PerUsa EnviroMet Inc., 228 Pinellas Street, Lakeland, FL 33803-4832, USA Phone/Fax: (863) 646-5096 E-mail: fsotillo@msn.com

TO: Mr. Marten Walters, President, KEMWorks Technology, Inc.
CC. Mr. Neville Bergin, General Manager, MINEMAKERS Limited.

FROM: Dr. Francisco J. Sotillo, President, PerUsa EnviroMet, Inc.

SUBJECT: Screen Analysis and Assays of the HPGR Head Samples for Composite A, B, and C for MPH Samples from Arruwurra Wonarah Phosphate Project–Data Analysis.

DATE: March 05, 2014

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

- The analysis of the data on the particle size distributions (PSD) and screen assays of the HPGR Head Samples of Composite A, B, and C indicated that the Model prepared could predict the HPGR + Attrition Scrubbing results for MPH Phosphate Ore for Composites A and B.
- The data analysis confirmed that selective grinding occurred due to the difference in hardness of the mineral species. The data indicated the P_2O_5 bearing minerals were the hardest, followed by SiO_2 bearing minerals, Al_2O_3 bearing minerals being the softest.
- The Head Samples data supported the selected HPGR operating conditions chosen to carry out the comminution tests for Composite A and B: **40 bars of Applied Pressure and 0.77 m/s of Rolls Speed.**

INTRODUCTION

Following recommendations on the report of January 27, 2014, screen analysis and assays of the Head Samples of Composites A, B, and C were carried out to validate the Model prepared to predict the results of the HPGR + Attrition Scrubbing on Composite A and B from data obtained from HPGR + Attrition Scrubbing of Composite C. Moreover, these tests were suggested to confirm the HPGR operating conditions selected to be used for Composites A and B. The following Excel Files were prepared on screen analysis of Composite A, B, and C; and screen assays of Composite A, Composite B and Composite C, respectively:

- KEMWorks-PN2069-K12013 HPGR Comp A-C Head Sizing-1.
- KEMWorks-PN2069-K12023SA20.
- KEMWorks-PN2069-K12023SA21.
- KEMWorks-PN2069-K12023SA22.

As in previous reports, a bullet form for easy following is presented in the following paragraphs.

SCREEN ANALYSIS

- Screen analyses of the HPGR Head Samples are presented in Figures 1 and 2, and in Table 5. The data included for completion the Head Samples chemical analysis obtained from the Screen Assays. Composite A reported 2.65% Al_2O_3 and 22.82% P_2O_5, Composite B analyzed 5.49% Al_2O_3 and 16.26% P_2O_5, and Composite C reported 11.87% Al_2O_3 and 6.04% P_2O_5.

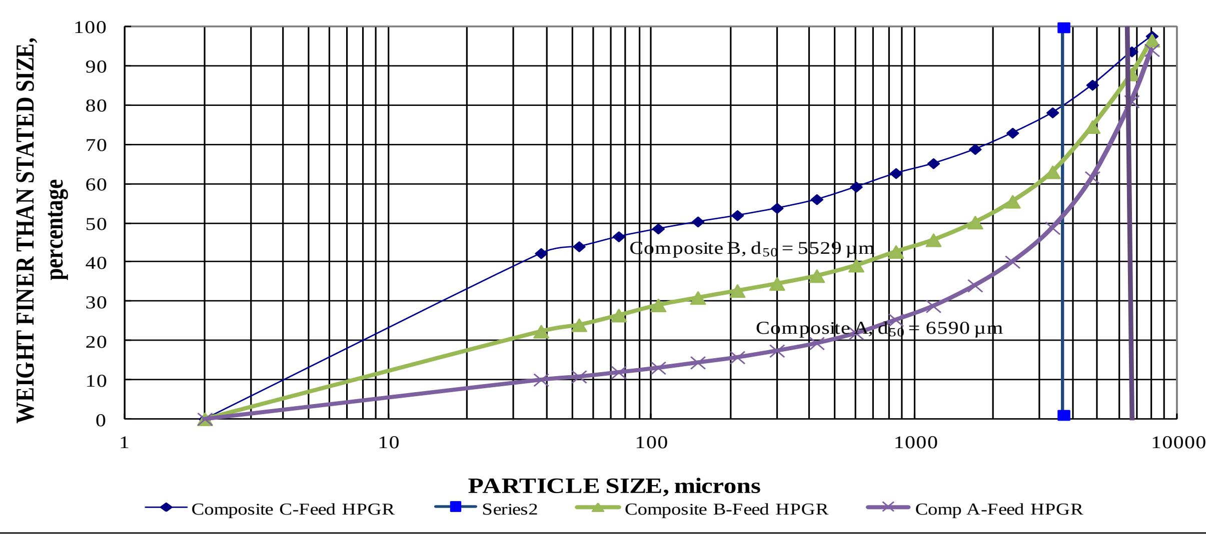
- The data showed that the higher the P_2O_5 content and the lower the Al_2O_3 content, the lower the value of the Ratio of F_{80} and the Ratio of Nominal/F_{80}, indicating that a stronger-harder phosphate ore will be submitted to HPGR comminution.
- Knowing that the Standard process produces 63.45% of P_2O_5 recovery and 69.82% of Al_2O_3rejection at about 1.42 Ratio of Nominal/F_{80}, larger ratio should result in better liberation under similar conditions; thus, improved results. This is in agreement with the concept of the effect of Al_2O_3 and P_2O_5 contents on the hardness of the ore.
- Since selective comminution of Al_2O_3 bearing minerals by P_2O_5 and SiO_2 bearing minerals was demonstrated in previous reports, it is expected that the results predicted by the Model be achieved.

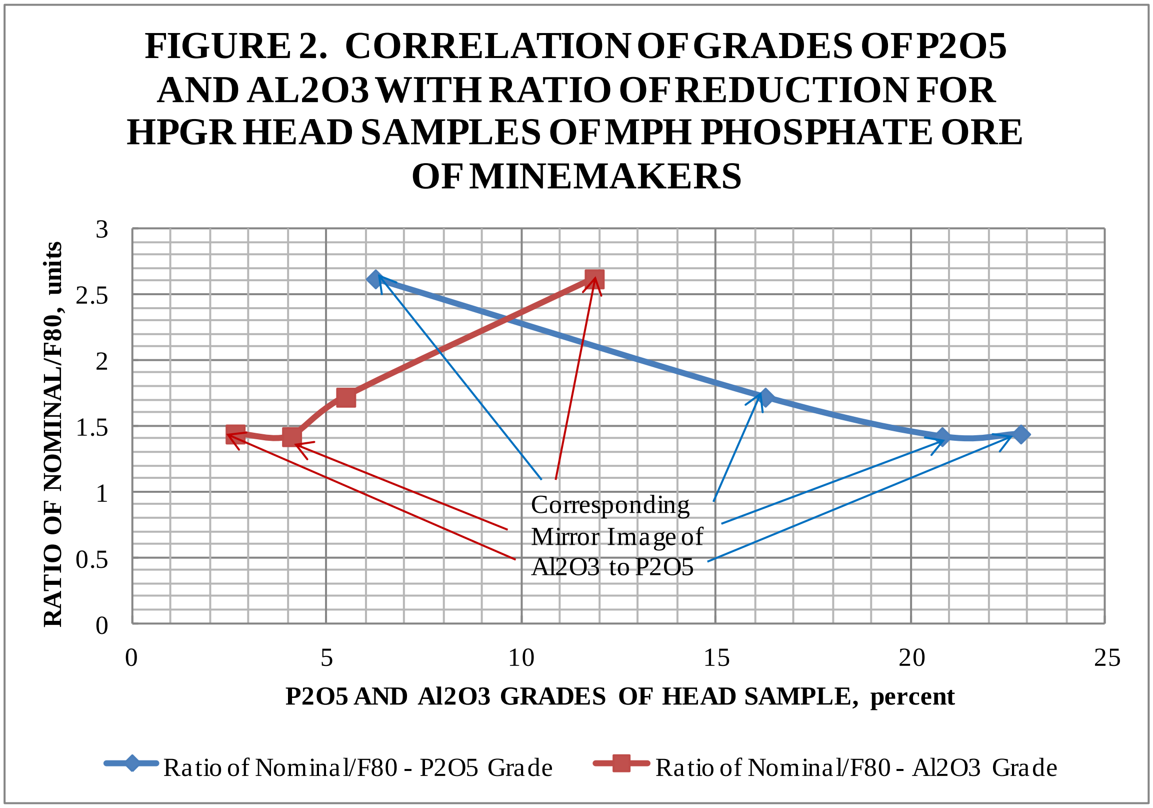
TABLE 5. NOMINAL, F_{80}, AND P_{80} VALUES FOR MPH COMPOSITE SAMPLES

TEST 4

Composite MPH Ore Type	Nominal Feed Size mm	Ratio of Nominal Size	Particle F_{80} µm	Ratio of F_{80} Particle	Ratio of Nominal / F_{80}	Crushing HPGR P_{80}, µm	Ratio of Reduction HPGR, R_{80}	Attrition P_{80} µm	Ratio of Reduction Attrition, R_{80}	Head Grades P_2O_5 %	Head Grades Al_2O_3 %
Standard	-12.7	--	8900.00	--	1.43	--	--	--	--		
Standard	-2	6.35	1410.00	6.31	1.42	--	--	550.00	2.56	20.8	4.1
Composite A	-9.5	1.34	6590.00	1.35	1.44					22.82	2.65
Composite B	-9.5	1.34	5529.00	1.61	1.72					16.26	5.49
Composite C, 0.77 m/s	-9.5	1.34	3625.00	2.46	2.62	395.00	9.18	95.00	4.16	6.25	11.87

FIGURE 1. PARTICLE SIZE DISTRIBUTIONS FOR COMPOSITES A, B, AND C OF MPH PHOSPHATE ORE OF MINEMAKERS





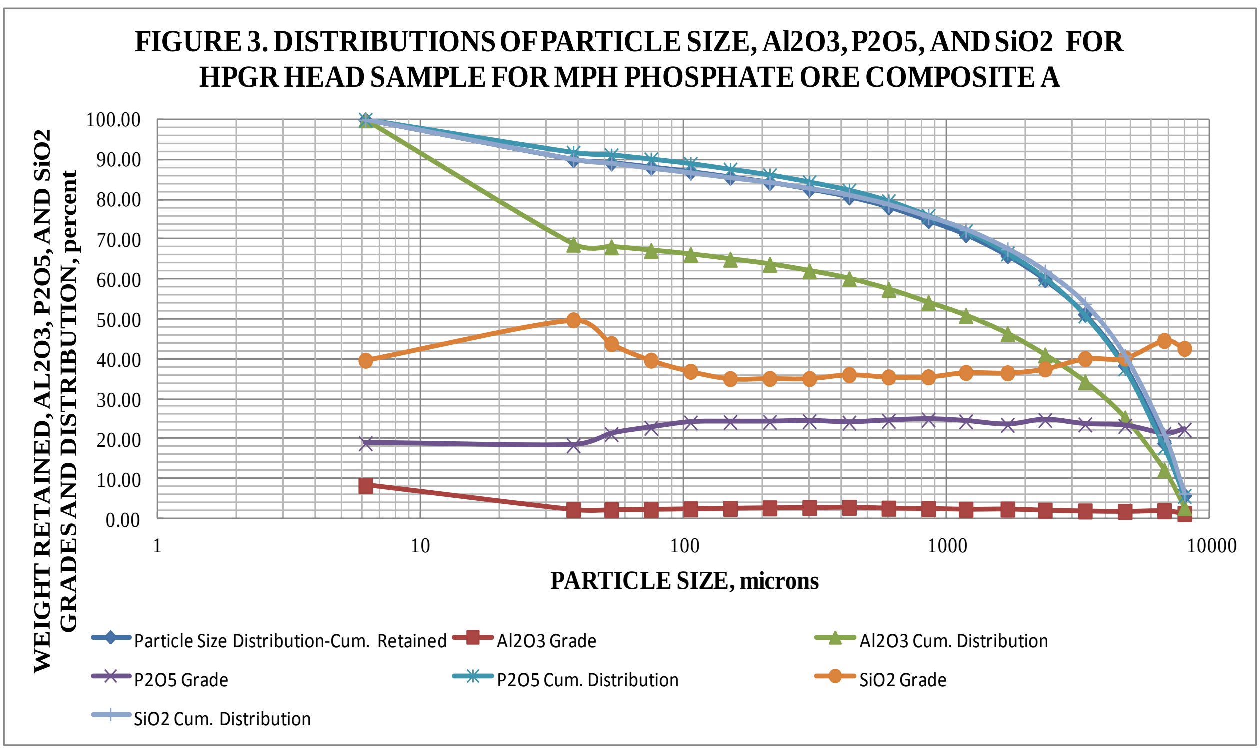
- Figure 2 showed that there was clear proportionality of the Head Samples Ratio of Nominal/F_{80} with the P_2O_5 and Al_2O_3 Head Samples grades, validating the basis for the applied Model. **Moreover, this information confirmed the HPGR operating conditions selected 40 bars of Applied Pressure and 0.77 m /s of Rolls Speed.**

SCREEN ASSAYS

Composite A

- Composite A Head Samples analyzed 2.65% Al_2O_3 and 22.82% P_2O_5. Clearly, this composite corresponded to the hardest phosphate ore since only 10.01% by weight reported to the -38-µm size fraction. Moreover, Al_2O_3 material concentrated in this size fraction, resulting in 8.27% Al_2O_3 with 18.86% P_2O_5. Thus, 31.19% of Al_2O_3 is present in the -38-µm size fraction containing only 8.27% of P_2O_5.
- Again, the +2360-µm size fraction of the Composite A Head Sample showed a hard phosphate ore as indicated by 59.87% by weight in this size fraction. This material was low in Al_2O_3 (1.82%) and high in P_2O_5 (22.97%). Therefore, it appeared that after submitting Composite A to HPGR most of the +2360-µm material will report to the product (2360x38 µm). In the +2360-µm size fraction, 41.01% of Al_2O_3 with 60.26% of P_2O_5 was reported, P_2O_5 being expected to be recovered in the 2360x38-µm size fraction after comminution in a HPGR.

- Product size, 2360x38 µm corresponded to 30.11% by weight with 2.45% Al_2O_3 and 23.85% P_2O_5. This size fraction contained 27.80% of Al_2O_3 and 31.46% of P_2O_5. After HPGR comminution, it is expected to reduce Al_2O_3 below 2.00%, the Al_2O_3 reporting in the -38-µm size fraction; whereas, most of the P_2O_5 content remaining in the product, 2360x38 µm.
- Consequently, it is expected above 90% of the Al_2O_3 being reported in the -38-µm size fraction with a total recovered in the 2360x38-µm size fraction of P_2O_5 of about 87%.
- Figure 3 presented the Distributions of Al_2O_3, P_2O_5, and SiO_2 for Composite A. These Distributions showed that the weight Retained (PSD) was dominated by the P_2O_5 and SiO_2 bearing minerals species (same locus of the curve); whereas, the Al_2O_3 corresponded to a different locus, indicating that Al_2O_3 bearing minerals will be preferentially comminuted by the harder material (P_2O_5 and SiO_2). The locus of the Grade Distribution Curves showed that P_2O_5 was slightly higher in grade in the 2360x38-µm size fraction decreasing in grade in the -38-µm size fraction. SiO_2 grade increased in the +2360 µm and -38-µm size fractions; whereas, Al_2O_3 was flat for all size fractions increasing only at -38 µm.



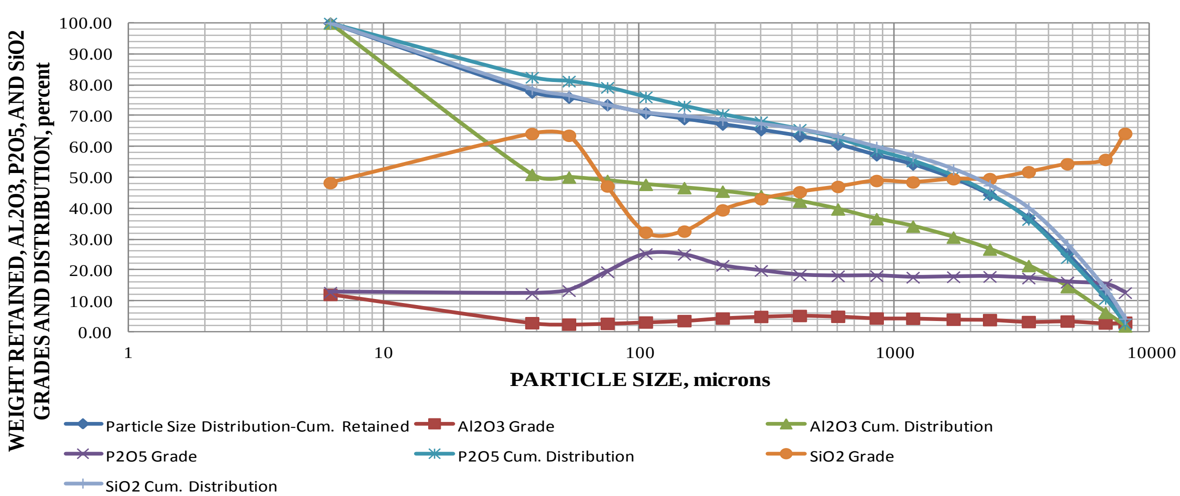
Composite B

- Composite B Head Sample behaved similar than Composite A. This composite reported 5.49% Al_2O_3 and 16.26% P_2O_5 and higher weight fraction retained in the -38µm, 22.37%; thus, a medium-hard phosphate ore. As expected, Al_2O_3 concentrated in the -

38-µm size fraction, reporting 12.04% Al_2O_3 and 12.76% P_2O_5 corresponding to 49.05% of Al_2O_3 content and 17.55% of P_2O_5 content.

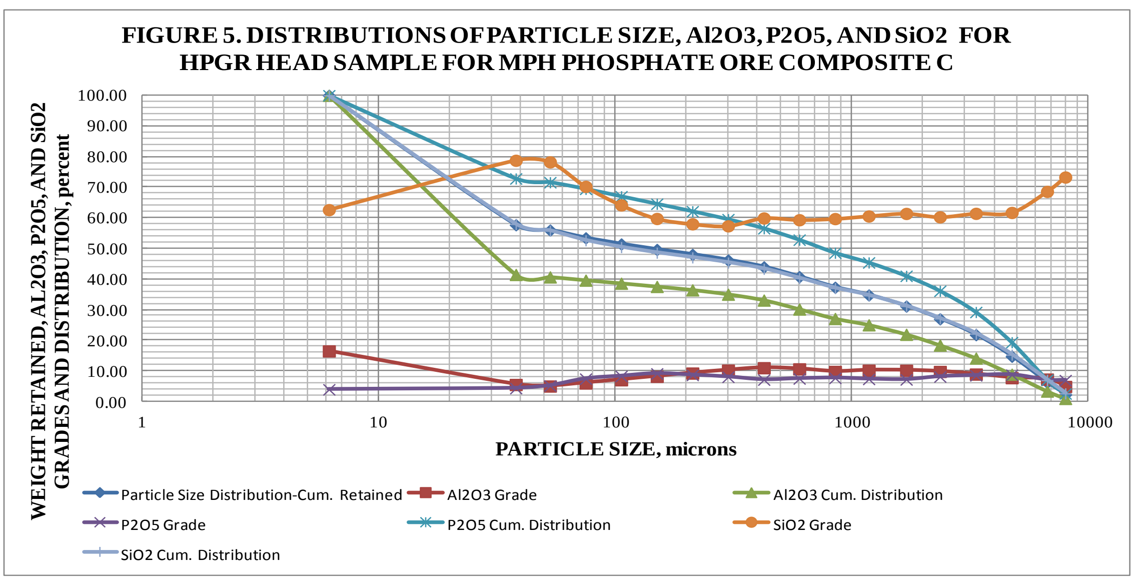
- The +2360-µm size fraction corresponded to 44.45% by weight of the material with higher Al_2O_3 (3.30%) and lower P_2O_5 (16.32%) than those observed for Composite A. Again, it is assumed that by submitting this size fraction to HPGR comminution most of the material will report to the Product, 2360x38 µm. The +2360-µm material contained 26.74% of Al_2O_3 and 44.62% of P_2O_5 that it is expected to be recovered in the 2360x38-µm size fraction after HPGR comminution.
- The Product size fraction, 2360x38 µm, was 33.18% by weight, similar than that reported for the Composite A, which may indicate that the +2360-µm material may trend to report in the 2360x38 µm after comminution. 2360x38-µm material analyzed 4.01% Al_2O_3 and 18.54% P_2O_5, containing 24.21% of Al_2O_3 and 37.82% of P_2O_5 similar values than those of the Standard process. Thus, it is expected that Al_2O_3 grade will drop below 2.00%, the Al_2O_3 reporting in the -38-µm size fraction; whereas, the P_2O_5 remaining in the 2360x38-µm size fraction.
- It is expected that about 92% of Al_2O_3 being reported in the -38-µm size fraction and above 82% of P_2O_5 being recovered in the 2360x38 µm.
- Figure 4 presented the Distributions of Al_2O_3, P_2O_5, and SiO_2 for Composite B. Similar to Composite A, the Distributions Curves showed that the PSD and the SiO_2 Distribution shared the same locus; whereas, the locus of the P_2O_5 Distribution Curve was slightly above the PSD, indicating that the phosphate bearing minerals were the hardest species (coarser material), the Al_2O_3 bearing minerals being the softest (finer material). Thus, it was expected that the Al_2O_3 bearing minerals will be preferentially ground by the harder P_2O_5 and SiO_2 bearing minerals. The Grade Distribution Curves showed that P_2O_5 grade remained almost constant from 2360x200 µm, increasing at 200x75 µm, and decreasing in the -75-µm size range. SiO_2 decreased in grade from 8000 µm to 106 µm, increasing at -106-µm size fraction. Al_2O_3 grade increased in the size fraction 1700x150 µm, increasing again in the -38-µm size fraction.

FIGURE 4. DISTRIBUTIONS OF PARTICLE SIZE, Al2O3, P2O5, AND SiO2 FOR HPGR HEAD SAMPLE FOR MPH PHOSPHATE ORE COMPOSITE B



Composite C

- HPGR effect on Composite C has been analyzed in previous reports (January 27, 2014). However, Composite C Head Sample showed some important information that needed to be addressed. First, it was found that the P_{80} for Composite C was 3625 µm instead of 3152 µm reported by JK Tech. Since the difference corresponded to a coarser Head sample, the results clearly demonstrated that Composite C was the softest phosphate ore producing even large Ratio of Nominal/F_{80} than those already reported, and that selective comminution of Al_2O_3 bearing minerals occurred, P_2O_5 bearing minerals being ground at a slower rate. Therefore, Composite C Head Sample reported 11.87% Al_2O_3 and 6.04% P_2O_5, the -38-µm size fraction weight being 42.32%. Composite C Al_2O_3 grade in the -38-µm size fraction was 16.43% and that of P_2O_5 was 3.88%. This corresponded to 58.58% of Al_2O_3 and 27.19% of P_2O_5 contents.
- Composite C +2360-µm size fraction corresponded to 26.93% by weight with 8.08% Al_2O_3 and 8.09% P_2O_5. The size fraction contained 18.33% of Al_2O_3 and 36.74% of P_2O_5.
- The 2360x38-µm size fraction reported 30.74% by weight analyzing 8.92% Al_2O_3 and 7.21% P_2O_5, corresponding to 23.10% of Al_2O_3 and 36.72% of P_2O_5.
- Figure 5 presented the Distributions of Al_2O_3, P_2O_5, and SiO_2 for Composite C. The Distributions Curves showed that the locus of the P_2O_5 Distribution Curve corresponded to a much coarser product than that of other minerals. The PSD and SiO_2 locus of the Distribution Curves were identical; whereas, the locus of the Al_2O_3 Distribution showed the finest material in the phosphate ore. In the case of the Grade Distribution Curves, it was clear that SiO_2 grade decreased in the 8000x4000-µm size fraction, maintaining a constant grade for the 400x200-µm size range, the SiO_2 grade increasing in the -200-µm fine fraction. P_2O_5 grade increased from 800x500-µm, level off from 500x200 µm, and decreased in the -200-µm size fraction. Al_2O_3 grade increased in the 800x400-µm range, decreased from 400x38 µm, and increased again in the -38-µm size fraction.



K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 3 Product)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +3350 µm Fraction	20.95	2.49	3.27	6.56	6.31	0.27	0.14	0.05	0.02	4.91	75.91	0.15	1.50	0.44	194	188	13	2.71
Product Size +2360 µm Fraction	21.25	2.53	3.82	9.22	3.39	0.31	0.18	0.02	0.03	6.85	73.08	0.16	0.02	0.60	182	178	19	2.74
Product Size +1700 µm Fraction	20.26	2.41	5.22	10.52	4.56	0.48	0.27	0.03	0.03	7.85	67.73	0.21	3.90	0.69	207	183	21	3.83
Product Size +1180 µm Fraction	26.73	3.18	6.75	10.80	4.54	0.65	0.38	0.05	0.04	8.20	63.96	0.28	0.90	0.72	219	262	22	4.19
Product Size +850 µm Fraction	20.91	2.49	7.05	11.61	4.85	0.68	0.41	0.06	0.04	8.67	62.07	0.29	1.00	0.81	257	218	25	4.61
Product Size +600 µm Fraction	17.89	2.13	6.87	11.75	4.56	0.66	0.41	0.06	0.04	8.67	57.90	0.28	4.70	0.81	277	210	25	4.70
Product Size +425 µm Fraction	16.43	1.96	7.01	12.57	4.66	0.66	0.42	0.07	0.04	9.19	60.39	0.28	4.60	0.79	298	200	25	4.65
Product Size +300 µm Fraction	13.19	1.57	6.58	13.10	4.54	0.60	0.38	0.07	0.04	9.63	59.90	0.26	0.50	0.86	300	211	26	4.58
Product Size +212 µm Fraction	18.43	2.19	6.90	12.99	4.24	0.65	0.43	0.08	0.04	10.03	59.88	0.29	2.70	0.85	321	205	25	4.53
Product Size +150 µm Fraction	16.13	1.92	6.38	12.91	3.75	0.62	0.45	0.06	0.04	9.63	61.79	0.29	3.50	0.67	300	242	23	4.26
Product Size +106 µm Fraction	15.90	1.89	5.44	12.60	3.31	0.50	0.36	0.05	0.04	9.21	64.07	0.26	0.20	0.64	289	156	23	3.83
Product Size +75 µm Fraction	17.04	2.03	4.60	11.83	2.74	0.42	0.27	0.04	0.15	8.74	67.82	0.25	0.20	0.54	266	133	21	3.20
Product Size +53 µm Fraction	32.86	3.91	3.82	8.01	1.93	0.36	0.20	0.02	0.03	6.08	75.89	0.28	0.20	0.44	175	107	16	2.40
Product Size +38 µm Fraction	18.18	2.16	4.17	6.32	1.90	0.43	0.24	0.01	0.04	4.81	78.76	0.41	4.30	0.33	149	93	14	2.49
Product Size -38 µm Fraction	564.00	67.13	15.02	6.47	3.38	1.68	0.87	0.01	0.07	5.10	59.84	0.76	1.70	0.40	201	160	18	6.35
(Calculated Head)	(840.15)	(100.00)	(11.87)	(7.79)	(3.55)	(1.30)	(0.69)	(0.02)	(0.06)	(6.00)	(62.24)	(0.60)	(1.76)	(0.48)	(213)	(167)	(19)	(5.47)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	0.69	2.10	4.44	0.52	0.51	5.75	0.82	2.04	3.04	0.63	2.13	2.29	2.27	2.80	1.71	1.24
Product Size +2360 µm Fraction	0.81	2.99	2.42	0.61	0.66	2.33	1.24	2.89	2.97	0.68	0.03	3.16	2.16	2.69	2.54	1.27
Product Size +1700 µm Fraction	1.06	3.26	3.10	0.89	0.95	3.34	1.19	3.16	2.62	0.85	5.34	3.47	2.34	2.64	2.68	1.69
Product Size +1180 µm Fraction	1.81	4.41	4.07	1.60	1.76	7.34	2.09	4.35	3.27	1.49	1.63	4.78	3.27	4.98	3.70	2.44
Product Size +850 µm Fraction	1.48	3.71	3.40	1.31	1.48	6.89	1.63	3.60	2.48	1.21	1.41	4.20	3.00	3.24	3.29	2.10
Product Size +600 µm Fraction	1.23	3.21	2.74	1.08	1.27	5.89	1.40	3.08	1.98	1.00	5.69	3.60	2.77	2.67	2.81	1.83
Product Size +425 µm Fraction	1.15	3.16	2.57	1.00	1.20	6.31	1.28	3.00	1.90	0.92	5.11	3.22	2.74	2.34	2.58	1.66
Product Size +300 µm Fraction	0.87	2.64	2.01	0.73	0.87	5.07	1.03	2.52	1.51	0.68	0.45	2.82	2.21	1.98	2.16	1.31
Product Size +212 µm Fraction	1.27	3.66	2.62	1.10	1.37	8.09	1.44	3.67	2.11	1.07	3.37	3.89	3.31	2.69	2.90	1.82
Product Size +150 µm Fraction	1.03	3.18	2.03	0.92	1.26	5.31	1.26	3.08	1.91	0.93	3.82	2.68	2.71	2.77	2.33	1.50
Product Size +106 µm Fraction	0.87	3.06	1.77	0.73	0.99	4.36	1.24	2.91	1.95	0.82	0.22	2.53	2.57	1.76	2.30	1.33
Product Size +75 µm Fraction	0.79	3.08	1.57	0.66	0.80	3.74	4.99	2.95	2.21	0.85	0.23	2.28	2.53	1.61	2.25	1.19
Product Size +53 µm Fraction	1.26	4.02	2.13	1.09	1.14	3.61	1.92	3.96	4.77	1.84	0.44	3.59	3.21	2.50	3.31	1.72
Product Size +38 µm Fraction	0.76	1.76	1.16	0.72	0.76	1.00	1.42	1.73	2.74	1.49	5.29	1.49	1.51	1.20	1.60	0.99
Product Size -38 µm Fraction	84.92	55.76	63.98	87.06	84.99	30.96	77.05	57.07	64.54	85.54	64.85	56.00	63.38	64.14	63.85	77.94
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS Duplicate (Composite C HPGR Test 3 Product)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +3350 µm Fraction	17.95	2.14	4.21	5.65	4.91	0.28	0.12	0.01	0.02	4.86	76.76	0.15	2.10	0.43	143	119	14	2.80
Product Size +2360 µm Fraction	21.43	2.55	4.45	10.54	3.41	0.38	0.19	0.01	0.03	7.83	70.12	0.17	0.20	0.63	197	163	21	3.03
Product Size +1700 µm Fraction	22.07	2.63	5.01	10.50	3.99	0.47	0.27	0.01	0.03	7.78	68.05	0.21	1.00	0.66	198	149	22	3.47
Product Size +1180 µm Fraction	26.29	3.13	6.70	10.51	4.96	0.63	0.37	0.04	0.04	8.04	64.11	0.27	5.50	0.74	230	195	24	4.39
Product Size +850 µm Fraction	20.88	2.49	7.07	11.56	4.73	0.67	0.41	0.07	0.04	8.65	62.20	0.28	3.30	0.82	230	201	25	4.65
Product Size +600 µm Fraction	17.84	2.12	7.15	12.01	4.65	0.68	0.42	0.06	0.04	8.95	60.73	0.28	1.10	0.86	291	207	27	4.76
Product Size +425 µm Fraction	15.98	1.90	6.98	12.57	4.65	0.64	0.40	0.08	0.04	9.26	60.11	0.27	2.40	0.88	295	218	27	4.65
Product Size +300 µm Fraction	13.27	1.58	6.66	13.13	4.58	0.59	0.37	0.08	0.04	9.65	60.43	0.26	0.20	0.84	329	195	27	4.50
Product Size +212 µm Fraction	16.91	2.01	6.43	13.57	4.23	0.56	0.36	0.08	0.04	9.96	59.41	0.27	2.00	0.83	314	189	26	4.31
Product Size +150 µm Fraction	15.56	1.85	6.04	13.06	3.74	0.56	0.39	0.06	0.04	9.51	62.30	0.26	1.20	0.70	303	165	24	4.07
Product Size +106 µm Fraction	16.12	1.92	5.06	12.13	3.20	0.46	0.32	0.05	0.04	9.44	64.26	0.25	2.10	0.68	305	146	24	3.65
Product Size +75 µm Fraction	17.43	2.07	4.45	11.65	2.76	0.41	0.24	0.04	0.04	8.67	68.71	0.24	0.20	0.57	271	133	21	3.05
Product Size +53 µm Fraction	33.07	3.94	3.97	7.71	1.99	0.39	0.22	0.02	0.04	5.89	77.23	0.30	0.20	0.36	176	94	16	2.49
Product Size +38 µm Fraction	18.92	2.25	4.45	6.59	1.99	0.46	0.25	0.01	0.04	5.05	79.14	0.41	0.20	0.35	153	98	15	2.57
Product Size -38 µm Fraction	566.48	67.42	15.17	6.33	3.40	1.65	0.85	0.01	0.06	5.00	59.79	0.76	0.90	0.41	195	155	19	6.24
(Calculated Head)	(840.20)	(100.00)	(12.03)	(7.69)	(3.52)	(1.28)	(0.67)	(0.02)	(0.05)	(5.95)	(62.30)	(0.60)	(1.13)	(0.49)	(208)	(156)	(20)	(5.40)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	0.75	1.57	2.98	0.47	0.38	1.07	0.81	1.75	2.63	0.54	3.98	1.88	1.47	1.63	1.50	1.11
Product Size +2360 µm Fraction	0.94	3.49	2.47	0.76	0.72	1.27	1.46	3.36	2.87	0.73	0.45	3.30	2.41	2.66	2.69	1.43
Product Size +1700 µm Fraction	1.09	3.59	2.98	0.97	1.06	1.31	1.50	3.44	2.87	0.92	2.33	3.56	2.50	2.51	2.90	1.69
Product Size +1180 µm Fraction	1.74	4.28	4.41	1.54	1.72	6.24	2.38	4.23	3.22	1.41	15.25	4.75	3.45	3.91	3.77	2.54
Product Size +850 µm Fraction	1.46	3.73	3.34	1.30	1.52	8.68	1.89	3.61	2.48	1.17	7.27	4.18	2.74	3.20	3.12	2.14
Product Size +600 µm Fraction	1.26	3.32	2.81	1.13	1.33	6.36	1.62	3.20	2.07	1.00	2.07	3.75	2.96	2.81	2.88	1.87
Product Size +425 µm Fraction	1.10	3.11	2.51	0.95	1.13	7.59	1.45	2.96	1.84	0.86	4.04	3.43	2.69	2.66	2.58	1.64
Product Size +300 µm Fraction	0.87	2.70	2.06	0.73	0.87	6.30	1.20	2.56	1.53	0.69	0.28	2.72	2.49	1.97	2.14	1.32
Product Size +212 µm Fraction	1.08	3.55	2.42	0.88	1.08	8.03	1.53	3.37	1.92	0.91	3.57	3.43	3.03	2.44	2.62	1.61
Product Size +150 µm Fraction	0.93	3.14	1.97	0.81	1.08	5.54	1.41	2.96	1.85	0.81	1.97	2.66	2.69	1.96	2.23	1.40
Product Size +106 µm Fraction	0.81	3.03	1.75	0.69	0.91	4.79	1.46	3.05	1.98	0.80	3.57	2.68	2.81	1.79	2.31	1.30
Product Size +75 µm Fraction	0.77	3.14	1.63	0.67	0.74	4.14	1.58	3.02	2.29	0.83	0.37	2.43	2.70	1.77	2.18	1.17
Product Size +53 µm Fraction	1.30	3.95	2.23	1.20	1.29	3.93	3.00	3.90	4.88	1.98	0.70	2.91	3.32	2.37	3.16	1.81
Product Size +38 µm Fraction	0.83	1.93	1.27	0.81	0.84	1.12	1.71	1.91	2.86	1.55	0.40	1.62	1.65	1.41	1.69	1.07
Product Size -38 µm Fraction	85.05	55.48	65.17	87.08	85.33	33.63	77.00	56.68	64.71	85.81	53.77	56.71	63.08	66.92	64.24	77.91
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 6 Product)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +3350 µm Fraction	15.16	1.80	3.48	10.62	5.09	0.31	0.15	0.13	0.02	7.90	77.29	0.13	4.40	1.03	418	217	26	2.26
Product Size +2360 µm Fraction	16.92	2.01	3.98	8.87	4.08	0.33	0.16	0.03	0.03	6.64	72.50	0.17	0.20	0.56	168	189	19	3.00
Product Size +1700 µm Fraction	18.27	2.17	4.81	10.69	4.85	0.42	0.23	0.04	0.03	7.95	68.29	0.21	1.20	0.71	196	182	23	3.49
Product Size +1180 µm Fraction	22.88	2.72	6.15	10.44	5.26	0.57	0.31	0.06	0.04	8.13	64.94	0.26	3.00	0.72	229	209	26	4.27
Product Size +850 µm Fraction	18.78	2.23	6.38	11.54	5.17	0.58	0.34	0.07	0.03	8.53	62.47	0.25	2.10	0.83	238	252	26	4.39
Product Size +600 µm Fraction	15.44	1.84	6.27	11.39	4.83	0.54	0.32	0.07	0.03	9.17	61.56	0.27	2.10	0.89	262	215	27	4.66
Product Size +425 µm Fraction	14.77	1.76	6.12	12.91	4.83	0.52	0.31	0.08	0.04	9.70	61.35	0.25	10.00	0.90	234	222	29	4.59
Product Size +300 µm Fraction	11.87	1.41	5.72	13.14	4.62	0.49	0.28	0.09	0.04	9.86	60.90	0.24	0.20	0.96	323	233	28	4.42
Product Size +212 µm Fraction	16.63	1.98	6.00	13.64	4.41	0.50	0.31	0.09	0.04	10.05	59.94	0.27	3.90	0.86	332	207	28	4.58
Product Size +150 µm Fraction	16.12	1.92	5.59	13.23	3.83	0.49	0.33	0.07	0.04	9.82	61.88	0.27	5.90	0.73	304	172	25	4.35
Product Size +106 µm Fraction	15.35	1.82	4.84	12.81	3.41	0.42	0.27	0.05	0.04	9.42	65.54	0.26	0.20	0.69	387	153	23	3.85
Product Size +75 µm Fraction	17.47	2.08	4.23	11.97	2.76	0.37	0.21	0.04	0.04	8.90	68.43	0.26	1.20	0.57	262	126	22	3.23
Product Size +53 µm Fraction	36.07	4.29	3.76	7.92	2.01	0.35	0.19	0.02	0.04	6.01	76.44	0.31	0.20	0.40	173	94	16	2.77
Product Size +38 µm Fraction	15.59	1.85	4.08	6.75	2.04	0.41	0.22	0.01	0.04	5.12	76.74	0.42	0.20	0.36	153	104	15	3.02
Product Size -38 µm Fraction	589.97	70.13	14.85	6.64	3.44	1.64	0.85	0.01	0.06	5.26	60.14	0.77	0.20	0.44	194	150	19	6.36
(Calculated Head)	(841.29)	(100.00)	(11.91)	(7.89)	(3.59)	(1.28)	(0.67)	(0.02)	(0.05)	(6.12)	(62.42)	(0.62)	(0.83)	(0.52)	(211)	(158)	(20)	(5.57)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	0.53	2.43	2.55	0.44	0.40	9.81	0.68	2.33	2.23	0.38	9.60	3.59	3.56	2.47	2.32	0.73
Product Size +2360 µm Fraction	0.67	2.26	2.28	0.52	0.48	2.53	1.14	2.18	2.34	0.55	0.49	2.18	1.60	2.41	1.89	1.08
Product Size +1700 µm Fraction	0.88	2.94	2.93	0.71	0.74	3.64	1.23	2.82	2.38	0.74	3.15	2.98	2.01	2.50	2.47	1.36
Product Size +1180 µm Fraction	1.40	3.60	3.98	1.21	1.25	6.83	2.06	3.61	2.83	1.15	9.88	3.79	2.95	3.60	3.49	2.09
Product Size +850 µm Fraction	1.20	3.26	3.21	1.01	1.13	6.54	1.27	3.11	2.23	0.90	5.68	3.58	2.51	3.56	2.87	1.76
Product Size +600 µm Fraction	0.97	2.65	2.47	0.77	0.87	5.38	1.04	2.75	1.81	0.80	4.67	3.16	2.27	2.50	2.45	1.54
Product Size +425 µm Fraction	0.90	2.87	2.36	0.71	0.81	5.88	1.33	2.78	1.73	0.71	21.25	3.06	1.94	2.47	2.52	1.45
Product Size +300 µm Fraction	0.68	2.35	1.81	0.54	0.59	5.32	1.07	2.27	1.38	0.55	0.34	2.62	2.16	2.08	1.95	1.12
Product Size +212 µm Fraction	1.00	3.42	2.43	0.77	0.91	7.45	1.50	3.24	1.90	0.86	9.33	3.29	3.10	2.59	2.74	1.63
Product Size +150 µm Fraction	0.90	3.21	2.04	0.73	0.94	5.62	1.45	3.07	1.90	0.84	13.69	2.71	2.76	2.09	2.37	1.50
Product Size +106 µm Fraction	0.74	2.96	1.73	0.60	0.73	3.82	1.38	2.81	1.92	0.77	0.44	2.44	3.34	1.77	2.07	1.26
Product Size +75 µm Fraction	0.74	3.15	1.60	0.60	0.65	3.48	1.57	3.02	2.28	0.87	3.02	2.29	2.57	1.66	2.26	1.21
Product Size +53 µm Fraction	1.35	4.30	2.40	1.17	1.21	3.59	3.25	4.21	5.25	2.15	1.04	3.32	3.51	2.55	3.39	2.13
Product Size +38 µm Fraction	0.63	1.59	1.05	0.59	0.61	0.78	1.40	1.55	2.28	1.26	0.45	1.29	1.34	1.22	1.37	1.01
Product Size -38 µm Fraction	87.42	59.01	67.15	89.64	88.67	29.36	79.63	60.25	67.56	87.46	16.98	59.70	64.36	66.56	65.85	80.14
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS Duplicate (Composite C HPGR Test 6 Product)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +3350 µm Fraction	11.71	1.40	3.46	7.88	2.08	0.27	0.12	0.01	0.03	6.12	77.29	0.13	0.60	0.43	126	72	16	2.26
Product Size +2360 µm Fraction	17.86	2.14	4.41	8.23	4.18	0.36	0.17	0.03	0.03	6.47	72.50	0.17	3.20	0.51	163	158	21	3.00
Product Size +1700 µm Fraction	17.77	2.13	5.22	10.26	4.06	0.49	0.27	0.03	0.07	7.67	68.29	0.21	2.10	2.52	225	699	23	3.49
Product Size +1180 µm Fraction	24.67	2.95	6.66	10.14	4.95	0.63	0.34	0.05	0.05	7.78	64.94	0.26	4.50	0.74	223	197	24	4.27
Product Size +850 µm Fraction	19.56	2.34	6.62	11.53	4.89	0.62	0.36	0.06	0.04	8.65	62.47	0.25	6.60	0.83	257	228	27	4.39
Product Size +600 µm Fraction	16.84	2.01	6.83	11.72	4.89	0.64	0.38	0.07	0.04	8.69	61.56	0.27	2.70	0.87	284	214	28	4.66
Product Size +425 µm Fraction	15.56	1.86	6.68	12.17	4.98	0.61	0.36	0.09	0.06	9.07	61.35	0.25	3.30	0.94	300	238	28	4.59
Product Size +300 µm Fraction	11.90	1.42	6.32	12.86	4.72	0.55	0.33	0.09	0.05	9.63	60.90	0.24	3.40	0.92	320	217	28	4.42
Product Size +212 µm Fraction	16.80	2.01	6.62	13.11	4.50	0.59	0.38	0.08	0.04	9.68	59.94	0.27	3.90	0.85	324	191	28	4.58
Product Size +150 µm Fraction	17.01	2.03	6.25	12.61	3.98	0.59	0.42	0.06	0.04	9.33	61.88	0.27	3.10	0.69	302	160	25	4.35
Product Size +106 µm Fraction	15.84	1.89	5.52	12.43	3.49	0.50	0.35	0.05	0.04	9.14	65.54	0.26	3.50	0.71	284	145	24	3.85
Product Size +75 µm Fraction	18.56	2.22	4.75	11.36	2.90	0.43	0.28	0.04	0.04	8.41	68.43	0.26	3.00	0.51	262	110	22	3.23
Product Size +53 µm Fraction	37.25	4.45	4.47	7.67	2.21	0.45	0.26	0.02	0.04	5.82	76.44	0.31	0.20	0.36	169	91	16	2.77
Product Size +38 µm Fraction	16.01	1.91	5.14	6.59	2.26	0.54	0.32	0.01	0.04	5.02	76.74	0.42	0.20	0.39	155	112	15	3.02
Product Size -38 µm Fraction	578.80	69.22	15.19	6.55	3.35	1.66	0.88	0.01	0.04	5.29	60.14	0.77	2.60	0.47	198	145	19	6.36
(Calculated Head)	(836.14)	(100.00)	(12.24)	(7.73)	(3.49)	(1.31)	(0.70)	(0.02)	(0.04)	(6.06)	(62.44)	(0.61)	(2.66)	(0.56)	(210)	(161)	(20)	(5.55)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	0.40	1.43	0.84	0.29	0.24	0.66	1.02	1.41	1.73	0.30	0.32	1.07	0.84	0.63	1.11	0.57
Product Size +2360 µm Fraction	0.77	2.27	2.56	0.59	0.52	3.00	1.56	2.28	2.48	0.59	2.57	1.93	1.66	2.10	2.23	1.15
Product Size +1700 µm Fraction	0.91	2.82	2.48	0.80	0.81	2.99	3.82	2.69	2.32	0.73	1.68	9.49	2.28	9.22	2.43	1.34
Product Size +1180 µm Fraction	1.61	3.87	4.19	1.42	1.42	6.92	3.58	3.79	3.07	1.25	4.99	3.87	3.13	3.61	3.51	2.27
Product Size +850 µm Fraction	1.27	3.49	3.28	1.11	1.20	6.58	2.27	3.34	2.34	0.95	5.81	3.44	2.86	3.31	3.13	1.85
Product Size +600 µm Fraction	1.12	3.05	2.83	0.98	1.09	6.61	1.96	2.89	1.99	0.89	2.04	3.10	2.73	2.68	2.80	1.69
Product Size +425 µm Fraction	1.02	2.93	2.66	0.87	0.95	7.85	2.71	2.78	1.83	0.76	2.31	3.10	2.66	2.75	2.59	1.54
Product Size +300 µm Fraction	0.73	2.37	1.93	0.60	0.67	6.00	1.73	2.26	1.39	0.56	1.82	2.32	2.17	1.92	1.98	1.13
Product Size +212 µm Fraction	1.09	3.41	2.59	0.91	1.08	7.54	1.95	3.21	1.93	0.88	2.95	3.03	3.10	2.38	2.79	1.66
Product Size +150 µm Fraction	1.04	3.32	2.32	0.92	1.21	5.72	1.98	3.13	2.02	0.90	2.37	2.49	2.93	2.02	2.52	1.59
Product Size +106 µm Fraction	0.85	3.05	1.90	0.72	0.94	4.44	1.84	2.86	1.99	0.80	2.49	2.38	2.56	1.71	2.26	1.31
Product Size +75 µm Fraction	0.86	3.26	1.85	0.73	0.88	4.16	2.16	3.08	2.43	0.94	2.50	2.01	2.77	1.52	2.42	1.29
Product Size +53 µm Fraction	1.63	4.42	2.82	1.53	1.64	4.18	4.33	4.28	5.45	2.25	0.34	2.84	3.59	2.52	3.54	2.22
Product Size +38 µm Fraction	0.80	1.63	1.24	0.79	0.87	0.90	1.86	1.59	2.35	1.31	0.14	1.32	1.41	1.33	1.43	1.04
Product Size -38 µm Fraction	85.91	58.67	66.52	87.76	86.47	32.45	67.24	60.42	66.68	86.89	67.67	57.63	65.30	62.32	65.27	79.33
(Calculated Head)	(100.00)	#######	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 1 Product)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +3350 µm Fraction	22.99	2.73	2.97	6.70	3.69	0.25	0.17	0.03	0.01	5.22	78.78	0.13	9.70	0.42	138	178	17	2.02
Product Size +2360 µm Fraction	19.57	2.32	4.31	10.31	3.97	0.37	0.18	0.08	0.01	7.95	69.94	0.17	11.00	0.73	230	163	22	3.13
Product Size +1700 µm Fraction	23.21	2.75	5.46	11.37	4.70	0.51	0.28	0.03	0.03	8.67	66.02	0.20	13.60	0.94	259	810	24	3.28
Product Size +1180 µm Fraction	26.17	3.11	7.12	10.86	4.75	0.65	0.35	0.04	0.05	8.62	63.30	0.27	11.50	0.72	215	190	25	4.16
Product Size +850 µm Fraction	21.05	2.50	7.42	11.78	4.90	0.70	0.40	0.06	0.04	9.37	60.97	0.29	12.20	0.80	254	279	27	4.42
Product Size +600 µm Fraction	18.56	2.20	7.53	12.53	4.68	0.71	0.43	0.07	0.04	9.83	59.24	0.28	12.30	0.88	293	517	28	4.61
Product Size +425 µm Fraction	16.85	2.00	7.51	12.61	4.67	0.71	0.43	0.08	0.04	9.91	59.01	0.29	14.30	0.86	320	269	27	4.68
Product Size +300 µm Fraction	14.61	1.73	7.11	13.35	4.45	0.64	0.39	0.09	0.04	10.52	58.94	0.27	9.60	0.82	335	213	27	4.41
Product Size +212 µm Fraction	14.09	1.67	6.43	13.45	3.94	0.54	0.34	0.08	0.04	10.70	59.60	0.25	12.70	0.85	330	197	27	4.05
Product Size +150 µm Fraction	14.28	1.69	5.57	13.98	3.47	0.46	0.28	0.07	0.04	11.18	61.50	0.23	7.30	0.70	347	169	26	3.50
Product Size +106 µm Fraction	15.57	1.85	4.89	13.27	3.09	0.40	0.24	0.05	0.07	10.37	64.53	0.22	10.00	0.66	296	164	23	3.10
Product Size +75 µm Fraction	21.94	2.60	5.33	11.42	2.94	0.50	0.31	0.04	0.07	9.17	66.52	0.28	6.10	0.53	259	141	22	3.13
Product Size +53 µm Fraction	37.54	4.45	4.70	7.62	2.13	0.49	0.30	0.01	0.04	6.03	76.05	0.32	8.20	0.38	258	100	15	2.55
Product Size +38 µm Fraction	14.35	1.70	4.97	6.60	2.14	0.53	0.34	0.01	0.04	5.22	76.69	0.44	7.60	0.35	147	94	15	2.67
Product Size -38 µm Fraction	561.87	66.68	15.68	6.28	3.34	1.71	0.89	0.01	0.07	5.18	59.13	0.75	8.40	0.46	189	139	18	6.27
(Calculated Head)	(842.65)	(100.00)	(12.36)	(7.77)	(3.48)	(1.32)	(0.70)	(0.02)	(0.06)	(6.27)	(61.67)	(0.59)	(9.06)	(0.53)	(212)	(176)	(20)	(5.33)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	0.66	2.35	2.89	0.52	0.66	3.60	0.46	2.27	3.49	0.60	2.92	2.17	1.78	2.76	2.38	1.03
Product Size +2360 µm Fraction	0.81	3.08	2.65	0.65	0.60	8.18	0.39	2.94	2.63	0.67	2.82	3.20	2.52	2.15	2.62	1.36
Product Size +1700 µm Fraction	1.22	4.03	3.72	1.07	1.11	3.64	1.38	3.81	2.95	0.94	4.14	4.89	3.37	12.69	3.39	1.69
Product Size +1180 µm Fraction	1.79	4.34	4.24	1.53	1.56	5.47	2.59	4.27	3.19	1.43	3.94	4.23	3.16	3.35	3.98	2.42
Product Size +850 µm Fraction	1.50	3.79	3.51	1.33	1.43	6.60	1.67	3.73	2.47	1.24	3.37	3.78	3.00	3.96	3.45	2.07
Product Size +600 µm Fraction	1.34	3.55	2.96	1.19	1.36	6.79	1.47	3.45	2.12	1.05	2.99	3.66	3.05	6.47	3.16	1.90
Product Size +425 µm Fraction	1.22	3.25	2.68	1.08	1.23	7.04	1.34	3.16	1.91	0.99	3.16	3.25	3.02	3.06	2.76	1.75
Product Size +300 µm Fraction	1.00	2.98	2.22	0.84	0.97	6.87	1.16	2.91	1.66	0.80	1.84	2.69	2.75	2.10	2.40	1.43
Product Size +212 µm Fraction	0.87	2.89	1.89	0.69	0.81	5.89	1.12	2.85	1.62	0.71	2.35	2.69	2.61	1.87	2.31	1.27
Product Size +150 µm Fraction	0.76	3.05	1.69	0.59	0.68	5.22	1.13	3.02	1.69	0.66	1.37	2.24	2.78	1.63	2.26	1.11
Product Size +106 µm Fraction	0.73	3.16	1.64	0.56	0.64	4.07	2.16	3.05	1.93	0.69	2.04	2.30	2.59	1.72	2.18	1.07
Product Size +75 µm Fraction	1.12	3.83	2.20	0.99	1.16	4.58	3.04	3.80	2.81	1.24	1.75	2.61	3.19	2.09	2.93	1.53
Product Size +53 µm Fraction	1.69	4.37	2.72	1.66	1.92	1.96	2.98	4.28	5.49	2.43	4.03	3.20	5.43	2.53	3.42	2.13
Product Size +38 µm Fraction	0.68	1.45	1.05	0.69	0.83	0.75	1.14	1.42	2.12	1.28	1.43	1.13	1.18	0.91	1.31	0.85
Product Size -38 µm Fraction	84.61	53.89	63.95	86.62	85.05	29.35	77.98	55.04	63.93	85.26	61.85	57.97	59.57	52.70	61.46	78.37
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 2 Product)

PRODUCT	WEIGHT	WEIGHT	ASSAY																DISTRIBUTION, %															
	g	%	Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	19.17	2.27	2.95	6.15	3.41	0.23	0.12	0.10	0.07	4.91	79.68	0.11	11.10	0.51	143	141	15	2.14	0.53	1.79	2.18	0.39	0.39	9.75	1.96	1.79	2.92	0.43	2.42	2.20	1.53	2.06	1.68	0.93
Product Size +2360 µm Fraction	21.18	2.51	4.15	9.34	5.19	0.37	0.19	0.03	0.06	7.38	69.89	0.16	14.20	0.64	171	194	20	2.95	0.83	3.01	3.66	0.70	0.69	3.23	1.85	2.97	2.83	0.68	3.41	3.06	2.03	3.13	2.48	1.41
Product Size +1700 µm Fraction	22.08	2.62	6.10	10.04	4.52	0.55	0.30	0.04	0.03	8.10	66.57	0.23	14.70	0.68	224	182	22	3.65	1.27	3.37	3.32	1.08	1.13	4.49	0.97	3.40	2.81	1.03	3.69	3.39	2.77	3.06	2.84	1.82
Product Size +1180 µm Fraction	29.30	3.48	7.16	11.10	4.89	0.68	0.38	0.05	0.04	8.98	62.18	0.28	12.70	0.74	245	215	26	4.24	1.98	4.94	4.77	1.77	1.90	7.45	1.71	5.01	3.48	1.66	4.22	4.89	4.02	4.80	4.46	2.81
Product Size +850 µm Fraction	22.40	2.66	7.64	11.54	4.77	0.76	0.45	0.05	0.03	9.21	60.61	0.30	11.90	0.80	256	220	28	4.56	1.61	3.93	3.56	1.51	1.72	5.70	0.98	3.93	2.59	1.36	3.03	4.04	3.21	3.76	3.67	2.31
Product Size +600 µm Fraction	19.03	2.26	7.91	12.06	4.79	0.78	0.48	0.07	0.04	9.44	58.90	0.31	13.60	0.85	255	211	28	4.95	1.42	3.49	3.04	1.32	1.56	6.77	1.11	3.42	2.14	1.19	2.94	3.65	2.72	3.06	3.12	2.13
Product Size +425 µm Fraction	18.42	2.18	7.82	12.40	4.77	0.75	0.47	0.08	0.04	9.83	58.96	0.30	14.20	0.84	290	210	28	4.77	1.36	3.47	2.93	1.23	1.48	7.49	1.07	3.45	2.07	1.12	2.97	3.49	2.99	2.95	3.02	1.98
Product Size +300 µm Fraction	15.29	1.81	7.39	13.11	4.55	0.68	0.44	0.08	0.04	10.17	58.75	0.28	13.00	0.89	310	207	27	4.60	1.07	3.05	2.32	0.92	1.15	6.22	0.89	2.96	1.71	0.86	2.26	3.07	2.65	2.41	2.42	1.59
Product Size +212 µm Fraction	13.84	1.64	6.68	13.66	4.06	0.59	0.37	0.07	0.04	10.70	59.51	0.26	10.30	0.77	327	194	27	4.28	0.87	2.87	1.87	0.73	0.87	4.93	0.81	2.82	1.57	0.73	1.62	2.40	2.53	2.05	2.19	1.34
Product Size +150 µm Fraction	14.52	1.72	5.83	13.71	3.58	0.50	0.30	0.06	0.04	10.81	61.55	0.24	11.20	0.70	326	170	26	3.71	0.80	3.03	1.73	0.65	0.74	4.43	0.85	2.99	1.71	0.70	1.85	2.29	2.65	1.88	2.21	1.22
Product Size +106 µm Fraction	14.69	1.74	5.09	13.13	3.25	0.42	0.27	0.05	0.07	10.20	64.00	0.23	8.00	0.67	309	159	24	3.26	0.71	2.93	1.59	0.55	0.68	3.74	1.50	2.85	1.79	0.68	1.33	2.22	2.54	1.78	2.06	1.08
Product Size +75 µm Fraction	23.58	2.80	5.62	11.51	3.01	0.52	0.33	0.04	0.05	8.88	66.82	0.29	8.90	0.54	245	133	22	3.29	1.25	4.12	2.36	1.09	1.33	4.80	1.72	3.99	3.01	1.38	2.38	2.87	3.23	2.39	3.04	1.75
Product Size +53 µm Fraction	40.04	4.75	4.82	7.67	2.15	0.49	0.30	0.01	0.04	5.91	76.05	0.33	9.40	0.40	164	105	16	2.58	1.82	4.67	2.87	1.74	2.05	2.04	2.34	4.50	5.81	2.67	4.27	3.61	3.68	3.21	3.75	2.33
Product Size +38 µm Fraction	11.63	1.38	5.13	6.47	2.16	0.54	0.31	0.01	0.05	5.12	76.58	0.45	6.80	0.36	147	101	15	2.67	0.56	1.14	0.84	0.56	0.61	0.59	0.85	1.13	1.70	1.06	0.90	0.94	0.96	0.90	1.02	0.70
Product Size -38 µm Fraction	557.96	66.18	15.95	6.39	3.39	1.73	0.88	0.01	0.10	5.16	59.98	0.75	9.90	0.46	200	147	19	6.08	83.92	54.19	62.98	85.77	83.71	28.38	81.40	54.79	63.87	84.47	62.72	57.88	62.48	62.55	62.05	76.61
(Calculated Head)	(843.13)	(100.00)	(12.58)	(7.80)	(3.56)	(1.33)	(0.70)	(0.02)	(0.08)	(6.23)	(62.15)	(0.59)	(10.45)	(0.53)	(212)	(156)	(20)	(5.25)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																																		

K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 4 Product)

PRODUCT	WEIGHT	WEIGHT	ASSAY																DISTRIBUTION, %															
	g	%	Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +3350 µm Fraction	19.43	2.30	3.64	6.13	3.48	0.28	0.14	0.01	0.05	5.02	78.49	0.13	10.50	0.40	137	118	14	2.13	0.67	1.82	2.31	0.50	0.47	0.99	1.44	1.88	2.91	0.51	2.89	1.77	1.49	1.75	1.61	0.89
Product Size +2360 µm Fraction	21.87	2.59	5.25	7.95	4.39	0.49	0.27	0.04	0.03	6.27	72.37	0.21	11.90	0.55	160	170	17	3.00	1.09	2.65	3.28	0.98	1.02	4.46	0.97	2.64	3.02	0.93	3.69	2.74	1.96	2.83	2.20	1.42
Product Size +1700 µm Fraction	25.42	3.01	6.59	9.77	4.14	0.65	0.38	0.03	0.03	7.76	67.73	0.26	12.20	0.61	198	161	22	3.61	1.60	3.79	3.59	1.51	1.67	3.89	1.13	3.79	3.29	1.34	4.39	3.53	2.82	3.12	3.30	1.98
Product Size +1180 µm Fraction	31.28	3.71	7.55	10.29	5.00	0.75	0.44	0.05	0.03	8.08	63.30	0.30	13.80	0.69	207	204	24	4.02	2.25	4.91	5.34	2.15	2.38	7.98	1.39	4.86	3.78	1.91	6.11	4.92	3.63	4.87	4.43	2.71
Product Size +850 µm Fraction	24.00	2.85	8.26	11.36	4.76	0.81	0.51	0.07	0.07	8.80	60.97	0.32	11.30	0.80	258	217	26	4.36	1.89	4.16	3.90	1.78	2.11	8.57	2.49	4.06	2.80	1.56	3.84	4.38	3.47	3.97	3.68	2.26
Product Size +600 µm Fraction	21.94	2.60	8.38	11.60	4.69	0.85	0.55	0.08	0.07	8.92	59.62	0.33	11.10	0.80	260	232	26	4.61	1.75	3.88	3.51	1.71	2.08	8.96	2.28	3.76	2.50	1.47	3.45	4.00	3.19	3.88	3.37	2.18
Product Size +425 µm Fraction	20.53	2.43	8.38	11.68	4.58	0.84	0.56	0.08	0.04	9.06	58.94	0.33	11.10	0.77	270	240	26	5.37	1.64	3.66	3.21	1.58	1.99	8.38	1.22	3.58	2.31	1.38	3.23	3.60	3.10	3.76	3.15	2.38
Product Size +300 µm Fraction	17.76	2.11	8.16	12.14	4.45	0.80	0.54	0.07	0.09	9.57	58.78	0.32	10.20	0.77	368	254	27	4.70	1.38	3.29	2.70	1.30	1.66	6.34	2.37	3.27	1.99	1.15	2.57	3.12	3.66	3.44	2.83	1.80
Product Size +212 µm Fraction	16.60	1.97	7.62	12.88	4.09	0.72	0.50	0.07	0.09	9.85	59.39	0.31	11.60	0.78	325	212	26	4.79	1.21	3.26	2.32	1.10	1.43	5.93	2.22	3.14	1.88	1.05	2.73	2.95	3.02	2.68	2.55	1.72
Product Size +150 µm Fraction	17.22	2.04	6.84	12.95	3.70	0.63	0.45	0.06	0.09	10.10	60.19	0.29	7.80	0.70	322	205	25	4.26	1.12	3.40	2.17	0.99	1.34	5.27	2.30	3.34	1.98	1.01	1.90	2.75	3.10	2.69	2.54	1.58
Product Size +106 µm Fraction	17.05	2.02	6.06	12.56	3.40	0.55	0.39	0.05	0.08	9.83	62.88	0.27	12.10	0.64	292	200	23	4.22	0.98	3.27	1.98	0.86	1.15	4.35	2.02	3.22	2.05	0.94	2.92	2.49	2.79	2.60	2.32	1.55
Product Size +75 µm Fraction	24.38	2.89	5.38	10.94	2.73	0.50	0.32	0.04	0.08	8.58	68.24	0.29	9.50	0.54	248	143	22	3.24	1.25	4.07	2.27	1.12	1.35	4.98	2.89	4.02	3.18	1.44	3.28	3.00	3.39	2.66	3.17	1.70
Product Size +53 µm Fraction	37.36	4.43	4.93	7.53	2.10	0.49	0.29	0.01	0.08	5.89	75.25	0.33	7.80	0.39	169	107	16	3.35	1.75	4.29	2.68	1.68	1.87	1.91	4.43	4.23	5.37	2.50	4.13	3.32	3.54	3.05	3.53	2.70
Product Size +38 µm Fraction	11.63	1.38	5.43	6.67	2.14	0.55	0.33	0.01	0.07	5.23	76.12	0.43	5.50	0.43	160	113	16	3.01	0.60	1.18	0.85	0.59	0.66	0.59	1.21	1.17	1.69	1.02	0.91	1.14	1.04	1.00	1.10	0.76
Product Size -38 µm Fraction	536.77	63.66	15.80	6.39	3.27	1.67	0.85	0.01	0.09	5.14	59.73	0.75	7.10	0.46	199	141	19	6.42	80.81	52.35	59.90	82.15	78.82	27.39	71.64	53.04	61.24	81.79	53.97	56.28	59.81	57.70	60.22	74.36
(Calculated Head)	(843.24)	(100.00)	(12.45)	(7.77)	(3.47)	(1.29)	(0.69)	(0.02)	(0.08)	(6.17)	(62.08)	(0.58)	(8.37)	(0.52)	(212)	(156)	(20)	(5.50)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																																		

TABLE 1. NOMINAL, F_{80}, AND P_{80} VALUES FOR MPH (

TESTS 3 AND 6

Composite MPH Ore Type	Nominal Feed Size mm	Ratio of Nominal Size	Particle F_{80} µm	Ratio of F_{80} Particle	Ratio of Nominal / F_{80}	Crushing HPGR P_{80}, µm
Standard	-12.7	--	8900.00	--	1.43	--
Standard	-2	6.35	1410.00	6.31	1.42	--
Composite C, 0.38 m/s	-9	1.41	3152.00	2.82	2.86	243.00
Composite C, 0.77 m/s	-9	1.41	3152.00	2.82	2.86	152.00

:OMPOSITE SAMPLES

Ratio of Reduction HPGR, R_{80}	Attrition P_{80} µm	Ratio of Reduction Attrition, R_{80}
--	--	--
--	550.00	2.56
12.97	92.00	2.64
20.74	86.00	1.77

K12023 ATTRITIONING TEST 88 RESULTS (Composite C/HPGR Test 6 Product : 15 min attritiong time at 47.5% solids pulp density and 1200 rpm)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Attritioned +3350 µm Fraction	12.76	1.51	2.34	7.17	1.25	0.16	0.08	0.02	0.01	5.66	81.06	0.08	5.30	0.44	127	82	19	1.67	0.29	1.39	0.54	0.19	0.18	1.57	0.36	1.41	1.97	0.20	1.44	1.27	0.97	1.06	1.65	0.46
Attritioned -3350+2360 µm Fraction	14.12	1.68	2.82	6.16	4.79	0.17	0.08	0.01	0.01	5.03	78.79	0.11	9.80	0.43	118	158	16	2.35	0.39	1.32	2.27	0.22	0.20	0.87	0.40	1.39	2.12	0.31	2.95	1.37	1.00	2.26	1.54	0.71
(Attritioned +2360 µm Fraction)	(26.88)	(3.19)	(2.59)	(6.64)	(3.11)	(0.17)	(0.08)	(0.01)	(0.01)	(5.33)	(79.87)	(0.10)	(7.66)	(0.43)	(122)	(122)	(17)	(2.03)	(0.69)	(2.72)	(2.81)	(0.42)	(0.38)	(2.44)	(0.75)	(2.80)	(4.08)	(0.52)	(4.39)	(2.64)	(1.97)	(3.32)	(3.19)	(1.17)
Attritioned -2360+1400 µm Fraction	23.27	2.76	3.35	10.57	4.51	0.23	0.11	0.03	0.02	7.71	69.72	0.12	15.20	0.66	189	137	21	3.01	0.77	3.75	3.52	0.50	0.45	4.30	1.30	3.50	3.08	0.56	7.54	3.47	2.64	3.23	3.33	1.51
(Attritioned +1400 µm Fraction)	(50.15)	(5.95)	(2.94)	(8.46)	(3.76)	(0.20)	(0.09)	(0.02)	(0.01)	(6.43)	(75.16)	(0.11)	(11.16)	(0.54)	(153)	(129)	(19)	(2.48)	(1.45)	(6.46)	(6.33)	(0.92)	(0.83)	(6.75)	(2.06)	(6.30)	(7.17)	(1.08)	(11.94)	(6.11)	(4.61)	(6.55)	(6.52)	(2.68)
Attritioned -1400+425 µm Fraction	46.45	5.51	4.53	12.55	4.97	0.32	0.16	0.07	0.02	9.60	64.22	0.17	14.20	0.83	259	201	27	3.56	2.07	8.88	7.75	1.39	1.32	20.04	2.60	8.70	5.67	1.58	14.07	8.71	7.21	9.46	8.54	3.56
(Attritioned +425 µm Fraction)	(96.60)	(11.47)	(3.71)	(10.43)	(4.34)	(0.26)	(0.13)	(0.04)	(0.02)	(7.96)	(69.90)	(0.14)	(12.62)	(0.68)	(204)	(164)	(23)	(3.00)	(3.52)	(15.34)	(14.08)	(2.31)	(2.15)	(26.79)	(4.66)	(15.00)	(12.84)	(2.66)	(26.00)	(14.82)	(11.82)	(16.00)	(15.05)	(6.23)
Attritioned -425+106 µm Fraction	46.49	5.52	3.96	13.23	3.77	0.26	0.15	0.08	0.03	10.03	64.67	0.16	11.20	0.79	307	160	26	2.99	1.81	9.37	5.88	1.13	1.24	22.92	3.91	9.10	5.72	1.49	11.10	8.30	8.56	7.53	8.23	2.99
(Attritioned +106 µm Fraction)	(143.09)	(16.99)	(3.79)	(11.34)	(4.16)	(0.26)	(0.13)	(0.06)	(0.02)	(8.63)	(68.20)	(0.14)	(12.16)	(0.72)	(238)	(162)	(24)	(3.00)	(5.33)	(24.71)	(19.96)	(3.44)	(3.39)	(49.71)	(8.57)	(24.10)	(18.55)	(4.15)	(37.11)	(23.12)	(20.38)	(23.54)	(23.28)	(9.22)
Attritioned -106+20 µm Fraction	116.66	13.85	4.10	7.76	2.16	0.39	0.18	0.02	0.03	5.86	76.41	0.35	3.80	0.42	174	74	17	2.37	4.71	13.79	8.46	4.26	3.72	14.38	9.81	13.34	16.95	8.19	9.45	11.07	12.17	8.74	13.50	5.95
(Attritioned +20 µm Fraction)	(259.75)	(30.83)	(3.93)	(9.73)	(3.26)	(0.32)	(0.15)	(0.04)	(0.03)	(7.39)	(71.89)	(0.24)	(8.41)	(0.58)	(209)	(46)	(9)	(2.72)	(10.04)	(38.50)	(28.42)	(7.71)	(7.11)	(64.09)	(18.37)	(37.45)	(35.50)	(12.34)	(46.56)	(34.18)	(32.56)	(12.06)	(16.69)	(15.17)
Attritioned -20 µm Fraction	582.69	69.17	15.69	6.93	3.66	1.69	0.90	0.01	0.05	5.50	58.22	0.75	4.30	0.50	193	149	21	6.77	89.96	61.50	71.58	92.29	92.89	35.91	81.63	62.55	64.50	87.66	53.44	65.82	67.44	87.94	83.31	84.83
(Calculated Head)	(842.44)	(100.00)	(12.06)	(7.79)	(3.54)	(1.27)	(0.67)	(0.02)	(0.04)	(6.08)	(62.43)	(0.59)	(5.57)	(0.53)	(198)	(117)	(17)	(5.52)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																																		

K12023 ATTRITIONING TEST 88 RESULTS (Composite C/HPGR Test 6 Product : 15 min attritiong time at 47.5% solids pulp density and 1200 rpm)

PRODUCT	WEIGHT g	WEIGHT %	CUM WEIGHT %	PASSING WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	P_2O_5 %	SiO_2 %	CUM. ASSAY Al_2O_3 % CUM	CaO % CUM	Fe_2O_3 % CUM	P_2O_5 % CUM	SiO_2 % CUM	DISTRIBUTION, % Al_2O_3 %	CaO %	Fe_2O_3 %	P_2O_5 %	SiO_2 %	CUM. DISTRIBUTION, % Al_2O_3 CUM	CaO CUM	Fe_2O_3 CUM	P_2O_5 CUM	SiO_2 CUM	Size Fraction Opening µm
Attritioned +3350 µm Fraction	12.76	1.51	1.51	98.49	2.34	7.17	1.25	5.66	81.06	2.34	7.17	1.25	5.66	81.06	0.29	1.39	0.54	1.41	1.97	0.29	1.39	0.54	1.41	1.97	3350
Attritioned -3350+2360 µm Fraction	14.12	1.68	3.19	96.81	2.82	6.16	4.79	5.03	78.79	2.59	6.64	3.11	5.33	79.87	0.39	1.32	2.27	1.39	2.12	0.69	2.72	2.81	2.80	4.08	2360
Attritioned -2360+1400 µm Fraction	23.27	2.76	5.95	94.05	3.35	10.57	4.51	7.71	69.72	2.94	8.46	3.76	6.43	75.16	0.77	3.75	3.52	3.50	3.08	1.45	6.46	6.33	6.30	7.17	1400
Attritioned -1400+425 µm Fraction	46.45	5.51	11.47	88.53	4.53	12.55	4.97	9.60	64.22	3.71	10.43	4.34	7.96	69.90	2.07	8.88	7.75	8.70	5.67	3.52	15.34	14.08	15.00	12.84	425
Attritioned -425+106 µm Fraction	46.49	5.52	16.99	83.01	3.96	13.23	3.77	10.03	64.67	3.79	11.34	4.16	8.63	68.20	1.81	9.37	5.88	9.10	5.72	5.33	24.71	19.96	24.10	18.55	106
Attritioned -106+20 µm Fraction	116.66	13.85	30.83	69.17	4.10	7.76	2.16	5.86	76.41	3.93	9.73	3.26	7.39	71.89	4.71	13.79	8.46	13.34	16.95	10.04	38.50	28.42	37.45	35.50	20
Attritioned -20 µm Fraction	582.69	69.17	100.00	0.00	15.69	6.93	3.66	5.50	58.22	12.06	7.79	3.54	6.08	62.43	89.96	61.50	71.58	62.55	64.50	100.00	100.00	100.00	100.00	100.00	4.47
(Calculated Head)	(842.44)	(100.00)			(12.06)	(7.79)	(3.54)	(6.08)	(62.43)						(100.00)	(100.00)	(100.00)	(100.00)	(100.00)						

SUMMARY K12023 ATTRITIONING TEST 88 RESULTS (Composite C/HPGR Test 6 Product : 15 min attritiong time at 47.5% solids pulp density and 1200 rpm)

(Attritioned +2360 µm Fraction)	**26.88**	**3.19**	**3.19**	**96.81**	**2.59**	**6.64**	**3.11**	**5.33**	**79.87**						**0.69**	**2.72**	**2.81**	**2.80**	**4.08**					
(Attritioned 2360x20 µm Fraction)	**232.87**	**27.64**	**27.64**	**69.17**	**4.08**	**10.09**	**3.28**	**7.62**	**70.97**						**9.36**	**35.78**	**25.61**	**34.65**	**31.42**					
Attritioned -20 µm Fraction	**582.69**	**69.17**	**100.00**	**0.00**	**15.69**	**6.93**	**3.66**	**5.50**	**58.22**	**12.06**	**7.79**	**3.54**	**6.08**	**62.43**	**89.96**	**61.50**	**71.58**	**62.55**	**64.50**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

SUMMARY K12023 SIZE-ASSAY RESULTS (Composite C HPGR Test 6 Product)

Product Size +2360	**32.08**	**3.81**	**3.81**	**96.19**	**3.74**	**9.70**	**4.56**	**7.24**	**74.76**						**1.20**	**4.69**	**4.84**	**4.51**	**4.57**					
Product Size 2360x38	**221.00**	**26.06**	**26.06**	**70.13**	**5.20**	**10.99**	**3.86**	**8.28**	**66.76**						**11.38**	**36.31**	**28.02**	**35.25**	**27.87**					
Product Size -38 µm Fraction	**589.97**	**70.13**	**100.00**	**0.00**	**14.85**	**6.64**	**3.44**	**5.26**	**60.14**	**11.91**	**7.89**	**3.59**	**6.12**	**62.42**	**87.42**	**59.01**	**67.15**	**60.25**	**67.56**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

K12023 ATTRITIONING TEST 89 (duplicate of Test 88) RESULTS (Composite C/HPGR Test 6 Product : 15 min attritiong time at 47.5% solids pulp density and 1200 rpm)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Attritioned +3350 µm Fraction	9.90	1.17	2.06	4.23	2.14	0.14	0.06	0.01	0.01	3.48	86.38	0.08	3.10	0.32	94	65	11	1.73	0.20	0.63	0.70	0.13	0.10	0.56	0.23	0.67	1.62	0.16	0.34	0.73	0.55	0.61	0.74	0.36
Attritioned -3350+2360 µm Fraction	12.95	1.53	3.20	9.47	3.27	0.23	0.10	0.01	0.03	7.44	73.89	0.11	8.20	0.62	143	160	20	2.44	0.41	1.86	1.40	0.27	0.22	0.73	0.92	1.87	1.82	0.28	1.18	1.84	1.10	1.97	1.76	0.66
(Attritioned +2360 µm Fraction)	(22.85)	(2.71)	(2.71)	(7.20)	(2.78)	(0.19)	(0.08)	(0.01)	(0.02)	(5.72)	(79.30)	(0.10)	(5.99)	(0.49)	(122)	(119)	(16)	(2.13)	(0.61)	(2.49)	(2.11)	(0.40)	(0.32)	(1.29)	(1.15)	(2.54)	(3.44)	(0.44)	(1.52)	(2.56)	(1.65)	(2.58)	(2.50)	(1.02)
Attritioned -2360+1400 µm Fraction	23.80	2.82	3.77	10.14	5.18	0.25	0.12	0.05	0.01	7.85	70.59	0.14	12.70	1.33	204	397	22	3.09	0.88	3.66	4.09	0.55	0.49	6.71	0.56	3.62	3.19	0.66	3.37	7.24	2.88	8.96	3.56	1.53
(Attritioned +1400 µm Fraction)	(46.65)	(5.53)	(3.25)	(8.70)	(4.00)	(0.22)	(0.10)	(0.03)	(0.02)	(6.81)	(74.86)	(0.12)	(9.41)	(0.92)	(164)	(261)	(19)	(2.62)	(1.49)	(6.15)	(6.20)	(0.95)	(0.81)	(8.00)	(1.72)	(6.16)	(6.63)	(1.10)	(4.89)	(9.81)	(4.52)	(11.54)	(6.07)	(2.55)
Attritioned -1400+425 µm Fraction	45.84	5.43	4.53	12.36	5.11	0.33	0.17	0.07	0.03	9.34	64.46	0.17	11.60	0.88	242	227	27	3.58	2.04	8.58	7.77	1.39	1.34	18.09	3.25	8.30	5.61	1.54	5.92	9.23	6.57	9.87	8.42	3.42
(Attritioned +425 µm Fraction)	(92.49)	(10.96)	(3.88)	(10.51)	(4.55)	(0.28)	(0.14)	(0.05)	(0.02)	(8.06)	(69.70)	(0.14)	(10.50)	(0.90)	(203)	(244)	(23)	(3.10)	(3.52)	(14.73)	(13.97)	(2.35)	(2.15)	(26.09)	(4.97)	(14.46)	(12.24)	(2.64)	(10.81)	(19.04)	(11.09)	(21.41)	(14.49)	(5.98)
Attritioned -425+106 µm Fraction	46.57	5.52	3.99	13.52	3.76	0.28	0.18	0.08	0.03	10.11	64.53	0.22	10.80	0.71	308	179	26	3.27	1.82	9.54	5.81	1.20	1.44	21.01	3.30	9.13	5.70	2.03	5.60	7.57	8.49	7.91	8.24	3.18
(Attritioned +106 µm Fraction)	(139.06)	(16.48)	(3.92)	(11.52)	(4.29)	(0.28)	(0.15)	(0.06)	(0.03)	(8.75)	(67.97)	(0.17)	(10.60)	(0.84)	(238)	(222)	(24)	(3.15)	(5.34)	(24.27)	(19.78)	(3.55)	(3.59)	(47.10)	(8.27)	(23.59)	(17.94)	(4.67)	(16.41)	(26.61)	(19.59)	(29.32)	(22.72)	(9.15)
Attritioned -106+20 µm Fraction	116.80	13.84	4.11	7.81	2.13	0.40	0.18	0.03	0.03	5.95	76.20	0.35	8.90	0.38	171	94	17	2.70	4.71	13.82	8.25	4.31	3.61	19.76	8.29	13.48	16.89	8.09	11.58	10.16	11.83	10.42	13.51	6.58
(Attritioned +20 µm Fraction)	(255.86)	(30.33)	(4.01)	(9.83)	(3.30)	(0.33)	(0.16)	(0.05)	(0.03)	(7.47)	(71.73)	(0.25)	(9.82)	(0.63)	(207)	(54)	(9)	(2.95)	(10.05)	(38.10)	(28.03)	(7.86)	(7.20)	(66.85)	(16.56)	(37.07)	(34.84)	(12.76)	(27.99)	(36.77)	(31.42)	(12.99)	(16.01)	(15.73)
Attritioned -20 µm Fraction	587.85	69.67	15.61	6.95	3.69	1.70	0.92	0.01	0.06	5.52	58.40	0.75	11.00	0.47	197	156	21	6.87	89.95	61.90	71.97	92.14	92.80	33.15	83.44	62.93	65.16	87.24	72.01	63.23	68.58	87.01	83.99	84.27
(Calculated Head)	(843.71)	(100.00)	(12.09)	(7.82)	(3.57)	(1.29)	(0.69)	(0.02)	(0.05)	(6.11)	(62.44)	(0.60)	(10.64)	(0.52)	(200)	(125)	(17)	(5.68)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																																		

K12023 SIZE-ASSAY RESULTS (HPGR Composite A -9.5 mm Head Sample)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +8000 µm Fraction	57.79	5.79	1.25	30.31	0.96	0.13	0.07	0.01	0.01	22.27	42.65	0.06	2	2.00	159	217	17	1.38
Product Size +6700 µm Fraction	130.92	13.11	1.91	28.59	0.97	0.21	0.08	0.01	0.01	21.20	44.64	0.10	4	2.10	185	183	17	1.44
Product Size +4750 µm Fraction	194.23	19.45	1.78	31.39	0.78	0.18	0.08	0.03	0.01	23.21	40.24	0.09	1	2.30	211	172	18	1.32
Product Size +3350 µm Fraction	128.55	12.87	1.87	31.34	0.95	0.20	0.08	0.03	0.01	23.58	40.08	0.10	4	2.20	197	190	19	1.39
Product Size +2360 µm Fraction	86.39	8.65	2.07	32.69	1.01	0.21	0.08	0.04	0.01	24.68	37.50	0.11	3	2.50	285	227	20	1.52
Product Size +1700 µm Fraction	60.35	6.04	2.34	32.53	1.29	0.21	0.10	0.04	0.03	23.46	36.52	0.11	3	2.40	265	284	21	1.53
Product Size +1180 µm Fraction	52.60	5.27	2.30	33.19	1.33	0.23	0.15	0.04	0.03	24.35	36.61	0.12	4	2.50	266	273	21	1.63
Product Size +850 µm Fraction	35.10	3.52	2.48	33.76	1.41	0.25	0.10	0.05	0.03	24.80	35.52	0.12	7	2.50	301	292	21	1.68
Product Size +600 µm Fraction	34.11	3.42	2.57	33.60	1.60	0.25	0.10	0.05	0.01	24.49	35.50	0.13	1	2.90	323	339	22	1.76
Product Size +425 µm Fraction	25.37	2.54	2.79	32.26	1.79	0.26	0.10	0.07	0.03	24.03	36.07	0.14	6	2.60	343	374	22	1.88
Product Size +300 µm Fraction	19.23	1.93	2.68	33.10	1.93	0.26	0.10	0.08	0.03	24.38	35.09	0.13	6	2.70	390	404	22	1.96
Product Size +212 µm Fraction	16.76	1.68	2.64	32.88	2.00	0.25	0.10	0.09	0.03	24.19	35.11	0.13	6	2.70	393	424	22	1.96
Product Size +150 µm Fraction	13.32	1.33	2.53	33.33	2.15	0.24	0.10	0.10	0.01	24.19	35.07	0.13	3	2.60	402	454	23	1.94
Product Size +106 µm Fraction	13.46	1.35	2.39	32.47	1.94	0.22	0.10	0.09	0.01	24.05	36.91	0.13	10	2.60	390	435	23	2.01
Product Size +75 µm Fraction	11.42	1.14	2.27	31.02	1.78	0.22	0.10	0.08	0.04	22.74	39.71	0.14	6	2.40	363	424	21	1.86
Product Size +53 µm Fraction	11.01	1.10	2.16	28.79	1.53	0.22	0.10	0.07	0.04	21.15	43.86	0.15	6	2.20	334	376	20	1.85
Product Size +38 µm Fraction	7.98	0.80	2.24	25.25	1.39	0.24	0.10	0.06	0.04	18.32	49.81	0.17	5	2.10	305	354	18	1.74
Product Size -38 µm Fraction	99.98	10.01	8.27	26.07	1.91	0.65	0.25	0.05	0.04	18.86	39.69	0.32	5	2.40	333	393	22	3.55
(Calculated Head)	(998.57)	(100.00)	(2.65)	(30.89)	(1.21)	(0.25)	(0.11)	(0.04)	(0.02)	(22.82)	(39.61)	(0.13)	(4)	(2.34)	(253)	(255)	(20)	(1.72)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +8000 µm Fraction	2.72	5.68	4.60	3.01	3.85	1.54	3.20	5.65	6.23	2.75	3.31	4.94	3.63	4.93	5.04	4.65
Product Size +6700 µm Fraction	9.43	12.13	10.54	11.01	9.98	3.49	7.24	12.18	14.78	10.37	14.98	11.75	9.58	9.41	11.41	11.00
Product Size +4750 µm Fraction	13.04	19.76	12.57	14.00	14.81	15.52	10.74	19.78	19.76	13.84	5.56	19.09	16.21	13.12	17.93	14.96
Product Size +3350 µm Fraction	9.07	13.06	10.13	10.30	9.80	10.28	7.11	13.30	13.03	10.18	14.71	12.09	10.02	9.59	12.52	10.43
Product Size +2360 µm Fraction	6.75	9.15	7.24	7.27	6.59	9.21	4.78	9.36	8.19	7.52	7.41	9.23	9.74	7.70	8.86	7.66
Product Size +1700 µm Fraction	5.33	6.36	6.46	5.08	5.75	6.43	10.01	6.21	5.57	5.26	5.18	6.19	6.33	6.73	6.50	5.39
Product Size +1180 µm Fraction	4.56	5.66	5.80	4.85	7.52	5.61	8.73	5.62	4.87	5.00	6.02	5.62	5.53	5.64	5.66	5.00
Product Size +850 µm Fraction	3.28	3.84	4.11	3.51	3.34	4.68	5.82	3.82	3.15	3.33	7.03	3.75	4.18	4.03	3.78	3.44
Product Size +600 µm Fraction	3.31	3.71	4.53	3.42	3.25	4.54	1.89	3.67	3.06	3.51	0.98	4.23	4.36	4.54	3.85	3.50
Product Size +425 µm Fraction	2.67	2.65	3.77	2.64	2.42	4.73	4.21	2.67	2.31	2.81	4.36	2.82	3.44	3.73	2.86	2.78
Product Size +300 µm Fraction	1.94	2.06	3.08	2.00	1.83	4.10	3.19	2.06	1.71	1.98	3.30	2.22	2.97	3.05	2.17	2.20
Product Size +212 µm Fraction	1.67	1.79	2.78	1.68	1.60	4.02	2.78	1.78	1.49	1.73	2.88	1.93	2.61	2.79	1.89	1.92
Product Size +150 µm Fraction	1.27	1.44	2.38	1.28	1.27	3.55	0.74	1.41	1.18	1.37	1.14	1.48	2.12	2.38	1.57	1.51
Product Size +106 µm Fraction	1.21	1.42	2.17	1.19	1.28	3.23	0.74	1.42	1.26	1.39	3.85	1.50	2.08	2.30	1.59	1.58
Product Size +75 µm Fraction	0.98	1.15	1.69	1.01	1.09	2.43	2.53	1.14	1.15	1.27	1.96	1.17	1.64	1.90	1.23	1.24
Product Size +53 µm Fraction	0.90	1.03	1.40	0.97	1.05	2.05	2.44	1.02	1.22	1.31	1.89	1.04	1.45	1.63	1.13	1.19
Product Size +38 µm Fraction	0.67	0.65	0.92	0.77	0.76	1.28	1.76	0.64	1.01	1.07	1.14	0.72	0.96	1.11	0.74	0.81
Product Size -38 µm Fraction	31.19	8.45	15.84	26.03	23.82	13.32	22.11	8.27	10.03	25.33	14.30	10.25	13.17	15.43	11.28	20.72
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS (HPGR Composite B -9.5 mm Head Sample)

PRODUCT	WEIGHT g	WEIGHT %	ASSAY Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +8000 µm Fraction	32.92	3.30	3.04	17.04	0.82	0.35	0.13	0.01	0.03	12.64	64.27	0.15	1	2.00	125	118	14	1.66
Product Size +6700 µm Fraction	86.23	8.63	2.79	21.78	0.94	0.28	0.13	0.01	0.04	15.34	55.81	0.12	1	1.80	155	132	19	2.06
Product Size +3350 µm Fraction	134.20	13.44	3.42	21.74	1.50	0.32	0.13	0.01	0.04	16.08	54.39	0.14	1	2.00	156	168	20	2.13
Product Size +3350 µm Fraction	115.33	11.55	3.25	24.14	0.74	0.34	0.15	0.03	0.04	17.37	51.83	0.14	1	2.10	168	130	21	1.31
Product Size +2360 µm Fraction	75.26	7.54	3.88	24.71	1.00	0.37	0.18	0.03	0.04	17.88	49.59	0.16	1	2.20	197	164	22	2.50
Product Size +1700 µm Fraction	53.07	5.31	4.02	24.30	1.00	0.40	0.20	0.05	0.04	17.79	49.55	0.16	1	2.20	192	170	22	2.49
Product Size +1180 µm Fraction	45.10	4.52	4.33	24.59	1.00	0.44	0.22	0.04	0.05	17.63	48.51	0.17	1	2.30	208	161	23	2.60
Product Size +850 µm Fraction	29.98	3.00	4.40	24.46	0.99	0.43	0.25	0.06	0.05	18.11	48.97	0.17	4	2.20	211	171	21	2.72
Product Size +600 µm Fraction	34.81	3.49	4.96	24.92	0.97	0.51	0.30	0.05	0.05	18.07	47.05	0.20	1	2.20	236	181	23	3.04
Product Size +425 µm Fraction	26.63	2.67	5.22	25.00	1.01	0.54	0.35	0.06	0.06	18.40	45.33	0.22	1	2.20	253	186	24	3.27
Product Size +300 µm Fraction	20.11	2.01	4.91	27.08	0.97	0.49	0.32	0.06	0.07	19.82	43.06	0.20	2	2.40	275	193	26	3.18
Product Size +212 µm Fraction	17.97	1.80	4.38	29.22	0.92	0.44	0.27	0.07	0.08	21.48	39.45	0.18	2	2.40	313	213	29	3.06
Product Size +150 µm Fraction	17.77	1.78	3.56	33.78	0.80	0.35	0.22	0.07	0.11	25.05	32.57	0.15	1	2.60	310	242	35	2.82
Product Size +106 µm Fraction	18.89	1.89	3.10	34.92	0.71	0.31	0.20	0.05	0.10	25.27	32.23	0.14	1	2.40	293	246	36	2.61
Product Size +75 µm Fraction	25.95	2.60	2.67	26.98	0.56	0.27	0.15	0.03	0.09	19.41	47.19	0.15	1	1.90	196	187	26	2.21
Product Size +53 µm Fraction	24.60	2.46	2.43	18.08	0.46	0.27	0.13	0.01	0.05	13.30	63.63	0.18	1	1.30	141	130	18	1.71
Product Size +38 µm Fraction	16.46	1.65	2.88	17.20	0.52	0.34	0.17	0.01	0.07	12.34	64.21	0.29	1	1.30	133	134	18	1.87
Product Size -38 µm Fraction	223.40	22.37	12.04	17.37	1.30	1.31	0.60	0.01	0.07	12.76	48.29	0.58	1	1.70	186	207	23	4.98
(Calculated Head)	(998.68)	(100.00)	(5.49)	(22.33)	(1.05)	(0.57)	(0.27)	(0.03)	(0.05)	(16.26)	(50.53)	(0.25)	(1)	(1.99)	(188)	(171)	(22)	(2.85)
Assayed Head																		

PRODUCT	DISTRIBUTION, % Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +8000 µm Fraction	1.82	2.52	2.58	2.01	1.56	1.27	1.84	2.56	4.19	1.96	2.92	3.32	2.19	2.27	2.09	1.92
Product Size +6700 µm Fraction	4.39	8.42	7.74	4.21	4.08	3.33	6.42	8.15	9.54	4.11	7.65	7.82	7.11	6.66	7.44	6.25
Product Size +3350 µm Fraction	8.37	13.08	19.23	7.49	6.36	5.18	10.00	13.29	14.46	7.47	11.91	13.53	11.14	13.19	12.18	10.06
Product Size +3350 µm Fraction	6.83	12.48	8.15	6.84	6.30	13.35	8.59	12.34	11.84	6.42	10.24	12.21	10.31	8.77	10.99	5.32
Product Size +2360 µm Fraction	5.32	8.34	7.19	4.86	4.94	8.71	5.61	8.29	7.40	4.79	6.68	8.34	7.89	7.22	7.51	6.62
Product Size +1700 µm Fraction	3.89	5.78	5.07	3.70	3.87	10.24	3.95	5.81	5.21	3.38	4.71	5.88	5.42	5.28	5.30	4.65
Product Size +1180 µm Fraction	3.56	4.97	4.31	3.46	3.61	6.96	4.20	4.90	4.34	3.05	4.00	5.23	4.99	4.25	4.71	4.13
Product Size +850 µm Fraction	2.41	3.29	2.83	2.25	2.73	6.94	2.79	3.34	2.91	2.03	10.64	3.32	3.37	3.00	2.86	2.87
Product Size +600 µm Fraction	3.15	3.89	3.23	3.10	3.80	6.71	3.24	3.87	3.25	2.77	3.09	3.86	4.37	3.69	3.63	3.72
Product Size +425 µm Fraction	2.53	2.98	2.57	2.51	3.40	6.16	2.98	3.02	2.39	2.33	2.36	2.95	3.58	2.90	2.90	3.06
Product Size +300 µm Fraction	1.80	2.44	1.86	1.72	2.34	4.65	2.62	2.45	1.72	1.60	3.57	2.43	2.94	2.27	2.37	2.25
Product Size +212 µm Fraction	1.44	2.35	1.58	1.38	1.77	4.85	2.68	2.38	1.40	1.29	3.19	2.17	2.99	2.24	2.37	1.93
Product Size +150 µm Fraction	1.15	2.69	1.36	1.08	1.42	4.80	3.64	2.74	1.15	1.06	1.58	2.33	2.93	2.52	2.82	1.76
Product Size +106 µm Fraction	1.07	2.96	1.28	1.02	1.38	3.64	3.52	2.94	1.21	1.05	1.68	2.28	2.94	2.72	3.09	1.73
Product Size +75 µm Fraction	1.26	3.14	1.39	1.22	1.42	3.00	4.35	3.10	2.43	1.55	2.30	2.48	2.71	2.84	3.06	2.02
Product Size +53 µm Fraction	1.09	1.99	1.08	1.16	1.17	0.95	2.29	2.01	3.10	1.76	2.18	1.61	1.85	1.87	2.01	1.48
Product Size +38 µm Fraction	0.86	1.27	0.82	0.98	1.02	0.63	2.15	1.25	2.09	1.90	1.46	1.08	1.16	1.29	1.34	1.08
Product Size -38 µm Fraction	49.05	17.40	27.74	51.03	48.83	8.62	29.13	17.55	21.38	51.51	19.83	19.14	22.11	27.05	23.32	39.14
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

K12023 SIZE-ASSAY RESULTS (HPGR Composite C -9.5 mm Head Sample)

PRODUCT	WEIGHT	WEIGHT	ASSAY															
	g	%	Al_2O_3 %	CaO %	Fe_2O_3 %	K_2O %	MgO %	MnO %	Na_2O %	P_2O_5 %	SiO_2 %	TiO_2 %	As ppm	Cd ppm	Pb ppm	Zn ppm	U ppm	LOI %
Product Size +8000 µm Fraction	21.98	2.20	4.82	9.29	1.85	0.52	0.20	0.01	0.04	6.88	73.28	0.24	3	0.60	134	72	17	2.45
Product Size +6700 µm Fraction	39.48	3.96	7.22	9.61	1.89	0.69	0.27	0.01	0.05	6.94	68.59	0.29	1	0.40	136	76	26	3.55
Product Size +3350 µm Fraction	84.99	8.52	7.68	11.14	4.80	0.68	0.30	0.01	0.04	8.66	61.70	0.32	7	0.70	180	130	29	4.18
Product Size +3350 µm Fraction	70.34	7.05	8.86	11.35	4.42	0.85	0.40	0.01	0.05	8.46	61.41	0.40	7	0.70	188	115	26	4.63
Product Size +2360 µm Fraction	51.81	5.19	9.71	10.75	3.93	1.04	0.66	0.01	0.06	8.06	60.26	0.43	6	0.60	186	141	25	5.14
Product Size +1700 µm Fraction	41.45	4.16	10.10	9.69	4.49	1.21	0.84	0.01	0.05	7.12	61.38	0.47	4	0.60	167	147	23	5.34
Product Size +1180 µm Fraction	36.20	3.63	10.13	9.96	4.20	1.24	0.93	0.04	0.06	7.27	60.54	0.48	5	0.60	192	166	24	5.11
Product Size +850 µm Fraction	25.17	2.52	9.72	10.68	4.06	1.20	0.90	0.04	0.06	7.62	59.69	0.45	7	0.60	191	149	23	5.79
Product Size +600 µm Fraction	34.58	3.47	10.57	10.00	4.16	1.29	1.01	0.04	0.06	7.43	59.32	0.50	7	0.50	184	154	22	5.86
Product Size +425 µm Fraction	31.83	3.19	10.94	9.71	4.30	1.34	1.03	0.04	0.06	7.06	59.89	0.52	5	0.50	222	150	22	6.03
Product Size +300 µm Fraction	22.33	2.24	10.15	10.64	4.43	1.18	0.93	0.05	0.05	7.97	57.33	0.49	4	0.50	220	153	20	5.90
Product Size +212 µm Fraction	18.37	1.84	9.19	11.49	4.19	0.99	0.78	0.05	0.05	8.58	57.98	0.45	9	0.60	243	158	23	5.53
Product Size +150 µm Fraction	16.16	1.62	8.12	11.84	4.03	0.83	0.65	0.04	0.06	9.07	59.73	0.42	7	0.50	245	147	22	6.05
Product Size +106 µm Fraction	17.91	1.80	7.00	11.28	3.69	0.69	0.51	0.04	0.05	8.23	64.16	0.39	6	0.50	233	136	21	4.29
Product Size +75 µm Fraction	19.96	2.00	5.95	9.66	2.79	0.56	0.38	0.03	0.04	7.36	70.22	0.36	3	0.40	188	108	18	3.60
Product Size +53 µm Fraction	25.32	2.54	4.95	6.56	2.01	0.47	0.28	0.01	0.03	5.12	78.24	0.37	3	0.30	133	81	14	2.90
Product Size +38 µm Fraction	17.34	1.74	5.46	5.44	1.97	0.55	0.30	0.01	0.04	4.28	78.76	0.51	1	0.30	119	80	13	2.89
Product Size -38 µm Fraction	422.10	42.32	16.43	4.80	2.90	1.84	0.99	0.01	0.06	3.88	62.62	0.83	1	0.30	177	134	16	6.63
(Calculated Head)	(997.32)	(100.00)	(11.87)	(7.91)	(3.44)	(1.31)	(0.76)	(0.02)	(0.05)	(6.04)	(63.01)	(0.59)	(3)	(0.45)	(180)	(131)	(20)	(5.50)
Assayed Head																		

PRODUCT	DISTRIBUTION, %															
	Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	Na_2O	P_2O_5	SiO_2	TiO_2	As	Cd	Pb	Zn	U	LOI
Product Size +8000 µm Fraction	0.89	2.59	1.19	0.88	0.58	1.30	1.63	2.51	2.56	0.90	1.90	2.93	1.64	1.21	1.85	0.98
Product Size +6700 µm Fraction	2.41	4.81	2.17	2.09	1.41	2.34	3.65	4.55	4.31	1.96	1.14	3.51	2.98	2.30	5.10	2.55
Product Size +3350 µm Fraction	5.51	12.00	11.89	4.44	3.38	5.04	6.28	12.22	8.34	4.65	17.10	13.21	8.50	8.48	12.24	6.47
Product Size +3350 µm Fraction	5.26	10.11	9.06	4.59	3.73	4.17	6.50	9.88	6.87	4.81	14.16	10.93	7.35	6.21	9.08	5.93
Product Size +2360 µm Fraction	4.25	7.06	5.93	4.14	4.53	3.07	5.75	6.93	4.97	3.81	8.94	6.90	5.35	5.61	6.43	4.85
Product Size +1700 µm Fraction	3.54	5.09	5.42	3.85	4.62	2.46	3.83	4.90	4.05	3.33	4.77	5.52	3.85	4.68	4.73	4.03
Product Size +1180 µm Fraction	3.10	4.57	4.43	3.45	4.46	8.59	4.02	4.37	3.49	2.97	5.20	4.82	3.86	4.61	4.31	3.37
Product Size +850 µm Fraction	2.07	3.41	2.98	2.32	3.00	5.97	2.79	3.18	2.39	1.94	5.07	3.35	2.67	2.88	2.87	2.65
Product Size +600 µm Fraction	3.09	4.38	4.19	3.43	4.63	8.21	3.84	4.27	3.26	2.96	6.96	3.84	3.54	4.09	3.78	3.69
Product Size +425 µm Fraction	2.94	3.92	3.99	3.28	4.35	7.55	3.53	3.73	3.03	2.83	4.58	3.53	3.93	3.67	3.48	3.50
Product Size +300 µm Fraction	1.91	3.01	2.88	2.02	2.75	6.62	2.06	2.95	2.04	1.87	2.57	2.48	2.73	2.62	2.22	2.40
Product Size +212 µm Fraction	1.43	2.67	2.24	1.40	1.90	5.45	1.70	2.62	1.69	1.41	4.75	2.45	2.48	2.23	2.10	1.85
Product Size +150 µm Fraction	1.11	2.42	1.90	1.03	1.39	3.83	1.79	2.43	1.54	1.16	3.25	1.79	2.20	1.82	1.76	1.78
Product Size +106 µm Fraction	1.06	2.56	1.93	0.95	1.21	4.25	1.66	2.45	1.83	1.19	3.09	1.99	2.32	1.87	1.87	1.40
Product Size +75 µm Fraction	1.00	2.44	1.62	0.86	1.01	3.55	1.48	2.44	2.23	1.23	1.72	1.77	2.08	1.65	1.78	1.31
Product Size +53 µm Fraction	1.06	2.10	1.48	0.91	0.94	1.50	1.40	2.15	3.15	1.60	2.18	1.69	1.87	1.57	1.76	1.34
Product Size +38 µm Fraction	0.80	1.20	1.00	0.73	0.69	1.03	1.28	1.23	2.17	1.51	0.50	1.16	1.15	1.06	1.12	0.91
Product Size -38 µm Fraction	58.58	25.67	35.68	59.64	55.41	25.04	46.82	27.19	42.06	59.88	12.14	28.12	41.51	43.42	33.53	50.98
(Calculated Head)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)
Assayed Head																

PerUsa EnviroMet Inc., 228 Pinellas Street, Lakeland, FL 33803-4832, USA Phone/Fax: (863) 646-5096 E-mail: fsotillo@msn.com

TO: Mr. Marten Walters, President, KEMWorks Technology, Inc.
CC. Mr. Neville Bergin, General Manager, MINEMAKERS Limited.

FROM: Dr. Francisco J. Sotillo, President, PerUsa EnviroMet, Inc.

SUBJECT: Laboratory Tests to Determine the Potential Use of High Pressure Grinding Roll (HPGR) and Attrition Tests 86 to 93 for MPH Samples from Arruwurra Wonarah Phoshate Project,.Composite C and Duplicates – Data Analysis .

DATE: January 27, 2014

SUMMARY, MODEL, AND RECOMMENDATIONS

- Table 4 presented the Summary of data for all HPGR and HPGR = attrition tests carried out for Composite C:

TABLE 4. SUMMARY OF RESULTS OF HPGR - COMPOSITE C FOR MPH PHOSPHATE ORE - MINEMAKERS

					HPGR/Crusher				HPGR + Attrition				Feed	
	Pressure	Rolls Speed	P_{80} HPGR	P_{80} Crush +	Grades**		Al_2O_3	P_2O_5	Grades		Al_2O_3	P_2O_5	Grades	
Product/HPGR Test	bars*	m/s	µm	Attrition, µm	Al_2O_3, %	P_2O_5, %	Rejec., %	Reco., %	Al_2O_3, %	P_2O_5, %	Rejec., %	Reco., %	Al_2O_3, %	P_2O_5, %
Standard	10			550.00	4.10	20.80	0.00	100.00	1.98	21.11	69.82	63.45	4.10	20.80
Test 1	40	0.38	266.00	95.00	6.09	8.82	84.61	39.74	4.39	8.17	88.65	37.59	11.89	6.18
Test 2	50	0.38	289.00	95.00	6.37	8.68	83.92	40.44	4.44	8.07	88.48	36.57	11.93	6.24
Test 3	70	0.38	243.00	92.00	5.75	8.17	84.99	38.11	4.09	7.80	89.67	35.30	11.98	6.14
Standard	10			550.00	4.10	20.80	0.00	100.00	1.98	21.11	69.82	63.45	4.10	20.80
Test 4	40	0.77	395.00	95.00	6.90	8.33	80.81	42.45	4.38	8.11	88.66	36.83	11.87	6.25
Test 5	50	0.77	205.00	83.00	6.05	8.33	84.68	37.60	4.12	7.85	89.91	34.70	11.97	6.28
Test 6	70	0.77	152.00	86.00	5.51	8.13	86.60	35.57	4.11	7.63	89.96	34.59	12.08	6.10

- For Composite C (soft phosphate ore), the use of 40 bar and 0.77 m/s Rolls Speed (Test 4) shows advantages:
  - Reducing the excessive grinding due to high Applied Pressure
  - Reporting the highest capacity
  - Obtaining the lowest Specific net Comminution Energy ($E_{cs(net0)}$)
  - Selective grinding of Al_2O_3 bearing minerals with respect to P_2O_5 and SiO_2 bearing minerals
  - Higher P_2O_5 recovery and Al_2O_3 rejection in the 2360x20-µm product than those tests at 0.77 m/s Rolls Speed even though excessive grinding takes place using HPGR on Composite C (see Excel File KEMWorks-PN2069-HPGR-K12023 MPH AT90_91).

		Test 1	Test 4	Ratio	Observation
+ Throughput, t/h =		1.44	2.84	1.97	more capacity
+ Sp. Energy, KWh/t =		1.36	1.34	0.99	less energy

- Processing of HPGR Tests 1 and 4 and HPGR Tests 2 and 5 results were carried out not only to determine the effect of Applied Pressure and Rolls Speed. Moreover, all data were required to predict the results at the best operating conditions for HPGR obtained for Composite C for Composite A and Composite B.
- A model was developed to try to extrapolate the results obtained for Composite C to those to be obtained on Composite A and B based on different composition of the MPH Phosphate Ore. This Model is presented in Excel File KEMWorks-PN2069-HPGR-K12023 MPH AT90_91 too. The predicted results were:

COMPOSITE B	**Maximum P_2O_5 Recovery =**	((Standard - HPGR + attrition Recoveries) * Factor) + HPGR + attriton Recovery =	**73.19**	**%**
	Maximum Al_2O_3 Rejection =	((HPGR + attrition Recoveries - Standard) / Factor) + Standard Recovery =	**83.61**	**%**
COMPOSITE A	**Maximum P_2O_5 Recovery =**	((Standard - HPGR + attrition Recoveries) * $Factor^2$) + HPGR + attriton Recovery =	**86.50**	**%**
	Maximum Al_2O_3 Rejection =	Data showed that there is a plateau at about 89% Al_2O_3 Rejection =	**89.00**	**%**

- Since the operating conditions of the HPGR crushing (Applied Pressure and Rolls Speed) depends on the hardness of the ore (Al_2O_3 content), it is of utmost importance to determine the F_{80}s of Composites A and B prepared at Nominal size -9 mm for the HPGR tests, and compare them with the Standard and Composite C. This is required to validate the Model prediction for P_2O_5 recovery and Al_2O_3 rejection with the Applied Pressure and Rolls Speed selected from Composite C tests, and applied those operating conditions to Composite A and B for HPGR testing based in potential ratios of reduction (R_{80}).

INTRODUCTION

As requested by Minemakers Australia PTY LTD, the analysis of the Interim Test Results of:

- HPGR Test 1 (40 bar Applied Pressure and 0.38 m/s Rolls Speed),
- HPGR Test 2 (50 bar Applied Pressure and 0.38 m/s Rolls Speed),
- HPGR Test 4 (40 bar Applied Pressure and 0.77 m/s Rolls Speed),
- HPGR Test 5 (50 bar Applied Pressure and 0.77 m/s Rolls Speed),

the previous reviewed data for:

- HPGR Test 3 (70 bar Applied Pressure and 0.38 m/s Rolls Speed) and
- HPGR Test 6 (70 bar Applied Pressure and 0.77 m/s Rolls Speed),

and their corresponding attrition scrubbing of HPGR Tests 1, 2, 3, 4, 5, and 6 products (47.5% solids content, 1200 rpm, and 15 minutes) were performed.

This analysis included a mathematical modeling of the effect of the phosphate ore composition to predict the results on P_2O_5 Recovery and Al_2O_3 Rejection for Composite A (<2% Al_2O_3), and Composite B (<4% Al_2O_3, >9% Al_2O_3) at the selected best HPGR operating conditions that corresponded to Test 4, 40 bar Applied Pressure and 0.77 m/s Rolls Speed. The processed information is presented in the following Excel Files:

- KEMWorks-PN2069-HPGR Results-K12023SA12.

- KEMWorks-PN2069-HPGR Results-K12023SA13.
- KEMWorks-PN2069-HPGR Results-K12023SA14.
- KEMWorks-PN2069-HPGR Results-K12023SA15.
- KEMWorks-PN2069-HPGR Results-K12023SA16.
- KEMWorks-PN2069-HPGR Results-K12023SA17.
- KEMWorks-PN2069-HPGR Results-K12023SA18.
- KEMWorks-PN2069-HPGR Results-K12023SA19.
- KEMWorks-PN2069-HPGR-K12023 MPH AT86_87.
- KEMWorks-PN2069-HPGR-K12023 MPH AT88_89.
- KEMWorks-PN2069-HPGR-K12023 MPH AT90_91.
- KEMWorks-PN2069-HPGR-K12023 MPH AT92_93.

These tests results were aimed at determining the feasibility of using High Pressure Grinding Roll (HPGR) on the PFD for the beneficiation of a composite sample of the Main Zone (MPH), Arruwurra, Wonarah Phosphate Project. For these tests, MPH Phosphate Ore Composite C (>9% Al_2O_3) were submitted to HPGR testing program. Test 1, 2, and 3 deferred from Test 4, 5, and 6 on the Rolls Speed, 0.38 m/s and 0.77 m/s, respectively, but followed the same Applied Pressure sequence of 40, 50, and 70 bar, respectively. The following paragraphs presented the comments and observations in a bullet form for easy following.

COMMENTS AND OBSERVATIONS

General Comments

- As mentioned in previous reports (September 05 and November 11, 2013) for the Interim Tests Results, the use of HPGR may be possible due to these encouraging results. Thus, a SAG mill could be replaced, and savings in energy, CAPEX, and water may be obtained.
- Generally, the results showed that the selective grinding of Al_2O_3 minerals took place during these tests, P_2O_5 and SiO_2 being ground at a slower rate than Al_2O_3.
- Data showed that at all Applied Pressures (40 bar, 50, bar, and 70 bar), excessive grinding of P_2O_5 occurred, increasing P_2O_5 losses for Composite C. Thus, the lower the Applied Pressure the lower the P_2O_5 losses obtained with higher Al_2O_3 rejection than that reported for the Standard crushing + attrition system. Therefore, 40 bar of Applied Pressure was selected.
- It was also shown that grinding at higher Rolls Speed was beneficial at 40 bar of Applied Pressure since higher P_2O_5 was recovered even though Al_2O_3 rejection was lower at 0.77 m/s of Rolls Speed; slower Rolls Speed being beneficial for 50 bar and 70 bar of Applied Pressure with similar Al_2O_3 rejection but higher P_2O_5 recovery. However, differences in both Al_2O_3 rejections and P_2O_5 recoveries were not significant to be considered the defining factor for the selection of the best Rolls Speed to be used.
- At slower Rolls Speed (0.38 m/s) the P_{80} of the ground product was significantly coarser than that of high Rolls Speed (0.77 m/s), 266 µm, 289 µm, and 243 µm for Tests 1, 2, and 3, respectively, versus 395 µm, 205 µm, and 152 µm for Test 4, 5, and 6, the exception

being Test 4, showing a coarse HPGR ground product (?). Probably, the coarser size fraction at 0.38 m/s Rolls Speed was a consequence of the plasticity of Composite C (energy lost in the material deformation).

- The capacity increased at higher Rolls Speed (0.77 m/s) for all the Applied Pressures tested. The selected HPGR operating conditions (Test 4) reported 1.97 times the throughput (t/h) obtained for the slow Rolls Speed, 0.38 m/s (Test 1). Test 5 (50 bar Applied Pressure and 0.77 m/s Rolls Speed) resulted in 1.96 times the throughput (t/h) obtained for the slow Rolls Speed, 0.38 m/s (Test 2); whereas, Test 6 (70 bar Applied Pressure and 0.77 m/s Rolls Speed) reported 1.94 times the throughput (t/h) obtained for the slow Rolls Speed, 0.38 m/s (Test 3). This parameter was a significant factor in the selection of the Rolls Speed to be used.
- The Specific Net Comminution Energy ($E_{cs(net)}$) was slightly lower at high Rolls Speed (0.77 m/s) that that at low Rolls Speed (0.38 m/s), decreasing as the Applied Pressure increased. Thus, the $E_{cs(net)}$ at 40 bar and 0.77 m/s Rolls Speed (Test 4) was 0.99 that of Test 1 at 0.38 m/s Rolls Speed; $E_{cs(net)}$ at 50 bar and 0.77 m/s Rolls Speed (Test 5) was 0.93 that of Test 2 at 0.38 m/s Rolls Speed; and $E_{cs(net)}$ 70 bar and 0.77 m/s Rolls Speed (Test 6) was 0.94 that of Test 3 at 0.38 m/s Rolls Speed. This factor indicated that using higher Rolls Speed (0.77 m/s) was beneficial in reducing specific energy consumption.
- It must also bear in mind that Composite C was high in Al_2O_3 and low in P_2O_5, which may increase the overall grindability of the material, resulting in high P_2O_5 losses for all Applied Pressures (40 bar, 50 bar, and 70 bar). Moreover, HPGR is a more efficient comminution technology due to the application of the Bed Comminution Mechanism, which resulted in finer product than that obtained by conventional crushing. Under these conditions, it is necessary to model the effect of change in composition of the MPH Phosphate Ore and the use of more efficient HPGR to determine the potential Al_2O_3 rejection and P_2O_5 recovery for Composite A and B.
- Attrition of the HPGR products significantly reduced the particle size demonstrating the micro-cracking and residual stresses in the particles generated by the Bed Comminution Mechanism of the HPGR. As is shown in Excel File KEMWorks-PN2069-HPGR-K12023 MPH AT90_91, Table 4. Summary of Results of HPGR – Composite C for MPH Phosphate Ore – Minemakers, the Standard (crushing + attrition) resulted in a P_{80} of 550 µm; whereas, HPGR + Attrition Tests 1, 2, 3, 4, 5, and 6 reported a P_{80} of 95 µm, 95 µm, 92 µm, 95 µm, 83 µm, and 86 µm; respectively.
- In general, the analysis of the results was complicated by the different size fractions chosen for the HPGR Tests, and those size fractions used for the Attrition Scrubbing Tests 86 to 93. As a consequence, plotting of the results was a better way to analyze this information.
- The results of Duplicates for both HPGR Tests 3 and 6, and the Attrition Scrubbing Tests 87 and 89 were virtually identical to those of the Original samples studied. However, average data for the Original and Duplicate tests were used for the analysis. No Duplicates results were shown for HPGR Tests 1, 2, 4, and 5.
- For this evaluation, we must be aware that the data on Distribution and Grades takes into consideration the rejection of the +2360-µm size fraction and the -38 µm or -20-µm size fraction for the HPGR and HPGR + attrition tests, respectively, for the calculations.

Preliminary Analysis

To put in an appropriate context the data generated on these HPGR tests, Table 1 presented the Nominal, F_{80}, and P_{80} values of the Standard MPH Phosphate Ore prepared at different nominal sizes in comparison with those produced by preparing Composite C at nominal -9-mm feed size for Test 3 and 6. Table 2 presented this information for Tests 1 and 4; whereas, Table 3 presented the Nominal, F_{80}, and P_{80} Values for MPH Phosphate Samples for Tests 2 and 5.

TABLE 1. NOMINAL, F_{80}, AND P_{80} VALUES FOR MPH COMPOSITE SAMPLES TESTS 3 AND 6

Composite MPH Ore Type	Nominal Feed Size mm	Ratio of Nominal Size	Particle F_{80} µm	Ratio of F_{80} Particle	Ratio of Nominal / F_{80}	Crushing HPGR P_{80}, µm	Ratio of Reduction HPGR, R_{80}	Attrition P_{80} µm	Ratio of Reduction Attrition, R_{80}
Standard	-12.7	--	8900.00	--	1.43	--	--	--	--
Standard	-2	6.35	1410.00	6.31	1.42	--	--	550.00	2.56
Composite C, 0.38 m/s	-9	1.41	3152.00	2.82	2.86	243.00	12.97	92.00	2.64
Composite C, 0.77 m/s	-9	1.41	3152.00	2.82	2.86	152.00	20.74	86.00	1.77

TABLE 2. NOMINAL, F_{80}, AND P_{80} VALUES FOR MPH COMPOSITE SAMPLES TESTS 1 AND 4

Composite MPH Ore Type	Nominal Feed Size mm	Ratio of Nominal Size	Particle F_{80} µm	Ratio of F_{80} Particle	Ratio of Nominal / F_{80}	Crushing HPGR P_{80}, µm	Ratio of Reduction HPGR, R_{80}	Attrition P_{80} µm	Ratio of Reduction Attrition, R_{80}
Standard	-12.7	--	8900.00	--	1.43	--	--	--	--
Standard	-2	6.35	1410.00	6.31	1.42	--	--	550.00	2.56
Composite C, 0.38 m/s	-9	1.41	3152.00	2.82	2.86	266.00	11.85	95.00	2.80
Composite C, 0.77 m/s	-9	1.41	3152.00	2.82	2.86	395.00	7.98	95.00	4.16

TABLE 3. NOMINAL, F_{80}, AND P_{80} VALUES FOR MPH COMPOSITE SAMPLES TESTS 2 AND 5

Composite MPH Ore Type	Nominal Feed Size mm	Ratio of Nominal Size	Particle F_{80} µm	Ratio of F_{80} Particle	Ratio of Nominal / F_{80}	Crushing HPGR P_{80}, µm	Ratio of Reduction HPGR, R_{80}	Attrition P_{80} µm	Ratio of Reduction Attrition, R_{80}
Standard	-12.7	--	8900.00	--	1.43	--	--	--	--
Standard	-2	6.35	1410.00	6.31	1.42	--	--	550.00	2.56
Composite C, 0.38 m/s	-9	1.41	3152.00	2.82	2.86	289.00	10.91	95.00	3.04
Composite C, 0.77 m/s	-9	1.41	3152.00	2.82	2.86	205.00	15.38	83.00	2.47

- These tables showed that the feed preparation procedure was quite consistent for the Standard Phosphate Ore Composites producing similar Ratio of F_{80} Particle than that obtained for the Nominal Size, and the same Ratio of Nominal/F_{80} Sizes of the Standard MPH Phosphate Ore Composite Samples than that of the Composites C Ratio of Nominal Size.
- The Ratio of Nominal Sizes of the Standard -12.7 mm to Composite C, -9 mm was only 1.41, but the Ratio of F_{80} produced for Composite C was 2.82, and that of Nominal/F_{80} for Composite C was 2.86. This data indicated that the preparation procedure of the MPH Phosphate Ore, Composite C produced material twice finer than that produced with the Standard MPH Composite samples, probably due to the presence of higher Al_2O_3.
- The presence of high Al_2O_3 and low P_2O_5 in Composite C reduced the strength of the phosphate ore, and increased its plasticity. This is reflected in the HPGR comminution with high reduction ratios. The data in Table 1 clearly showed a soft ore and the effect of

plasticity on HPGR comminution since Test 3 (at 0.38 m/s Rolls Speed) resulted in a much lower R_{80} (12.61) than that R_{80} (21.01) of Test 6 (0.77 m/s Rolls Speed) both at 70 bar of Applied Pressure. Table 3 showed a soft phosphate ore and the same plasticity effect using HPGR. Test 2 (at 0.38 m/s Rolls Speed) resulted in a much lower R_{80} (10.91) than that R_{80} (15.38) of Test 5 (0.77 m/s Rolls Speed) both at 50 bar of Applied Pressure. In the case of Table 2 for tests at 40 bar of Applied Pressure, the results for Test 1 are in agreement with those of Tests 2 and 3, showing an R_{80} of 11.85 at 0.38 m/s Rolls Speed. However, Test 4 showed R_{80} of only 7.98 at 0.77 m/s Rolls Speed, which is out of sequence with the R_{80} reported for Test 5 and 6 at 0.77 m/s Rolls Speed. This is related to the coarse feed to the attrition scrubbing (product of the HPGR crushing) of 395 µm (?). However, the reduction of the strength of the phosphate ore is clearly shown since the attrition R_{80} produced was 4.16, the highest of all tests.

- The effect of micro-cracking and residual stresses produced during HPGR comminution in the attrition scrubbing was demonstrated by the increase in the overall R_{80} of all tests. Test 3 reported R_{80} of 2.65 and Test 6, 1.77 for an overall R_{80} of 34.26 and 36.65, respectively, with respect to the attrition of the Standard MPH Phosphate Ore Composite (2.56 and overall of 16.18). Test 2 showed R_{80} of 3.04 and Test 5, 2.47 for an overall R_{80} of 33.18 and 37.98, respectively; whereas, Test 1 reported R_{80} of 2.80 and Test 4, R_{80} of 4.16 for an overall R_{80} of 33.18 for both tests. Since attrition scrubbing should clean the surfaces and break agglomerates of particles of different mineralogical species from fines not actually ground, the higher R_{80} for attrition of Composite C samples could be attributed to the weakening of the grain border between different mineral species (micro-cracks).
- Consequently, the selection of the operating conditions of the HPGR will have to take into consideration the Al_2O_3 and P_2O_5 content of Composite C and both the capacity and Specific Net Comminution Energy ($E_{cs(net)}$) to achieve the highest Al_2O_3 rejection and the highest P_2O_5 recovery without excessive grinding of phosphate (Test 4). These will be used to extrapolate the effect of the operating parameters to MPH Composite A and B to avoid under or over-grinding of the material, and limiting grinding of P_2O_5. Under these conditions, it will be possible to predict the highest recovery of P_2O_5 with the highest rejection of Al_2O_3; thus, the lowest Al_2O_3 grade in the Phosphate Concentrate. This is presented in Excel File KEMWorks-PN2069-HPGR-K12023 MPH AT90_91 and explained below.

HPGR Test 3 and Attrition Scrubbing Tests 86 and 87

- From the HPGR Test 3 and Duplicate Test plots of Particle Size Distribution (PSD) Al_2O_3, P_2O_5, and SiO_2 Distributions for MPH Phosphate Ore Composite C, the locus of the curves clearly showed that Al_2O_3 bearing minerals were preferentially ground resulting in lower recovery in the 2360x38-µm material, 13.42% (84.93% rejection in the -38-µm size fraction); whereas, P_2O_5 recovery on the 2360x38-µm size fraction was 38.11% (55.88% losses in the -38-µm material). The SiO_2 recovery in the 2360x38-µm size fraction being somewhere in between at 29.62% (64.63% rejection in the -38-µm size fraction). SiO_2 Distribution curve was almost identical to that of the Weight Distribution (yield), reporting 27.87% yield in the 2360x38-µm size fraction. This demonstrates that selective grinding of Al_2O_3 bearing minerals takes place upon using HPGR due to the Bed Comminution Mechanism.

- HPGR Test 3 and Duplicate (70 bar and 0.38 m/s Rolls Speed) resulted in a drop in the Al_2O_3 grade in the 2360x38-µm product from a feed grade of 11.95% Al_2O_3 to a product containing 5.75% Al_2O_3, a reduction of 2.08 times, which is the same as that for the Standard MPH Composite sample submitted to crushing and Attrition (4.10% Al_2O_3 to 1.98% Al_2O_3).
- When the product of the HPGR Test 3 and Duplicate were submitted to our attrition process as reported in MPH Attrition Tests 86 and 87, respectively, the results were improved. These tests showed that the locus of the PSD, Al_2O_3, P_2O_5, and SiO_2 for MPH Phosphate Ore Composite C were in agreement with the concept of selective grinding with the Al_2O_3 bearing minerals being preferentially ground with respect to P_2O_5 and SiO_2 bearing minerals. The data showed that Al_2O_3 recovery in the 2360x20-µm size fraction decreased to 9.47% (89.67% of Al_2O_3 rejected in the -20-µm material), the P_2O_5 recovery in the 2360x20-µm product being 35.30% with P_2O_5 losses of 61.26% in the -20-µm size fraction. SiO_2 Distribution showed a recovery in the 2360x20-µm material of 31.41% (63.84% rejection in the -20-µm size fraction). As in the case of the HPGR Test 3 results, the locus of the Distributions curves for SiO_2 was somewhere in between that of the P_2O_5 and Al_2O_3, and closer to the locus of the Weight Distribution curve (yield), showing 27.76% yield in the 2360x20-µm size fraction with 68.42% in the -20-µm.
- MPH Phosphate Attrition Tests 86 and 87 reported a further drop in the Al_2O_3 grade to 4.09% Al_2O_3 in the 2360x20-µm product from an overall reduction of Al_2O_3 of 2.93 times from 11.98% Al_2O_3 in the feed to the system. These results corresponded to a better reduction in Al_2O_3 grade than that obtained for the Standard MPH Phosphate Ore Composite sample after crushing and attrition (2.07 times).
- Even though over-grinding occurred due to the soft MPH Phosphate Ore Composite C and the high pressure applied (70 bar), the recovery of P_2O_5 (35.30%) was significantly higher than that of the yield (27.76%) with 84.67% rejection of Al_2O_3. This also demonstrated that selective grinding took place, the right HPGR operating conditions (Applied Pressure and Rolls Speed) requiring to be determined.

HPGR Test 6 and Attrition Scrubbing Tests 88 and 89

- In the case of the HPGR Test 6 and Duplicate Test, the PSD, Al_2O_3, P_2O_5, and SiO_2 locus of the Distribution curves showed similar results than those presented for HPGR Test 3 and Duplicate. However, Al_2O_3 bearing minerals were further ground resulting in a recovery of 12.15% in the 2360x38-µm size fraction (86.66% of Al_2O_3 rejection in the -38-µm material). On the other hand, P_2O_5 recovery also decreased but in a smaller proportion to 35.57% in the 2360x38-µm product with P_2O_5 losses of 60.33% in the -38-µm material. Again, SiO_2 locus of the Distribution curve was in between, and similar to that of the Weight Distribution (yield). SiO_2 recovery in the 2360x38-µm size fraction was 28.49% with rejection of SiO_2 of 67.12% in the -38-µm material, the Weight Distribution (yield being 26.65% for 2380x38-µm product and 69.67% for -38-µm size fraction.

- By using 70 bar and 0.77 m/s Rolls Speed in the HPGR Test 6, the Al_2O_3 grade drop to 5.51% Al_2O_3 in the 2360x38-µm product from a feed of 12.08% Al_2O_3; thus, a reduction of 2.32 times. This is higher than the reduction in Al_2O_3 grade obtained by the Standard System (2.07 times).
- The Attrition process was applied to the HPGR Test 6 and its Duplicate as shown in the results of Attrition Tests 88 and 89, respectively. Here, the locus of the curves for the PSD, Al_2O_3, P_2O_5, and SiO_2 Distributions showed that selective grinding of Al_2O_3 bearing minerals resulted in a recovery of 9.40% of Al_2O_3 for the 2360x20-µm product with a rejection of 89.96% of Al_2O_3 in the -20-µm size fraction. P_2O_5 recovery in the 2360x20-µm product was decreased to 34.59% with an increase in losses to 62.74% in the -20-µm size fraction. SiO_2 recovery in the 2360x20-µm product was 31.41% with higher rejection in the -20-µm material of 64.83% than that obtained for Tests 86 and 87, indicating additional grinding of this material, but with similar Weight Distribution (yield) of 27.63% in the 2360x20-µm product, and 69.42% in the -20-µm size fraction.
- The Al_2O_3 grade for the HPGR Attrition Tests 88 an 89 resulted in 4.11% Al_2O_3 grade for the 2360x20-µm size fraction, and a reduction of Al_2O_3 grade of 2.93 times. Thus, a marginal improvement over those reductions in Al_2O_3 obtained for HPGR + Attrition Test 86 and 87, but superior than that for the Standard MPH Phosphate Ore Composite samples.
- Further over-grinding of Composite C sample using 0.77 m/s Rolls Speed at 70 bar of Applied Pressure resulted in a lower P_2O_5 recovery (34.59%) than that obtained for 0.38 m/s Rolls Speed (35.30%) on the 2360x20-µm size fraction. On the other hand, a marginal increase in Al_2O_3 in the -20-µm was observed from 89.67% to 89.96% for 0.38 m/s and 0.77 m/s Rolls Speed, respectively with almost the same yields, 27.76% for 0.38 m/s Rolls Speed, and 27.63% for 0.77 m/s Rolls Speed.

HPGR Tests 1, 2, and Attrition Scrubbing Tests 90, and 91

- Again, from the HPGR Test 1 and Test 2 plots of Particle Size Distribution (PSD) Al_2O_3, P_2O_5, and SiO_2 Distributions for MPH Phosphate Ore Composite C, the locus of the curves clearly showed that Al_2O_3 bearing minerals were preferentially ground resulting in lower recovery in the 2360x38-µm material for Test 1 (40 bar and 0.38 m/s Rolls Speed), 13.93% (84.61% rejection in the -38-µm size fraction); whereas, P_2O_5 recovery on the 2360x38-µm size fraction was 39.74% (55.04% losses in the -38-µm material). The SiO_2 recovery for Test 1 in the 2360x38-µm size fraction was somewhere in between at 29.65% (63.93% rejection in the -38-µm size fraction). SiO_2 Distribution curve was almost identical to that of the Weight Distribution (yield), reporting 28.27% yield in the 2360x38-µm size fraction and 66.65% in the -38-µm size fraction. This demonstrates that selective grinding of Al_2O_3 takes place upon using HPGR due to the Bed Comminution Mechanism.
- HPGR Test 1 (40 bar and 0.38 m/s Rolls Speed) resulted in a drop in the Al_2O_3 grade in the 2360x38-µm product from a feed grade of 11.89% Al_2O_3 to a product containing 6.09% Al_2O_3, a reduction of 1.95 times, which is lower than that for the Standard MPH Composite sample submitted to crushing and attrition (4.10% Al_2O_3 to 1.98% Al_2O_3) a reduction of 2.07.

- When the product of the HPGR Test 1 was submitted to our attrition process as reported in MPH Attrition Test 90 the results were improved. These test showed that the locus of the PSD, Al_2O_3, P_2O_5, and SiO_2 for MPH Phosphate Ore Composite C were in agreement with the concept of selective grinding with the Al_2O_3 bearing minerals being preferentially ground with respect to P_2O_5 and SiO_2 bearing minerals. The data showed that Al_2O_3 recovery in the 2360x20-µm size fraction decreased to 10.51% (88.65% of Al_2O_3 rejected in the -20-µm material), the P_2O_5 recovery in the 2360x20-µm product being 37.59% with P_2O_5 losses of 58.38% in the -20-µm size fraction. SiO_2 Distribution showed a recovery in the 2360x20-µm material of 31.86% (63.05% rejection in the -20-µm size fraction). As in the case of the HPGR Test 1 results, the locus of the Distributions curves for SiO_2 was somewhere in between that of the P_2O_5 and Al_2O_3, and closer to the locus of the Weight Distribution curve (yield), showing 28.45% yield in the 2360x20-µm size fraction and 67.45% in the -20-µm size fraction.
- MPH Phosphate Attrition Test 90 reported a further drop in the Al_2O_3 grade to 4.39% Al_2O_3 in the 2360x20-µm product from an overall reduction of Al_2O_3 of 2.71 times from 11.89% Al_2O_3 in the feed to the system. These results corresponded to a better reduction in Al_2O_3 grade than that obtained for the Standard MPH Phosphate Ore Composite sample after crushing and attrition (2.07 times).
- Even though over-grinding occurred due to the soft MPH Phosphate Ore Composite C for the pressure applied (40 bar), the recovery of P_2O_5 (37.59%) was significantly higher than that of the yield (28.45%) with 88.65% rejection of Al_2O_3. This also demonstrated that selective grinding took place, the right HPGR operating conditions (Applied Pressure and Rolls Speed) requiring to be determined.
- In the case of the HPGR Test 2 (50 bar and 0.38 m/s), the PSD, Al_2O_3, P_2O_5, and SiO_2 locus of the Distribution curves showed similar results than those presented for HPGR Test 1. Al_2O_3 bearing minerals were ground resulting in a recovery of 14.71% in the 2360x38-µm size fraction (83.92% of Al_2O_3 rejection in the -38-µm material). On the other hand, P_2O_5 recovery was 40.44% in the 2360x38-µm product with P_2O_5 losses of 54.79% in the -38-µm material. Again, SiO_2 locus of the Distribution curve was in between, and similar to that of the Weight Distribution (yield). SiO_2 recovery in the 2360x38-µm size fraction was 30.39% with rejection of SiO_2 of 63.87% in the -38-µm material, the Weight Distribution reporting 29.04% in the 2380x38-µm size fraction with 66.18% in the -38-µm size fraction.
- Using 0.38 m/s Rolls Speed in the HPGR Test 2, the Al_2O_3 grade drop to 6.37% Al_2O_3 in the 2360x38-µm product from a feed of 11.93% Al_2O_3; thus, a reduction of 1.87 times. This is lower than the reduction in Al_2O_3 grade obtained by the Standard System (2.07 times).
- The Attrition process was applied to the HPGR Test 2 as shown in the results of Attrition Test 91. Here, the locus of the curves for the PSD, Al_2O_3, P_2O_5, and SiO_2 Distributions showed that selective grinding of Al_2O_3 bearing minerals resulted in a recovery of 10.52% of Al_2O_3 for the 2360x20-µm product with a rejection of 88.48% of Al_2O_3 in the -20-µm size fraction. P_2O_5 recovery in the 2360x20-µm product was decreased to 36.57% with an increase in losses to 59.68% in the -20-µm size fraction. SiO_2 recovery in the 2360x20-µm product was 31.69% with higher SiO_2 rejection in the -20-µm material of 63.09% than that obtained for Tests 90, indicating additional

grinding of this material, but with similar Weight Distribution (yield) of 28.28% in the 2360x20-µm product, and 67.51% in the -20-µm size fraction.

- The Al_2O_3 grade for the HPGR Attrition Test 91 resulted in 4.44% Al_2O_3 grade for the 2360x20-µm size fraction, and a reduction of Al_2O_3 grade of 2.69 times. Thus, a marginal difference over that reduction in Al_2O_3 obtained for HPGR + Attrition Test 90, but superior than that for the Standard MPH Phosphate Ore Composite samples.

HPGR Tests 4, 5, and Attrition Scrubbing Tests 92, and 93

- From the HPGR Test 4 and Test 5 plots of Particle Size Distribution (PSD) Al_2O_3, P_2O_5, and SiO_2 Distributions for MPH Phosphate Ore Composite C, the locus of the curves clearly showed that Al_2O_3 bearing minerals were preferentially ground resulting in lower recovery in the 2360x38-µm material for Test 4 (40 bar and 0.77 m/s Rolls Speed), 17.43% (80.81% rejection in the -38-µm size fraction); whereas, P_2O_5 recovery on the 2360x38-µm size fraction was 42.45% (53.04% losses in the -38-µm material). The SiO_2 recovery for Test 4 in the 2360x38-µm size fraction was somewhere in between at 32.82% (61.24% rejection in the -38-µm size fraction). SiO_2 Distribution curve was almost identical to that of the Weight Distribution (yield), reporting 31.45% yield in the 2360x38-µm size fraction and 63.66% in the -38-µm size fraction. This demonstrates that selective grinding of Al_2O_3 bearing minerals takes place upon using HPGR due to the Bed Comminution Mechanism.
- HPGR Test 4 (40 bar and 0.77 m/s Rolls Speed) resulted in a drop in the Al_2O_3 grade in the 2360x38-µm product from a feed grade of 11.87% Al_2O_3 to a product containing 6.90% Al_2O_3, a reduction of 1.72 times, which is lower than that for the Standard MPH Composite sample submitted to crushing and attrition (4.10% Al_2O_3 to 1.98% Al_2O_3) a reduction of 2.07.
- When the product of the HPGR Test 4 was submitted to our attrition process as reported in MPH Attrition Test 92 the results were improved. These test showed that the locus of the PSD, Al_2O_3, P_2O_5, and SiO_2 for MPH Phosphate Ore Composite C were in agreement with the concept of selective grinding with the Al_2O_3 bearing minerals being preferentially ground with respect to P_2O_5 and SiO_2 bearing minerals. The data showed that Al_2O_3 recovery in the 2360x20-µm size fraction decreased to 10.45% (88.66% of Al_2O_3 rejected in the -20-µm material), the P_2O_5 recovery in the 2360x20-µm product being 36.83% with P_2O_5 losses of 59.25% in the -20-µm size fraction. SiO_2 Distribution showed a recovery in the 2360x20-µm material of 32.10% (62.83% rejection in the -20-µm size fraction). As in the case of the HPGR Test 1 results, the locus of the Distributions curves for SiO_2 was somewhere in between that of the P_2O_5 and Al_2O_3, and closer to the locus of the Weight Distribution curve (yield), showing 28.36% yield in the 2360x20-µm size fraction and 67.67% in the -38-µm size fraction.
- MPH Phosphate Attrition Test 90 reported a further drop in the Al_2O_3 grade to 4.38% Al_2O_3 in the 2360x20-µm product from an overall reduction of Al_2O_3 of 2.71 times from 11.87% Al_2O_3 in the feed to the system. These results corresponded to a better reduction in Al_2O_3 grade than that obtained for the Standard MPH Phosphate Ore Composite sample after crushing and attrition (2.07 times).

- Even though over-grinding occurred due to the soft MPH Phosphate Ore Composite C for the pressure applied (40 bar), the recovery of P_2O_5 (36.83%) was significantly higher than that of the yield (28.36%) with 88.66% rejection of Al_2O_3. This also demonstrated that selective grinding took place. The right HPGR operating conditions of Applied Pressure and Rolls Speed were considered to be those of this test due to the less excessive grinding, higher capacity, and lower specific net Comminution Energy $E_{cs(net)}$.
- In the case of the HPGR Test 5 (50 bar and 0.77 m/s), the PSD, Al_2O_3, P_2O_5, and SiO_2 locus of the Distribution curves showed similar results than those presented for HPGR Test 2. Al_2O_3 minerals were ground resulting in a recovery of 13.88% in the 2360x38-µm size fraction (84.68% of Al_2O_3 rejection in the -38-µm material). On the other hand, P_2O_5 recovery was 37.60% in the 2360x38-µm product with P_2O_5 losses of 58.15% in the -38-µm material. Again, SiO_2 locus of the Distribution curve was in between, and similar to that of the Weight Distribution (yield). SiO_2 recovery in the 2360x38-µm size fraction was 29.83% with rejection of SiO_2 of 65.38% in the -38-µm material, the Weight Distribution (yield) being 28.06% for 2380x38-µm product and 6791% for the -38-µm size fraction.
- Using 0.77 m/s Rolls Speed in the HPGR Test 5, the Al_2O_3 grade drop to 6.05% Al_2O_3 in the 2360x38-µm product from a feed of 11.97% Al_2O_3; thus, a reduction of 1.98 times. This is lower than the reduction in Al_2O_3 grade obtained by the Standard System (2.07 times).
- The Attrition process was applied to the HPGR Test 5 as shown in the results of Attrition Test 93. Here, the locus of the curves for the PSD, Al_2O_3, P_2O_5, and SiO_2 Distributions showed that selective grinding of Al_2O_3 bearing minerals resulted in a recovery of 9.55% of Al_2O_3 for the 2360x20-µm product with a rejection of 89.91% of Al_2O_3 in the -20-µm size fraction. P_2O_5 recovery in the 2360x20-µm product was decreased to 34.70% with an increase in losses to 63.08% in the -20-µm size fraction. SiO_2 recovery in the 2360x20-µm product was 31.72% with higher rejection in the -20-µm material of 64.85% than that obtained for Tests 91, indicating additional grinding of this material, but with similar Weight Distribution (yield) of 27.75% in the 2360x20-µm product, and 69.59% in the -20-µm size fraction.
- The Al_2O_3 grade for the HPGR Attrition Test 93 resulted in 4.12% Al_2O_3 grade for the 2360x20-µm size fraction, and a reduction of Al_2O_3 grade of 2.91 times. Thus, a slight difference with that reduction in Al_2O_3 obtained for HPGR + Attrition Test 92, and superior than that for the Standard MPH Phosphate Ore Composite samples.
- Further over-grinding of Composite C sample using 0.77 m/s Rolls Speed at 70 bar of Applied Pressure resulted in a lower P_2O_5 recovery (34.59%) than that obtained 50 bar and 0.77 m/s Rolls Speed (34.70%) on the 2360x20-µm size fraction. On the other hand, a marginal increase in Al_2O_3 in the -20-µm was observed from 89.91% to 89.96% for 50 bar and 70 bar at 0.77 m/s Rolls Speed, respectively with almost the same yields, 27.75% for 50 bar, and 27.63% for 70 bar.