1.0	5.8	2.0	11.3	2.6	15.2	2.0	11.5	2.2	13.5	2.8	16.9	2.1	12.9	2.7	16.7	3.2	17.7	0.2	2.3
150	106	0.8	5.0	1.8	9.6	2.3	12.9	1.7	9.8	2.0	11.5	2.5	14.4	1.9	11.0	2.4	14.3	2.5	15.2	0.2	2.1
200	75	0.7	4.3	1.5	8.1	2.0	10.9	1.4	8.4	1.7	9.9	2.1	12.3	1.6	9.4	2.1	12.2	2.3	12.9	0.2	1.9
270	53	0.5	3.8	1.0	7.1	1.4	9.5	1.0	7.3	1.2	8.6	1.6	10.7	1.2	8.2	1.5	10.7	1.8	11.1	0.2	1.8
400	38	0.2	3.5	0.5	6.5	0.9	8.6	0.6	6.7	0.7	7.9	0.9	9.8	0.7	7.4	1.0	9.7	1.1	10.0	0.1	1.7
Pan	-38	3.5	-	6.5	-	8.6	-	6.7	-	7.9	-	9.8	-	7.4	-	9.7	-	10.0	-	1.7	-
Total	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-
K50		*4,914*		*2,284*		*1,506*		*2,341*		*1,937*		*1,424*		*2,195*		*1,508*		*1,046*		*4,279*	
K80		*8,624*		*5,203*		*3,734*		*5,139*		*4,291*		*3,715*		*4,996*		*3,557*		*2,220*		*5,790*	
K85		*9,172*		*5,866*		*4,360*		*5,714*		*4,936*		*4,383*		*5,589*		*4,125*		*2,460*		*6,197*	
%, -1 mm		*16.3*		*30.9*		*40.0*		*30.5*		*34.5*		*41.8*		*32.4*		*40.4*		*48.6*		*3.0*	
%, -250 microns		*7.4*		*14.6*		*19.5*		*14.6*		*17.0*		*21.3*		*16.3*		*20.9*		*22.6*		*2.5*	

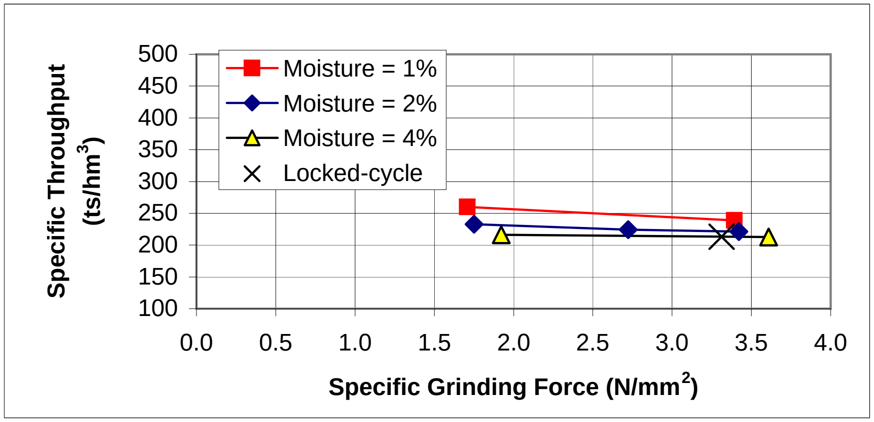
Particle Size Distributions - Sulphurets

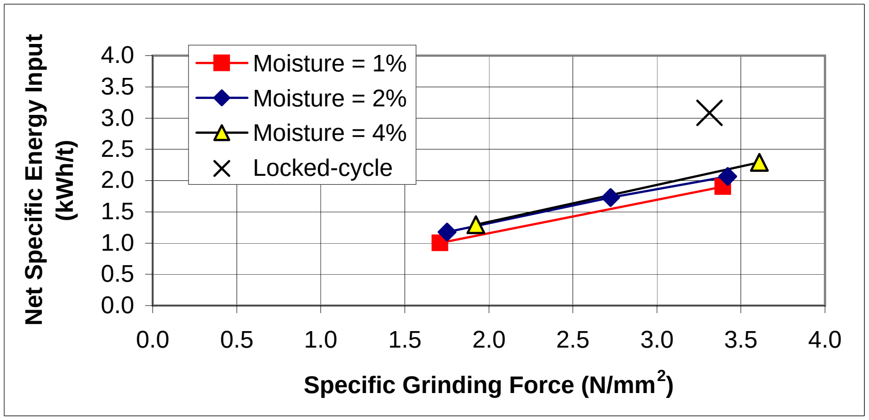


LABWAL Performance Graphs





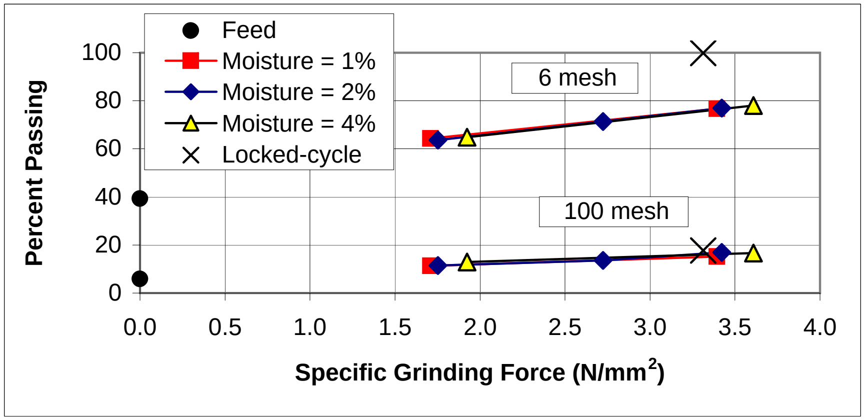


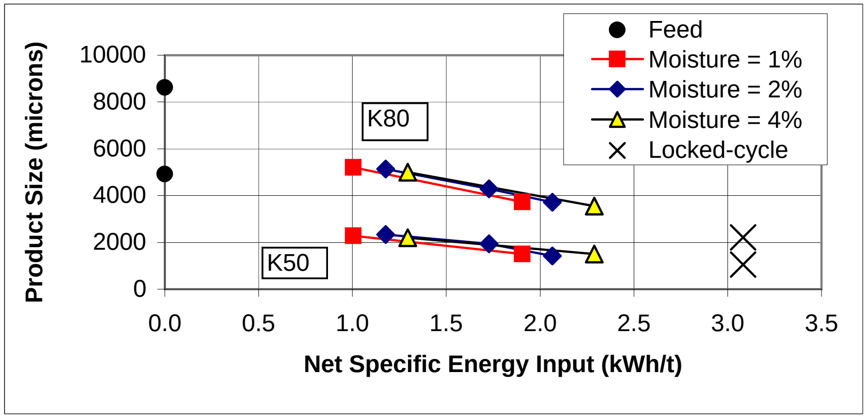


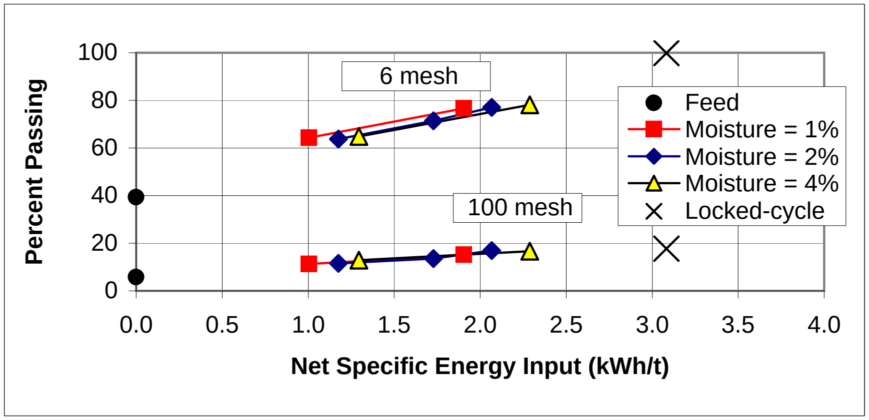
Seabridge Gold Inc. **Project Number: 12248-001**

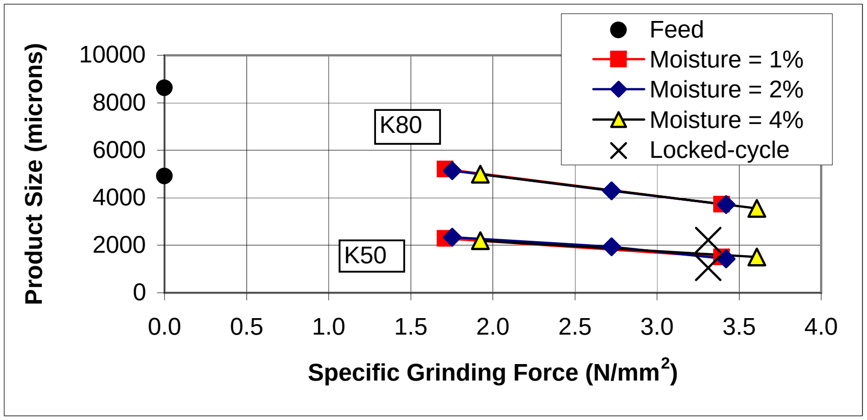
KSM

LABWAL Performance Graphs









Appendix D – Flotation Batch Test Details

Test No.: F1 **Project No.**: 12248-001 **Operator**: CC **Date**: Aug. 27th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 95µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Mitchell Comp

Grind: 35 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 91 µm
Regrind: Comb Ro Conc 1-2 : 20 minutes in the laboratory pebble mill. P80 = 30 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes			pH	Ep (mV)
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth		
Grind	350	-	-	-	-	-		35			9.5	+90
Rougher Circuit												
Rougher 1	-	5	5	-	7.5	-			1	3	9.5	+20
Rougher 2	-	5	5	-	5	-			1	4	9.0	-50
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	500	-	-	-	-	-		20			12.0	-110
Cu 1st Cleaner	-	2.5	2.5	-	1.25	-			1	5	12.0	-70
Cu 2nd Cleaner	-	1.25	1.25	-	1.25	-			1	4	11.6	-80
Cu 3rd Cleaner	75	-	-	-	1.25	2.5			1	3	12.0	-30
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-			1	4	8.8	-40
Pyrite Ro 2	-	-	30	30	7.5	-			1	4	8.4	-40
Total	925	14	74	60	29	3	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	26.8	0.7	26.7	56.6	0.22	34.2	31.8	85.2	53.2	20.6	7.4	4.1
Cu 3rd Cl Tail	11.5	0.3	2.09	12.8	0.20	34.9	32.0	2.9	5.2	8.0	3.2	1.8
Cu 2nd Cl Tail	17.5	0.4	0.44	3.82	0.14	21.6	21.2	0.9	2.3	8.6	3.1	1.8
Cu 1st Cl Tail	259.9	6.5	0.072	1.65	0.010	28.9	26.8	2.2	15.0	9.1	60.8	33.6
Pyrite Conc	231.2	5.8	0.082	1.21	0.047	12.9	14.6	2.3	9.8	38.0	24.1	16.3
Pyrite Tail	3435.8	86.3	0.016	0.12	0.0013	< 0.05	2.56	6.5	14.5	15.6	1.4	42.4
Head (calc.)	3982.7	100.0	0.21	0.72	0.007	3.10	5.20	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.7	26.7	56.6	0.22	34.2	31.8	85.2	53.2	20.6	7.4	4.1
Cu 2nd Cl Conc		1.0	19.3	43.4	0.21	34.4	31.9	88.1	58.4	28.7	10.7	5.9
Cu 1st Cl Conc		1.4	13.4	31.0	0.19	30.4	28.5	89.0	60.7	37.3	13.7	7.7
Cu/Mo Rougher Conc		7.9	2.43	6.84	0.042	29.2	27.1	91.2	75.7	46.3	74.5	41.3
Pyrite Conc		5.8	0.082	1.21	0.047	12.9	14.6	2.3	9.8	38.0	24.1	16.3
Sulphide Conc		12.3	0.077	1.44	0.027	21.4	21.1	4.5	24.8	47.1	84.9	49.9
Pyrite Tail		86.3	0.016	0.12	0.0013	0.05	2.56	6.5	14.5	15.6	1.4	42.4

Test No.: F2 **Project No.**: 12248-001 **Operator**: CC **Date**: Aug. 27th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 95µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Sulphurets Comp

Grind: 58 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = 92 µm
Regrind: Comb Ro Conc 1-2 : 20 minutes in the laboratory pebble mill. P80 = 28 µm

Conditions:

Stage	Reagents added, grams per tonne: Lime	3418A	AERO 208	PAX	MIBC	CMC		Time, minutes: Grind	Cond.	Froth	pH	Ep (mV)
Grind	450	-	-	-	-	-		58			9.7	-80
Rougher Circuit												
Rougher 1	-	5	5	-	15	-			1	3	9.7	-40
Rougher 2	-	5	5	-	5	-			1	4	9.6	-50
Cleaner Circuit - *Rougher Conc 1-2*												
Regrind (Comb Conc)	250	-	-	-	-	-		20			11.5	-100
Cu 1st Cleaner	-	2.5	2.5	-	-	-			1	5	11.5	-100
Cu 2nd Cleaner	30	1.25	1.25	-	-	-			1	4	11.5	-40
Cu 3rd Cleaner	60	-	-	-	-	5			1	3	12.0	-20
Pyrite Rougher - *on Rougher Tail*												
Pyrite Ro 1	-	-	30	30	5	-			1	4	9.4	-60
Pyrite Ro 2	-	-	30	30	7.5	-			1	4	9.2	-40
Total	790	14	74	60	33	5	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight** g	**%**	**Assays %, g/t** Cu	Au	Mo	S^{2-}	Fe	**% Distribution** Cu	Au	Mo	S^{2-}	Fe
Cu 3rd Cl Conc	25.8	0.6	25.6	53.2	0.29	31.1	28.5	83.2	51.2	23.9	6.7	3.6
Cu 3rd Cl Tail	8.1	0.2	1.72	12.5	0.64	32.5	28.8	1.8	3.8	16.6	2.2	1.1
Cu 2nd Cl Tail	10.3	0.3	0.53	4.00	0.14	20.8	19.4	0.7	1.5	4.6	1.8	1.0
Cu 1st Cl Tail	297.8	7.4	0.10	2.31	0.024	27.8	25.7	3.6	25.7	22.9	69.2	37.2
Pyrite Conc	208.7	5.2	0.110	0.97	0.028	10.7	12.1	2.9	7.5	18.7	18.7	12.3
Pyrite Tail	3452.4	86.2	0.018	0.080	0.0012	< 0.05	2.68	7.8	10.3	13.3	1.4	44.9
Head (calc.)	4003.1	100.0	0.20	0.67	0.008	2.99	5.15	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.6	25.6	53.2	0.29	31.1	28.5	83.2	51.2	23.9	6.7	3.6
Cu 2nd Cl Conc		0.8	19.9	43.5	0.37	31.4	28.6	85.0	55.0	40.5	8.9	4.7
Cu 1st Cl Conc		1.1	15.4	34.3	0.32	29.0	26.4	85.6	56.5	45.2	10.7	5.7
Cu/Mo Rougher Conc		8.5	2.07	6.44	0.062	27.9	25.8	89.3	82.2	68.0	79.9	42.8
Pyrite Conc		5.2	0.110	0.97	0.028	10.7	12.1	2.9	7.5	18.7	18.7	12.3
Sulphide Conc		12.7	0.102	1.76	0.026	20.8	20.1	6.5	33.2	41.6	87.9	49.4
Pyrite Tail		86.2	0.018	0.080	0.0012	0.05	2.68	7.8	10.3	13.3	1.4	44.9

Test No.: F3 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 8th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 130µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Mitchell Comp

Grind: 27 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 120 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 32 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes			pH	Ep
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth	pH	(mV)
Grind	350	-	-	-	-	-	-	27			9.5	-30
Rougher Circuit												
Rougher 1	-	5	5	-	7.5	-	-		1	3	9.5	-20
Rougher 2	-	5	5	-	5	-	-		1	4	9.0	0
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	250	-	-	-	-	-	-	25			11.0	-40
Cu 1st Cleaner	50	2.5	2.5	-	1.25	5	-		1	5	11.5	0
Cu 2nd Cleaner	32.5	1.25	1.25	-	1.25	-	-		1	4	11.5	+10
Cu 3rd Cleaner	87.5	-	-	-	1.25	3.75	-		1	3	12.0	+20
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-	-		1	4	8.6	-40
Pyrite Ro 2	-	-	30	30	7.5	-	-		1	4	8.4	-20
Total	770	14	74	60	29	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	27.1	0.7	25.4	57.9	0.12	34.2	31.9	88.0	56.4	11.3	7.3	4.3
Cu 3rd Cl Tail	11.8	0.3	1.41	12.2	0.62	40.8	37.9	2.1	5.2	25.4	3.8	2.2
Cu 2nd Cl Tail	9.4	0.2	0.36	2.90	0.11	20.0	20.4	0.4	1.0	3.6	1.5	1.0
Cu 1st Cl Tail	311.6	8.0	0.052	1.49	0.011	27.7	25.7	2.1	16.7	11.9	68.1	40.1
Pyrite Conc	254.5	6.6	0.100	0.61	0.040	8.34	9.63	3.3	5.6	35.3	16.7	12.3
Pyrite Tail	3262.2	84.2	0.010	0.13	0.0011	0.10	2.45	4.2	15.2	12.5	2.6	40.1
Head (calc.)	3876.6	100.0	0.20	0.72	0.007	3.27	5.15	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.7	25.4	57.9	0.12	34.2	31.9	88.0	56.4	11.3	7.3	4.3
Cu 2nd Cl Conc		1.0	18.1	44.0	0.27	36.2	33.7	90.1	61.5	36.7	11.1	6.6
Cu 1st Cl Conc		1.2	14.7	36.0	0.24	33.0	31.1	90.5	62.5	40.3	12.6	7.5
Cu/Mo Rougher Conc		9.3	2.01	6.13	0.042	28.4	26.4	92.6	79.2	52.2	80.7	47.7
Pyrite Conc		6.6	0.100	0.61	0.040	8.34	9.63	3.3	5.6	35.3	16.7	12.3
Sulphide Conc		14.6	0.074	1.09	0.024	19.0	18.5	5.3	22.3	47.3	84.8	52.4
Pyrite Tail		84.2	0.010	0.13	0.0011	0.10	2.45	4.2	15.2	12.5	2.6	40.1

Test No.: F4 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 8th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 115µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Mitchell Comp

Grind: 30 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 104 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 31 µm

Conditions:

	Reagents added, grams per tonne							Time, minutes				
Stage	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth	pH	Ep (mV)
Grind	350	-	-	-	-	-	-	30			9.5	-60
Rougher Circuit												
Rougher 1	-	5	5	-	7.5	-	-		1	3	9.5	-20
Rougher 2	-	5	5	-	5	-	-		1	4	9.0	0
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	350	-	-	-	-	-	-	25			11.7	-20
Cu 1st Cleaner	-	2.5	2.5	-	1.25	5	-		1	5	11.7	0
Cu 2nd Cleaner	32.5	1.25	1.25	-	1.25	-	-		1	4	11.5	+20
Cu 3rd Cleaner	87.5	-	-	-	1.25	3.75	-		1	3	12.0	+20
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-	-		1	4	8.8	-40
Pyrite Ro 2	-	-	30	30	7.5	-	-		1	4	8.6	-40
Total	820	14	74	60	29	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	25.4	0.6	27.9	56.5	0.03	33.9	32.2	86.4	53.1	2.6	7.0	4.1
Cu 3rd Cl Tail	9.7	0.2	2.80	19.3	0.71	39.7	38.1	3.3	6.9	23.4	3.1	1.8
Cu 2nd Cl Tail	6.5	0.2	0.59	4.50	0.18	22.2	20.8	0.5	1.1	4.0	1.2	0.7
Cu 1st Cl Tail	315.5	8.0	0.061	1.62	0.014	27.6	25.6	2.3	18.9	15.0	71.2	40.1
Pyrite Conc	225.8	5.7	0.077	0.59	0.046	8.69	10.2	2.1	4.9	35.4	16.0	11.4
Pyrite Tail	3385.2	85.3	0.013	0.12	0.0017	<0.05	2.50	5.4	15.0	19.6	1.4	42.0
Head (calc.)	3968.1	100.0	0.21	0.68	0.007	3.08	5.08	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.6	27.9	56.5	0.03	33.9	32.2	86.4	53.1	2.6	7.0	4.1
Cu 2nd Cl Conc		0.9	21.0	46.2	0.22	35.5	33.8	89.7	60.0	26.0	10.2	5.9
Cu 1st Cl Conc		1.0	17.8	39.7	0.21	33.4	31.8	90.2	61.1	30.0	11.4	6.6
Cu/Mo Rougher Conc		9.0	2.13	6.06	0.037	28.3	26.3	92.5	80.0	45.1	82.6	46.6
Pyrite Conc		5.7	0.077	0.59	0.046	8.69	10.2	2.1	4.9	35.4	16.0	11.4
Sulphide Conc		13.6	0.068	1.19	0.027	19.7	19.2	4.5	23.8	50.4	87.2	51.5
Pyrite Tail		85.3	0.013	0.12	0.0017	0.05	2.50	5.4	15.0	19.6	1.4	42.0

Test No.: F5 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 9th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 130µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Sulphurets Comp

Grind: 49 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = 121 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 38 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes				
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth	pH	Ep (mV)
Grind	450	-	-	-	-	-		49			9.8	+20
Rougher Circuit												
Rougher 1	-	5	5	-	15	-			1	3	9.8	+40
Rougher 2	-	5	5	-	5	-			1	4	9.5	+40
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	250	-	-	-	-	-		25			11.3	+40
Cu 1st Cleaner	22.5	2.5	2.5	-	-	5			1	5	11.5	+40
Cu 2nd Cleaner	37.5	1.25	1.25	-	-	-			1	4	11.5	+40
Cu 3rd Cleaner	100	-	-	-	-	3.75			1	3	12.0	+40
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-			1	4	9.4	+30
Pyrite Ro 2	-	-	30	30	7.5	-			1	4	9.2	0
Total	860	14	74	60	33	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	25.9	0.6	25.3	51.6	0.28	31.6	29.5	85.0	52.4	24.2	6.7	3.6
Cu 3rd Cl Tail	6.8	0.2	1.64	12.5	1.14	33.6	31.0	1.4	3.3	25.9	1.9	1.0
Cu 2nd Cl Tail	9.9	0.2	0.66	4.84	0.15	21.5	20.7	0.8	1.9	5.0	1.7	1.0
Cu 1st Cl Tail	348.8	8.7	0.055	2.02	0.012	26.0	24.8	2.5	27.6	14.0	74.1	41.0
Pyrite Conc	256.1	6.4	0.099	0.56	0.023	6.26	8.2	3.3	5.6	19.7	13.1	9.9
Pyrite Tail	3353.7	83.8	0.016	0.070	0.0010	0.09	2.74	7.0	9.2	11.2	2.5	43.5
Head (calc.)	4001.2	100.0	0.19	0.64	0.007	3.06	5.28	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.6	25.3	51.6	0.28	31.6	29.5	85.0	52.4	24.2	6.7	3.6
Cu 2nd Cl Conc		0.8	20.4	43.5	0.46	32.0	29.8	86.4	55.7	50.1	8.6	4.6
Cu 1st Cl Conc		1.1	15.8	34.5	0.39	29.6	27.7	87.3	57.6	55.1	10.3	5.6
Cu/Mo Rougher Conc		9.8	1.77	5.55	0.053	26.4	25.1	89.8	85.2	69.1	84.4	46.6
Pyrite Conc		6.4	0.099	0.56	0.023	6.26	8.15	3.3	5.6	19.7	13.1	9.9
Sulphide Conc		15.1	0.074	1.40	0.017	17.6	17.8	5.8	33.2	33.7	87.2	50.9
Pyrite Tail		83.8	0.016	0.070	0.0010	0.09	2.74	7.0	9.2	11.2	2.5	43.5

Test No.: F6 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 10th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 115µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Sulphurets Comp

Grind: 52 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = 123 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 29 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes			pH	Ep (mV)
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth		
Grind	450	-	-	-	-	-		52			9.5	-80
Rougher Circuit												
Rougher 1	-	5	5	-	15	-			1	3	9.5	-40
Rougher 2	-	5	5	-	5	-			1	4	9.3	-20
Cleaner Circuit - *Rougher Conc 1-2*												
Regrind (Comb Conc)	300	-	-	-	-	-		25			11.0	-40
Cu 1st Cleaner	40	2.5	2.5	-	-	5			1	5	11.5	0
Cu 2nd Cleaner	45	1.25	1.25	-	-	-			1	4	11.5	+40
Cu 3rd Cleaner	100	-	-	-	-	3.75			1	3	12.0	-20
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-			1	4	9.4	-30
Pyrite Ro 2	-	-	30	30	7.5	-			1	4	8.9	0
Total	935	14	74	60	33	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	28.7	0.7	24.2	49.0	0.39	32.8	30.6	85.3	52.5	36.5	7.8	4.3
Cu 3rd Cl Tail	14.5	0.4	1.17	9.76	0.57	38.4	34.0	2.1	5.3	27.0	4.6	2.4
Cu 2nd Cl Tail	11.9	0.3	0.44	3.66	0.056	21.0	20.4	0.6	1.6	2.2	2.1	1.2
Cu 1st Cl Tail	340.3	8.5	0.038	1.86	0.006	24.9	24.1	1.6	23.6	6.7	70.2	39.9
Pyrite Conc	257.2	6.4	0.120	0.73	0.020	6.41	8.10	3.8	7.0	16.8	13.7	10.1
Pyrite Tail	3355.7	83.7	0.016	0.080	0.001	0.06	2.58	6.6	10.0	10.9	1.7	42.1
Head (calc.)	4008.3	100.0	0.20	0.67	0.008	3.01	5.13	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.7	24.2	49.0	0.39	32.8	30.6	85.3	52.5	36.5	7.8	4.3
Cu 2nd Cl Conc		1.1	16.5	35.8	0.45	34.7	31.7	87.4	57.7	63.5	12.4	6.7
Cu 1st Cl Conc		1.4	13.0	28.9	0.37	31.7	29.3	88.0	59.4	65.6	14.5	7.9
Cu/Mo Rougher Conc		9.9	1.85	5.63	0.056	25.9	24.8	89.6	83.0	72.3	84.7	47.7
Pyrite Conc		6.4	0.120	0.73	0.020	6.41	8.10	3.8	7.0	16.8	13.7	10.1
Sulphide Conc		14.9	0.073	1.37	0.012	16.9	17.2	5.4	30.6	23.4	83.9	50.0
Pyrite Tail		83.7	0.016	0.080	0.0010	0.06	2.58	6.6	10.0	10.9	1.7	42.1

Test No.: F7 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 9th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 95µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Mitchell Comp

Grind: 35 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 93 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 27 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes				
	Lime	3418A	AERO 208	PAX	MIBC	CMC	Fuel oil	Grind	Cond.	Froth	pH	Ep (mV)
Grind	350	-	-	-	-	-	5	35			9.0	+100
Rougher Circuit												
Rougher 1	37.5	5	5	-	7.5	-	-		1	3	9.5	+70
Rougher 2	-	5	5	-	5	-	-		1	4	9.0	+80
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	300	-	-	-	-	-	2.5	25			11.5	+20
Cu 1st Cleaner	-	2.5	2.5	-	1.25	5	-		1	5	11.5	+20
Cu 2nd Cleaner	32.5	1.25	1.25	-	1.25	-	-		1	4	11.5	+40
Cu 3rd Cleaner	87.5	-	-	-	1.25	5	2.5		1	3	12.0	+50
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-	-		1	4	8.8	0
Pyrite Ro 2	-	-	30	30	7.5	-	-		1	4	8.4	0
Total	808	14	74	60	29	10	10					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	27.4	0.7	26.2	62.2	0.12	35.0	31.8	89.6	58.6	11.4	7.5	4.1
Cu 3rd Cl Tail	11.7	0.3	1.24	11.9	1.23	42.0	38.2	1.8	4.8	50.0	3.9	2.1
Cu 2nd Cl Tail	10.0	0.3	0.36	3.79	0.12	23.2	22.8	0.4	1.3	4.2	1.8	1.1
Cu 1st Cl Tail	296.8	7.4	0.049	1.53	0.005	28.7	27.9	1.8	15.6	5.2	67.0	39.0
Pyrite Conc	227.2	5.7	0.059	0.71	0.022	9.85	11.4	1.7	5.5	17.4	17.6	12.2
Pyrite Tail	3414.7	85.6	0.011	0.12	<0.001	0.08	2.58	4.7	14.1	11.9	2.1	41.5
Head (calc.)	3987.8	100.0	0.20	0.73	0.007	3.19	5.32	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.7	26.2	62.2	0.12	35.0	31.8	89.6	58.6	11.4	7.5	4.1
Cu 2nd Cl Conc		1.0	18.7	47.1	0.45	37.1	33.7	91.4	63.4	61.4	11.4	6.2
Cu 1st Cl Conc		1.2	15.0	38.3	0.38	34.3	31.5	91.8	64.7	65.6	13.2	7.3
Cu/Mo Rougher Conc		8.7	2.17	6.75	0.059	29.5	28.4	93.6	80.4	70.8	80.2	46.3
Pyrite Conc		5.7	0.059	0.71	0.022	9.85	11.4	1.7	5.5	17.4	17.6	12.2
Sulphide Conc		13.1	0.053	1.17	0.012	20.5	20.7	3.5	21.2	22.5	84.6	51.2
Pyrite Tail		85.6	0.011	0.12	0.0010	0.08	2.58	4.7	14.1	11.9	2.1	41.5

Test No.: F8 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 9th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 95µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Sulphurets Comp

Grind: 58 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = 90 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 26 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes				
	Lime	3418A	AERO 208	PAX	MIBC	CMC	Fuel oil	Grind	Cond.	Froth	pH	Ep (mV)
Grind	450	-	-	-	-	-	5	58			9.6	+10
Rougher Circuit												
Rougher 1	-	5	5	-	15	-	-		1	3	9.7	+20
Rougher 2	-	5	5	-	5	-	-		1	4	9.4	+100
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	250	-	-	-	-	-	2.5	25			11.0	+40
Cu 1st Cleaner	62.5	2.5	2.5	-	-	6.25	-		1	5	11.5	+40
Cu 2nd Cleaner	32.5	1.25	1.25	-	-	-	-		1	4	11.5	+50
Cu 3rd Cleaner	87.5	-	-	-	-	5	2.5		1	3	12.0	+50
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-	-		1	4	9.4	-20
Pyrite Ro 2	-	-	30	30	7.5	-	-		1	4	9.2	0
Total	883	14	74	60	33	11	10					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	24.8	0.6	26.9	54.6	0.27	32.0	29.5	85.7	52.7	22.4	6.5	3.4
Cu 3rd Cl Tail	9.5	0.2	1.72	13.2	1.47	36.1	33.1	2.1	4.9	46.7	2.8	1.4
Cu 2nd Cl Tail	15.7	0.4	0.41	4.23	0.070	25.3	24.0	0.8	2.6	3.7	3.3	1.7
Cu 1st Cl Tail	339.1	8.5	0.067	1.97	0.006	25.8	24.9	2.9	26.0	6.8	71.7	38.9
Pyrite Conc	226.8	5.7	0.065	0.52	0.012	6.66	9.07	1.9	4.6	9.1	12.4	9.5
Pyrite Tail	3392.6	84.6	0.015	0.070	0.001	0.12	2.89	6.5	9.2	11.3	3.3	45.1
Head (calc.)	4008.5	100.0	0.19	0.64	0.007	3.04	5.42	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.6	26.9	54.6	0.27	32.0	29.5	85.7	52.7	22.4	6.5	3.4
Cu 2nd Cl Conc		0.9	19.9	43.1	0.60	33.1	30.5	87.8	57.6	69.1	9.3	4.8
Cu 1st Cl Conc		1.2	13.8	30.9	0.44	30.7	28.5	88.6	60.2	72.8	12.6	6.5
Cu/Mo Rougher Conc		9.7	1.83	5.69	0.061	26.4	25.4	91.6	86.2	79.6	84.3	45.4
Pyrite Conc		5.7	0.065	0.52	0.012	6.66	9.07	1.9	4.6	9.1	12.4	9.5
Sulphide Conc		14.1	0.066	1.39	0.008	18.1	18.6	4.8	30.6	15.9	84.1	48.3
Pyrite Tail		84.6	0.015	0.070	0.001	0.12	2.89	6.5	9.2	11.3	3.3	45.1

Test No.: F9 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 17th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 150µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Mitchell Comp

Grind: 25 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 140 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 32 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes			pH	Ep (mV)
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth		
Grind	350	-	-	-	-	-	-	25			9.0	-60
Rougher Circuit												
Rougher 1	25	5	5	-	7.5	-	-		1	3	9.5	-20
Rougher 2	-	5	5	-	5	-	-		1	4	9.0	-40
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	300	-	-	-	-	-	-	25			11.2	0
Cu 1st Cleaner	50	2.5	2.5	-	1.25	5	-		1	5	11.5	0
Cu 2nd Cleaner	37.5	1.25	1.25	-	1.25	-	-		1	4	11.5	+10
Cu 3rd Cleaner	125	-	-	-	1.25	3.75	-		1	3	12.0	+20
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-	-		1	4	8.6	0
Pyrite Ro 2	-	-	30	30	7.5	-	-		1	4	8.4	0
Total	888	14	74	60	29	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	26.7	0.7	25.4	58.6	0.06	35.2	32.3	82.7	52.0	6.2	7.5	4.3
Cu 3rd Cl Tail	12.0	0.3	1.52	12.5	0.56	40.6	37.3	2.2	5.0	25.5	3.9	2.2
Cu 2nd Cl Tail	8.6	0.2	0.35	3.02	0.13	18.8	18.7	0.4	0.9	4.2	1.3	0.8
Cu 1st Cl Tail	329.5	8.3	0.085	1.73	0.009	26.4	24.8	3.4	19.0	11.2	69.2	40.5
Pyrite Conc	252.9	6.4	0.140	0.90	0.042	7.80	8.76	4.3	7.6	40.2	15.7	11.0
Pyrite Tail	3349.1	84.2	0.017	0.14	0.0010	0.09	2.49	6.9	15.6	12.7	2.4	41.3
Head (calc.)	3978.8	100.0	0.21	0.76	0.007	3.16	5.08	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.7	25.4	58.6	0.06	35.2	32.3	82.7	52.0	6.2	7.5	4.3
Cu 2nd Cl Conc		1.0	18.0	44.3	0.22	36.9	33.9	85.0	57.0	31.6	11.4	6.5
Cu 1st Cl Conc		1.2	14.8	36.8	0.20	33.6	31.1	85.3	57.9	35.9	12.6	7.3
Cu/Mo Rougher Conc		9.5	1.93	6.13	0.033	27.3	25.6	88.7	76.8	47.1	81.9	47.7
Pyrite Conc		6.4	0.140	0.90	0.042	7.80	8.76	4.3	7.6	40.2	15.7	11.0
Sulphide Conc		14.6	0.109	1.37	0.023	18.3	17.8	7.7	26.5	51.5	85.0	51.4
Pyrite Tail		84.2	0.017	0.14	0.0010	0.09	2.49	6.9	15.6	12.7	2.4	41.3

Test No.: F10 **Project No.**: 12248-001 **Operator**: CC **Date**: Sept. 17th 2009

Purpose: Batch cleaner test - As G&T KM2344-66
Target 150µm

Procedure: As outlined below.

Feed: 2 x 2 kg of minus 10 mesh Sulphurets Comp

Grind: 44 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = 149 µm
Regrind: Comb Ro Conc 1-2 : 25 minutes in the laboratory pebble mill. P80 = 29 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes			pH	Ep (mV)
	Lime	3418A	AERO 208	PAX	MIBC	CMC		Grind	Cond.	Froth		
Grind	450	-	-	-	-	-		44			9.4	-100
Rougher Circuit												
Rougher 1	20	5	5	-	15	-			1	3	9.5	-30
Rougher 2	-	5	5	-	5	-			1	4	9.0	-10
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	300	-	-	-	-	-		25			11.0	+40
Cu 1st Cleaner	50	2.5	2.5	-	-	5			1	5	11.5	+20
Cu 2nd Cleaner	50.0	1.25	1.25	-	-	-			1	4	11.5	+20
Cu 3rd Cleaner	125	-	-	-	-	3.75			1	3	12.0	-20
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	5	-			1	4	9.0	-40
Pyrite Ro 2	-	-	30	30	7.5	-			1	4	8.8	-60
Total	995	14	74	60	33	9	0					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	500g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1500	1200	1700

Metallurgical Balance

Product	**Weight**		**Assays %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
Cu 3rd Cl Conc	24.1	0.6	25.8	54.0	0.25	32.5	29.8	78.3	51.4	18.2	6.5	3.6
Cu 3rd Cl Tail	8.9	0.2	1.62	12.8	0.98	34.8	30.7	1.8	4.5	26.4	2.6	1.4
Cu 2nd Cl Tail	13.2	0.3	0.51	4.74	0.13	24.5	22.1	0.8	2.5	5.2	2.7	1.5
Cu 1st Cl Tail	329.7	8.2	0.075	1.81	0.011	26.4	24.4	3.1	23.6	11.0	71.9	40.3
Pyrite Conc	299.6	7.5	0.190	0.75	0.021	6.06	7.47	7.2	8.9	19.0	15.0	11.2
Pyrite Tail	3325.4	83.1	0.021	0.070	0.0020	0.05	2.53	8.8	9.2	20.1	1.4	42.1
Head (calc.)	4000.9	100.0	0.20	0.63	0.008	3.02	4.99	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products				Estimated value - Insufficient sample mass								
Cu 3rd Cl Conc		0.6	25.8	54.0	0.25	32.5	29.8	78.3	51.4	18.2	6.5	3.6
Cu 2nd Cl Conc		0.8	19.3	42.9	0.45	33.1	30.0	80.1	55.9	44.6	9.0	5.0
Cu 1st Cl Conc		1.2	13.9	32.0	0.36	30.7	27.8	80.9	58.4	49.8	11.7	6.4
Cu/Mo Rougher Conc		9.4	1.78	5.52	0.053	26.9	24.8	84.0	81.9	60.8	83.6	46.7
Pyrite Conc		7.5	0.190	0.75	0.021	6.06	7.47	7.2	8.9	19.0	15.0	11.2
Sulphide Conc		15.7	0.130	1.31	0.016	16.7	16.3	10.3	32.4	30.0	86.9	51.5
Pyrite Tail		83.1	0.021	0.070	0.0020	0.05	2.53	8.8	9.2	20.1	1.4	42.1

Appendix E – Flotation Locked-cycle Test Details

Test No.: LCT1 **Project No.**: 12248-001 **Operator**: CC/TM **Date**: Oct. 5th 2009

Purpose: Locked cycle test
Target 120µm

Procedure: As outlined below.

Feed: 6 x 4 kg of minus 10 mesh Mitchell Comp (2 x 2kg grinds per cycle)

Grind: 27 minutes / 2 kg @ 65% solids in laboratoryTitan rod mill (RM#1&2). P80 = 129 µm
Regrind: Comb Ro Conc 1-2 : 30 minutes in the laboratory pebble mill. P80 = 28 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes				
	Lime	3418A	AERO 208	PAX	Fuel Oil	MIBC	CMC	Grind	Cond.	Froth	pH	Ep (mV)
Grind **(2kg grinds)**	350	-	-	-	5	-	-	27			9.6	+40
Rougher Circuit ***(4kg in D2 cell)***												
Rougher 1	-	5	5	-	-	7.5	-		1	3	9.6	+15
Rougher 2	-	5	5	-	2.5	5	-		1	4	9.2	+35
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	-	5	-		1	4	8.8	-60
Pyrite Ro 2	-	-	30	30	-	7.5	-		1	4	8.6	-20
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	343	-	-	-	2.5	-	-	30			11.7	-30
Cu 1st Cleaner	25	2.5	2.5	-	-	-	5		1	5	11.8	-30
Cu 1st Cleaner Scavenger	-	2.5	2.5	-	-	-	-		1	2	11.5	-10
Cu 2nd Cleaner	35	1.25	1.25	-	-	-	-		1	4	11.8	-20
Cu 3rd Cleaner	83	-	-	-	1.25	-	*		1	3	12.0	-20
Total	836	16	76	60	11	25	5					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	750g-D1	250g-D1	2000g-D2
Speed: rpm	1700	1600	1200	1700

*cycle A,B ph too high 10.2 reduced lime from 425 to 350
Cycle C pH raised from 11.5 to 11.8 in 1st & 2nd cleaner.Fuel Oil was reduced in cycle C to 1.25 g/t
*Cycle F 5g/t CMC was added to the 3rd cleaner

Metallurgical Projection (D-F)

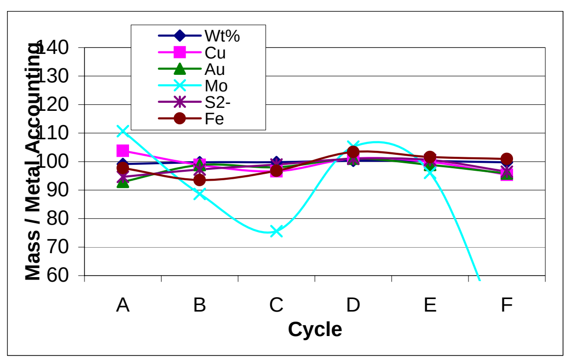
Product	**Weight**	**Weight**	**Assays, %, g/t**					**% Distribution**				
	g	**%**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**	**Cu**	**Au**	**Mo**	**S^{2-}**	**Fe**
3rd Cleaner Conc	95.3	0.80	23.1	53.7	0.41	38.1	32.7	89.0	59.6	59.6	9.7	5.1
Sulphide Conc	1799.2	15.1	0.07	1.25	0.011	18.6	18.3	5.2	26.3	29.1	89.0	53.9
Pyrite Rougher Tail	10043.5	84.1	0.01	0.12	0.001	0.05	2.49	5.8	14.1	11.3	1.3	41.0
Head	11938.0	100.0	0.21	0.72	0.005	3.15	5.11	100.0	100.0	100.0	100.0	100.0

Metallurgical Balance

Product	Weight		Assays %, g/t					% Distribution				
	g	%	Cu	Au	Mo	S^{2-}	Fe	Cu	Au	Mo	S^{2-}	Fe
3rd Cleaner Conc A	30.3	0.13	23.4	53.2	0.42	37.1	31.4	14.2	9.3	7.7	1.5	0.8
3rd Cleaner Conc B	37.0	0.16	19.8	47.8	0.48	38.1	32.1	14.6	10.2	10.7	1.9	1.0
3rd Cleaner Conc C	33.4	0.14	21.9	51.9	0.37	37.4	32.1	14.6	10.0	7.4	1.7	0.9
3rd Cleaner Conc D	34.5	0.14	21.7	50.8	0.57	38.6	33.3	14.9	10.1	11.8	1.8	1.0
3rd Cleaner Conc E	34.2	0.14	21.4	50.5	0.53	38.5	32.3	14.6	9.9	10.9	1.7	0.9
3rd Cleaner Conc F	26.6	0.11	27.1	61.3	0.042	36.9	32.4	14.4	9.4	0.7	1.3	0.7
3rd Cleaner Tail F	12.9	0.05	1.57	16.6	1.47	41.9	35.7	0.4	1.2	11.4	0.7	0.4
2nd Cleaner Tail F	16.1	0.07	0.60	6.79	0.23	29.1	24.6	0.2	0.6	2.2	0.6	0.3
1st Cl Scav Conc F	11.7	0.05	0.60	8.43	0.18	33.4	29.2	0.1	0.6	1.3	0.5	0.3
1st Cl Scav Tail A	362.7	1.52	0.042	1.26	0.0066	22.8	21.1	0.3	2.6	1.4	10.9	6.4
1st Cl Scav Tail B	323.7	1.36	0.050	1.33	0.0039	24.4	19.2	0.3	2.5	0.8	10.4	5.2
1st Cl Scav Tail C	425.0	1.78	0.040	1.34	0.0083	22.8	19.8	0.3	3.3	2.1	12.8	7.0
1st Cl Scav Tail D	373.1	1.56	0.064	1.54	0.0100	24.9	23.7	0.5	3.3	2.2	12.3	7.4
1st Cl Scav Tail E	362.5	1.52	0.048	1.53	0.0084	26.4	24.1	0.3	3.2	1.8	12.7	7.3
1st Cl Scav Tail F	366.3	1.54	0.064	1.54	0.0087	25.4	23.8	0.5	3.2	1.9	12.3	7.3
Pyrite Ro Conc A	240.4	1.01	0.096	0.94	0.0110	9.85	11.1	0.5	1.3	1.6	3.1	2.2
Pyrite Ro Conc B	233.1	0.98	0.082	1.11	0.0093	11.9	13.2	0.4	1.5	1.3	3.7	2.6
Pyrite Ro Conc C	220.6	0.92	0.085	0.65	0.0140	6.21	8.15	0.4	0.8	1.9	1.8	1.5
Pyrite Ro Conc D	229.3	0.96	0.092	0.87	0.0120	8.45	9.87	0.4	1.1	1.7	2.6	1.9
Pyrite Ro Conc E	228.8	0.96	0.093	0.79	0.0150	7.09	9.06	0.4	1.0	2.1	2.1	1.7
Pyrite Ro Conc F	239.2	1.00	0.092	0.76	0.0120	7.12	9.18	0.4	1.0	1.7	2.3	1.8
Pyrite Ro Tail A	3307.7	13.9	0.036	0.12	0.0039	0.05	2.48	2.4	2.3	7.8	0.2	6.9
Pyrite Ro Tail B	3371.7	14.1	0.017	0.12	0.0010	< 0.05	2.42	1.1	2.3	2.0	0.2	6.8
Pyrite Ro Tail C	3289.9	13.8	0.012	0.12	0.0006	< 0.05	2.43	0.8	2.3	1.2	0.2	6.7
Pyrite Ro Tail D	3351.9	14.1	0.015	0.12	0.0009	< 0.05	2.49	1.0	2.3	1.8	0.2	7.0
Pyrite Ro Tail E	3357.9	14.1	0.019	0.12	0.0006	< 0.05	2.48	1.3	2.3	1.2	0.2	7.0
Pyrite Ro Tail F	3333.7	14.0	0.009	0.12	0.0007	< 0.05	2.50	0.6	2.3	1.4	0.2	7.0
Head (calc.)	23854	100.0	0.21	0.73	0.007	3.17	5.01	100.0	100.0	100.0	100.0	100.0
(direct)			0.21	0.80	0.006	3.17	4.86					
Combined Products			Not sufficient sample									
3rd Cleaner Conc A-F	196.0	0.82	22.3	52.2	0.42	37.8	32.3	72.9	49.4	48.5	8.5	4.6
1st Cl Scav Tail A-F	2213.3	9.28	0.051	1.42	0.008	24.4	21.9	4.3	23.9	18.8	84.8	50.6
Ro Conc A-F	2450.0	10.3	1.85	5.63	0.050	25.6	22.9	92.4	85.1	82.9	96.4	56.9
Py Conc A-F	1391.4	5.83	0.090	0.86	0.012	8.46	10.1	1.8	14.9	8.4	59.1	33.3
Py Tail A-F	20012.8	83.9	0.018	0.120	0.001	0.050	2.5	2.1	5.8	8.5	13.3	9.9
Rougher Tail A-F	21404.2	89.7	0.023	0.168	0.002	0.60	2.96	7.2	13.8	15.4	1.3	41.3

Stability Check

Cycle	Wt%	Cu	Au	Mo	S2-	Fe
A	99.1	103.8	92.9	110.7	94.6	97.8
B	99.7	98.8	98.8	88.7	97.2	93.6
C	99.8	96.6	98.0	75.6	99.0	96.8
D	100.3	101.1	101.1	105.3	101.0	103.4
E	100.2	99.9	98.9	96.1	100.6	101.6
F	99.8	95.4	95.8	34.3	96.5	100.9
ave B-F	100.0	98.4	98.5	80.0	98.8	99.2
ave C-F	100.0	98.2	98.4	77.8	99.3	100.7
ave D-F	100.1	98.8	98.6	78.6	99.3	102.0
ave E-F	100.0	97.6	97.3	65.2	98.5	101.3



Test No.: LCT2 **Project No.**: 12248-001 **Operator**: CC/TM **Date**: Oct. 6th 2009

Purpose: Locked cycle test
Target 120µm

Procedure: As outlined below.

Feed: 6 x 4 kg of minus 10 mesh Sulphurets Comp (2 x 2kg grinds per cycle)

Grind: 49 minutes / 2 kg @ 65% solids in laboratory Titan rod mill (RM#1&2). P80 = ~125 µm
Regrind: Comb Ro Conc 1-2 : 30 minutes in the laboratory pebble mill. P80 = 20 µm

Conditions:

Stage	Reagents added, grams per tonne							Time, minutes				
	Lime	3418A	AERO 208	PAX	Fuel Oil	MIBC	CMC	Grind	Cond.	Froth	pH	Ep (mV)
Grind **(2kg grinds)**	425	-	-	-	5	-	-	49			9.6	+35
***Rougher Circuit* (4kg in D2 cell)**												
Rougher 1	-	5	5	-	-	15	-		1	3	9.6	+35
Rougher 2	-	5	5	-	2.5	5	-		1	4	9.5	+30
Pyrite Rougher - on Rougher Tail												
Pyrite Ro 1	-	-	30	30	-	5	-		1	4	9.2	+40
Pyrite Ro 2	-	-	30	30	-	7.5	-		1	4	9.1	-60
Cleaner Circuit - Rougher Conc 1-2												
Regrind (Comb Conc)	370	-	-	-	2.5	-	-	30			11.5	0
Cu 1st Cleaner	40	2.5	2.5	-	-	-	7.5		1	5	11.5	-20
Cu 1st Cleaner Scavenger	-	2.5	2.5	-	-	-	-		1	2	11.2	0
Cu 2nd Cleaner	64.5	1.25	1.25	-	-	-	-		1	4	11.8	-20
Cu 3rd Cleaner	110	-	-	-	1.25	-	*		1	3	12.0	-20
Total	1010	16	76	60	11	33	8					

* as required to maintain pH

Stage	Rougher	Cu 1st Cl	Cu 2nd-3rd Cl	Py Rougher
Flotation Cell # 12 & 8	2000g-D2	750g-D1	250g-D1	2000g-D1
Speed: rpm	1700	1600	1200	1700

*Roughers do not filter quickly
Cycle A increased pH from 11.5 to 11.8
Cycle C reduced fuel oil from 2.5g/t to 1.25 g/t in the 3rd clnr
*Cycle F added 5g/t CMC in the 3rd clnr

Metallurgical Projection (C-F)

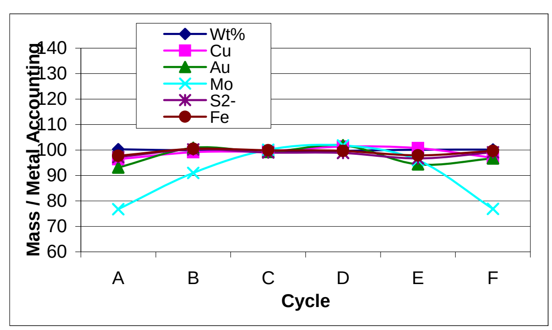
Product	Weight		Assays, %, g/t					% Distribution				
	g	%	Cu	Au	Mo	S^{2-}	Fe	Cu	Au	Mo	S^{2-}	Fe
3rd Cleaner Conc	120.6	0.75	22.7	49.1	0.63	32.1	29.0	85.7	56.1	66.6	8.3	4.3
Sulphide Conc	2764.3	17.3	0.08	1.31	0.008	15.2	15.7	6.7	34.3	20.3	90.0	53.8
Pyrite Rougher Tail	13120.8	82.0	0.02	0.08	0.001	0.06	2.57	7.6	9.6	13.2	1.7	41.8
Head	16005.7	100.0	0.20	0.66	0.007	2.92	5.03	100.0	100.0	100.0	100.0	100.0

Metallurgical Balance

Product	Weight		Assays %, g/t					% Distribution				
	g	%	Cu	Au	Mo	S^{2-}	Fe	Cu	Au	Mo	S^{2-}	Fe
3rd Cleaner Conc A	25.5	0.11	26.2	54.3	0.62	33.1	29.9	13.8	8.6	8.6	1.2	0.6
3rd Cleaner Conc B	27.3	0.11	24.8	54.9	0.60	32.9	29.2	14.0	9.3	8.9	1.3	0.7
3rd Cleaner Conc C	30.6	0.13	23.1	50.2	0.70	32.5	29.6	14.6	9.5	11.7	1.4	0.7
3rd Cleaner Conc D	32.5	0.13	21.3	47.2	0.66	32.0	28.8	14.3	9.5	11.7	1.5	0.8
3rd Cleaner Conc E	29.0	0.12	23.3	48.3	0.67	32.4	29.6	14.0	8.7	10.6	1.3	0.7
3rd Cleaner Conc F	28.5	0.12	23.7	51.3	0.49	31.7	28.3	14.0	9.0	7.6	1.3	0.7
3rd Cleaner Tail F	11.4	0.05	2.08	14.2	0.94	29.6	26.0	0.5	1.0	5.8	0.5	0.2
2nd Cleaner Tail F	18.0	0.07	0.81	6.93	0.26	23.4	21.4	0.3	0.8	2.6	0.6	0.3
1st Cl Scav Conc F	12.2	0.05	0.72	6.91	0.18	24.4	22.4	0.2	0.5	1.2	0.4	0.2
1st Cl Scav Tail A	418.5	1.74	0.056	1.64	0.005	21.8	20.5	0.5	4.2	1.2	12.8	7.0
1st Cl Scav Tail B	433.6	1.80	0.067	1.70	0.011	21.7	21.0	0.6	4.6	2.6	13.2	7.5
1st Cl Scav Tail C	403.5	1.68	0.062	1.79	0.009	22.3	21.9	0.5	4.5	1.9	12.6	7.2
1st Cl Scav Tail D	405.9	1.69	0.060	1.73	0.009	21.3	20.9	0.5	4.3	2.0	12.1	7.0
1st Cl Scav Tail E	405.7	1.69	0.064	1.64	0.008	21.0	20.6	0.5	4.1	1.8	11.9	6.9
1st Cl Scav Tail F	428.5	1.78	0.056	1.67	0.008	20.9	20.3	0.5	4.4	1.8	12.5	7.1
Pyrite Ro Conc A	286.2	1.19	0.110	0.620	0.007	5.07	7.25	0.7	1.1	1.0	2.0	1.7
Pyrite Ro Conc B	274.2	1.14	0.110	0.690	0.010	5.22	7.21	0.6	1.2	1.5	2.0	1.6
Pyrite Ro Conc C	266.1	1.11	0.100	0.710	0.009	6.04	8.24	0.6	1.2	1.3	2.2	1.8
Pyrite Ro Conc D	310.6	1.29	0.100	0.700	0.008	6.09	7.86	0.6	1.3	1.3	2.6	2.0
Pyrite Ro Conc E	282.6	1.17	0.120	0.770	0.008	6.49	8.30	0.7	1.3	1.3	2.6	1.9
Pyrite Ro Conc F	261.4	1.09	0.096	0.760	0.008	6.69	7.89	0.5	1.2	1.2	2.4	1.7
Pyrite Ro Tail A	3293.0	13.7	0.016	0.080	0.001	0.05	2.56	1.1	1.6	2.0	0.2	6.9
Pyrite Ro Tail B	3270.2	13.6	0.019	0.090	0.001	0.06	2.61	1.3	1.8	2.1	0.3	7.0
Pyrite Ro Tail C	3294.2	13.7	0.013	0.070	0.001	0.06	2.54	0.9	1.4	1.8	0.3	6.9
Pyrite Ro Tail D	3250.0	13.5	0.021	0.090	0.001	0.06	2.58	1.4	1.8	1.9	0.3	6.9
Pyrite Ro Tail E	3276.6	13.6	0.023	0.080	0.001	0.07	2.54	1.6	1.6	2.3	0.3	6.8
Pyrite Ro Tail F	3300.0	13.7	0.017	0.070	0.001	0.06	2.63	1.2	1.4	2.2	0.3	7.1
Head (calc.)	24076	100.0	0.20	0.67	0.008	2.97	5.06	100.0	100.0	100.0	100.0	100.0
(direct)			0.20	0.69	0.008	2.92	4.87					
Combined Products			Not sufficient sample									
3rd Cleaner Conc A-F	173.4	0.72	23.6	50.8	0.63	32.4	29.2	84.8	54.5	59.1	7.9	4.2
1st Cl Scav Tail A-F	2495.7	10.4	0.06	1.69	0.008	21.5	20.9	3.1	26.1	11.4	75.1	42.7
Ro Conc A-F	2710.7	11.3	1.58	4.95	0.054	22.3	21.4	88.9	82.9	80.1	84.4	47.6
Py Conc A-F	1681.1	6.98	0.11	0.71	0.008	5.9	7.8	3.7	7.4	7.6	13.9	10.7
Py Tail A-F	19684.0	81.8	0.018	0.080	0.001	0.06	2.58	7.4	9.7	12.3	1.7	41.6
Rougher Tail A-F	21365.1	88.7	0.025	0.129	0.002	0.52	2.99	11.1	17.1	19.9	15.6	52.4

Stability Check

Cycle	Wt%	Cu	Au	Mo	S2-	Fe
A	100.3	96.4	93.2	76.7	97.2	97.7
B	99.8	99.2	100.8	91.0	100.2	100.5
C	99.5	99.5	99.3	100.1	99.0	99.9
D	99.7	101.4	101.8	101.8	98.8	99.7
E	100.1	100.7	94.4	96.0	96.7	97.9
F	100.1	97.0	96.7	76.9	99.1	99.7
ave C-F	100.0	99.7	97.6	91.6	98.2	99.1
ave D-F	100.1	98.9	95.5	86.4	97.9	98.8
ave E-F	100.1	98.9	95.5	86.4	97.9	98.8



Appendix F – Cyanidation Test Details

CN- 1	12248-001	SA	November 3, 2009

Purpose: To examine the Au extraction by cyanide on a sulphide concentrate

Procedure: The feed was pulped to 40% solids with fresh water in a 2L bottle. The pulp was brought to pH 12.0 with lime. The pulp was rolles and aerated (at 2 lpm air) for 5 hours. 2.0 g/L of cyanide was added. NaCN, DO and pH were monitored over the duration of the test and the NaCN was allowed to drop to 0.5 g/L. At 24h, the termination of the test, the pulp was filtered and the residue was washed well with fresh water. The final leach solution was submitted for Au and Cu assay. The Residue was assayed for Au and Cu in duplicate and a size analysis was done.

Feed: 250 g **LCT-1 $S^{=}$ Concentrate F**

Solution Volume: 375 mL

Pulp Density: 40.0 % solids

Sol'n Composition: 2.0 g/L NaCN initial
0.5 g/L NaCN maintained (0.19g)
-

pH Range: 10.5 - 11 maintained with lime as required.

Regrind: 30 min/ 250g @ 50% solids in lab pebble mill #2. P_{80} =15.51µm

Reagent Addition (kg/t of cyanide feed) NaCN: 3.08 CaO: 1.24
Reagent Consumption (kg/t of cyanide feed) NaCN: 0.99 CaO: 1.19

Time	Added, Grams				Residual		Consumed		pH	DO
	Actual		Equivalent		Grams		Grams			
hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
Aeration:									7.2	<1
0-1		0.749		0.55					12.0 - 11.4	1.4
1-3		0.259		0.19					12.0 - 11.5	8.9
3-5		0.207		0.15					12.0 - 11.4	5.8
Cyanidation:										
0-1	0.79	0.21	0.75	0.16	0.69		0.06		12.0 - 11.9	
1-3	0.00	0.00	0.00	0.00	0.65		0.04		11.9 - 11.5	
3-18	0.00	0.00	0.00	0.00	0.59		0.10		11.5 - 11.5	7.7
18-24	0.00	0.20	0.00	0.14	0.51	0.01	0.08	0.29	12.0 - 11.2	8.8
Total	0.79	0.41	0.75	0.30	0.51	0.01	0.24	0.29		

Final Titration: Sample Vol. (mL): 23.75 $AgNO_3$Vol.(mL): 5.99 Oxalic Vol. (mL): 0.70

Cyanidation Results:

Product	Amount g, mL	Assays mg/L, g/t		% Distribution	
		Au	Cu	Au	Cu
24 h Pregnant Solution	404	0.34	119	59.1	33.0
Final Residue	243.8	0.39	0.040	40.9	67.0
Head (calc.)	243.8	0.95	0.060	40.9	100.0

Replicate Assays: 0.39 **g/t Au**
0.39 **g/t Au**
0.39 **g/t Au**

Purpose: To examine the Au extraction by cyanide on a sulphide concentrate

Procedure: The feed was pulped to 40% solids with fresh water in a 2L bottle. The pulp was brought to pH 12.0 with lime. The pulp was rolles and aerated (at 2 lpm air) for 5 hours. 2.0 g/L of cyanide was added. NaCN, DO and pH were monitored over the duration of the test and the NaCN was allowed to drop to 0.5 g/L. At 24h, the termination of the test, the pulp was filtered and the residue was washed well with fresh water. The final leach solution was submitted for Au and Cu assay. The Residue was assayed for Au and Cu in duplicate and a size analysis was done.

Feed: 250 g **LCT-2 $S^{=}$ Concentrate F**

Solution Volume: 375 mL

Pulp Density: 40.0 % solids

Sol'n Composition: 2.0 g/L NaCN initial (0.75g)
0.5 g/L NaCN maintained (0.19g)

pH Range: 10.5 - 11 maintained with lime as required.

Regrind: 30 min/ 250g @ 50% solids in lab pebble mill #2. P_{80} = 14.78 µm

Reagent Addition (kg/t of cyanide feed) NaCN: 3.07 CaO: 1.57
Reagent Consumption (kg/t of cyanide feed) NaCN: 1.39 CaO: 1.55

Time	Added, Grams				Residual		Consumed		pH	DO
	Actual		Equivalent		Grams		Grams			
hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
Aeration:									7.1	<1
0-1		0.785		0.58					12.1 - 11.3	2.6
1-3		0.281		0.21					12.0 - 11.3	<1
3-5		0.275		0.20					12.1 - 10.7	5.1
Cyanidation:										
0-1	0.79	0.25	0.75	0.19	0.72		0.03		10.2 - 11.9	
1-3	0.00	0.00	0.00	0.00	0.66		0.06		11.9 - 11.1	
3-18	0.00	0.00	0.00	0.00	0.55		0.17		11.1 - 11.1	7.1
18-24	0.00	0.27	0.00	0.20	0.41	0.01	0.14	0.38	12.0 - 11.1	8.9
Total	0.79	0.52	0.75	0.38	0.41	0.01	0.34	0.38		

Final Titration: Sample Vol. (mL): 25.36 $AgNO_3$Vol.(mL): 5.17 Oxalic Vol. (mL): 0.40

Cyanidation Results:

Product	Amount	Assays mg/L, g/t		% Distribution	
	g, mL	Au	Cu	Au	Cu
24 h Pregnant Solution	402	0.50	131	51.5	30.1
Final Residue	244	0.78	0.050	48.5	69.9
Head (calc.)	244	1.60	0.072	48.5	69.9

Replicate Assays: 0.79 **g/t Au**
0.76 **g/t Au**
0.78 **g/t Au**
0.80 **g/t Au**
Average 0.78 **g/t Au**

Purpose: To examine the Au extraction by CIL on a sulphide concentrate

Procedure: The feed was ground 30 minutes in a lab pebble mil. The mill discharge was pulped to 40% solids with fresh water in a 2L bottle. The pulp was brought to pH 12.0 with lime. The pulp was placed on rolls and aerated (at 2 lpm air) for 5 hours. After 5 hours, 20 g/L of carbon (that had been soaked overnight in cyanide) and 2.0 g/L of cyanide were added. NaCN, DO and pH were monitored over the duration of the test and the NaCN was allowed to drop to 0.5 g/L-1.0 g/L. At 24h, the termination of the test, the carbon was screened from the pulp and the pulp was filtered. The residue was washed well with fresh water. The final leach solution was submitted for Au and Cu assay. The residue was assayed for Au (in duplicate) and Cu. .

Feed: 250 g **LCT-1 $S^{=}$ Concentrate E**

Solution Volume: 375 mL

Pulp Density: 40.0 % solids

Sol'n Composition: 2.0 g/L NaCN initial
0.5 - 1.0 g/L NaCN maintained (0.19g)

Carbon: 20.0 g/L soaked in a 1g/L NaCN solution overnight

pH Range: 10.5 - 11 maintained with lime as required.

Regrind: 30 min/ 250g @ 50% solids in lab pebble mill #2.

Reagent Addition (kg/t of cyanide feed) NaCN: 3.06 CaO: 4.58
Reagent Consumption (kg/t of cyanide feed) NaCN: 1.02 CaO: 4.39

Time	Added, Grams				Residual		Consumed		pH	DO
	Actual		Equivalent		Grams		Grams			
hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
Aeration:									7.0	<1
0-1		0.59		0.44					12.0 - 11.2	<1
1-3		0.24		0.18					12.0 - 11.2	8.0
3-5		0.18		0.13					12.0 - 11.2	1.6
Cyanidation:										
0-3	0.79	0.19	0.75	0.14	---		---		12.0 - 11.6	7.70
3-19	0.00	0.11	0.00	0.08	0.52		0.23		12.0 - 11.2	5.30
19-24	0.00	0.20	0.00	0.15	0.50	0.05	0.02	1.08	12.0 - 11.8	6.1
Total	0.79	1.52	0.75	1.12	0.50	0.05	0.25	1.08		

Final Titration: Sample Vol. (mL): 22.82 $AgNO_3$Vol.(mL): 5.43 Oxalic Vol. (mL): 2.60

Cyanidation Results:

Product	Amount	Assays mg/L, g/t		% Distribution	
	g, mL	Au	Cu	Au	Cu
24 h Barren Solution	421	<0.01	116	1.2	30.1
Carbon	7.81	30.2	0.10	69.8	4.8
Final Residue	245	0.40	0.043	29.0	65.1
Head (calc.)	245	1.38	0.066	29.0	100.0

Replicate Assays: 0.40 **g/t Au**
0.40 **g/t Au**
0.40 **g/t Au**
Average: 0.40 g/t Au

CIL- 4	12248-001	SA	November 19, 2009

Purpose: To examine the Au extraction by CIL on a sulphide concentrate

Procedure: The feed was ground 30 minutes in a lab pebble mil. The mill discharge was pulped to 40% solids with fresh water in a 2L bottle. The pulp was brought to pH 12.0 with lime. The pulp was placed on rolls and aerated (at 2 lpm air) for 5 hours. After 5 hours, 20 g/L of carbon (that had been soaked overnight in cyanide) and 2.0 g/L of cyanide were added. NaCN, DO and pH were monitored over the duration of the test and the NaCN was allowed to drop to 0.5 g/L-1.0 g/L. At 24h, the termination of the test, the carbon was screened from the pulp and the pulp was filtered. The residue was washed well with fresh water. The final leach solution was submitted for Au and Cu assay. The residue was assayed for Au (in duplicate) and Cu. .

Feed: 250 g **LCT-2 $S^{=}$ Concentrate E**

Solution Volume: 375 mL

Pulp Density: 40.0 % solids

Sol'n Composition: 2.0 g/L NaCN initial
0.5 - 1.0 g/L NaCN maintained (0.19g)

Carbon: 20.0 g/L soaked in a 1g/L NaCN solution overnight

pH Range: 10.5 - 11 maintained with lime as required.

Regrind: 30 min/ 250g @ 50% solids in lab pebble mill #2.

Reagent Addition (kg/t of cyanide feed) NaCN: 3.12 CaO: 4.84
Reagent Consumption (kg/t of cyanide feed) NaCN: 1.16 CaO: 4.67

Time	Added, Grams				Residual		Consumed		pH	DO
	Actual		Equivalent		Grams		Grams			
hours	NaCN	$Ca(OH)_2$	NaCN	CaO	NaCN	CaO	NaCN	CaO		
Aeration:									6.6	<1
0-1		0.696		0.52					12.0 - 10.8	<1
1-3		0.220		0.16					12.0 - 10.9	4.8
3-5		0.158		0.12					12.0 - 10.9	2.8
Cyanidation:										
0-3	0.79	0.16	0.75	0.12	---		---		11.9 - 11.4	9.70
3-19	0.00	0.16	0.00	0.12	0.49		0.26		12.0 - 11.3	6.20
19-24	0.00	0.17	0.00	0.13	0.47	0.04	0.02	1.12	12.0 - 11.8	6.4
Total	0.79	1.57	0.75	1.16	0.47	0.04	0.28	1.12		

Final Titration: Sample Vol. (mL): 26.16 $AgNO_3$Vol.(mL): 5.99 Oxalic Vol. (mL): 2.60

Cyanidation Results:

Product	Amount	Assays mg/L, g/t		% Distribution	
	g, mL	Au	Cu	Au	Cu
24 hBarren Solution	411	<0.01	107	1.3	27.5
Carbon	7.84	28.3	0.10	69.2	4.9
Final Residue	240	0.39	0.045	29.5	67.6
Head (calc.)	240	1.33	0.067	29.5	100.0

Duplicate Assays: 0.40 **g/t Au**
0.39 **g/t Au**
0.39
Average 0.39 g/t Au

KOEPPERN MACHINERY AUSTRALIA
ABN 26 072 782 891

John (Jianhui) Huang
Senior Metallurgist
Wardrop Engineering Inc.

CC: Hassan Ghaffari
Manager, Metallurgy
Wardrop Engineering Inc.

Our reference	Telephone No.	Facsimile No.	Date
KMA913snR	08 9248 4170	08 9248 4176	22 February 2010

High Pressure Comminution Test Work

on

Processing of

Mitchell Zone Ore

for

Seabridge Gold / Wardrop Engineering Inc.

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1 Executive Summary

The purpose of the test work program was to assess the high pressure comminution process in application to material from the Mitchell zone.

Material from the Mitchell zone was supplied in core form to the University of British Columbia. The whole sample was crushed, screened, combined and homogenized. A range of grinding and feed parameters was tested to evaluate the response of the ore to the HPGR process. The scenario of an HPGR operating in closed circuit was also investigated using Mitchell Zone material. The influence of machine and process parameters on comminution performance was determined through analysis of final test work data.
The main observations are:

- Significant size reduction was achieved in comparison to previously tested materials
- A specific pressing force of 4 N/mm^2 was considered to be optimum on the basis of both size reduction and throughput performance
- Varying roll speed did not produce a significant impact on HPGR performance
- An increase in feed moisture had a negative impact on throughput and energy consumption
- Variation in feed top size did not produce a significant difference in P50 percentage particle size of HPGR product
- Higher HPGR throughputs were achieved with closed circuit tests than with single pass tests at equivalent machine testing parameters

The HPGR test work program showed that the supplied Mitchell material is amenable to the HPGR process. Test work results from the program are sufficient to carry out HPGR and motor sizing once HPGR circuit and feed parameters are established.
The test work program was carried out on Köppern's pilot HPGR plant located at the University of British Columbia. The pilot plant HPGR is fitted with rollers 0.75 m in diameter and a width of 0.22 m.

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1.1 Test Equipment

All experiments were carried out on the HPGR designed by Köppern. The HPGR is fitted with Köppern's proprietary wear protection Hexadur® WTII specifically designed for comminution of highly abrasive minerals.

Table 1 Pilot Plant HPGR technical data

Roller Diameter:	750mm
Roller width:	220mm
Press drive:	Dual output shaft gear reducer
Feed system:	Gravity
Wear surface:	Hexadur® WTII
Installed Power:	200kW
Maximum pressing force:	1600kN
Maximum specific pressing force:	8.5N/mm^2
Variable speed drive:	up to 40 rpm (1.55 m/s)

Figure 1: Main view of the HPGR pilot plant and Hexadur® wear surface.

Experimental data is recorded every 200ms. The computer system measures: time; roller gap (left and right); pressing force (left and right); power consumption. This data allows for in-depth process analysis and sizing of HPGR presses for industrial applications.

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2 Definitions

2.1 Process Specific Throughput Constant (m-dot)

The press throughput W [t/h] is a function of, roller diameter D[m], roller width L [m] and roller peripheral speed ν [m/s] and the specific throughput constant (m-dot). The value is calculated from:

$$m-dot = \frac{W}{DL\nu} \qquad [ts/hm^3]$$

Where:	W [t/h]	–	throughput rate
	D [m]	–	roller diameter
	L [m]	–	roller width
	ν [m/s]	–	roller peripheral speed

The specific throughput constant m-dot is used to calculate the throughput of HPGRs which differ in size. For a given feed material, m-dot represents the throughput [t/h] of an HPGR fitted with rollers 1 m in diameter, 1 m width and revolving at 1 m/s peripheral speed.

2.2 Specific Pressing Force (F_{sp})

Specific pressing force represents the total pressing force applied on the floating roller by the HPGR hydraulic system per unit surface area of the roller cross section.

$$F_{sp} = \frac{F}{LD} \qquad [kN/m^2]$$

Where:	F [kN]	–	Total pressing (grinding) force

Specific pressing force is used for process performance comparison of HPGRs which differ in size.

2.3 Net Specific Energy Consumption (E_{sp})

Net specific energy describes the energy consumed by the grinding process for each tonne of feed/product material. It is determined by the following:

$$E_{SPnet} = \frac{P_t - P_i}{W_{sp}} \qquad \text{[kWh/t]}$$

Where:	P_t [kW]	–	total power draw (fixed and floating roller combined)
	P_i [kW]	–	power draw (fixed and floating roll combined) in idle conditions
	W_{sp} [t/h]	–	press throughput

Net specific power consumption is used to determine the required main motor size for an industrial application.

3 HPGR Pilot Plant Tests

3.1 HPGR Feed Material Preparation and Description of Test Samples

The University of British Columbia received 15 drums (~5.5 tons) of core from the Mitchell Zone. The contents of the15 drums was crushed, screened, combined, homogenized and then split into drums. Representative samples were taken for determination of PSD, bulk density and moisture. Additional details regarding feed preparation are shown in the appendix, Table A4.
The following feed material parameters were determined:

KSM-(32 mm) Sample
Tests KSMO01 – KSM008

Moisture:	0.4 %
Bulk Density:	1.97 t/m^3
F100:	32 mm
F80:	23.04 mm
F50:	13.87 mm

KSM –(25 mm) Sample
Test KSM009

Moisture:	0.4 %
Bulk Density:	1.96 t/m^3
F100:	25 mm
F80:	19.85 mm
F50:	10.76 mm

KSM –(19 mm) Sample
Test KSM010

Moisture:	0.4 %
Bulk Density:	1.83 t/m^3
F100:	19 mm
F80:	12.69 mm
F50:	7.60 mm

Fresh feed weights can be found in appendix (A – Table A2).

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3.2 Test Program

Table 2: Process set point parameters

Test Description	Test Number	Feed Type	Moisture	Static Gap	Specific Pressing Force	Roller speed
				X_0	F_{SP}	ν
			[%]	[mm]	[N/mm^2]	[m/s]
Pressure Tests	KSM001	(-32 mm)	2.5	9	4.0	0.75
	KSM002		2.5	9	3.5	0.75
	KSM003		2.5	9	3.0	0.75
	KSM004		2.5	9	5.0	0.75
Roll Speed Tests	KSM005		2.5	9	4.0	0.60
	KSM006		2.5	9	4.0	0.92
Moisture Tests	KSM007		0.4	9	4.0	0.75
	KSM008		5.0	9	4.0	0.75
Top Size Tests	KSM009	(-25 mm)	2.5	9	4.0	0.75
	KSM010	(-19 mm)	2.5	9	4.0	0.75
Recycle Tests	KSM011	Rec 1 (-32 mm)	2.5	9	4.0	0.75
	KSM012	Rec 2 (-32 mm)	2.5	9	4.0	0.75
	KSM013	Rec 3 (-32 mm)	2.5	9	4.0	0.75

HPGR products were split at the product conveyor using a diverter gate. Approximately equal amounts of drive and non-drive edge product were collected. The diverter gate was adjusted to a setting where 32% of HPGR product material is collected as edge product and 68% as centre product. During each test run pieces of flake were collected from the centre of the belt for thickness and density tests. Flake densities were derived from buoyancy tests.

3.3 Test Results

A summary of main test results is presented below in
Table 3. For the case of KSM HPGR test work, values included in the summary are considered to be critical indicators of grinding performance.
Full results are tabulated in appendix A.

Table 3: Summary of test results

Test Description	Test Number	Feed Type	Specific Pressing Force [N/mm²]	Specific Throughput Constant [ts/hm³]	Net Specific Energy Consumption [kWh/t]	Centre & 1/3 Edge P80 [mm]	Centre & 1/3 Edge P50 [mm]
Pressure Tests	KSM001	(-32 mm)	4.0	219	1.99	4.79	1.23
	KSM002		3.5	235	1.74	5.22	1.43
	KSM003		3.0	237	1.55	5.58	1.60
	KSM004		5.0	217	2.61	4.29	1.04
Roll Speed Tests	KSM005		4.0	223	2.05	4.70	1.28
	KSM006		4.0	222	1.99	5.12	1.41
Moisture Tests	KSM007		4.0	256	1.76	5.09	1.36
	KSM008		4.0	196	2.75	5.03	1.23
Top Size Tests	KSM009	(-25 mm)	4.0	226	1.98	5.15	1.39
	KSM010	(-19 mm)	4.0	229	1.94	3.88	0.99
Recycle Tests	KSM011	Rec 1	4.0	231	1.95	4.50	1.25
	KSM012	Rec 2	4.0	233	1.95	4.72	1.36
	KSM013	Rec 3	4.0	242	1.87	4.46	1.24

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3.3.1 Comminution Effect – Product PSD

Considerable size reduction of Mitchell Zone material was achieved with the high pressure grinding process. Comminution performance is assessed through the comparison of product P80 and P50 percentage particle sizes. Figure 2 shows the F80/P80 and F50/P50 reduction ratios found with the tested material. It can be seen that increasing specific pressing force had a significant impact on size reduction. Complete particle size distribution results are presented in the appendix.

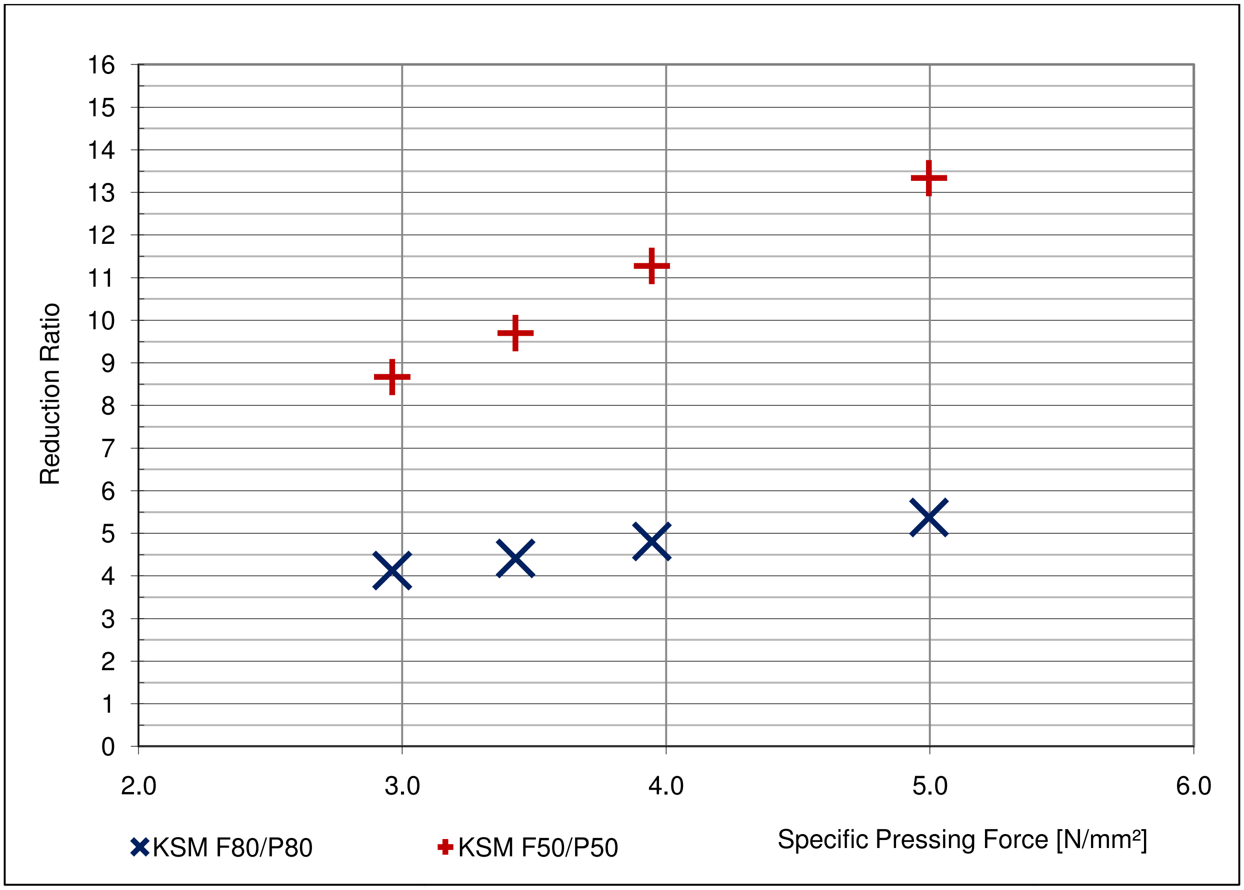

Figure 2 Reduction ratio F80/P80 & F50/P50 versus specific pressing force

Similarly, Figure 3 shows how P80 and P50 percentage particle sizes decreased as specific pressing force increased.

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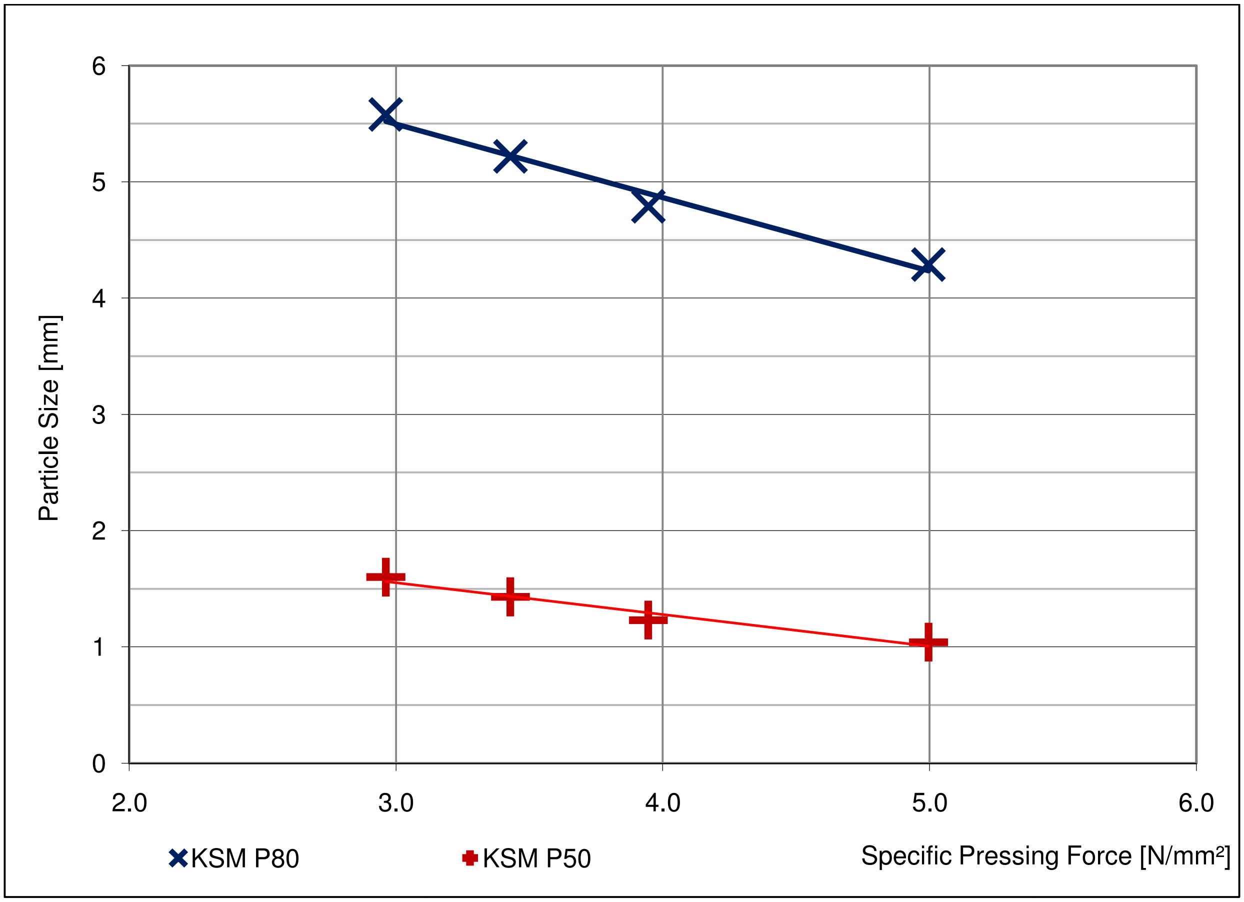

Figure 3: Combined centre and 1/3 edge P80 & P50 versus specific pressing force

3.3.2 Specific Throughput

The specific throughput constant m-dot has been calculated from experimental data. Figure 4 shows the relationship between specific throughput and specific pressing force for the tested Mitchell material. As seen in the graph, lower values of specific throughput m-dot are typically achieved with higher specific pressing forces.

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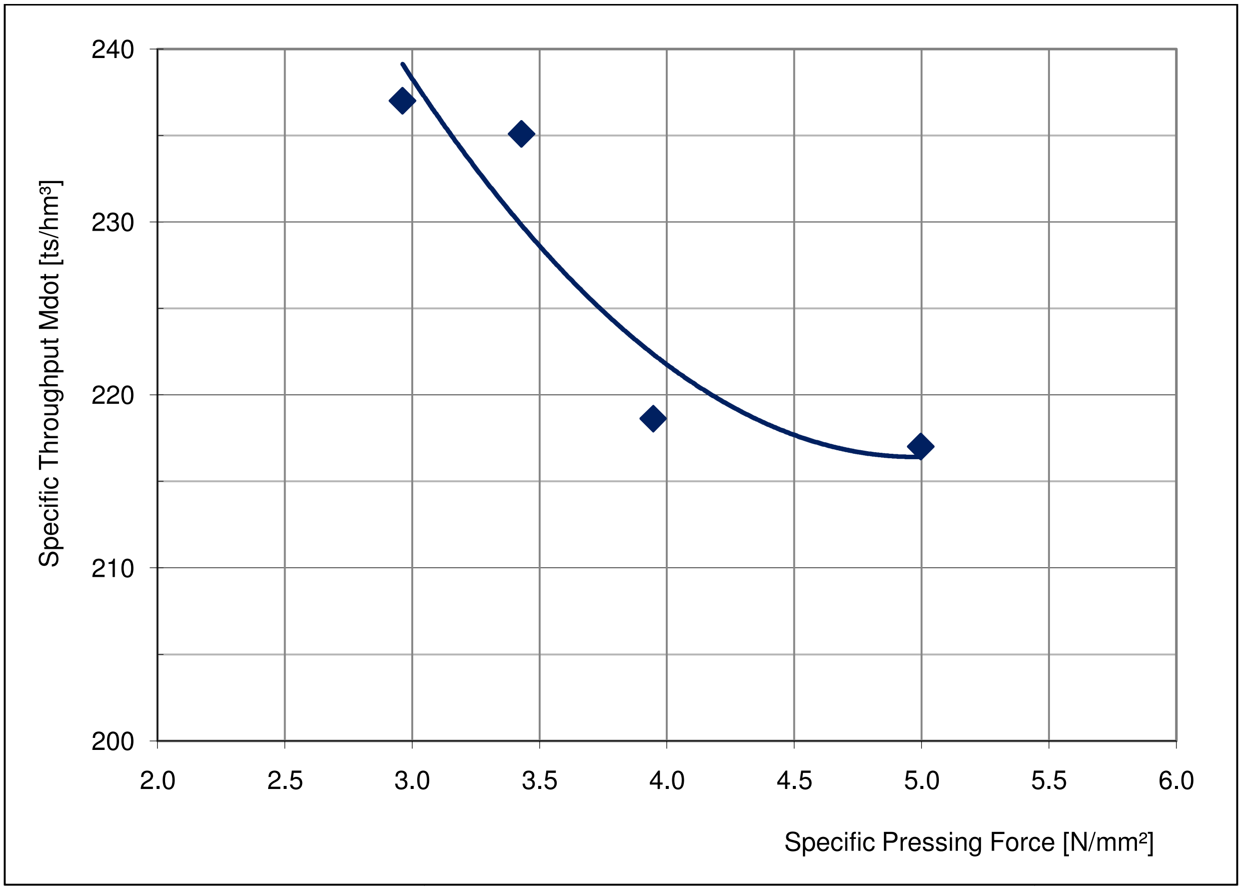

Figure 4: Specific throughput m-dot versus specific pressing force

3.3.3 Energy Consumption

Figure 5 compares the net specific energy consumption across a range of tested specific pressing force settings. The highest net specific energy consumption of 2.61 kWh/t was recorded at 5 N/mm^2. An increase in specific pressing force produced a linear increase in net specific energy consumption. The increase in specific energy consumption also reflected the improvement in size reduction as previously shown in section 3.3.1.

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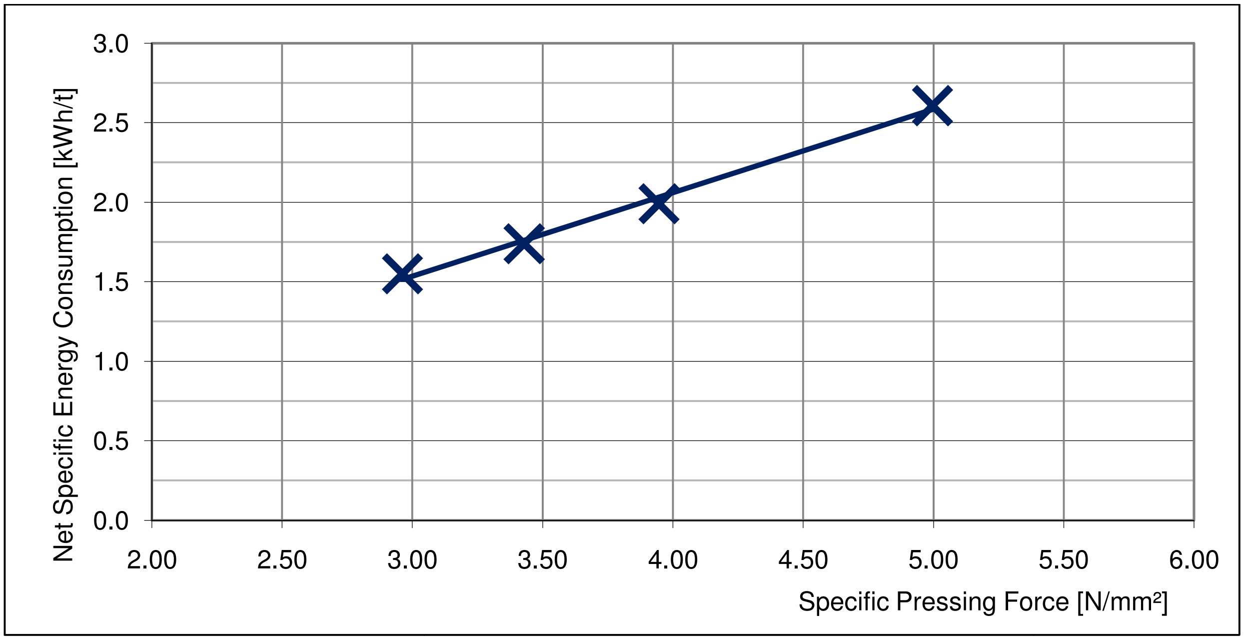

Figure 5: Net specific energy consumption versus specific pressing force

3.3.4 Assessment of Roll Speed

Investigation into the influence of roll speed on product particle size was carried out by conducting three tests varying only in roll speed set-point. Comparison of results showed that the roll speed did not have a strong influence on product particle size, as shown in Figure 6.

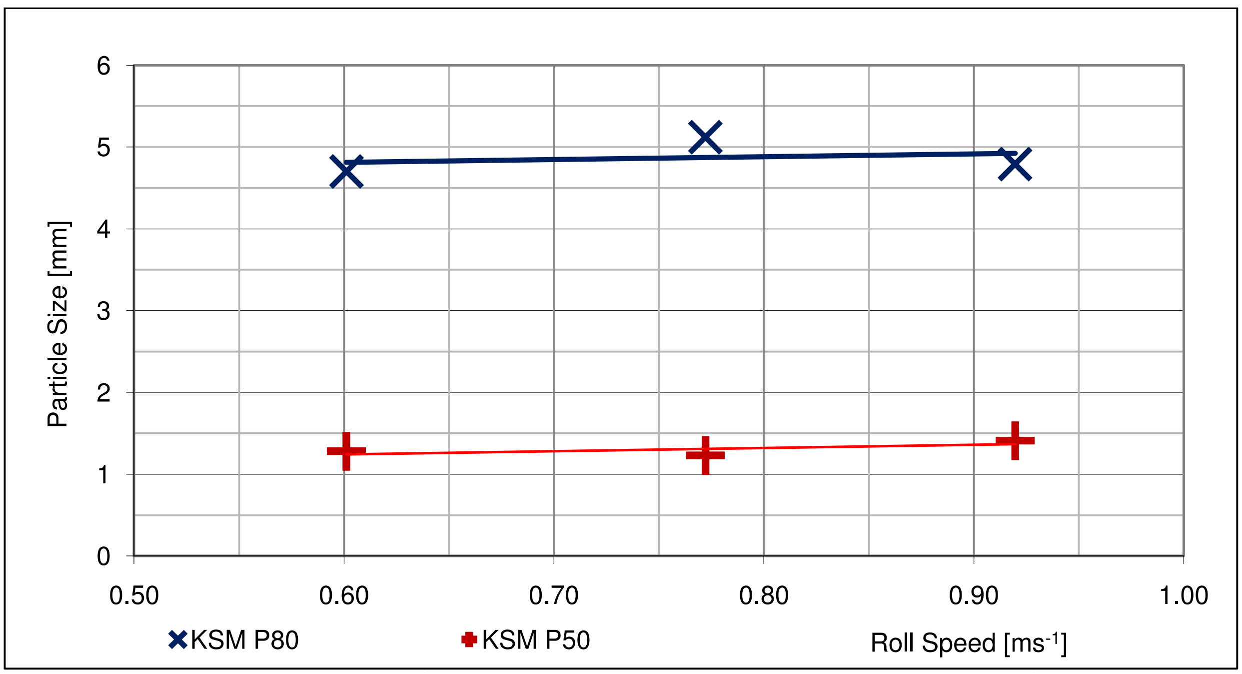

Figure 6: Combined centre and 1/3 edge P80 & P50 versus roll speed

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Small differences in net specific energy consumption and specific throughput m-dot were found when the roll speed was increased from 0.6 to 0.92 ms^{-1}. Figure 7 shows that increasing the roll speed from 0.6 to 0.92 ms^{-1} had little influence on specific throughput m-dot.

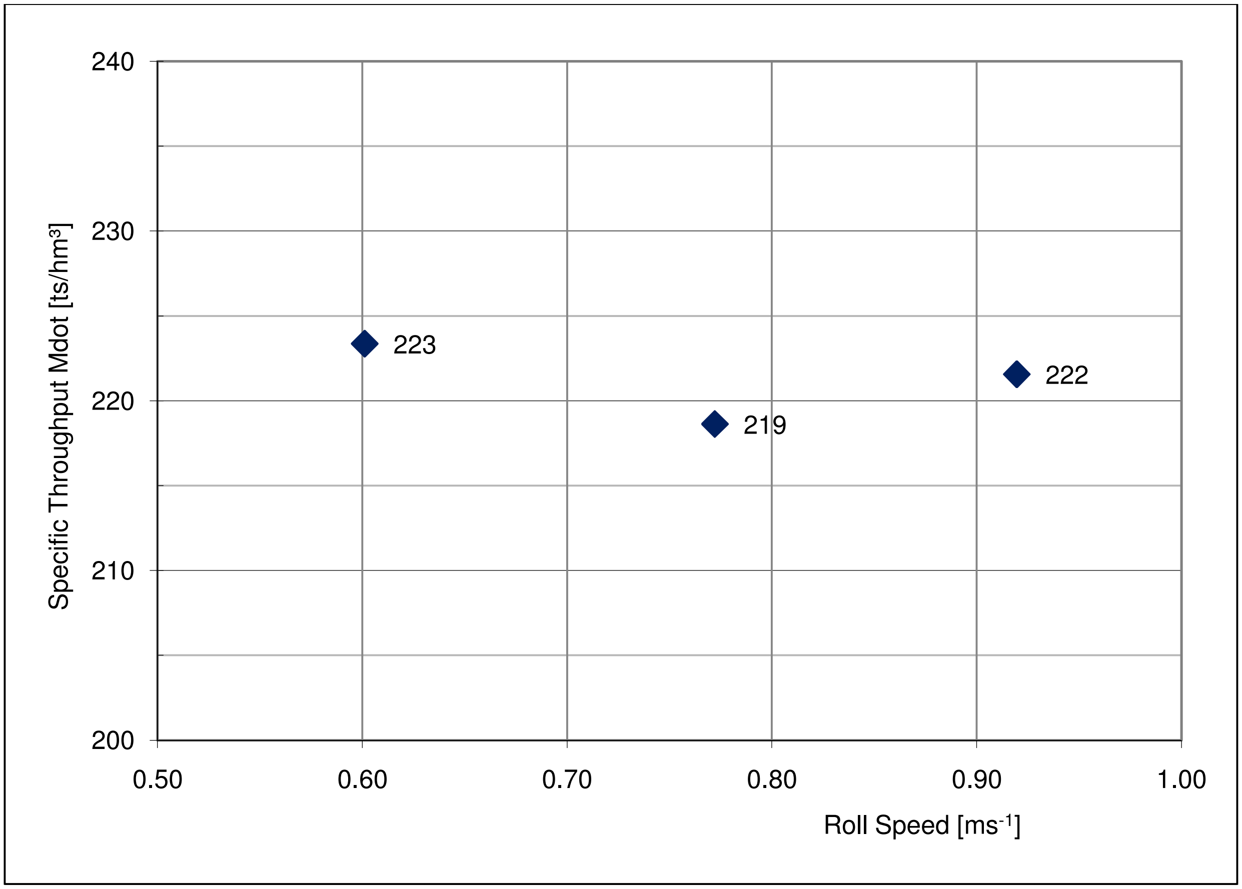

Figure 7: Specific throughput m-dot versus roll speed

3.3.5 Assessment of Feed Moisture

Three HPGR tests were carried out using feed which had been adjusted to different moisture levels. The HPGR set point parameters, sample type and feed size distribution was equivalent for the three tests. Figure 8 shows the influence of feed moisture content on the fineness of combined centre and edge product. Only slight variations in P80 and P50 percentage particle sizes of combined HPGR product were observed. A distinct relationship between moisture and product particle size was not apparent.

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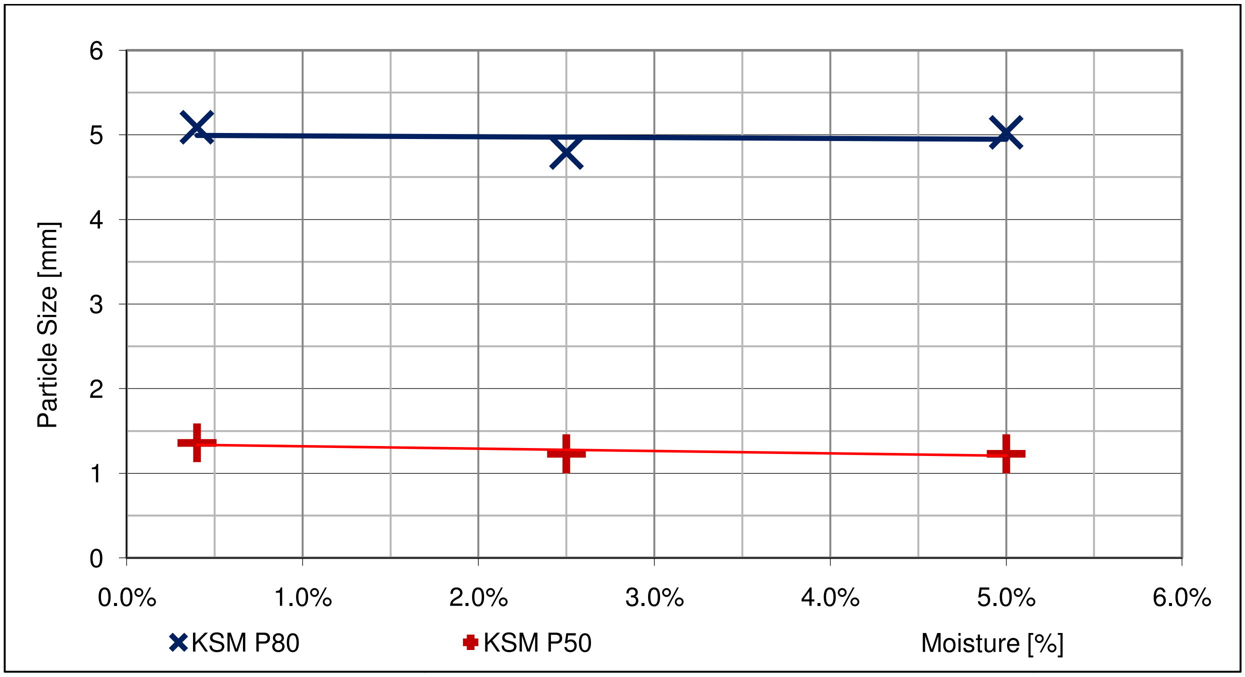

Figure 8: Combined centre and 1/3 edge P80 & P50 versus feed moisture

The influence of feed moisture on specific throughput is shown in Figure 9. A distinct relationship between specific throughput and moisture content of feed material is evident. A decrease in HPGR throughput for higher levels of feed moisture is a characteristic of HPGR processing.

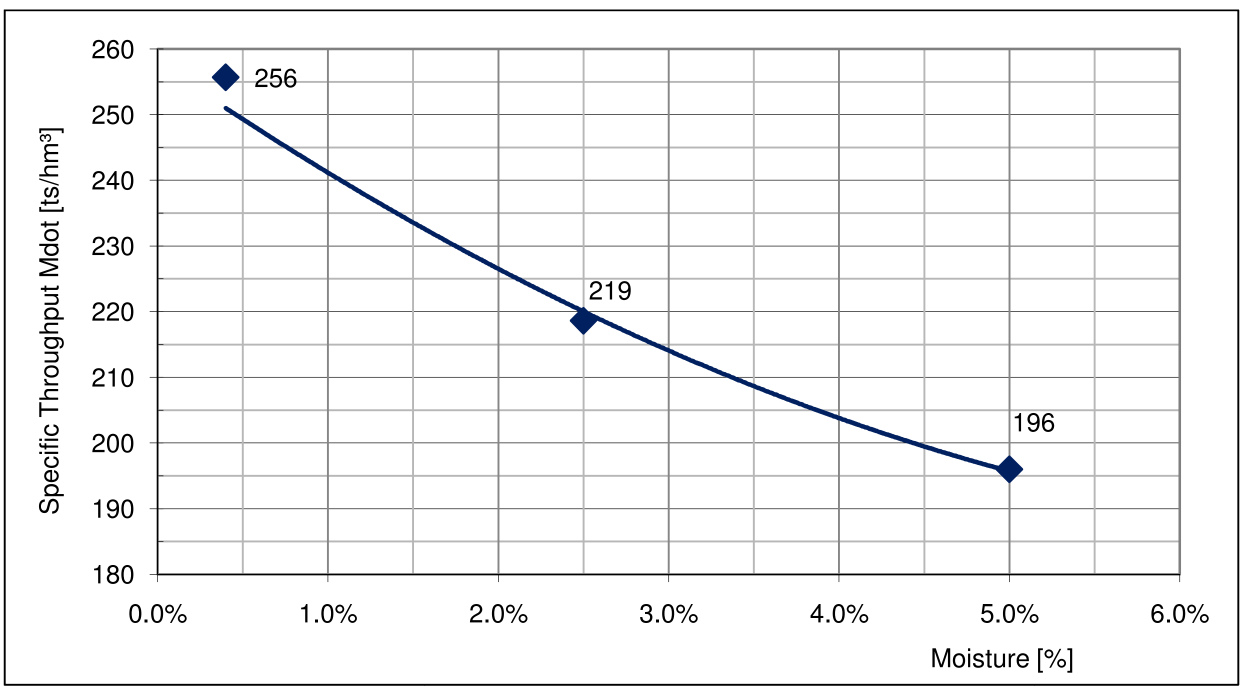

Figure 9: Specific throughput m-dot versus feed moisture

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Net specific energy consumption, shown in Figure 10, increased with higher levels of feed moisture content. Increasing feed moisture from 0.4% to 5 % resulted in a 56% increase in net specific energy consumption.

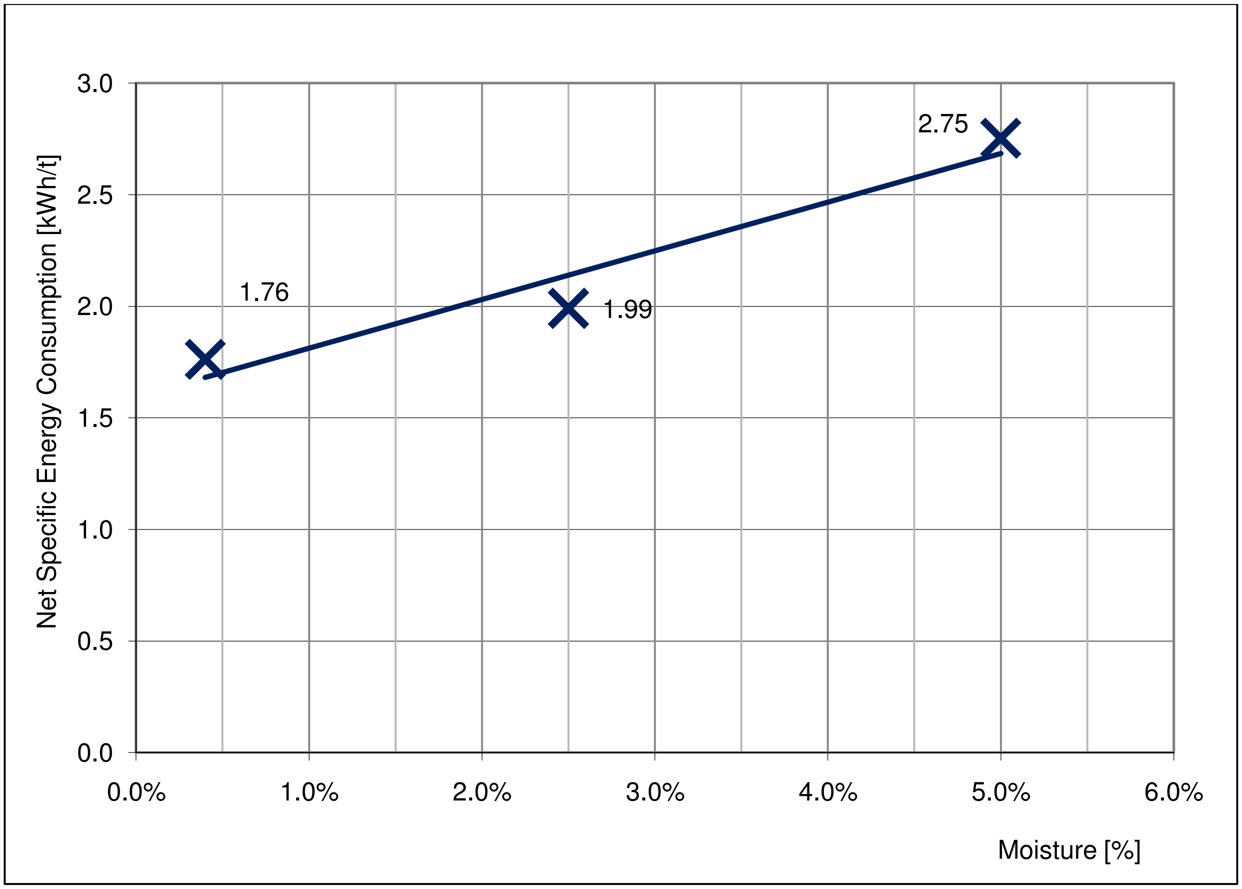

Figure 10: Net specific energy consumption versus moisture

3.3.6 Assessment of Feed Top Size

The influence of feed top size on HPGR performance was assessed using Mitchell Zone material. The P80 and P50 reduction ratios are shown in Figure 11. Due to misalignment of the HPGR product splitter during test KSM009, size distribution results for the (-25 mm) top size tests were coarser since edge material was present in the centre product stream. The diamond shaped points in the graph show the expected size reduction values for the (-25 mm) test.

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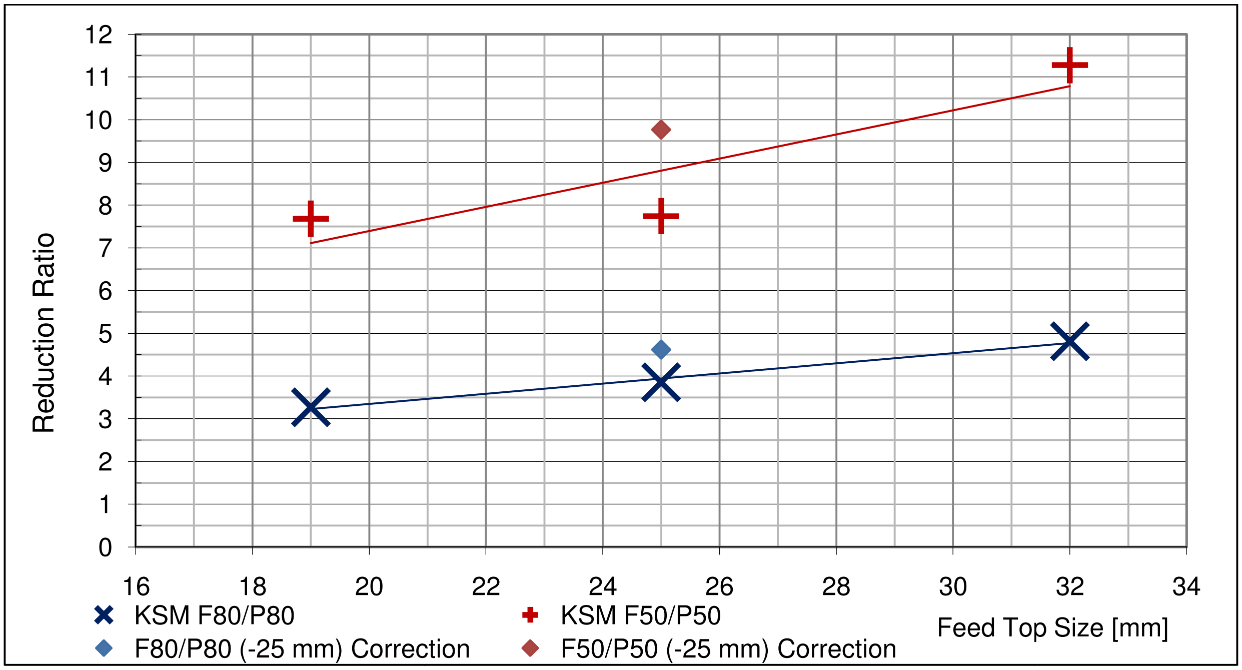

Figure 11: Combined centre and 1/3 edge P80 & P50 reduction ratio versus feed top size

The variation in P80 and P50 product particle size due to changes in feed top size is shown in Figure 12. A large reduction in feed top size, from 32 to 19 mm, resulted in P50 combined product particle sizes of 1.23 and 0.99 mm respectively.

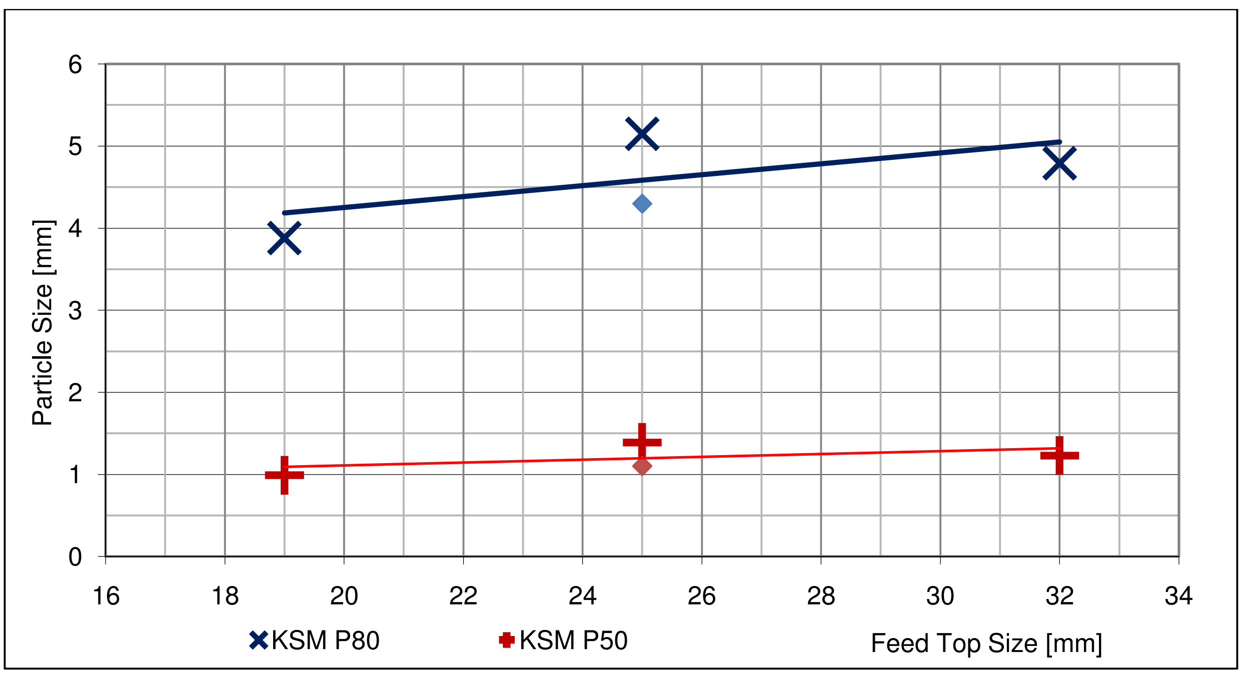

Figure 12: Combined centre and 1/3 edge P80 & P50 versus feed top size

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The specific throughput m-dot recorded with feed samples which vary in top size is shown in Figure 13. The highest throughput was recorded with a feed top size of –(19 mm). The average recorded operating gap for all three tests was similar, ranging from 17.2 to 17.5 mm.

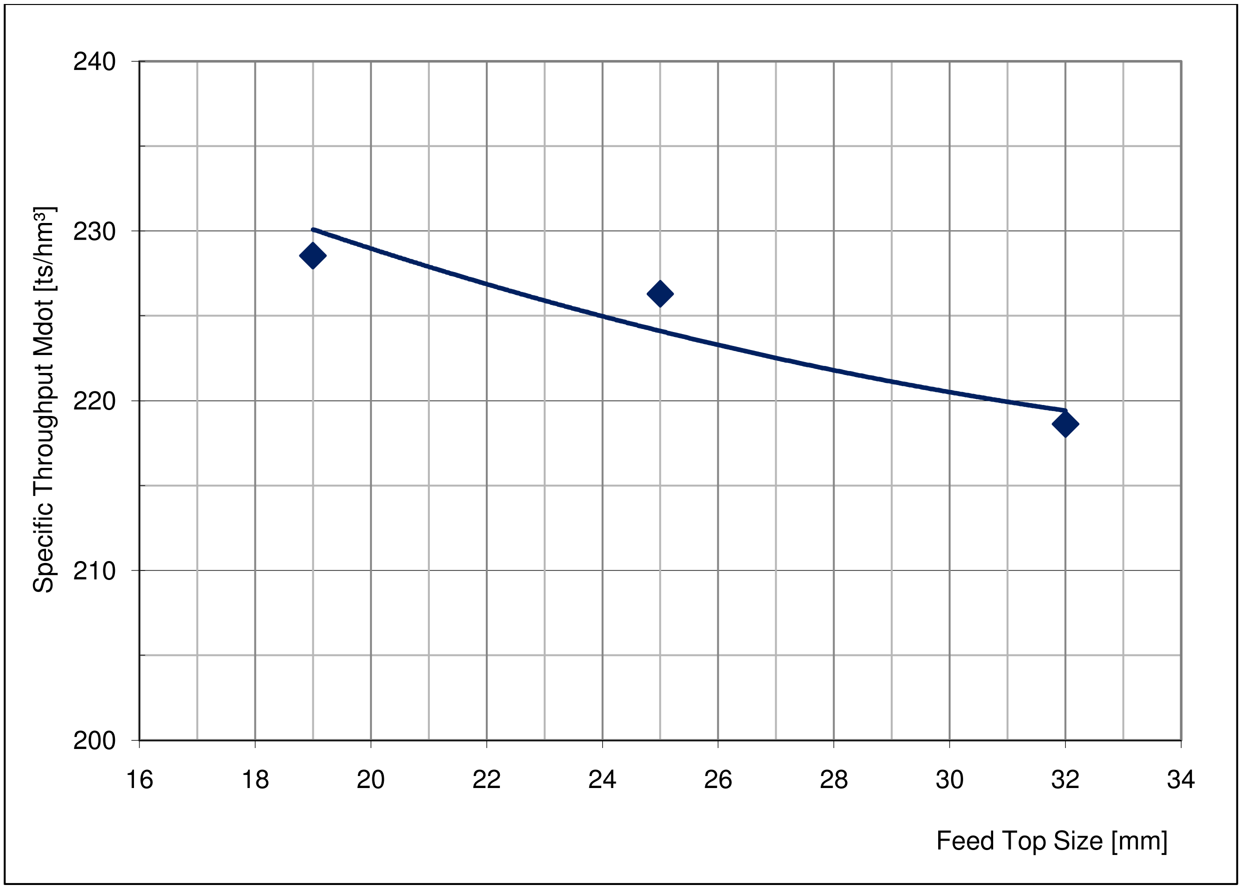

Figure 13: Specific throughput m-dot versus feed top size

The net specific energy consumption recorded for a range of Mitchell feed top sizes is shown in Figure 14. A slight increase in energy consumption was found as feed top size is increased.

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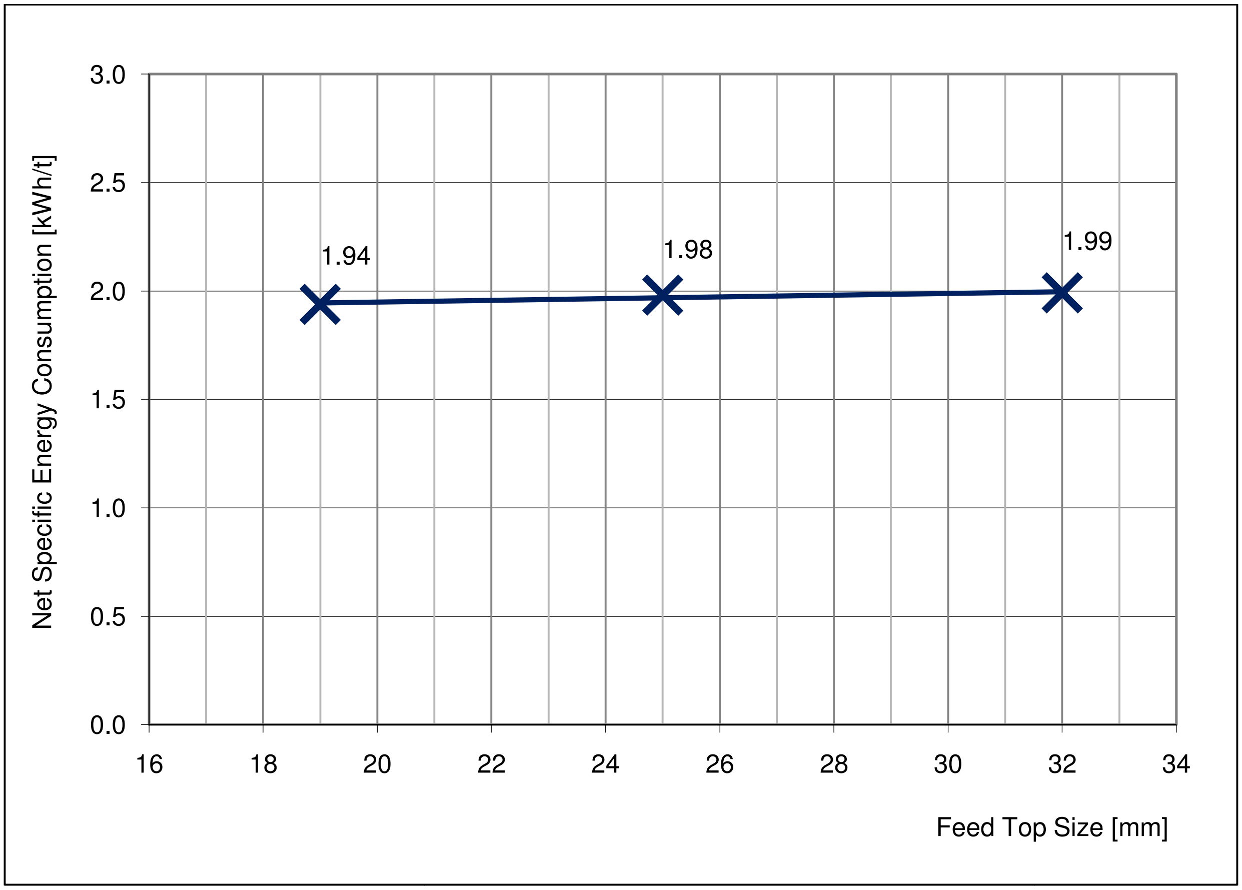

Figure 14: Net specific energy consumption versus feed top size

3.3.7 Assessment of Closed Circuit Operation

One single pass and three recycle tests were carried out to simulate an HPGR operating in closed circuit with a 3.35 mm (6 mesh) screen. The machine parameters were equivalent for all four tests. Recycle and fresh feed weights are shown in the appendix, table A6. Figure 15 shows the reduction ratio achieved with each cycle number. The feed to the first cycle was the coarsest as it contained fresh feed only. For this reason the highest size reduction is associated with the first cycle.

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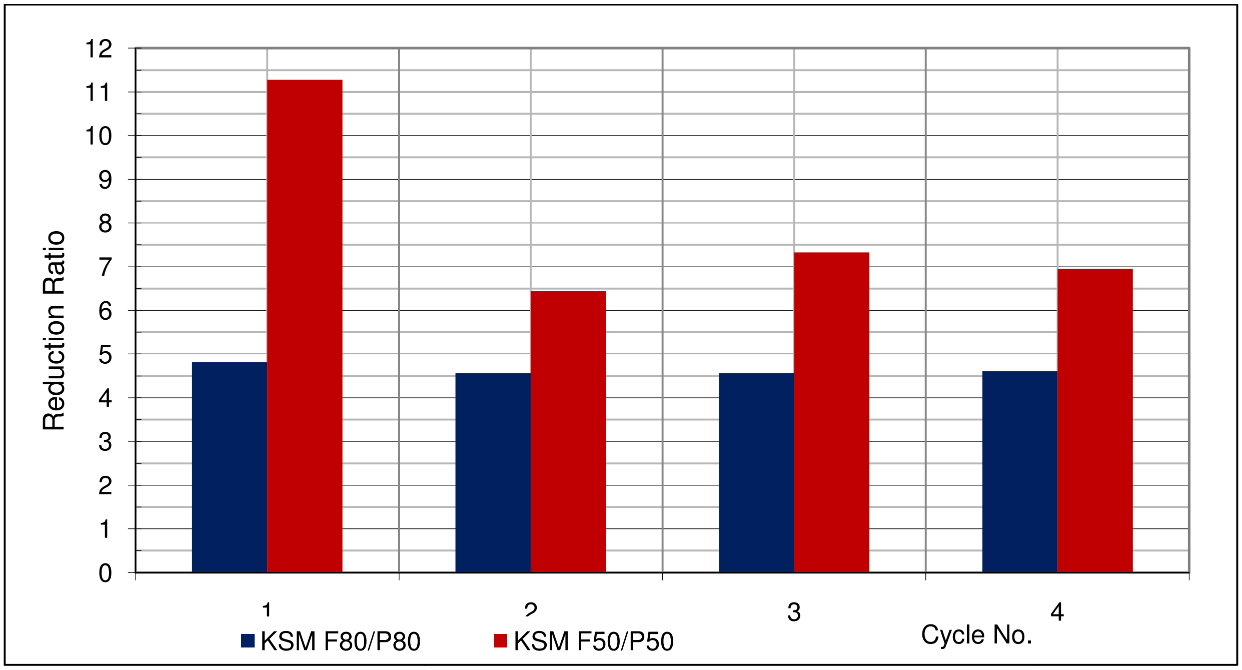

Figure 15 Combined centre and 1/3 edge P80 & P50 versus closed circuit cycle No.

The combined product P80 and P50 found for each cycle is shown in Figure 16. A distinct stabilization of results was not found as cycles were repeated.

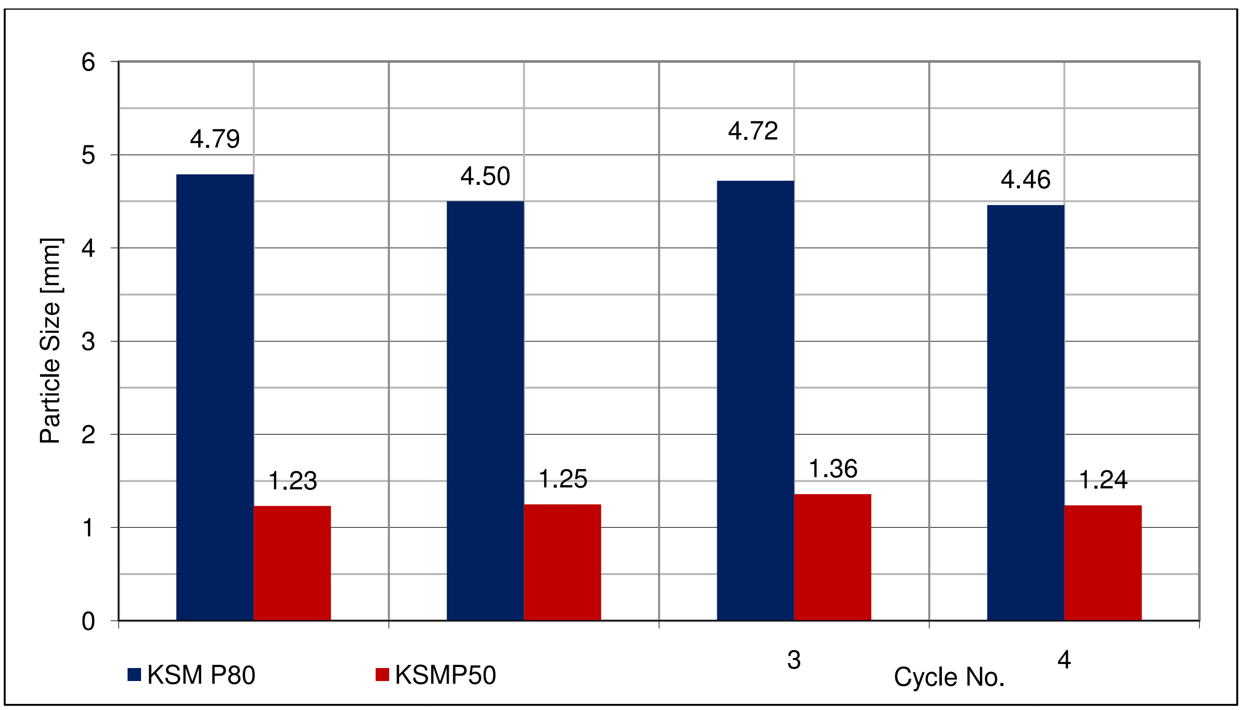

Figure 16 Combined centre and 1/3 edge P80 & P50 versus closed circuit cycle No.

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The specific throughput m-dot for each closed circuit test is shown in Figure 17. The specific throughput is shown to increase as recycle tests continue. However, analysis of machine data showed that the average pressing force during the fourth cycle was lower, 3.89 N/mm^2, when compared to cycles two and three, which recorded an average pressing force of 3.96 N/mm^2. The change in specific throughput m-dot is most probably attributed to the difference in specific pressing force rather than an ever increasing process phenomenon.

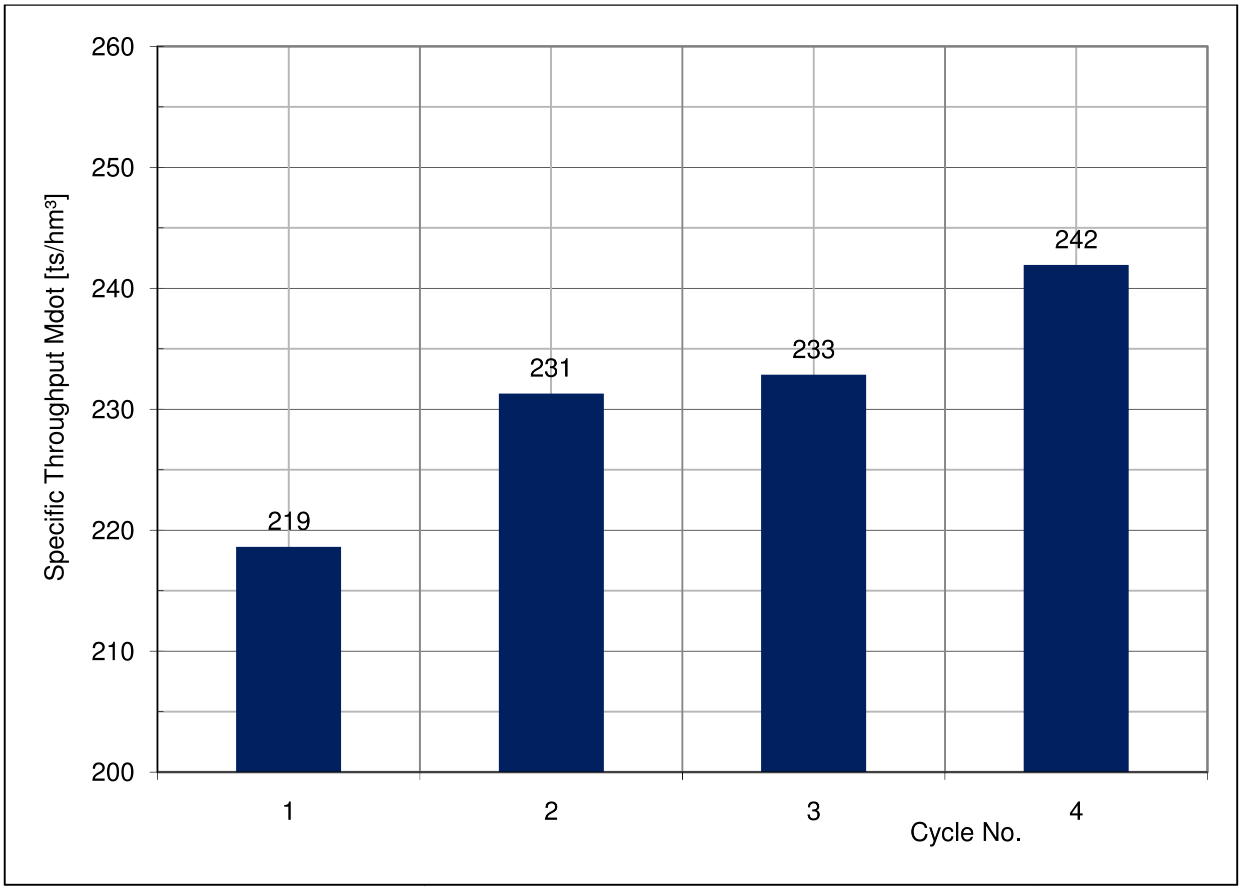

Figure 17: Specific throughput m-dot versus closed circuit cycle No.

A reduction in net specific energy consumption was recorded with increasing cycle numbers and is shown in Figure 18. The previously mentioned variation in specific pressing force is considered to be responsible for the lower net specific energy value found with the fourth cycle.

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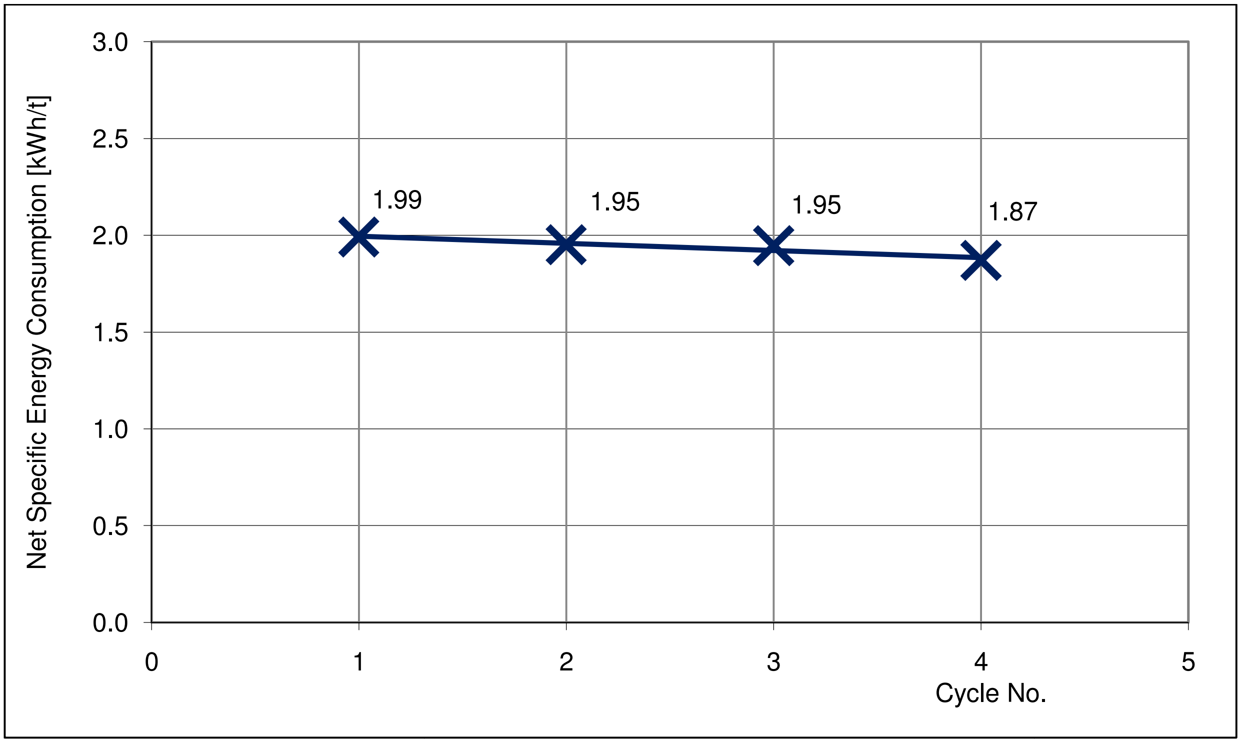

Figure 18: Net specific energy consumption versus closed circuit cycle No.

4 Discussion of Test Work Results

Relationships between critical grinding factors and HPGR process parameters were determined and are described below:

Influence of Specific Pressing Force

- Increasing specific pressing force from 3 to 5 N/mm^2 produced finer product P80 and P50 percentage particle sizes
- P80 and P50 product particle sizes were 4.79 and 1.23 mm (combined centre and one third edge) respectively, at a specific pressing force of 4 N/mm^2
- A specific pressing force of 4 N/mm^2 was considered to be optimum on the basis of both size reduction and throughput performance
- The specific throughput m-dot reduced by approximately 9% as specific pressing force increased from 3 to 5 N/mm^2.
- Net specific energy consumption increased linearly with increasing specific pressing force. A net specific energy consumption of 2.61 kWh/t was recorded for the 5 N/mm^2 test

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Influence of Roll Speed

- Variation in roll speed did not significantly affect product fineness, net specific energy consumption or throughput

Influence of Feed Moisture

- A distinct relationship between product fineness and feed moisture was not apparent
- Specific throughput decreased as feed moisture content increased; 256 ts/hm^3 for a dry feed (0.4% moisture) and 196 ts/hm^3 for a feed moisture content of 5%
- An increase in feed moisture from 0.4 to 5 % resulted in a 56% increase in net specific energy consumption

Influence of Feed Top Size

- Decreasing feed top size from –(32 mm) to –(19 mm) reduced the P50 percentage product particle size from 1.23 to 0.99 mm
- A reduction in specific throughput from 229 ts/hm^3 to 219 ts/hm^3 was found as top size decreased from –(32 mm) to –(19 mm)
- A small (less than 3%) increase in net specific energy consumption was recorded when feed top size was increased from –(19 mm) to –(32 mm)

Assessment of Closed Circuit Operation

- Comparison of single pass and closed circuit product showed a variation of less than 10 % in P50 percentage particle size for combined product
- A lower net specific energy consumption, approximately 1.94 kWh/t, was recorded for the closed circuit tests. In comparison, the net specific energy consumption for the single pass test was 1.99 kWh/t
- All closed circuit tests recorded a higher specific throughput when compared to a single pass test conducted at the same machine parameters

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5 Final Comments and Recommendations

The test work program assessed the response of the supplied Mitchell Zone sample to HPGR processing. Results showed that the supplied material is amenable to the HPGR process. Significant size reduction was achieved, especially when compared to previously tested copper porphyry ores.

Once HPGR circuit requirements and feed parameters are established, data generated from the program can be used to size HPGRs and motors.

Should Wardrop Engineering have any questions regarding this report please do not hesitate to contact KMA.

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Appendix A: Experimental Results

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Table A 1 Summary of Process Data (a)

Data	Description	Symbol	Unit	KSM001	KSM002	KSM003	KSM004	KSM005	KSM006	KSM007	KSM008
Press Constants	Roller Diameter (**D**)		[m]	0.750							
	Roller Width (**W**)		[m]	0.220							
Process Set Points	Speed	**ν**	[m/s]	0.75	0.75	0.75	0.75	0.60	0.90	0.75	0.75
		n	[rpm]	19.10	19.10	19.10	19.10	15.30	22.90	19.10	19.10
	Static Gap	**X_0**	[mm]	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
	Hydraulic Pressure	**P**	[bar]	82	72	82	103	82	82	82	82
	Pressing Force	**F**	[kN]	658.2	576.0	493.7	822.8	658.2	658.2	658.2	658.2
	Specific Pressing Force	**F_{SP}**	**[N/mm^2]**	**4.0**	**3.5**	**3.0**	**5.0**	**4.0**	**4.0**	**4.0**	**4.0**
Process Data	**Test Time**	t	[s]	19.40	19.79	19.81	20.40	24.59	15.59	19.61	21.80
	Average Actual Speed:	**ω_{AV}**	[m/s]	0.77	0.75	0.74	0.75	0.60	0.92	0.77	0.75
	Standard Deviation	**σ_ω**		0.25	0.04	0.07	0.13	0.14	0.23	0.22	0.10
	Actual Roller gap (average)	**X_{gAV}**	**[mm]**	**17.25**	**18.12**	**17.81**	**15.37**	**17.45**	**17.37**	**20.46**	**14.17**
	Standard Deviation	**σ_X**		0.50	0.60	0.60	0.49	0.55	0.51	0.60	0.56
	Actual Hydraulic Pressure (average)	**P_{AV}**	**[bar]**	**80.7**	**70.2**	**60.6**	**102.23**	**81.16**	**80.5**	**80.6**	**81.2**
	Standard Deviation			0.76	0.63	1.68	0.70	1.00	0.96	1.28	0.59
	Actual Pressing Force (average)	**F_{AV}**	[kN]	649	564	487	822	653	647	648	653
	Actual Specific Pressure (average)	**F_{SPAV}**	**[N/mm^2]**	**3.95**	**3.43**	**2.96**	**5.00**	**3.97**	**3.93**	**3.94**	**3.97**
	Idle Power Draw	Pi	[kW]	10.14	9.22	9.17	8.73	7.21	11.51	8.83	8.63
	Power Draw	P	[kW]	65.45	59.57	54.18	78.88	52.60	78.17	65.64	75.38
	Total Specific Energy Consumption	E_{SP}	[kWh/t]	2.36	2.06	1.87	2.93	2.38	2.33	2.04	3.11
	Specific Energy Consumption	**$E_{SP\ net}$**	**[kWh/t]**	**1.99**	**1.74**	**1.55**	**2.61**	**2.05**	**1.99**	**1.76**	**2.75**
	Press throughput	W	[t/h]	27.78	28.96	29.04	26.91	22.09	33.53	32.24	24.24
	Specific Throughput Constant	**m dot**	**[ts/hm^3]**	**219**	**235**	**237**	**217**	**223**	**222**	**256**	**196**

Table A 2 Summary of Process Data (b)

Press Constants	Roller Diameter (**D**)	[m]	0.750					
	Roller Width (**W**)	[m]	0.220					
Data	**Description**	**Test Number:**		**KSM009**	**KSM010**	**KSM011**	**KSM012**	**KSM013**
		Symbol	**Unit**					
Process Set Points	Speed	**ν**	[m/s]	0.75	0.75	0.75	0.75	0.75
		n	[rpm]	19.10	19.10	19.10	19.10	19.10
	Static Gap	**X_0**	[mm]	9.0	9.0	9.0	9.0	9.0
	Hydraulic Pressure	**P**	[bar]	82	82	82.0	82	82
	Pressing Force	**F**	[kN]	658.2	658.2	658.2	658.2	658.2
	Specific Pressing Force	**F_{SP}**	**[N/mm^2]**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**
Process Data	**Test Time**	t	[s]	19.90	20.39	20.20	19.59	19.41
	Average Actual Speed:	**ω_{AV}**	[m/s]	0.77	0.76	0.77	0.75	0.75
	Standard Deviation	**σ_ω**		0.20	0.16	0.22	0.06	0.16
	Actual Roller gap (average)	**X_{gAV}**	**[mm]**	**17.50**	**17.23**	**17.13**	**17.87**	**17.24**
	Standard Deviation	**σ_X**		0.51	0.84	0.50	0.40	0.64
	Actual Hydraulic Pressure (average)	**P_{AV}**	**[bar]**	**80.47**	**80.12**	**81.1**	**81.00**	**79.58**
	Standard Deviation			1.4	1.9	0.70	1.0	2.2
	Actual Pressing Force (average)	**F_{AV}**	[kN]	647.20	644.38	652.48	651.42	640.03
	Actual Specific Pressure (average)	**F_{SPAV}**	**[N/mm^2]**	**3.93**	**3.92**	**3.97**	**3.96**	**3.89**
	Idle Power Draw	Pi	[kW]	9.04	8.92	8.79	8.91	9.04
	Power Draw	P	[kW]	65.64	64.21	65.84	64.79	64.94
	Total Specific Energy Consumption	E_{SP}	[kWh/t]	2.30	2.25	2.25	2.26	2.17
	Specific Energy Consumption	**$E_{SP\ net}$**	**[kWh/t]**	**1.98**	**1.94**	**1.95**	**1.95**	**1.87**
	Press throughput	W	[t/h]	28.57	28.52	29.24	28.70	29.89
	Specific Throughput Constant	**m dot**	**[ts/hm^3]**	**226**	**229**	**231**	**233**	**242**

Table A 3 Summary of Process Data (a) continued,

	Description	Test Number: Symbol	Unit	KSM001	KSM002	KSM003	KSM004	KSM005	KSM006	KSM007	KSM008
Material Data	**Average Flake Density**	r_F	**[t/m^3]**	**2.33**	**2.38**	**2.39**	**2.40**	**2.37**	**2.38**	**2.40**	**2.37**
	Standard Deviation			0.03	0.02	0.03	0.03	0.04	0.03	0.02	0.03
	Flake Thickness Average	X_F	**[mm]**	**20.4**	**20.3**	**21.4**	**18.9**	**20.0**	**19.5**	**23.7**	**17.2**
	Standard Deviation			1.8	0.6	0.6	1.3	1.0	2.1	1.3	1.2
	Feed Moisture		**[%]**	**2.5%**	**2.5%**	**2.5%**	**2.5%**	**2.5%**	**2.5%**	**0.4%**	**5.0%**
	Feed Bulk Density		**[t/m^3]**	**1.97**	**1.97**	**1.97**	**1.97**	**1.97**	**1.97**	**1.97**	**1.97**
	Particle Size Distribution										
	Feed: 100% Passing Size	F_{100}	[mm]	32	32	32	32	32	32	32	32
	Feed: 80% Passing Size	F_{80}	[mm]	23.04	23.04	23.04	23.04	23.04	23.04	23.04	23.04
	Feed: 50% Passing Size	F_{50}	[mm]	13.87	13.87	13.87	13.87	13.87	13.87	13.87	13.87
	Centre: 80% Passing Size	P_{80}	[mm]	4.47	4.89	5.19	3.98	4.33	4.81	4.42	4.99
	Centre: 50% Passing Size	P_{50}	[mm]	1.15	1.32	1.43	0.98	1.18	1.31	1.17	1.21
	Edge: 80% Passing Size	P_{80}	[mm]	7.22	7.92	8.98	6.31	7.35	7.54	10.05	5.30
	Edge: 50% Passing Size	P_{50}	[mm]	2.26	2.66	3.29	1.89	3.33	2.58	3.83	1.38
	Combined Centre & 1/3 Edge: 80% Passing Size	P_{80}	[mm]	4.79	5.22	5.58	4.29	4.70	5.12	5.09	5.03
	Combined Centre & 1/3 Edge: 50% Passing Size	P_{50}	[mm]	1.23	1.43	1.60	1.04	1.28	1.41	1.36	1.23
	Reduction Ratio F80/P80			4.81	4.41	4.13	5.37	4.90	4.50	4.53	4.58
	Reduction Ratio F50/P50			11.28	9.70	8.67	13.34	10.84	9.84	10.20	11.28
	Mass Balance										
	Total Feed Material	M_F	[kg]	301	283	290	295	308	301	289	302
	Total Centre Product	M_C	[kg]	103.9	109.8	112.5	106.0	103.9	102.0	121.7	105.7
	Centre Product % of Centre & Edge Material	**MCE%**	[%]	34.9%	39.1%	39.0%	36.3%	34.0%	34.4%	42.8%	35.7%
	Total Edge Product	M_E	[kg]	42.8	49.4	47.3	46.5	47.0	43.2	53.9	41.1
	Edge Product % of Centre & Edge Material	$M_{EF\%}$	[%]	29.2%	31.0%	29.6%	30.5%	31.1%	29.8%	30.7%	28.0%
	Edge Product % of Centre Product	$M_{EC\%}$	[%]	41.2%	45.0%	42.0%	43.9%	45.2%	42.4%	44.3%	38.9%
	Total Waste Product	M_W	[kg]	150.9	121.5	128.5	139.3	154.5	151.6	108.8	149.1
	Waste Product % of Total Feed	$M_{WF\%}$	[%]	50.1%	42.9%	44.3%	47.2%	50.2%	50.4%	37.6%	49.4%
	Total Recovered Product	M_P	[kg]	298	281	288	292	305	297	284	296
	Mass Reconciliation (+ "gain; - "loss")	$M_{PF\%}$	[%]	-1.1%	-0.8%	-0.6%	-1.1%	-0.8%	-1.4%	-1.6%	-2.0%

Table A 4 Summary of Process Data (b) continued,

	Description	Test Number:		KSM009	KSM010	KSM011	KSM012	KSM013
		Symbol	Unit					
Material Data	**Average Flake Density**	**r_F**	**[t/m^3]**	**2.36**	**2.34**	**2.41**	**2.38**	**2.39**
	Standard Deviation			0.02	0.02	0.03	0.04	0.02
	Flake Thickness Average	**X_F**	**[mm]**	**19.7**	**21.4**	**20.3**	**21.2**	**21.4**
	Standard Deviation			2.2	1.2	1.7	0.8	1.7
	Feed Moisture		**[%]**	**2.5%**	**2.5%**	**2.5%**	**2.5%**	**2.5%**
	Feed Bulk Density		**[t/m^3]**	**1.96**	**1.83**	**NA**	**NA**	**NA**
	Particle Size Distribution							
	Feed: 100% Passing Size	F_{100}	[mm]	25	19	32	32	32
	Feed: 80% Passing Size	F_{80}	[mm]	19.85	12.69	20.54	21.53	20.56
	Feed: 50% Passing Size	F_{50}	[mm]	10.76	7.60	8.05	9.97	8.62
	Centre: 80% Passing Size	P_{80}	[mm]	4.93	3.55	4.16	4.21	4.14
	Centre: 50% Passing Size	P_{50}	[mm]	1.31	0.99	1.15	1.17	1.14
	Edge: 80% Passing Size	P_{80}	[mm]	7.02	6.12	6.54	6.22	6.80
	Edge: 50% Passing Size	P_{50}	[mm]	2.28	1.99	2.10	2.07	2.30
	Scale-up: 80% Passing Size	P_{80}	[mm]	5.15	3.88	4.50	4.72	4.46
	Scale-up: 50% Passing Size	P_{50}	[mm]	1.39	0.99	1.25	1.36	1.24
	Reduction Ratio F80/P80			3.85	3.27	4.56	4.56	4.61
	Reduction Ratio F50/P50			7.74	7.68	6.44	7.33	6.95
	Mass Balance							
	Total Feed Material	**M_F**	[kg]	297	298	303	300	300
	Total Centre Product	**M_C**	[kg]	114.3	110.3	112.2	78.4	116.2
	Centre Product % of Centre & Edge Material	**MCE%**	[%]	38.7%	37.5%	37.3%	26.4%	39.2%
	Total Edge Product	**M_E**	[kg]	43.6	51.2	51.9	77.8	45.0
	Edge Product % of Centre & Edge Material	**$M_{EF\%}$**	[%]	27.6%	31.7%	31.6%	49.8%	27.9%
	Edge Product % of Centre Product	**$M_{EC\%}$**	[%]	38.1%	46.4%	46.3%	99.2%	38.7%
	Total Waste Product	**M_W**	[kg]	137.6	132.7	136.9	140.3	135.4
	Waste Product % of Total Feed	**$M_{WF\%}$**	[%]	46.3%	44.5%	45.2%	46.8%	45.1%
	Total Recovered Product	**M_P**	[kg]	296	294	301	297	297
	Mass Reconciliation (+ "gain; - "loss")	**$M_{PF\%}$**	[%]	-0.5%	-1.3%	-0.7%	-1.2%	-1.1%

Table A 5 Feed Particle Size Distributions

Sample No.		Mitchell –(32 mm) Feed			Mitchell –(25 mm) Feed		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	48.3	0.4%	99.6%	0.0	0.0%	100.0%
-32000 to +25000	25000	1410.4	12.2%	87.3%	60.3	0.6%	99.4%
-25000 to +19000	19000	2595.2	22.5%	64.8%	2160.8	22.6%	76.8%
-19000 to +16000	16000	1134.4	9.8%	55.0%	922.2	9.6%	67.2%
-16000 to +12500	12500	941.8	8.2%	46.8%	965.7	10.1%	57.1%
-12500 to +8000	8000	1673.2	14.5%	32.3%	1756.9	18.3%	38.7%
-8000 to +5600	5600	885.2	7.7%	24.6%	896.0	9.4%	29.4%
-5600 to +4000	4000	561.3	4.9%	19.7%	658.4	6.9%	22.5%
-4000 to +2800	2800	425.3	3.7%	16.0%	447.1	4.7%	17.8%
-2800 to +2000	2000	340.1	3.0%	13.1%	290.2	3.0%	14.8%
-2000 to +1400	1400	301.4	2.6%	10.5%	238.1	2.5%	12.3%
-1400 to +1000	1000	215.9	1.9%	8.6%	216.2	2.3%	10.1%
-1000 to +710	710	174.2	1.5%	7.1%	125.8	1.3%	8.8%
-710 to +500	500	141.6	1.2%	5.9%	143.5	1.5%	7.3%
-500 to +355	355	117.1	1.0%	4.8%	117.7	1.2%	6.0%
-355 to +250	250	106.8	0.9%	3.9%	106.0	1.1%	4.9%
-250 to +180	180	93.8	0.8%	3.1%	94.0	1.0%	3.9%
-180 to +125	125	122.8	1.1%	2.0%	75.4	0.8%	3.1%
-125 to +90	90	53.6	0.5%	1.6%	52.3	0.5%	2.6%
-90 to +63	63	58.4	0.5%	1.1%	50.8	0.5%	2.1%
-63 to +45	45	32.2	0.3%	0.8%	28.0	0.3%	1.8%
-45	Pan	90.6	0.8%		170.3	1.8%	
Total		11523.6	100.0%		9575.7	100.0%	
		Calculated P_{80}	[mm]	23.04	Calculated P_{80}	[mm]	19.85
		Calculated P_{50}	[mm]	13.87	Calculated P_{50}	[mm]	10.76

Table A 6 Feed Particle Size Distributions continued,

Sample No.		Mitchell –(19 mm) Feed			Mitchell –(32 mm) Rec1 Feed		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	1213.0	13.0%	87.0%
-25000 to +19000	19000	0.0	0.0%	100.0%	1468.0	15.8%	71.2%
-19000 to +16000	16000	672.7	7.7%	92.3%	860.8	9.2%	61.9%
-16000 to +12500	12500	1126.7	13.0%	79.3%	671.7	7.2%	54.7%
-12500 to +8000	8000	2339.1	26.9%	52.4%	1564.2	16.8%	37.9%
-8000 to +5600	5600	1248.8	14.4%	38.0%	1058.9	11.4%	26.5%
-5600 to +4000	4000	931.4	10.7%	27.3%	863.6	9.3%	17.3%
-4000 to +2800	2800	556.6	6.4%	20.9%	616.3	6.6%	10.6%
-2800 to +2000	2000	378.9	4.4%	16.5%	213.0	2.3%	8.4%
-2000 to +1400	1400	240.4	2.8%	13.8%	100.9	1.1%	7.3%
-1400 to +1000	1000	210.8	2.4%	11.3%	100.6	1.1%	6.2%
-1000 to +710	710	181.9	2.1%	9.2%	57.9	0.6%	5.6%
-710 to +500	500	136.7	1.6%	7.7%	73.6	0.8%	4.8%
-500 to +355	355	115.8	1.3%	6.3%	62.4	0.7%	4.1%
-355 to +250	250	99.5	1.1%	5.2%	59.5	0.6%	3.5%
-250 to +180	180	81.7	0.9%	4.2%	42.1	0.5%	3.0%
-180 to +125	125	75.4	0.9%	3.4%	48.5	0.5%	2.5%
-125 to +90	90	42.1	0.5%	2.9%	28.6	0.3%	2.2%
-90 to +63	63	53.3	0.6%	2.3%	28.9	0.3%	1.9%
-63 to +45	45	34.4	0.4%	1.9%	48.8	0.5%	1.4%
-45	Pan	163.9	1.9%		126.0	1.4%	
Total		8690.1	100.0%		9307.3	100.0%	
		Calculated P_{80}	[mm]	12.69			22.35
		Calculated P_{50}	[mm]	7.60			11.23

Table A 7 Feed Particle Size Distributions continued,

Sample No.		Mitchell –(32 mm) Rec2Feed			Mitchell –(32 mm) Rec3 Feed		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[μm]	[μm]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	1088.0	11.1%	88.9%	994.0	10.0%	90.0%
-25000 to +19000	19000	1429.2	14.6%	74.3%	1351.7	13.6%	76.5%
-19000 to +16000	16000	732.5	7.5%	66.9%	655.8	6.6%	69.9%
-16000 to +12500	12500	735.8	7.5%	59.4%	644.1	6.5%	63.4%
-12500 to +8000	8000	1425.5	14.5%	44.8%	1553.3	15.6%	47.8%
-8000 to +5600	5600	1048.0	10.7%	34.1%	1166.6	11.7%	36.1%
-5600 to +4000	4000	933.6	9.5%	24.6%	1046.0	10.5%	25.6%
-4000 to +2800	2800	777.6	7.9%	16.7%	879.1	8.8%	16.8%
-2800 to +2000	2000	293.0	3.0%	13.7%	315.0	3.2%	13.7%
-2000 to +1400	1400	191.9	2.0%	11.7%	192.6	1.9%	11.7%
-1400 to +1000	1000	170.7	1.7%	10.0%	177.0	1.8%	9.9%
-1000 to +710	710	105.7	1.1%	8.9%	104.2	1.0%	8.9%
-710 to +500	500	125.1	1.3%	7.6%	131.1	1.3%	7.6%
-500 to +355	355	108.0	1.1%	6.5%	110.1	1.1%	6.5%
-355 to +250	250	97.6	1.0%	5.5%	101.3	1.0%	5.5%
-250 to +180	180	74.8	0.8%	4.8%	87.9	0.9%	4.6%
-180 to +125	125	75.8	0.8%	4.0%	63.5	0.6%	3.9%
-125 to +90	90	49.3	0.5%	3.5%	48.2	0.5%	3.5%
-90 to +63	63	55.4	0.6%	2.9%	50.5	0.5%	3.0%
-63 to +45	45	31.7	0.3%	2.6%	27.7	0.3%	2.7%
-45	Pan	255.4	2.6%		266.8	2.7%	
Total		9804.6	100.0%		9966.5	100.0%	
		Calculated P_{80}	[mm]	21.34			20.56
		Calculated P_{50}	[mm]	9.61			8.62

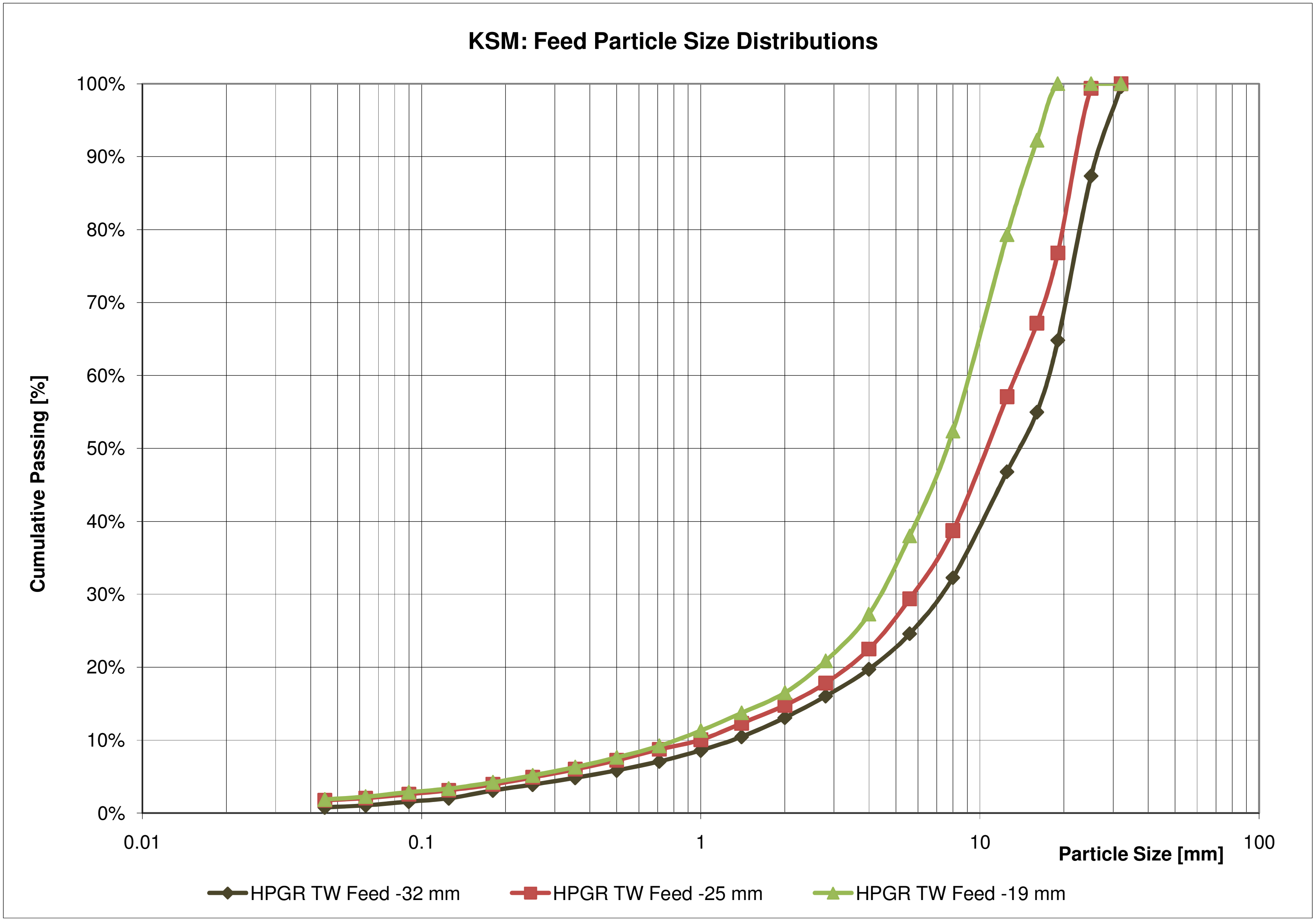

Figure A 1 Particle size distributions of feed for top-size tests

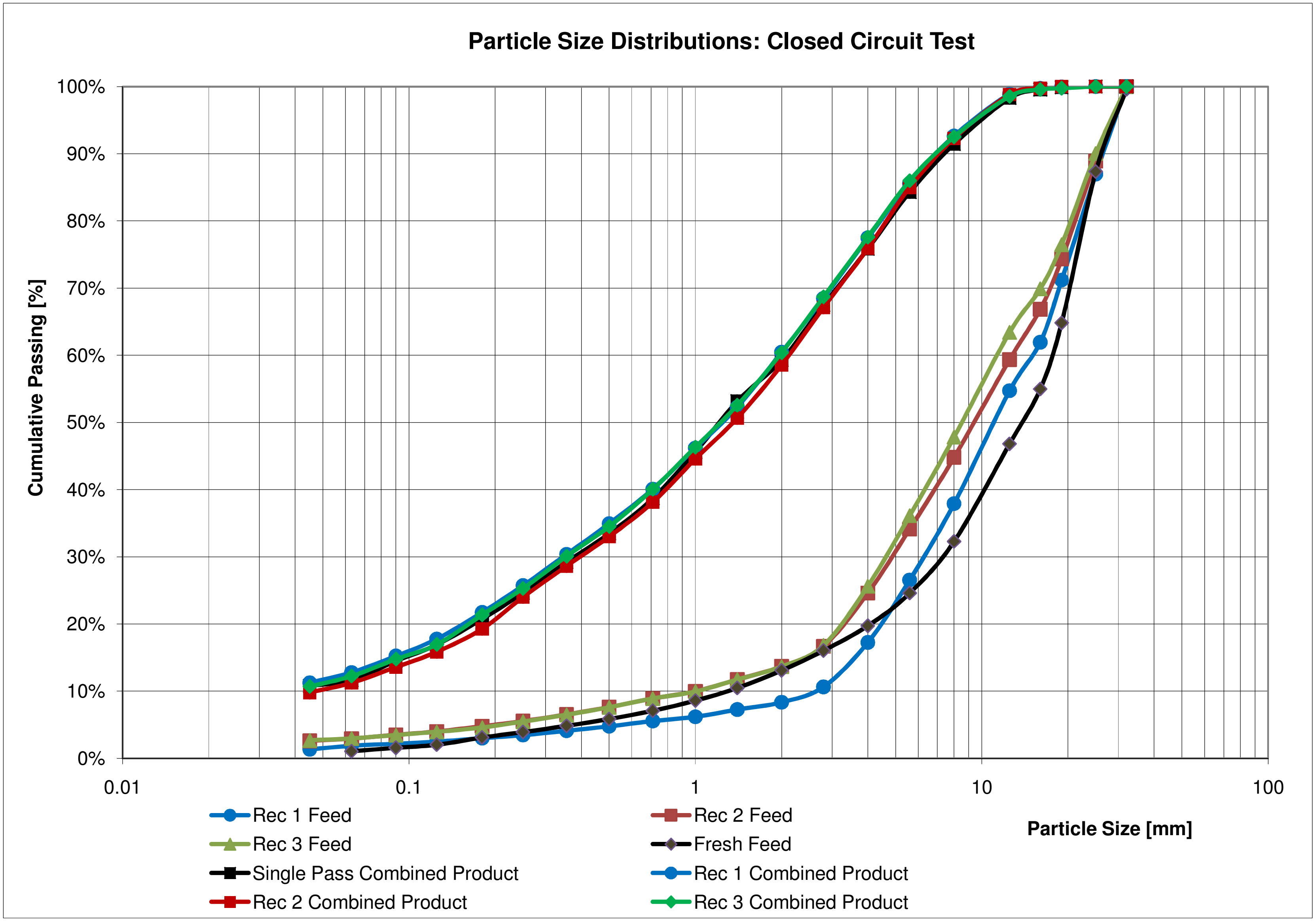

Figure A 2 Particle size distributions of closed circuit tests

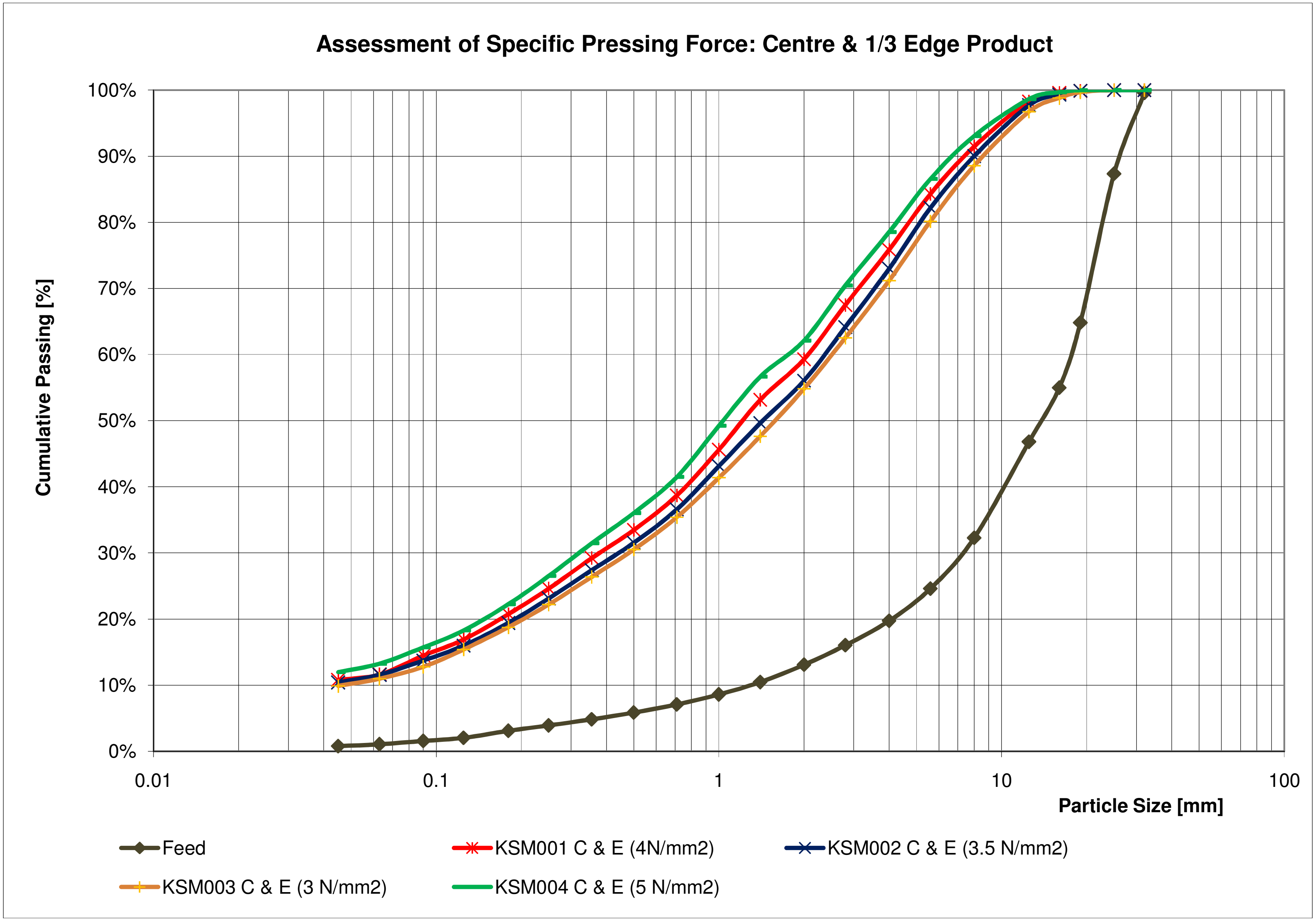

Figure A 3 Comparison of specific pressing force

Table A 8 Particle Size Distribution of KSM001

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM001 (4 N/mm²)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		103.9	70.8		42.8	29.2		146.7		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	13.3	0.1%	99.9%	0.0	0.0%	100.0%	9.8	0.1%	99.9%
-19000 to +16000	16000	24.6	0.3%	99.6%	93.6	0.9%	99.1%	26.8	0.3%	99.5%
-16000 to +12500	12500	94.6	1.0%	98.6%	348.4	3.3%	95.8%	102.0	1.3%	98.3%
-12500 to +8000	8000	578.5	6.0%	92.6%	1330.1	12.6%	83.2%	550.2	6.8%	91.4%
-8000 to +5600	5600	648.5	6.8%	85.8%	1052.7	10.0%	73.3%	576.5	7.2%	84.3%
-5600 to +4000	4000	786.8	8.2%	77.6%	1060.9	10.0%	63.2%	679.5	8.4%	75.9%
-4000 to +2800	2800	799.0	8.3%	69.2%	905.3	8.6%	54.6%	674.2	8.4%	67.5%
-2800 to +2000	2000	802.0	8.4%	60.9%	728.2	6.9%	47.8%	660.1	8.2%	59.3%
-2000 to +1400	1400	588.8	6.1%	54.7%	636.1	6.0%	41.7%	494.0	6.1%	53.2%
-1400 to +1000	1000	736.2	7.7%	47.0%	681.5	6.5%	35.3%	607.2	7.5%	45.6%
-1000 to +710	710	698.9	7.3%	39.7%	439.4	4.2%	31.1%	557.3	6.9%	38.7%
-710 to +500	500	511.7	5.3%	34.4%	465.7	4.4%	26.7%	421.3	5.2%	33.5%
-500 to +355	355	412.5	4.3%	30.1%	394.6	3.7%	23.0%	341.4	4.2%	29.2%
-355 to +250	250	454.0	4.7%	25.4%	386.4	3.7%	19.3%	371.3	4.6%	24.6%
-250 to +180	180	379.4	4.0%	21.4%	335.8	3.2%	16.1%	311.5	3.9%	20.8%
-180 to +125	125	380.2	4.0%	17.4%	305.6	2.9%	13.3%	309.3	3.8%	16.9%
-125 to +90	90	234.4	2.4%	15.0%	238.5	2.3%	11.0%	195.3	2.4%	14.5%
-90 to +63	63	292.6	3.1%	11.9%	162.0	1.5%	9.5%	231.3	2.9%	11.6%
-63 to +45	45	78.7	0.8%	11.1%	87.5	0.8%	8.6%	66.3	0.8%	10.8%
-45	Pan	1062.7	11.1%		911.8	8.6%		869.8	10.8%	
Total		9577.4	100.0%		10564.1	100.0%		8055.0	100.0%	

		Centre	Edge	Combined
Calculated P_{80}	[mm]	4.47	7.22	4.79
Calculated P_{50}	[mm]	1.15	2.26	1.23

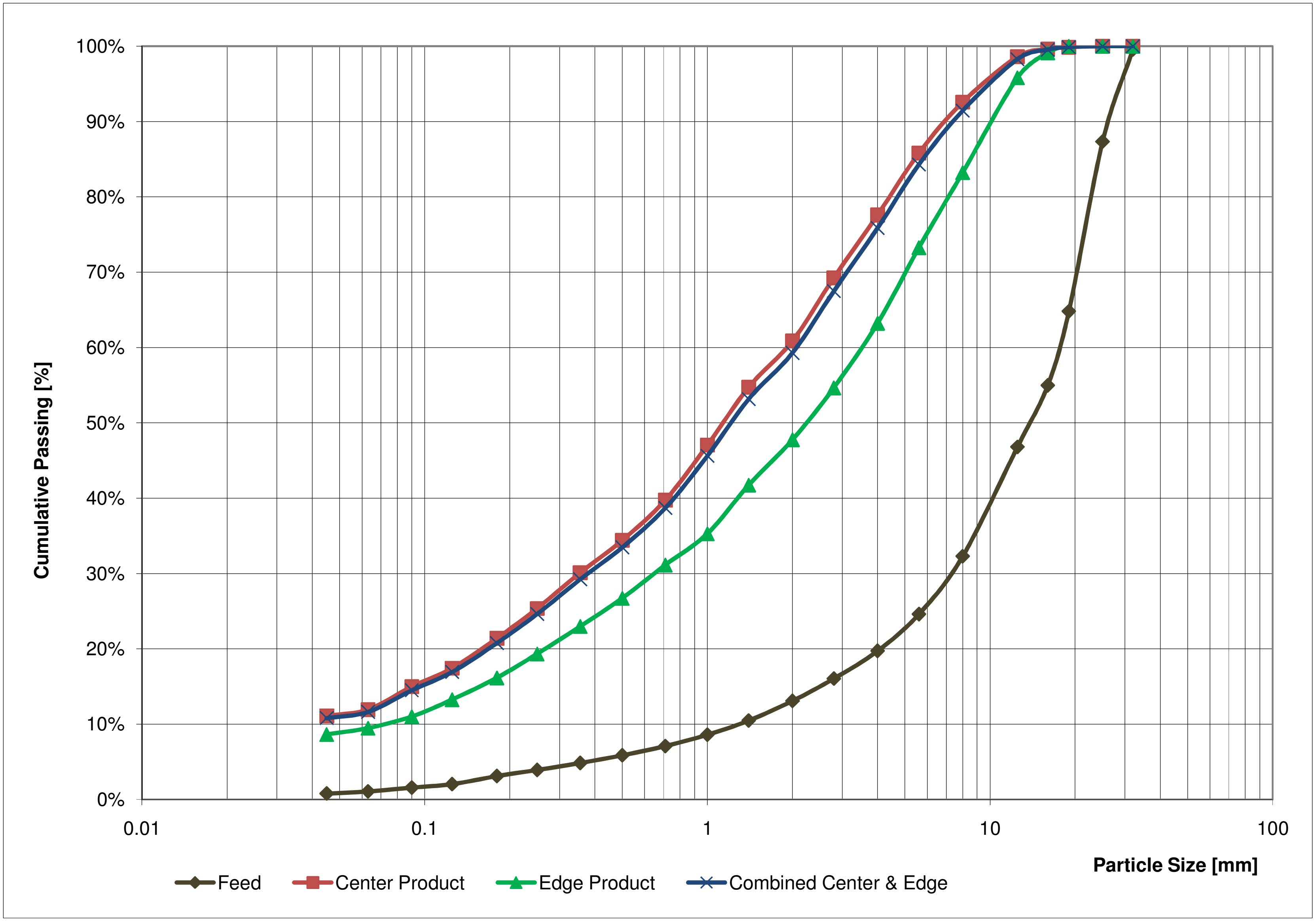

Figure A 4 Product particle size distributions of KSM001

Table A 9 Particle Size Distribution of KSM002

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM002 (3.5 N/mm²)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		109.8	69.0		49.4	31.0		159.2		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	12.3	0.1%	99.9%	0.0	0.0%	100.0%	8.8	0.1%	99.9%
-19000 to +16000	16000	36.6	0.4%	99.5%	204.1	1.7%	98.3%	43.9	0.6%	99.3%
-16000 to +12500	12500	121.0	1.3%	98.2%	490.2	4.1%	94.2%	129.1	1.6%	97.7%
-12500 to +8000	8000	650.5	6.8%	91.5%	1656.5	13.8%	80.4%	609.5	7.7%	90.0%
-8000 to +5600	5600	719.5	7.5%	84.0%	1231.1	10.3%	70.1%	622.2	7.8%	82.2%
-5600 to +4000	4000	867.9	9.0%	75.0%	1227.5	10.3%	59.8%	728.2	9.2%	73.0%
-4000 to+2800	2800	853.6	8.9%	66.1%	1028.5	8.6%	51.2%	700.8	8.8%	64.2%
-2800 to +2000	2000	793.8	8.2%	57.9%	852.9	7.1%	44.1%	642.7	8.1%	56.1%
-2000 to +1400	1400	618.9	6.4%	51.4%	756.9	6.3%	37.8%	509.1	6.4%	49.6%
-1400 to +1000	1000	647.3	6.7%	44.7%	603.1	5.0%	32.7%	516.1	6.5%	43.1%
-1000 to +710	710	653.0	6.8%	37.9%	597.4	5.0%	27.7%	519.7	6.6%	36.6%
-710 to +500	500	500.7	5.2%	32.7%	482.5	4.0%	23.7%	400.6	5.1%	31.5%
-500 to +355	355	411.8	4.3%	28.4%	389.5	3.3%	20.4%	328.8	4.1%	27.4%
-355 to +250	250	426.3	4.4%	24.0%	381.9	3.2%	17.2%	338.6	4.3%	23.1%
-250 to +180	180	371.0	3.9%	20.1%	331.7	2.8%	14.5%	294.6	3.7%	19.4%
-180 to +125	125	339.9	3.5%	16.6%	319.5	2.7%	11.8%	271.3	3.4%	16.0%
-125 to +90	90	227.8	2.4%	14.2%	194.5	1.6%	10.2%	180.1	2.3%	13.7%
-90 to +63	63	215.0	2.2%	12.0%	192.2	1.6%	8.6%	170.7	2.2%	11.6%
-63 to +45	45	114.8	1.2%	10.8%	102.2	0.9%	7.7%	91.1	1.1%	10.4%
-45	Pan	1040.2	10.8%		923.3	7.7%		825.4	10.4%	
Total		9621.9	100.0%		11965.5	100.0%		7931.3	100.0%	

Calculated P_{80}	[mm]	4.89	7.92	5.22
Calculated P_{50}	[mm]	1.32	2.66	1.43

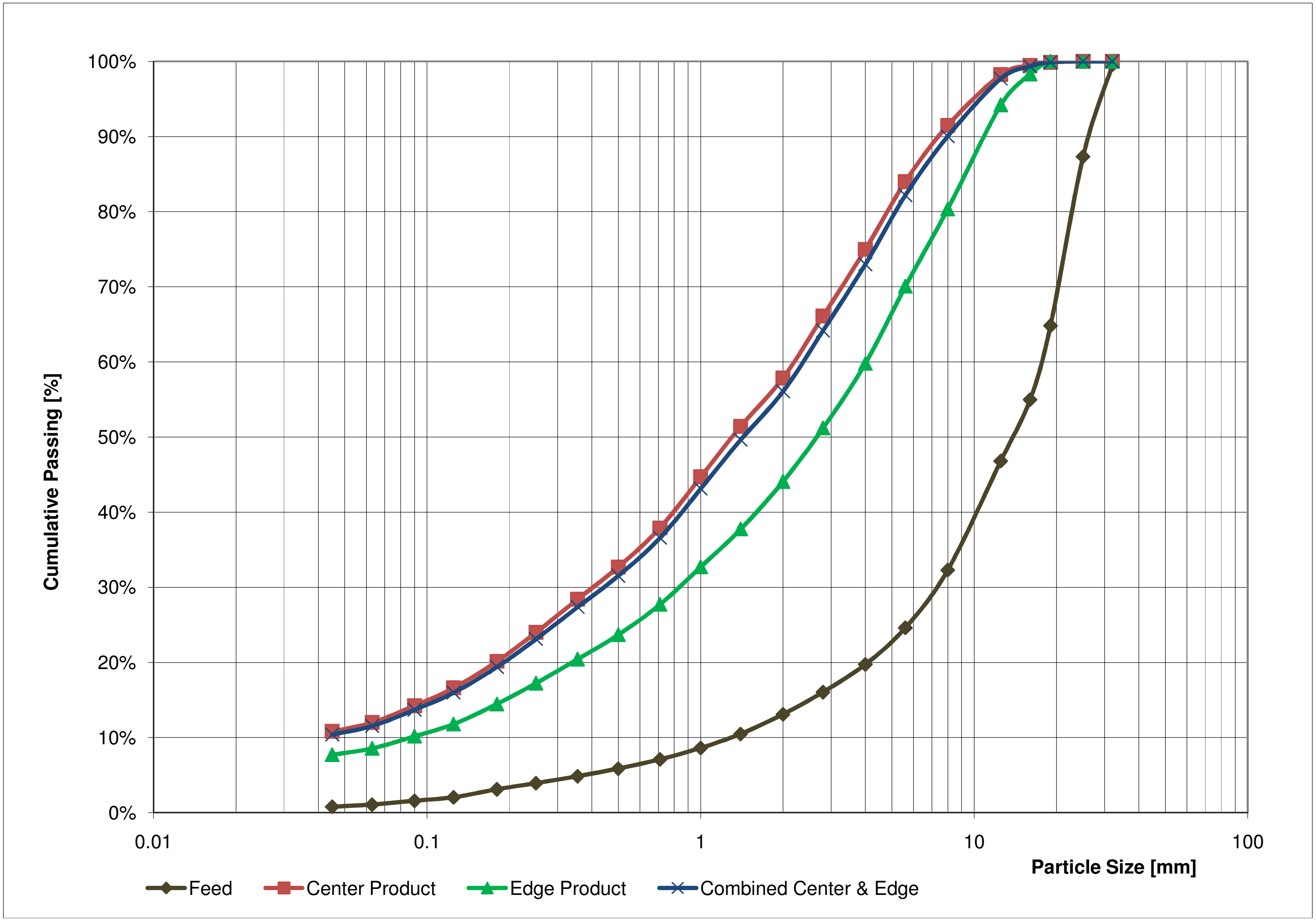

Figure A 5 Product particle size distributions of KSM002

Table A 10 Particle Size Distribution of KSM003

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM003 (3 N/mm^2)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		112.5	70.4		47.3	29.6		159.8		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.00	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.00	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	36.70	0.4%	99.6%	19.3	0.2%	99.8%	27.0	0.3%	99.7%
-19000 to +16000	16000	65.50	0.6%	99.0%	274.0	2.5%	97.3%	69.6	0.9%	98.8%
-16000 to +12500	12500	169.80	1.7%	97.3%	553.8	5.0%	92.3%	166.5	2.1%	96.7%
-12500 to +8000	8000	728.20	7.1%	90.2%	1725.7	15.7%	76.6%	655.5	8.2%	88.6%
-8000 to +5600	5600	818.30	8.0%	82.2%	1263.8	11.5%	65.1%	676.0	8.4%	80.1%
-5600 to +4000	4000	901.30	8.8%	73.4%	1110.0	10.1%	55.0%	719.2	9.0%	71.2%
-4000 to +2800	2800	888.80	8.7%	64.8%	922.7	8.4%	46.6%	693.8	8.6%	62.5%
-2800 to +2000	2000	800.20	7.8%	57.0%	757.1	6.9%	39.7%	618.0	7.7%	54.8%
-2000 to +1400	1400	756.70	7.4%	49.6%	645.8	5.9%	33.8%	578.1	7.2%	47.6%
-1400 to +1000	1000	673.40	6.6%	43.0%	452.9	4.1%	29.7%	503.5	6.3%	41.4%
-1000 to +710	710	621.00	6.1%	36.9%	570.7	5.2%	24.5%	478.1	6.0%	35.4%
-710 to +500	500	522.40	5.1%	31.8%	376.6	3.4%	21.0%	392.9	4.9%	30.5%
-500 to +355	355	440.10	4.3%	27.5%	327.4	3.0%	18.1%	331.9	4.1%	26.4%
-355 to +250	250	446.30	4.4%	23.2%	310.7	2.8%	15.2%	334.7	4.2%	22.2%
-250 to +180	180	368.20	3.6%	19.6%	265.0	2.4%	12.8%	276.9	3.4%	18.8%
-180 to +125	125	355.80	3.5%	16.1%	276.0	2.5%	10.3%	269.3	3.4%	15.4%
-125 to +90	90	289.30	2.8%	13.3%	133.4	1.2%	9.1%	210.8	2.6%	12.8%
-90 to +63	63	187.20	1.8%	11.5%	171.4	1.6%	7.5%	144.1	1.8%	11.0%
-63 to +45	45	119.20	1.2%	10.3%	76.6	0.7%	6.8%	88.8	1.1%	9.9%
-45	Pan	1054.50	10.3%		749.9	6.8%		792.1	9.9%	
Total		10242.9	100.0%		10982.8	100.0%		8026.7	100.0%	

Calculated P_{80}	[mm]	5.19			8.98			5.58
Calculated P_{50}	[mm]	1.43			3.29			1.60

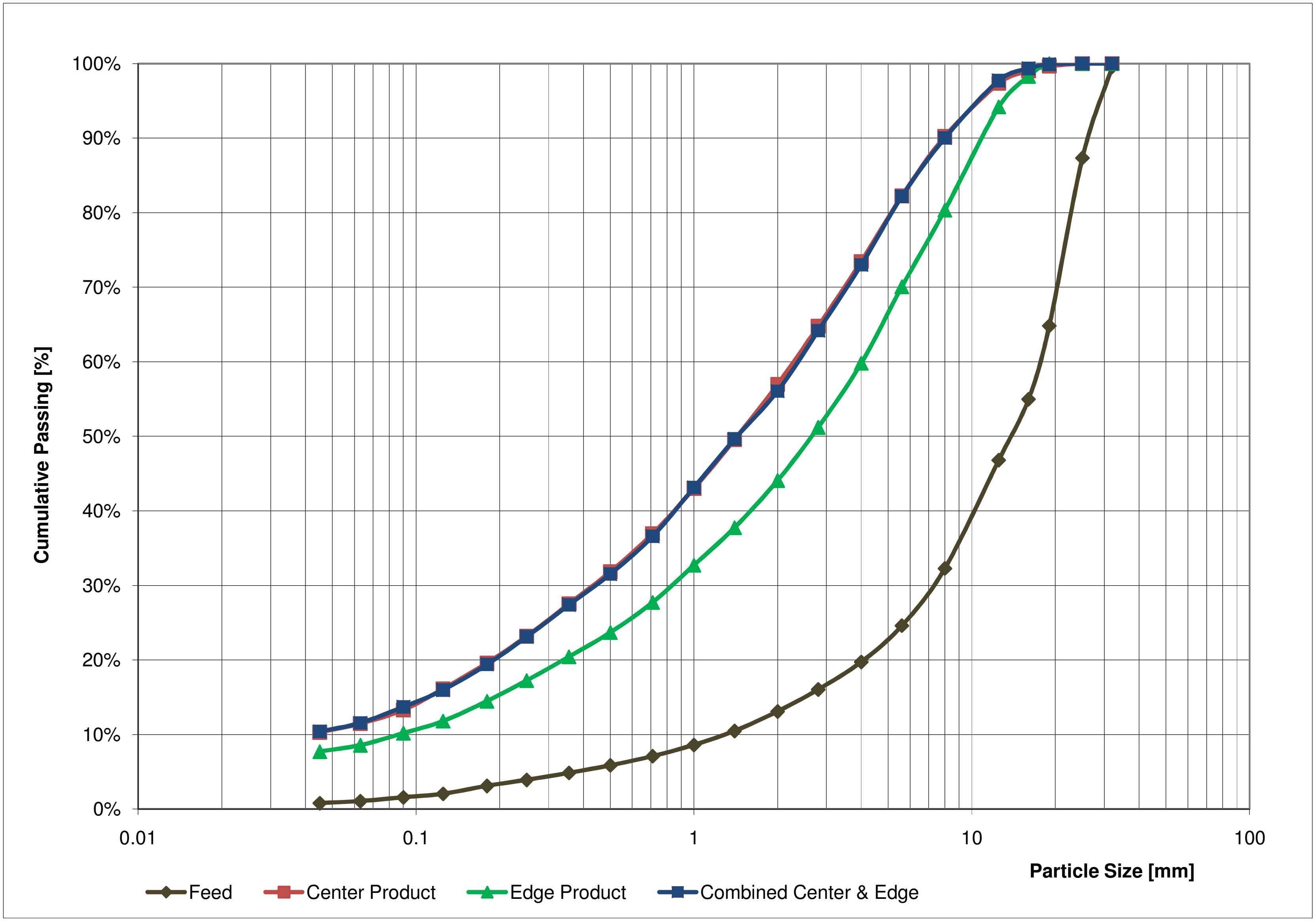

Figure A6 Product particle size distributions of KSM003

Table A 11 Particle size distribution of KSM004

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM004 (5 N/mm^2)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		106.0	69.5		46.5	30.5		152.5		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.00	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.00	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	0.00	0.0%	100.0%	13.7	0.1%	99.9%	1.2	0.0%	100.0%
-19000 to +16000	16000	32.30	0.3%	99.7%	21.5	0.2%	99.7%	24.4	0.3%	99.7%
-16000 to +12500	12500	86.00	0.9%	98.8%	250.7	2.2%	97.5%	82.0	1.0%	98.6%
-12500 to +8000	8000	481.40	4.8%	94.0%	1247.7	10.8%	86.7%	445.5	5.6%	93.1%
-8000 to +5600	5600	604.60	6.1%	87.9%	1097.6	9.5%	77.2%	518.1	6.5%	86.6%
-5600 to +4000	4000	773.80	7.8%	80.2%	1130.8	9.8%	67.4%	639.0	8.0%	78.5%
-4000 to +2800	2800	798.80	8.0%	72.2%	997.2	8.6%	58.7%	644.7	8.1%	70.4%
-2800 to +2000	2000	838.40	8.4%	63.7%	897.1	7.8%	51.0%	663.4	8.3%	62.1%
-2000 to +1400	1400	550.00	5.5%	58.2%	595.5	5.2%	45.8%	435.8	5.5%	56.6%
-1400 to +1000	1000	759.20	7.6%	50.6%	688.4	6.0%	39.8%	589.9	7.4%	49.2%
-1000 to +710	710	793.40	8.0%	42.7%	729.5	6.3%	33.5%	617.3	7.7%	41.5%
-710 to +500	500	554.20	5.6%	37.1%	536.3	4.6%	28.9%	433.6	5.4%	36.1%
-500 to +355	355	468.10	4.7%	32.4%	443.2	3.8%	25.0%	365.3	4.6%	31.5%
-355 to +250	250	508.30	5.1%	27.3%	444.8	3.9%	21.2%	393.5	4.9%	26.5%
-250 to +180	180	440.40	4.4%	22.9%	372.3	3.2%	17.9%	339.8	4.3%	22.3%
-180 to +125	125	409.30	4.1%	18.8%	368.3	3.2%	14.7%	317.8	4.0%	18.3%
-125 to +90	90	259.90	2.6%	16.2%	251.7	2.2%	12.6%	203.3	2.6%	15.7%
-90 to +63	63	254.30	2.6%	13.6%	214.0	1.9%	10.7%	196.1	2.5%	13.3%
-63 to +45	45	132.40	1.3%	12.3%	113.6	1.0%	9.7%	102.3	1.3%	12.0%
-45	Pan	1227.00	12.3%		1121.8	9.7%		954.1	12.0%	
Total		9971.8	100.0%		11535.7	100.0%		7967.2	100.0%	
		Calculated P_{80}	[mm]	6.04			9.14			6.45
		Calculated P_{50}	[mm]	2.23			3.87			2.38

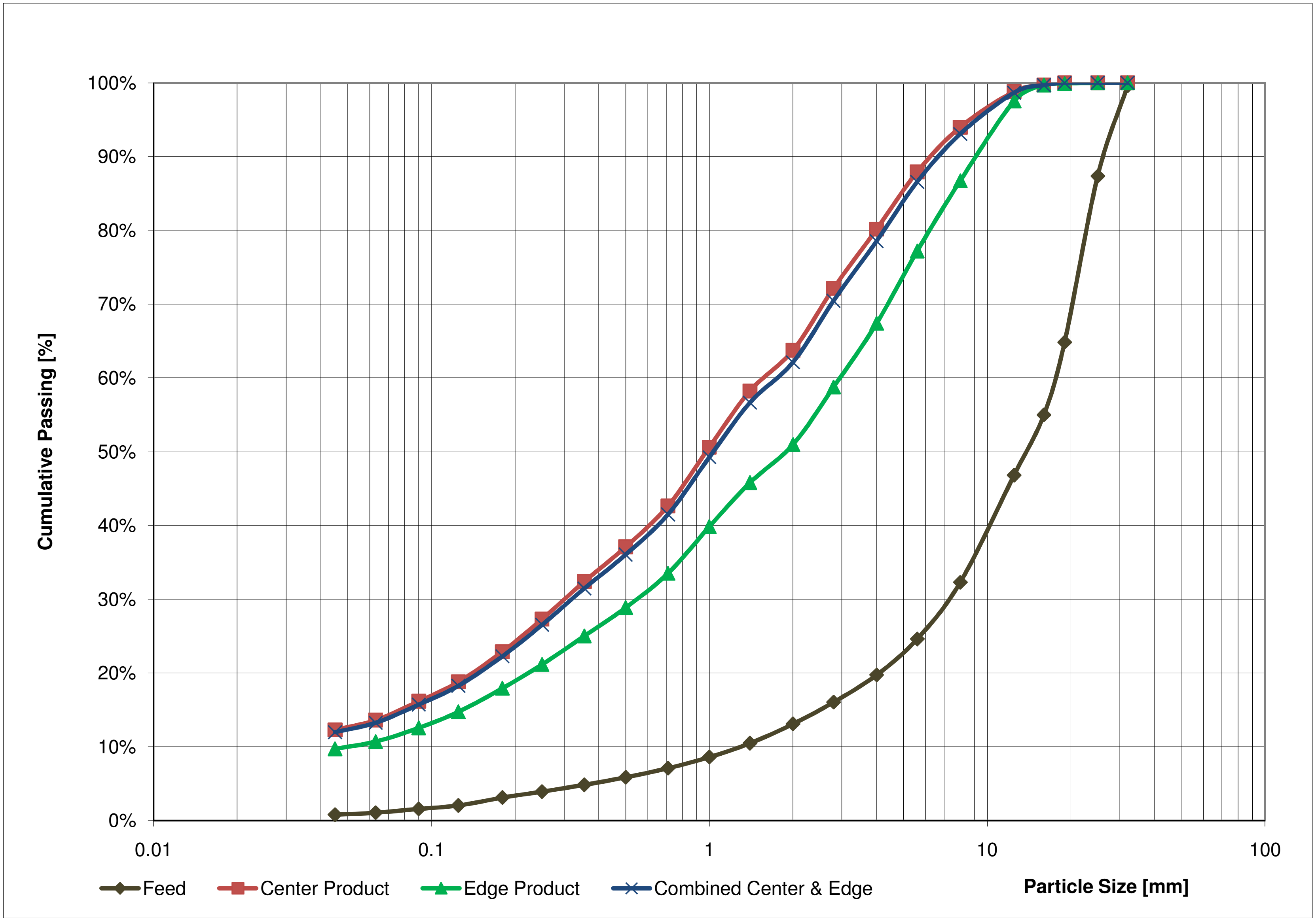

Figure A7 Product particle size distributions of KSM004

Table A 12 Particle Size Distribution of KSM005

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM005 (4 N/mm²)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		103.9	68.9		47.0	31.1		150.9		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	9.1	0.1%	99.9%	24.4	0.2%	99.8%	8.9	0.1%	99.9%
-19000 to +16000	16000	35.6	0.4%	99.5%	105.3	0.9%	98.9%	35.8	0.5%	99.4%
-16000 to +12500	12500	83.0	0.9%	98.6%	342.0	2.9%	96.0%	91.9	1.2%	98.3%
-12500 to +8000	8000	475.0	5.2%	93.5%	1587.9	13.4%	82.7%	493.9	6.2%	92.0%
-8000 to +5600	5600	625.1	6.8%	86.7%	1177.2	9.9%	72.8%	570.3	7.2%	84.8%
-5600 to +4000	4000	775.7	8.4%	78.2%	1178.6	9.9%	62.8%	683.1	8.6%	76.2%
-4000 to +2800	2800	779.5	8.5%	69.8%	1015.0	8.5%	54.3%	671.6	8.5%	67.7%
-2800 to +2000	2000	736.5	8.0%	61.8%	872.4	7.3%	47.0%	627.0	7.9%	59.8%
-2000 to +1400	1400	736.1	8.0%	53.8%	777.3	6.5%	40.4%	618.4	7.8%	52.0%
-1400 to +1000	1000	638.1	6.9%	46.8%	735.3	6.2%	34.2%	541.4	6.8%	45.2%
-1000 to +710	710	613.6	6.7%	40.2%	533.0	4.5%	29.8%	505.4	6.4%	38.8%
-710 to +500	500	500.6	5.4%	34.7%	484.8	4.1%	25.7%	416.7	5.3%	33.6%
-500 to +355	355	413.9	4.5%	30.3%	406.2	3.4%	22.3%	345.0	4.4%	29.2%
-355 to +250	250	430.3	4.7%	25.6%	407.2	3.4%	18.8%	357.4	4.5%	24.7%
-250 to +180	180	404.7	4.4%	21.2%	404.7	3.4%	15.4%	338.0	4.3%	20.4%
-180 to +125	125	319.7	3.5%	17.7%	314.3	2.6%	12.8%	266.5	3.4%	17.1%
-125 to +90	90	263.6	2.9%	14.8%	187.4	1.6%	11.2%	213.5	2.7%	14.4%
-90 to +63	63	197.1	2.1%	12.7%	209.2	1.8%	9.4%	165.7	2.1%	12.3%
-63 to +45	45	108.2	1.2%	11.5%	98.0	0.8%	8.6%	89.5	1.1%	11.1%
-45	Pan	1061.6	11.5%		1025.1	8.6%		883.5	11.1%	
Total		9207.0	100.0%		11885.3	100.0%		7923.6	100.0%	
		Calculated P_{80}	[mm]	4.33			7.35			4.70
		Calculated P_{50}	[mm]	1.18			2.33			1.28

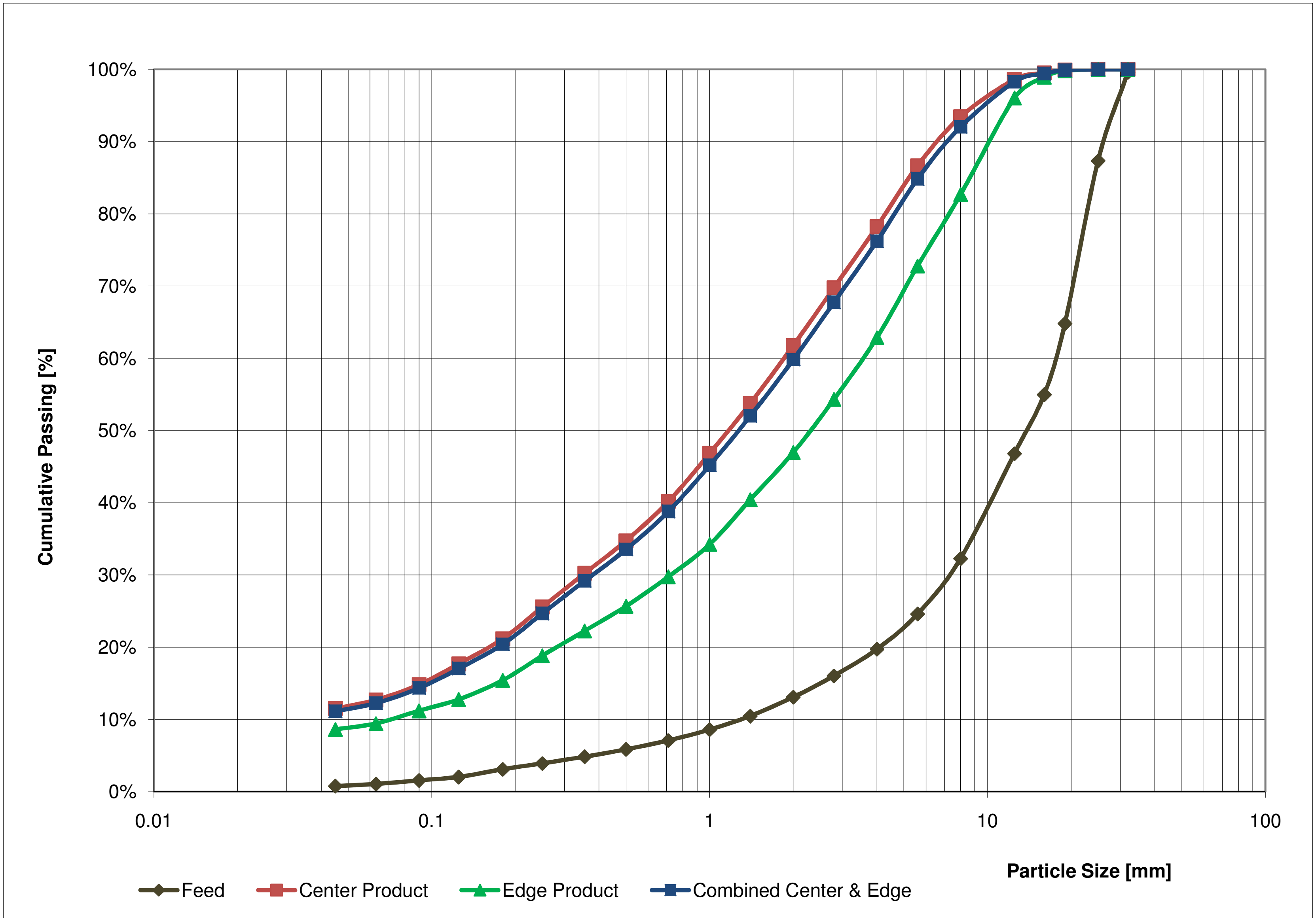

Figure A 8 Product particle size distributions of KSM005

Table A 13 Particle Size Distribution of KSM006

Sample No.		Centre			Edge			Combined Centre + 1/3 Edge		
KSM006 (4 N/mm^2)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		102.0	70.2		43.2	29.8		145.2		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	14.3	0.2%	99.8%	7.7	0.1%	99.9%	12.0	0.1%	99.9%
-19000 to +16000	16000	53.5	0.6%	99.2%	80.0	0.8%	99.2%	49.8	0.6%	99.2%
-16000 to +12500	12500	132.6	1.5%	97.7%	362.3	3.5%	95.7%	139.2	1.7%	97.5%
-12500 to +8000	8000	588.1	6.6%	91.1%	1413.7	13.6%	82.1%	598.7	7.5%	90.0%
-8000 to +5600	5600	618.3	6.9%	84.2%	1123.4	10.8%	71.3%	594.9	7.4%	82.6%
-5600 to +4000	4000	758.8	8.5%	75.7%	1072.8	10.3%	61.0%	700.9	8.7%	73.9%
-4000 to +2800	2800	760.3	8.5%	67.1%	928.6	8.9%	52.0%	688.3	8.6%	65.3%
-2800 to +2000	2000	703.0	7.9%	59.3%	757.6	7.3%	44.7%	626.8	7.8%	57.5%
-2000 to +1400	1400	696.1	7.8%	51.4%	662.2	6.4%	38.4%	612.2	7.6%	49.8%
-1400 to +1000	1000	569.4	6.4%	45.0%	555.4	5.3%	33.0%	502.1	6.3%	43.6%
-1000 to +710	710	532.3	6.0%	39.1%	483.3	4.6%	28.4%	466.0	5.8%	37.7%
-710 to +500	500	470.2	5.3%	33.8%	408.9	3.9%	24.4%	409.9	5.1%	32.6%
-500 to +355	355	394.5	4.4%	29.4%	348.0	3.3%	21.1%	344.4	4.3%	28.3%
-355 to +250	250	408.7	4.6%	24.8%	342.3	3.3%	17.8%	355.0	4.4%	23.9%
-250 to +180	180	407.2	4.6%	20.2%	299.1	2.9%	14.9%	349.7	4.4%	19.5%
-180 to +125	125	300.0	3.4%	16.8%	267.5	2.6%	12.4%	262.2	3.3%	16.3%
-125 to +90	90	174.1	2.0%	14.9%	153.8	1.5%	10.9%	152.0	1.9%	14.4%
-90 to +63	63	219.8	2.5%	12.4%	190.4	1.8%	9.0%	191.5	2.4%	12.0%
-63 to +45	45	94.6	1.1%	11.3%	70.0	0.7%	8.4%	81.3	1.0%	11.0%
-45	Pan	1010.0	11.3%		870.3	8.4%		879.7	11.0%	
Total		8905.8	100.0%		10397.3	100.0%		8016.5	100.0%	

		Centre	Edge	Combined
Calculated P_{80}	[mm]	4.81	7.54	5.12
Calculated P_{50}	[mm]	1.31	2.58	1.41

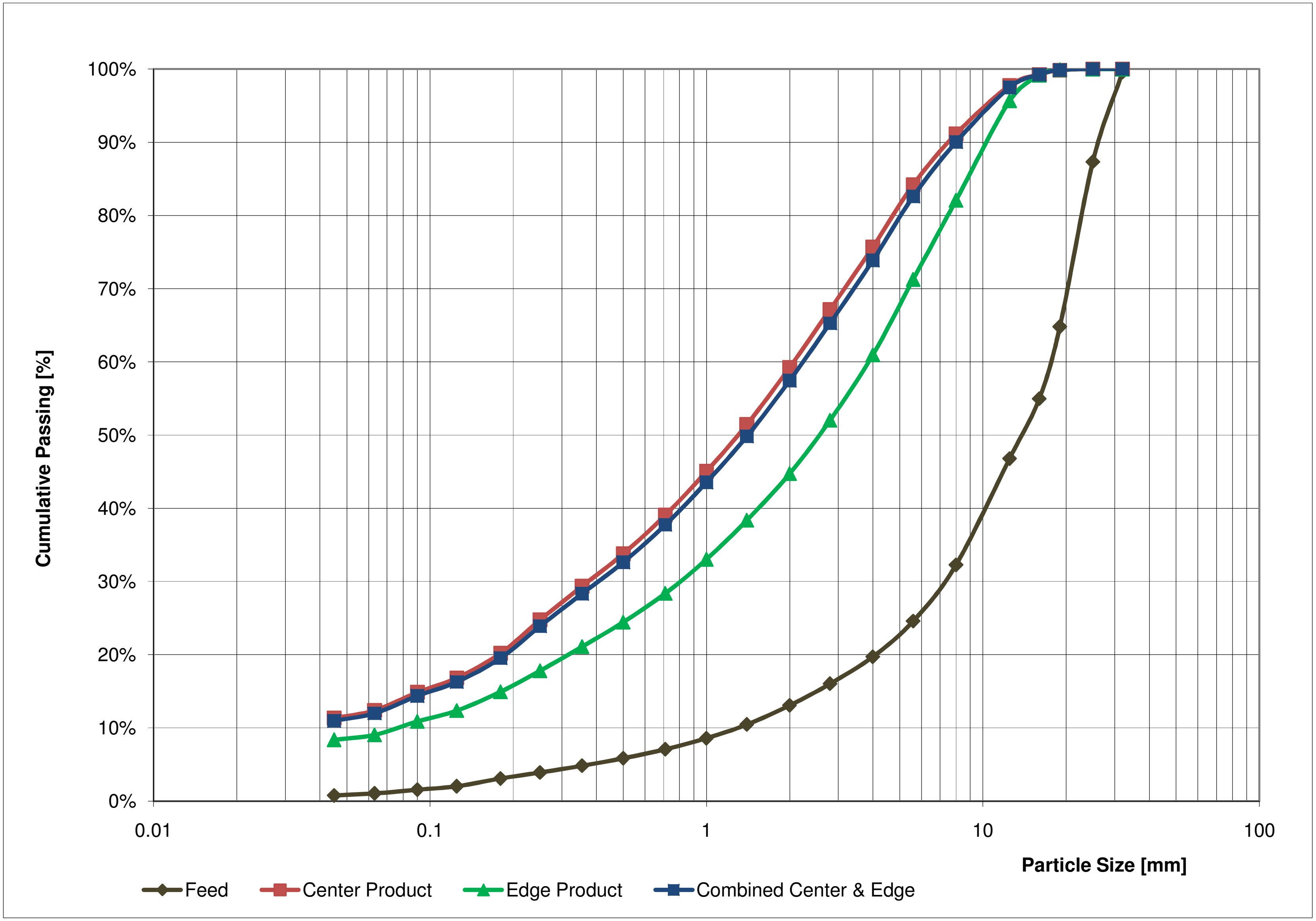

Figure A 9 Product particle size distributions of KSM006

Table A 14 Particle Size Distribution of KSM007

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM007 (4 N/mm²)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		121.7	69.3		53.9	30.7		175.6		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	0.0	0.0%	100.0%	127.0	0.9%	99.1%	9.5	0.1%	99.9%
-19000 to +16000	16000	58.6	0.5%	99.5%	455.5	3.3%	95.8%	68.3	0.9%	99.0%
-16000 to +12500	12500	124.8	1.1%	98.4%	929.2	6.8%	89.0%	142.5	1.8%	97.2%
-12500 to +8000	8000	737.1	6.2%	92.2%	2266.0	16.5%	72.5%	601.3	7.6%	89.7%
-8000 to +5600	5600	772.5	6.5%	85.7%	1517.8	11.1%	61.4%	566.2	7.1%	82.6%
-5600 to +4000	4000	909.8	7.7%	78.0%	1405.6	10.2%	51.2%	638.4	8.0%	74.5%
-4000 to +2800	2800	964.0	8.2%	69.8%	1136.1	8.3%	42.9%	650.1	8.2%	66.4%
-2800 to +2000	2000	936.2	7.9%	61.9%	845.0	6.2%	36.7%	612.1	7.7%	58.7%
-2000 to +1400	1400	967.7	8.2%	53.7%	882.7	6.4%	30.3%	633.4	8.0%	50.7%
-1400 to +1000	1000	776.5	6.6%	47.1%	645.2	4.7%	25.6%	503.5	6.3%	44.4%
-1000 to +710	710	751.3	6.4%	40.8%	562.7	4.1%	21.5%	482.6	6.1%	38.3%
-710 to +500	500	666.5	5.6%	35.1%	471.8	3.4%	18.1%	426.1	5.4%	32.9%
-500 to +355	355	560.6	4.7%	30.4%	384.0	2.8%	15.3%	357.4	4.5%	28.4%
-355 to +250	250	568.1	4.8%	25.6%	352.2	2.6%	12.7%	359.4	4.5%	23.9%
-250 to +180	180	487.3	4.1%	21.5%	313.8	2.3%	10.4%	309.2	3.9%	20.0%
-180 to +125	125	470.0	4.0%	17.5%	262.1	1.9%	8.5%	295.2	3.7%	16.3%
-125 to +90	90	278.8	2.4%	15.1%	163.7	1.2%	7.3%	175.7	2.2%	14.1%
-90 to +63	63	345.7	2.9%	12.2%	191.4	1.4%	5.9%	217.0	2.7%	11.4%
-63 to +45	45	184.7	1.6%	10.6%	108.0	0.8%	5.1%	116.4	1.5%	9.9%
-45	Pan	1256.9	10.6%		701.8	5.1%		789.5	9.9%	
Total		11817.1	100.0%		13721.6	100.0%		7953.7	100.0%	

		Centre	Edge	Combined
Calculated P_{80}	[mm]	4.42	10.05	5.09
Calculated P_{50}	[mm]	1.17	3.83	1.36

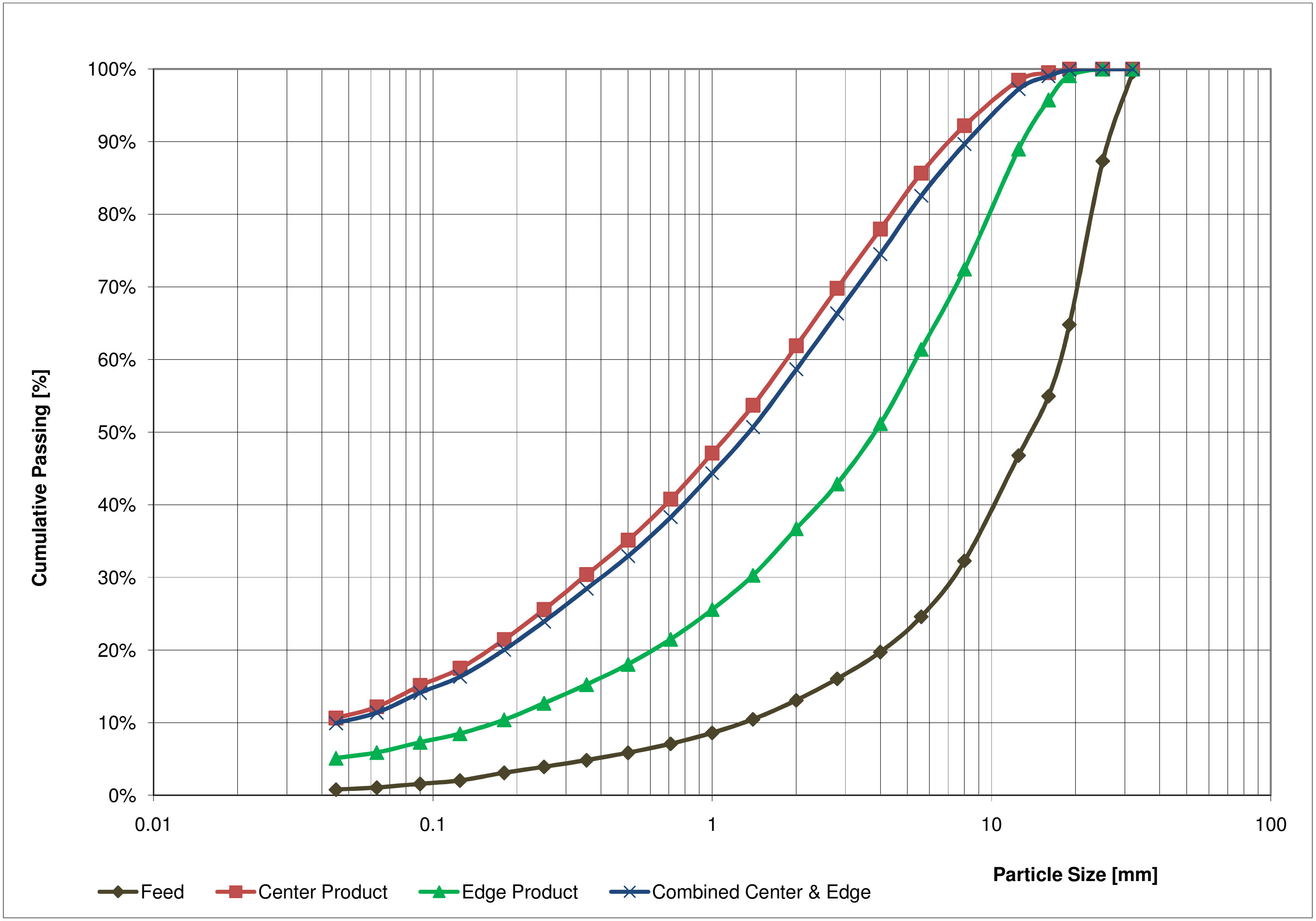

Figure A10 Product particle size distributions of KSM007

Table A 15 Particle Size Distribution of KSM008

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM008 (4 N/mm²)		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		105.7	72.0		41.1	28.0		146.8		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-19000 to +16000	16000	28.1	0.3%	99.7%	32.3	0.3%	99.7%	23.7	0.3%	99.7%
-16000 to +12500	12500	125.3	1.3%	98.4%	131.1	1.4%	98.3%	104.3	1.3%	98.4%
-12500 to +8000	8000	695.4	7.0%	91.4%	693.2	7.4%	90.9%	575.3	7.1%	91.4%
-8000 to +5600	5600	802.2	8.1%	83.3%	860.7	9.1%	81.8%	669.7	8.2%	83.1%
-5600 to +4000	4000	857.5	8.7%	74.6%	880.4	9.3%	72.4%	711.9	8.8%	74.4%
-4000 to +2800	2800	790.6	8.0%	66.6%	813.6	8.6%	63.8%	656.5	8.1%	66.3%
-2800 to +2000	2000	695.7	7.0%	59.6%	697.7	7.4%	56.4%	575.9	7.1%	59.2%
-2000 to +1400	1400	669.6	6.8%	52.8%	575.0	6.1%	50.3%	544.8	6.7%	52.5%
-1400 to +1000	1000	577.8	5.8%	47.0%	525.1	5.6%	44.7%	472.9	5.8%	46.7%
-1000 to +710	710	576.0	5.8%	41.1%	539.0	5.7%	39.0%	473.0	5.8%	40.9%
-710 to +500	500	487.1	4.9%	36.2%	483.5	5.1%	33.8%	402.7	5.0%	35.9%
-500 to +355	355	412.3	4.2%	32.0%	388.7	4.1%	29.7%	338.9	4.2%	31.8%
-355 to +250	250	448.5	4.5%	27.5%	400.6	4.3%	25.5%	366.4	4.5%	27.3%
-250 to +180	180	432.8	4.4%	23.1%	388.0	4.1%	21.4%	353.7	4.3%	22.9%
-180 to +125	125	383.3	3.9%	19.2%	333.5	3.5%	17.8%	312.3	3.8%	19.1%
-125 to +90	90	227.8	2.3%	16.9%	223.6	2.4%	15.4%	188.1	2.3%	16.8%
-90 to +63	63	260.3	2.6%	14.3%	220.5	2.3%	13.1%	211.5	2.6%	14.2%
-63 to +45	45	140.5	1.4%	12.9%	135.4	1.4%	11.7%	115.8	1.4%	12.7%
-45	Pan	1273.1	12.9%		1098.2	11.7%		1036.2	12.7%	
Total		9883.9	100.0%		9420.1	100.0%		8133.5	100.0%	

		Centre	Edge	Combined
Calculated P_{80}	[mm]	4.99	5.30	5.03
Calculated P_{50}	[mm]	1.21	1.38	1.23

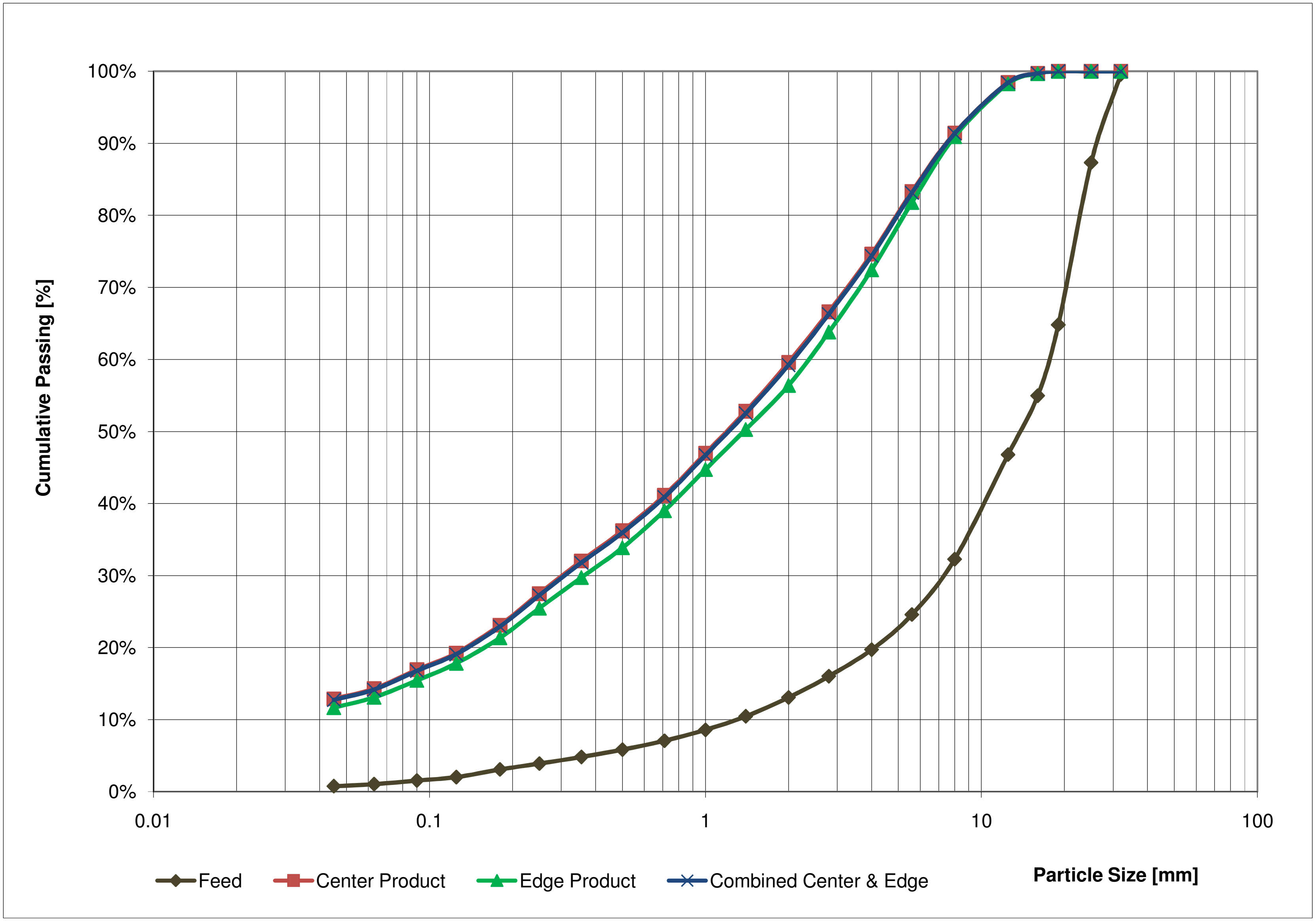

Figure A 11 Product particle size distributions of KSM008

Table A 16 Particle Size Distribution of KSM009

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM009		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		114.3	72.4		43.6	27.6		157.9		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	20.9	0.2%	99.8%	0.0	0.0%	100.0%	14.2	0.2%	99.8%
-19000 to +16000	16000	29.1	0.3%	99.5%	110.4	1.1%	98.9%	29.7	0.4%	99.5%
-16000 to +12500	12500	98.1	0.9%	98.6%	279.0	2.7%	96.2%	91.8	1.1%	98.3%
-12500 to +8000	8000	721.1	6.8%	91.8%	1223.6	12.0%	84.2%	600.3	7.4%	91.0%
-8000 to +5600	5600	881.4	8.3%	83.6%	1045.4	10.3%	73.9%	693.1	8.5%	82.5%
-5600 to +4000	4000	913.4	8.6%	75.0%	1053.5	10.3%	63.6%	715.6	8.8%	73.7%
-4000 to +2800	2800	863.4	8.1%	66.9%	906.6	8.9%	54.7%	668.4	8.2%	65.5%
-2800 to +2000	2000	817.9	7.7%	59.2%	743.5	7.3%	47.4%	622.8	7.6%	57.9%
-2000 to +1400	1400	830.1	7.8%	51.4%	732.3	7.2%	40.2%	630.0	7.7%	50.2%
-1400 to +1000	1000	650.2	6.1%	45.3%	530.8	5.2%	35.0%	489.6	6.0%	44.2%
-1000 to +710	710	676.5	6.3%	39.0%	479.1	4.7%	30.3%	502.8	6.2%	38.0%
-710 to +500	500	586.5	5.5%	33.5%	457.8	4.5%	25.8%	439.8	5.4%	32.6%
-500 to +355	355	468.7	4.4%	29.1%	353.9	3.5%	22.4%	350.4	4.3%	28.3%
-355 to +250	250	491.0	4.6%	24.5%	360.0	3.5%	18.8%	366.1	4.5%	23.8%
-250 to +180	180	436.6	4.1%	20.4%	311.8	3.1%	15.8%	324.7	4.0%	19.9%
-180 to +125	125	393.0	3.7%	16.7%	300.5	2.9%	12.8%	294.1	3.6%	16.2%
-125 to +90	90	283.4	2.7%	14.0%	183.7	1.8%	11.0%	209.1	2.6%	13.7%
-90 to +63	63	242.3	2.3%	11.7%	188.2	1.8%	9.2%	181.6	2.2%	11.5%
-63 to +45	45	162.2	1.5%	10.2%	126.1	1.2%	7.9%	121.6	1.5%	10.0%
-45	Pan	1089.6	10.2%		810.5	7.9%		813.4	10.0%	
Total		10655.4	100.0%		10196.7	100.0%		8159.2	100.0%	

		Centre	Edge	Combined
Calculated P_{80}	[mm]	4.93	7.02	5.15
Calculated P_{50}	[mm]	1.31	2.28	1.39

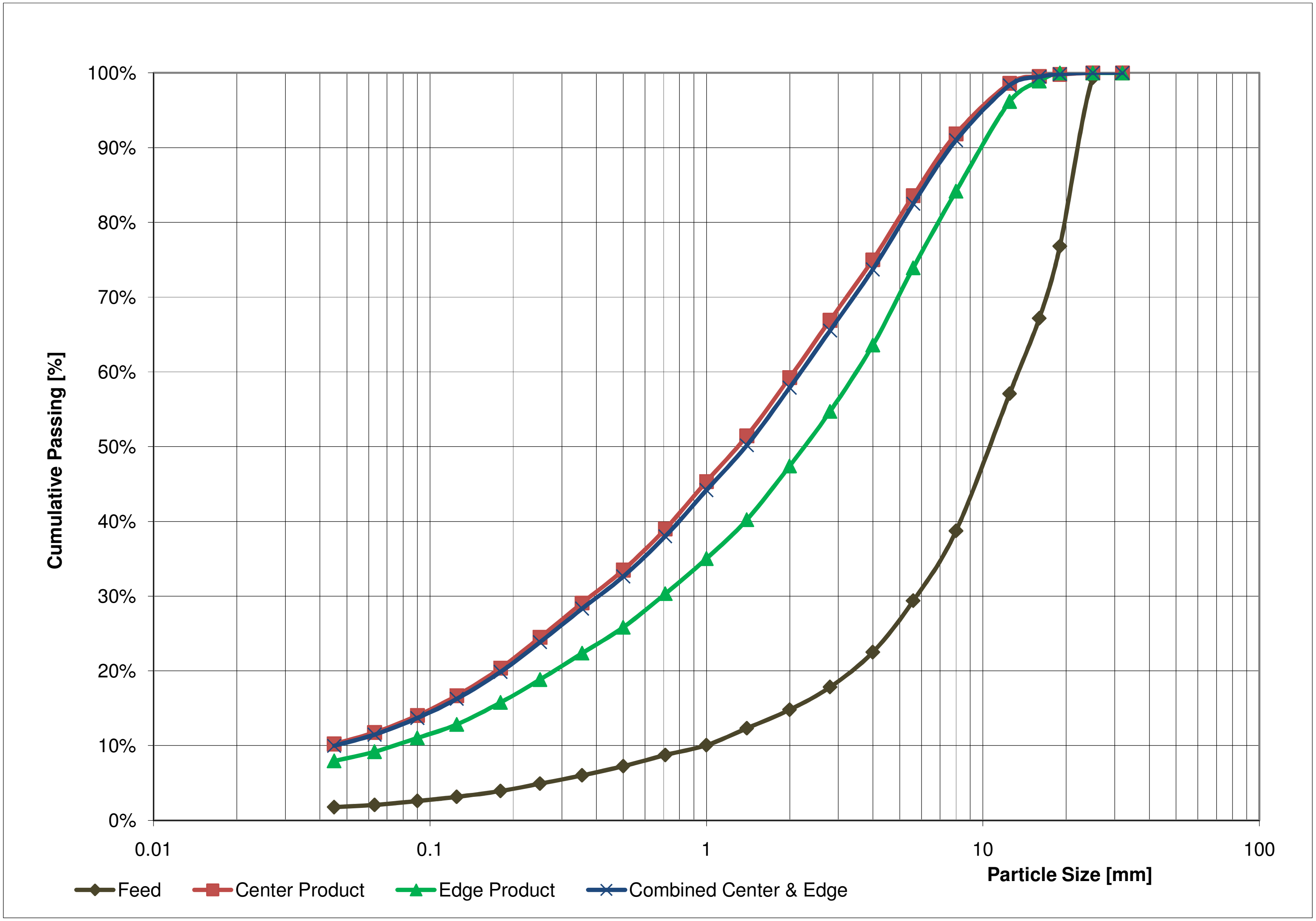

Figure A12 Product particle size distributions of KSM009

Table A 17 Particle Size Distribution of KSM010

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM010		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		110.3	68.3		51.2	31.7		161.5		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-19000 to +16000	16000	0.0	0.0%	100.0%	8.4	0.1%	99.9%	0.7	0.0%	100.0%
-16000 to +12500	12500	29.4	0.3%	99.7%	155.0	1.3%	98.7%	35.4	0.4%	99.5%
-12500 to +8000	8000	325.1	3.6%	96.1%	1254.9	10.2%	88.5%	352.3	4.5%	95.1%
-8000 to +5600	5600	508.5	5.6%	90.5%	1330.8	10.8%	77.6%	496.7	6.3%	88.8%
-5600 to +4000	4000	680.5	7.5%	83.0%	1320.3	10.7%	66.9%	625.2	7.9%	80.8%
-4000 to +2800	2800	724.2	8.0%	75.0%	1170.5	9.5%	57.4%	645.1	8.2%	72.7%
-2800 to +2000	2000	733.2	8.1%	67.0%	900.7	7.3%	50.1%	628.7	8.0%	64.7%
-2000 to +1400	1400	750.4	8.3%	58.7%	917.5	7.5%	42.6%	643.1	8.2%	56.5%
-1400 to +1000	1000	585.4	6.4%	52.3%	701.2	5.7%	36.9%	500.4	6.3%	50.2%
-1000 to +710	710	645.5	7.1%	45.1%	627.8	5.1%	31.8%	539.3	6.8%	43.4%
-710 to +500	500	564.2	6.2%	38.9%	557.5	4.5%	27.3%	472.2	6.0%	37.4%
-500 to +355	355	456.2	5.0%	33.9%	450.0	3.7%	23.6%	381.7	4.8%	32.5%
-355 to +250	250	483.0	5.3%	28.6%	464.0	3.8%	19.8%	403.1	5.1%	27.4%
-250 to +180	180	463.7	5.1%	23.5%	395.5	3.2%	16.6%	382.7	4.9%	22.6%
-180 to +125	125	397.8	4.4%	19.1%	380.0	3.1%	13.5%	331.8	4.2%	18.4%
-125 to +90	90	254.3	2.8%	16.3%	238.3	1.9%	11.6%	211.7	2.7%	15.7%
-90 to +63	63	253.6	2.8%	13.5%	251.2	2.0%	9.6%	212.3	2.7%	13.0%
-63 to +45	45	146.5	1.6%	11.9%	152.8	1.2%	8.3%	123.3	1.6%	11.4%
-45	Pan	1081.2	11.9%		1021.9	8.3%		900.8	11.4%	
Total		9082.7	100.0%		12298.3	100.0%		7886.5	100.0%	

		Centre	Edge	Combined Centre + Edge
Calculated P_{80}	[mm]	3.55	6.12	3.88
Calculated P_{50}	[mm]	0.91	1.99	0.99

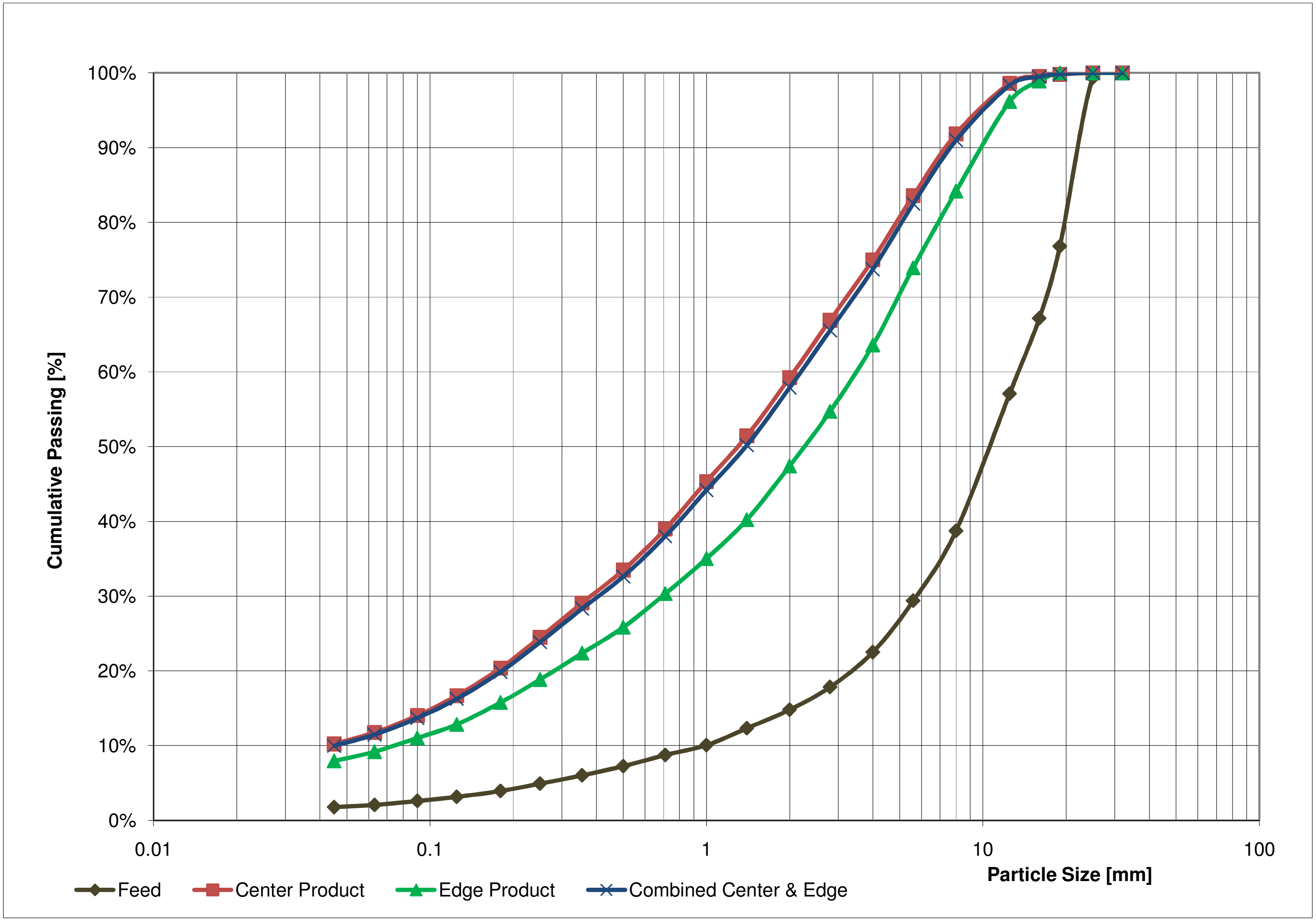

Figure A13 Product particle size distributions of KSM010

Table A 18 Particle Size Distribution of KSM011

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM011		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		112.2	68.4		51.9	31.6		164.1		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	7.6	0.1%	99.9%	5.3	0.0%	100.0%	5.2	0.1%	99.9%
-19000 to +16000	16000	17.0	0.2%	99.8%	58.4	0.5%	99.5%	15.7	0.2%	99.7%
-16000 to +12500	12500	66.2	0.6%	99.2%	323.5	2.6%	96.8%	69.4	0.9%	98.9%
-12500 to +8000	8000	595.1	5.5%	93.7%	1348.5	11.0%	85.8%	489.3	6.2%	92.7%
-8000 to +5600	5600	730.7	6.7%	87.0%	1164.0	9.5%	76.3%	558.4	7.1%	85.6%
-5600 to +4000	4000	849.5	7.8%	79.2%	1236.1	10.1%	66.2%	639.0	8.1%	77.5%
-4000 to +2800	2800	974.0	8.9%	70.3%	1166.2	9.5%	56.6%	711.1	9.0%	68.5%
-2800 to +2000	2000	880.2	8.1%	62.2%	927.5	7.6%	49.0%	631.7	8.0%	60.5%
-2000 to +1400	1400	910.4	8.3%	53.9%	889.4	7.3%	41.8%	647.3	8.2%	52.3%
-1400 to +1000	1000	675.9	6.2%	47.7%	640.0	5.2%	36.5%	478.8	6.1%	46.2%
-1000 to +710	710	687.3	6.3%	41.4%	598.5	4.9%	31.6%	482.4	6.1%	40.1%
-710 to +500	500	574.3	5.3%	36.1%	528.5	4.3%	27.3%	405.5	5.1%	34.9%
-500 to +355	355	514.4	4.7%	31.4%	446.2	3.7%	23.6%	360.9	4.6%	30.4%
-355 to +250	250	525.3	4.8%	26.6%	444.0	3.6%	20.0%	367.5	4.7%	25.7%
-250 to +180	180	450.8	4.1%	22.5%	380.3	3.1%	16.9%	315.3	4.0%	21.7%
-180 to +125	125	448.1	4.1%	18.4%	366.2	3.0%	13.9%	312.4	4.0%	17.8%
-125 to +90	90	288.8	2.6%	15.7%	216.2	1.8%	12.1%	199.7	2.5%	15.2%
-90 to +63	63	275.7	2.5%	13.2%	239.4	2.0%	10.2%	193.4	2.5%	12.8%
-63 to +45	45	170.3	1.6%	11.6%	162.9	1.3%	8.8%	120.8	1.5%	11.2%
-45	Pan	1267.5	11.6%		1080.7	8.8%		887.6	11.2%	
Total		10909.1	100.0%		12221.8	100.0%		7891.5	100.0%	
		Calculated P_{80}	[mm]	4.16			6.54			4.50
		Calculated P_{50}	[mm]	1.15			2.10			1.25

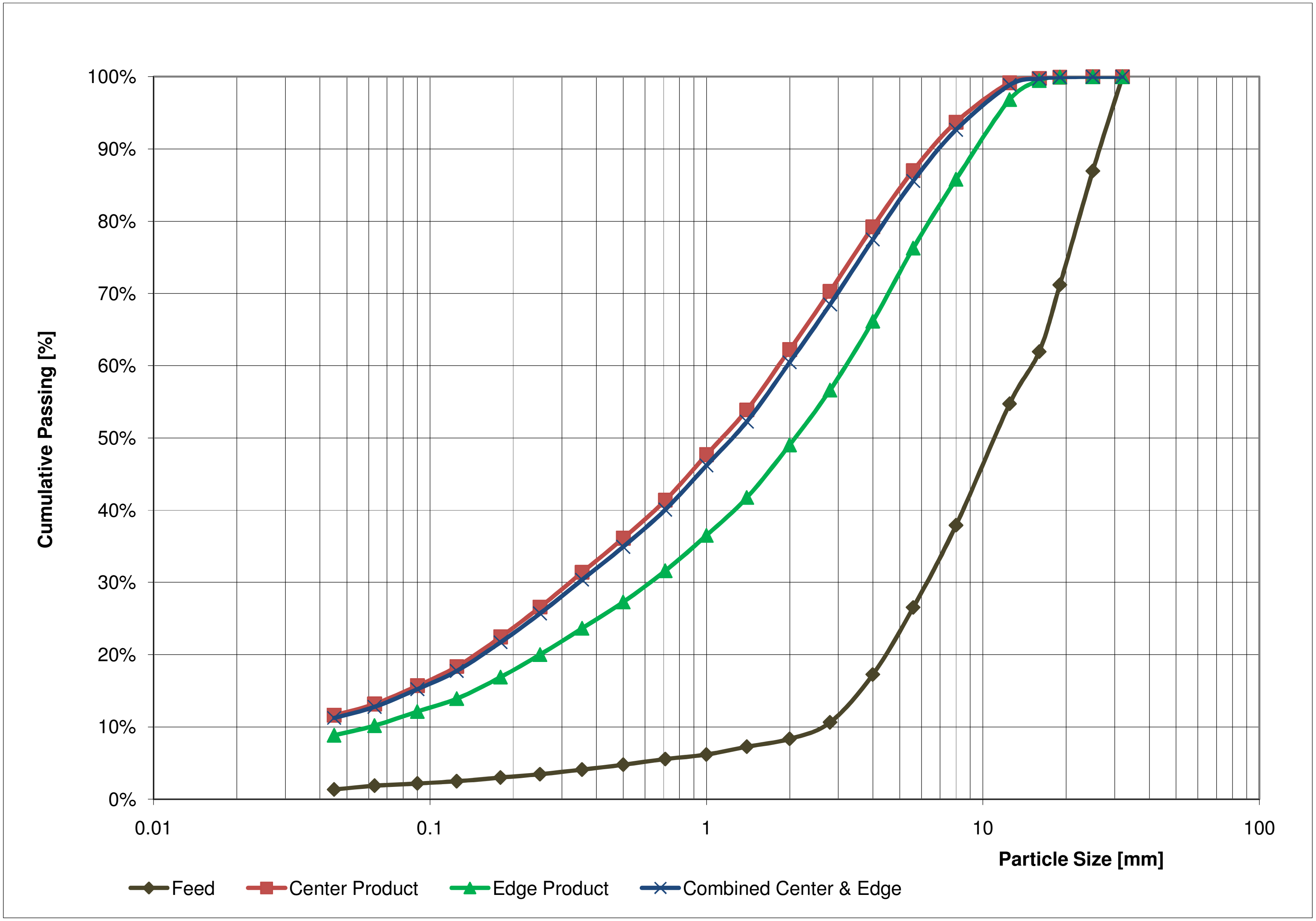

Figure A14 Product particle size distributions of KSM011

Table A 19 Particle Size Distribution of KSM012

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM012		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		78.4	50.2		77.8	49.8		156.2		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-19000 to +16000	16000	20.6	0.2%	99.8%	39.1	0.4%	99.6%	17.5	0.3%	99.7%
-16000 to +12500	12500	49.9	0.5%	99.3%	205.0	2.2%	97.4%	61.7	0.9%	98.8%
-12500 to +8000	8000	509.4	5.3%	94.0%	983.4	10.3%	87.1%	436.3	6.5%	92.3%
-8000 to +5600	5600	633.9	6.6%	87.4%	911.0	9.6%	77.5%	488.3	7.3%	85.0%
-5600 to +4000	4000	827.0	8.6%	78.9%	1004.5	10.6%	66.9%	604.9	9.1%	75.9%
-4000 to +2800	2800	820.6	8.5%	70.4%	929.5	9.8%	57.2%	588.5	8.8%	67.1%
-2800 to +2000	2000	846.1	8.8%	61.6%	748.3	7.9%	49.3%	570.1	8.5%	58.6%
-2000 to +1400	1400	774.5	8.0%	53.6%	728.5	7.7%	41.6%	529.5	7.9%	50.6%
-1400 to +1000	1000	600.3	6.2%	47.4%	529.3	5.6%	36.1%	404.2	6.1%	44.6%
-1000 to +710	710	667.6	6.9%	40.5%	487.4	5.1%	30.9%	431.8	6.5%	38.1%
-710 to +500	500	515.1	5.3%	35.2%	427.3	4.5%	26.4%	342.1	5.1%	33.0%
-500 to +355	355	446.2	4.6%	30.6%	345.7	3.6%	22.8%	292.1	4.4%	28.6%
-355 to +250	250	477.2	4.9%	25.6%	350.2	3.7%	19.1%	309.0	4.6%	24.0%
-250 to +180	180	509.9	5.3%	20.3%	298.8	3.1%	16.0%	317.0	4.7%	19.3%
-180 to +125	125	347.2	3.6%	16.8%	272.7	2.9%	13.1%	227.9	3.4%	15.8%
-125 to +90	90	218.7	2.3%	14.5%	217.8	2.3%	10.8%	151.6	2.3%	13.6%
-90 to +63	63	246.1	2.5%	11.9%	163.4	1.7%	9.1%	156.4	2.3%	11.2%
-63 to +45	45	149.4	1.5%	10.4%	105.5	1.1%	8.0%	96.0	1.4%	9.8%
-45	Pan	1004.6	10.4%		759.1	8.0%		654.3	9.8%	
Total		9664.3	100.0%		9506.5	100.0%		6679.5	100.0%	
		Calculated P_{80}	[mm]	4.21			6.22			4.72
		Calculated P_{50}	[mm]	1.17			2.07			1.36

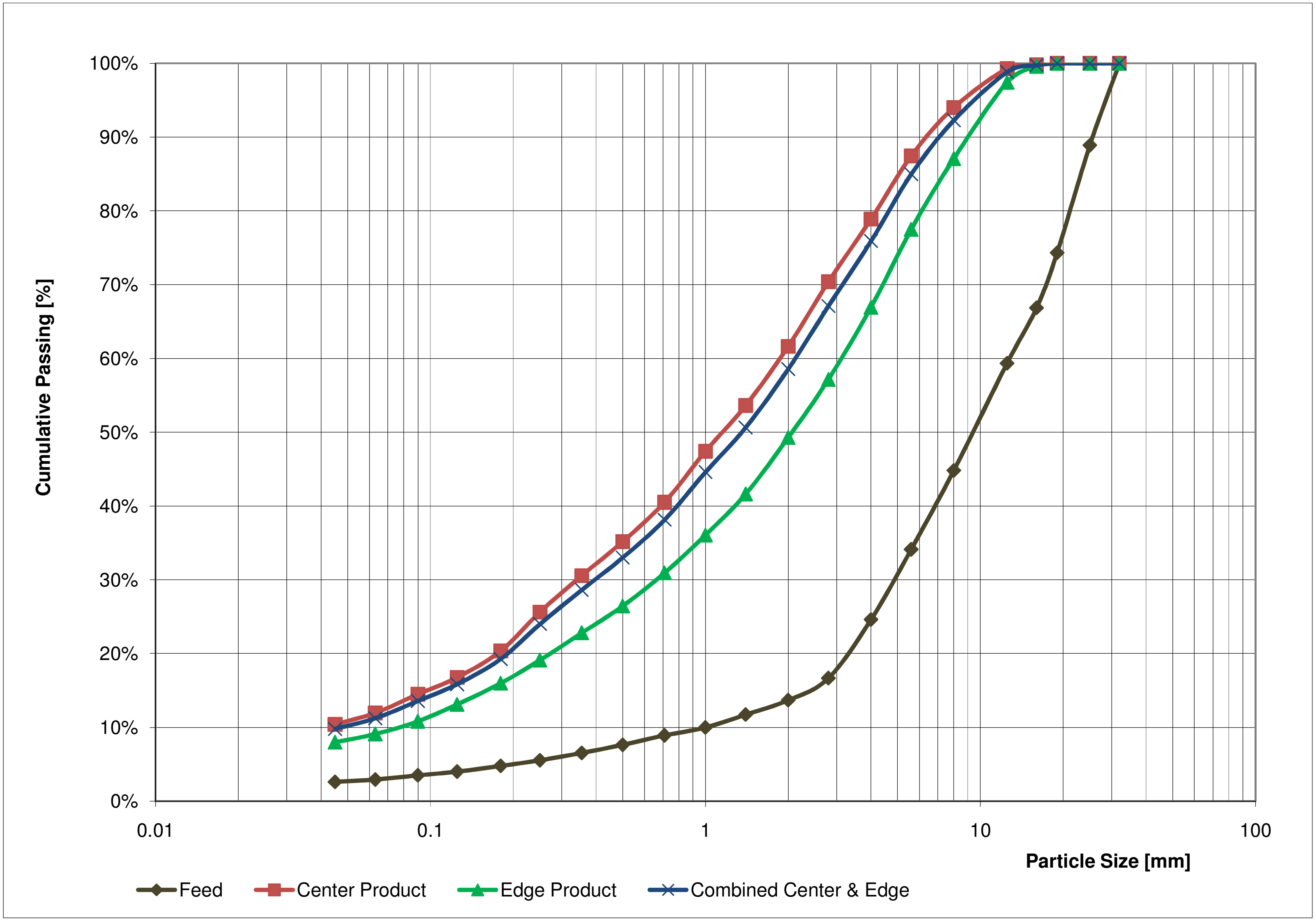

Figure A15 Product particle size distributions of KSM012

Table A 20 Particle Size Distribution of KSM013

Sample No.		Centre			Edge			Combined Centre + Edge		
KSM013		Total Weight	% of total Product Sample Weight		Total Weight	% of total Product Sample Weight		Total Weight		
		[kg]	%		[kg]	%		[kg]		
		116.2	72.1		45.0	27.9		161.2		
Screen Size	Particle Size	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing	Screen Weight	Weight Percentage	Cumulative Passing
[µm]	[µm]	[g]	[%]	[%]	[g]	[%]	[%]	[g]	[%]	[%]
-35500 to +32000	32000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-32000 to +25000	25000	0.0	0.0%	100.0%	0.0	0.0%	100.0%	0.0	0.0%	100.0%
-25000 to +19000	19000	29.6	0.3%	99.7%	16.1	0.1%	99.9%	20.4	0.3%	99.7%
-19000 to +16000	16000	18.2	0.2%	99.6%	71.3	0.7%	99.2%	17.8	0.2%	99.5%
-16000 to +12500	12500	85.7	0.8%	98.8%	313.0	2.9%	96.3%	81.8	1.0%	98.5%
-12500 to +8000	8000	596.9	5.3%	93.5%	1238.5	11.3%	85.0%	489.8	6.0%	92.5%
-8000 to +5600	5600	679.2	6.1%	87.4%	1097.6	10.0%	75.0%	530.8	6.5%	86.0%
-5600 to +4000	4000	909.3	8.1%	79.3%	1149.8	10.5%	64.5%	683.4	8.4%	77.6%
-4000 to +2800	2800	984.3	8.8%	70.5%	1058.0	9.7%	54.8%	723.9	8.9%	68.7%
-2800 to +2000	2000	940.6	8.4%	62.1%	837.6	7.7%	47.2%	677.0	8.3%	60.4%
-2000 to +1400	1400	889.9	8.0%	54.1%	740.0	6.8%	40.4%	636.1	7.8%	52.6%
-1400 to +1000	1000	712.2	6.4%	47.8%	575.6	5.3%	35.1%	507.7	6.2%	46.3%
-1000 to +710	710	720.3	6.4%	41.3%	544.3	5.0%	30.2%	510.2	6.3%	40.1%
-710 to +500	500	638.8	5.7%	35.6%	458.1	4.2%	26.0%	450.4	5.5%	34.5%
-500 to +355	355	509.1	4.5%	31.1%	380.8	3.5%	22.5%	360.3	4.4%	30.1%
-355 to +250	250	557.2	5.0%	26.1%	380.5	3.5%	19.0%	391.2	4.8%	25.3%
-250 to +180	180	451.2	4.0%	22.1%	336.8	3.1%	16.0%	319.2	3.9%	21.4%
-180 to +125	125	514.5	4.6%	17.5%	321.6	2.9%	13.0%	358.7	4.4%	17.0%
-125 to +90	90	250.3	2.2%	15.2%	190.8	1.7%	11.3%	177.4	2.2%	14.8%
-90 to +63	63	290.3	2.6%	12.6%	218.8	2.0%	9.3%	205.6	2.5%	12.3%
-63 to +45	45	178.7	1.6%	11.0%	127.5	1.2%	8.1%	125.9	1.5%	10.7%
-45	Pan	1235.6	11.0%		887.4	8.1%		871.3	10.7%	
Total		11191.9	100.0%		10944.1	100.0%		8139.0	100.0%	

		Centre	Edge	Combined Centre + Edge
Calculated P_{80}	[mm]	4.14	6.80	4.46
Calculated P_{50}	[mm]	1.14	2.30	1.24

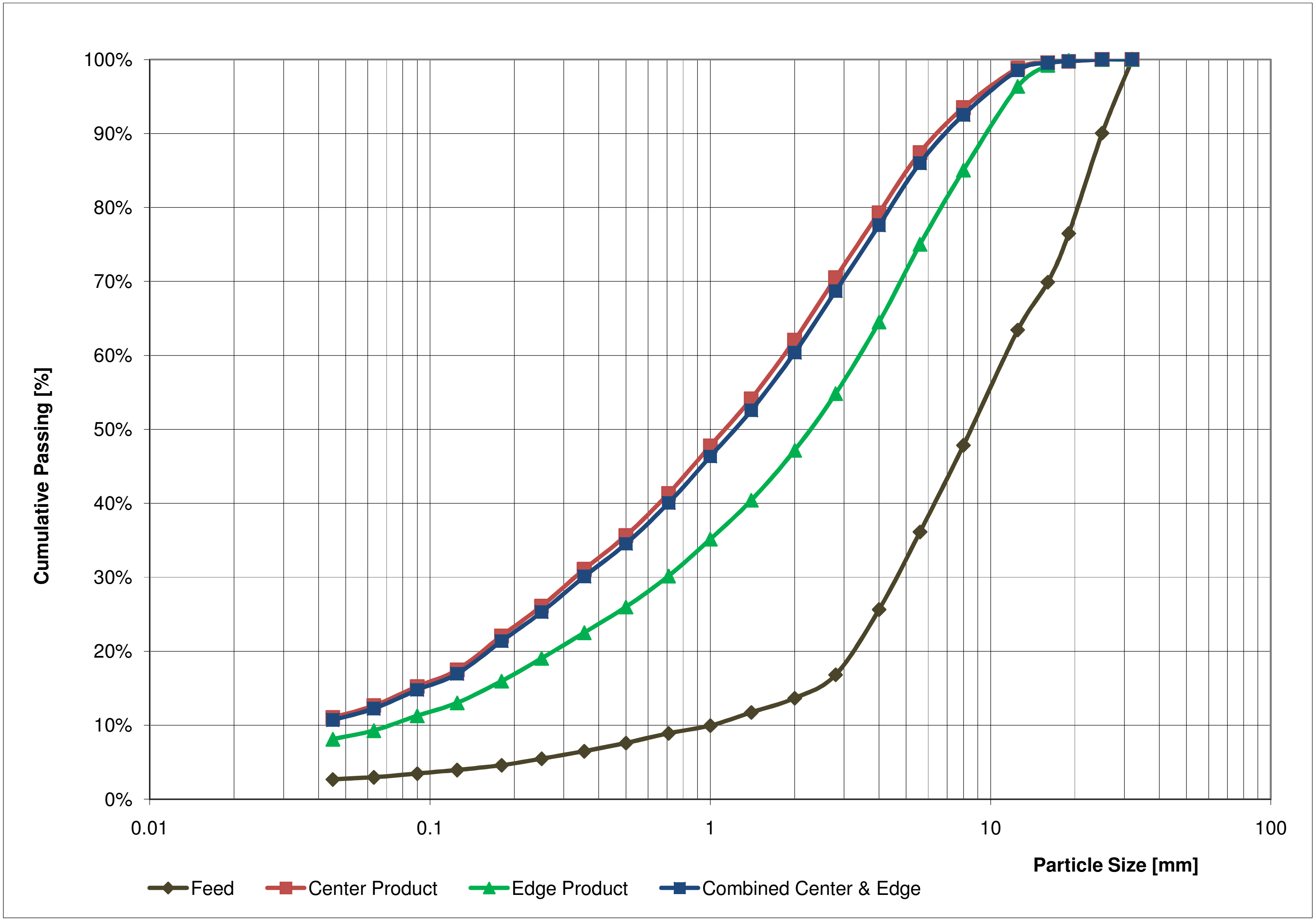

Figure A16 Product particle size distributions of KSM013

ORE HARDNESS AND FLOTATION TESTING
KERR-SULPHURETS-MITCHELL
(KSM) PROJECT

SEABRIDGE GOLD INC.

KM3174

January 6, 2012

G&T METALLURGICAL SERVICES LTD.

2957 Bowers Place, Kamloops, B.C. Canada V1S 1W5

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ISO 9001:2008
Certificate No. FS 63170

ALS Metallurgy

G & T METALLURGICAL SERVICES LTD.

January 6, 2012

Mr. T.J. Smolik
Technical Services Manager
Seabridge Gold Inc.
Suite 400-106 Front Street
Toronto, ON
M5A 1E7

Dear Mr. Smolik;

Re: Ore Hardness and Flotation Testing – Kerr-Sulphurets-Mitchell (KSM) Project – KM3174

We are pleased to report that we have completed the scope of work approved by you under our project number KM3174. Eleven composite samples from the KSM project were tested for ore hardness and flotation properties.

The samples tested had copper feed grades ranging from 0.13 to 0.68 percent. Gold feed grades ranged from 0.26 to 1.1 g/tonne. SAG mill comminution (SMC) tests on each sample produced A*b parameter values ranging from 38 to 59 and averaging 49. The A*b value is a measure of resistance breakage in a SAG mill. Lower numbers indicate higher resistance. On the basis of the numbers recovered the samples ranged from moderately soft to moderately hard from a SAG milling perspective.

Bond ball mill work index tests were also completed on each sample. Bond ball mill work index values ranged from 14.1 to 18.7 kWh/tonne. The two Sulphuret samples had the highest Bond ball mill work indices at 16.7 and 18.7 kWh/tonne.

Open circuit cleaner flotation tests on seven Mitchell Zone composites, using the standard KSM flowsheet, produced typical metallurgical results for six of the seven samples. Copper recoveries ranged between 74 to 85 percent at copper grades between 21 to 30 percent for the seven samples. Composite 7 had a low copper feed grade and this likely explains the inferior metallurgical performance.

Locked cycle flotation tests on two Sulphurets and two Kerr composites produced copper recoveries ranging between 61 and 86 percent at copper grades ranging between 26 to 31 percent copper. The Sulphurets Hazetton composite had lower copper recovery at 61 percent and 26 percent copper grade for unknown reasons. Additional mineralogical and flotation testing would be required to troubleshoot this problem.

The copper scavenger cleaner tailing and pyrite concentrates produced in flotation testing on the 11 composites, were further processed in a standard 24 hour CIL cyanidation bottle roll test. On average, 52 percent of the feed gold was recovered to the copper concentrate, 8 percent to the 24 hour CIL solution from the scavenger tailing and 11 percent to the 24 hour CIL solution from the pyrite concentrate. The overall gold recovery was, on average, 71 percent and ranged from 65 to 77 percent.

Thank you for choosing G&T Metallurgical Services Ltd. for your testing needs. If you have any questions regarding this report or the test program, please contact us directly.

Sincerely,

PROFESSIONAL PROVINCE OF J.A. FOLINSBEE 25634 BRITISH COLUMBIA ENGINEER

John Folinsbee, P.Eng
VP - Operations

Helen Johnston
Project Metallurgist

January 6, 2012
KM3174

Report Distribution:
T.J. Smolik, Seabridge Gold Inc., Arizona, USA – 2 Copies
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ORE HARDNESS AND FLOTATION TESTING

KERR-SULPHURETS-MITCHELL (KSM) PROJECT

KM3174

January 6, 2012

Work Performed on Behalf of Seabridge Gold Inc.

INDEX

1.0 Introduction

The Kerr-Sulphurets-Mitchell (KSM) Project is wholly owned by Seabridge Gold Inc. G&T Metallurgical Services Ltd. has completed multiple metallurgical test programs on samples from the KSM project*. The KSM project is a large tonnage copper-gold-silver-molybdenum project located in Northwest British Columbia, about 68 kilometers, by air, north-northwest of Stewart, BC.

A Request For Proposal was received from Mr. Dean Lindsay, Metallurgical Consultant to Seabridge Gold, to conduct ore hardness and flotation testing on 11 samples from the KSM deposit. A proposal was constructed based on the received RFP and was sent to Mr. Lindsay via email on September 23, 2011.

The main objectives of the current test program can be summarized by the following points:

- Measure ore hardness properties for the suite of 11 samples using the SMC and Bond ball mill work index test procedures.

- Determine flotation metallurgical performance using batch open circuit flotation testing protocols on seven of the samples and locked cycle flotation testing protocols on the other four.

- Measure the concentrations of As, Cd, Pb, Sb and Zn in the flotation concentrates.

- Test the gold extraction from the cleaner scavenger tailing and reground pyrite rougher concentrates using a standard CIL cyanidation bottle roll procedure.

* For a complete listing of previous projects, please see Appendix V – Special Data.

The samples used in this test program were received at G&T Metallurgical Services Ltd. on October 3, 2011. The total weight of the sample shipment was estimated at 300 kg. The samples were received as half core and had individual sample weights between 25 to 30 kg*.

The test program commenced in early October 2011 and was essentially complete during the first week of December 2011 with a final batch cleaner test on Composite 9.

The main findings from this test program are detailed in the main body of this report. Individual test results, along with supporting data, can be found in the following appendices.

Appendix I – Sample Origin
Appendix II – Metallurgical Test Data
Appendix III – Particle Sizing Data
Appendix IV – Comminution Data
Appendix V – Special Data

* For more details on the samples received and utilized in this test program please see Appendix I – Sample Origin.

2.0 Properties of the Test Samples

Chemical content and ore hardness are two important properties that influence the process flowsheet for a given ore. These properties, for the 11 KSM samples tested in this program, are discussed in more detail in the following subsections.

2.1 Chemical Content Data

The chemical contents of the 11 samples were measured using standard analytical protocols. The chemical content data is presented in Table 1.

TABLE 1
CHEMICAL CONTENT DATA

Sample Name	Element for Assay – percent or g/tonne										
	Cu	Mo	Pb	Zn	Fe	S	Ag	Au	As	Sb	Cd
Composite 1	0.20	0.005	0.01	0.01	3.89	3.17	4	0.77	0.004	<0.001	1
Composite 2	0.20	0.003	0.01	0.01	3.82	3.62	3	0.69	0.002	<0.001	1
Composite 3	0.20	0.004	0.01	0.01	4.32	4.52	3	0.71	0.001	<0.001	2
Composite 4	0.20	0.006	0.02	0.01	4.22	4.17	4	1.10	0.003	<0.001	2
Composite 5	0.23	0.005	0.02	0.01	4.08	4.89	3	0.56	0.001	<0.001	2
Composite 6	0.19	0.003	0.02	0.01	4.21	3.22	2	0.62	0.001	<0.001	1
Composite 7	0.13	0.009	0.05	0.02	4.19	3.75	3	0.65	0.001	<0.001	1
Composite 8	0.46	0.008	0.02	0.02	2.74	2.21	1	0.70	0.008	<0.001	2
Composite 9	0.17	0.004	0.05	0.04	5.50	3.51	2	0.65	0.006	<0.001	<1
Composite 10	0.59	0.001	0.02	0.02	5.65	5.74	1	0.26	0.009	<0.001	1
Composite 11	0.68	0.001	0.01	0.04	5.79	6.32	2	0.29	0.010	<0.001	1

Note: a) Au, Ag and Cd assays are reported in g/tonne. All others are reported in percent.
b) The sulphur assay is S_{TOTAL} reported by Leco.

The cross reference between the composite number and the source deposit is shown in Table 2.

TABLE 2
SAMPLE LEGEND

Composite Number	Deposit
1	Mitchell Year 0-5
2	Mitchell Year 0-10
3	Mitchell Year 10-LOM
4	Mitchell QSP
5	Mitchell HI QSZ
6	Mitchell CR PR
7	Mitchell IRAG
8	Sulphurets Raewyn CV
9	Sulphurets Lower Hazetton
10	Kerr CL Quartz
11	Kerr QSP Quartz

The 11 samples had feed copper grades ranging from about 0.13 to 0.68 percent. The seven Mitchell Zone samples tested had copper feed grades ranging from about 0.13 to 0.23 percent.

Gold feed grades ranged from about 0.26 to 1.10 g/tonne across the full sample suite. The two Kerr Zone composites had the lowest gold feed grades at an average of about 0.27 g/tonne.

The Kerr and Sulphurets samples had higher arsenic feed grades than the suite of Mitchell samples analyzed. In general, Pb, Zn, Sb and Cd values in the feed were low for all samples measured.

2.2 Ore Hardness Data

Ore hardness data was generated by completing an SMC (SAG Mill Comminution) and Bond ball mill work index test on each of the 11 composites. The SMC test data is used to provide information regarding ore grindability in a SAG (Semi-autogenous) mill. The Bond ball mill work index test provides information regarding ore grindability in a ball mill. The results of the ore hardness tests are displayed in Table 3*.

TABLE 3
ORE HARDNESS DATA

Composite	Type	A*b	Bond Ball Mill Work Index kWh/tonne
1	Mitchell Year 0-5	54.4	14.3
2	Mitchell Year 0-10	57.9	14.3
3	Mitchell Year 10-LOM	44.7	14.9
4	Mitchell QSP	47.4	14.1
5	Mitchell HI QSZ	59.6	14.5
6	Mitchell CR PR	47.6	14.4
7	Mitchell IRAG	53.2	15.3
8	Sulphurets Raewyn CV	41.7	18.7
9	Sulphurets Lower Hazetton	38.7	16.7
10	Kerr CL Quartz	46.1	14.8
11	Kerr QSP Quartz	47.0	14.1

The A*b parameter, a measure of resistance to impact breakage in two SAG mills, ranged between 38 and 59 for the samples tested. The average A*b value was 48.9.

On the basis of the recorded A*b values the samples tested ranged in hardness from moderately soft to moderately hard with respect to breakage in a SAG mill. On average, the sample suite tested can be considered to be of moderate hardness with respect to impact breakage in the SAG mill.

* The full JKTech report can be found in Appendix IV – Comminution.

The Bond ball mill work index ranged in value from 14.1 to 18.7 kWh/tonne. The Mitchell Zone and Kerr samples had relatively consistent Bond ball mill work indices, ranging from about 14 to 15 kWh/tonne. On this basis, these samples can be considered moderately hard.

The two Sulphurets samples had Bond ball mill work indices of 16.7 and 18.7 kWh/tonne. On this basis, these samples can be considered to be hard with respect to breakage in a ball mill.

3.0 Metallurgical Test Results

Composites 1 to 7 were tested using open circuit batch cleaner flotation testing protocols. Composites 8 to 11 were tested using locked cycle flotation testing protocols. The pyrite concentrates (reground) and cleaner scavenger tailing were further treated using cyanidation bottle roll testing protocols.

3.1 The Flowsheets

The flowsheets and test conditions used in the flotation tests are presented in Figure 1. The following comments provide a summary of the key features of this flowsheet:

- The flotation feed was ground to a target primary grind sizing of 120μm K_{80}. The rougher concentrate was ground to a target regrind sizing of 20μm K_{80}.

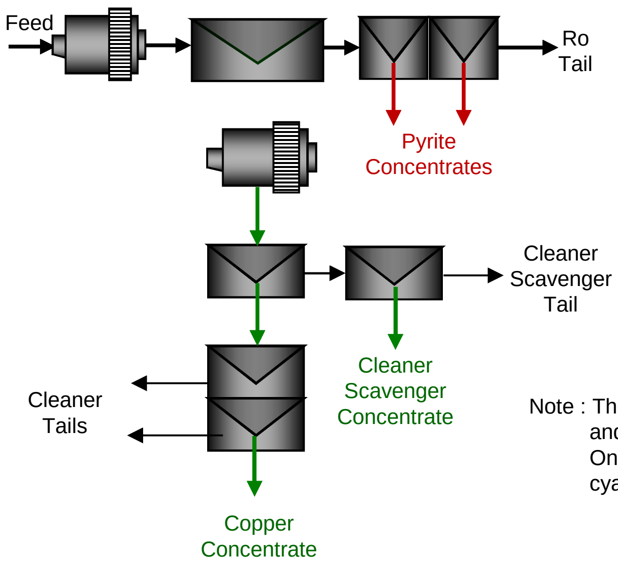
- The pH in both the rougher and cleaner circuits was modulated with the addition of about 400 g/tonne lime into the primary and regrind milling steps. The rougher pH was maintained at between pH 10.0 and 11.0 and the cleaner pH at about 11.5.

- A gangue depressant, PE26, was added to the regrind circuit at an addition rate of 20 g/tonne. PE26 is a mixture of CMC (Carboxy Methyl Cellulose) and guar gum.

- Cytec 3418A was added to the rougher and cleaning circuits as the primary copper sulphide mineral collector. Collector 208 was also added as an enhanced collector for precious metals. PAX (Potassium Amyl Xanthate) was added to the pyrite circuit to assist in collection of pyrite to the pyrite rougher concentrate.

FIGURE 1
FLOWSHEET AND TEST CONDITION PERFORMANCE DATA

Open Circuit Cleaner Flowsheet and Test Conditions

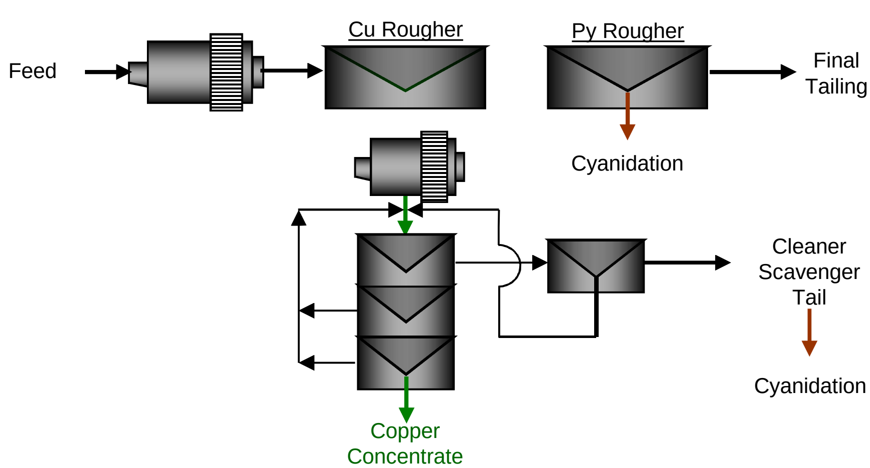


Stage	Grind µm K_{80}	pH	Reagents - g/t					
			Lime	PE26	Fuel Oil	208	3418A	PAX
Grind	116-131	10.50	400	-	10	-	-	-
Bulk Roughers	-	10-11	-	-	-	4-7	4-7	-
Regrind	14-23	11.5	400	-	50	-	-	-
Cleaner	-	11.5	-	20	40	9-19	9-19	-
Py Rougher	-	10.0	-	-	-	60	-	60

Note : The cleaner scavenger tailing and pyrite concentrates produced in both open and locked cycle tests were further treated in a CIL cyanidation bottle roll test. Only the pyrite rougher concentrate was subjected to regrinding prior to cyanidation.

Cycle Test Flowsheet and Test Conditions

Stage	Grind µm K_{80}	pH	Reagents - g/t					
			Lime	PE26	Fuel Oil	208	3418A	PAX
Grind	121-130	10.50	400-465	-	10	-	-	-
Bulk Roughers	-	10-11	0-65	-	-	2-5	2-5	-
Regrind	18-21	11.5	400	-	50	-	-	-
Cleaner	-	11.5	-	20	40	7-14	7-14	-
Py Rougher	-	10.0	-	-	-	60	-	60



Note: Additional test data can be located in Appendix II.

3.2 Flotation Test Results

The results of both the batch open circuit cleaner and locked cycle flotation tests are presented in Figure 2 and are further discussed as follows:

- Open circuit batch cleaner tests on the seven Mitchell Zone composites produced copper recoveries of between 74 and 85 percent at a copper grade of 25 to 30 percent for all but Composite 7. Composite 7 was a low copper feed grade Mitchell IARG sample*.

- Results from this series of open circuit tests are typical for the KSM deposit based on previous testing, with the exception of Composite 7, which had a low copper feed grade..

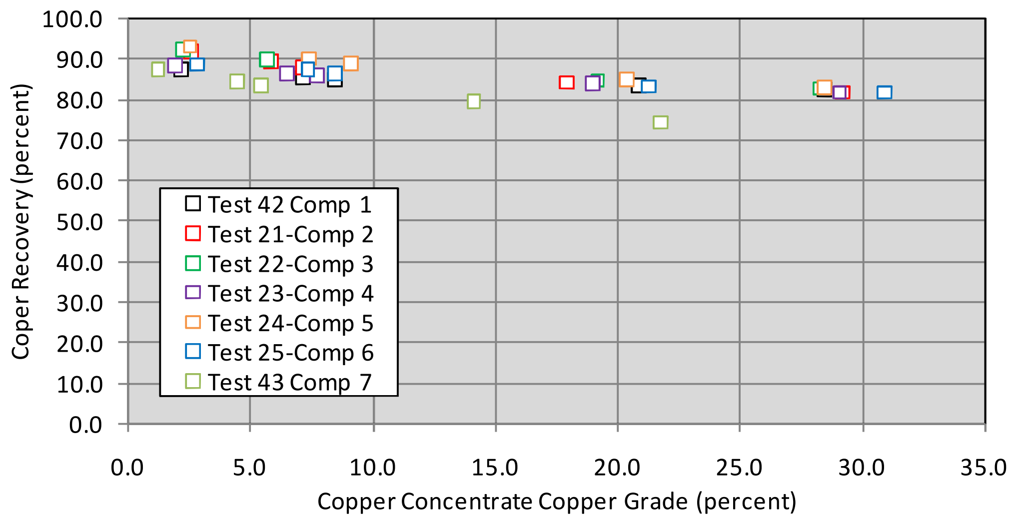
- Locked cycle flotation tests on two Sulphurets and two Kerr composites produced copper recoveries of between 61 and 86 percent at a concentrate copper grades ranging between 26 and 31 percent. The lower grade Sulphurets Hazetton composite, with a copper feed grade of 0.16 percent copper, produced the lower copper recovery of 61 percent at 26 percent copper grade in the copper concentrate. The lower copper feed grade may have contributed to inferior copper metallurgical performance for this sample.

- Gold recoveries, to the copper concentrate from the locked cycle tests, ranged between about 40 to 59 percent. Gold grades in the copper concentrate ranged between 5 to 64 percent.

* Only the best test results are shown in Figure 2. Data for all but the final initial set of tests can be found in Appendix II – Metallurgical Test Data. Reagent additions were modified from the standard KSM recipe to achieve the final result.

FIGURE 2
FLOTATION TEST RESULTS

Open Circuit Cleaner Test Results



Cycle Test Results

Product	Weight	Weight	Assay - percent or g/t						Distribution - percent					
	g	%	Cu	Mo	Fe	S	Ag	Au	Cu	Mo	Fe	S	Ag	Au
Test 8 -Sulphurets-Raewyn CV														
Flotation Feed	3995.3	100.0	0.46	0.008	2.9	2.01	1	0.70	100.0	100.0	100.0	100.0	100.0	100.0
Bulk Concentrate	52.4	1.3	29.3	0.227	27.2	32.4	34	31.4	83.6	37.7	12.2	21.1	31.1	58.6
Bulk Cleaner Scav Tail	368.3	9.2	0.37	0.044	11.9	13.0	1	2.20	7.3	51.4	37.3	59.3	6.4	28.9
Pyrite Rougher Conc	268.5	6.7	0.26	0.005	5.9	5.34	1	0.67	3.8	4.4	13.5	17.8	4.7	6.4
Pyrite Rougher Tail	3306.1	82.7	0.03	0.001	1.3	0.04	1	0.05	5.2	6.6	37.0	1.8	57.8	6.0
Test 9 -Sulphurets-Hazelton														
Flotation Feed	4014.1	100.0	0.16	0.004	5.7	3.28	2	0.59	100.0	100.0	100.0	100.0	100.0	100.0
Bulk Concentrate	14.9	0.4	26.0	0.170	29.3	34.4	130	63.7	60.6	14.1	1.9	3.9	21.3	40.1
Bulk Cleaner Scav Tail	224.3	5.6	0.82	0.055	27.4	29.5	11	3.55	28.8	68.6	27.1	50.2	28.4	33.7
Pyrite Rougher Conc	267.2	6.7	0.12	0.004	20.4	20.64	4	1.26	4.8	5.4	24.1	41.8	11.8	14.3
Pyrite Rougher Tail	3507.7	87.4	0.01	0.001	3.0	0.15	1	0.08	5.8	11.9	46.9	4.1	38.6	11.9
Test 10 -Kerr-Cl Qtz														
Flotation Feed	3979.4	100.0	0.59	0.002	5.9	5.44	2	0.24	100.0	100.0	100.0	100.0	100.0	100.0
Bulk Concentrate	66.4	1.7	30.7	0.023	29.4	34.0	49	7.2	86.3	25.6	8.2	10.4	39.8	49.7
Bulk Cleaner Scav Tail	409.0	10.3	0.39	0.006	22.0	23.7	3	0.72	6.7	43.6	38.1	44.8	17.4	30.8
Pyrite Rougher Conc	413.9	10.4	0.16	0.001	17.3	18.36	1	0.38	2.8	3.8	30.3	35.1	5.1	16.3
Pyrite Rougher Tail	3090.1	77.7	0.03	0.001	1.8	0.68	1	0.01	4.2	27.1	23.3	9.7	37.8	3.2
Test 11 -Kerr QSP-Qtz														
Flotation Feed	3995.5	100.0	0.69	0.002	5.8	6.08	3	0.24	100.0	100.0	100.0	100.0	100.0	100.0
Bulk Concentrate	78.8	2.0	29.0	0.038	29.1	36.1	77	5.1	83.4	34.9	9.9	11.7	47.4	41.1
Bulk Cleaner Scav Tail	368.6	9.2	0.34	0.007	24.8	28.7	5	0.60	4.6	30.6	39.6	43.6	14.4	22.7
Pyrite Rougher Conc	539.7	13.5	0.33	0.001	16.2	19.03	3	0.54	6.5	7.9	37.9	42.3	14.7	30.0
Pyrite Rougher Tail	3008.4	75.3	0.05	0.001	1.0	0.19	1	0.02	5.4	26.6	12.6	2.4	23.5	6.2

Notes : a) Additional test data can be located in Appendix II. Multiple Tests were done on each composite - the best result reported.
b) Comp 1- Mitchell Year 0-5, Comp 2- Mitchell Year 0-10, Comp 3- Mitchell Year 10-LOM, Comp 4 –Mitchell QSP, Comp 5 –Mitchell Mitchell Hi Qtz, Comp 6 – Mitchell Cr Pr, Comp 7-Mitchell IARG

3.3 Cyanidation Test Results

The cleaner scavenger tail and pyrite concentrates produced in Tests 8 to 11 and 20 to 26 were further tested using a standard cyanidation bottle roll testing procedure. The results of these tests, along with overall gold recovery data, is presented in Figure 3 and further discussed in the following points:

- The average percent of feed gold recovered to the flotation copper concentrate was 52 percent. This percentage ranged from 37 to 64 percent.

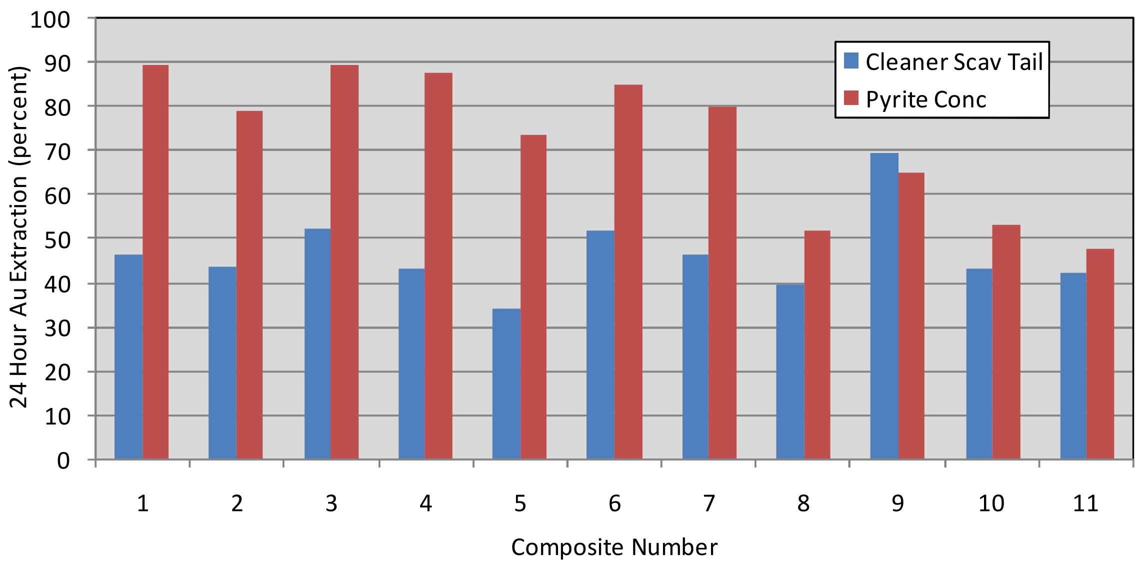
- On average, the 24 hour gold extraction from the cleaner scavenger tail was 47 percent. This percentage ranged from 39 to 70 percent. This translated into an average incremental gold recovery of 8 percent from the flotation feed.

- Gold in the pyrite concentrate was, on average, 73 percent extracted to the 24 hour cyanidation solution. This percentage ranged from 48 to 90 percent. The average incremental gold extraction to the 24 hour leach solution was 11 percent with respect to the flotation feed.

- The average overall gold extraction for this suite of 11 samples was 71 percent and ranged from 61 to 77 percent. On average, 52 percent was recovered to the copper concentrate and the balance to the 24 hour cyanidation solutions.

FIGURE 3
CYANIDATION TEST RESULTS

24 Hour Gold Extraction Data



Overall Gold Recovery

Composite	Copper Concentrate				Inc. Au Rec %		Overall Au
	Cu Dist %	Cu Grade %	Au Dist %	Au Grade g/t	Clean. Tail	Py Conc	Recovery %
1	71.9	27.0	64	89	4	8	76
2	81.8	29.0	56	80	2	11	69
3	82.9	28.2	58	78	4	12	74
4	81.8	29.0	62	146	4	11	77
5	82.5	28.5	53	54	5	10	69
6	81.8	30.9	56	67	3	14	73
7	57.9	20.7	37	56	8	15	61
8	83.6	29.3	59	31	11	3	73
9	60.6	26.0	40	64	23	9	73
10	86.3	30.7	50	7	13	9	72
11	83.4	29	41	5	10	14	65
Average	**78**	**28.0**	**52**	**61**	**8**	**11**	**71**

Notes : a) Additional test data can be located in Appendix II.
b) Comp 1- Mitchell Year 0-5, Comp 2- Mitchell Year 0-10, Comp 3- Mitchell Year 10-LOM, Comp 4 –Mitchell QSP, Comp 5 –Mitchell Mitchell Hi Qtz, Comp 6 – Mitchell Cr Pr, Comp 7-Mitchell IARG , Comp 8- Sulphurets Raewyn CV, Comp 9-Sulphurets Hazelton, Comp 10- Kerr Cl Qtz, Comp 11 – Kerr QSP Qtz

3.4 Quality of the Concentrates

The copper concentrates, produced in locked cycle flotation tests on Composites 8 to 11 (Sulphurets and Kerr Zone samples), were analyzed for a limited suite of minor elements. This minor element data is presented in Table 3.

TABLE 3
MINOR ELEMENT DATA

Element	Symbol	Unit	Test 8	Test 9	Test 10	Test 11
Antimony	Sb	g/t	**2100**	370	620	180
Arsenic	As	g/t	1768	205	621	**2793**
Cadmium	Cd	g/t	**68**	26	6	32
Lead	Pb	%	0.19	**0.72**	0.04	0.05
Zinc	Zin	%	0.29	0.18	0.08	0.75

The arsenic and antimony concentrations, in the copper concentrate, are bordering at the penalty limit for some samples.

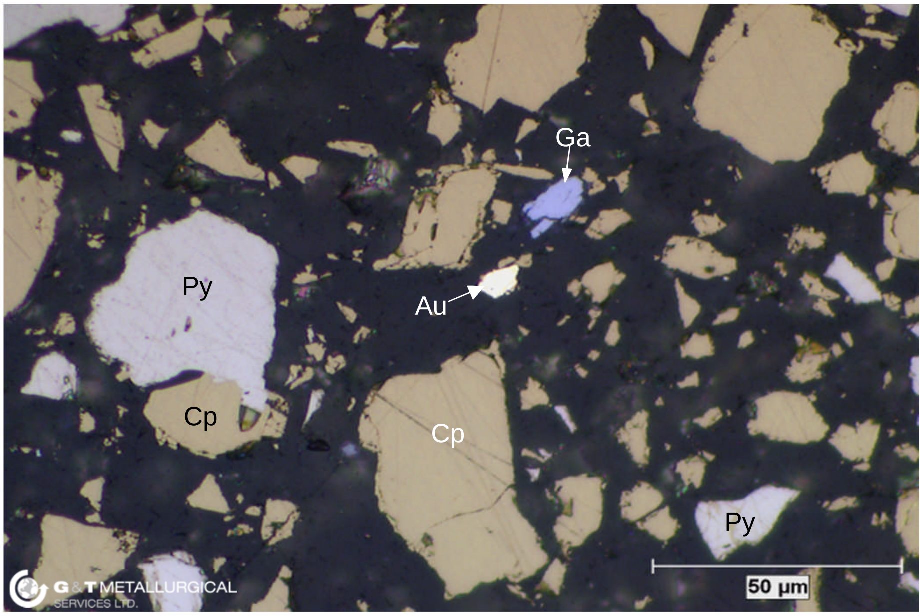
Cadmium is elevated in the copper concentrate produced from Test 8 – Sulphurets Raewyn CV composite. The level is not overly high, but could attract penalties at some smelters.

The lead content is elevated in the concentrate produced from Test 9 – Sulphurets Hazetton composite.

The minor element data should be reviewed by a concentrate marketing specialist to ensure that there are no marketing issues with these concentrates.

PHOTOMICROGRAPH 1
KERR SULPHURETS – BULK CONCENTRATE II
Test 9 KM3174

Unsized



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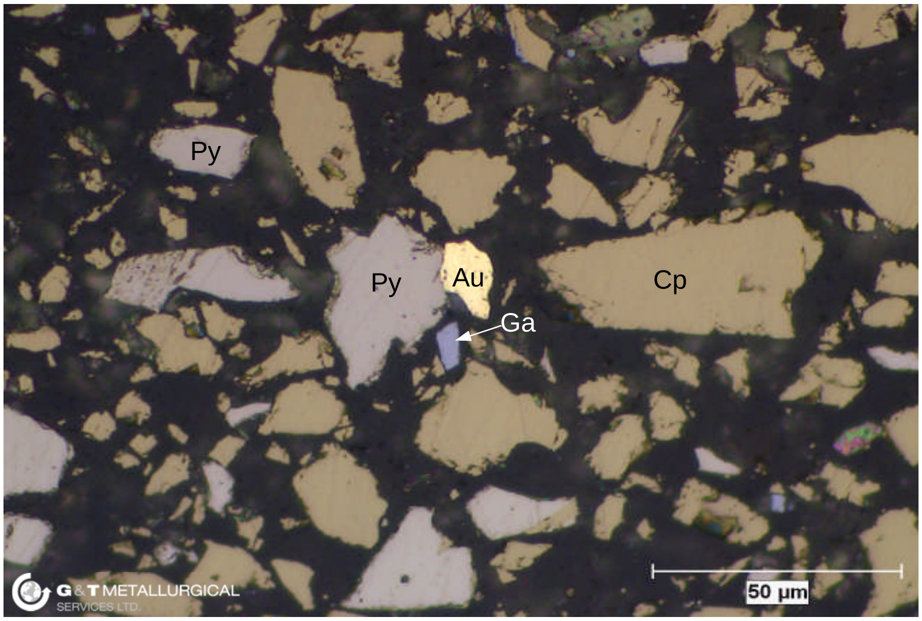


*Au-Gold, Cp-Chalcopyrite, Ga-Galena, Py-Pyrite

4.0 Conclusions and Recommendations

A metallurgical test program involving ore hardness and flotation testing has been completed on 11 composite samples from the KSM (Kerr-Sulphurets-Mitchell) project. The samples tested were reportedly representative of material from the Mitchell, Sulphurets and Kerr Zones at KSM.

The samples tested had copper feed grades ranging from about 0.13 up to 0.68 percent. Gold grades, in the feed, ranged from 0.26 to 1.10 g/tonne.

SMC (SAG mill comminution) tests on the 11 samples produced A*b values ranging from 38 to 59 and averaging 48.9. The A*b value is a measure of resistance to impact breakage in a SAG mill. On this basis, the samples tested ranged in classification from moderately soft to moderately hard and, on average, were of moderate hardness.

Bond ball mill work index tests produced Bond ball mill work indices ranging from 14.1 to 18.7 kWh/tonne. The Mitchell Zone samples had relatively consistent Bond ball mill work indices ranging from 14 to 15 kWh/tonne. The two Sulphurets samples had higher Bond ball mill work index values of 16.7 and 18.7 kWh/tonne. On the basis of these results, the samples tested ranged from moderately hard to hard with respect to breakage in a ball mill.

Open circuit cleaner tests on Composites 1 to 7 (Mitchell Zone composites), using a standard flowsheet and either standard or modified conditions, produced copper recoveries ranging from 74 to 85 percent at copper grades from 21 to 31 percent[*].

Composite 7, with a low copper feed grade of about 0.13 percent, also produced lower than typical copper recoveries and copper concentrate grades.

[*] Multiple tests were run on each composite with reagent additions being increased from standard conditions to achieve optimal performance.

Locked cycle flotation tests on two Sulphurets and two Kerr samples (Tests 8 to 11) produced final concentrate copper recoveries ranging from 61 to 86 percent. The copper grades in the concentrates ranged from 26 to 31 percent. Only the Sulphurets Hazetton composite produced a copper recovery of less than 80 percent at 26 percent copper grade.

The scavenger cleaner tailing and ground pyrite rougher concentrates from Test 8 to 11 and 20 to 26 were further processed using a standard 24 hour CIL cyanidation flowsheet. Average incremental gold recoveries were 8 and 11 percent from the cleaner scavenger tail and pyrite concentrate, respectively. The average overall gold recovery for all 11 samples was 71 percent.

A limited number of minor elements were assayed from the final copper concentrates from Tests 8 to 11 (Sulphurets and Kerr composites). Antimony, arsenic, cadmium and lead were somewhat elevated in some concentrates. The minor element data should be reviewed by a concentrate marketing specialist to determine any marketing issues with these concentrates.

APPENDIX IV – KM3174

COMMINUTION DATA

INDEX

TABLE | PAGE

BOND BALL

REFERENCE

JKTech Pty Ltd SMC Test Report - Kerr

TABLE IV-1A

BOND BALL GRINDABILITY TEST

KM3174 Composite 1

Weight of 700 ml Sample : 1395.1 g.

1/3.5 of Sample Weight : 398.6 g.

Aperture Test Sieve : 106µm

Percent Undersize : 13.6%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1395.1	100	260.7	189.7	71.0	0.71
2	260.7	512	615.0	35.5	579.5	1.13
3	615.0	278	443.4	83.6	359.8	1.29
4	443.4	262	412.6	60.3	352.3	1.35
5	412.6	254	399.0	56.1	342.9	1.35
6	399.0	255	396.2	54.3	341.9	1.34

BOND'S WORK INDEX FORMULA

Wi = 44.5 / (Pi^.23 x Gpb^.82 x (10/√P - 10/√F))

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.35 g.
P = 80% Passing size of test product.	78 µm
F = 80% Passing size of test feed.	2154 µm

WORK INDEX (Wi)

13.0 kw-hr/ton

14.3 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-1B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 1 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	2.29	97.7
170 Mesh	90	9.87	87.8
200 Mesh	75	9.67	78.2
270 Mesh	53	14.16	64.0
325 Mesh	45	7.68	56.3
400 Mesh	38	5.68	50.6
TOTAL		100.00	**

K80 =78µm

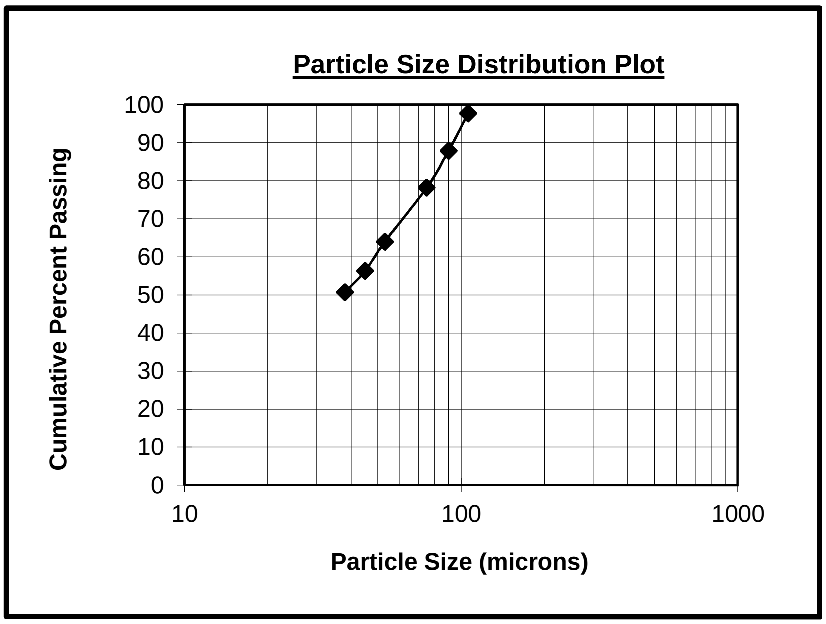


TABLE IV-1C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 1 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.22	99.8
7 Mesh	2800	2.71	97.1
8 Mesh	2360	11.02	86.0
9 Mesh	2000	10.66	75.4
10 Mesh	1700	8.19	67.2
12 Mesh	1400	9.18	58.0
14 Mesh	1180	5.40	52.6
20 Mesh	850	9.88	42.7
28 Mesh	600	8.09	34.6
35 Mesh	425	5.79	28.9
48 Mesh	300	5.28	23.6
65 Mesh	212	4.05	19.5
100 Mesh	150	3.22	16.3
150 Mesh	106	2.69	13.6
TOTAL		100.00	**

K80 =2154µm

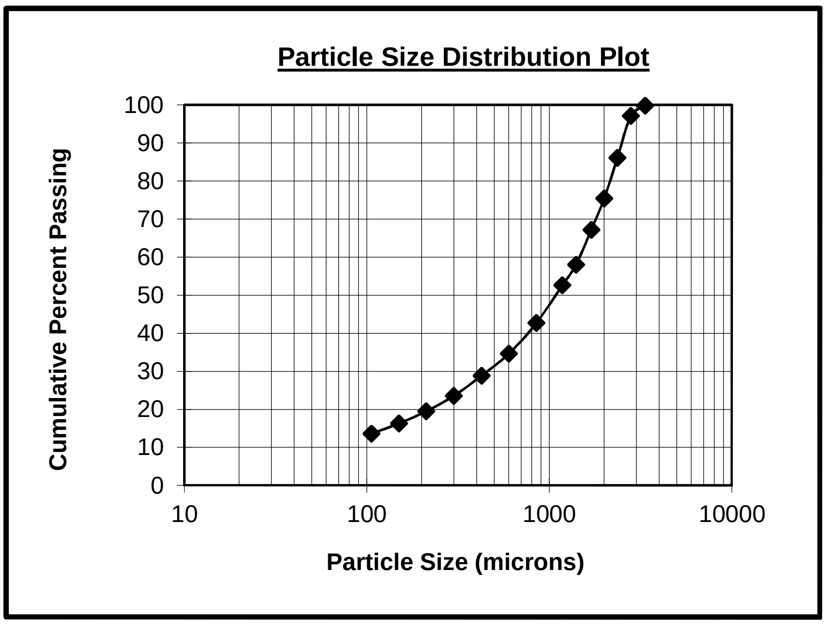


TABLE IV-1D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 1 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.18	99.8
7 Mesh	2800	2.91	96.9
8 Mesh	2360	10.55	86.4
9 Mesh	2000	10.41	75.9
10 Mesh	1700	8.00	67.9
12 Mesh	1400	9.14	58.8
14 Mesh	1180	5.37	53.4
20 Mesh	850	10.05	43.4
28 Mesh	600	8.28	35.1
35 Mesh	425	5.87	29.2
48 Mesh	300	5.37	23.9
65 Mesh	212	4.09	19.8
100 Mesh	150	3.32	16.5
150 Mesh	106	2.73	13.7
TOTAL		100.00	**

K80 =2139µm

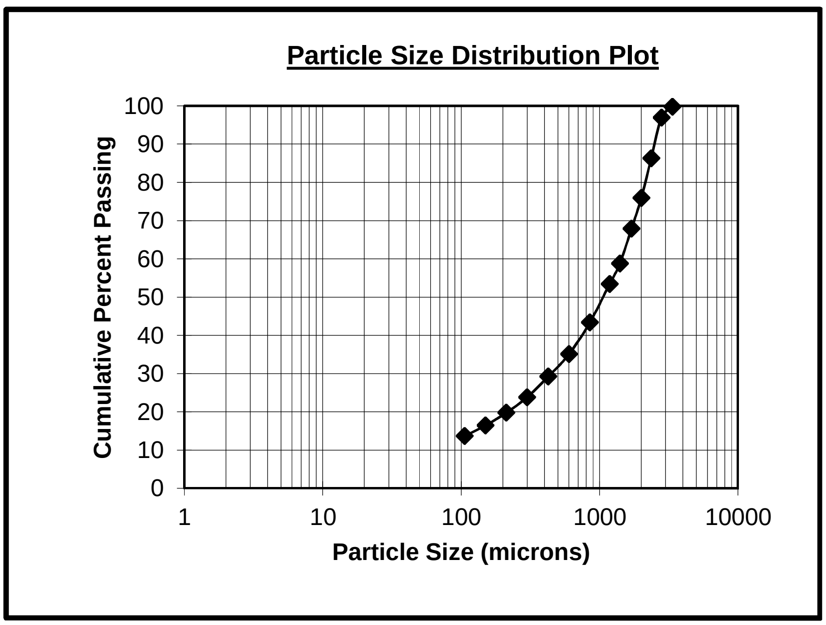


TABLE IV-1E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 1 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.26	99.7
7 Mesh	2800	2.49	97.3
8 Mesh	2360	11.56	85.7
9 Mesh	2000	10.94	74.8
10 Mesh	1700	8.40	66.4
12 Mesh	1400	9.23	57.1
14 Mesh	1180	5.44	51.7
20 Mesh	850	9.69	42.0
28 Mesh	600	7.88	34.1
35 Mesh	425	5.70	28.4
48 Mesh	300	5.18	23.2
65 Mesh	212	3.99	19.2
100 Mesh	150	3.11	16.1
150 Mesh	106	2.64	13.5
TOTAL		100.00	**

K80 =2171µm

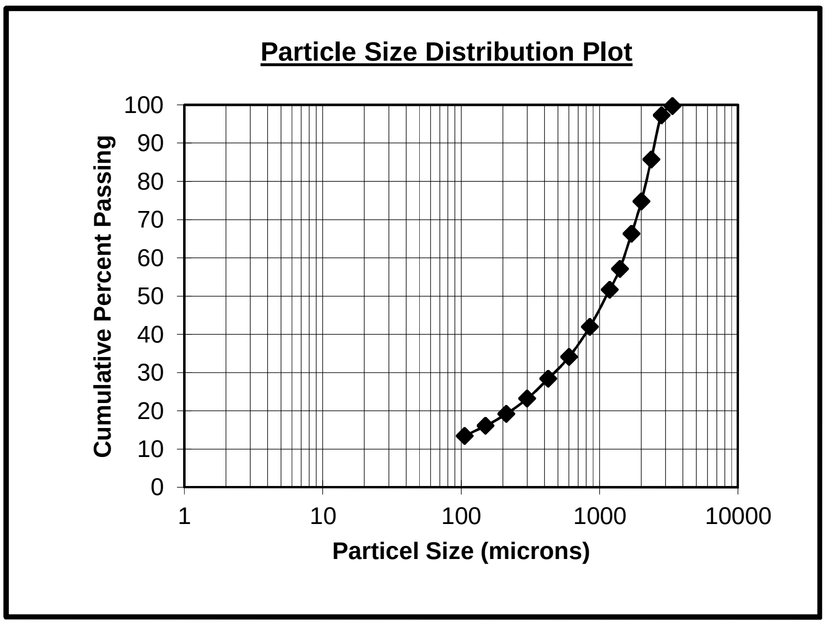


TABLE IV-2A
BOND BALL GRINDABILITY TEST
KM3174 Composite 2

Weight of 700 ml Sample : 1391.3 g.
1/3.5 of Sample Weight : 397.5 g.

Aperture Test Sieve : 106µm
Percent Undersize : 13.2%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1391.3	200	360.7	183.7	177.0	0.89
2	360.7	395	508.2	47.6	460.6	1.17
3	508.2	284	431.6	67.1	364.5	1.29
4	431.6	265	407.1	57.0	350.1	1.32
5	407.1	260	402.5	53.7	348.8	1.34
6	402.5	257	409.7	53.1	356.6	1.39
7	409.7	247	396.7	54.1	342.6	1.38

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.37 g.
P = 80% Passing size of test product.	80 µm
F = 80% Passing size of test feed.	2204 µm

WORK INDEX (Wi)
13.0 kw-hr/ton
14.3 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-2B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 2 - Cycle 7 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	1.68	98.3
170 Mesh	90	9.89	88.4
200 Mesh	75	13.19	75.2
270 Mesh	53	15.76	59.5
325 Mesh	45	7.10	52.4
400 Mesh	38	4.70	47.7
TOTAL		100.00	**

K80 =80µm

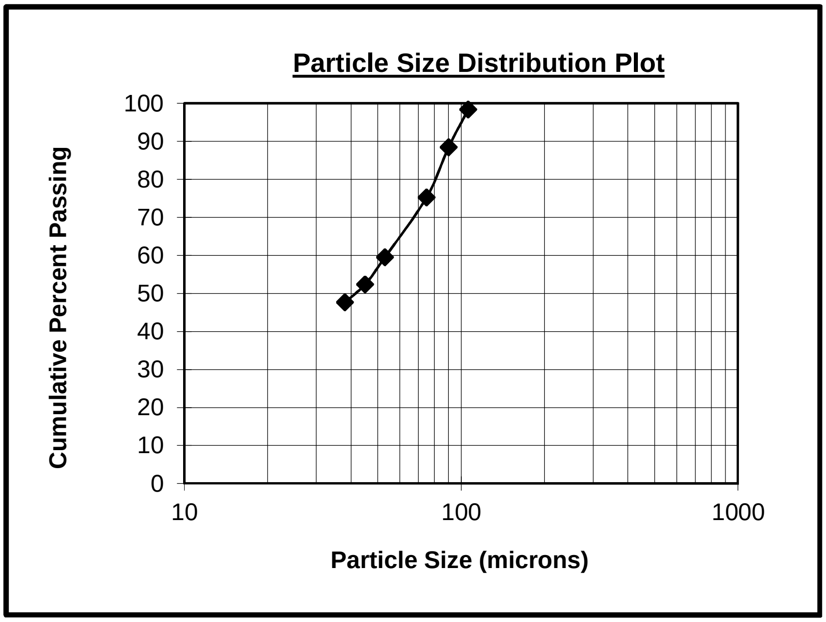


TABLE IV-2C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 2 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.34	99.7
7 Mesh	2800	3.12	96.5
8 Mesh	2360	11.74	84.8
9 Mesh	2000	11.17	73.6
10 Mesh	1700	8.00	65.6
12 Mesh	1400	9.34	56.3
14 Mesh	1180	5.52	50.8
20 Mesh	850	9.70	41.1
28 Mesh	600	7.78	33.3
35 Mesh	425	5.60	27.7
48 Mesh	300	4.97	22.7
65 Mesh	212	3.82	18.9
100 Mesh	150	3.07	15.8
150 Mesh	106	2.62	13.2
TOTAL		100.00	**

K80 =2204µm

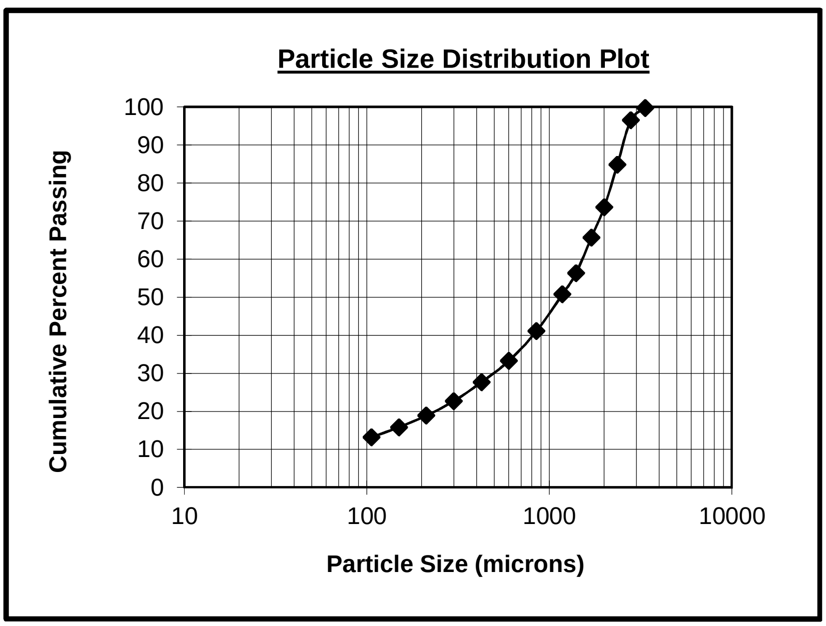


TABLE IV-2D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 2 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.23	99.8
7 Mesh	2800	3.47	96.3
8 Mesh	2360	11.60	84.7
9 Mesh	2000	11.41	73.3
10 Mesh	1700	7.81	65.5
12 Mesh	1400	9.52	56.0
14 Mesh	1180	5.50	50.5
20 Mesh	850	9.66	40.8
28 Mesh	600	7.49	33.3
35 Mesh	425	5.50	27.8
48 Mesh	300	4.90	22.9
65 Mesh	212	3.74	19.2
100 Mesh	150	3.05	16.1
150 Mesh	106	2.54	13.6
TOTAL		100.00	**

K80 =2211µm

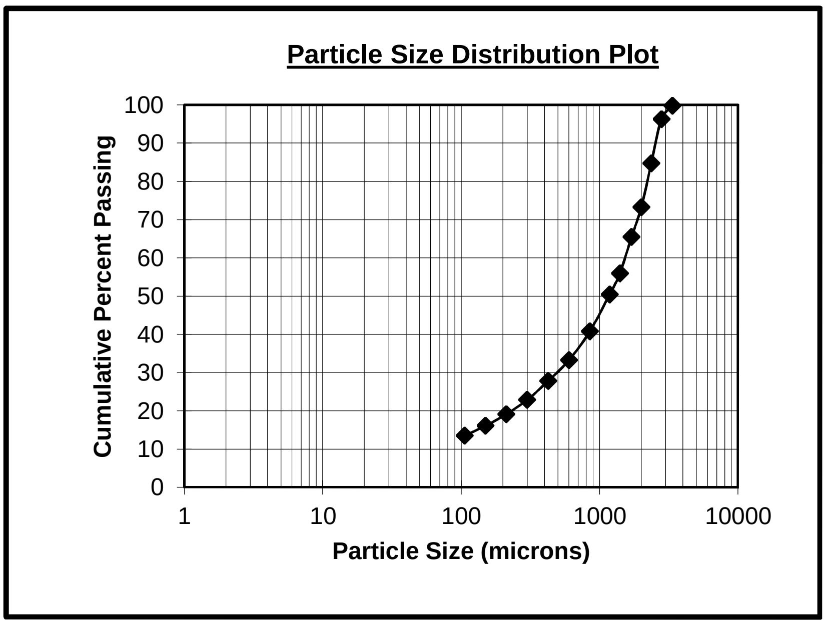


TABLE IV-2E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 2 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.45	99.6
7 Mesh	2800	2.75	96.8
8 Mesh	2360	11.90	84.9
9 Mesh	2000	10.90	74.0
10 Mesh	1700	8.20	65.8
12 Mesh	1400	9.15	56.7
14 Mesh	1180	5.55	51.1
20 Mesh	850	9.75	41.4
28 Mesh	600	8.10	33.3
35 Mesh	425	5.70	27.6
48 Mesh	300	5.05	22.5
65 Mesh	212	3.90	18.6
100 Mesh	150	3.10	15.5
150 Mesh	106	2.70	12.8
TOTAL		100.00	**

K80 =2197µm

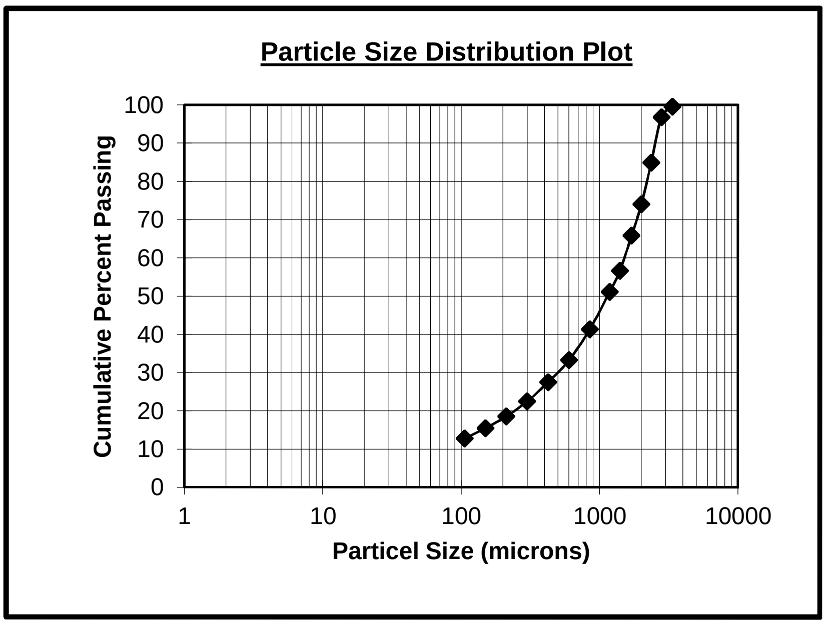


TABLE IV-3A

BOND BALL GRINDABILITY TEST

KM3174 Composite 3

Weight of 700 ml Sample :	1400.7 g.		Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	400.2 g.		Percent Undersize :	12.3%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1400.7	100	276.8	172.3	104.5	1.05
2	276.8	350	452.7	34.0	418.7	1.19
3	452.7	288	436.8	55.7	381.1	1.32
4	436.8	262	411.5	53.7	357.8	1.37
5	411.5	256	396.2	50.6	345.6	1.35
6	396.2	260	397.1	48.7	348.4	1.34
7	397.1	263	398.7	48.8	349.9	1.33
8	398.7	264	402.7	49.0	353.7	1.34

BOND'S WORK INDEX FORMULA

Wi = 44.5 / (Pi^.23 x Gpb^.82 x (10/√P - 10/√F))

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.34 g.
P = 80% Passing size of test product.	83 µm
F = 80% Passing size of test feed.	2248 µm

WORK INDEX (Wi)

13.5 kw-hr/ton

14.9 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-3B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 3 - Cycle 8 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	2.03	98.0
170 Mesh	90	12.15	85.8
200 Mesh	75	13.31	72.5
270 Mesh	53	15.72	56.8
325 Mesh	45	7.33	49.5
400 Mesh	38	4.73	44.7
TOTAL		100.00	**

K80 =83µm

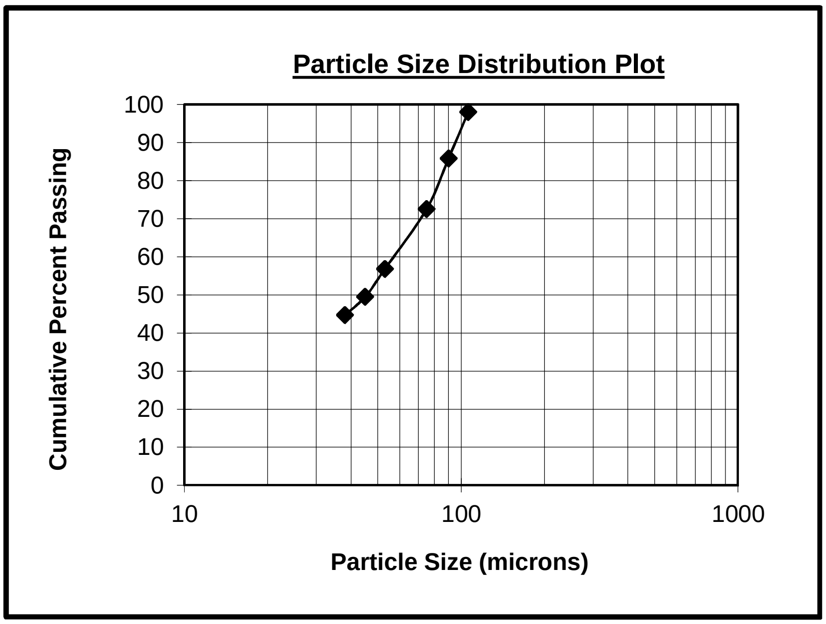


TABLE IV-3C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 3 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.31	99.7
7 Mesh	2800	2.92	96.8
8 Mesh	2360	12.97	83.8
9 Mesh	2000	12.22	71.6
10 Mesh	1700	8.57	63.0
12 Mesh	1400	9.18	53.8
14 Mesh	1180	5.42	48.4
20 Mesh	850	9.37	39.0
28 Mesh	600	7.52	31.5
35 Mesh	425	5.40	26.1
48 Mesh	300	4.76	21.4
65 Mesh	212	3.65	17.7
100 Mesh	150	2.94	14.8
150 Mesh	106	2.49	12.3
TOTAL		100.00	**

K80 =2248µm

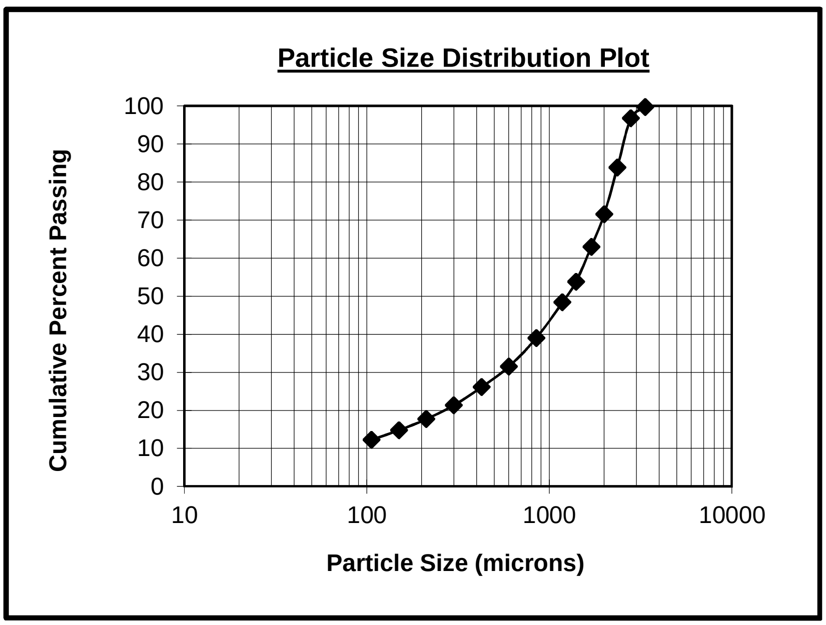


TABLE IV-3D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 3 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.29	99.7
7 Mesh	2800	2.63	97.1
8 Mesh	2360	11.99	85.1
9 Mesh	2000	11.60	73.5
10 Mesh	1700	8.29	65.2
12 Mesh	1400	8.87	56.3
14 Mesh	1180	5.31	51.0
20 Mesh	850	9.75	41.2
28 Mesh	600	7.95	33.3
35 Mesh	425	5.66	27.6
48 Mesh	300	5.07	22.6
65 Mesh	212	3.95	18.6
100 Mesh	150	3.22	15.4
150 Mesh	106	2.63	12.8
TOTAL		100.00	**

K80 =2202µm

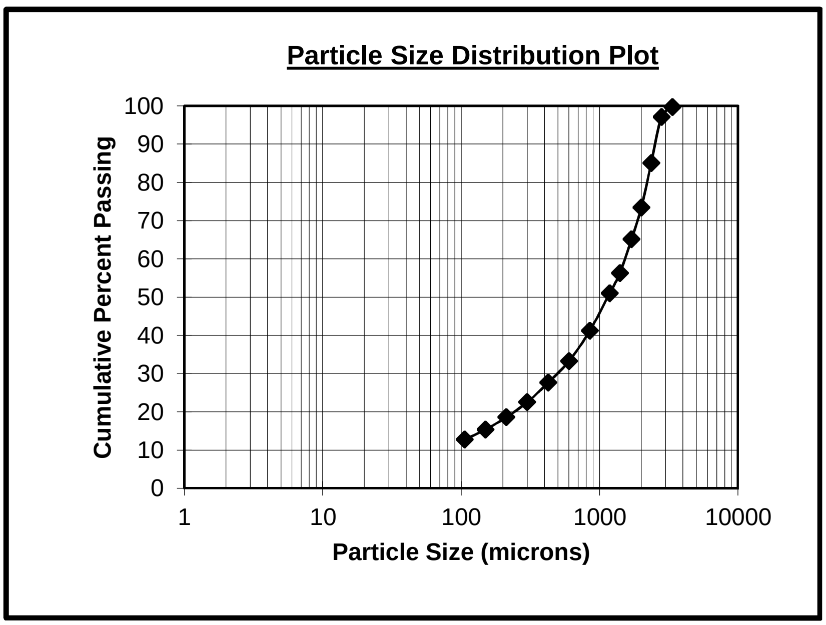


TABLE IV-3E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 3 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.20	99.8
7 Mesh	2800	2.17	97.6
8 Mesh	2360	10.93	86.7
9 Mesh	2000	11.13	75.6
10 Mesh	1700	8.17	67.4
12 Mesh	1400	9.26	58.1
14 Mesh	1180	5.81	52.3
20 Mesh	850	9.85	42.5
28 Mesh	600	8.07	34.4
35 Mesh	425	5.91	28.5
48 Mesh	300	5.22	23.3
65 Mesh	212	4.04	19.3
100 Mesh	150	3.25	16.0
150 Mesh	106	2.81	13.2
TOTAL		100.00	**

K80 =2142µm

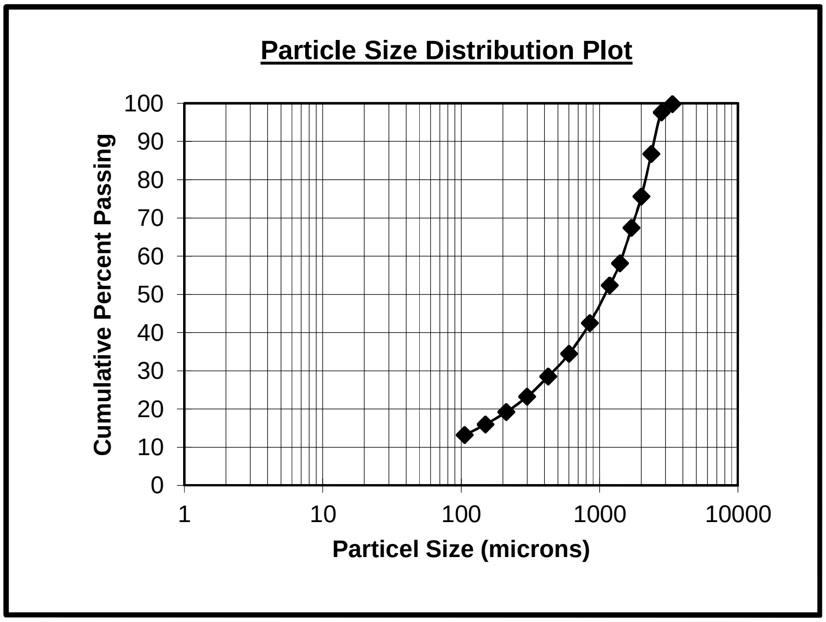


TABLE IV-3F
BOND BALL SCREEN ANALYSIS
KM3174 Composite 3 - Feed 3

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.46	99.5
7 Mesh	2800	4.01	95.5
8 Mesh	2360	16.08	79.5
9 Mesh	2000	14.00	65.5
10 Mesh	1700	9.28	56.2
12 Mesh	1400	9.43	46.8
14 Mesh	1180	5.12	41.6
20 Mesh	850	8.47	33.2
28 Mesh	600	6.49	26.7
35 Mesh	425	4.61	22.1
48 Mesh	300	3.96	18.1
65 Mesh	212	2.94	15.2
100 Mesh	150	2.33	12.8
150 Mesh	106	2.03	10.8
TOTAL		100.00	**

K80 =2375µm

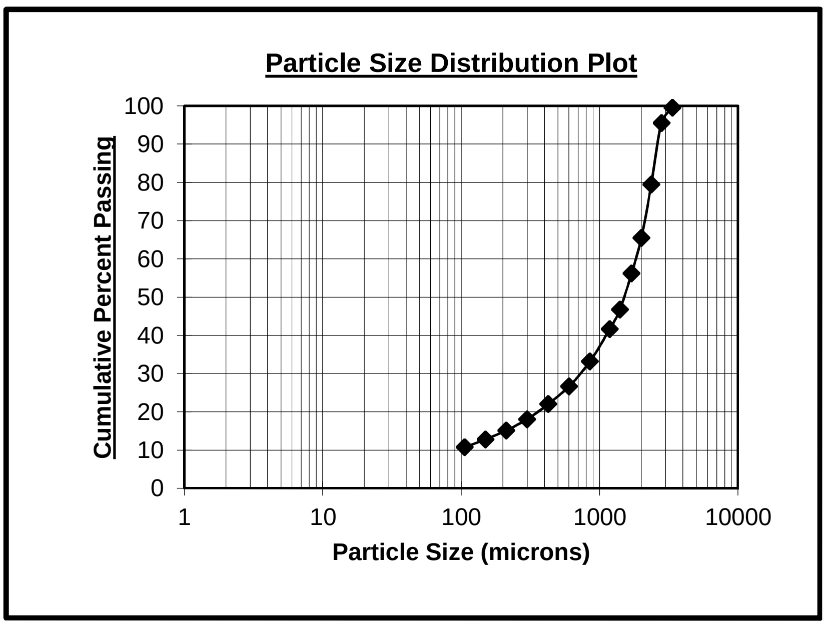


TABLE IV-4A

BOND BALL GRINDABILITY TEST

KM3174 Composite 4

Weight of 700 ml Sample :	1409.9 g.		Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	402.8 g.		Percent Undersize :	12.7%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1409.9	100	291.0	179.1	111.9	1.12
2	291.0	327	449.0	37.0	412.0	1.26
3	449.0	274	411.1	57.0	354.1	1.29
4	411.1	272	426.9	52.2	374.7	1.38
5	426.9	253	405.8	54.2	351.6	1.39
6	405.8	253	405.1	51.5	353.6	1.40
7	405.1	251	400.1	51.4	348.7	1.39

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.39 g.
P = 80% Passing size of test product.	80 µm
F = 80% Passing size of test feed.	2226 µm

WORK INDEX (Wi)
12.8 kw-hr/ton
14.1 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-4B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 4 - Cycle 7 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	1.71	98.3
170 Mesh	90	10.29	88.0
200 Mesh	75	12.57	75.4
270 Mesh	53	14.76	60.7
325 Mesh	45	6.76	53.9
400 Mesh	38	4.38	49.5
TOTAL		100.00	**

K80 =80µm

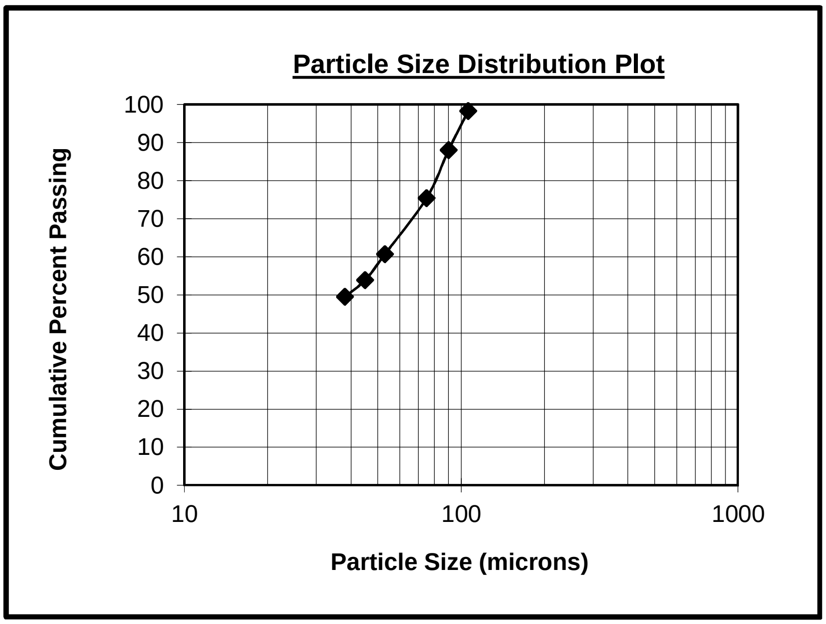


TABLE IV-4C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 4 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.30	99.7
7 Mesh	2800	3.38	96.3
8 Mesh	2360	12.11	84.2
9 Mesh	2000	11.33	72.9
10 Mesh	1700	8.40	64.5
12 Mesh	1400	8.88	55.6
14 Mesh	1180	5.63	50.0
20 Mesh	850	9.56	40.4
28 Mesh	600	7.70	32.7
35 Mesh	425	5.53	27.2
48 Mesh	300	5.02	22.2
65 Mesh	212	3.86	18.3
100 Mesh	150	3.10	15.2
150 Mesh	106	2.50	12.7
TOTAL		100.00	**

K80 =2226µm

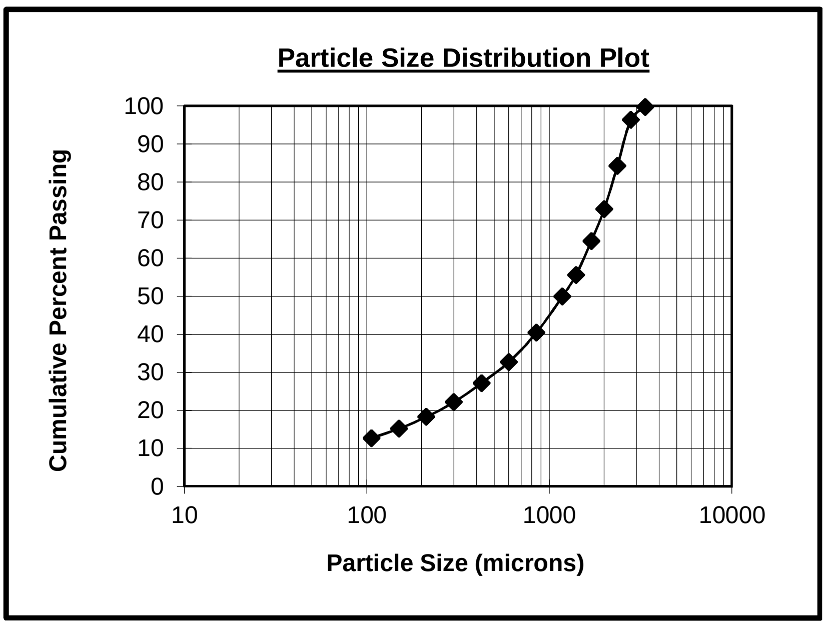


TABLE IV-4D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 4 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.30	99.7
7 Mesh	2800	3.24	96.5
8 Mesh	2360	12.71	83.7
9 Mesh	2000	11.86	71.9
10 Mesh	1700	8.62	63.3
12 Mesh	1400	8.92	54.3
14 Mesh	1180	5.33	49.0
20 Mesh	850	9.32	39.7
28 Mesh	600	7.53	32.2
35 Mesh	425	5.43	26.7
48 Mesh	300	4.94	21.8
65 Mesh	212	3.74	18.0
100 Mesh	150	3.09	15.0
150 Mesh	106	2.44	12.5
TOTAL		100.00	**

K80 =2246µm

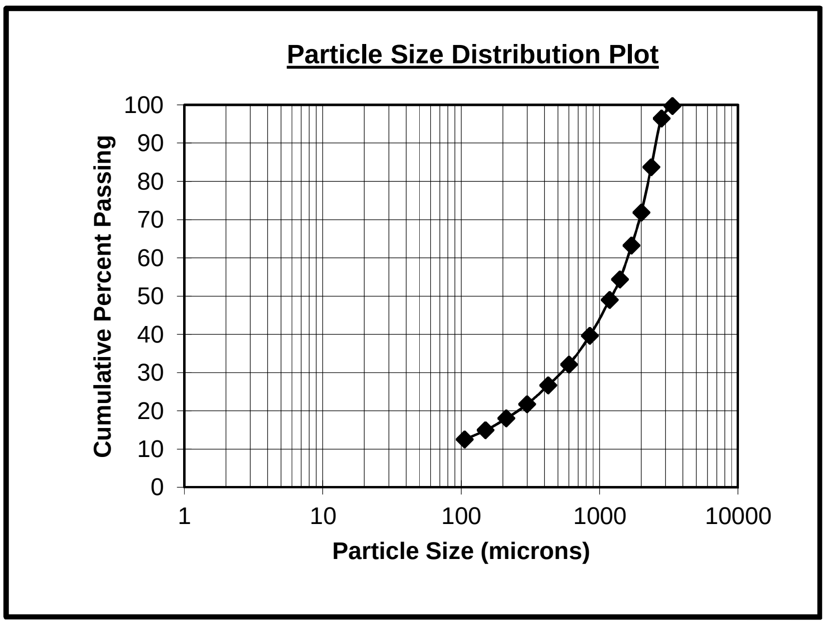


TABLE IV-4E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 4 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.31	99.7
7 Mesh	2800	3.53	96.2
8 Mesh	2360	11.50	84.7
9 Mesh	2000	10.78	73.9
10 Mesh	1700	8.18	65.7
12 Mesh	1400	8.84	56.9
14 Mesh	1180	5.93	50.9
20 Mesh	850	9.81	41.1
28 Mesh	600	7.87	33.3
35 Mesh	425	5.62	27.6
48 Mesh	300	5.11	22.5
65 Mesh	212	3.99	18.5
100 Mesh	150	3.12	15.4
150 Mesh	106	2.55	12.9
TOTAL		100.00	**

K80 =2203µm

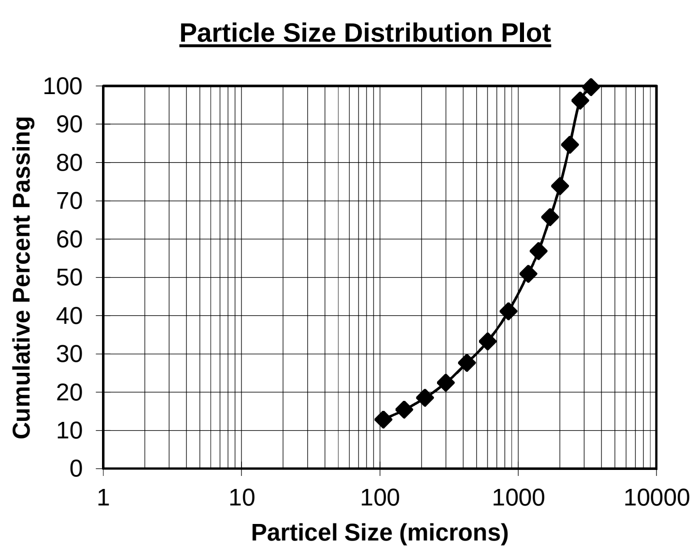


TABLE IV-5A

BOND BALL GRINDABILITY TEST

KM3174 Composite 5

Weight of 700 ml Sample :	1385 g.	Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	395.7 g.	Percent Undersize :	12.3%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1385.0	100	266.7	170.4	96.3	0.96
2	266.7	377	479.9	32.8	447.1	1.19
3	479.9	284	433.5	59.0	374.5	1.32
4	433.5	259	408.8	53.3	355.5	1.37
5	408.8	252	397.8	50.3	347.5	1.38
6	397.8	251	393.6	48.9	344.7	1.37

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.37 g.
P = 80% Passing size of test product.	82 µm
F = 80% Passing size of test feed.	2182 µm

WORK INDEX (Wi)
13.2 kw-hr/ton
14.5 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-5B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 5 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	1.84	98.2
170 Mesh	90	10.96	87.2
200 Mesh	75	13.94	73.3
270 Mesh	53	16.79	56.5
325 Mesh	45	7.54	48.9
400 Mesh	38	4.88	44.0
TOTAL		100.00	**

K80 =82µm

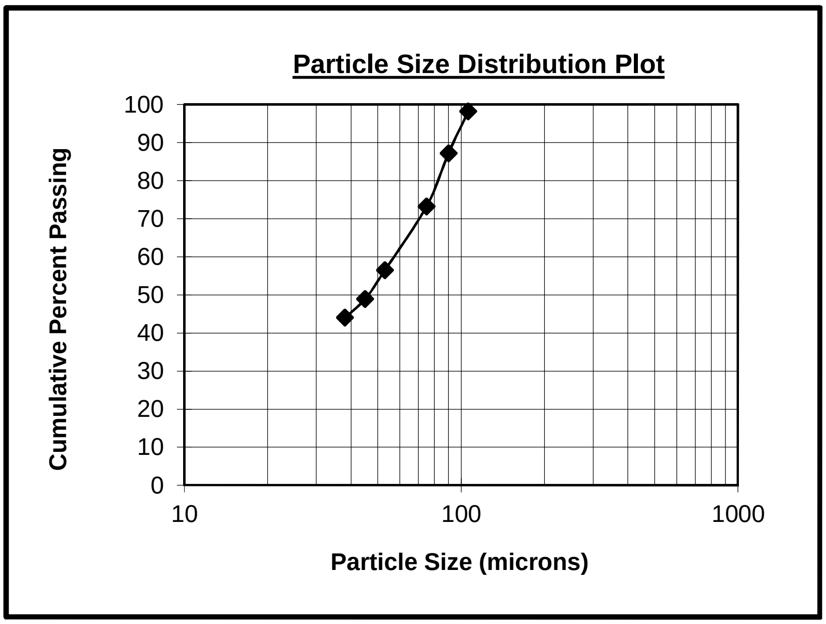


TABLE IV-5C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 5 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.46	99.5
7 Mesh	2800	2.93	96.6
8 Mesh	2360	11.32	85.3
9 Mesh	2000	10.78	74.5
10 Mesh	1700	8.52	66.0
12 Mesh	1400	9.01	57.0
14 Mesh	1180	5.54	51.4
20 Mesh	850	9.55	41.9
28 Mesh	600	7.83	34.1
35 Mesh	425	5.80	28.3
48 Mesh	300	5.42	22.8
65 Mesh	212	4.26	18.6
100 Mesh	150	3.47	15.1
150 Mesh	106	2.85	12.3
TOTAL		100.00	**

K80 =2182µm

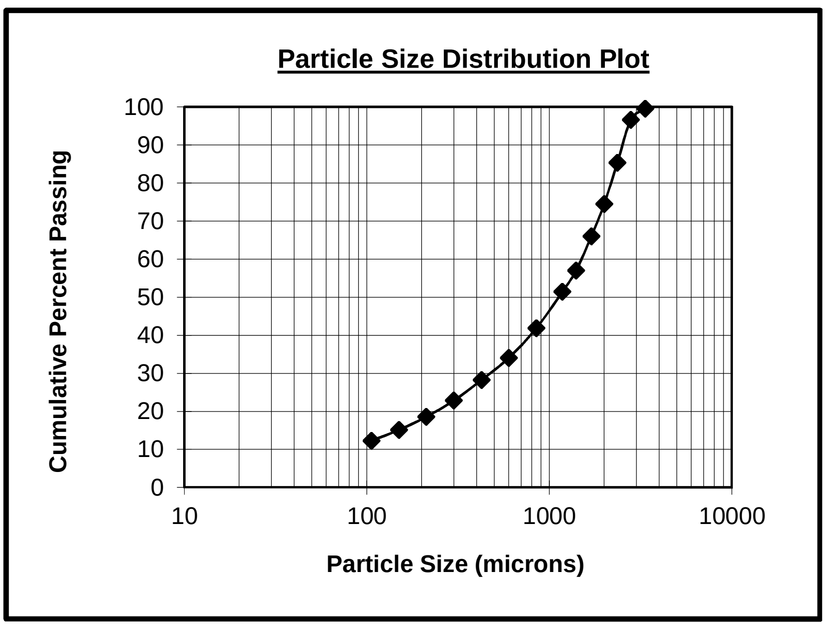


TABLE IV-5D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 5 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.46	99.5
7 Mesh	2800	3.20	96.3
8 Mesh	2360	11.02	85.3
9 Mesh	2000	10.71	74.6
10 Mesh	1700	8.12	66.5
12 Mesh	1400	8.73	57.8
14 Mesh	1180	5.63	52.1
20 Mesh	850	9.75	42.4
28 Mesh	600	7.87	34.5
35 Mesh	425	5.79	28.7
48 Mesh	300	5.43	23.3
65 Mesh	212	4.26	19.0
100 Mesh	150	3.50	15.5
150 Mesh	106	2.84	12.7
TOTAL		100.00	**

K80 =2179µm

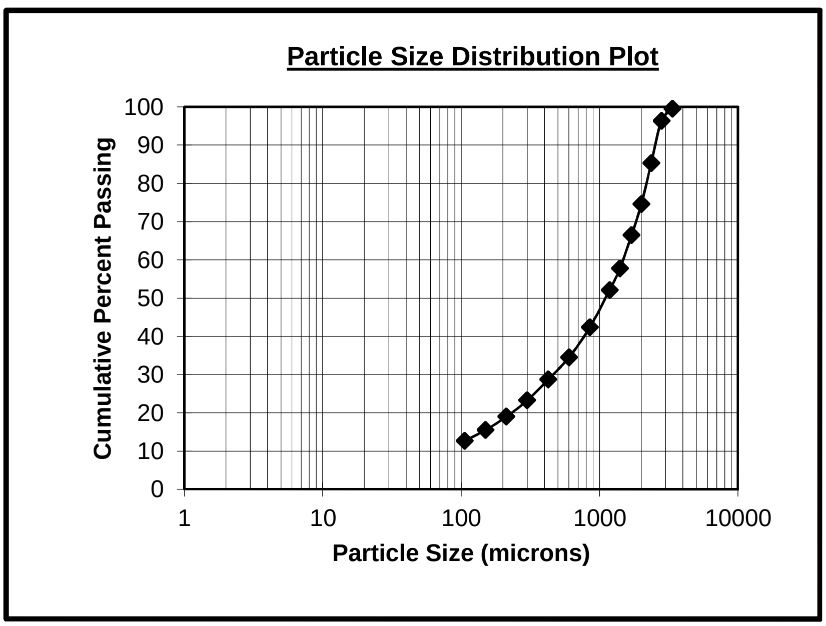


TABLE IV-5E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 5 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.47	99.5
7 Mesh	2800	2.65	96.9
8 Mesh	2360	11.63	85.3
9 Mesh	2000	10.85	74.4
10 Mesh	1700	8.93	65.5
12 Mesh	1400	9.29	56.2
14 Mesh	1180	5.45	50.7
20 Mesh	850	9.35	41.4
28 Mesh	600	7.79	33.6
35 Mesh	425	5.82	27.8
48 Mesh	300	5.40	22.4
65 Mesh	212	4.26	18.1
100 Mesh	150	3.43	14.7
150 Mesh	106	2.86	11.8
TOTAL		100.00	**

K80 =2184µm

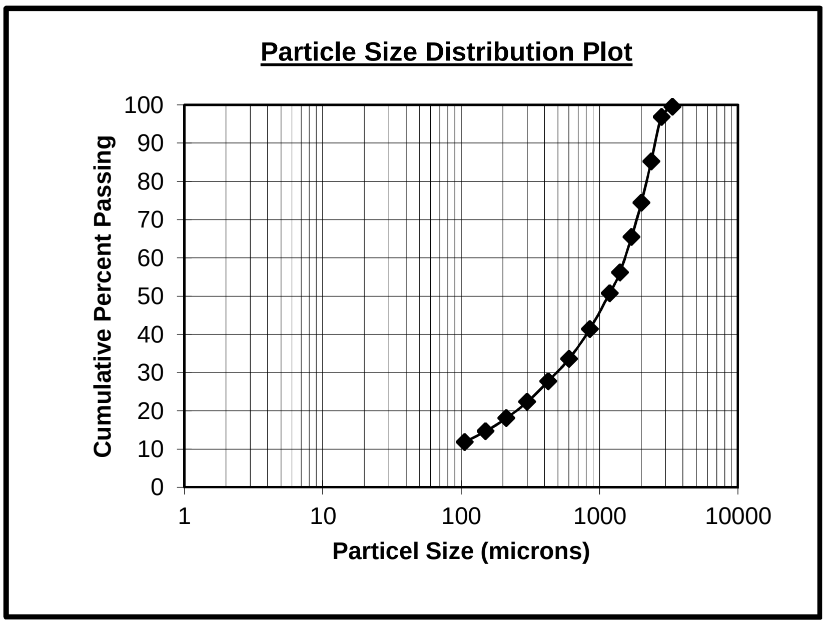


TABLE IV-6A

BOND BALL GRINDABILITY TEST

KM3174 Composite 6

Weight of 700 ml Sample :	1375.3 g.		Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	392.9 g.		Percent Undersize :	11.9%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1375.3	100	282.6	163.7	118.9	1.19
2	282.6	302	396.7	33.6	363.1	1.20
3	396.7	288	416.0	47.2	368.8	1.28
4	416.0	268	406.6	49.5	357.1	1.33
5	406.6	258	390.7	48.4	342.3	1.32
6	390.7	262	399.9	46.5	353.4	1.35

BOND'S WORK INDEX FORMULA

Wi = 44.5 / (Pi^.23 x Gpb^.82 x (10/√P - 10/√F))

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.34 g.
P = 80% Passing size of test product.	79 µm
F = 80% Passing size of test feed.	2289 µm

WORK INDEX (Wi)

13.1 kw-hr/ton

14.4 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-6B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 6 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	2.01	98.0
170 Mesh	90	8.90	89.1
200 Mesh	75	12.57	76.5
270 Mesh	53	15.45	61.1
325 Mesh	45	6.98	54.1
400 Mesh	38	4.71	49.4
TOTAL		100.00	**

K80 =79µm

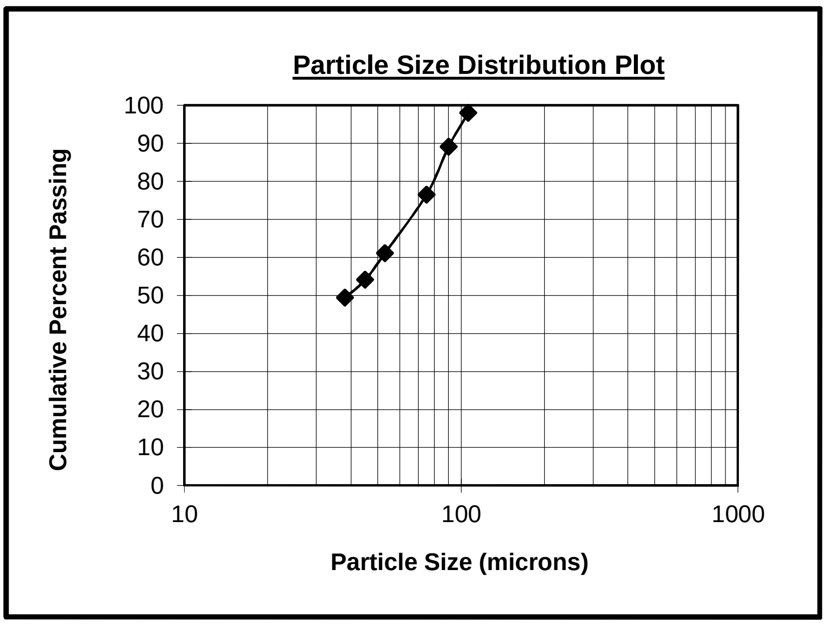


TABLE IV-6C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 6 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.36	99.6
7 Mesh	2800	3.36	96.3
8 Mesh	2360	13.76	82.5
9 Mesh	2000	12.75	69.8
10 Mesh	1700	8.97	60.8
12 Mesh	1400	8.97	51.8
14 Mesh	1180	5.33	46.5
20 Mesh	850	9.07	37.4
28 Mesh	600	7.21	30.2
35 Mesh	425	5.23	25.0
48 Mesh	300	4.56	20.4
65 Mesh	212	3.47	17.0
100 Mesh	150	2.75	14.2
150 Mesh	106	2.29	11.9
TOTAL		100.00	**

K80 =2289µm

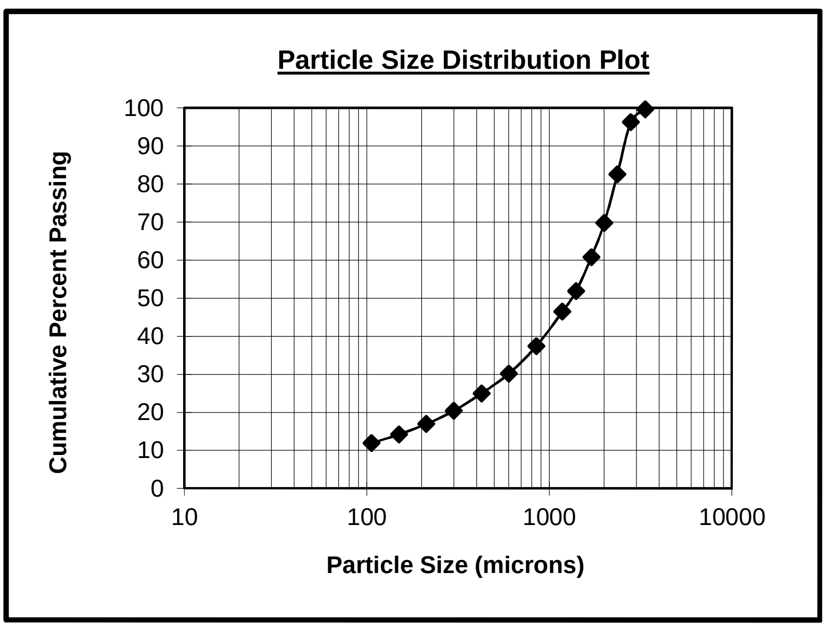


TABLE IV-6D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 6 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.41	99.6
7 Mesh	2800	3.30	96.3
8 Mesh	2360	13.87	82.4
9 Mesh	2000	12.14	70.3
10 Mesh	1700	8.74	61.5
12 Mesh	1400	8.69	52.8
14 Mesh	1180	5.23	47.6
20 Mesh	850	9.15	38.5
28 Mesh	600	7.37	31.1
35 Mesh	425	5.44	25.7
48 Mesh	300	4.83	20.8
65 Mesh	212	3.66	17.2
100 Mesh	150	2.90	14.3
150 Mesh	106	2.39	11.9
TOTAL		100.00	**

K80 =2288µm

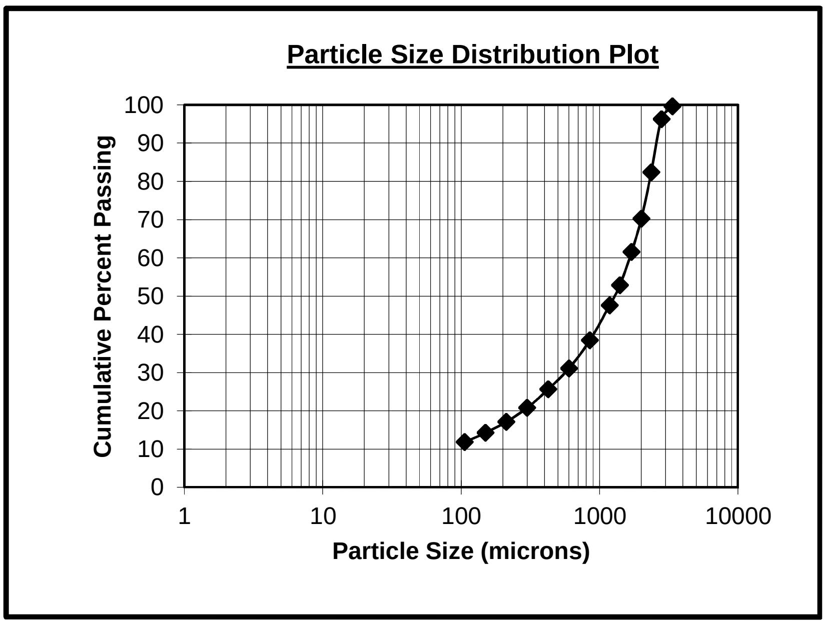


TABLE IV-6E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 6 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.31	99.7
7 Mesh	2800	3.43	96.3
8 Mesh	2360	13.66	82.6
9 Mesh	2000	13.35	69.3
10 Mesh	1700	9.21	60.1
12 Mesh	1400	9.26	50.8
14 Mesh	1180	5.42	45.4
20 Mesh	850	9.00	36.4
28 Mesh	600	7.06	29.3
35 Mesh	425	5.01	24.3
48 Mesh	300	4.30	20.0
65 Mesh	212	3.27	16.7
100 Mesh	150	2.61	14.1
150 Mesh	106	2.20	11.9
TOTAL		100.00	**

K80 =2290µm

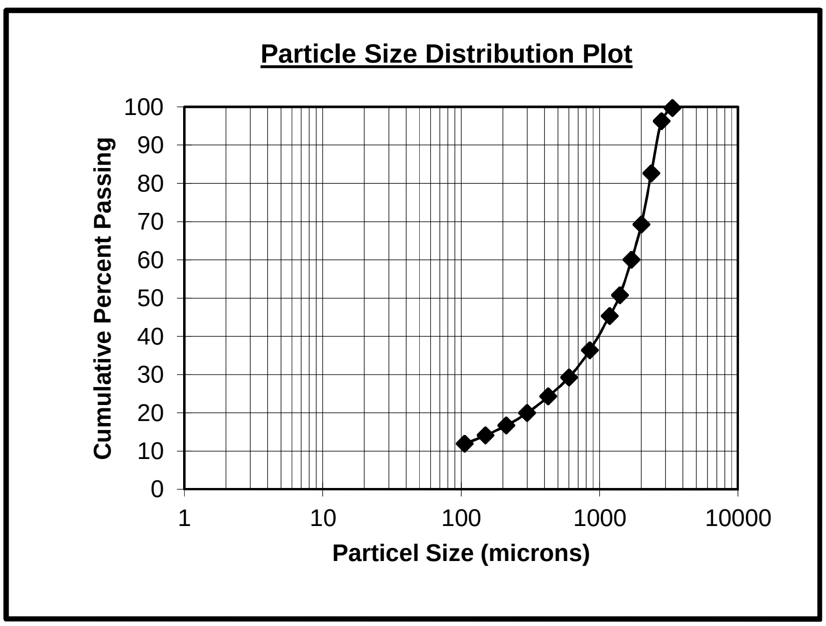


TABLE IV-7A

BOND BALL GRINDABILITY TEST

KM3174 Composite 7

Weight of 700 ml Sample :	1399.7 g.	Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	399.9 g.	Percent Undersize :	15.2%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1399.7	100	286.6	212.8	73.8	0.74
2	286.6	483	589.9	43.6	546.3	1.13
3	589.9	274	442.6	89.7	352.9	1.29
4	442.6	258	403.0	67.3	335.7	1.30
5	403.0	261	407.0	61.3	345.7	1.33
6	407.0	255	388.4	61.9	326.5	1.28

BOND'S WORK INDEX FORMULA

Wi = 44.5 / (Pi^.23 x Gpb^.82 x (10/√P - 10/√F))

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.30 g.
P = 80% Passing size of test product.	82 µm
F = 80% Passing size of test feed.	2015 µm

WORK INDEX (Wi)
13.9 kw-hr/ton
15.3 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-7B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 7 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	2.74	97.3
170 Mesh	90	10.75	86.5
200 Mesh	75	11.83	74.7
270 Mesh	53	14.47	60.2
325 Mesh	45	6.65	53.6
400 Mesh	38	3.91	49.7
TOTAL		100.00	**

K80 =82µm

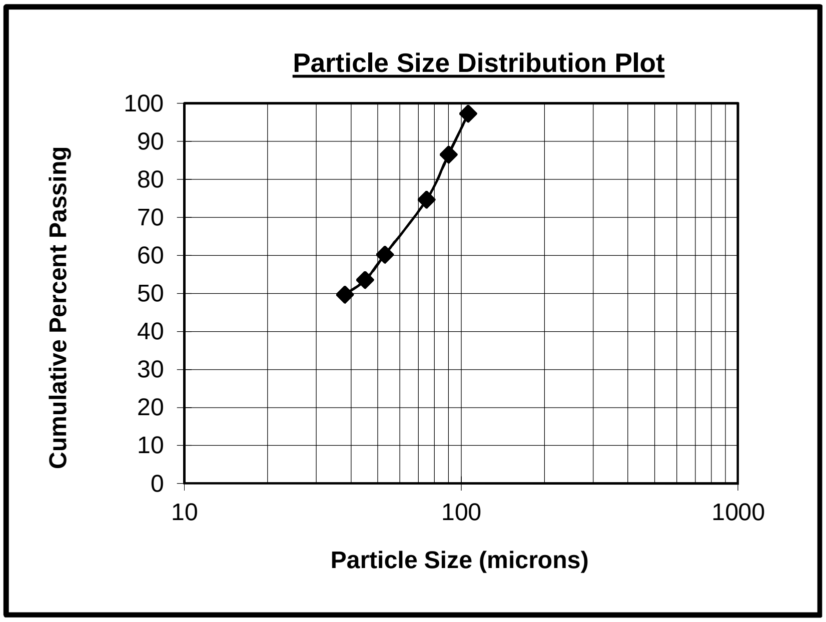


TABLE IV-7C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 7 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.28	99.7
7 Mesh	2800	1.98	97.7
8 Mesh	2360	8.90	88.8
9 Mesh	2000	9.23	79.6
10 Mesh	1700	7.16	72.5
12 Mesh	1400	8.64	63.8
14 Mesh	1180	5.41	58.4
20 Mesh	850	10.43	48.0
28 Mesh	600	8.73	39.2
35 Mesh	425	6.51	32.7
48 Mesh	300	6.11	26.6
65 Mesh	212	4.67	22.0
100 Mesh	150	3.69	18.3
150 Mesh	106	3.07	15.2
TOTAL		100.00	**

K80 =2015µm

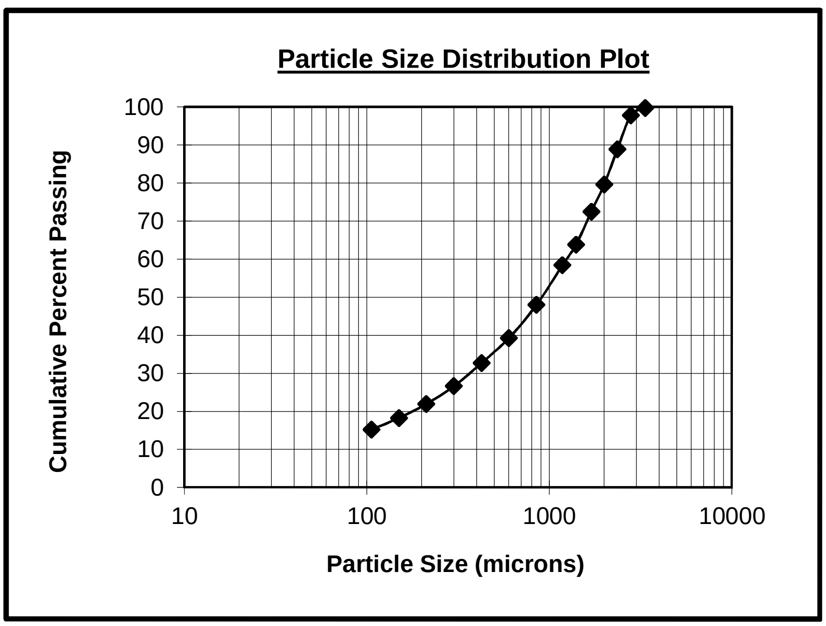


TABLE IV-7D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 7 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.20	99.8
7 Mesh	2800	1.16	98.6
8 Mesh	2360	7.69	91.0
9 Mesh	2000	8.29	82.7
10 Mesh	1700	6.78	75.9
12 Mesh	1400	8.44	67.4
14 Mesh	1180	5.23	62.2
20 Mesh	850	10.80	51.4
28 Mesh	600	9.25	42.2
35 Mesh	425	6.93	35.2
48 Mesh	300	6.58	28.6
65 Mesh	212	5.03	23.6
100 Mesh	150	4.02	19.6
150 Mesh	106	3.42	16.2
TOTAL		100.00	**

K80 =1879µm

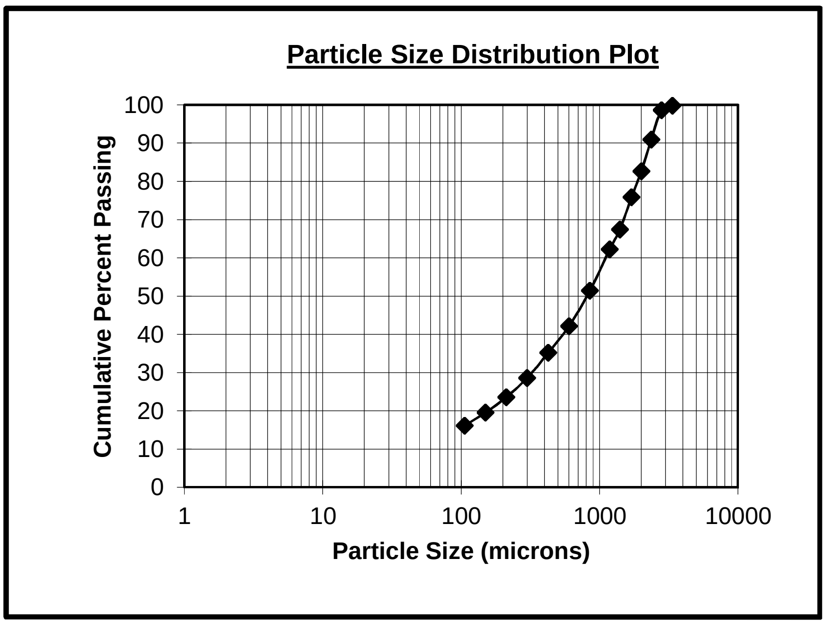


TABLE IV-7E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 7 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.20	99.8
7 Mesh	2800	2.40	97.4
8 Mesh	2360	9.35	88.1
9 Mesh	2000	9.50	78.6
10 Mesh	1700	7.25	71.3
12 Mesh	1400	8.77	62.5
14 Mesh	1180	5.39	57.1
20 Mesh	850	10.09	47.1
28 Mesh	600	8.57	38.5
35 Mesh	425	6.42	32.1
48 Mesh	300	5.93	26.2
65 Mesh	212	4.55	21.6
100 Mesh	150	3.57	18.0
150 Mesh	106	3.09	14.9
TOTAL		100.00	**

K80 =2054µm

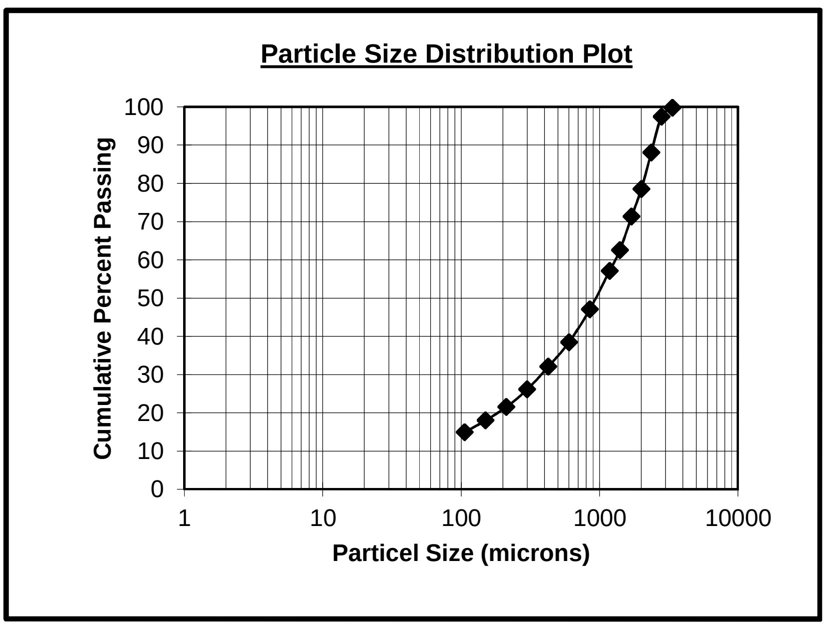


TABLE IV-7F
BOND BALL SCREEN ANALYSIS
KM3174 Composite 7 - Feed 3

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.45	99.5
7 Mesh	2800	2.36	97.2
8 Mesh	2360	9.65	87.5
9 Mesh	2000	9.90	77.6
10 Mesh	1700	7.44	70.2
12 Mesh	1400	8.69	61.5
14 Mesh	1180	5.63	55.9
20 Mesh	850	10.40	45.5
28 Mesh	600	8.39	37.1
35 Mesh	425	6.18	30.9
48 Mesh	300	5.83	25.1
65 Mesh	212	4.42	20.7
100 Mesh	150	3.47	17.2
150 Mesh	106	2.71	14.5
TOTAL		100.00	**

K80 =2084µm

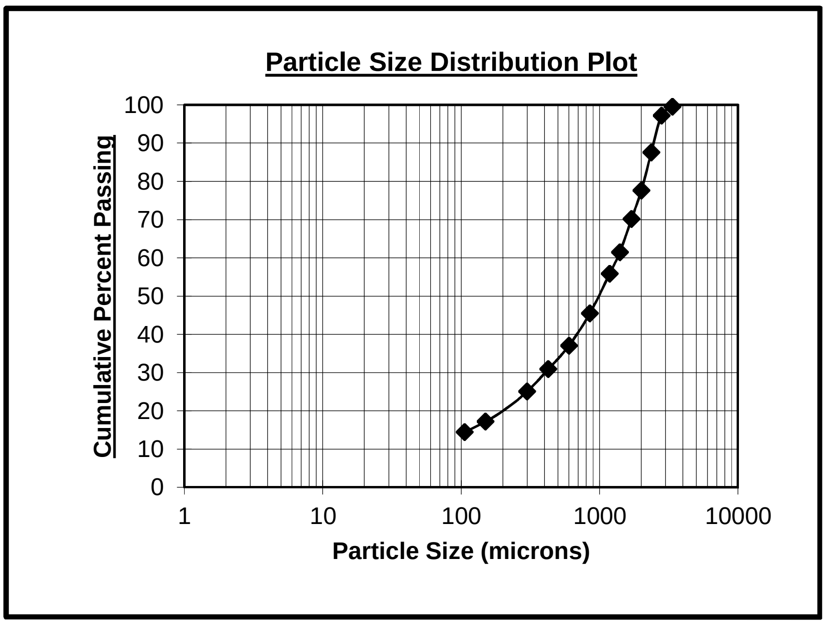


TABLE IV-8A

BOND BALL GRINDABILITY TEST

KM3174 Composite 8

Weight of 700 ml Sample :	1348.7 g.	Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	385.3 g.	Percent Undersize :	10.5%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1348.7	100	197.7	141.6	56.1	0.56
2	197.7	650	541.9	20.8	521.1	0.80
3	541.9	410	428.1	56.9	371.2	0.91
4	428.1	376	405.1	45.0	360.1	0.96
5	405.1	358	388.1	42.5	345.6	0.97
6	388.1	357	384.3	40.8	343.5	0.96

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	0.96 g.
P = 80% Passing size of test product.	78 µm
F = 80% Passing size of test feed.	2312 µm

WORK INDEX (Wi)
17.0 kw-hr/ton
18.7 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-8B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 8 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	0.00	100.0
170 Mesh	90	9.69	90.3
200 Mesh	75	12.53	77.8
270 Mesh	53	15.85	61.9
325 Mesh	45	6.86	55.1
400 Mesh	38	4.36	50.7
TOTAL		100.00	**

K80 =78µm

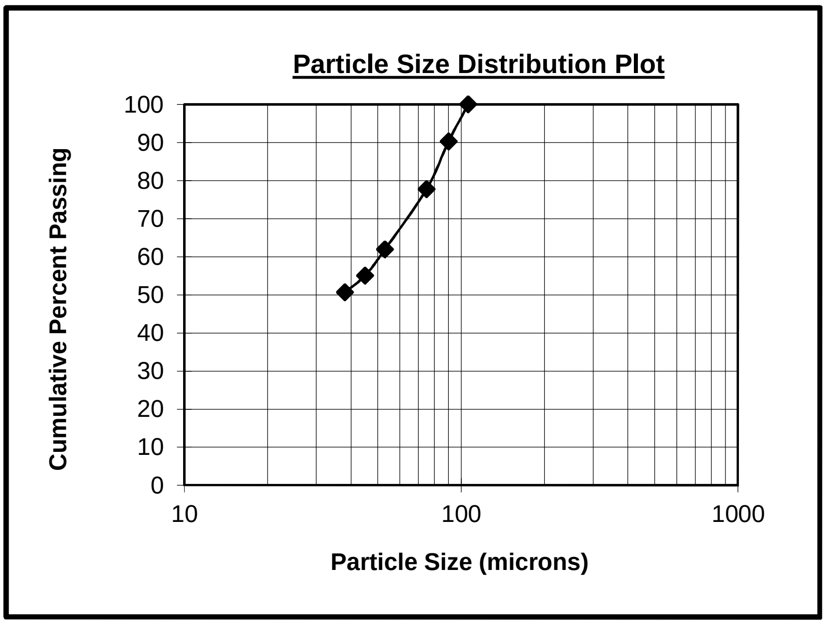


TABLE IV-8C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 8 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.33	99.7
7 Mesh	2800	3.92	95.7
8 Mesh	2360	14.11	81.6
9 Mesh	2000	12.27	69.4
10 Mesh	1700	8.96	60.4
12 Mesh	1400	9.22	51.2
14 Mesh	1180	5.51	45.7
20 Mesh	850	9.58	36.1
28 Mesh	600	7.45	28.6
35 Mesh	425	5.31	23.3
48 Mesh	300	4.67	18.7
65 Mesh	212	3.49	15.2
100 Mesh	150	2.69	12.5
150 Mesh	106	2.02	10.5
TOTAL		100.00	**

K80 =2312µm

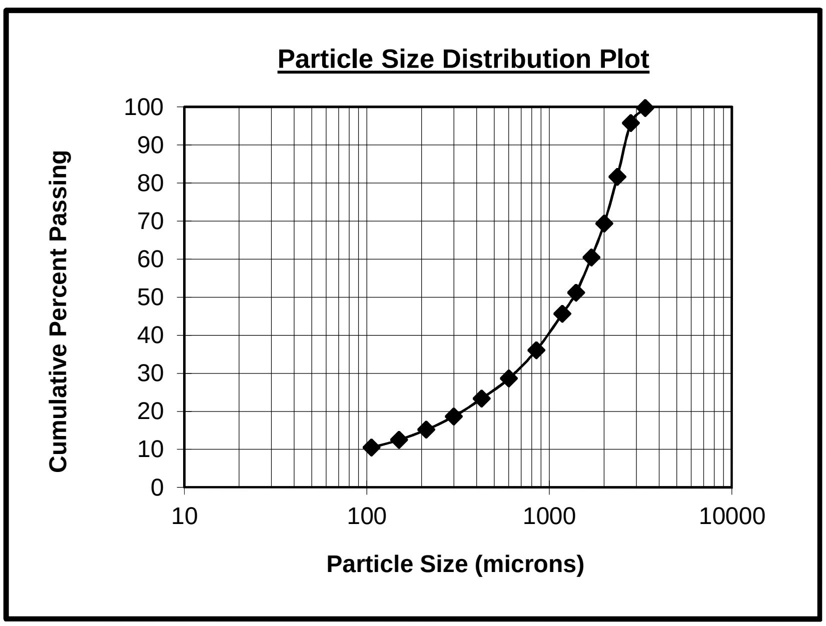


TABLE IV-8D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 8 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.52	99.5
7 Mesh	2800	4.47	95.0
8 Mesh	2360	14.92	80.1
9 Mesh	2000	12.58	67.5
10 Mesh	1700	9.00	58.5
12 Mesh	1400	9.62	48.9
14 Mesh	1180	5.56	43.3
20 Mesh	850	9.78	33.5
28 Mesh	600	7.12	26.4
35 Mesh	425	4.99	21.4
48 Mesh	300	4.26	17.2
65 Mesh	212	3.12	14.0
100 Mesh	150	2.39	11.6
150 Mesh	106	1.82	9.8
TOTAL		100.00	**

K80 =2358µm

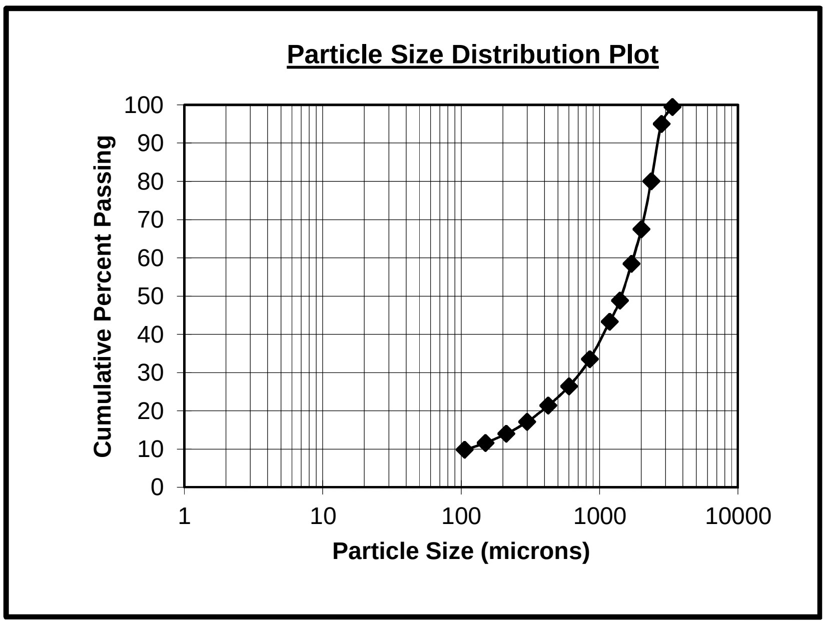


TABLE IV-8E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 8 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.25	99.8
7 Mesh	2800	3.53	96.2
8 Mesh	2360	13.23	83.0
9 Mesh	2000	11.89	71.1
10 Mesh	1700	8.86	62.2
12 Mesh	1400	9.20	53.0
14 Mesh	1180	5.62	47.4
20 Mesh	850	9.60	37.8
28 Mesh	600	7.71	30.1
35 Mesh	425	5.52	24.6
48 Mesh	300	4.93	19.7
65 Mesh	212	3.63	16.0
100 Mesh	150	2.79	13.2
150 Mesh	106	2.04	11.2
TOTAL		100.00	**

K80 =2269µm

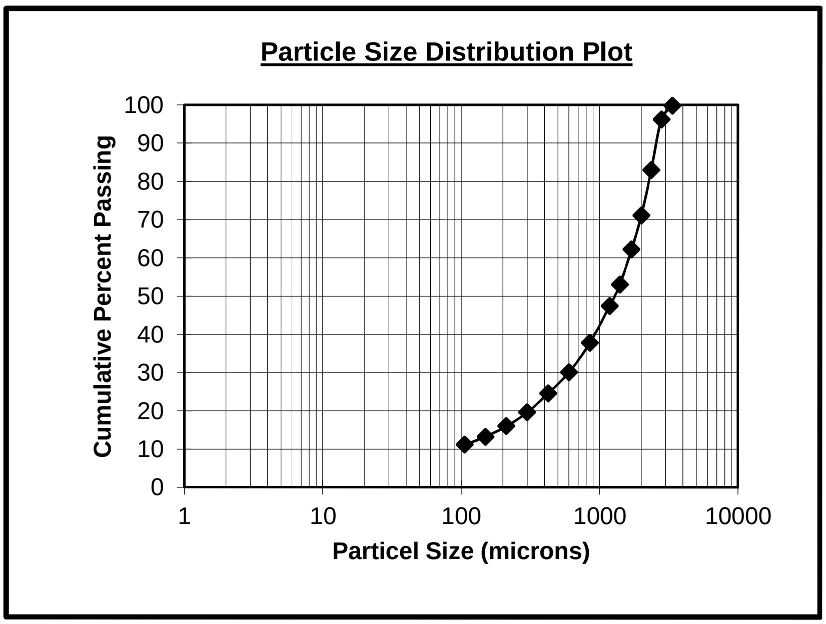


TABLE IV-8F
BOND BALL SCREEN ANALYSIS
KM3174 Composite 8 - Feed 3

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.24	99.8
7 Mesh	2800	3.79	96.0
8 Mesh	2360	14.20	81.8
9 Mesh	2000	12.35	69.4
10 Mesh	1700	9.04	60.4
12 Mesh	1400	8.85	51.5
14 Mesh	1180	5.35	46.2
20 Mesh	850	9.38	36.8
28 Mesh	600	7.49	29.3
35 Mesh	425	5.40	23.9
48 Mesh	300	4.81	19.1
65 Mesh	212	3.69	15.4
100 Mesh	150	2.87	12.5
150 Mesh	106	2.19	10.4
TOTAL		100.00	**

K80 =2308µm

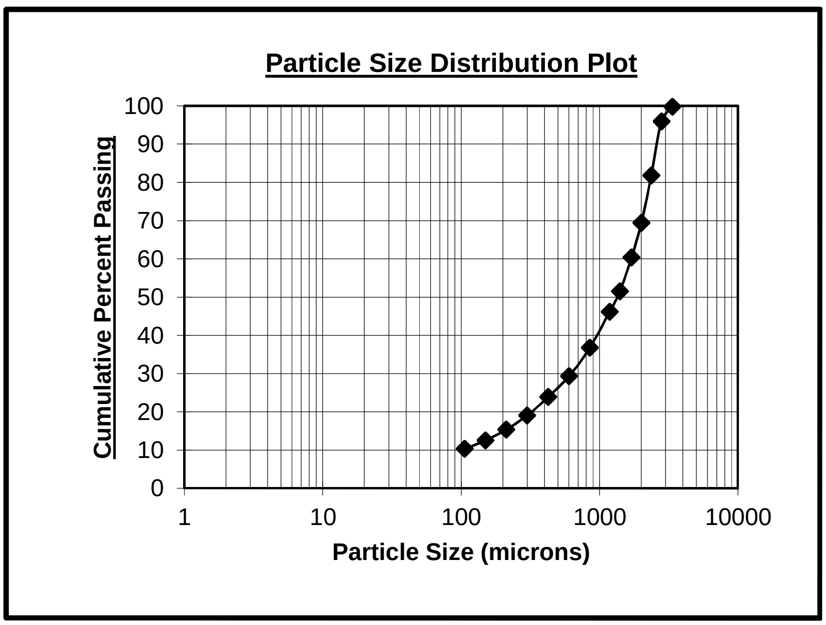


TABLE IV-9A

BOND BALL GRINDABILITY TEST

KM3174 Composite 9

Weight of 700 ml Sample :	1446.3 g.		Aperture Test Sieve :	106µm
1/3.5 of Sample Weight :	413.2 g.		Percent Undersize :	10.5%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1446.3	200	341.9	151.9	190.0	0.95
2	341.9	397	426.2	35.9	390.3	0.98
3	426.2	375	438.1	44.8	393.3	1.05
4	438.1	350	421.2	46.0	375.2	1.07
5	421.2	344	424.8	44.2	380.6	1.11
6	424.8	333	412.7	44.6	368.1	1.10

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.09 g.
P = 80% Passing size of test product.	77 µm
F = 80% Passing size of test feed.	2369 µm

WORK INDEX (Wi)

15.1 kw-hr/ton

16.7 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-9B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 9 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	1.23	98.8
170 Mesh	90	8.90	89.9
200 Mesh	75	11.65	78.2
270 Mesh	53	16.00	62.2
325 Mesh	45	7.29	54.9
400 Mesh	38	4.64	50.3
TOTAL		100.00	**

K80 =77µm

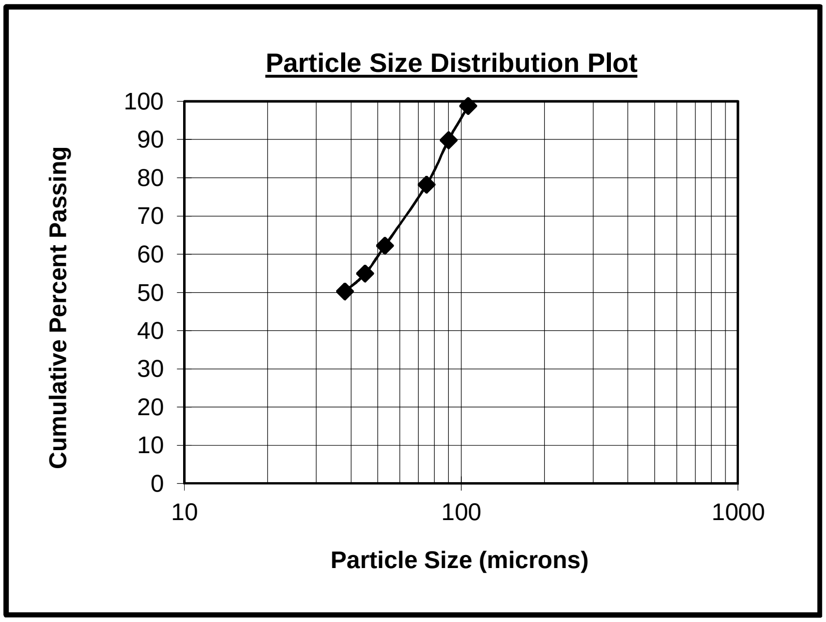


TABLE IV-9C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 9 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.48	99.5
7 Mesh	2800	4.61	94.9
8 Mesh	2360	15.23	79.7
9 Mesh	2000	12.70	67.0
10 Mesh	1700	9.12	57.9
12 Mesh	1400	9.33	48.5
14 Mesh	1180	5.55	43.0
20 Mesh	850	9.08	33.9
28 Mesh	600	7.02	26.9
35 Mesh	425	4.86	22.0
48 Mesh	300	4.20	17.8
65 Mesh	212	3.11	14.7
100 Mesh	150	2.41	12.3
150 Mesh	106	1.85	10.5
TOTAL		100.00	**

K80 =2369µm

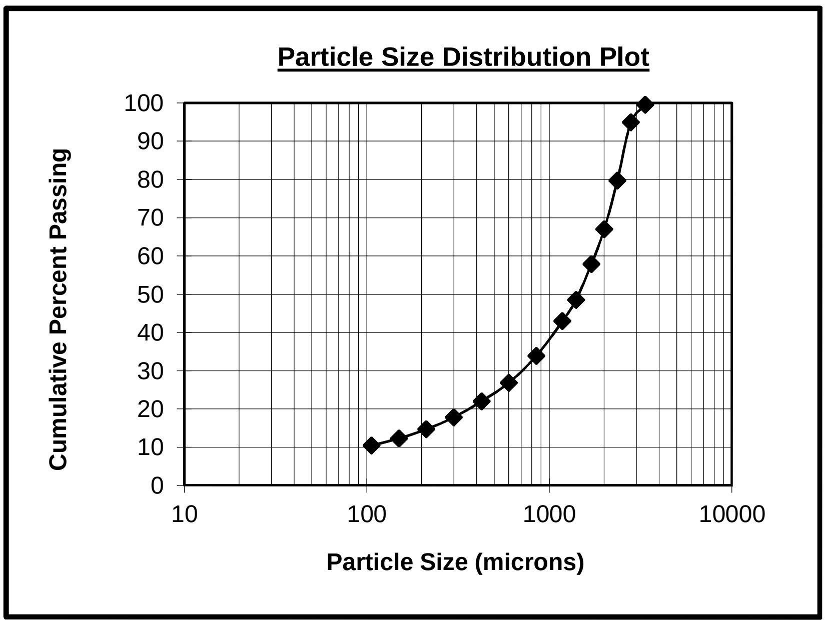


TABLE IV-9D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 9 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.40	99.6
7 Mesh	2800	4.21	95.4
8 Mesh	2360	14.45	81.0
9 Mesh	2000	12.32	68.6
10 Mesh	1700	9.35	59.3
12 Mesh	1400	9.75	49.5
14 Mesh	1180	5.54	44.0
20 Mesh	850	9.30	34.7
28 Mesh	600	7.17	27.5
35 Mesh	425	4.90	22.6
48 Mesh	300	4.26	18.4
65 Mesh	212	3.12	15.2
100 Mesh	150	2.42	12.8
150 Mesh	106	1.98	10.8
TOTAL		100.00	**

K80 =2332µm

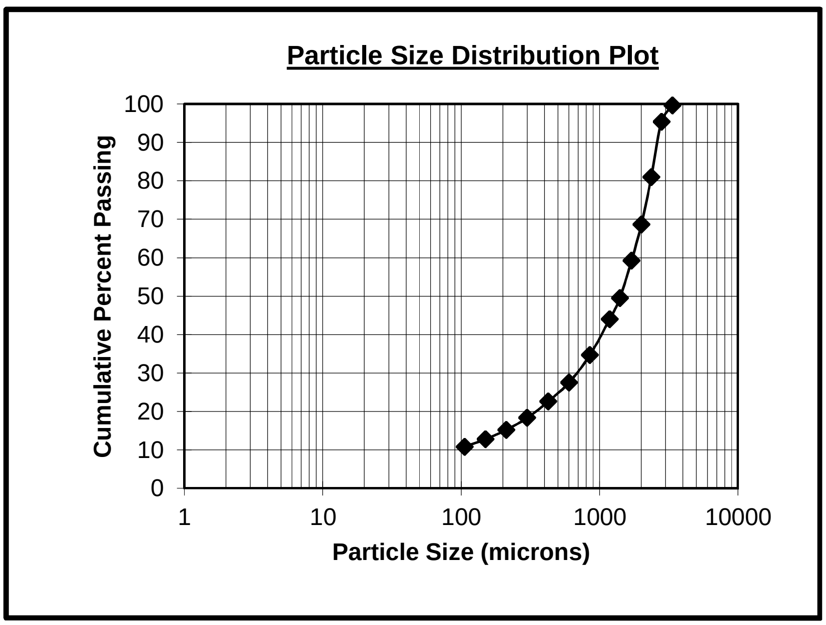


TABLE IV-9E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 9 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.43	99.6
7 Mesh	2800	5.54	94.0
8 Mesh	2360	16.25	77.8
9 Mesh	2000	13.65	64.1
10 Mesh	1700	9.21	54.9
12 Mesh	1400	8.82	46.1
14 Mesh	1180	5.45	40.6
20 Mesh	850	8.68	32.0
28 Mesh	600	6.61	25.4
35 Mesh	425	4.53	20.8
48 Mesh	300	3.91	16.9
65 Mesh	212	2.94	14.0
100 Mesh	150	2.31	11.7
150 Mesh	106	1.88	9.8
TOTAL		100.00	**

K80 =2421µm

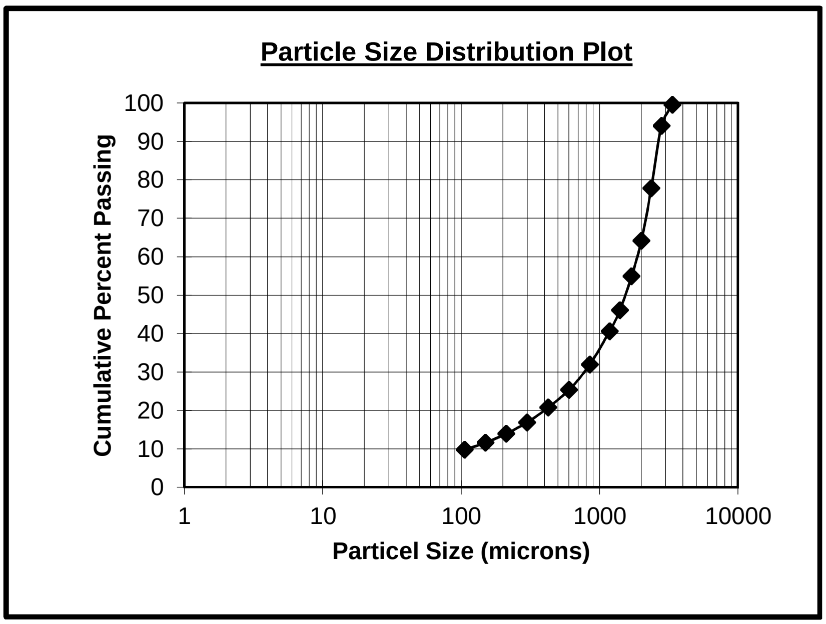


TABLE IV-9F
BOND BALL SCREEN ANALYSIS
KM3174 Composite 9 - Feed 3

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.61	99.4
7 Mesh	2800	4.03	95.4
8 Mesh	2360	14.96	80.4
9 Mesh	2000	12.10	68.3
10 Mesh	1700	8.78	59.5
12 Mesh	1400	9.44	50.1
14 Mesh	1180	5.67	44.4
20 Mesh	850	9.29	35.1
28 Mesh	600	7.30	27.8
35 Mesh	425	5.16	22.7
48 Mesh	300	4.44	18.2
65 Mesh	212	3.27	15.0
100 Mesh	150	2.50	12.5
150 Mesh	106	1.68	10.8
TOTAL		100.00	**

K80 =2348µm

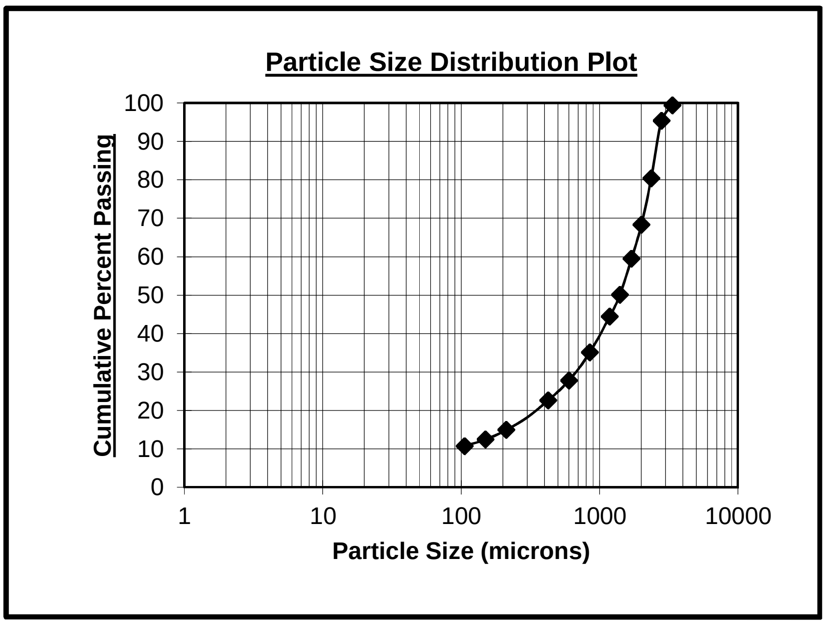


TABLE IV-10A
BOND BALL GRINDABILITY TEST
KM3174 Composite 10

Weight of 700 ml Sample : 1474 g.
1/3.5 of Sample Weight : 421.1 g.

Aperture Test Sieve : 106µm
Percent Undersize : 17.1%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1474.0	100	308.3	252.1	56.2	0.56
2	308.3	655	765.1	52.7	712.4	1.09
3	765.1	267	463.4	130.8	332.6	1.25
4	463.4	274	426.1	79.2	346.9	1.26
5	426.1	276	422.6	72.9	349.7	1.27
6	422.6	275	419.8	72.3	347.5	1.26

BOND'S WORK INDEX FORMULA

Wi = 44.5 / (Pi^.23 x Gpb^.82 x (10/√P - 10/√F))

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.27 g.
P = 80% Passing size of test product.	75 µm
F = 80% Passing size of test feed.	2024 µm

WORK INDEX (Wi)
13.5 kw-hr/ton
14.8 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-10B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 10 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	1.49	98.5
170 Mesh	90	7.44	91.1
200 Mesh	75	11.11	80.0
270 Mesh	53	15.18	64.8
325 Mesh	45	6.75	58.0
400 Mesh	38	4.27	53.8
TOTAL		100.00	**

K80 =75µm

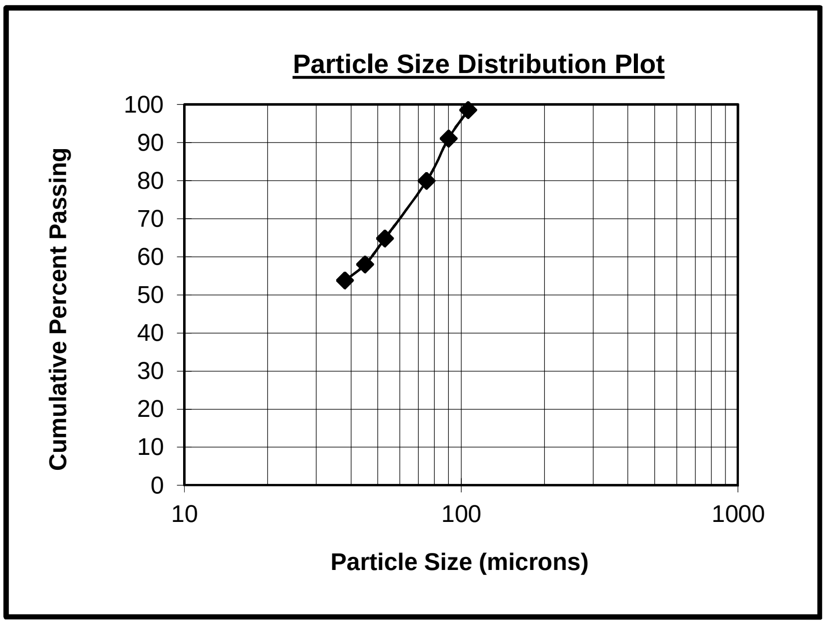


TABLE IV-10C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 10 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.19	99.8
7 Mesh	2800	2.05	97.8
8 Mesh	2360	9.19	88.6
9 Mesh	2000	9.19	79.4
10 Mesh	1700	6.96	72.4
12 Mesh	1400	7.99	64.4
14 Mesh	1180	5.03	59.4
20 Mesh	850	9.55	49.8
28 Mesh	600	8.40	41.4
35 Mesh	425	6.38	35.1
48 Mesh	300	6.06	29.0
65 Mesh	212	4.86	24.1
100 Mesh	150	3.95	20.2
150 Mesh	106	3.10	17.1
TOTAL		100.00	**

K80 =2024µm

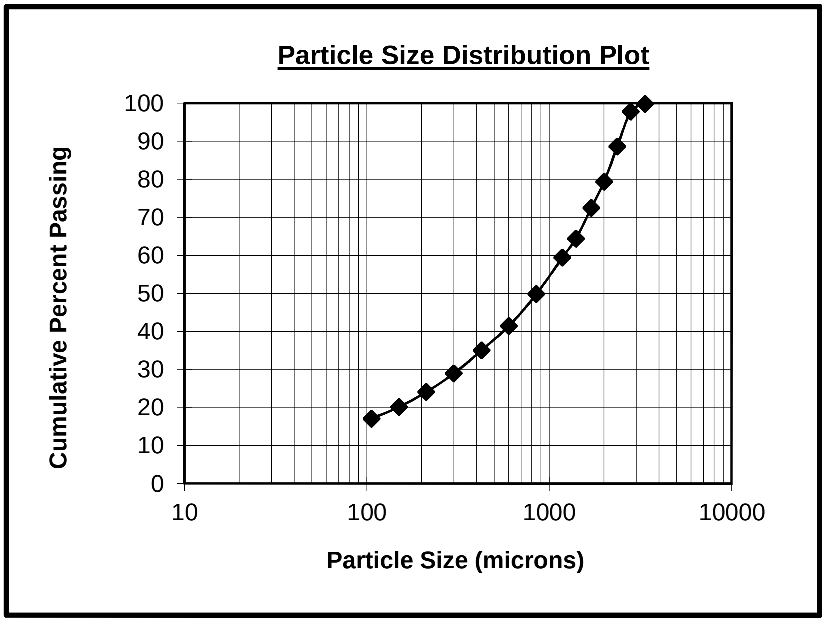


TABLE IV-10D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 10 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.29	99.7
7 Mesh	2800	2.03	97.7
8 Mesh	2360	8.99	88.7
9 Mesh	2000	9.43	79.3
10 Mesh	1700	6.96	72.3
12 Mesh	1400	8.08	64.2
14 Mesh	1180	5.08	59.1
20 Mesh	850	9.43	49.7
28 Mesh	600	8.22	41.5
35 Mesh	425	6.24	35.3
48 Mesh	300	6.00	29.3
65 Mesh	212	4.79	24.5
100 Mesh	150	3.87	20.6
150 Mesh	106	2.90	17.7
TOTAL		100.00	**

K80 =2028µm

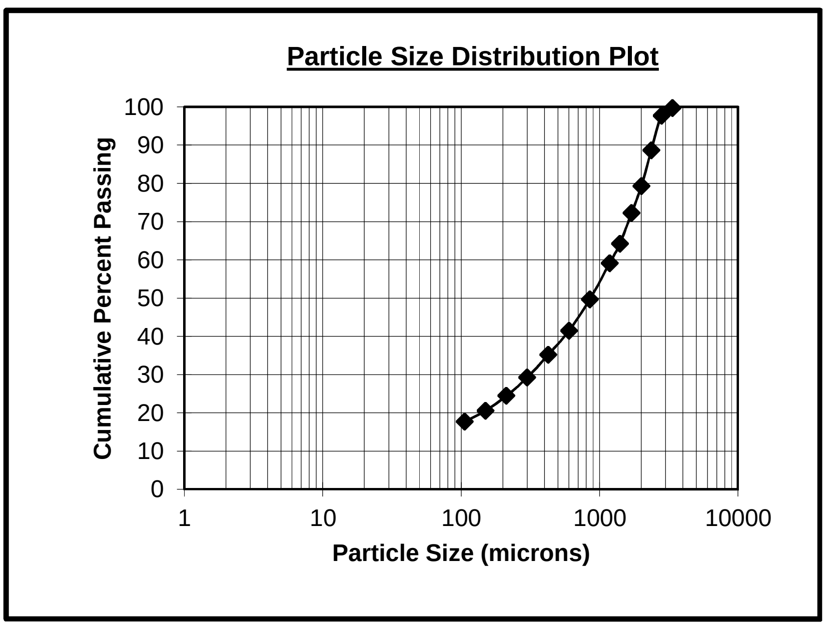


TABLE IV-10E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 10 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.10	99.9
7 Mesh	2800	2.06	97.8
8 Mesh	2360	9.39	88.5
9 Mesh	2000	8.96	79.5
10 Mesh	1700	6.95	72.5
12 Mesh	1400	7.91	64.6
14 Mesh	1180	4.98	59.7
20 Mesh	850	9.68	50.0
28 Mesh	600	8.58	41.4
35 Mesh	425	6.52	34.9
48 Mesh	300	6.13	28.7
65 Mesh	212	4.94	23.8
100 Mesh	150	4.02	19.8
150 Mesh	106	3.31	16.5
TOTAL		100.00	**

K80 =2020µm

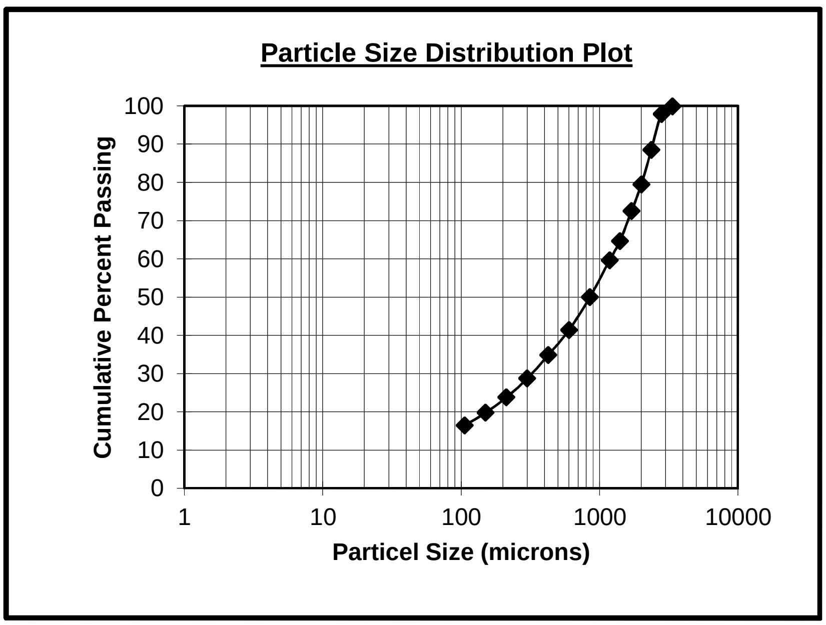


TABLE IV-11A

BOND BALL GRINDABILITY TEST

KM3174 Composite 11

Weight of 700 ml Sample : 1465.4 g.

1/3.5 of Sample Weight : 418.7 g.

Aperture Test Sieve : 106µm

Percent Undersize : 16.6%

Cycle	Weight of New Feed	Number of Revolutions	Weight of Undersize			
			Product	Feed	Net Product	Net / Rev
1	1465.4	100	296.6	243.3	53.3	0.53
2	296.6	693	821.3	49.2	772.1	1.11
3	821.3	253	467.9	136.3	331.6	1.31
4	467.9	261	423.2	77.7	345.5	1.33
5	423.2	263	420.7	70.3	350.4	1.33
6	420.7	261	417.7	69.8	347.9	1.33

BOND'S WORK INDEX FORMULA

$$Wi = 44.5 / (Pi^{.23} \times Gpb^{.82} \times (10/\sqrt{P} - 10/\sqrt{F}))$$

Pi = Sieve Size Tested	106 µm
Gbp = Net undersize produced per revolution of mill.	1.33 g.
P = 80% Passing size of test product.	74 µm
F = 80% Passing size of test feed.	2018 µm

WORK INDEX (Wi)

12.8 kw-hr/ton

14.1 kw-hr/tonne

NB: Gbp = Average of last 3 Net/Rev Cycles

TABLE IV-11B
BOND BALL SCREEN ANALYSIS
KM3174 Composite 11 - Cycle 6 Undersize

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
150 Mesh	106	0.00	100.0
170 Mesh	90	7.79	92.2
200 Mesh	75	11.38	80.8
270 Mesh	53	16.29	64.5
325 Mesh	45	7.17	57.4
400 Mesh	38	4.60	52.8
TOTAL		100.00	**

K80 =74µm

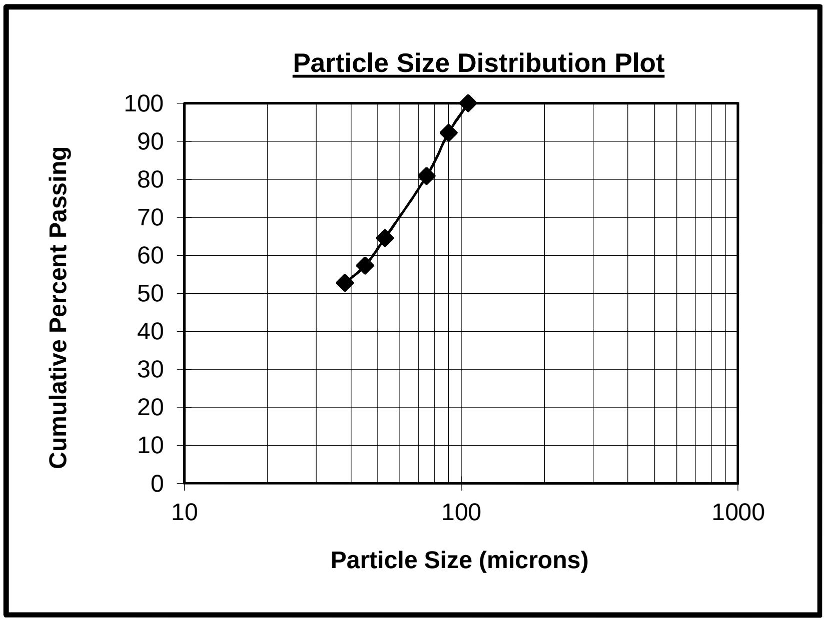


TABLE IV-11C
BOND BALL SCREEN ANALYSIS
KM3174 Composite 11 - Average Feed

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.59	99.4
7 Mesh	2800	2.78	96.6
8 Mesh	2360	8.50	88.1
9 Mesh	2000	8.57	79.6
10 Mesh	1700	6.70	72.9
12 Mesh	1400	7.88	65.0
14 Mesh	1180	5.20	59.8
20 Mesh	850	9.83	50.0
28 Mesh	600	8.57	41.4
35 Mesh	425	6.57	34.8
48 Mesh	300	6.18	28.6
65 Mesh	212	4.90	23.7
100 Mesh	150	3.99	19.7
150 Mesh	106	3.15	16.6
TOTAL		100.00	**

K80 =2018µm

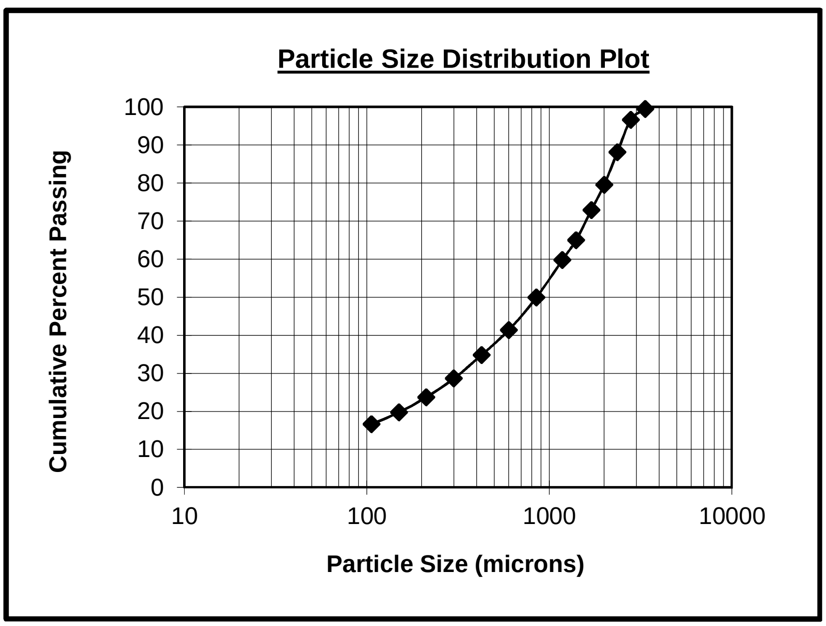


TABLE IV-11D
BOND BALL SCREEN ANALYSIS
KM3174 Composite 11 - Feed 1

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.60	99.4
7 Mesh	2800	2.35	97.1
8 Mesh	2360	8.33	88.7
9 Mesh	2000	8.78	79.9
10 Mesh	1700	6.39	73.6
12 Mesh	1400	7.78	65.8
14 Mesh	1180	4.94	60.8
20 Mesh	850	9.83	51.0
28 Mesh	600	8.58	42.4
35 Mesh	425	6.64	35.8
48 Mesh	300	6.29	29.5
65 Mesh	212	4.99	24.5
100 Mesh	150	4.09	20.4
150 Mesh	106	3.39	17.0
TOTAL		100.00	**

K80 =2002µm

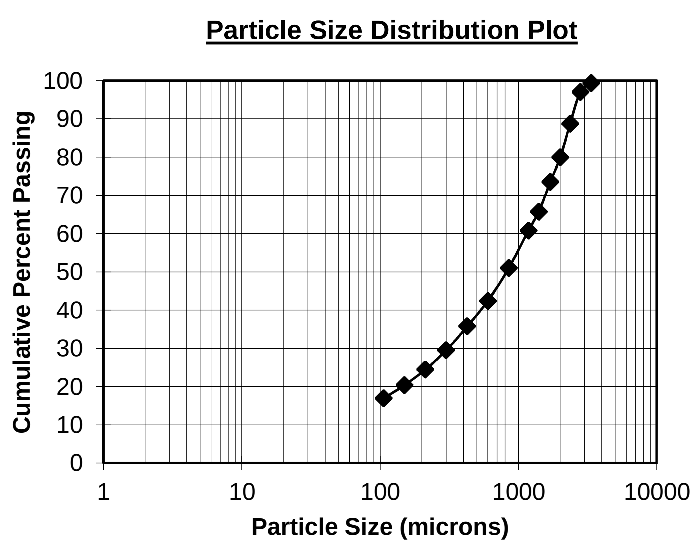
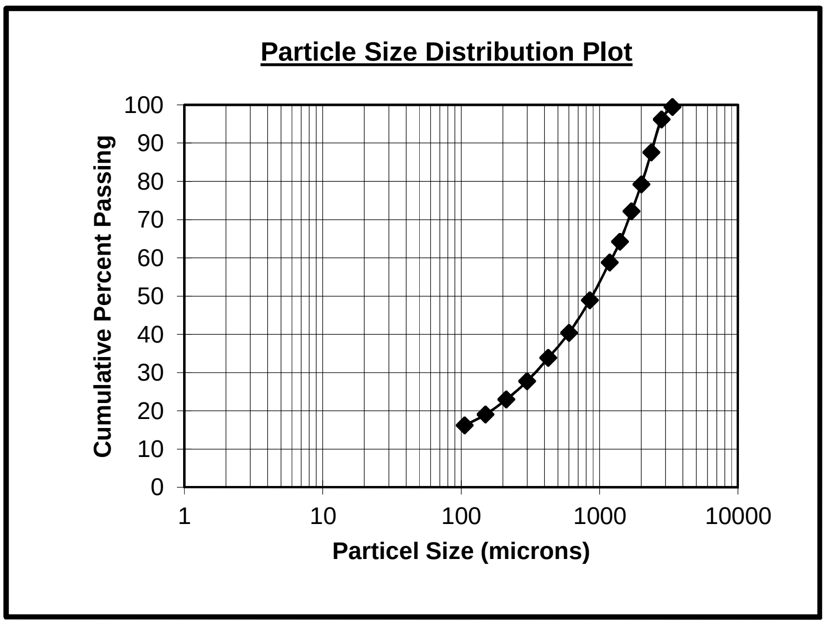


TABLE IV-11E
BOND BALL SCREEN ANALYSIS
KM3174 Composite 11 - Feed 2

Product	Particle Size µm	Weight % Retained	Cumulative % Passing
6 Mesh	3360	0.58	99.4
7 Mesh	2800	3.21	96.2
8 Mesh	2360	8.65	87.6
9 Mesh	2000	8.36	79.2
10 Mesh	1700	7.00	72.2
12 Mesh	1400	7.97	64.2
14 Mesh	1180	5.44	58.8
20 Mesh	850	9.82	49.0
28 Mesh	600	8.56	40.4
35 Mesh	425	6.51	33.9
48 Mesh	300	6.08	27.8
65 Mesh	212	4.81	23.0
100 Mesh	150	3.89	19.1
150 Mesh	106	2.92	16.2
TOTAL		100.00	**

K80 =2034µm



JKTech Pty Ltd

SMC TEST REPORT

Kerr

Prepared by: Tim Dam

JKTech Job No: 11017/P24
Date: Oct, 2011

JKTech Pty Ltd

SMC Test Report

on

Eleven Samples

from

Kerr Project

JKTech Job No. 11017/P24 - Oct, 2011

Submitted to

Kerr

Tested at G & T, Kamloops, BC, Canada

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1 INTRODUCTION

SMC data for eleven samples from Kerr Project were received from G & T on Oct, 2011, by JKTech for SMC test analysis. The samples were identified as Composite 1, Composite 2, Composite 3, Composite 4, Composite 5, Composite 6, Composite 7, Composite 8, Composite 9, Composite 10 & Composite 11. The data were analysed to determine the JKSimMet comminution parameters. SMC test results were forwarded to SMC Testing Pty Ltd for the analysis. Analysis and reporting were completed on October 28, 2011.

2 THE SMC TEST®

2.1 INTRODUCTION

The standard JKTech drop-weight test provides ore specific parameters for use in the JKSimMet Mineral Processing Simulator software. In JKSimMet, these parameters are combined with equipment details and operating conditions to analyse and/or predict SAG/autogenous mill performance. The same test procedure also provides ore type characterisation for the JKSimMet crusher model.

The SMC (SAG Mill Comminution) test was developed by Steve Morrell of SMC Testing Pty Ltd (SMCT) to provide a cost effective means of obtaining these parameters from drill core or in situations where limited quantities of material are available. The ore specific parameters have been calculated from the test results and are supplied to Kerr in this report as part of the standard procedure.

2.2 GENERAL DESCRIPTION AND TEST BACKGROUND

The SMC Test® was originally designed for the breakage characterisation of drill core and it generates a relationship between input energy (kWh/t) and the percent of broken product passing a specified sieve size. The results are used to determine the so-called drop-weight index (DWi), which is a measure of the strength of the rock when broken under impact conditions and has the units kWh/m^3. The DWi is directly related to the JK rock breakage parameters A and b and hence can be used to estimate the values of these parameters as well as being correlated with the JK abrasion parameter - t_a. For crusher modelling the t_{10}-E_{cs} matrix can also be derived. This is done by using the size-by-size A*b values that are used in the SMC Test® data analysis (see below) to estimate the t_{10}-E_{cs} values for each of the relevant size fractions in the crusher model matrix.

For power-based calculations, (see APPENDIX B), the SMC Test® provides the comminution parameters M_{ia}, M_{ih} and M_{ic}. M_{ia} is the work index for the grinding of coarser particles (> 750 µm) in tumbling mills such as autogenous (AG), semi-autogenous (SAG), rod and ball mills. M_{ih} is the work index for the grinding in High Pressure Grinding Rolls (HPGR) and M_{ic} for size reduction in conventional crushers.

The SMC Test® is a precision test, which uses particles that are either cut from drill core using a diamond saw to achieve close size replication or else selected from crushed material so that particle mass variation is controlled within a prescribed range. The particles are then broken at a number of prescribed impact energies. The high degree of control imposed on both the size of particles and the breakage energies used, means that the test is largely free of the repeatability problems associated with tumbling-mill based tests. Such tests usually suffer from variations in feed size (which is not closely controlled) and energy input, often assumed to be constant when in reality it can be highly variable (Levin, 1989).

The relationship between the DWi and the JK rock breakage parameters makes use of the size-by-size nature of rock strength that is often apparent from the results of full JK Drop-Weight tests. The effect is illustrated in Figure 1, which plots the normalized values of A*b against particle size. This figure also shows how the gradient of these plots varies across the full range of rock types tested. In the case of a conventional Drop-Weight test, these values are effectively averaged and a mean value of A and b is reported. The SMC Test® uses a single size and makes use of relationships such as that shown in Figure 1 to predict the A and b of the particle size that has the same value as the mean for a full drop-weight test.

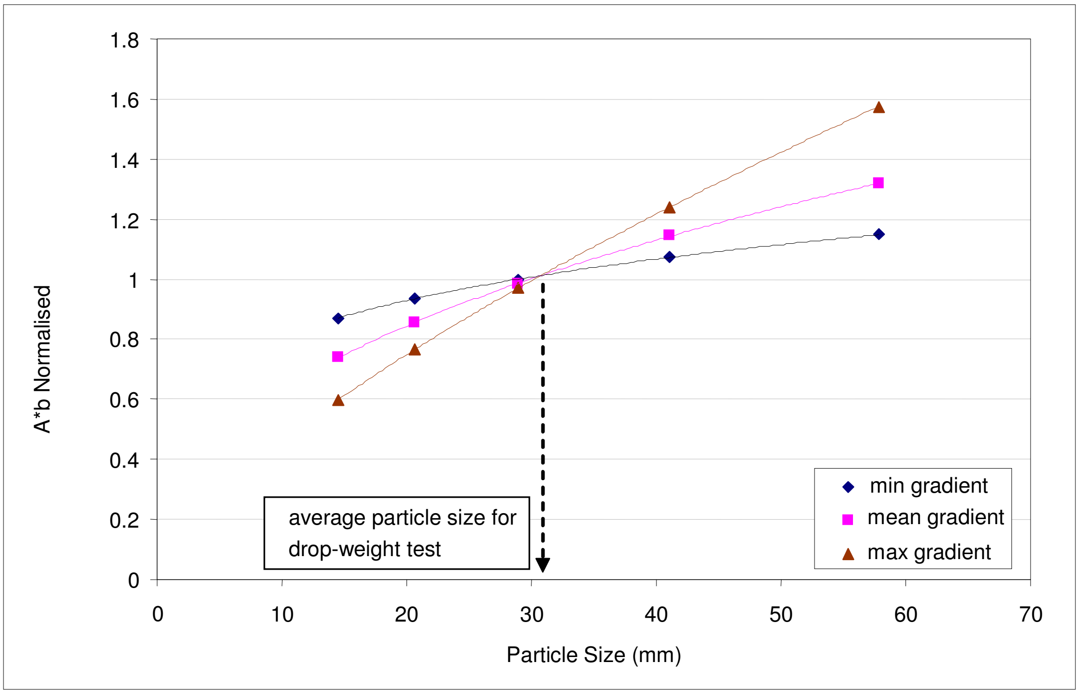

Figure 1 – Relationship between Particle Size and A*b

2.3 THE TEST PROCEDURE

In the SMC Test®, five sets of 20 particles are broken, each set at a different specific energy level, using a JK Drop-Weight tester. The breakage products are screened at a sieve size selected to provide a direct measurement of the t_{10} value.

The test calls for a prescribed target average volume for the particles, with the target being chosen to be equivalent to the mean volume of particles in one of the standard drop-weight test size fractions.

The rest height of the drop-head (gap) is recorded after breakage of each particle to allow for a correction to the drop energy. After breaking all 20 particles in a set, the broken product is sieved at an aperture size, one tenth of the original particle size. Thus, the percent passing mass gives a direct reading of the t_{10} value for breakage at that energy level.

There are two alternative methods of preparing the particle sets for breakage testing: the particle selection method and the cut core method. The particle selection method is the most commonly used as it is generally less time consuming. The cut core method requires less material, so tends to be used as a fallback method, only when necessary to cope with restricted sample availability.

2.3.1 Particle Selection Method

For the particle selection method, the test is carried out on material in one of three alternative size fractions: -31.5+26.5, -22.4+19 or -16+12.4 mm. The largest size fraction is preferred but requires more material. The middle size fraction tends to be most commonly used, whilst the finest size fraction tends only to be used if there is an issue with starting material size distribution or quantity.

In the particle selection method, particles are chosen so that their individual masses lie within ±30% of the target mass and the mean mass for each set of 20 lies within ±10% of the target mass. A typical set of particles is shown in Figure 2.

Figure 2 – A Typical Set of Particles for Breakage (Particle Selection Method)

Before commencing breakage tests on the particles, the ore density is determined by first weighing a representative sample of particles in air and then in water.

2.3.2 Cut Core Method

The cut core method uses cut pieces of quartered (slivered) drill core. Whole core or half core can be used, but when received in this form it needs to be first quartered as a preliminary step in the procedure. Once quartered, any broken or tapered ends of the quartered lengths are cut, to square them off. Before the lengths of quartered core are cut to produce the pieces for the drop-weight testing, each one is weighed in air and then in water, to obtain a density measurement and a measure of its mass per unit length.

The size fraction targeted when the cut core method is used depends on the original core diameter. The target size fraction is selected to ensure that pieces of the correct volume will have “chunky” rather than “slabby” proportions.

Having measured the density of the core, the target volume can be translated into a target mass and with the average mass per unit length also known, an average cutting interval can be determined for the core.

Sufficient pieces of the quartered core are cut to generate 100 particles. These are then divided into the five sets of 20 and broken in the drop-weight tester at the five different energy levels. Within each set, the three possible orientations of the particles are equally represented (as far as possible, given that there are 20 particles). The orientations prescribed for testing are shown in Figure 3.

Figure 3 – Orientations of Pieces for Breakage (Cut Core Method)

The cut core method cannot be used for cores with diameters exceeding 70 mm, where the particle masses would be too large to achieve the highest prescribed energy level.

2.4 SMC TEST® RESULTS

The SMC Test® results for samples Composite 1, Composite 2, Composite 3, Composite 4, Composite 5, Composite 6, Composite 7, Composite 8, Composite 9, Composite 10 & Composite 11 from Kerr Project are given in Table 1. This table includes the average rock density and the drop-weight index that is the direct result of the test procedure, plus the derived estimates of parameters A, b and t_a that are required for JKSimMet comminution modelling. The values determined for the M_{ia}, M_{ih} and M_{ic} parameters developed by SMCT are also presented in this table. The M_{ia} parameter represents the coarse particle component (down to 750 µm), of the overall comminution energy and can be used together with the M_{ib} (fine particle component) to estimate the total energy requirements of a conventional comminution circuit. The use of these parameters is explained further in APPENDIX B.

In the case of the Composite 1, Composite 2, Composite 3, Composite 4, Composite 5, Composite 6, Composite 7, Composite 8, Composite 9, Composite 10 &

Composite 11 samples from Kerr Project, the A and b estimates are based on a correlation using the database of all results so far accumulated by SMCT.

Table 1 - SMC Test® Results

Sample Designation	DWi kWh/m³	DWi %	Mia kWh/t	Mih kWh/t	Mic kWh/t	A	b	SG	t_a
Composite 1	5.12	42	15.2	10.6	5.5	59.8	0.91	2.79	0.51
Composite 2	4.83	38	14.4	10.0	5.2	57.3	1.01	2.81	0.54
Composite 3	6.21	57	17.8	12.9	6.7	68.8	0.65	2.79	0.42
Composite 4	5.96	54	16.9	12.2	6.3	60.0	0.79	2.83	0.43
Composite 5	4.61	35	14.2	9.7	5.0	66.2	0.90	2.75	0.56
Composite 6	5.86	52	16.9	12.2	6.3	55.3	0.86	2.79	0.44
Composite 7	5.23	43	15.4	10.9	5.6	53.2	1.00	2.79	0.50
Composite 8	6.58	62	19.0	14.0	7.2	63.2	0.66	2.73	0.39
Composite 9	7.17	69	19.9	14.9	7.7	57.7	0.67	2.79	0.36
Composite 10	6.25	58	17.3	12.6	6.5	56.9	0.81	2.87	0.41
Composite 11	6.11	56	17.0	12.4	6.4	65.3	0.72	2.86	0.42

Note: For more details on how the M_{ia}, M_{ih} and M_{ic} parameters are derived and used, see APPENDIX B or go to the JKTech website at http://www.jktech.com.au/index1.php?p=cms&CMSID=128&SectionID=46&MenuID=126 and click on the link to download Steve Morrell's paper on this subject.

The influence of particle size on the specific comminution energy needed to achieve a particular t_{10} value can also be inferred from the SMC Test® results. The energy requirements for three particle sizes, each crushed to three different t_{10} values, are presented in Table 2.

Table 2 – Energy Requirements Related to Particle Size

Sample Designation	Particle Size (mm)								
	14.5			28.9			57.8		
	t_{10} Values for Given Specific Energies (%)								
	10 kWh/t	20 kWh/t	30 kWh/t	10 kWh/t	20 kWh/t	30 kWh/t	10 kWh/t	20 kWh/t	30 kWh/t
Composite 1	0.26	0.57	0.95	0.20	0.42	0.67	0.15	0.31	0.48
Composite 2	0.25	0.54	0.89	0.19	0.39	0.63	0.14	0.29	0.46
Composite 3	0.32	0.70	1.15	0.24	0.51	0.82	0.18	0.38	0.59
Composite 4	0.30	0.66	1.09	0.23	0.48	0.77	0.17	0.35	0.56
Composite 5	0.24	0.53	0.87	0.18	0.38	0.61	0.14	0.28	0.44
Composite 6	0.30	0.66	1.09	0.23	0.48	0.77	0.17	0.35	0.56
Composite 7	0.27	0.59	0.97	0.20	0.43	0.69	0.15	0.32	0.49
Composite 8	0.35	0.76	1.25	0.26	0.55	0.88	0.19	0.41	0.64
Composite 9	0.37	0.81	1.33	0.28	0.59	0.94	0.21	0.43	0.68
Composite 10	0.31	0.68	1.13	0.23	0.50	0.80	0.18	0.37	0.58
Composite 11	0.31	0.67	1.10	0.23	0.49	0.78	0.17	0.36	0.56

The SMC Test® database now contains over 11,000 test results on samples representing more than 600 different deposits worldwide.

Around 99% of the DWi values lie in the range 0.5 to14.0 kWh/m^3, with soft ores being at the low end of this range and hard ores at the high end.

A cumulative graph of DWi values from the SMC Test® Database is shown in Figure 4 below. This graph can be used to compare the DWi of the material from Kerr Project, with the entire population of ores in the SMCT database. The figures on the y-axis of the graph represent the percentages of all ores tested that are softer than the x-axis (DWi) value selected.

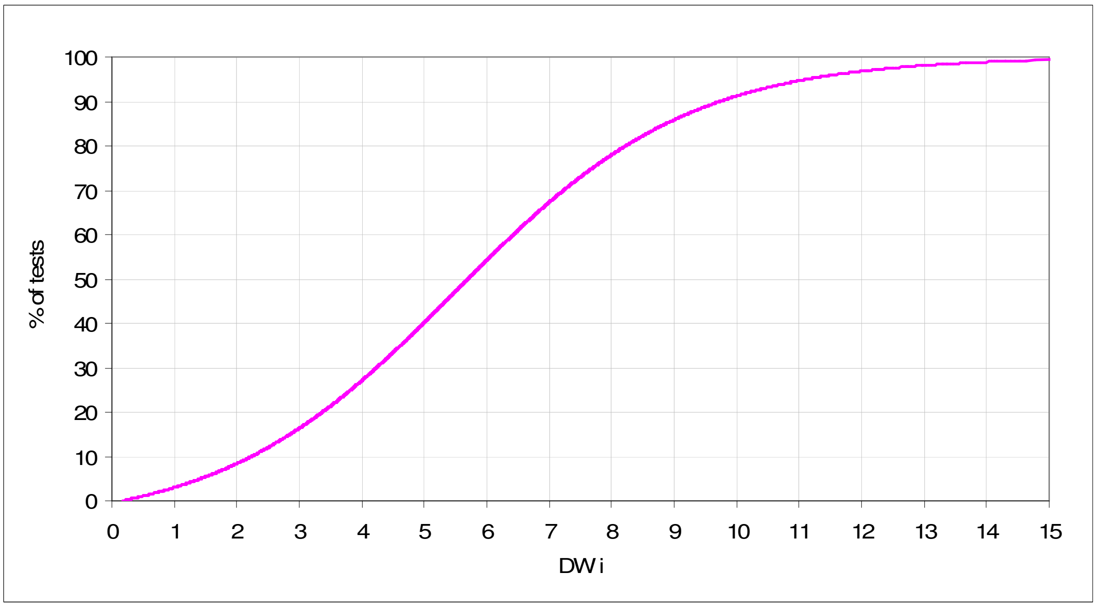

Figure 4 – Cumulative Distribution of DWi Values in SMC Test® Database

A further cumulative distribution graph is provided in Figure 5 to allow a comparison of the M_{ia}, M_{ih} and M_{ic} values obtained for the Kerr Project material, with the entire population of values for these parameters contained in the SMCT database.

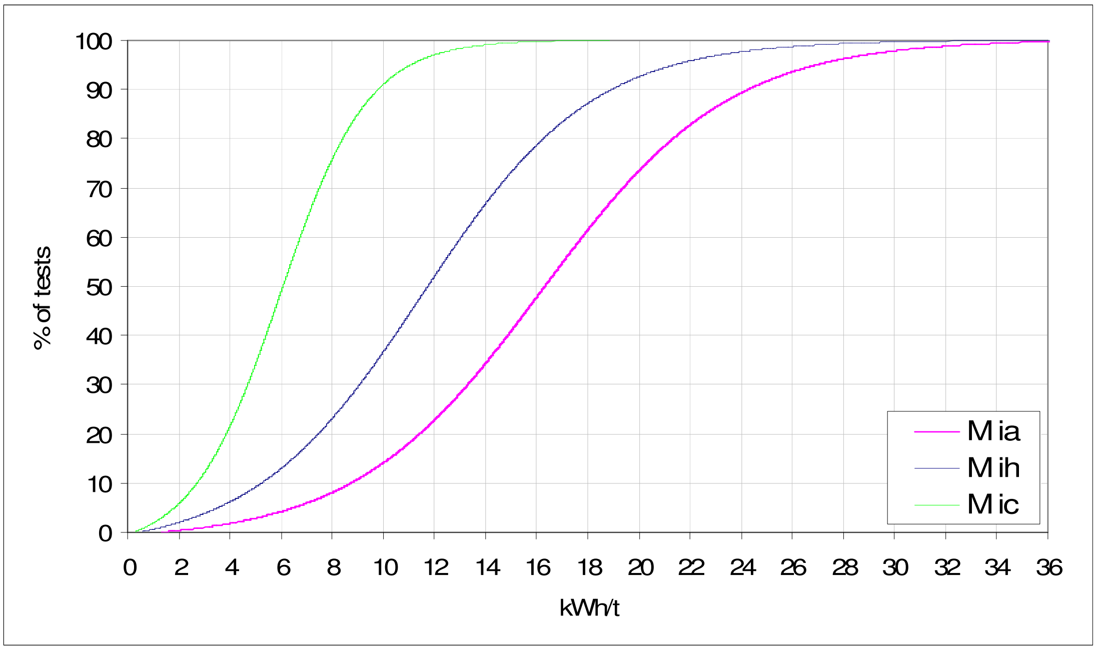

Figure 5 - Cumulative Distribution of M_{ia}, M_{ih} and M_{ic} Values in the SMCT Database

The value of A*b, which is also a measure of resistance to impact breakage, is calculated and presented in Table 3 along with indicators of how each A*b value compares with the accumulated values in the JKTech DW database (from full drop-weight testing). These indicators are the Category (eg "soft" etc), the Rank (how many out of 3,480 recordings in database are harder) and the percent of database values that are harder. Note that in contrast to the DWi, a high value of A*b means that an ore is soft whilst a low value means that it is hard.

Table 3 – Derived Values for A*b and t10 at 1 kWh/t

Sample Designation	A*b				t10 @ 1 kWh/t			
	Value	Category	Rank	%	Value	Category	Rank	%
Composite 1	54.4	moderately soft	2082	60.2%	35.7	moderately soft	2132	61.7%
Composite 2	57.9	moderately soft	2219	64.2%	36.4	moderately soft	2220	64.2%
Composite 3	44.7	medium	1588	45.9%	32.9	medium	1800	52.1%
Composite 4	47.4	medium	1751	50.6%	32.8	medium	1789	51.7%
Composite 5	59.6	moderately soft	2280	65.9%	39.3	soft	2487	71.9%
Composite 6	47.6	medium	1758	50.8%	31.9	medium	1663	48.1%
Composite 7	53.2	medium	2021	58.4%	33.6	medium	1886	54.5%
Composite 8	41.7	medium	1397	40.4%	30.5	medium	1488	43.0%
Composite 9	38.7	moderately hard	1164	33.7%	28.2	moderately hard	1128	32.6%
Composite 10	46.1	medium	1679	48.6%	31.6	medium	1619	46.8%
Composite 11	47.0	medium	1725	49.9%	33.5	medium	1871	54.1%

The calculated value of t_{10} at an E_{cs} of 1 kWh/t is also shown in Table 3. This is again accompanied by Category, Rank and the % of values in the database that are harder, so each can be seen against the yard-stick of all other samples in the JKTech database.

The derived A*b values range from 38.7 to 59.6 giving an average of 48.9, while the t_{10} at 1 kWh/t values ranged from 28.2 to 39.3 giving an average of 33.3.

In Figure 6 and Figure 7 below, histogram style frequency distributions for the A*b values and for the t_{10} at 1 kWh/t values in the JKTech DW database are shown respectively.

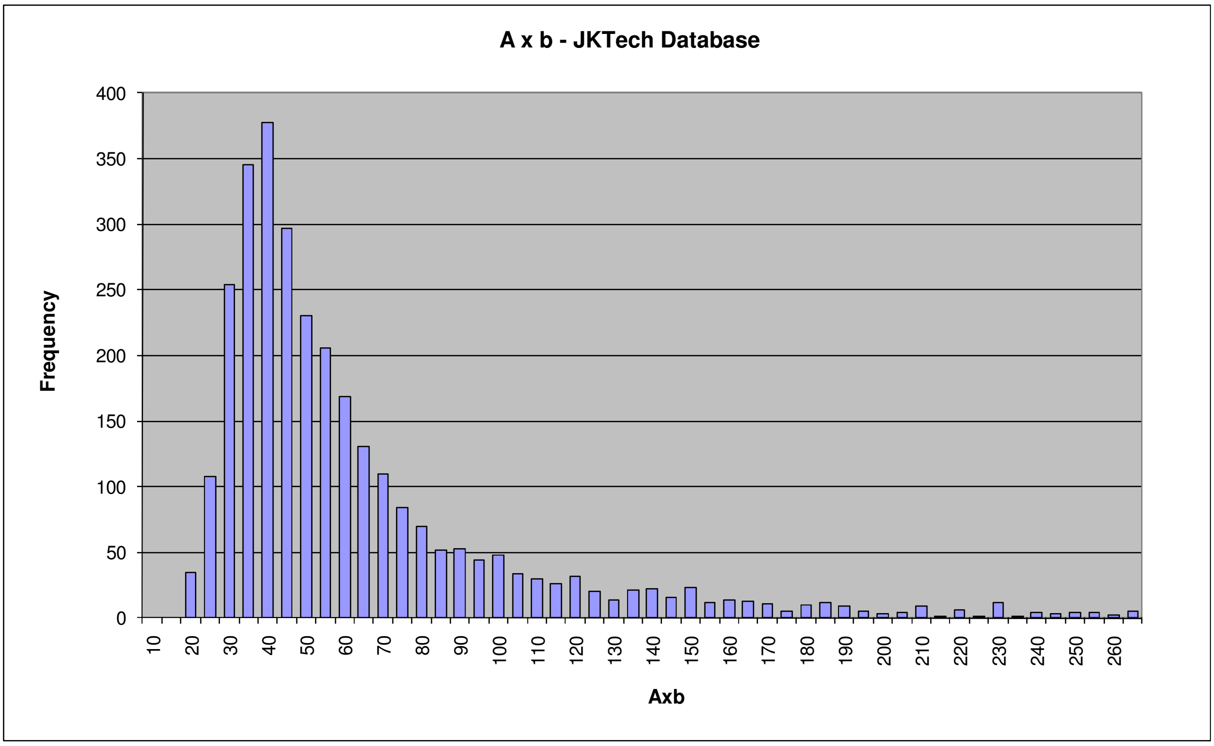

Figure 6 - Frequency Distribution of A*b in the JKTech Database

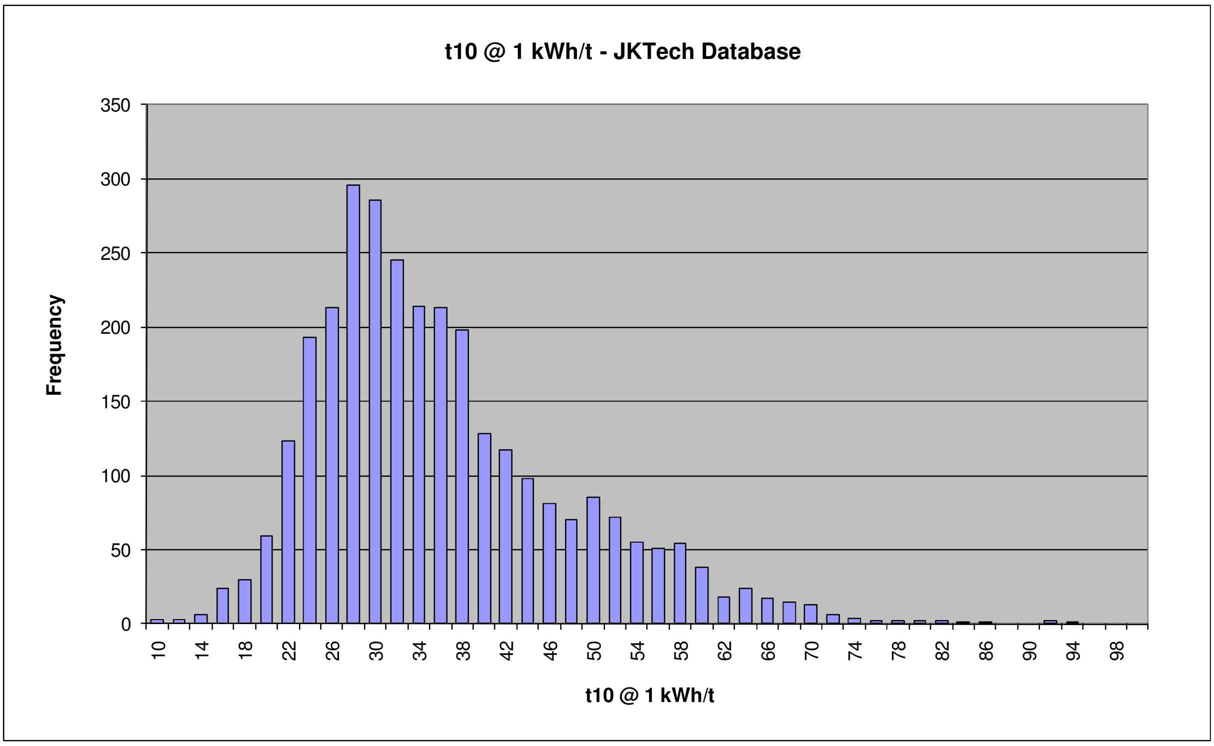

Figure 7 - Frequency Distribution of t_{10}@1kWh/t in the JKTech Database

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Extent of Warranty by JKTech

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APPENDICES

APPENDIX A. BACKGROUND TO THE SMC TEST®

A 1 HOW THE SMC TEST® RESULTS ARE USED

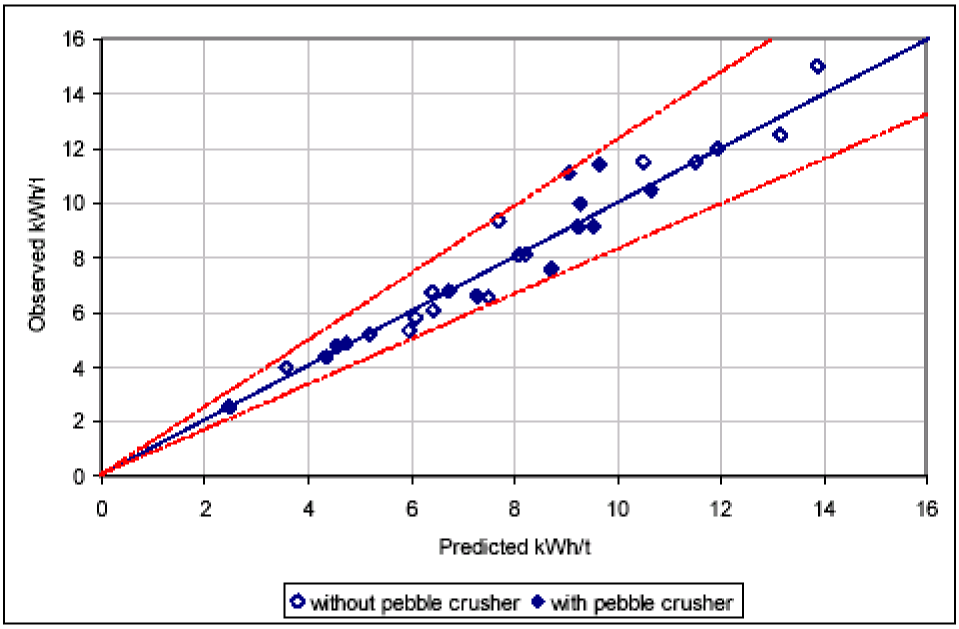
The SMC Test® generates a relationship between specific input energy (kWh/t) and the percent of broken product passing a specified sieve size. The results are used to determine the drop-weight index (DWi), which is a measure of the strength of the rock when broken under impact conditions. The DWi is directly related to the JK rock breakage parameters A and b and hence can be used to estimate the values of these parameters.

Provision of a relatively low cost method of estimating the A and b parameters opens the possibility of incorporating these data into mine and mill planning operations. However a number of full drop-weight tests is still recommended for any particular orebody, to ensure that an accurate correlation between the DWi and the A and b parameters is available. The number of full drop-weight tests required for a given orebody will depend on its variability and should at least cover the major recognised ore types.

The A and b parameters are used in AG/SAG mill models, such as those in JKSimMet, for predicting how the rock will break inside the mill. From this description the models can predict what the throughput, power draw and product size distribution will be (Napier-Munn et al (1996)). Modelling also enables a detailed flowsheet to be built up of the comminution circuit response to changes in ore type. It also allows optimisation strategies to be developed to overcome any deleterious changes in circuit performance predicted from differences in ore type when such changes are indicated by the SMC Test®. These strategies can include both changes to how mills are operated (eg ball load, speed etc) and changes to feed size distribution through modification of blasting practices and primary crusher operation (mine-to-mill).

The mine to mill models require information on rock mass competence such as provided by the point load index. The DWi is correlated with the point load index and hence can also be used in blast fragmentation modelling where direct measurements of point load index are not available.

The DWi is related to the resistance of a rock to breakage under impact. SMCT has developed a series of equations that relate the DWi to the specific energy (kWh/t) requirements of complete AG and SAG mill circuits. These equations take into consideration factors such as ball charge, feed size, aspect ratio, whether the mill is operated with or without a pebble crusher and whether it is closed with a fine classifier such as a cyclone. The ability of these equations to predict AG/SAG mill circuit specific energy is illustrated in App Figure 1. The data shown cover 19 different operations and include Cu, Au, Ni and Pb/Zn ores.



App Figure 1 - Mill Power Prediction Based on DWi

It should be noted that the parameter ta, which is the parameter representing the low energy abrasion component of breakage, is not yielded by the SMC Test®. This parameter is derived from a tumbling test that is carried out as part of the full drop-weight test. The fact that it is also required as an input to the JKSimMet SAG/AG models provides a further reason for ensuring that some full drop-weight tests are also performed to represent at least the main rock types of an orebody.

A 2 IMPACT COMMINUTION THEORY

When a rock fragment is broken, the degree of breakage can be characterised by the "t10" parameter. The t10 value is the percentage of the original rock mass that passes a screen aperture one tenth of the original rock fragment size. This parameter allows the degree of breakage to be compared across different starting sizes.

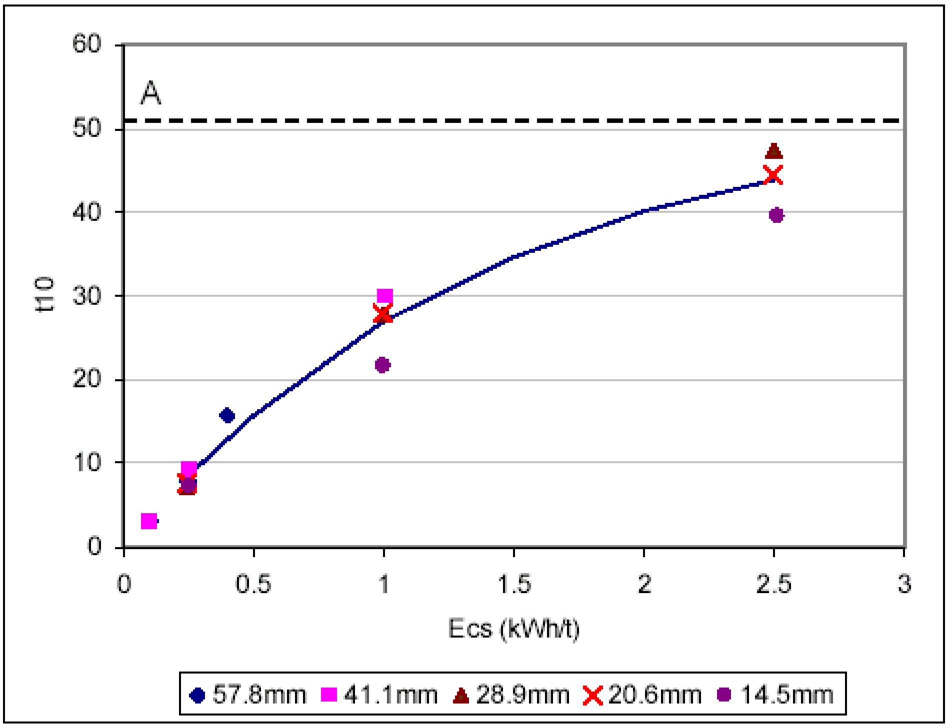
The specific comminution energy (Ecs) has the units kWh/t and is the energy applied during impact breakage. As the impact energy is varied, so does the t10 value vary in response. Higher impact energies produce higher values of t10, which of course means products with finer size distributions.

The equation describing the relationship between the t10 and Ecs is given below.

$t_{10} = A (1 - e^{-b.Ecs})$

As can be seen from this equation, there are two rock breakage parameters A and b that relate the t10 (size distribution index) to the applied specific energy (Ecs). These parameters are ore specific and are normally determined from a full drop-weight test.

A typical plot of t10 vs Ecs from a drop-weight test is shown in App Figure 2. The relationship is characterised by the two-parameter equation above, where t10 is the dependent variable.

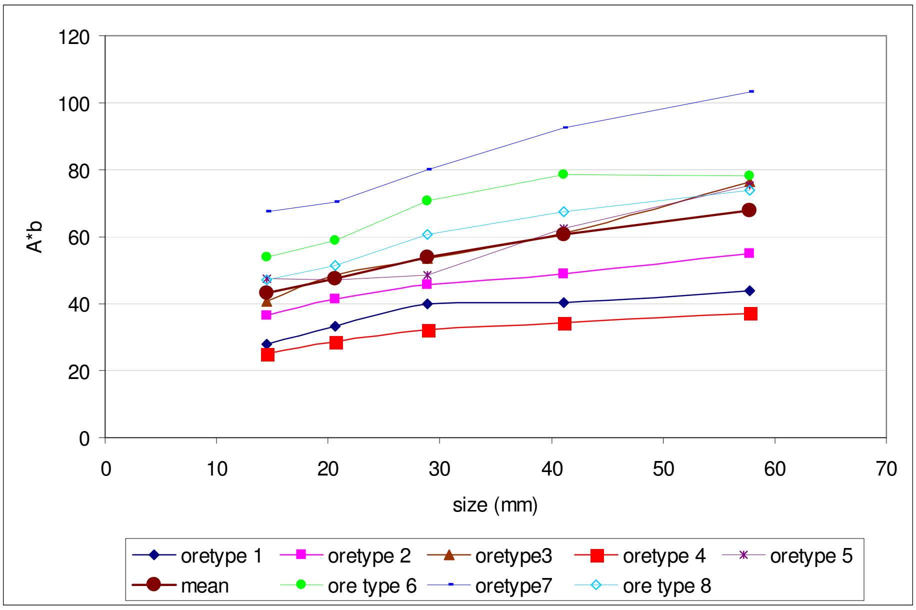


App Figure 2 - Typical t_{10} v Ecs Plot

The t10 can be thought of as a “fineness index” with larger values of t10 indicating a finer product size distribution. The value of parameter A is the limiting value of t10. This limit indicates that at higher energies, little additional size reduction occurs as the Ecs is increased beyond a certain value. A*b is the slope of the curve at ‘zero’ input energy and is generally regarded as an indication of the strength of the rock, lower values indicating a higher strength.

The A and b parameters can also be used with equation 1 to generate a table of Ecs values, given a range of t10 values. Such a table is used in crusher modelling to predict the power requirement of the crusher given a feed and a product size specification.

The DWi can be used to estimate the JK rock breakage parameters A and b by utilizing the fact that there is usually a pronounced (and ore specific) trend to decreasing rock strength with increasing particle size. This trend is illustrated in App Figure 3 which shows a plot of A*b versus particle size for a number of different rock types.

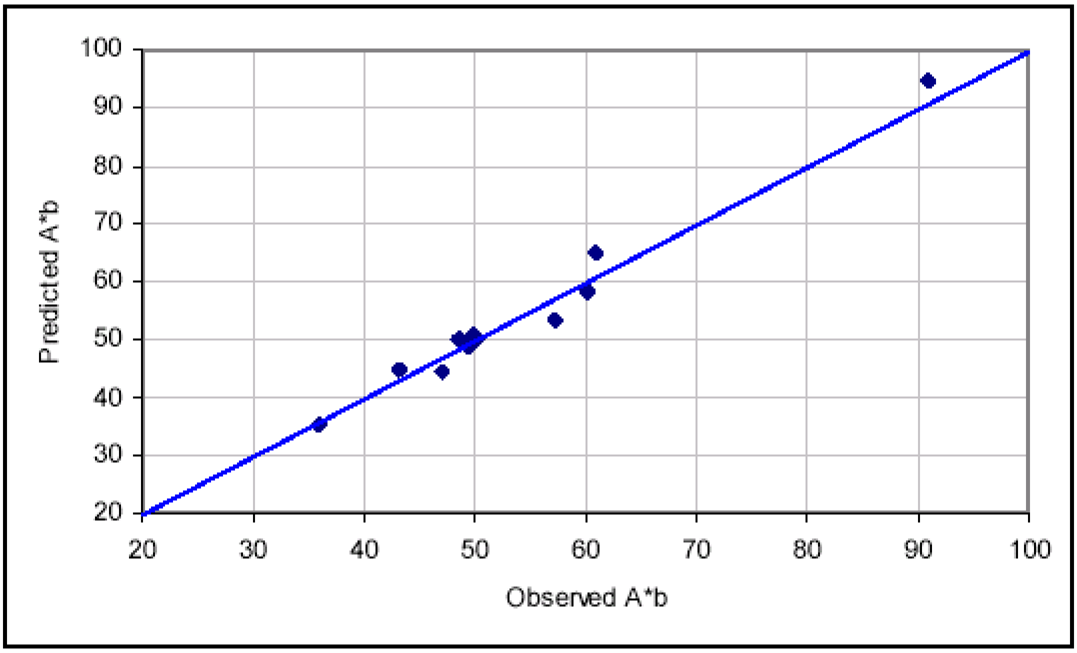


App Figure 3 - Size Dependence of A*b for a Range of Ore Types

In the case of a conventional drop-weight test these values are effectively averaged and a mean value of A and b is reported. The SMC Test® uses a single size and makes use of relationships such as that shown in App Figure 3 to predict the A and b of the particle size that has the same value as the mean for a full drop-weight test.

An example of this is illustrated in App Figure 4 - Predicted v Observed A*b

where the observed values of the product A*b are plotted against those predicted using the DWi. Each of the data points in App Figure 4 is a result from a different ore type within an orebody.



App Figure 4 - Predicted v Observed A*b

APPENDIX B. USE OF THE Mia, Mib, Mih, Mic IN PREDICTING COMMINUTION CIRCUIT SPECIFIC ENERGY

B 1 INTRODUCTION

The following technical note describes the recently extended use of the SMC Test® to include crushers and HPGRs in determining the overall specific energy demand of comminution circuits. It builds on previous work which included tumbling mills only and should be read in conjunction with an earlier technical note dated September 2007 entitled "*Use of the SMC Test® in Predicting Total Comminution Circuit Specific Energy"* as well as published papers: Morrell, 2008a, 2008b. This enhancement now enables the SMC Test® to be used in conjunction with the Bond ball work index test to predict the specific energy of comminution circuits where such circuits include combinations of any of the following equipment:

- AG and SAG mills
- Ball mills
- Rod mills
- Crushers
- High pressure Grinding Rolls (HPGR)

B 2 EQUATIONS

B 2.1 General

The approach divides comminution equipment into three categories:

- Tumbling mills, eg AG, SAG, rod and ball mills
- Conventional reciprocating crushers, eg jaw, gyratory and cone
- HPGRs

Tumbling mills are described using 2 indices: M_{ia} and M_{ib}

Crushers have one index: M_{ic}

HPGRs have one index: M_{ih}

For tumbling mills the 2 indices relate to "coarse" and "fine" ore properties plus an efficiency factor which represents the influence of a pebble crusher in AG/SAG mill circuits. "Coarse" in this case is defined as spanning the size range from a P_{80} of 750 µm up to the P_{80} of the product of the last stage of crushing or HPGR size reduction prior to grinding. "Fine" covers the size range from a P_{80} of 750 µm down to P_{80} sizes typically reached by conventional ball milling, ie about 45 µm. The choice of 750 µm as the division between "coarse" and "fine" particle sizes was determined during the development of the technique and was found to give the best overall results across the range of plants in SMCT's database. Implicit in the approach is that distributions are parallel and linear in log-log space.

The work index covering grinding in tumbling mills of coarse sizes is labelled M_{ia}. The work index covering grinding of fine particles is labelled M_{ib}. M_{ia} values are provided as a standard output from a SMC Test® (Morrell, 2004[a]) whilst M_{ib} values can be determined using the data generated by a conventional Bond ball mill work index test (M_{ib} is NOT the Bond ball work index). M_{ic} and M_{ih} values are also provided as a standard output from a SMC Test®.

The general size reduction equation is as follows (Morrell, 2004[b]):

$$W_i = M_i 4\left(x_2^{f(x_2)} - x_1^{f(x_1)}\right) \qquad (1)$$

Where:

M_i = Work index related to the breakage property of an ore (kWh/tonne). For grinding from the product of the final stage of crushing to a P_{80} of 750 µm (coarse particles) the index is labelled M_{ia} and for size reduction from 750 µm to the final product P_{80} normally reached by conventional ball mills (fine particles) it is labelled M_{ib}. For conventional crushing M_{ic} is used and for HPGRs M_{ih} is used.

W_i = Specific comminution (kWh/tonne)

x_2 = 80% passing size for the product (µm)

x_1 = 80% passing size for the feed (µm)

$f(x_j)$ = $-(0.295 + x_j/1000000)$ (Morrell, 2006) (2)

For tumbling mills the specific comminution energy (Wi) relates to the power at the pinion or for gearless drives - the motor output. For HPGRs it is the energy inputted to the rolls, whilst for conventional crushers Wi relates to the specific energy as determined using the motor input power less the no-load power.

B 2.2 Specific Energy Determination for Comminution Circuits

The total specific energy (W_T) to reduce in size primary crusher product to final product is given by:

$$W_T = W_a + W_b + W_c + W_h + W_s \qquad (3)$$

Where:

W_a = specific energy to grind coarser particles in tumbling mills

W_b = specific energy to grind finer particles in tumbling mills

W_c = specific energy for conventional crushing

W_h = specific energy for HPGRs

W_s = specific energy correction for size distribution

Clearly only the *W* values associated with the relevant equipment in the circuit being studied are included in equation 3.

B 2.2.1 Tumbling mills

For coarse particle grinding in tumbling mills equation 1 is written as:

$$W_a = K_1 M_{ia} 4\left(x_2^{f(x_2)} - x_1^{f(x_1)}\right) \qquad (4)$$

Where:

K_1 = 1.0 for all circuits that do not contain a recycle pebble crusher and 0.95 where circuits do have a pebble crusher

x_1 = P_{80} (µm) of the product of the last stage of crushing before grinding

x_2 = 750 µm

M_{ia} = Coarse ore work index and is provided directly by SMC Test®

For fine particle grinding equation 1 is written as:

$$W_b = M_{ib} 4\left(x_3^{f(x_3)} - x_2^{f(x_2)}\right) \qquad (5)$$

Where:

x_2 = 750 µm

x_3 = P_{80} (µm) of final grind

M_{ib} = Provided by data from the standard Bond ball work index test using the following equation (Morrell, 2006):

$$M_{ib} = \frac{18.18}{P_1^{0.295}(Gbp)\left(p_{80}^{f(p_{80})} - f_{80}^{f(f_{80})}\right)} \qquad (6)$$

Where:

M_{ib} = fine ore work index (kWh/tonne)

P_1 = closing screen size (µm)

Gbp = net grams of screen undersize per mill revolution

p_{80} = 80% passing size of the product (µm)

f_{80} = 80% passing size of the feed (µm)

Note that the Bond ball work index test should be carried out with a closing screen size chosen to give a final product P_{80} similar to that intended for the full-scale circuit.

B 2.2.2 Conventional Crushers

Equation 1 for conventional crushers is written as:

$$W_c = K_2 M_{ic} 4\left(x_2^{f(x_2)} - x_1^{f(x_1)}\right) \qquad (7)$$

K_2 = 1.0 for all crushers operating in closed circuit with a classifying screen. If the crusher is in open circuit, eg pebble crusher in a AG/SAG circuit, K2 takes the value of 1.19.

x_1 = P_{80} (µm) of the circuit feed

x_2 = P_{80} (µm) of the circuit product

M_{ic} = Crushing ore work index and is provided directly by SMC Test®

B 2.2.3 HPGR

Equation 1 for conventional crushers is written as:

$$W_h = K_3 M_{ih} 4\left(x_2^{f(x_2)} - x_1^{f(x_1)}\right) \qquad (8)$$

K_3 = 1.0 for all HPGRs operating in closed circuit with a classifying screen. If the HPGR is in open circuit, K3 takes the value of 1.19.

x_1 = P_{80} (µm) of the circuit feed

x_2 = P_{80} (µm) of the circuit product

M_{ih} = HPGR ore work index and is provided directly by SMC Test®

B 2.2.4 Specific Energy Correction for Size Distribution (Ws)

Implicit in the approach described in this paper is that the feed and product size distributions are parallel and linear in log-log space. Where they are not, allowances (corrections) need to be made. By and large, such corrections are most likely to be necessary (or are large enough to be warranted) when evaluating circuits in which closed circuit secondary/tertiary crushing is followed by ball milling. This is because such crushing circuits tend to produce a product size distribution which is relatively steep when compared to the ball mill circuit cyclone overflow. This is illustrated in App Figure 5, which shows measured distributions from an open and closed crusher circuit as well as a ball mill cyclone overflow. The closed circuit crusher distribution can be seen to be relatively steep compared with the open circuit crusher distribution and ball mill cyclone overflow. Also the open circuit distribution more closely follows the gradient of the cyclone overflow. If a ball mill circuit were to be fed 2 distributions, each with same P_{80} but with the open and closed circuit gradients in App Figure 5, the closed circuit distribution would require more energy to grind to the final P_{80}. How much more energy is required is difficult to determine. However, for the purposes of this approach it has been assumed that the additional specific energy for ball milling is the same as the difference in specific energy between open and closed crushing to reach the nominated ball mill feed size. This assumes that a crusher would provide this energy. However, in this situation the ball mill has to supply this energy and it has a different (higher) work index than the crusher (ie the ball mill is less energy efficient than a crusher and has to input more energy to do the same amount of size reduction). Hence from equation 7, to crush to the ball mill circuit feed size (x_2) in open circuit requires specific energy equivalent to:

$$W_c = 1.19 * M_{ic} 4\left(x_2^{\,f(x_2)} - x_1^{\,f(x_1)}\right) \tag{9}$$

For closed circuit crushing the specific energy is:

$$W_c = 1 * M_{ic} 4\left(x_2^{\,f(x_2)} - x_1^{\,f(x_1)}\right) \tag{10}$$

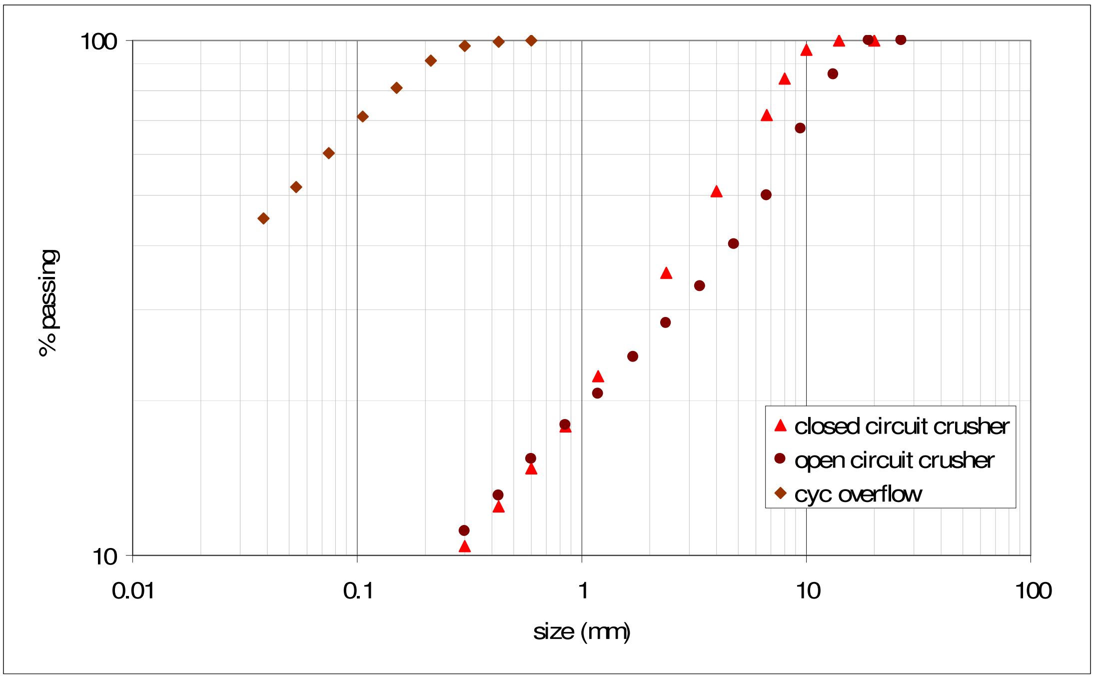
The difference between the two (eq 9 – eq 10) has to be provided by the milling circuit with an allowance for the fact that the ball mill, with its lower energy efficiency, has to provide it and not the crusher. This is what is referred to in equation 3 as W_s and for the above example is therefore represented by:

$$W_s = 0.19 * M_{ia} 4\left(x_2^{\,f(x_2)} - x_1^{\,f(x_1)}\right) \tag{11}$$

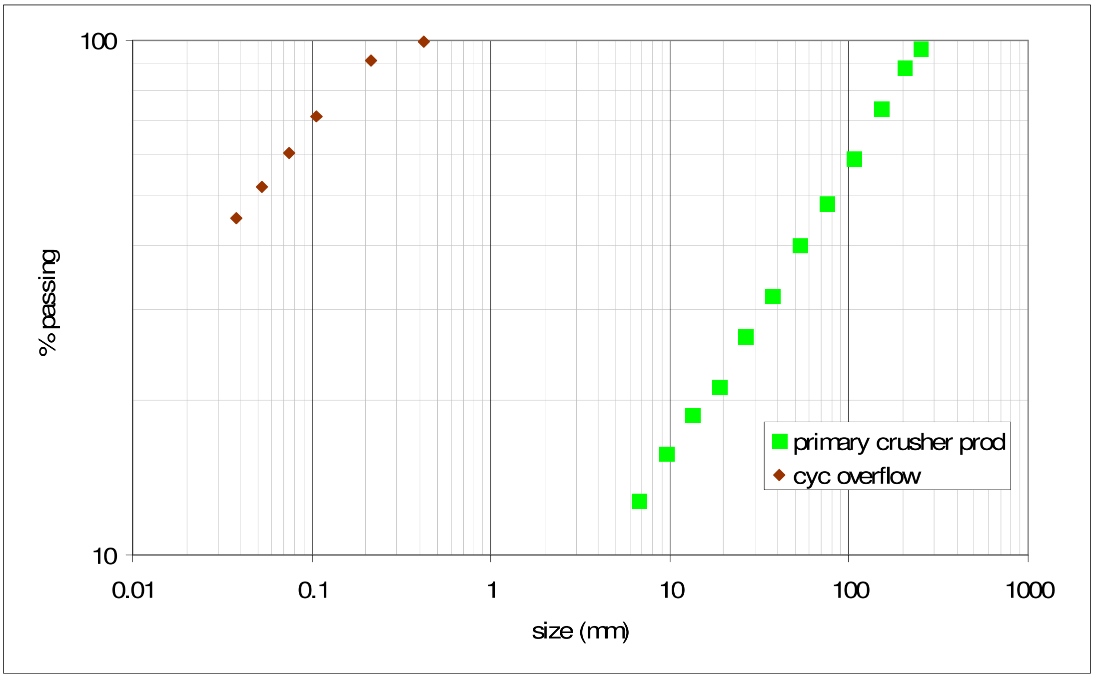
Note that in equation 11 M_{ic} has been replaced with M_{ia}, the coarse particle tumbling mill grinding work index.

In AG/SAG based circuits the need for W_s appears to be unnecessary as App Figure 6 illustrates. Primary crusher feeds often have the shape shown in App Figure 6 and this has a very similar gradient to typical ball mill cyclone overflows. A similar situation appears to apply with HPGR product size distributions, as illustrated in App Figure 7. Interestingly SMCT's data show that for HPGRs, closed circuit operation appears to require a lower specific energy to reach the same P_{80} as in open circuit, even though the distributions for open and closed circuit look to have almost identical gradients. Closer examination of the distributions in fact shows that in closed circuit the final product tends to have slightly less very fine material, which may account for the different energy requirements between the two modes of operation. It is also possible that recycled material in closed circuit is inherently weaker than new feed, as it has already passed through the HPGR previously and may have sustained micro-cracking. A reduction in the Bond ball mill work index as measured by testing HPGR products compared it to the Bond ball mill work index of HPGR feed has been noticed in many cases in the laboratory (see next section) and hence there is no reason to expect the same phenomenon would not affect the recycled HPGR screen oversize.

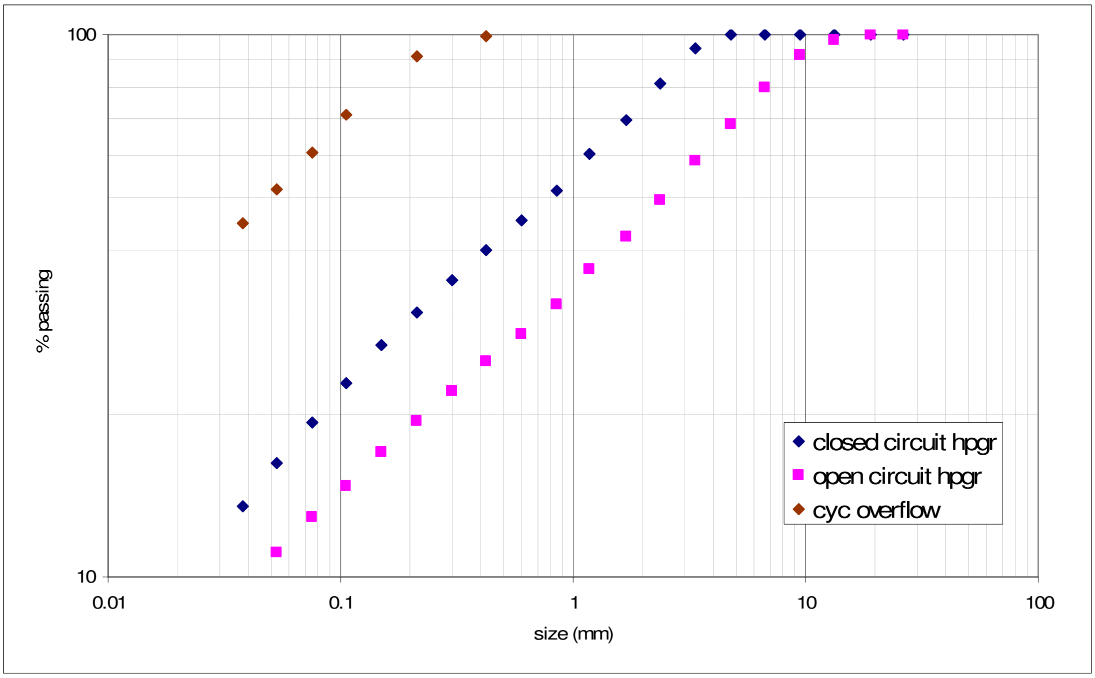
It follows from the above arguments that in HPGR circuits, which are typically fed with material from closed circuit secondary crushers, a similar feed size distribution correction should also be applied. However, as the secondary crushing circuit uses such a relatively small amount of energy compared to the rest of the circuit (as it crushes to a relatively coarse size) the magnitude of size distribution correction is very small indeed – much smaller than the error associated with the technique - and hence may be omitted in calculations.



App Figure 5 – Examples of Open and Closed Circuit Crushing Distributions Compared with a Typical Ball Mill Cyclone Overflow Distribution



App Figure 6 – Example of a Typical Primary Crusher (Open and Circuit) Product Distribution Compared with a Typical Ball Mill Cyclone Overflow Distribution



App Figure 7 – Examples of Open and Closed Circuit HPGR Distributions Compared with a Typical Ball Mill Cyclone Overflow Distribution

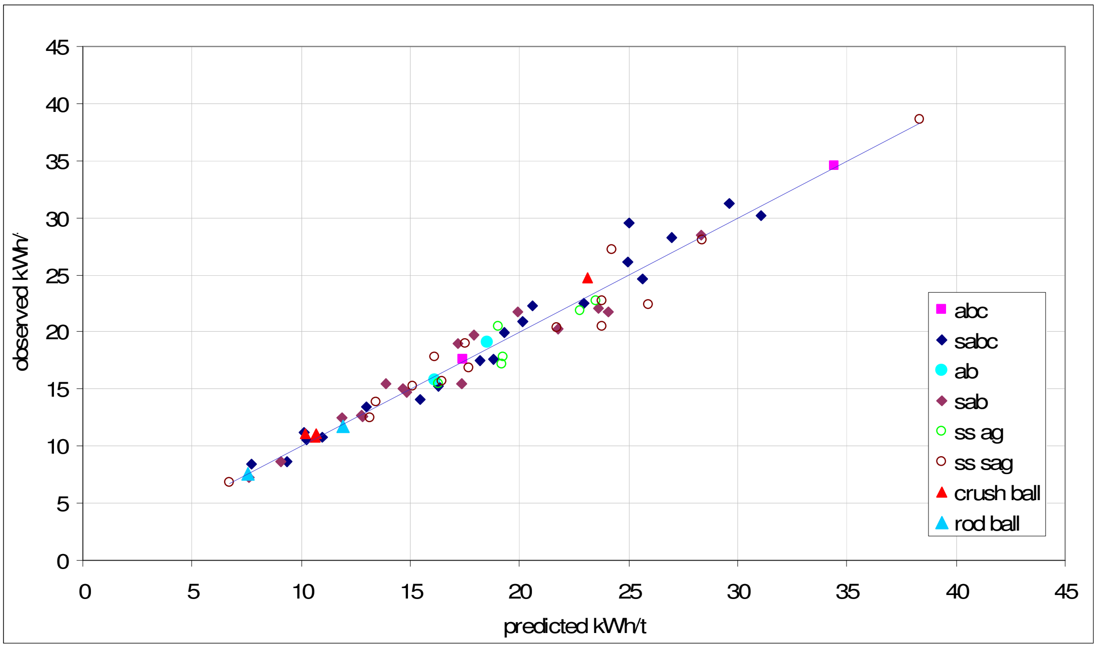
B 2.2.5 Weakening of HPGR Products

As mentioned in the previous section, laboratory experiments have been reported by various researchers in which the Bond ball work index of HPGR products is less than that of the feed. The amount of this reduction appears to vary with both material type and the pressing force used. Observed reductions in the Bond ball work index have typically been in the range 0-10%. In the approach described in this paper no allowance has been made for such weakening. However, if HPGR products are available which can be used to conduct Bond ball work index tests on then M_{ib} values obtained from such tests can be used in equation 5. Alternatively the M_{ib} values from Bond ball mill work index tests on HPGR feed material can be reduced by an amount that the user thinks is appropriate. Until more data become available from full scale HPGR/ball mill circuits it is suggested that, in the absence of Bond ball mill work index data on HPGR products, the M_{ib} results from HPGR feed material are reduced by no more than 5% to allow for the effects of micro-cracking.

B 3 VALIDATION

B 3.1 Tumbling Mill Circuits

The approach described in the previous section was applied to 65 industrial data sets. The results are shown in App Figure 8. In all cases, the specific energy relates to the tumbling mills contributing to size reduction from the product of the final stage of crushing to the final grind. Data are presented in terms of equivalent specific energy at the pinion. In determining what these values were on each of the plants in the data base it was assumed that power at the pinion was 93.5% of the measured gross (motor input) power, this figure being typical of what is normally accepted as being reasonable to represent losses across the motor and gearbox. For gearless drives (so-called wrap-around motors) a figure of 97% was used.



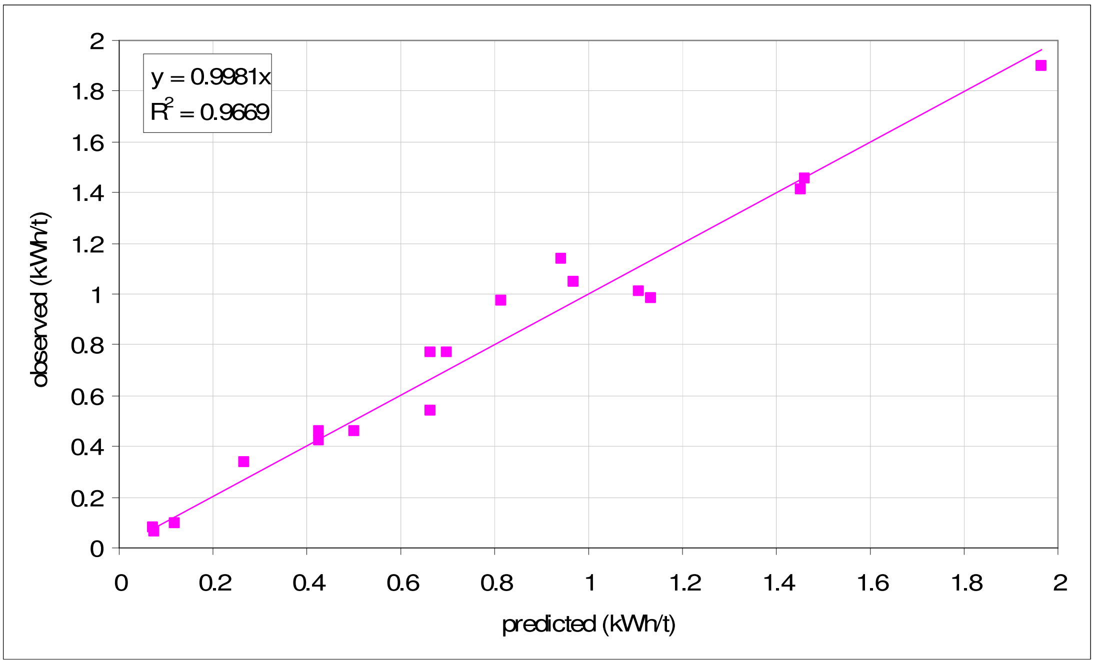
App Figure 8 – Observed vs Predicted Tumbling Mill Specific Energy

B 3.2 Conventional Crushers

Validation of equation 1 used 10 different crushing circuits (18 data sets), including secondary, tertiary and pebble crushers in AG/SAG circuits. Observed vs predicted specific energies are given in App Figure 9. The observed specific energies were calculated from the crusher throughput and the net power draw of the crusher as defined by:

$$\text{Net Power} = \text{Motor Input Power} - \text{No Load Power} \qquad (12)$$

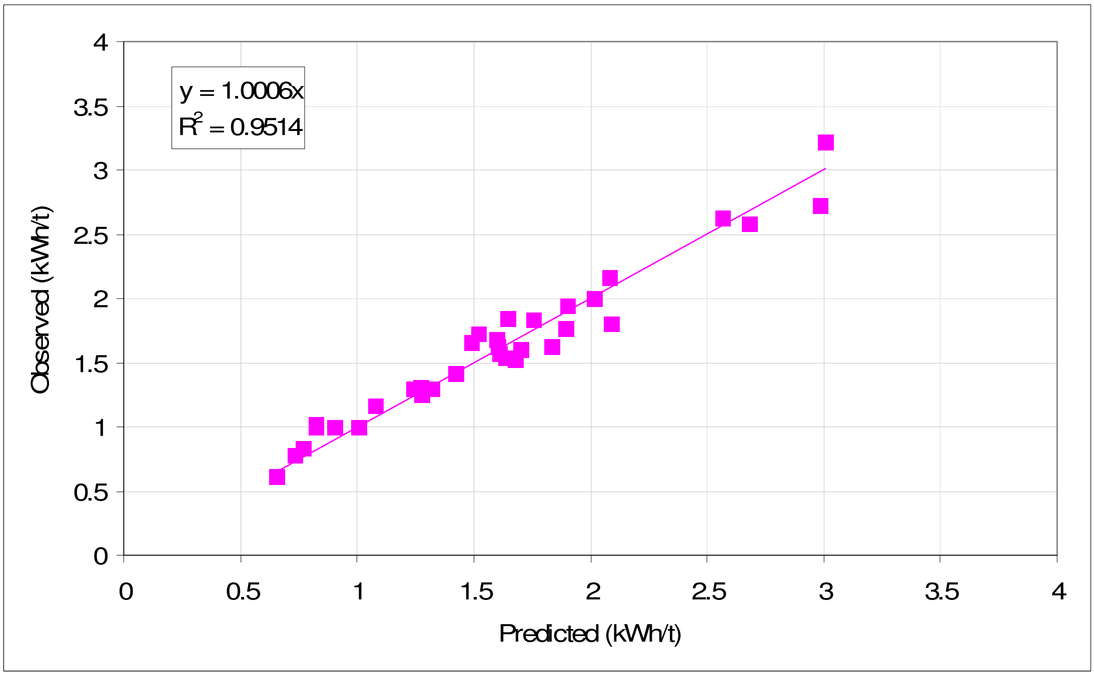
No-load power tends to be relatively high in conventional crushers and hence net power is significantly lower than the motor input power. From examination of the 18 crusher data sets the motor input power was found to be on average 35% higher than the net power.



App Figure 9 – Observed vs Predicted Conventional Crusher Specific Energy

B 3.3 HPGRs

Validation of equation 1 for HPGRs used data from 18 different circuits (35 data sets) including laboratory, pilot and industrial scale equipment. Observed vs predicted specific energies are given in App Figure 10. The data relate to HPGRs operating with specific grinding forces typically in the range 2.5-3.5 N/mm^2. The observed specific energies relate to power delivered by the roll drive shafts. Motor input power for full scale machines is expected to be 8-10% higher.



App Figure 10 – Observed vs Predicted HPGR Specific Energy

B 4 WORKED EXAMPLES

A SMC Test® and Bond ball work index test were carried out on a representative ore sample. The following results were obtained:

SMC Test:

M_{ia} = 19.4 kWh/t

M_{ic} = 7.2 kWh/t

M_{ih} = 13.9 kWh/t

Bond test carried out with a 150 micron closing screen:

M_{ib} = 18.8 kWh/t

Three circuits are to be evaluated:

SABC

HPGR/ball mill

Conventional crushing/ball mill

The overall specific grinding energy to reduce a primary crusher product with a P_{80} of 100 mm to a final product P_{80} of 106 µm needs to be estimated.

B 4.1 SABC Circuit

Coarse particle tumbling mill specific energy

Combining eq 2 and 4:

$$W_a = 0.95 * 19.4 * 4 * \left(750^{-(0.295+750/1000000)} - 100000^{-(0.295+100000/1000000)}\right)$$

= 9.6 kWh/t

Fine particle tumbling mill specific energy

Combining eq 2 and 5:

$$W_b = 18.8 * 4 * \left(106^{-(0.295+106/1000000)} - 750^{-(0.295+750/1000000)}\right)$$

= 8.4 kWh/t

Pebble crusher specific energy

In this circuit, it is assumed that the pebble crusher feed P_{80} is 52.5mm. As a rule of thumb this value can be estimated by assuming that it is 0.75 of the nominal pebble port aperture (in this case the pebble port aperture is 70mm). The pebble crusher is set to give a product P_{80} of 12mm. The pebble crusher feed rate is expected to be 25% of new feed tph.

Combining eq 2 and 7:

$$W_c = 1.19 * 7.2 * 4 * \left(12000^{-(0.295+12000/1000000)} - 52500^{-(0.295+52500/1000000)}\right)$$

= 1.12 kWh/t when expressed in terms of the crusher feed rate

= 1.12 * 0.25 kWh/t when expressed in terms of the SABC circuit new feed rate

= 0.3 kWh/t of SAG mill circuit new feed

Total net comminution specific energy:

From eq 3:

W_T = 9.6 + 8.4 + 0.3 kWh/t

= 18.3 kWh/t

B 4.2 HPGR/Ball Milling Circuit

In this circuit primary crusher product is reduced to a HPGR circuit feed P_{80} of 35 mm by closed circuit secondary crushing. The HPGR is also in closed circuit and reduces the 35 mm feed to a circuit product P_{80} of 4 mm. This is then fed to a closed circuit ball mill which takes the grind down to a P_{80} of 106 µm.

Secondary crushing specific energy

Combining eq 2 and 7:

$$W_c = 1 * 7.2 * 4 * \left(35000^{-(0.295+35000/1000000)} - 100000^{-(0.295+100000/1000000)}\right)$$

= 0.6 kWh/t

HPGR specific energy

Combining eq 2 and 8:

$$W_c = 1*13.9*4*\left(4000^{-(0.295+4000/1000000)} - 35000^{-(0.295+35000/1000000}\right)$$

= 2.9 kWh/t

Coarse particle tumbling mill specific energy

Combining eq 2 and 4:

$$W_a = 1*19.4*4*\left(750^{-(0.295+750/1000000)} - 4000^{-(0.295+4000/1000000}\right)$$

= 4.5 kWh/t

Fine particle tumbling mill specific energy

Combining eq 2 and 5:

$$W_b = 18.8*4*\left(106^{-(0.295+106/1000000)} - 750^{-(0.295+750/1000000}\right)$$

= 8.4 kWh/t

Total net comminution specific energy:

From eq 3:

W_T = 4.5 + 8.4 + 0.6 + 2.9 kWh/t

= 16.4 kWh/t

B 4.3 Conventional Crushing/Ball Milling Circuit

In this circuit primary crusher product is reduced in size to P_{80} of 6.5 mm via a secondary/tertiary crushing circuit (closed). This is then fed to a closed circuit ball mill which grinds to a P80 of 106 µm.

Secondary/tertiary crushing specific energy

Combining eq 2 and 7:

$$W_c = 1*7.2*4*\left(6500^{-(0.295+6500/1000000)} - 100000^{-(0.295+100000/1000000}\right)$$

= 1.7 kWh/t

Coarse particle tumbling mill specific energy

Combining eq 2 and 4:

$$W_a = 1*19.4*4*\left(750^{-(0.295+750/1000000)} - 6500^{-(0.295+6500/1000000)}\right)$$

= 5.5 kWh/t

Fine particle tumbling mill specific energy

Combining eq 2 and 5:

$$W_b = 18.8*4*\left(106^{-(0.295+106/1000000)} - 750^{-(0.295+750/1000000)}\right)$$

= 8.4 kWh/t

Size distribution correction

$$W_s = 0.19*19.4*4*\left(6500^{-(0.295+6500/1000000)} - 100000^{-(0.295+100000/1000000)}\right)$$

= 0.9 kWh/t

Total net comminution specific energy:

From eq 3:

W_T = 5.5 + 8.4 + 1.7 + 0.9kWh/t

= 16.5 kWh/t

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