



An Investigation into
PRESSURE OXIDATION TESTING FOR THE REVEL RIDGE PROJECT

prepared for

ROKMASTER RESOURCES

Project 18988-01 – Final Report
August 18, 2022

NOTES

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Executive Summary

A metallurgical test program was conducted for Rokmaster Resources Corp. on their Revel Ridge project located in British Columbia, Canada. The testwork, requested and directed by Stacy Freudigmann of Canenco Consulting Corp., included pressure oxidation (POX) and hot curing followed by cyanidation for the recovery of gold from sulphide concentrates.

Four samples were received at SGS in Lakefield, Ontario and analyzed for gold (13.7 to 25.5 g/t), silver (40.6 to 128 g/t), sulphur (23.0 to 27.3%), and sulphide (22.2 to 27%) analysis.

Three tests were conducted on the first sample (BL 801 Bulk Concentrate 1) to examine the effects of pre-acidulation pH and retention time. An excess of acid was added during pre-acidulation for the first test (POX), resulting in a POX feed pH of around 0.8 with 959 kg/t H_2SO_4 added. Sulphide oxidation after 120 minutes at 220°C was very high (>99%), with a high final free acid in the POX solution (145 g/L), and significant iron and As were solubilized. Despite the high oxidation, gold extraction from the POX residue by CIL (following hot curing) was low at 63% while silver extraction was fair at 84%. This was a somewhat surprising result for a POX residue without a lime boil pre-treatment, which is normally required to break down refractory silver jarosite compounds formed during POX. In the second test (POX2), a more typical acid dosage was used (65 kg/t, to pH 2) and oxidation remained high at 99%. This approach was used in the tests following. In POX3, the residence time was lowered to 60 minutes and sulphide oxidation was 97%. The POX2 and 3 residues were combined and split to compare cyanidation with and without a regrind (as it was indicated by the client that previous testing had indicated regrinding the POX residue may be required to increase gold extraction) and to decrease residence times. Consequently, gold extraction from the unground POX residue returned 92% versus 98% from the reground residue. The 92% extraction from unground CIL feed took 48 hours while the 98% extraction from reground CIL feed was achieved in under 10 hours. Cyanide consumption increased following regrind, from ~7 kg/t to 58 kg/t NaCN, however optimization of dosage and other parameters in subsequent testing reduced this to 8.8 kg/t (CN13).

The following three tests were completed on sample BL 802 Bulk Concentrate 2, looking at the effects of POX feed grind size (POX6), temperature (POX5) and retention time (POX4). Acid added during pre-acidulation increased relatively slightly with regrinding, prior to oxidation, but produced similar concentrations of iron, arsenic, and sulphur in the POX filtrate as the test with no regrind (POX 4). Cyanidation of the reground POX feed had relatively lower consumption of cyanide while lime consumptions remained similar however of these comparative tests, (POX6) produced the best gold recovery at 96.7%. Dissolution of iron and sulphur were lower in the test at increased temperature of 230°C but shorter retention time (POX5). This POX5 test resulted in the best sulphide oxidation and overall weight loss and gave a similar gold extraction to POX 6 of 96.4%.

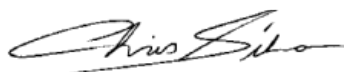
A third set of tests (POX 7 and 8) were undertaken on the BL 801-16 concentrate, a bulk concentrate with a coarse primary grind target of $\sim 150\mu\text{m}$ P80, to examine the effects of regrinding such a concentrate and potentially understand the indicative effects of a lime boil step. Regrinding of the POX feed (POX 8a and 8b) produced iron tenors that were double those found in tests POX 7a and 7b with unground feed. Hot cure solution concentrations of iron, arsenic, and sulphur in the reground feed tests were also all higher than the tests with the unground feed. Comparative cyanidation tests indicated that gold extraction increased slightly with regrinding the POX feed from $\sim 184\mu\text{m}$ P80 to $16\mu\text{m}$ P80 (from 80.3% to 82.4%) and both sets of tests indicated that a finer POX feed ($\sim 16\text{--}30\mu\text{m}$ P80) may provide lower cyanide and lime consumptions. Lime boiling produced relatively higher gold extractions on reground and unground POX feeds, however on the coarser POX feed the improvement of gold recovery was only 3.2% from 80.3% to 83.1%. Silver recoveries increased on both the unground and reground POX feeds.

POX tests were finally undertaken on the fourth concentrate (BL 801-24 Final Tails + BL 801-25 Final tails, from the recently developed flowsheet locked cycle tests 24 and 25), to study the effects of hot curing (HC) as well as oxygen and air sparging post neutralization reground samples prior to cyanidation. Two POX tests (POX 9a and 9b) were carried out and the POX residues were combined and then split in half. One half was hot cured for four hours and the other not. The POX and hot cure residues were then ground and each one was split in half prior to cyanide leaching, resulting in four cyanidation tests – two with oxygen and two with air sparging. Cyanide consumption was lower with oxygen sparging and lime consumption was lower with HC and oxygen relative to the non-HC tests. Oxygen sparging had minimal effect on gold recovery but marginally improved silver recovery. Hot curing resulted in significantly lower cyanide and lime consumption, may impact gold recovery slightly, from 98.7% to 98.2%. As expected for POX residues, silver recovery was poor for all tests and according to the client, similar to previous testing without lime boiling. POX 10 was conducted with concentrate to produce oxidized solids for mineralogy examination at SGS and Surface Science Western while POX11 produced oxidized concentrate for testing of cyanide alternatives.

Introduction

This report presents the details from testwork conducted on samples from the Revel Ridge project in British Columbia, Canada. SGS was contacted by Stacy Freudigmann from Basemet (for Canerco) to undertake POX testing and to examine the effect of a Hot Cure step following pressure oxidation to potentially reduce lime consumption during cyanidation.

The test program was directed by Stacy Freudigmann and all results were forwarded to him as they became available.



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Testwork Summary

1. Sample Receipt and Characterization

Four flotation concentrate samples were received at SGS in Lakefield, Ontario for testing purposes: Bulk Conc 1 (BL 801), BL 801 Conc 2, BL 801-16 (products 1-4), and a combination of the two concentrates (BL 801-24 final tails + BL 801-25 final tails). The head assays and size analyses are presented in Table 1.

Table 1: Head Analysis

Element		Bulk Con 1 (BL 801)	BL 801 Conc. 2 Head	BL 801-16 pdts 1-4	BL 801-24 Final Tails + BL 801-25 Final Tails
Au	g/t	25.5	20.7	15.3	13
Ag	g/t	41	40.6	128	60
Al	g/t	3940	-	-	11900
As	%	20.6	18.0	11.8	13.2
Ba	g/t	205	-	-	98
Be	g/t	0.1	-	-	0.29
Bi	g/t	< 30	-	-	< 30
Ca	g/t	11300	-	-	35000
Cd	g/t	323	-	-	178
Co	g/t	52	-	-	63
Cr	g/t	634	-	-	1630
Cu	g/t	1350	-	-	3640
Fe	%	30.8	28.4	22.9	25.2
K	g/t	1990	-	-	5810
Li	g/t	< 20	-	-	< 20
Mg	g/t	870	-	-	2180
Mn	g/t	143	-	-	298
Mo	g/t	18	-	-	50
Na	g/t	184	-	-	591
Ni	g/t	309	-	-	777
P	g/t	< 200	-	-	223
Pb	g/t	23200	-	52700	7330
Sb	g/t	999	-	-	807
Se	g/t	< 30	-	-	< 30
Sn	g/t	< 20	-	-	< 20
Sr	g/t	25.4	-	-	68
Ti	g/t	772	-	-	1160
Tl	g/t	< 30	-	-	< 30
V	g/t	< 10	-	-	21
Y	g/t	3	-	-	3.4
Zn	g/t	60200	-	86500	33700
S	%	27.3	23.7	24.2	23.0
S ⁼	%	27	23.0	23.9	22.2
C(t)	%	0.33	-	-	-
CO ₃	%	1.46	-	-	-
C(g)	%	< 0.05	-	< 0.05	< 0.05
TOC	%	< 0.05	-	0.13	0.15
Cl (HNO ₃ soluble)	%	< 10	-	26	< 10
K80	µm	28.9	26.1	184.0	20.6

2. Head Characterization

The four concentrates were analyzed for gold, silver, sulphur, and sulphide with two of the four samples receiving a full ICP scan analysis. In addition to the ICP scan, three of the four samples were also assayed for carbon speciation (C(g), C(t) and TOC) and Cl (HNO₃ soluble). Gold assays ranged from a low of 13.0 g/t for the combined feed of BL 801-24 Final Tails + BL 801-25 Final Tails to a high of 25.5 g/t for BL 801 Bulk Conc. 1. The BL 801-16 (products 1-4) concentrate contained the most silver at 128 g/t, with the other three samples ranging from 40-60 g/t Ag. The BL 80-16 (products 1-4) concentrate was the coarsest sample with a K80 of 184 µm while the other 3 samples were all finer than 30 µm.

3. Pressure Oxidation- Hot Cure – CIL/CN Testwork

3.1. POX-HC Tests 1 to 3 and CN Tests 1 to 3

The first three POX (pressure oxidation) tests were conducted on sample BL 801 Bulk Con 1. Pressure oxidation tests were conducted in a 2 L titanium vessel at the target temperature and retention time and then cooled to 95°C. As soon as the temperature reached 95°C, a sample was taken for assays then heating at 95°C for several hours for the hot cure stage. The pre-acid pH target and retention time were varied in the three POX tests as shown in Table 2. By changing the pre-acid pH target from a pH of 2 to pH 1, the acid addition increased significantly from about 65 kg/t to 959 kg/t. This resulted in a POX PLS with a free acid of 145 g/L H₂SO₄, which was more than double that produced when the pre-acid target was pH 2. In addition, with the higher acid addition the average O₂% in the off gas was lower at 83% compared to 95%.

Table 2: POX Tests 1 to 3 Operating Parameters

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 1	BL 801 Bulk Con 1	9.1	No	28.9	1.0	959	220	120
POX 2	BL 801 Bulk Con 1	9.0	No	28.9	2.0	66	220	120
POX 3	BL 801 Bulk Con 1	9.0	No	28.9	2.0	65	220	60

Table 3: POX Tests 1 to 3 Test Details

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 1	220	435	250	83	0.73	802	1.08	612	145.1
POX 2	220	428	204	95	1.03	776	1.66	576	59.1
POX 3	220	432	250	95	1.25	783	1.69	548	64.9

Reducing the retention time from 120 minutes (POX 2) to 60 minutes (POX 3) appeared to have a slight effect in producing a POX PLS with a free acid of ~65 g/L compared to 59 g/L H₂SO₄. Acid is produced in POX from the oxidation of sulphides and some of this acid is then consumed during POX to form a basic iron sulphate (BFS) precipitate by hydrolysis. Therefore, the lower acid concentration in POX2 indicates more BFS was formed in POX2 owing to the longer retention time.

At the end of the POX, the oxidized slurry was cooled to 95°C, the vessel removed from the heating mantle, and the head removed. The pulp was mixed and sampled, and the sample was filtered and washed, with only the POX PLS being submitted for analysis. The autoclave head was then re-installed and the vessel returned to the heating mantle. The pulp was heated back up to 95°C for the hot cure stage. Upon completion of the hot cure, the vessel was removed from the heating mantle and opened, with a sample once again being removed and filtered. Samples of solution and washed solids were submitted for assay and the remaining washed solids were forwarded for cyanidation testing.

The extra acid added in POX 1 resulted in a lower pH and a significantly higher free acid concentration after POX and hot curing than in the other two tests, as seen in Table 4. Analysis of the POX filtrates (Table 5) showed that the very high acid in POX1 produced a solution with four times the iron and five times the arsenic concentrations compared to POX2 and POX 3. This indicates that ferric arsenate, which is the normal stable autoclave product under standard POX conditions, was unstable in ~150 g/L acid, and re-dissolved. Hot curing of the pulp resulted in higher concentrations of iron and arsenic compared to the POX discharge in all three tests. Sulphide oxidation in the high acid test (POX 1) was 99.3%, was only 1 to 2% higher than the lower acid addition POX tests. The solids weight loss was about double in POX 1 compared to POX 2 and 3, owing to the redissolution of ferric arsenate and basic iron sulphate in strong acid.

Shortening the retention time in POX 3 resulted in slightly lower sulphur oxidation of ~97% compared to 98%, as seen by the residue assay of 0.96% sulphide compared to 0.44%.

Table 4: Hot Cure Tests 1 to 3 Details

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 1	BL 801 Bulk Con 1	4	94.6	0.63	750	1.14	556	167.4	green
POX 2	BL 801 Bulk Con 1	4	94.8	0.94	710	1.58	559	59.4	orange
POX 3	BL 801 Bulk Con 1	4	95.0	0.94	744	1.70	550	58.2	org-yell

Table 5: POX-HC Test 1 to 3 Chemical Analysis

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 1	20600	5750	68000	22900	6670	77200	21.8	28.5	58	0.43	99.3	55.3
POX 2	5000	1020	23100	7520	2110	24200	27.7	22.2	57	0.44	98.8	27.8
POX 3	5820	1000	25200	8490	2260	25800	27.7	22.9	57	0.96	97.2	21.9

The bulk of the hot cure residue after washing was forwarded for cyanidation testing. The residue from POX-HC 1 was subjected to carbon-in-leach testing (CIL) whereas the other two tests were standard cyanidation tests (no carbon) with kinetic samples taken at prescribed intervals. For CN-2 and CN-3, the hot cure residues from POX-HC 2 and 3 were first combined then split in half with one half being leached as-is and the second half being ground in the attrition mill for 30 minutes at 34% solids. Test details for the cyanidation tests can be found in Table 6 and the results in Table 7.

Table 6: CN Test Details (CN tests on POX-HC Test 1 to 3 Residues)

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
					NaCN	CaO	NaCN	CaO	
POX 1	BL 801 Bulk Con 1	CIL-1	HC-1	No	24.63	14.01	4.22	13.24	1250
POX 2	BL 801 Bulk Con 1	CN-2	HC2 + HC3	No	48.52	2.29	6.73	1.86	2727
POX 3	BL 801 Bulk Con 1	CN-3	HC2 + HC3	Yes	93.66	11.42	58.11	9.78	2234

Cyanide leaching of POX-HC 1 residue with carbon achieved 63% Au extraction and 83.6% Ag extraction (Table 7). The poor gold recovery despite ~100% sulphide oxidation in POX, suggests that there might be a preg robbing problem with this concentrate. The high silver recovery indicated that silver jarosite, which is refractory to cyanide leaching, was destabilized in the high acid concentration generated in POX1. The POX-HC1 solids required the highest lime addition at 14 kg/t of cyanide feed as a result of the lower starting pH of 4.8 compared to CN-2 and 3 which had starting pH values of 6.5.

Table 7: CN Tests 1 to 3 Results

Test	LB, CN / CIL Test Number	Carbon Au Assay g/t	Barren /PLS Au Assay mg/L	Residue Au Assay g/t	Carbon Ag Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 1	CIL-1	258	0.02	14.5	583	0.27	11.4	63.2	83.6	39.36	69.60	25.0	41.0
POX 2	CN-2	-	2.60	2.12	-	0.58	54.6	92.1	9.3	26.74	60.22	25.0	41.0
POX 3	CN-3	-	2.47	0.39	-	1.01	11	98.4	47.0	24.60	20.76	25.0	41.0

CN-3 Residue assayed to Extinction, No more sample

Fine regrinding of the feed to cyanide leaching in CN-3 resulted in significantly higher cyanide consumption values of ~58 kg/t NaCN, probably due to exposure of fresh reactive iron surface in the finely ground

sample. With the extra cyanide and additional grinding, gold recovery increased from ~92% in the unground sample to 98%, while Ag recovery increased from 9% to 47%. An examining of the kinetic data for CN-2 and CN-3 presented in Figure 1 indicates that leaching is fast and that 56 hours of leaching is not required. In fact, a shorter period of 8 hours would be closer to optimum as calculated extractions in CN-2 and CN-3 were 92.3 and 99.9%, respectively, after 8 hours. The apparent dip in recovery in the 24 hour and 48 hour samples may not be a real effect but the results of assay uncertainty, since these calculated recoveries were based on a solution assay only rather than a full mass balance. In order to determine the optimum leach residence time more accurately, it will be necessary to conduct several leaches with variable residence times, with a full assay suite and mass balance at the end of each.

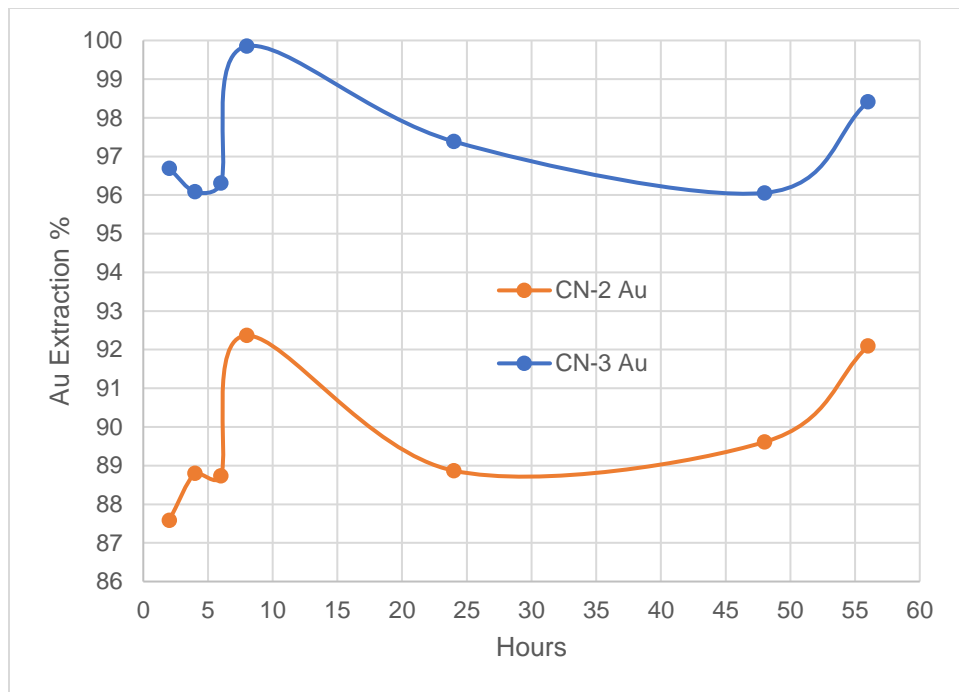


Figure 1: CN-2 and CN-3 Au Extraction % as a Function of Time

3.2. POX-HC Tests 4 to 6 and CN Tests 4 to 6

Pressure oxidation tests POX 4 to 6 were conducted on the second sample received (BL 801- Bulk Conc 2). The effects of grind size (POX6), temperature (POX5) and retention time (POX5) were examined (Table 8) in the three tests run. Grinding of the feed to POX (POX6), resulted in additional acid being required during pre-acidulation of 101 kg/t compared to 89 kg/t in the other two tests. Although POX 6 required the most acid in pre-acidulation, the final free acid concentrations were similar in the three tests (49-54 g/L).

Table 8: POX Test 4 to 6 Operating Parameters

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 4	BL 801 Bulk Con 2	9.0	No	26.0	2.0	89	220	90
POX 5	BL 801 Bulk Con 2	9.0	No	26.0	2.0	89	230	60
POX 6	BL 801 Bulk Con 2	9.0	Yes	7.7	2.0	101	220	90

Table 9: POX 4 to 6 Test Details

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 4	220	436	225	95	1.05	740	1.49	561	54.0
POX 5	230	505	229	96	0.94	749	1.69	547	48.4
POX 6	220	434	250	97	0.99	788	1.80	575	48.8

Hot curing of the pulp resulted in similar results for the three tests, as seen in Table 10. Residue colour was the only noticeable difference, with hot cure POX 4 and 5 producing orange residues and hot cure 6 (highest POX acid addition) producing a gold coloured residue

Table 10: Hot Cure Tests 4 to 6 Details

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 4	BL 801 Bulk Con 2	4	95.6	1.00	693	1.61	538	50.2	orange
POX 5	BL 801 Bulk Con 2	4	95.0	1.00	647	1.54	510	45.0	orange
POX 6	BL 801 Bulk Con 2	4	95.4	1.10	752	1.69	588	44.3	gold

The test at 230°C (POX5) produced the lowest residual sulphide of 0.43% (98.7% oxidation), while the test with regrinding of the concentrate produced the highest residual sulphide of 0.98% (96.9% oxidation). It is unclear why fine grinding failed to improve oxidation efficiency. Weight loss in POX and hot curing was similar in the three tests (27 to 30%).

Table 11: POX-HC Tests 4 to 6 Chemical Analysis

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ²⁻ %	Hot Cure Residue S ²⁻ Oxd'n %	Weightloss % Overall
POX 4	6060	1230	22600	7990	2640	22300	25.7	19.2	57	0.68	97.8	26.6
POX 5	4580	1250	22200	8220	3320	24500	25.8	17.6	52	0.43	98.7	29.5
POX 6	6360	1520	23300	10600	3460	26900	24.8	19.5	55	0.98	96.9	27.6

Cyanide consumption was similar in the three tests (6-9 kg/t NaCN), but it was highest in POX 5, the test at the higher POX temperature, and lowest in the test in which the feed was reground prior to POX (POX 4). This was unexpected. Lime consumption was similar in the three tests (3.3-3.9 kg/t CaO).

Table 12: CN Test Details (CN tests on POX-HC test 4 to 6 Residues)

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
					NaCN	CaO	NaCN	CaO	
POX 4	BL 801 Bulk Con 2	CN-4	HC-4	No	51.84	4.42	8.03	3.90	2658
POX 5	BL 801 Bulk Con 2	CN-5	HC-5	No	53.16	4.36	9.02	3.78	2633
POX 6	BL 801 Bulk Con 2	CN-6	HC-6	No	51.61	3.93	6.32	3.32	2707

All three residues from hot cure were forwarded for cyanidation for 56 hours, achieving excellent gold recovery ranging between 94% to 96.7% but, poor silver recovery with less than 16% in all three tests (Table 13). The best gold recoveries of ~97% were achieved in the tests with higher POX temperature (POX5) and reground feed (POX4). The calculated gold extractions in the kinetic tests suggested gold recovery increased over the 56-hour duration of the tests. This contradicts the results with the products of POX 1, 2, and 3 (Figure 1), but should be viewed with caution as stated previously, since the individual data points are based on solution assays only and subject to analytical variance.

Table 13: CN Tests 4 to 6 Results

Test	LB, CN / CIL Test Number	Barren /PLS Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 4	CN-4	2.24	1.40	1.06	53.5	94.2	15.7	24.0	63.5	20.7	40.6
POX 5	CN-5	2.23	0.85	0.64	48.9	96.4	11.7	23.9	55.4	20.7	40.6
POX 6	CN-6	2.43	0.86	0.28	55.1	96.7	4.6	25.7	57.8	20.7	40.6

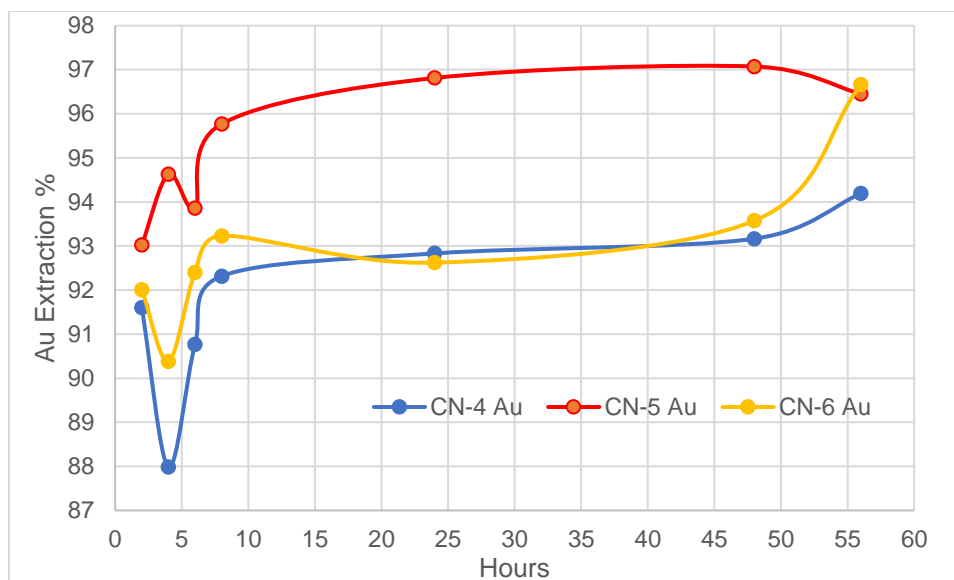


Figure 2: CN-4 to CN-6 Gold Extraction % as a Function of Time

3.3. POX-HC Tests 7 and 8, and CN Tests 7 to 10

On receipt of a third ore sample (BL 801-16 products 1-4 concentrate) a series of four pressure oxidation-hot cure tests was undertaken to examine the effects of regrinding and lime boiling. Feed to POX tests 7a and 7b was unground whereas the feed to POX 8a and 8b was reground. The sample was ground in the attrition mill at 50% solids. The first regrind for 30 minutes produced a k80 of 4.6 μm , which was too fine, and the second attempt at 2.5 minutes resulted in an acceptable K80 of 32.5 μm . The two pulps were combined, mixed, and sampled. The k80 on the combined feed to POX-HC 8a and 8b was 16.3 μm .

This series of four tests was run differently than previous tests with each test being comprised of an “a” and “b” procedure, and the two products were combined after hot curing. A sample was removed for analysis and the remaining pulp being split in half for two cyanidation tests, one preceded by a lime boil step to liberate silver, and the other a direct cyanidation without lime boiling. The percent solids for the POX tests was increased from 9% to 12% solids to ensure there would be sufficient solids for the two cyanidations. Acid addition to pH target of 2 prior to POX resulted in a range between 78 to 103 kg/t of sulphuric acid as displayed in Table 14.

Table 14: POX Test 7a, 7b, and 8a, 8b Operating Parameters

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 7a	BL 801-16 pdts 1-4	12.0	No	184.0	2.0	96	220	90
POX 7b	BL 801-16 pdts 1-4	12.0	No	184.0	2.0	78	220	90
POX 8a	BL 801-16 pdts 1-4	12.0	Yes	16.3	2.0	103	220	90
POX 8b	BL 801-16 pdts 1-4	12.0	Yes	16.3	2.0	88	220	90

Some variability within individual tests on the same concentrate was also seen in the POX pulp pH, ORP, PLS pH, ORP, and free acid values (Table 15). The variability was not consistently related to whether the feed was reground or not. The variability had almost disappeared after hot curing and the slurries produced in the four tests were very similar in terms of POX pulp pH, ORP, PLS pH, ORP, and free acid values (Table 15).

Table 15: POX 7a, 7b, and 8a, 8b Test Details

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 7a	220	436	233	97	0.96	594	1.27	431	55.7
POX 7b	220	440	256	95	1.19	528	1.30	407	35.7
POX 8a	220	439	250	98	1.15	650	1.38	491	56.7
POX 8b	220	438	256	97	1.38	473	1.35	356	40.9

Table 16: Hot Cure Tests 7a, 7b and 8a, 8b Details

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 7a	BL 801-16 pdts 1-4	4	95.4	1.18	474	1.34	413	42.6	red
POX 7b	BL 801-16 pdts 1-4	4	94.8	1.18	474	1.34	413	42.6	red
POX 8a	BL 801-16 pdts 1-4	4	94.8	1.27	476	1.41	404	49.5	brown
POX 8b	BL 801-16 pdts 1-4	4	94.6	1.27	476	1.41	404	49.5	brown

Pregnant leach solution from pressure oxidation contained significantly higher iron, arsenic, and total sulphur concentrations in the reground concentrate, and greater weight loss compared to the unground feed. This suggests that the ferric arsenate and basic iron sulphate precipitates were less stable in the POX tests on reground feed.

Table 17: POX-HC Tests 7a, 7b, and 8a, 8b Chemical Analysis

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ²⁻ %	Hot Cure Residue S ²⁻ Oxd'n %	Weightloss % Overall
POX 7a	4080	1690	26900	7020	4370	24100	21.7	12.1	149	5.75	83.1	29.7
POX 7b	5100	3590	20900	7020	4370	24100	21.7	12.1	149	5.75	83.1	29.7
POX 8a	12300	3020	32700	13300	5370	30200	19.3	12.0	159	3.52	90.3	34.4
POX 8b	11500	5640	26400	13300	5370	30200	19.3	12.0	159	3.52	90.3	34.5

After hot cure, the POX 7a and 7b pulps were combined, sampled, then filtered and washed. The same with the POX 8a and 8b pulps. The washed POX 7 and POX8 residues were split in half, with one half going directly to cyanidation and the other half processed by lime boiling prior to cyanidation. The lime boil procedures were conducted by pulping the two washed solids from POX 7 and POX 8 in deionized water and heating them to 95°C in a glass reaction vessel. Once at temperature, hydrated lime was added (0.25 g of Ca(OH)₂ per gram of feed) and the slurry was maintained at temperature for two hours. The temperature, pH, and ORP were monitored throughout the test. The amounts of cyanide and lime added and consumed during the lime boiling and cyanidation are shown in Table 18. Lime addition and consumption was obviously significantly higher in the two tests involving the lime boil step, but cyanide consumption was much lower. This indicated that certain cyanide-consuming species (probably iron) were passivated during the lime boil step.

Table 18: CN Test Details (CN tests on POX-HC test 7a, 7b, and 8a, 8b Residues)

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
					NaCN	CaO	NaCN	CaO	
POX 7a	BL 801-16 pdts 1-4	LB-1, CN-7	LB-1	No	39.7	143.1	8.4	136.7	2699
POX 7b	BL 801-16 pdts 1-4	CN-8	HC 7a + 7b	No	80.4	8.6	19.2	8.6	4216
POX 8a	BL 801-16 pdts 1-4	LB-2, CN-9	LB-2	No	42.0	159.7	6.6	154.5	2776
POX 8b	BL 801-16 pdts 1-4	CN-10	HC 8a + 8b	No	58.3	5.8	14.7	5.6	2757

Note: Reagent addition of CaO also takes into account lime added during lime boil

The lime added during the lime boil step was converted to gypsum (CaSO₄·2H₂O), so the addition of ~150 kg/t lime in Tests CN7 and CN9 increased the mass of solids in these two tests by at least 30% compared to the two direct cyanidation tests (CN8 and CN10). This is reflected in the calculated head values for gold and silver in the cyanidation tests, which were ~30% lower in CN7 and CN9 than in CN8 and CN10 (Table 19), and also in the residue values for gold.

Once the change in the mass of solids is taken into consideration, it appears that the lime boil step had minimal effect on gold recovery, which is consistent with previous investigations, but had a significant effect on silver recovery, particularly with the finely reground feed (CN9 and CN10). The results of CN10 show

that fine regrinding produced a higher proportion of refractory silver jarosite (silver extraction 40%) that produced with the unground CN8 feed (silver extraction 67%). Lime boiling improved silver recovery significantly in both cases, to the 75% - 81% range. Gold extraction was over 80% in all the tests, with the best recovery of ~90% achieved in after fine grinding and lime boiling (CN9). Gold and silver extractions are displayed graphically in Figure 3 and Figure 4.

Further testing is needed to optimize and minimize the addition of lime in the lime boil step so that a cost benefit analysis can be conducted, balancing the value of the additional silver recovery (and possibly lower cyanide consumption) against the cost of the higher lime consumption.

Table 19: CN Tests 7a, 7b, and 8a, 8b Results

Test	LB, CN / CIL Test Number	Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 7a	LB-1, CN-7	1.73	2.42	12.9	30.2	83.1	74.9	14.3	120.4	15.3	128
POX 7b	CN-8	2.01	4.08	13.8	56.3	80.3	67.3	20.4	172.4	15.3	128
POX 8a	LB-2, CN-9	1.66	1.48	12.4	22.3	89.5	81.0	14.0	117.6	15.3	128
POX 8b	CN-10	1.50	3.07	6.7	101.2	82.4	39.6	17.5	167.6	15.3	128

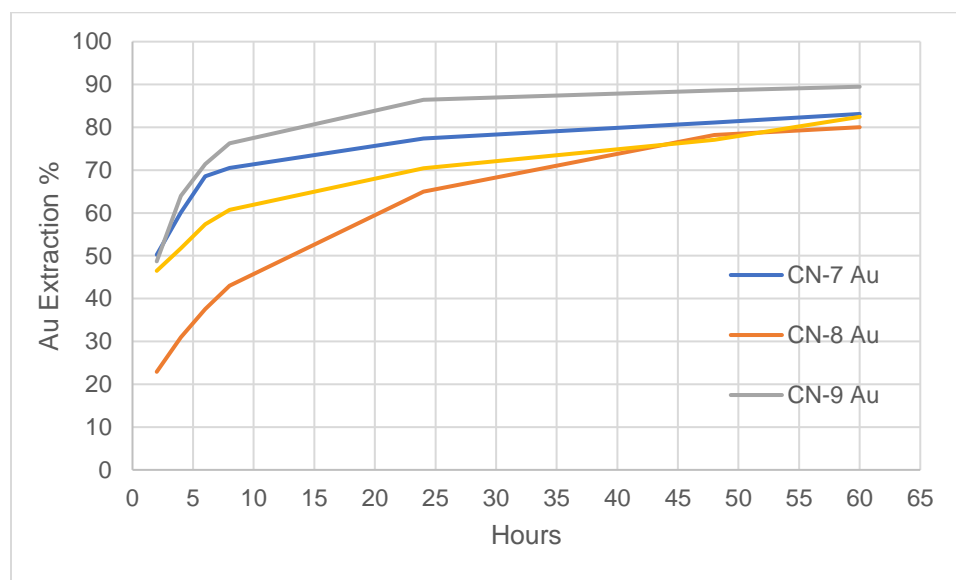


Figure 3: CN-7 to CN-10 Gold Extraction % as a Function of Time

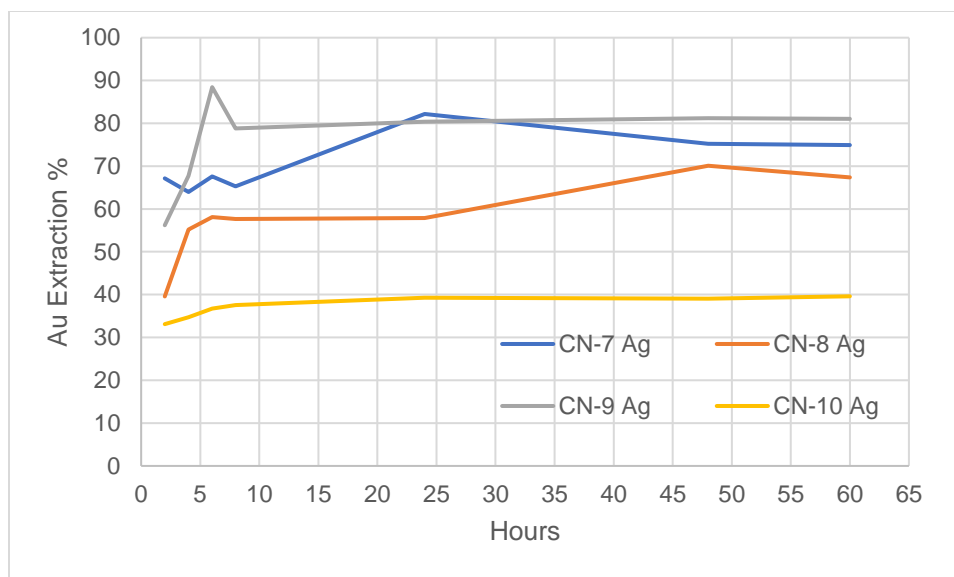


Figure 4: CN-7 to CN-10 Silver Extraction % as a Function of Time

3.4. POX-HC Test 9 and CN Tests 11 to 14

A fourth concentrate sample (BL 801-24 Final Tails + BL 801-25 Final Tails) was delivered to SGS Lakefield to examine the effects of hot curing along with a comparison of oxygen and air sparging during cyanide leaching. Two identical POX tests were conducted and the percent solids in the autoclave was increased slightly to 13.2% to ensure there would be sufficient solids for all tests that were planned. The feed for two POX tests was pre-acidified to pH 2 and run under the same POX conditions, and after POX the oxidized slurries were mixed and weighed. The test conditions and results are summarized in Table 20 and Table 21.

While continuing to mix the combined oxidized slurry, half of the pulp by weight was removed, filtered, and washed in preparation for direct cyanidation with either air or oxygen. The other half remained on the heating mantle and was heated at 95°C for 4 hours of hot curing before splitting for cyanidation tests with either air or oxygen sparging.

Table 20: POX 9 Operating Parameters

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 mm	Pre-acid pH Target	Acid Add'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 9	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2.0	107	220	90

Table 21: POX 9 Test Details

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 9	220	432	263	96	1.20	831	1.41	670	66.2

The pulp that had been hot cured (9b) produced an orange solution with a pH of 1.06 and an ORP of 687 mV (Table 22). Measurements done on the filtrate showed it contained 55 g/L free acid as H₂SO₄ at a pH of 1.65 and ORP of 514 mV.

Table 22: Hot Cure 9 Test Details

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 9	BL 801-24 Final Tails + BL 801-25 Final Tails	4	95.0	1.06	687	1.65	514	55.2	orange

Analysis of the POX and hot cure solutions from test 9 showed that the arsenic concentrations doubled, from 2140 mg/L to 4320 mg/L from POX to hot cure, and iron levels almost doubled, from 9380 mg/L to 16,200 mg/L (Table 23). This was due to the breakdown of ferric arsenate and BFS during hot curing. Sulphide oxidation was very high (99.7%) and weight loss was 33.5% after POX and hot cure,

Table 23: POX-HC 9 Chemical Analysis

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 9	9380	2140	32800	16200	4320	37300	18.4	14.6	71	0.20	99.7	33.5

Prior to running the four cyanidation tests, both residues (1 x POX and 1 x Hot cure) were reground in the attrition mill. The POX residue was ground for 3.6 minutes per 171 g at 50% solids and the hot cure residue was ground for 2.1 minutes per 120 g at 50% solids. Malvern analysis of the ground products reported a d80 of 10.9 µm for the POX residue and 12.0 µm for the hot cure residue (Malvern results appended). After grinding, the two samples were filtered separately and each was split in half for cyanide leaching, one half with oxygen-sparging and the other with air sparging, to compare the effect on gold and silver recovery.

In general, the purpose of the hot cure process is to lower lime consumption during gold leaching, by breaking down the basic iron sulphate complex in the POX solids before cyanidation and removing the solution by solid liquid separation. As can be seen in Table 24, the consumptions of both lime and cyanide were lowered significantly (by up to 80%) in the two cyanidation tests that were done on the hot cured POX

solids. Moreover, the consumption of cyanide was reduced by a further 50% in the cyanide leach that was conducted with oxygen sparging relative to the air-sparged test. The k80 values displayed in Table 24 are from measurements on the final residue of each cyanide test.

Table 24: POX_HC 9 CN Test Details (CN-11 to CN-14)

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Oxygen / Air Sparging	Size K80 mm	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
POX 9a + POX 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-11	POX 9a + 9b	Yes	Oxygen	12.24	68.2	41.9	47.1	41.9	1150
POX 9a + POX 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-12	POX 9a + 9b	Yes	Air	12.73	78.7	38.0	65.3	38.0	741
HC 9a + HC 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-13	HC 9a +9b	Yes	Oxygen	13.03	33.4	6.1	8.8	5.8	1398
HC 9a + HC 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-14	HC 9a +9b	Yes	Air	13.24	39.9	6.0	17.1	6.0	1365

The results of the four cyanidation tests are summarized in Table 25 and displayed in Figure 4 and Figure 5. Gold extraction was excellent in all four tests (>98%), with the average extraction from the POX residue (98.7%) being slightly higher than that of the hot cure residues (98.2%). The use of oxygen versus air lowered the consumption of cyanide and improved the kinetics of gold leaching but had no effect on final gold recovery after 48 hours.

Silver recovery was poor in all four tests, with less than 25% being recovered. These tests proved that the lime boil process, which was not used in any of these tests, is critical for maximizing silver recovery

Table 25: CN-11 to CN-14 Results

Test	LB, CN / CIL Test Number	Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 9a + POX 9b Residue	CN-11	1.42	0.19	1.42	46.2	98.8	24.6	15.3	61.3	13.7	60
POX 9a + POX 9b Residue	CN-12	1.46	0.21	1.46	49.1	98.6	23.7	15.4	64.3	13.7	60
HC 9a + HC 9b Residue	CN-13	1.74	0.38	1.74	78.8	98.0	18.8	18.7	97.1	13.7	60
HC 9a + HC 9b Residue	CN-14	1.83	0.33	1.83	58.1	98.3	24.0	18.7	76.4	13.7	60

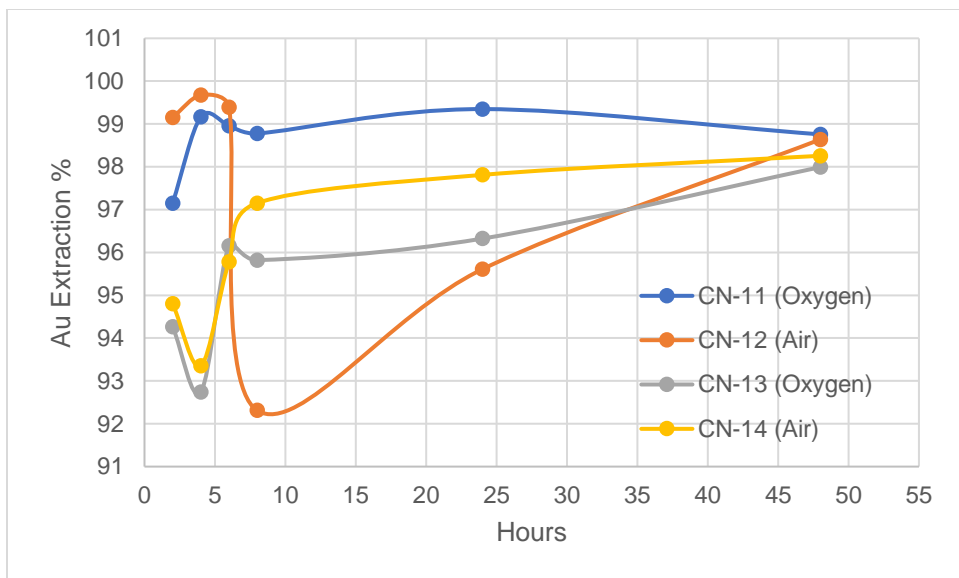


Figure 5: CN-11 to CN-14 Gold Extraction as a Function of Time

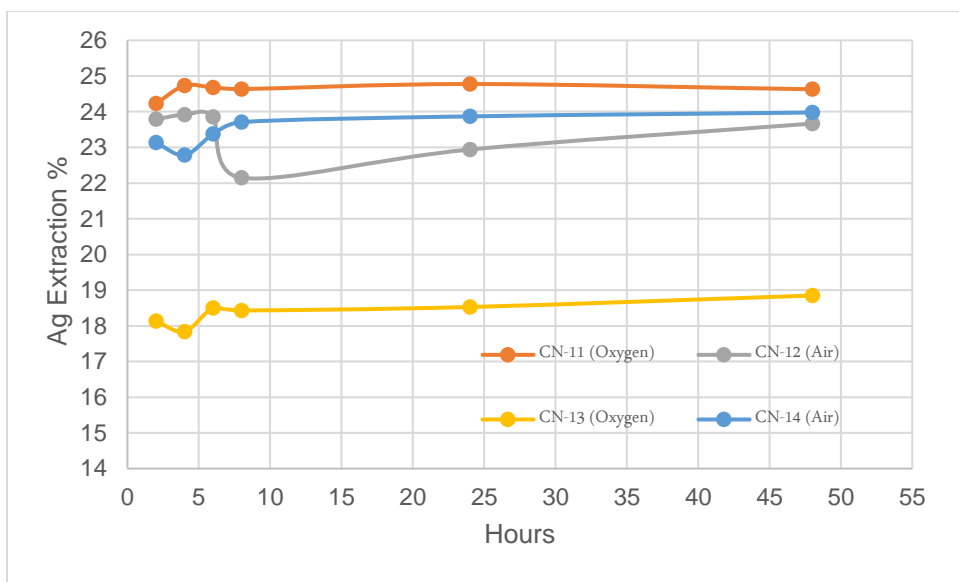


Figure 6: CN-11 to CN-14 Silver Extraction as a Function of Time

3.5. POX-HC Tests 10 and 11

Pressure oxidation-hot cure tests 10 and 11 were conducted to produce feed for downstream testing. As in previous tests, there were two POX tests, an “a” and a “b” for both POX 10 and 11, to ensure there were sufficient solids for downstream testing. There was no sampling of the POX products and the entire pulp was hot cured after each POX test. The final hot cure residue from POX 10 was sent to Surface Science Western for mineralogical investigation and the residue from POX 11 was sent to Environmental Technologies in BC. Additionally, a sample of the hot cure residue from POX 10 was sent to the SGS Mineralogy group for testing. Those findings will be presented in a separate report.

The feed for POX 10a and 10 b was a 50:50 blend of the first two samples received (BL 801 Bulk Conc 1 and BL 801 Bulk Conc. 2) and the feed to POX 11a and 11b was the combined final tails of BL 801-24 and BL 801-25. There was no regrinding of the feed material in any of the tests and the pulp density was kept at 13.2% solids. The feed was pre-acidulated to pH 2 for all tests.

Table 26: POX 10 and 11 Operating Parameters

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas
POX 10a	Blend of Bulk Conc. 1 and Bulk Conc. 2	13.2	No	27.5	2	94	220	90	220	430	256	90
POX 10b	Blend of Bulk Conc. 1 and Bulk Conc. 2	13.2	No	27.5	2	52	220	90	220	439	261	95
POX 11a	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2	115	220	90	220	432	239	94
POX 11b	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2	100	220	90	220	439	261	95

After 4 hours of hot curing separately, the “a” and “b” products were weighed, combined, and mixed. While mixing the pulp, the pH and ORP were measured, and the results are shown seen in Table 27. The “a” and “b” pulps for each test were then combined and mixed to ensure homogeneity and the pH and ORP readings taken again. The pulps were then filtered, and the residues well washed. Measurements on the filtrate showed good oxidation as determined by the high ORP values of 611 and 583 mV with free acids of 71 and 51 g/L H₂SO₄ for tests 10 and 11, along with low residual sulphide levels, as seen in Table 28.

Table 27: Hot Cure 10 and 11 Test Details

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 10a	Blend of Bulk Conc. 1 and Bulk Conc. 2	4	95.0	1.36	677	-	-	-	-
POX 10b	Blend of Bulk Conc. 1 and Bulk Conc. 2	4	95.4	1.41	707	-	-	-	-
	Hot Cure 10a + 10b Combined	-	-	1.38	680	1.51	611	71.3	yellow
POX 11a	BL 801-24 Final Tails + BL 801-25 Final Tails	4	95.2	1.19	656	-	-	-	-
POX 11b	BL 801-24 Final Tails + BL 801-25 Final Tails	4	94.8	1.17	628	-	-	-	-
	Hot Cure 11a + 11b Combined	-	-	1.13	632	1.14	583	50.9	orange

Table 28: Hot Cure 10 and 11 Test Results

Test	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 10a	-	-	-	-	-	-	-	-	-
POX 10b	-	-	-	-	-	-	-	-	-
HC 10a + 10b Comb	13100	6470	36400	25.2	20.9	54	0.64	98.2	29.0
POX 11a	-	-	-	-	-	-	-	-	-
POX 11b	-	-	-	-	-	-	-	-	-
HC 11a + 11b Comb	19100	3910	35500	18.0	14.6	73	0.17	99.5	32.1

Summary

4. BL 801 Bulk Concentrate 1 (POX-HC 1-3, CIL-1, CN-2 and CN-3)

The effects of varying the pre-acidulation pH target (pH1 and pH2) and regrinding the oxidized POX solids before cyanidation were examined in the three tests with this concentrate. The POX slurry was hot cured for 4 hours after POX in each of these tests. Hot curing is a technique that is designed to break down the BSF that is formed during POX, thereby lowering lime consumption in the downstream cyanidation process.

- Raising the pre-acidulation pH target from pH 1 to 2 resulted in a significant drop in acid addition, from 959 kg/t H_2SO_4 to ~65 kg/t H_2SO_4 .
- The higher acid addition during pre-acidulation at pH 1 destabilized jarosites, ferric arsenate, and basic iron sulphate (BFS), resulting in significantly higher concentrations of iron and arsenic in the POX and hot cure liquors.
- Gold recovery by cyanidation after pre-acidulation at pH 2 and POX was good (92%) but silver recovery was very poor (~9%). Reducing the POX residence time from 120 to 60 minutes and finely regrinding the oxidized POX solids prior to cyanidation improved gold recovery from 92% to ~99% and also increased silver recovery significantly, from 9% to 47%. However, cyanide and lime consumptions increased five to ten-fold as a direct result of fine regrinding, and further testing is needed to determine the economically optimum regrind particle size.
- The higher acid addition during pre-acidulation at pH 1 also destabilized silver jarosite, the compound that is very refractory to cyanidation. As a result, silver recovery increased from ~9 % when pre-acidulating was conducted at pH2, to ~84% at a pre-acidulation target of pH1. However, gold recovery dropped from ~92% to ~63% in the strong acid POX, possibly because of preg robbing. Since gold is the principal pay metal, strong acid POX is not recommended.
- Reducing the POX retention time from 120 to 60 minutes (both at 220°C) produced a much higher concentration of iron in the POX and hot cure solutions, indicating less BFS precipitate was formed in the shorter POX residence time.

5. BL 801 Bulk Concentrate 2 (POX-HC 4-6, CN-4 to CN-6)

The effects of POX temperature (220° and 230°C), retention time (60, 90 minutes) and regrinding of the feed to POX were examined in the series of three tests with this concentrate. The POX slurries were again hot cured for 4 hours after POX in each of these tests.

- Very good sulphide oxidation (97-99%) was achieved in all three tests. The higher temperature (230°C) and shorter retention time (60 minutes) resulted in slightly higher oxidation (99%) than 220°C POX for 90 minutes (~97%),
- The higher temperature also resulted in a slightly lower concentration of iron in the POX solution, indicating that more BSF precipitate was produced under these conditions.
- Regrinding the feed to POX did not improve sulphide oxidation.
- Gold recoveries by cyanidation were very good in all the tests (94-97%) but silver recoveries were poor (5-16%). The worst silver recovery of 5% was achieved in the test where the POX feed was reground, indicating that more silver jarosite was produced under those conditions.
- Cyanide (6-9 kg/t NaCN) and lime (~4 kg/t CaO) consumptions were very similar in the three tests.

6. BL 801-16 products 1-4 (POX-HC 7 and 8, CN-7 to CN-10)

The tests with this concentrate examined the effects of regrinding the feed to POX and lime boiling the feed to cyanidation. Lime boiling is designed to break down silver jarosite and enhance silver recovery by cyanidation.

- Sulphide oxidation under “standard” POX conditions of 220°C temperature and 90 minutes retention time was relatively poor (83-90%) in all the tests with this concentrate.
- Regrinding the feed to POX from a K80 of ~ 160 µm to ~16µm improved sulphide oxidation from 83% to 90%. Regrinding also resulted in higher concentrations of iron and arsenic in the POX and hot cure liquors.
- Gold recovery was adversely affected by the poor sulphide oxidation, which was in the 80-89% range, compared to the 92-99% range with the other concentrates.
- Silver recovery was enhanced by the lime boil process, from 40-67% without lime boiling to 75%-81% with lime boiling. The best silver recovery of 81% was achieved with the feed that had been reground prior to POX and lime-boiled prior to cyanidation.
- Lime boiling increased lime consumption from <10 kg/t to >130 kg/t CaO. Further optimization is needed to determine the improvement in silver recovery with an economically optimum lime dosage.

7. BL 801-24 Final Tails + BL 801-25 Final Tails (POX-HC 9, CN-1 to CN-14)

The four tests with this concentrate examined the benefit of hot curing as well as the effect of sparging with oxygen or air during cyanidation. All the POX tests were conducted under the same “standard” conditions of 220°C temperature for 90 minutes, and all the POX or hot cure residues were washed and reground prior to cyanidation.

- Gold extraction from this concentrate was excellent (98-99%) in all four cyanidations, after applying the standard POX conditions. Lime boiling was not applied in these tests and silver extraction was therefore poor (<25% in all tests).
- Hot curing had a dramatic beneficial effect on the consumption of lime as expected, and also on cyanide consumption. Lime consumption was reduced from ~40 kg/t CaO in the two tests without hot curing to ~6 kg/t in the tests with hot curing. In the tests with air sparging during cyanidation, cyanide consumption was reduced from 65 kg/t NaCN without hot curing to 17 kg/t with hot curing. The improvement was even more dramatic in the two tests with oxygen sparging, with cyanide consumption reducing from 47 kg/t NaCN to 9 kg/t.
- Cyanide consumption after POX is normally less than 2 kg/t NaCN, so detailed analysis of cyanidation liquors and further testwork is needed to determine the reason for the generally much higher cyanide consumption in the tests with all these concentrates.

Conclusions and Recommendations

The optimum POX conditions established in the testwork involved pre-acidulation of the concentrates at pH 2, followed by autoclaving at either 220°C for 90 minutes or 230°C for 60 minutes. Under these conditions, sulphide oxidation of 97-99% was generally achieved. The only exception was concentrate “BL 801-16 products 1-4”, where the sulphide oxidation was in the range 83-90%. Further testwork is needed to optimize the POX conditions for this concentrate. In addition, concentrate “BL801 Bulk Concentrate 1” exhibited some evidence of preg robbing during cyanidation, particularly after autoclaving under aggressive conditions.

Pre-acidifying at pH 1 destabilized silver jarosite and improved silver recovery significantly but was generally not beneficial. Acid addition/consumption was very high and gold recovery actually decreased quite significantly.

Gold recovery by cyanidation after oxidizing the concentrates was excellent (94-99%) for three of the four concentrates. The only exception was Concentrate “BL 801-16 products 1-4”, which suffered lower gold recoveries (82-89%); undoubtedly owing to incomplete oxidation of this feed in POX. Recovery from Concentrate “BL801 Bulk Con 1” improved from 92% to 99% when the oxidized solids were reground prior to cyanidation.

Silver recovery was influenced by the formation of the refractory silver jarosite compound during POX. Under the standard autoclave conditions, silver recovery was generally very low (<25%). Recovery improved dramatically to >80% by incorporation of the well-known lime boil process to break down the jarosites prior to cyanidation. However, lime consumption was very high under the lime boil conditions tested and further testing is needed to optimize this process and determine whether the value of additional silver recovered is greater than the cost of additional lime.

Lime and cyanide consumption were both reduced by >80% when the hot cure process was incorporated in the flowsheet, and cyanide consumption was further reduced by sparging the slurry with oxygen during the cyanide leach process.

The flowsheet developed in this testwork should incorporate the following unit operations and conditions:

- Regrinding the feed concentrate (it will likely be better to regrind the feed rather than the oxidized solids).
- POX at 220°C for 90 minutes or 230°C for 60 minutes. Economics of the two options to be established.

- Hot curing for 4 hours (optimum residence time to be established)
- Solid/liquid separation of the hot cure discharge by vacuum filtration of CCD and washing of the solids. Testwork required.
- Neutralization of the POX liquor with limestone or flotation tailings. To be tested.
- Repulping of the washed solids and neutralization to pH 10-10.5 with lime (lime boiling probably not justified because of low silver concentration in the concentrates relative to the cost of extra lime).
- Cyanidation and CIL or CIP to recovery gold. Further testwork needed to confirm the beneficial role of oxygen sparging during leaching and examine methods of minimizing cyanide consumption, which has been high in the testwork (4-6 kg/t NaCN under best conditions).

Appendix A – Head Characterization

Appendix A – Head Characterization

Element		Bulk Con 1 (BL 801)	BL 801 Conc. 2 Head	BL 801-16 pdts 1-4	BL 801-24 Final Tails + BL 801-25 Final Tails
Au	g/t	25.5	20.7	15.3	13
Ag	g/t	41	40.6	128	60
Al	g/t	3940	-	-	11900
As	%	20.6	18.0	11.8	13.2
Ba	g/t	205	-	-	98
Be	g/t	0.1	-	-	0.29
Bi	g/t	< 30	-	-	< 30
Ca	g/t	11300	-	-	35000
Cd	g/t	323	-	-	178
Co	g/t	52	-	-	63
Cr	g/t	634	-	-	1630
Cu	g/t	1350	-	-	3640
Fe	%	30.8	28.4	22.9	25.2
K	g/t	1990	-	-	5810
Li	g/t	< 20	-	-	< 20
Mg	g/t	870	-	-	2180
Mn	g/t	143	-	-	298
Mo	g/t	18	-	-	50
Na	g/t	184	-	-	591
Ni	g/t	309	-	-	777
P	g/t	< 200	-	-	223
Pb	g/t	23200	-	52700	7330
Sb	g/t	999	-	-	807
Se	g/t	< 30	-	-	< 30
Sn	g/t	< 20	-	-	< 20
Sr	g/t	25.4	-	-	68
Ti	g/t	772	-	-	1160
Tl	g/t	< 30	-	-	< 30
V	g/t	< 10	-	-	21
Y	g/t	3	-	-	3.4
Zn	g/t	60200	-	86500	33700
S	%	27.3	23.7	24.2	23.0
S=	%	27	23.0	23.9	22.2
C(t)	%	0.33	-	-	-
CO ₃	%	1.46	-	-	-
C(g)	%	< 0.05	-	< 0.05	< 0.05
TOC	%	< 0.05	-	0.13	0.15
Cl (HNO ₃ soluble)	%	< 10	-	26	< 10
K80	µm	28.9	26.1	184.0	20.6

Result Analysis Report

Sample Name:
18988-01 Pdts 1-4 - Average

SOP Name:
Defaultar

Measured:
March-24-22 2:09:07 PM

Sample Source & type:
BL 801-16

Measured by:
lr_malvern1

Analysed:
March-24-22 2:09:09 PM

Sample bulk lot ref:
KS

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
13.34 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
0.473 %

Result Emulation:
Off

Concentration:
0.0274 %Vol

Span :
2.970

Uniformity:
0.96

Result units:
Volume

Specific Surface Area:
0.48 m^2/g

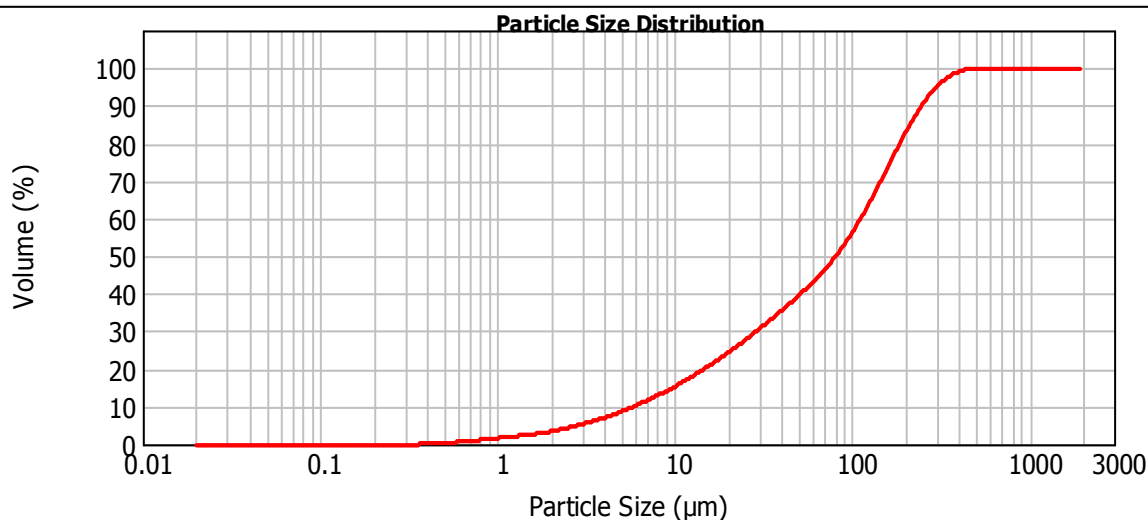
Surface Weighted Mean D[3,2]:
12.508 μm

Vol. Weighted Mean D[4,3]:
104.497 μm

d(0.1): 5.823 μm

d(0.5): 80.100 μm

d(0.8): 184.014 μm



— 18988-01 Pdts 1-4 - Average, March-24-22 2:09:07 PM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	1.79	11.482	17.01	120.226	63.03	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	2.08	13.183	18.71	138.038	68.39	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	2.41	15.136	20.50	158.489	73.98	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	2.79	17.378	22.40	181.970	79.56	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	3.23	19.953	24.39	208.930	84.83	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	3.76	22.909	26.47	239.883	89.51	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	4.37	26.303	28.64	275.423	93.38	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	5.07	30.200	30.88	316.228	96.31	3311.311	100.00
0.030	0.00	0.316	0.00	3.311	5.86	34.674	33.19	363.078	98.30	3801.894	100.00
0.035	0.00	0.363	0.01	3.802	6.73	39.811	35.56	416.869	99.45	4365.158	100.00
0.040	0.00	0.417	0.08	4.365	7.70	45.709	38.00	478.630	99.94	5011.872	100.00
0.046	0.00	0.479	0.23	5.012	8.75	52.481	40.57	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	0.44	5.754	9.90	60.256	43.33	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	0.68	6.607	11.14	69.183	46.36	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	0.95	7.586	12.46	79.433	49.78	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	1.22	8.710	13.89	91.201	53.67	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	1.50	10.000	15.40	104.713	58.09	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 BL 801 Con 1 - Average

SOP Name:
Defaultar

Measured:
March-22-22 7:58:17 AM

Sample Source & type:

Measured by:
lr_malvern1

Analysed:
March-22-22 7:58:19 AM

Sample bulk lot ref:
Les

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
15.82 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
0.363 %

Result Emulation:
Off

Concentration:
0.0118 %Vol

Span :
5.676

Uniformity:
4.1

Result units:
Volume

Specific Surface Area:
1.33 m^2/g

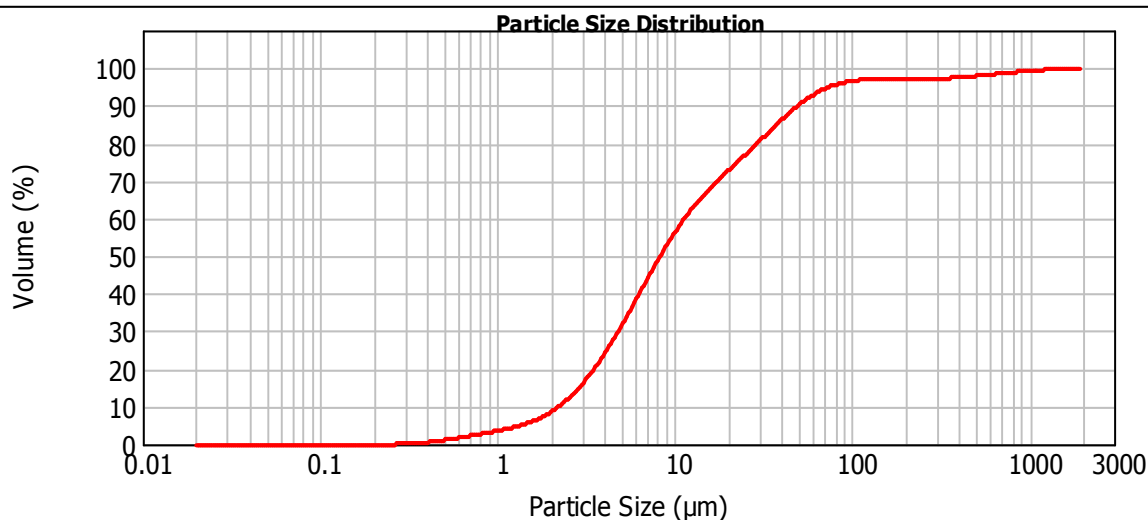
Surface Weighted Mean D[3,2]:
4.510 μm

Vol. Weighted Mean D[4,3]:
37.999 μm

d(0.1): 2.208 μm

d(0.5): 8.244 μm

d(0.8): 28.931 μm



— 18988-01 BL 801 Con 1 - Average, March-22-22 7:58:17 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	3.95	11.482	60.47	120.226	96.98	1258.925	99.59
0.011	0.00	0.120	0.00	1.259	4.62	13.183	64.08	138.038	97.06	1445.440	99.75
0.013	0.00	0.138	0.00	1.445	5.45	15.136	67.27	158.489	97.06	1659.587	99.89
0.015	0.00	0.158	0.00	1.660	6.55	17.378	70.15	181.970	97.06	1905.461	99.98
0.017	0.00	0.182	0.00	1.905	7.99	19.953	72.85	208.930	97.06	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	9.86	22.909	75.48	239.883	97.06	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	12.21	26.303	78.13	275.423	97.11	2884.032	100.00
0.026	0.00	0.275	0.01	2.884	15.08	30.200	80.85	316.228	97.20	3311.311	100.00
0.030	0.00	0.316	0.10	3.311	18.49	34.674	83.59	363.078	97.36	3801.894	100.00
0.035	0.00	0.363	0.29	3.802	22.44	39.811	86.29	416.869	97.59	4365.158	100.00
0.040	0.00	0.417	0.58	4.365	26.86	45.709	88.82	478.630	97.85	5011.872	100.00
0.046	0.00	0.479	0.95	5.012	31.67	52.481	91.08	549.541	98.14	5754.399	100.00
0.052	0.00	0.550	1.39	5.754	36.75	60.256	92.97	630.957	98.44	6606.934	100.00
0.060	0.00	0.631	1.86	6.607	41.92	69.183	94.46	724.436	98.72	7585.776	100.00
0.069	0.00	0.724	2.36	7.586	47.03	79.433	95.55	831.764	98.98	8709.636	100.00
0.079	0.00	0.832	2.86	8.710	51.90	91.201	96.29	954.993	99.20	10000.000	100.00
0.091	0.00	0.955	3.38	10.000	56.41	104.713	96.74	1096.478	99.41		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 BL 801 Conc 2 - Average

SOP Name:
Defaultar

Measured:
March-10-22 8:43:55 AM

Sample Source & type:
Head

Measured by:
lr_malvern1

Analysed:
March-10-22 8:43:57 AM

Sample bulk lot ref:
ar

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
15.31 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
0.759 %

Result Emulation:
Off

Concentration:
0.0120 %Vol

Span :
4.010

Uniformity:
1.27

Result units:
Volume

Specific Surface Area:
1.23 m^2/g

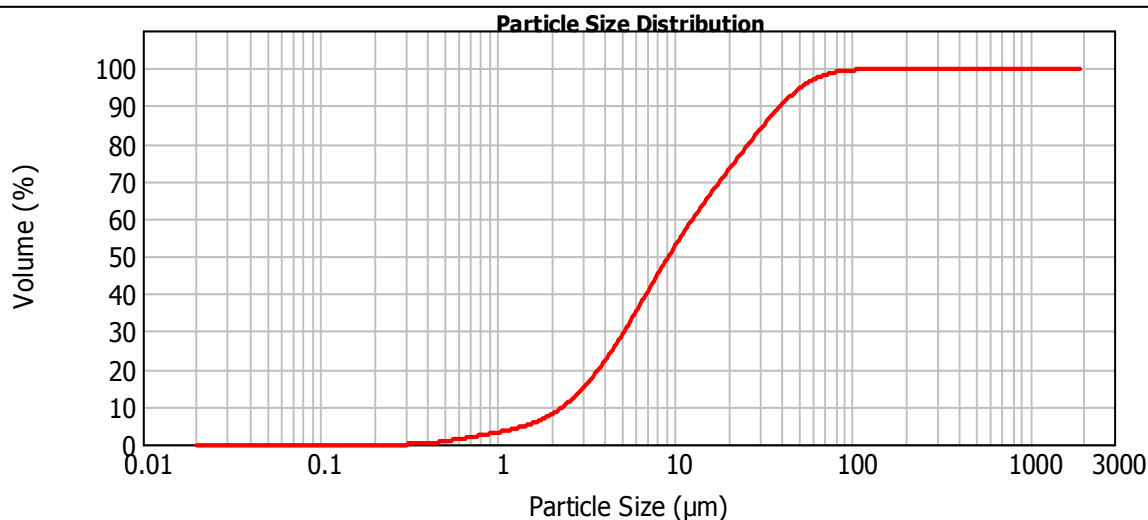
Surface Weighted Mean D[3,2]:
4.875 μm

Vol. Weighted Mean D[4,3]:
16.226 μm

d(0.1): 2.338 μm

d(0.5): 9.187 μm

d(0.8): 26.058 μm



— 18988-01 BL 801 Conc 2 - Average, March-10-22 8:43:55 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	3.51	11.482	57.20	120.226	99.65	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	4.15	13.183	61.35	138.038	99.71	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	4.94	15.136	65.32	158.489	99.76	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	5.96	17.378	69.14	181.970	99.82	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	7.30	19.953	72.88	208.930	99.89	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	9.02	22.909	76.58	239.883	99.95	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	11.18	26.303	80.25	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	13.81	30.200	83.83	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.01	3.311	16.93	34.674	87.23	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.11	3.802	20.53	39.811	90.34	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.33	4.365	24.58	45.709	93.05	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	0.64	5.012	28.99	52.481	95.27	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	1.02	5.754	33.68	60.256	96.97	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	1.47	6.607	38.53	69.183	98.16	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	1.94	7.586	43.40	79.433	98.92	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	2.44	8.710	48.19	91.201	99.35	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	2.95	10.000	52.81	104.713	99.56	1096.478	100.00		

Operator notes:

Appendix B – Tests 1 to 3

Appendix B – Tests 1 to 3

Project: 18988-01
Client:

Date: December 8, 2021
Technologist: Chris Silva

Test: POX-1

Purpose:

Sample: BL 801 Bulk Con 1

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 145 g of BL 801 Bulk Concentrate (dry equivalent) was added to the mixture.
 13.113 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 1 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 120 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 120 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted

Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	145
Feed Weight Wet Req'd (g):	145.0
H_2O Weight Added:	1300
H_2O Weight Req'd (g):	1300
Pre-acidulation H_2SO_4 added (g):	139.101
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	13.08
Total Pulp Weight with reagents (g):	1597 (Actual Pulp weight)
Pulp Density (% solids w/w):	9.1 (w/w)
Temperature (°C):	220
O_2 Over Pressure (psi):	100
Time (at temperature) (min):	120

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:43	0	17.7	6.64	216		0	Add Feed
5:43	0	17.7	4.06	436		0	Ad Fe
5:54	0	31.3	1.06	460	139.101	139.101	Add Acid
5:59	5	30.5	0.96	452		139.101	
6:04	10	30.1	0.89	448		139.101	
6:09	15	29.4	0.84	443		139.101	
						959	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas		Remarks
			Total	Steam	Over	O ₂	Flow	O ₂	
			meas	calculated			mL/min	%	
6:25		30		-	-	-	-		Start Heating
7:17	0.0	220	430	322	108	0			Start Test
7:27	10.0	218	435	309	126	0	250		Calibrate New O2 sensor
7:37	10.0	221	434	328	106	0	250		Dave B adjusted parameters
7:47	10.0	221	440	328	112	110	250	98	
7:57	10.0	218	437	309	128	128	250	100	
8:07	10.0	220	441	322	119	119	250	100	
8:17	10.0	221	446	328	118	118	250	100	
8:27	10.0	221	428	328	100	100	250	100	8:22 Dave B installed cooling pulse on for 1 s off for 6 s
8:37	10.0	220	434	322	112	112	250	100	
8:47	10.0	221	431	328	103	103	250	100	
8:57	10.0	219	424	315	109	109	250	100	
9:07	10.0	221	441	328	113	113	250	100	
9:17	10.0	219	426	315	111	111	250	100	End Test, Cool Down, Sample
9:18		218							Cool Down
9:27		95							
AVG. 0:240	120	220	435	322	113	93	250	83	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
120 min POX Pulp	802	0.73	77.3	67.9	57	1.1835	65	5.8		100.0	yellow	yellow	fast	0.0%	612	1.08
120 min POX Pulp B4 S4	802	0.73	1417.4	1417.4	1198	1.1835	1198		0.0		yellow	yellow	fast	0.0%	612	1.08

denotes calculated value

Final Sample Filtration:Diameter of filtration paper: mmtype of paper (Whatman #): Filtration time: minWashing time: Volume of wash: mLCake thickness: cm% Moisture: % Weightloss: Clarity of filtrate: Colour of filtrate: Clarity of wash: Colour of wash: Colour of residue:

Temp of POX Pulp: 83.5 °C

Temp of POX PLS: 32.5 °C

Note: Froth through the off gas system, had to rinse out off gas system

Condensate = 86.9 g

Hot Cure Data:

POX pulp weight for Hot Cure: 1340.1 g wt. not transferred to Hot Cure 77.3 g POX Residue to HC: 0.0 g

Time	Time mins	Temp	pH	ORP	Observations
9:30	0	83.5			Sample
9:33	0				Back in Mantle
9:39	0	95			Start Test
10:39	60	94			
11:39	120	94			
12:39	180	94			
13:39	240	96			End Test, Sample, Filter
		94.6			

4

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	750	0.63	219.0	197.9	166	1.1933	175	14.2	10.3	27.5	yellow	green	fast	4.7%	556	1.14
240 min HC Pulp B4 Sar	750	0.63	1302.5	1162.4	974	1.1933	1040	85.8	61.3	28.6	yellow	green	fast	4.7%	556	1.14
240 min HC Pulp After S	750	0.63	1083.5	964.5	808	1.1933	865	71.6	51.0	28.8	yellow	green	fast	4.7%	556	1.14

Temp of Hot Cure 240 min Pulp:	87.2 °C
Temp of Hot Cure 240 min PLS:	46.7 °C
Notes:	sulphur scale all around vessel at pulp height after POX (HC 0) sample

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
BL 801 Bulk Con	145		30.8		1350	20.6	27.3	27.0			25.5	41.0	< 10		
120 min PLS	1198		20600		255	5750				204000		1.32	16	68000	145

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
240 min Filtrat	1040		22900		269	6670				231600		0.91	21	77200	167
240 min Resid	61	55.3	21.8		36	28.5	1.27	0.43	2.5			58			
Dissolution			Fe		Cu	As									
Final HC			64%		99%	28%									

*SO₄ in solution calculated from S by bromine ICP**99.3 % Sulphide oxidation based on HC residue**

55.3 % Weight loss Overall

Weight for CIL: 51.0 g**POX Feed Eq.: 114.0 g**

Project: 18988-01
Client:

Date: January 26, 2022
Technologist: Chris Silva

Test: POX-2

Purpose:

Sample: BL 801 Bulk Con 1

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 119.95 g of BL 801 Bulk Concentrate (dry equivalent) was added to the mixture.
 12.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 120 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 120 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00	
Target Pulp Density (%):	10.0	
Feed Weight (dry equiv.) (g):	119.95	Wt for POX 2 and 3 - all there was left
Feed Weight Wet Req'd (g):	119.95	
H_2O Weight Added:	1200	
H_2O Weight Req'd (g):	1200	
Pre-acidulation H_2SO_4 added (g):	0.000	
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	12.08	
Total Pulp Weight with reagents (g):	1332	(Actual Pulp weight)
Pulp Density (% solids w/w):	9.0	(w/w)
Temperature (°C):	220	
O_2 Over Pressure (psi):	100	Total = 422 psi
Time (at temperature) (min):	120	

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:28	0	17.1	6.86	201		0	Add Feed
5:28	0	17.1	3.86	436		0	Ad Fe
5:38	0	18.4	2.02	438	7.901	7.901	Add Acid
5:43	5	18.3	2.01	427		7.901	
5:48	10	18.2	2.00	417		7.901	
5:53	15	18.2	2.00	413		7.901	
						66	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
6:05		18		-	-	-				Start Heat
7:04	0.0	220	427	322	105	0				Start test
7:14	10.0	221	419	328	91	85	37.1	94	250	Start Test, using Cooling Pulse
7:24	10.0	220	420	322	98	92	71.7	94	250	
7:34	10.0	219	427	315	112	105	79.1	94	250	
7:44	10.0	220	435	322	113	106	83.8	94	250	
7:54	10.0	221	430	328	102	96	88.4	94	250	
8:04	10.0	221	422	328	94	89	93.9	95	150	
8:14	10.0	221	433	328	105	100	100.4	95	0	
8:24	10.0	219	425	315	110	105	109.7	96	250	
8:34	10.0	221	422	328	94	90	115.9	96	250	
8:44	10.0	221	430	328	102	98	124.7	96	250	
8:54	10.0	220	446	322	124	119	131.2	96	250	
9:04	10.0	219	428	315	113	108	136.4	96	50	
9:05		220								
9:10		140								
9:15		95								
AVG. 0:240	120	220	428	323	105	99		95	204	

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
120 min POX Pulp	776	1.03	70.1	59.3	55	1.0700	61	7.7	4.9	36.4	yellow	orange	fast	7.0%	576	1.66
120 min POX Pulp B4 Sd	776	1.03	1286.2	1196.3	1118	1.0700	1118		89.9	#DIV/0!	yellow	orange	fast	7.0%	576	1.66

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: yellow (gold)
 Clarity of wash: clear
 Colour of wash: light yellow
 Colour of residue: Orange

% Moisture
 % Weightloss:

Temp of POX Pulp:	84.4	°C
Temp of POX PLS:	30.4	°C
Note: Froth through the off gas system, had to rinse out off gas system		
Sulphur scale around vessel at interface, thicker by cooling coils		
Condensate =	42.8	g

Hot Cure Data:

POX pulp weight for Hot Cure: 1216.1 g wt. not transferred to Hot Cure 70.1 g POX Residue to HC: 85.0 g

Time	Time mins	Temp	pH	ORP	Observations
9:20	0	84	1.03	776	Sample
9:23	0	63			Back in Mantle
9:31	0	95			Start Test
10:31	60	94			
11:31	120	96			
12:31	180	94			
13:31	240	95	0.94	710	End Test, Sample, Filter
		94.8			

4

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	710	0.94	203.1	178.0	165	1.0795	175	20.7	14.0	32.4	yellow	orange	fast	6.9%	559	1.58
240 min HC Pulp B4 Sar	710	0.94	1187.4	1024.7	949	1.0795	1024	122.0	81.8	32.9	yellow	orange	fast	6.9%	559	1.58
240 min HC Pulp After S	710	0.94	984.3	846.7	784	1.0795	849	101.3	67.8	33.0	yellow	orange	fast	6.9%	559	1.58

Temp of Hot Cure 240 min Pulp:	82.7 °C
Temp of Hot Cure 240 min PLS:	44.2 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils	

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
Bulk Con 1 (BL 8)	120		30.8		1350	20.6	27.3	27.0			25.5	41.0	< 10		
120 min PLS	1118		5000	75	112	1020				69300		0.17		23100	59

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
240 min Filtrat	1024		7520	470	125	2110				72600		0.11		24200	59
240 min Resid	82	27.8	27.7		380	22.2	3.31	0.44	8.6			57			
Dissolution			Fe		Cu	As	*SO ₄ in solution calculated from S by bromine ICP								
Final HC			25%		80%	11%	98.8 % Sulphide oxidation based on HC residue								

27.8 % Weight loss Overall

Weight for CIL: 67.8 g

POX Feed Eq.: 94.0 g

Project: 18988-01
Client:

Date: January 26, 2022
Technologist: Chris Silva

Test: POX-3

Purpose:

Sample: BL 801 Bulk Con 1

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 119.95 g of BL 801 Bulk Concentrate (dry equivalent) was added to the mixture.
 12.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 60 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 60 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00	
Target Pulp Density (%):	10.0	
Feed Weight (dry equiv.) (g):	119.95	Wt for POX 2 and 3 - all there was left
Feed Weight Wet Req'd (g):	119.95	
H_2O Weight Added:	1200	
H_2O Weight Req'd (g):	1200	
Pre-acidulation H_2SO_4 added (g):	7.315	
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	12.08	
Total Pulp Weight with reagents (g):	1332	(Actual Pulp weight)
Pulp Density (% solids w/w):	9.0	(w/w)
Temperature (°C):	220	
O_2 Over Pressure (psi):	100	Total = 422 psi
Time (at temperature) (min):	60	

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
6:05	0	16.6	6.67	40		0	Add Feed
6:05	0	16.7	3.93	394		0	Ad Fe
6:15	0	17.9	2.02	453	7.315	7.315	Add Acid
6:20	5	17.9	2.01	428	0.278	7.593	
6:25	10	18.0	2.00	419	0.168	7.761	
6:30	15					7.761	
						65	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas		Remarks
			Total	Steam	Over	O ₂	Flow	O ₂	
			meas	calculated			mL/min	%	
6:35		17		-	-	-	-		Start Heating
7:40	0.0	220	437	322	115	0			Start Test, using Cooling Pulse
7:50	10.0	222	421	335	86	79	250	92	
8:00	10.0	219	434	315	119	114	250	96	
8:10	10.0	220	437	322	115	111	250	96	
8:20	10.0	219	436	315	121	116	200	96	
8:30	10.0	221	424	328	96	92	250	96	
8:40	10.0	220	440	322	118	114	300	96	End Test, Cool Down, Sample
8:41		214							Cool Down
8:44		140							
8:47		95							
AVG. 0:240	60	220	432	323	109	104	250	95	

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
60 min POX Pulp	783	1.25	72.0	58.7	55	1.0758	62	8.6	5.3	38.4	yellow	gold	fast	7.4%	548	1.69
60 min POX Pulp B4 Sat	783	1.25	1336.3	1237.9	1151	1.0758	1151		98.4		yellow	gold	fast	7.4%	548	1.69

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: yellow (gold)
 Clarity of wash: clear
 Colour of wash: light yellow
 Colour of residue: gold

% Moisture
 % Weightloss:

Temp of POX Pulp:	81.6	°C
Temp of POX PLS:	20.7	°C
Note: Froth through the off gas system, had to rinse out off gas system		
Sulphur scale around vessel at interface, thicker by cooling coils		
Condensate =	66.2	g

Hot Cure Data:

POX pulp weight for Hot Cure: 1264.3 g wt. not transferred to Hot Cure 72.0 g POX Residue to HC: 93.1 g

Time	Time mins	Temp	pH	ORP	Observations
8:51	0	81	1.25	783	Sample
8:55	0	65			Back in Mantle
9:03	0	95			Start Test
10:03	60	95			
11:03	120	94			
12:03	180	96			
13:03	240	95	0.94	744	End Test, Sample, Filter
		95.0			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	744	0.94	203.0	176.2	163	1.0834	174	21.1	14.6	30.8	yellow	org-yell	fast	7.2%	550	1.70
240 min HC Pulp B4 Sar	744	0.94	1232.7	1056.0	975	1.0834	1056	130.5	88.7	32.1	yellow	org-yell	fast	7.2%	550	1.70
240 min HC Pulp After S	744	0.94	1029.7	879.8	812	1.0834	882	109.4	74.1	32.3	yellow	org-yell	fast	7.2%	550	1.70

Temp of Hot Cure 240 min Pulp:	85.3 °C
Temp of Hot Cure 240 min PLS:	38 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils	

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
Bulk Con 1 (BL 801)	120		30.8		1350	20.6	27.3	27.0			25.5	41.0	< 10		
60 min PLS	1151		5820	89	120	1000				75600		0.24		25200	65

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)											S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	Cl		
240 min Filtrate	1056		8490	318	124	2260				77400		0.18		25800	58
240 min Residue	89	21.9	27.7		398	22.9	3.45	0.96	7.5			57			
Dissolution			Fe		Cu	As	*SO ₄ in solution calculated from S by bromine ICP								
Final HC			27%		79%	11%	97.2 % Sulphide oxidation based on HC residue								

21.9 % Weight loss Overall

Weight for CIL: 74.1 g

POX Feed Eq.: 94.8 g

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 1	BL 801 Bulk Con 1	9.1	No	28.9	1.0	959	220	120
POX 2	BL 801 Bulk Con 1	9.0	No	28.9	2.0	66	220	120
POX 3	BL 801 Bulk Con 1	9.0	No	28.9	2.0	65	220	60

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 1	220	435	250	83	0.73	802	1.08	612	145.1
POX 2	220	428	204	95	1.03	776	1.66	576	59.1
POX 3	220	432	250	95	1.25	783	1.69	548	64.9

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 1	BL 801 Bulk Con 1	4	94.6	0.63	750	1.14	556	167.4	green
POX 2	BL 801 Bulk Con 1	4	94.8	0.94	710	1.58	559	59.4	orange
POX 3	BL 801 Bulk Con 1	4	95.0	0.94	744	1.70	550	58.2	org-yell

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 1	20600	5750	68000	22900	6670	77200	21.8	28.5	58	0.43	99.3	55.3
POX 2	5000	1020	23100	7520	2110	24200	27.7	22.2	57	0.44	98.8	27.8
POX 3	5820	1000	25200	8490	2260	25800	27.7	22.9	57	0.96	97.2	21.9

Result Analysis Report

Sample Name:
18988-01 Residue - Average

SOP Name:
Defaultar

Measured:
March-24-22 9:29:27 AM

Sample Source & type:
Hot Cure 2

Measured by:
lr_malvern1

Analysed:
March-24-22 9:29:29 AM

Sample bulk lot ref:
KS

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
12.28 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
1.356 %

Result Emulation:
Off

Concentration:
0.0081 %Vol

Span :
1.873

Uniformity:
0.587

Result units:
Volume

Specific Surface Area:
1.59 m^2/g

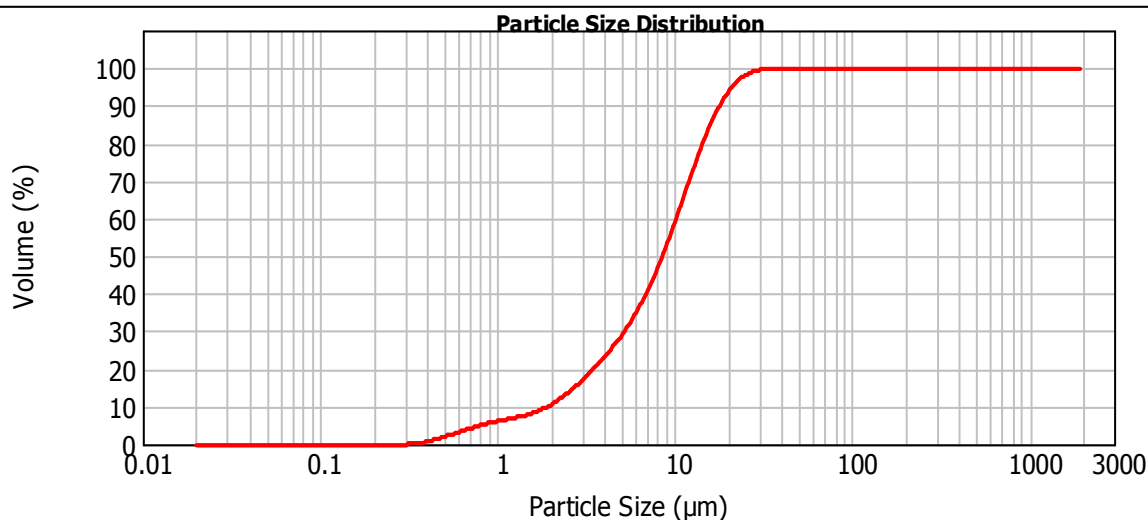
Surface Weighted Mean D[3,2]:
3.771 μm

Vol. Weighted Mean D[4,3]:
9.302 μm

d(0.1): 1.914 μm

d(0.5): 8.479 μm

d(0.8): 14.293 μm



— 18988-01 Residue - Average, March-24-22 9:29:27 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	6.46	11.482	67.46	120.226	100.00	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	7.04	13.183	75.56	138.038	100.00	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	7.73	15.136	82.93	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	8.66	17.378	89.09	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	9.95	19.953	93.74	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	11.66	22.909	96.88	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	13.78	26.303	98.71	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	16.25	30.200	99.62	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.02	3.311	19.00	34.674	99.93	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.33	3.802	22.01	39.811	100.00	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.88	4.365	25.31	45.709	100.00	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.64	5.012	29.03	52.481	100.00	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	2.54	5.754	33.32	60.256	100.00	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	3.49	6.607	38.41	69.183	100.00	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	4.39	7.586	44.43	79.433	100.00	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	5.19	8.710	51.43	91.201	100.00	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	5.87	10.000	59.23	104.713	100.00	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Residue - Average

SOP Name:
Defaultar

Measured:
March-24-22 10:14:15 AM

Sample Source & type:
Hot Cure 3

Measured by:
lr_malvern1

Analysed:
March-24-22 10:14:16 AM

Sample bulk lot ref:
KS

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
11.89 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
1.140 %

Result Emulation:
Off

Concentration:
0.0091 %Vol

Span :
1.919

Uniformity:
0.642

Result units:
Volume

Specific Surface Area:
1.36 m^2/g

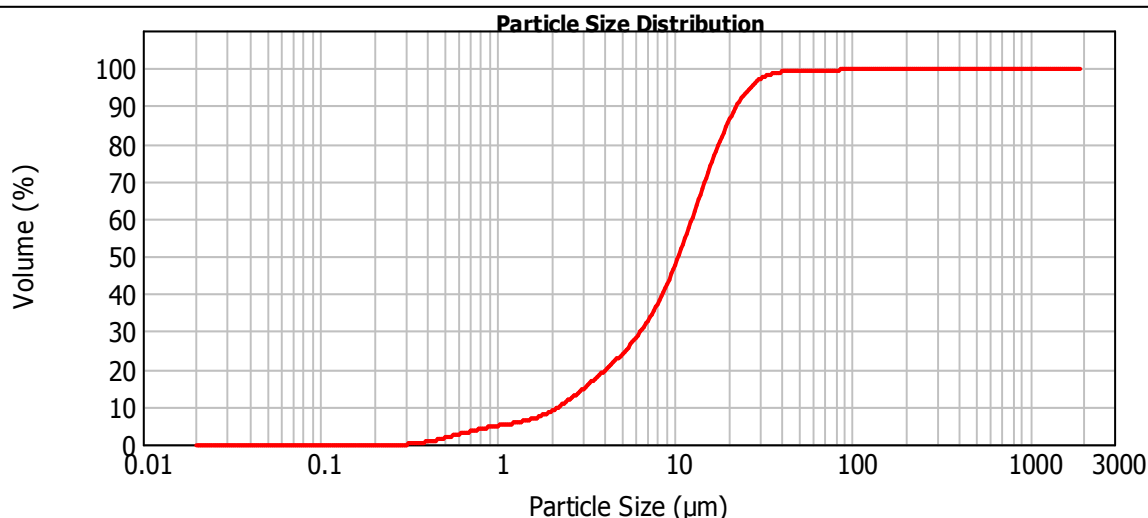
Surface Weighted Mean D[3,2]:
4.414 μm

Vol. Weighted Mean D[4,3]:
11.998 μm

d(0.1): 2.220 μm

d(0.5): 10.439 μm

d(0.8): 17.671 μm



— 18988-01 Residue - Average, March-24-22 10:14:15 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	5.18	11.482	55.28	120.226	99.90	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	5.67	13.183	63.38	138.038	99.97	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	6.27	15.136	71.52	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	7.11	17.378	79.14	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	8.28	19.953	85.73	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	9.82	22.909	90.98	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	11.69	26.303	94.74	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	13.83	30.200	97.14	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.01	3.311	16.16	34.674	98.44	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.29	3.802	18.60	39.811	99.00	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.75	4.365	21.17	45.709	99.16	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.37	5.012	23.95	52.481	99.20	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	2.08	5.754	27.10	60.256	99.24	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	2.82	6.607	30.87	69.183	99.34	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	3.53	7.586	35.47	79.433	99.48	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	4.16	8.710	41.08	91.201	99.64	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	4.71	10.000	47.73	104.713	99.79	1096.478	100.00		

Operator notes:

Appendix C – Tests 4 to 6

Appendix C – Tests 4 to 6

Project: 18988-01
Client:

Date: March 7, 2022
Technologist: Chris Silva

Test: POX-4

Purpose: To repeat POX 3 but, on BL 801 Bulk Concentrate 2 for 90 minutes.

Sample: BL 801 Bulk Con 2

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 119.95 g of BL 801 Bulk Concentrate (dry equivalent) was added to the mixture.
 12.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 60 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted

Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	119.95
Feed Weight Wet Req'd (g):	119.95
H_2O Weight Added:	1200
H_2O Weight Req'd (g):	1200
Pre-acidulation H_2SO_4 added (g):	10.454
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	12.08
Total Pulp Weight with reagents (g):	1332 (Actual Pulp weight)
Pulp Density (% solids w/w):	9.0 (w/w)
Temperature (°C):	220
O_2 Over Pressure (psi):	100
Time (at temperature) (min):	90

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:20	0	19.6	6.52	275		0	Add Feed
5:20	0	19.8	4.09	388		0	Ad Fe
5:30	0	21.7	2.02	425	10.454	10.454	Add Acid
5:35	5	21.7	2.00	414	0.247	10.701	
5:40	10	21.7	2.00	408	0	10.701	
5:45	15	21.7	2.00	402	0	10.701	
						89	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:52		21		-	-	-				Start Heat
6:48	0.0	221	432	328	104	0			250	Start test
6:58	10.0	221	431	328	103	92	33.0	90	250	Operating with Cooling Pulse
7:08	10.0	220	433	322	111	106	62.7	95	250	
7:18	10.0	220	437	322	115	111	74.5	96	250	
7:28	10.0	221	425	328	97	93	81.0	96	250	
7:38	10.0	220	446	322	124	119	85.3	96	100	
7:48	10.0	219	458	315	143	137	87.8	96	0	
7:58	10.0	219	435	315	120	115	95.8	96	250	
8:08	10.0	221	426	328	98	94	102.4	96	250	
8:18	10.0	221	435	328	107	102	110.3	96	400	
8:19		218								
8:24		145								
8:27		95								
AVG. 0:240	90	220	436	323	113	108		95	225	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
90 min POX Pulp	740	1.05	72.3	57.9	54	1.0676	62	8.5	5.9	30.6	green	orange	fast	8.2%	561	1.49
90 min POX Pulp B4 Sar	740	1.05	1291.7	1186.3	1111	1.0676	1111		105.4	#DIV/0!	green	orange	fast	8.2%	561	1.49

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: orange

% Moisture
 % Weightloss:

Temp of POX Pulp:	83.3	°C
Temp of POX PLS:	30.6	°C
Note: Froth through the off gas system, had to rinse out off gas system		
Sulphur scale around vessel at interface, thicker by cooling coils		
Condensate = 81.6 g		

Hot Cure Data:

POX pulp weight for Hot Cure: 1219.4 g wt. not transferred to Hot Cure 72.3 g POX Residue to HC: 99.5 g

Time	Time mins	Temp	pH	ORP	Observations
8:33	0	83.3	1.05	740	Sample
8:37	0	77			Back in Mantle
8:43	0	95			Start Test
9:43	60	96			
10:43	120	96			
11:43	180	96			
12:43	240	95	1.00	693	End Test, Sample, Filter
		95.6			

4

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	693	1.00	202.1	176.0	164	1.0755	175	20.3	14.2	30.0	green	orange	fast	7.0%	538	1.61
240 min HC Pulp B4 Sar	693	1.00	1183.5	1006.5	936	1.0755	1023	125.5	83.2	33.7	green	orange	fast	7.0%	538	1.61
240 min HC Pulp After S	693	1.00	981.4	830.5	772	1.0755	848	105.2	69.0	34.5	green	orange	fast	7.0%	538	1.61

Temp of Hot Cure 240 min Pulp:	84.9 °C
Temp of Hot Cure 240 min PLS:	47.7 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils	

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
BL 801 Bulk Con	120		28.4			18.0	23.7	23.0			20.7	40.6		
90 min PLS	1111		6060	120		1230				67800		< 0.2	22600	54

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
240 min Filtrat	1023		7990	512		2640				66900		< 0.2	22300	50
240 min Resid	83	26.6	25.7	9.20	638	19.2	3.55	0.68	8.6			57		
Dissolution			Fe		Cu	As	*SO ₄ in solution calculated from S by bromine ICP							
Final HC			28%		0%	14%								

97.8 % Sulphide oxidation based on HC residue

26.6 % Weight loss Overall

Weight for CIL: 69.0 g**POX Feed Eq.: 93.9 g**

Project: 18988-01
Client:

Date: March 8, 2022
Technologist: Chris Silva

Test: POX-5

Purpose: To repeat POX 3 but, on BL 801 Bulk Concentrate 2 at 230°C.

Sample: BL 801 Bulk Con 2

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 119.95 g of BL 801 Bulk Concentrate (dry equivalent) was added to the mixture.
 12.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 60 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 60 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted

Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	119.95
Feed Weight Wet Req'd (g):	119.95
H_2O Weight Added:	1200
H_2O Weight Req'd (g):	1200
Pre-acidulation H_2SO_4 added (g):	10.606
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	12.08
Total Pulp Weight with reagents (g):	1332 (Actual Pulp weight)
Pulp Density (% solids w/w):	9.0 (w/w)
Temperature (°C):	230
O_2 Over Pressure (psi):	100
Time (at temperature) (min):	60

Total = 491 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:20	0	18.6	6.84	77		0	Add Feed
5:20	0	18.6	4.23	374		0	Ad Fe
5:30	0	20.4	2.01	432	10.606	10.606	Add Acid
5:35	5	20.4	2.01	420	0	10.606	
5:40	10	20.0	2.00	412	0.08	10.686	
5:45	15	20.4	2.00	407		10.686	
						89	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:53		21		-	-	-				Start Heat
6:51	0.0	231	491	399	92	0			250	Start test
7:01	10.0	231	490	399	91	82	37.0	90	250	Operating with Cooling Pulse
7:11	10.0	229	506	384	122	115	63.9	94	250	
7:21	10.0	231	517	399	118	114	71	96	250	
7:31	10.0	230	514	391	123	120	76.8	98	0	
7:41	10.0	230	494	391	103	101	79.4	98	300	
7:51	10.0	229	507	384	123	121	88	98	300	
7:52		231								
7:57		145								
		95								
AVG. 0:240	60	230	505	391	114	109		96	229	

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
60 min POX Pulp	749	0.94	72.2	60.1	57	1.0611	63	8.7	5.8	33.3	green	orange	fast	8.0%	547	1.69
60 min POX Pulp B4 Sample	749	0.94	1287.6	1184.2	1116	1.0611	1116		103.4	#DIV/0!	green	orange	fast	8.0%	547	1.69

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: orange

% Moisture
 % Weightloss:

Temp of POX Pulp:	83.2	°C
Temp of POX PLS:	33.0	°C
Note:	Froth through the off gas system, had to rinse out off gas system	
	Sulphur scale around vessel at interface, thicker by cooling coils	
Condensate =	84.1	g

Hot Cure Data:

POX pulp weight for Hot Cure: 1215.4 g wt. not transferred to Hot Cure 72.2 g POX Residue to HC: 97.6 g

Time	Time mins	Temp	pH	ORP	Observations
8:06	0	83.2	0.94	749	Sample
8:09	0	77			Back in Mantle
8:16	0	95			Start Test
9:16	60	95			
10:16	120	95			
11:16	180	96			
12:16	240	94	1.00	647	End Test, Sample, Filter
		95.0			

4

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	647	1.00	202.8	176.0	164	1.0726	176	20.3	13.6	33.0	green	orange	fast	6.7%	510	1.54
240 min HC Pulp B4 Sar	647	1.00	1189.7	1019.7	951	1.0726	1035	121.8	79.8	34.5	green	orange	fast	6.7%	510	1.54
240 min HC Pulp After S	647	1.00	986.9	843.7	787	1.0726	858	101.5	66.2	34.8	green	orange	fast	6.7%	510	1.54

Temp of Hot Cure 240 min Pulp:	84.1 °C
Temp of Hot Cure 240 min PLS:	47.7 °C
Notes:	Sulphur scale around vessel at interface, thicker by cooling coils

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
BL 801 Bulk Con	120		28.4			18.0	23.7	23.0			20.7	40.6		
60 min PLS	1116		4580	93	126	1250				66600		0.22	22200	48

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, %, g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
240 min Filtrat	1035		8220	1310	139	3320				73500		0.11	24500	45
240 min Resid	80	29.5	25.8		396	17.6	3.83	0.43	10.2			52		
Dissolution			Fe		Cu	As								
Final HC			29%		82%	20%								

*SO₄ in solution calculated from S by bromine ICP**98.7 % Sulphide oxidation based on HC residue**

29.5 % Weight loss Overall

Weight for CIL: 66.2 g**POX Feed Eq.: 93.9 g**

Project: 18988-01
Client:

Date: March 9, 2022
Technologist: Chris Silva

Test: POX-6

Purpose: To repeat POX 3 but, on ground BL 801 Bulk Concentrate 2 (target K80 ~ 20µm).

Sample: BL 801 Bulk Con 2

Target K80:	10	µm
Actual K80:	7.7	µm

(Screen + Malvern)

H&S: Review MSDS for H₂SO₄

Procedure: 150 g of BL Conc 2 was ground in the Attrition Mill at 50% solids for 10 minutes.
 The Attrition mill balls were screened out to obtain ground pulp.
 The pulp was filtered and 119.95 g (dry equiv) was weighed out into a 2 L titanium vessel for POX 6.
 The target amount of R.O. water was weighed out into the 2 L titanium vessel less 100 g.
 12.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The final washed residue was forwarded for CN leaching.

Analysis:	POX PLS:	Fe, Fe ²⁺ , As, ICP Scan and S	Hot Cure PLS:	Fe, Fe ²⁺ , As, ICP Scan and S
	POX Residue:	Not Submitted	Hot Cure Residue:	S(t), S ⁻ , Fe, As and ICP Scan

Conditions:	Feed Moisture (%):	0.00	
	Target Pulp Density (%):	10.0	
	Feed Weight (dry equiv.) (g):	119.95	
	Feed Weight Wet Req'd (g):	119.95	
	H ₂ O Weight Added:	1200	
	H ₂ O Weight Req'd (g):	1200	
	Pre-acidulation H ₂ SO ₄ added (g):	11.594	
	2 g /L Fe ³⁺ added as Fe ₂ (SO ₄) ₃ ·9H ₂ O (g):	12.08	
	Total Pulp Weight with reagents (g):	1332	(Actual Pulp weight)
	Pulp Density (% solids w/w):	9.0	(w/w)
	Temperature (°C):	220	
	O ₂ Over Pressure (psi):	100	Total = 422 psi
	Time (at temperature) (min):	90	

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H ₂ SO ₄ Add'n (g)	H ₂ SO ₄ Add'n (Cum g)	Observations
5:10	0	18.2	7.30	-304		0	Add Feed
5:10	0	18.4	5.01	58		0	Ad Fe
5:20	0	20.8	2.01	346	11.594	11.594	Add Acid
5:25	5	20.8	2.00	328	0.359	11.953	
5:30	10	20.9	2.01	311	0.136	12.089	
5:35	15	20.9	2.00	308	0.093	12.089	frothy, shiny sheen on surface
						101	kg/t H ₂ SO ₄ Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:43		20		-	-	-				Start Heat
6:39	0.0	221	442	328	114	0				Start test
6:49	10.0	221	423	328	95	85	34.6	90	250	Operating with Cooling Pulse
6:59	10.0	217	441	303	138	135	68.2	98	250	
7:09	10.0	219	437	315	122	119	74.3	98	250	
7:19	10.0	219	433	315	118	115	82.2	98	250	
7:29	10.0	220	422	322	100	98	88.5	98	250	
7:39	10.0	221	438	328	110	108	95.8	98	250	
7:49	10.0	219	433	315	118	115	103.3	98	250	
7:59	10.0	221	439	328	111	109	110.7	98	250	
8:09	10.0	219	438	315	123	120	117	98	250	
8:10		221								
8:15		145								
8:20		95								
AVG. 0:240	90	220	434	319	115	112		97	250	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
90 min POX Pulp	788	0.99	71.8	58.6	55	1.0657	62	9.8	6.0	38.8	green	yellow	fast	8.4%	575	1.80
90 min POX Pulp B4 Sar	788	0.99	1328.6	1217.6	1143	1.0657	1143		111.0	#DIV/0!	green	yellow	fast	8.4%	575	1.80

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: yellow

% Moisture
 % Weightloss:

Temp of POX Pulp:	82.5	°C
Temp of POX PLS:	31.1	°C
Note: Froth through the off gas system, had to rinse out off gas system		
Sulphur scale around vessel at interface, thicker by cooling coils		
Condensate = 78.9 g		

Hot Cure Data:

POX pulp weight for Hot Cure: 1256.8 g wt. not transferred to Hot Cure 71.8 g POX Residue to HC: 105.0 g

Time	Time mins	Temp	pH	ORP	Observations
8:24	0	82.5	0.99	788	Sample
8:27	0	77			Back in Mantle
8:34	0	95			Start Test
9:34	60	96			
10:34	120	96			
11:34	180	95			
12:34	240	95	1.10	752	End Test, Sample, Filter
		95.4			

4

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
240 min HC Pulp	752	1.10	210.3	182.5	169	1.0826	181	23.0	14.1	38.7	green	gold	fast	6.7%	588	1.69
240 min HC Pulp B4 Sar	752	1.10	1226.1	1047.5	968	1.0826	1057	132.1	82.2	37.8	green	gold	fast	6.7%	588	1.69
240 min HC Pulp After S	752	1.10	1015.8	865.0	799	1.0826	875	109.1	68.1	37.6	green	gold	fast	6.7%	588	1.69

Temp of Hot Cure 240 min Pulp:	81.5 °C
Temp of Hot Cure 240 min PLS:	45.9 °C
Notes:	Sulphur scale around vessel at interface, thicker by cooling coils

Metallurgical Balance POX

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, % g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
BL 801 Bulk Con	120		28.4			18.0	23.7	23.0			20.7	40.6		
90 min PLS	1143		6360	99	139	1520				69900		< 0.08	23300	49

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	%Wt. Loss	Assay (mg/L, % g/t)										S Bromine	FA, g/L H ₂ SO ₄
			Fe	Fe ²⁺	Cu	As	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag		
240 min Filtrat	1057		10600	358	139	3460				80700		< 0.08	26900	44
240 min Resid	82	27.6	24.8		333	19.5	3.74	0.98	8.3			55		
Dissolution			Fe		Cu	As								
Final HC			35%		84%	19%								

*SO₄ in solution calculated from S by bromine ICP**96.9 % Sulphide oxidation based on HC residue**

27.6 % Weight loss Overall

Weight for CIL: **68.1 g**POX Feed Eq.: **94.0 g**

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 4	BL 801 Bulk Con 2	9.0	No	26.0	2.0	89	220	90
POX 5	BL 801 Bulk Con 2	9.0	No	26.0	2.0	89	230	60
POX 6	BL 801 Bulk Con 2	9.0	Yes	7.7	2.0	101	220	90

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 4	220	436	225	95	1.05	740	1.49	561	54.0
POX 5	230	505	229	96	0.94	749	1.69	547	48.4
POX 6	220	434	250	97	0.99	788	1.80	575	48.8

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 4	BL 801 Bulk Con 2	4	95.6	1.00	693	1.61	538	50.2	orange
POX 5	BL 801 Bulk Con 2	4	95.0	1.00	647	1.54	510	45.0	orange
POX 6	BL 801 Bulk Con 2	4	95.4	1.10	752	1.69	588	44.3	gold

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ²⁻ %	Hot Cure Residue S ²⁻ Oxd'n %	Weightloss % Overall
POX 4	6060	1230	22600	7990	2640	22300	25.7	19.2	57	0.68	97.8	26.6
POX 5	4580	1250	22200	8220	3320	24500	25.8	17.6	52	0.43	98.7	29.5
POX 6	6360	1520	23300	10600	3460	26900	24.8	19.5	55	0.98	96.9	27.6

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
					NaCN	CaO	NaCN	CaO	
POX 4	BL 801 Bulk Con 2	CN-4	HC-4	No	51.84	4.42	8.03	3.90	2658
POX 5	BL 801 Bulk Con 2	CN-5	HC-5	No	53.16	4.36	9.02	3.78	2633
POX 6	BL 801 Bulk Con 2	CN-6	HC-6	No	51.61	3.93	6.32	3.32	2707

Test	LB, CN / CIL Test Number	Barren /PLS Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 4	CN-4	2.24	1.40	1.06	53.5	94.2	15.7	24.0	63.5	20.7	40.6
POX 5	CN-5	2.23	0.85	0.64	48.9	96.4	11.7	23.9	55.4	20.7	40.6
POX 6	CN-6	2.43	0.86	0.28	55.1	96.7	4.6	25.7	57.8	20.7	40.6

Result Analysis Report

Sample Name:
18988-01 Feed - Average

SOP Name:
Defaultar

Measured:
March-14-22 2:32:50 PM

Sample Source & type:
POX 6

Measured by:
lr_malvern1

Analysed:
March-14-22 2:32:52 PM

Sample bulk lot ref:
KS

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
21.55 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
0.458 %

Result Emulation:
Off

Concentration:
0.0085 %Vol

Span :
3.323

Uniformity:
1.36

Result units:
Volume

Specific Surface Area:
3.04 m^2/g

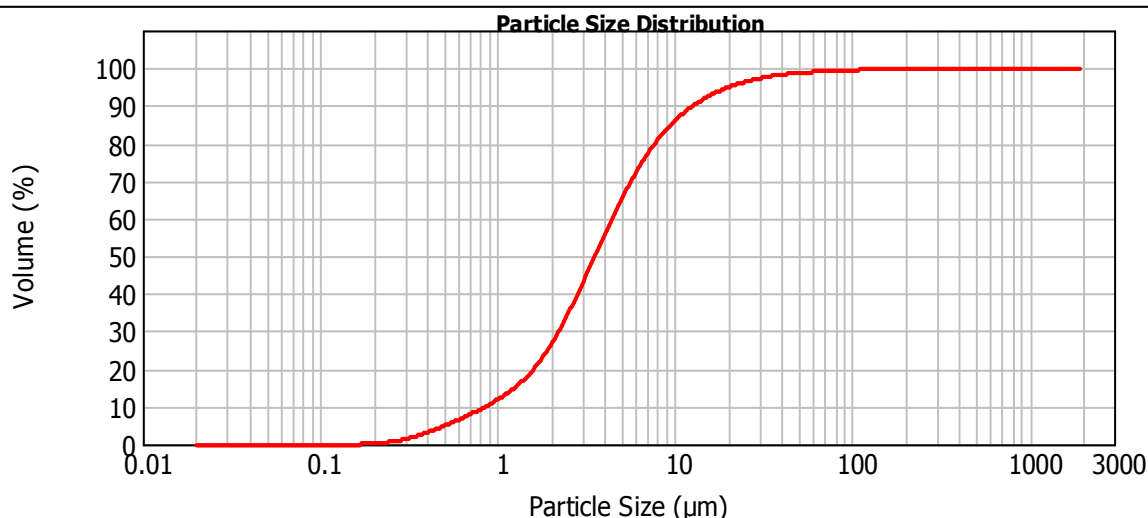
Surface Weighted Mean D[3,2]:
1.974 μm

Vol. Weighted Mean D[4,3]:
6.678 μm

d(0.1): 0.855 μm

d(0.5): 3.533 μm

d(0.8): 7.696 μm



— 18988-01 Feed - Average, March-14-22 2:32:50 PM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	12.99	11.482	88.60	120.226	99.62	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	15.09	13.183	90.63	138.038	99.71	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	17.68	15.136	92.31	158.489	99.79	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	20.92	17.378	93.71	181.970	99.86	1905.461	100.00
0.017	0.00	0.182	0.05	1.905	24.90	19.953	94.88	208.930	99.91	2187.762	100.00
0.020	0.00	0.209	0.20	2.188	29.61	22.909	95.86	239.883	99.95	2511.886	100.00
0.023	0.00	0.240	0.50	2.512	34.99	26.303	96.66	275.423	99.98	2884.032	100.00
0.026	0.00	0.275	0.95	2.884	40.87	30.200	97.33	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	1.58	3.311	47.06	34.674	97.86	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	2.38	3.802	53.33	39.811	98.28	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	3.34	4.365	59.47	45.709	98.60	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	4.43	5.012	65.29	52.481	98.84	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	5.64	5.754	70.65	60.256	99.02	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	6.93	6.607	75.43	69.183	99.17	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	8.28	7.586	79.60	79.433	99.30	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	9.70	8.710	83.15	91.201	99.42	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	11.24	10.000	86.13	104.713	99.52	1096.478	100.00		

Operator notes:

Appendix D – Tests 7 to 8

Appendix D – Tests 7 and 8

Project: 18988-01
Client:

Date: March 31, 2022
Technologist: Chris Silva

Test: POX-7a

Purpose: To conduct a POX test on the as-received BL 801-16 products 1-4 Concentrate in duplicate to produce enough feed for downstream testing.

Sample: BL 801-16 products 1-4 Concentrate

Target K80: μm
Actual K80: μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 125 g of BL 801-16 products 1-4 Concentrate (dry equivalent) was added to the mixture.
 9.06 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 60 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 60 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.
 The pulp was then combined with the Hot Cure pulp from 7b.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.
 The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split in half with half going directly to CN leaching and the 2nd half going for Lime Boil followed by CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions: Feed Moisture (%): 0.00
 Target Pulp Density (%): 10.0
 Feed Weight (dry equiv.) (g): 125.0
 Feed Weight Wet Req'd (g): 125.0
 H_2O Weight Added: 900
 H_2O Weight Req'd (g): 900
 Pre-acidulation H_2SO_4 added (g): 12.006
 2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g): 9.06
 Total Pulp Weight with reagents (g): 1034 (Actual Pulp weight)
 Pulp Density (% solids w/w): 12.1 (w/w)
 Temperature (°C): 220
 O_2 Over Pressure (psi): 100 Total = 422 psi
 Time (at temperature) (min): 90

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
4:55	0	17.8	7.26	-95		0	Add Feed
4:55	0	18.1	4.26	240		0	Ad Fe
5:02	0	20.5	2.00	476	12.006	12.006	Add Acid, froths
5:07	5	20.5	1.95	476		12.006	
5:12	10	20.4	1.95	473		12.006	
5:17	15	20.4	1.95	471		12.006	
						96.0	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:23		19		-	-	-				Start Heat
6:12	0.0	220	446	322	124	0				Start test
6:22	10.0	221	431	328	103	95	15.9	92	250	Operating with Cooling Pulse
6:32	10.0	219	444	315	129	123	28.2	96	250	
6:42	10.0	219	448	315	133	130	42.7	98	250	
6:52	10.0	220	423	322	101	99	56.5	98	250	
7:02	10.0	221	424	328	96	94	70.8	98	250	
7:12	10.0	220	459	322	137	134	83.0	98	200	
7:22	10.0	219	451	315	136	133	92.9	98	150	
7:32	10.0	221	424	328	96	94	101.0	98	250	
7:42	10.0	221	424	328	96	94	114.3	98	250	
7:43		220								
7:48		140								
7:52		95								
AVG. 0:240	90	220	436	323	114	111	114	97	233	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
90 min POX Pulp	594	0.96	49.3	39.4	37	1.0790	42	7.0	4.4	37.1	yellow	red	fast	8.9%	431	1.27
90 min POX Pulp B4 Sat	594	0.96	985.8	897.8	832	1.0790	832		88.0	#DIV/0!	yellow	red	fast	8.9%	431	1.27

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman ##):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: yellow
 Clarity of wash: clear
 Colour of wash: light yellow
 Colour of residue: red

% Moisture:
 % Weightloss:

Temp of POX Pulp:	79.3	°C
Temp of POX PLS:	21.8	°C
Note: sulphur scale on side of vessel cooling coils are		
Condensate = 77.2 g		

Hot Cure Data:

POX pulp weight for Hot Cure: 936.5 g wt. not transferred to Hot Cure 49.3 g POX Residue to HC: 83.6 g

Time	Time mins	Temp	pH	ORP	Observations
7:57	0	79	0.96	594	Sample
8:01	0	74			Back in Mantle
8:08	0	95			Start Test
9:08	60	95			
10:08	120	94			
11:08	180	96			
12:08	240	97	1.18	474	End Test, Sample, Filter
		95.4			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res. g	Dry res. g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	474	1.18	207.2	171.6	158	1.0848	174	26.2	18.3	30.2	green	red	fast	8.8%	413	1.34
HC 7a Pulp	-	-	914.4	749.1	691	1.0848	768		80.8		green	red	fast	8.8%	413	1.34
HC 7b Pulp	-	-	977.0	800.3	738	1.0848	821		86.3		green	red	fast	8.8%	413	1.34
Comb HC Pulp	474	1.18	1891.4	1549.4	1428	1.0848	1590	261.6	167.0	36.1	green	red	fast	8.8%	413	1.34
HC Pulp After Sample	474	1.18	1684.2	1377.8	1270	1.0848	1415	235.4	148.7	36.8	green	red	fast	8.8%	413	1.34

Temp of Hot Cure 240 min Pulp:	76.8 °C
Temp of Hot Cure 240 min PLS:	48.5 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils. Whitish scale.	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
BL 801-16 product	250	22.9			11.8	5.27	8.65	24.2	23.9			15.3	128	< 0.05	0.13	
90 min PLS	832	4080	1270	417	1690	7	11100				80700		0.68			26900 56

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
240 min Filtrate	1590	7020	5200	439	4370	6	11400				72300		0.16			
240 min Residue	167	21.7		0.038	12.1	6.3	1.4	9.68	5.75	11.8			149			24100 43
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP								
Final HC		24%		100%	26%	0%	89%	83.1 % Sulphide oxidation based on HC residue								

29.7 % Weight loss Overall

Weight for CIL: 148.7 g

POX Feed Eq.: 211.5 g

Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	Au	Ag
%	%	%	%	%	%	%	%	g/t	g/t	g/t

Project: 18988-01
Client:

Date: March 31, 2022
Technologist: Chris Silva

Test: POX-7b

Purpose: To conduct a POX test on the as-received BL 801-16 products 1-4 Concentrate in duplicate to produce enough feed for downstream testing.

Sample: BL 801-16 products 1-4 Concentrate

Target K80: - μm
Actual K80: 184 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 125 g of BL 801-16 products 1-4 Concentrate (dry equivalent) was added to the mixture.
 9.06 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 7a.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split in half with half going directly to CN leaching and the 2nd half going for Lime Boil followed by CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted
 Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions: Feed Moisture (%): 0.00
 Target Pulp Density (%): 10.0
 Feed Weight (dry equiv.) (g): 125.0
 Feed Weight Wet Req'd (g): 125.0
 H_2O Weight Added: 900
 H_2O Weight Req'd (g): 900
 Pre-acidulation H_2SO_4 added (g): 9.771
 2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g): 9.06
 Total Pulp Weight with reagents (g): 1034 (Actual Pulp weight)
 Pulp Density (% solids w/w): 12.1 (w/w)
 Temperature (°C): 220
 O_2 Over Pressure (psi): 100
 Time (at temperature) (min): 90
 Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:05	0	17.1	7.08	-128		0	Add Feed
5:05	0	17.1	3.90	289		0	Add Fe
5:15	0	19.1	2.00	448		0	Add Acid, froths
5:20	5	19.1	1.98	443		0	
5:25	10	19.1	1.96	438	9.771	9.771	
5:30	15	19.0	1.97	435		9.771	
						78.2	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:37		19		-	-	-				Start Heat
6:32	0.0	220	437	322	115	0				Start test
6:42	10.0	221	433	328	105	84		80	250	Operating with Cooling Pulse
6:52	10.0	221	423	328	95	88		93	250	
7:02	10.0	220	436	322	114	109		95	250	
7:12	10.0	221	455	328	127	122		96	250	
7:22	10.0	220	420	322	98	96		98	250	
7:32	10.0	221	428	328	100	98		98	300	
7:42	10.0	220	460	322	138	135		98	250	
7:52	10.0	219	451	315	136	133		98	250	
8:02	10.0	219	458	315	143	140		98	250	
8:03		221								
8:06		140								
8:09		95								
AVG. 0:240	90	220	440	323	117	112		95	256	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
90 min POX Pulp	528	1.19	51.3	38.5	36	1.0705	44	7.1	4.5	36.6	yellow	red	fast	8.8%	407	1.30
90 min POX Pulp B4 Sat	528	1.19	1029.4	939.1	877	1.0705	877		90.3	#DIV/0!	yellow	red	fast	8.8%	407	1.30

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman #):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: yellow
 Clarity of wash: clear
 Colour of wash: light yellow
 Colour of residue: red

% Moisture:
 % Weightloss:

Temp of POX Pulp:	82.0	°C
Temp of POX PLS:	24.5	°C
Note: sulphur scale on side of vessel cooling coils are		
Condensate =	9.1	g

Hot Cure Data:

POX pulp weight for Hot Cure: 978.1 g wt. not transferred to Hot Cure 51.3 g POX Residue to HC: 85.8 g

Time	Time mins	Temp	pH	ORP	Observations
8:14	0	82	1.19	528	Sample
8:18	0	68			Back in Mantle
8:25	0	95			Start Test
9:25	60	96			
10:25	120	94			
11:25	180	94			
12:25	240		1.18	474	End Test, Sample, Filter
		94.8			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res. g	Dry res. g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	474	1.18	207.2	171.6	158	1.0848	174	26.2	18.3	30.2	green	red	fast	8.8%	413	1.34
HC 7a Pulp	-	-	914.4	749.1	691	1.0848	768		80.8		green	red	fast	8.8%	413	1.34
HC 7b Pulp	-	-	977.0	800.3	738	1.0848	821		86.3		green	red	fast	8.8%	413	1.34
Comb HC Pulp	474	1.18	1891.4	1549.4	1428	1.0848	1590	261.6	167.0	36.1	green	red	fast	8.8%	413	1.34
HC Pulp After Sample	474	1.18	1684.2	1377.8	1270	1.0848	1415	235.4	148.7	36.8	green	red	fast	8.8%	413	1.34

Temp of Hot Cure 240 min Pulp:	76.8 °C
Temp of Hot Cure 240 min PLS:	48.5 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils. Whitish scale.	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
BL 801-16 product	250	22.9			11.8	5.27	8.65	24.2	23.9			15.3	128	< 0.05	0.13	
90 min PLS	877	5100	2910	325	3590	7	10400				62700		0.98			20900 36

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
240 min Filtrat	1590	7020	5200	439	4370	6	11400				72300		0.16			
240 min Resid	167	21.7		0.038	12.1	6.3	1.4	9.68	5.75	11.8			149			24100 43
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP								
Final HC		24%		100%	26%	0%	89%	83.1 % Sulphide oxidation based on HC residue								

29.7 % Weight loss Overall

Weight for CIL: 148.7 g

POX Feed Eq.: 211.5 g

Project: 18988-01
Client:

Date: April 1, 2022
Technologist: Chris Silva

Test: POX-8a

Purpose: To conduct a POX test on ground BL 801-16 products 1-4 Concentrate in duplicate to produce enough feed for downstream testing.

Sample: BL 801-16 products 1-4 Concentrate

Target K80: - μm
Actual K80: 16.3 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: BL 801-16 products 1-4 Conc was ground in the Attrition Mill at 50% solids.
 The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 125 g of BL 801-16 products 1-4 Concentrate (dry equivalent) was added to the mixture.
 9.06 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 8b.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.
 The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split in half with half going directly to CN leaching and the 2nd half going for Lime Boil followed by CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions: Feed Moisture (%): 0.00
 Target Pulp Density (%): 10.0
 Feed Weight (dry equiv.) (g): 125.0
 Feed Weight Wet Req'd (g): 125.0
 H_2O Weight Added: 900
 H_2O Weight Req'd (g): 900
 Pre-acidulation H_2SO_4 added (g): 12.460
 2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g): 9.06
 Total Pulp Weight with reagents (g): 1034 (Actual Pulp weight)
 Pulp Density (% solids w/w): 12.1 (w/w)
 Temperature (°C): 220
 O_2 Over Pressure (psi): 100 Total = 422 psi
 Time (at temperature) (min): 90

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
4:43	0	18.1	7.96	-232		0	Add Feed
4:43	0	18.2	5.51	-52		0	Add Fe
4:51	0	20.8	2.04	343	12.46	12.46	Add Acid, frothy
4:56	5	20.8	2.03	294		12.46	
5:01	10	20.8	2.04	268		12.46	
5:06	15	20.8	2.01	257	0.357	12.817	
						103	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:14		19		-	-	-				Start Heat
6:04	0.0	220	441	322	119	0	3.3		250	Start test
6:14	10.0	220	456	322	134	129	18.1	96	250	Operating with Cooling Pulse
6:24	10.0	220	426	322	104	102	31.9	98	250	
6:34	10.0	221	427	328	99	97	44.7	98	250	
6:44	10.0	220	457	322	135	133	56.7	98	250	
6:54	10.0	219	444	315	129	126	69.6	98	250	
7:04	10.0	220	455	322	133	131	82.4	98	250	
7:14	10.0	219	428	315	113	110	93.6	98	250	
7:24	10.0	220	415	322	93	91	106.4	98	250	
7:34	10.0	221	443	328	115	112	118.2	98	250	
7:35		217								
7:40		140								
7:45		95								
AVG. 0:240	90	220	439	322	117	115	118	98	250	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
60 min POX Pulp	650	1.15	54.1	42.5	38	1.1042	45	8.6	4.0	53.5	yellow	brown	fast	7.4%	491	1.38
60 min POX Pulp B4 Sat	650	1.15	993.3	919.9	833	1.1042	833		73.4	#DIV/0!	yellow	brown	fast	7.4%	491	1.38

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman ##):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: yellow
 Clarity of wash: clear
 Colour of wash: light yellow
 Colour of residue: brown

% Moisture
 % Weightloss:

Temp of POX Pulp:	80.7	°C
Temp of POX PLS:	20.6	°C
Note: sulphur smell from off gas upon initially opening off gas		
sulphur scale on side of vessel cooling coils are		
Condensate = 77.7 g		

Hot Cure Data:

POX pulp weight for Hot Cure: 939.2 g wt. not transferred to Hot Cure 54.1 g POX Residue to HC: 69.4 g

Time	Time mins	Temp	pH	ORP	Observations
7:49	0	81	1.15	650	Sample
7:52	0	74			Back in Mantle
7:58	0	95			Start Test
8:08	60	94			
9:08	120	96			
10:08	180	94			
11:08	240		1.27	476	End Test, Sample, Filter
		94.8			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res. g	Dry res. g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	476	1.27	215.4	173.0	157	1.1039	179	31.6	18.1	42.7	green	brown	med	8.4%	404	1.41
HC 8a Pulp	-	-	879.5	691.5	626	1.1039	730		73.9		green	brown	med	8.4%	404	1.41
HC 8b Pulp	-	-	965.8	759.3	688	1.1039	801		81.2		green	brown	med	8.4%	404	1.41
Comb HC Pulp	476	1.27	1845.3	1450.8	1314	1.1039	1531	268.9	155.1	42.3	green	brown	med	8.4%	404	1.41
HC Pulp After Sample	476	1.27	1629.9	1277.8	1158	1.1039	1352	237.3	137.0	42.3	green	brown	med	8.4%	404	1.41

Temp of Hot Cure 240 min Pulp:	67.2 °C
Temp of Hot Cure 240 min PLS:	42.1 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils	
Sulphur scale very hard to chip off.	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, %, g/t)														S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC		
BL 801-16 product	250	22.9			11.8	5.27	8.65	24.2	23.9			15.3	128	< 0.05	0.13		
60 min PLS	833	12300	1620	428	3020	< 20	10600				98100		0.22			32700	57

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, %, g/t)														S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC		
240 min Filtrate	1531	13300	6900	426	5370	< 20	10500				90600		0.55			30200	50
240 min Residue	155	19.3		0.021	12.0	7.4	1.6	7.43	3.52	11.7			159				
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP									
Final HC		40%		95%	31%	0%	87%	90.3 % Sulphide oxidation based on HC residue									

34.4 % Weight loss Overall

Weight for CIL: 137.0 g

POX Feed Eq.: 208.8 g

Project: 18988-01
Client:

Date: April 1, 2022
Technologist: Chris Silva

Test: POX-8b

Purpose: To conduct a POX test on ground BL 801-16 products 1-4 Concentrate in duplicate to produce enough feed for downstream testing.

Sample: BL 801-16 products 1-4 Concentrate

Target K80: - μm
Actual K80: 16.3 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: BL 801-16 products 1-4 Conc was ground in the Attrition Mill at 50% solids.
 The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 125 g of BL 801-16 products 1-4 Concentrate (dry equivalent) was added to the mixture.
 9.06 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp mixed and a sample removed - HC- Time 0.

The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.

The Time 0 sample was filtered and the products submitted for analysis.

Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min POX sample was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water. The POX residue was not submitted for assay.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 8a.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.
 The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split in half with half going directly to CN leaching and the 2nd half going for Lime Boil followed by CN leaching.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions: Feed Moisture (%): 0.00
 Target Pulp Density (%): 10.0
 Feed Weight (dry equiv.) (g): 125.0
 Feed Weight Wet Req'd (g): 125.0
 H_2O Weight Added: 900
 H_2O Weight Req'd (g): 900
 Pre-acidulation H_2SO_4 added (g): 9.901
 2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g): 9.06
 Total Pulp Weight with reagents (g): 1034 (Actual Pulp weight)
 Pulp Density (% solids w/w): 12.1 (w/w)
 Temperature (°C): 220
 O_2 Over Pressure (psi): 100 Total = 422 psi
 Time (at temperature) (min): 90

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
4:50	0	16.9	8.15	-272		0	Add Feed
4:50	0	16.9	4.36	115		0	Add Fe
4:57	0	19.3	22.00	342	9.901	9.901	Add Acid, frothy
5:02	5	19.3	1.94	268	0.70	10.60	
5:07	10	19.3	2.02	220		10.60	
5:12	15	19.3	1.96	214	0.402	11.00	
						88	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:27		20		-	-	-				Start Heat
6:25	0.0	220	437	322	115	0				Start test
6:35	10.0	221	425	328	97	83		86	250	Operating with Cooling Pulse
6:45	10.0	221	421	328	93	91		98	300	
6:55	10.0	221	426	328	98	96		98	250	
7:05	10.0	219	448	315	133	130		98	250	
7:15	10.0	219	449	315	134	131		98	250	
7:25	10.0	220	451	322	129	127		98	250	
7:35	10.0	219	448	315	133	130		98	250	
7:45	10.0	221	451	328	123	120		98	250	
7:55	10.0	221	424	328	96	94		98	250	
7:56		220								
7:59		140								
8:02		95								
AVG. 0:240	90	220	438	323	115	111		97	256	

Sampling Data:

Sample #	Pulp		Weights		Volume	SG	Calc PLS	Wet	Dry	%H ₂ O	Colours		Filtration	Pulp	PLS	
	ORP	pH	pulp, g	PLS, g	PLS, mL	g/mL	Vol, mL	res, g	res, g		PLS	Residue	fst /slw	% solids	ORP	pH
60 min POX Pulp	473	1.38	55.6	43.5	40	1.0910	47	8.2	3.9	52.4	green	brown	fast	7.0%	356	1.35
60 min POX Pulp B4 Sat	473	1.38	1038.2	965.4	885	1.0910	885		72.8	#DIV/0!	green	brown	fast	7.0%	356	1.35

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman ##):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: brown

% Moisture:
 % Weightloss:

Temp of POX Pulp:	81.1	°C
Temp of POX PLS:	23.6	°C
Note: sulphur smell from off gas upon initially opening off gas		
sulphur scale on side of vessel cooling coils are		
Condensate =	32.3	g

Hot Cure Data:

POX pulp weight for Hot Cure: 982.6 g wt. not transferred to Hot Cure 55.6 g POX Residue to HC: 68.9 g

Time	Time mins	Temp	pH	ORP	Observations
8:06	0	81	1.38	473	Sample
8:11	0	74			Back in Mantle
8:18	0	95			Start Test
9:18	60	95			
10:18	120	95			
11:18	180	94			
12:18	240	94	1.27	476	End Test, Sample, Filter
		94.6			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res. g	Dry res. g	%H ₂ O	Colours		Filtration fst / slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	476	1.27	215.4	173.0	157	1.1039	179	31.6	18.1	42.7	green	brown	med	8.4%	404	1.41
HC 8a Pulp	-	-	879.5	691.5	626	1.1039	730		73.9		green	brown	med	8.4%	404	1.41
HC 8b Pulp	-	-	965.8	759.3	688	1.1039	801		81.2		green	brown	med	8.4%	404	1.41
Comb HC Pulp	476	1.27	1845.3	1450.8	1314	1.1039	1531	268.9	155.1	42.3	green	brown	med	8.4%	404	1.41
HC Pulp After Sample	476	1.27	1629.9	1277.8	1158	1.1039	1352	237.3	137.0	42.3	green	brown	med	8.4%	404	1.41

Temp of Hot Cure 240 min Pulp:	67.2 °C
Temp of Hot Cure 240 min PLS:	42.1 °C
Notes: Sulphur scale around vessel at interface, thicker by cooling coils	
Sulphur scale very hard to chip off.	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)														S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC		
BL 801-16 product	250	22.9			11.8	5.27	8.65	24.2	23.9			15.3	128	< 0.05	0.13		
60 min PLS	885	11500	8740	399	5640	< 20	9990				79200		2.84			26400	41

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)														S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁼	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC		
240 min Filtrate	1531	13300	6900	426	5370	< 20	10500				90600		0.55			30200	50
240 min Residue	155	19.3		0.021	12.0	7.4	1.6	7.43	3.52	11.7			159				
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP									
Final HC		40%		95%	31%	0%	87%	90.3 % Sulphide oxidation based on HC residue									

34.5 % Weight loss Overall

Weight for CIL: 137.0 g

POX Feed Eq.: 209.0 g

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 7a	BL 801-16 pdts 1-4	12.0	No	184.0	2.0	96	220	90
POX 7b	BL 801-16 pdts 1-4	12.0	No	184.0	2.0	78	220	90
POX 8a	BL 801-16 pdts 1-4	12.0	Yes	16.3	2.0	103	220	90
POX 8b	BL 801-16 pdts 1-4	12.0	Yes	16.3	2.0	88	220	90

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 7a	220	436	233	97	0.96	594	1.27	431	55.7
POX 7b	220	440	256	95	1.19	528	1.30	407	35.7
POX 8a	220	439	250	98	1.15	650	1.38	491	56.7
POX 8b	220	438	256	97	1.38	473	1.35	356	40.9

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 7a	BL 801-16 pdts 1-4	4	95.4	1.18	474	1.34	413	42.6	red
POX 7b	BL 801-16 pdts 1-4	4	94.8	1.18	474	1.34	413	42.6	red
POX 8a	BL 801-16 pdts 1-4	4	94.8	1.27	476	1.41	404	49.5	brown
POX 8b	BL 801-16 pdts 1-4	4	94.6	1.27	476	1.41	404	49.5	brown

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 7a	4080	1690	26900	7020	4370	24100	21.7	12.1	149	5.75	83.1	29.7
POX 7b	5100	3590	20900	7020	4370	24100	21.7	12.1	149	5.75	83.1	29.7
POX 8a	12300	3020	32700	13300	5370	30200	19.3	12.0	159	3.52	90.3	34.4
POX 8b	11500	5640	26400	13300	5370	30200	19.3	12.0	159	3.52	90.3	34.5

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
POX 7a	BL 801-16 pdts 1-4	LB-1, CN-7	LB-1	No	39.7	143.1	8.4	136.7	2699
POX 7b	BL 801-16 pdts 1-4	CN-8	HC 7a + 7b	No	80.4	8.6	19.2	8.6	4216
POX 8a	BL 801-16 pdts 1-4	LB-2, CN-9	LB-2	No	42.0	159.7	6.6	154.5	2776
POX 8b	BL 801-16 pdts 1-4	CN-10	HC 8a + 8b	No	58.3	5.8	14.7	5.6	2757

Note: Reagent addition of CaO also takes into account lime added during lime boil

Test	LB, CN / CIL Test Number	Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head	
										Au	Ag
POX 7a	LB-1, CN-7	1.73	2.42	12.9	30.2	83.1	74.9	14.3	120.4	15.3	128
POX 7b	CN-8	2.01	4.08	13.8	56.3	80.3	67.3	20.4	172.4	15.3	128
POX 8a	LB-2, CN-9	1.66	1.48	12.4	22.3	89.5	81.0	14.0	117.6	15.3	128
POX 8b	CN-10	1.50	3.07	6.7	101.2	82.4	39.6	17.5	167.6	15.3	128

Result Analysis Report

Sample Name:
18988-01 POX 8 Comb Feed - Average

Sample Source & type:
19125-02

Sample bulk lot ref:
MW

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

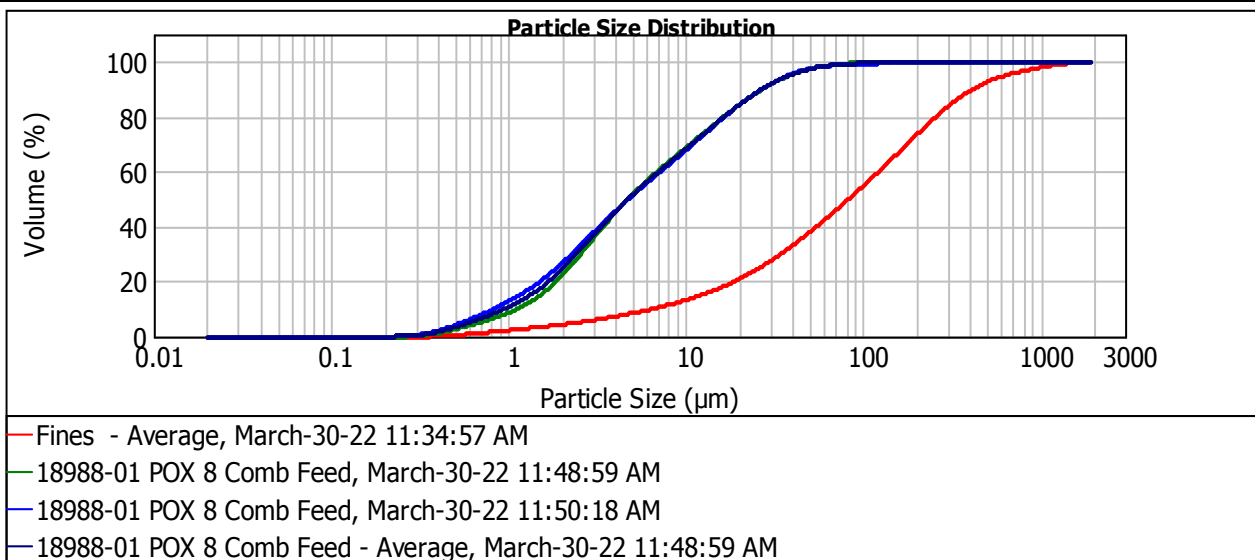
Measured:
March-30-22 11:48:59 AM

Analysed:
March-30-22 11:49:01 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 17.18 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.486 %	Result Emulation: Off

Concentration: 0.0077 %Vol	Span : 5.433	Uniformity: 1.82	Result units: Volume
Specific Surface Area: 2.5 m ² /g	Surface Weighted Mean D[3,2]: 2.397 um	Vol. Weighted Mean D[4,3]: 10.718 um	

d(0.1): 0.945 um **d(0.5): 4.708 um** **d(0.8): 16.339 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	12.00	11.482	71.68	120.226	99.67	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	14.15	13.183	74.96	138.038	99.74	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	16.68	15.136	78.22	158.489	99.79	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	19.67	17.378	81.41	181.970	99.82	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	23.14	19.953	84.45	208.930	99.86	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	27.02	22.909	87.29	239.883	99.90	2511.886	100.00
0.023	0.00	0.240	0.02	2.512	31.19	26.303	89.85	275.423	99.94	2884.032	100.00
0.026	0.00	0.275	0.13	2.884	35.49	30.200	92.11	316.228	99.98	3311.311	100.00
0.030	0.00	0.316	0.53	3.311	39.78	34.674	94.03	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	1.13	3.802	43.95	39.811	95.61	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.96	4.365	47.92	45.709	96.85	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	2.98	5.012	51.67	52.481	97.79	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	4.17	5.754	55.22	60.256	98.47	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	5.49	6.607	58.61	69.183	98.93	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	6.92	7.586	61.90	79.433	99.25	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	8.46	8.710	65.15	91.201	99.45	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	10.13	10.000	68.41	104.713	99.58	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Pdts 1-4 - Average

Sample Source & type:
BL 801-16

Sample bulk lot ref:
KS

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

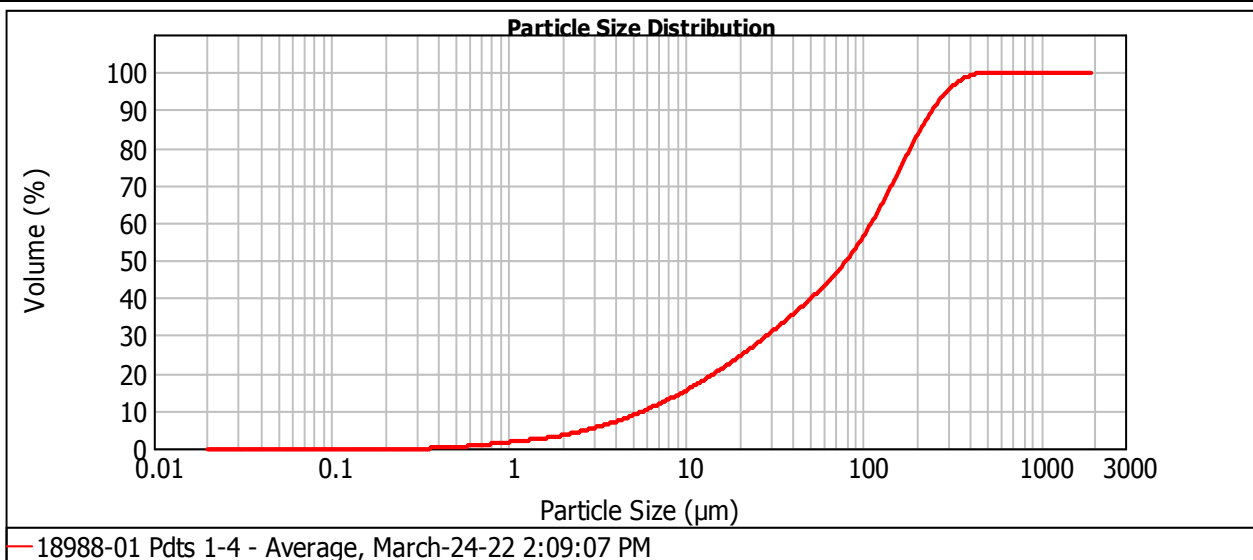
Measured:
March-24-22 2:09:07 PM

Analysed:
March-24-22 2:09:09 PM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 13.34 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.473 %	Result Emulation: Off

Concentration: 0.0274 %Vol	Span : 2.970	Uniformity: 0.96	Result units: Volume
Specific Surface Area: 0.48 m ² /g	Surface Weighted Mean D[3,2]: 12.508 um	Vol. Weighted Mean D[4,3]: 104.497 um	

d(0.1): 5.823 um **d(0.5): 80.100 um** **d(0.8): 184.014 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	1.79	11.482	17.01	120.226	63.03	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	2.08	13.183	18.71	138.038	68.39	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	2.41	15.136	20.50	158.489	73.98	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	2.79	17.378	22.40	181.970	79.56	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	3.23	19.953	24.39	208.930	84.83	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	3.76	22.909	26.47	239.883	89.51	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	4.37	26.303	28.64	275.423	93.38	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	5.07	30.200	30.88	316.228	96.31	3311.311	100.00
0.030	0.00	0.316	0.00	3.311	5.86	34.674	33.19	363.078	98.30	3801.894	100.00
0.035	0.00	0.363	0.01	3.802	6.73	39.811	35.56	416.869	99.45	4365.158	100.00
0.040	0.00	0.417	0.08	4.365	7.70	45.709	38.00	478.630	99.94	5011.872	100.00
0.046	0.00	0.479	0.23	5.012	8.75	52.481	40.57	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	0.44	5.754	9.90	60.256	43.33	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	0.68	6.607	11.14	69.183	46.36	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	0.95	7.586	12.46	79.433	49.78	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	1.22	8.710	13.89	91.201	53.67	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	1.50	10.000	15.40	104.713	58.09	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 POX 8 Feed 200g30 mins -

Sample Source & type:
13086-08

Sample bulk lot ref:
DA

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

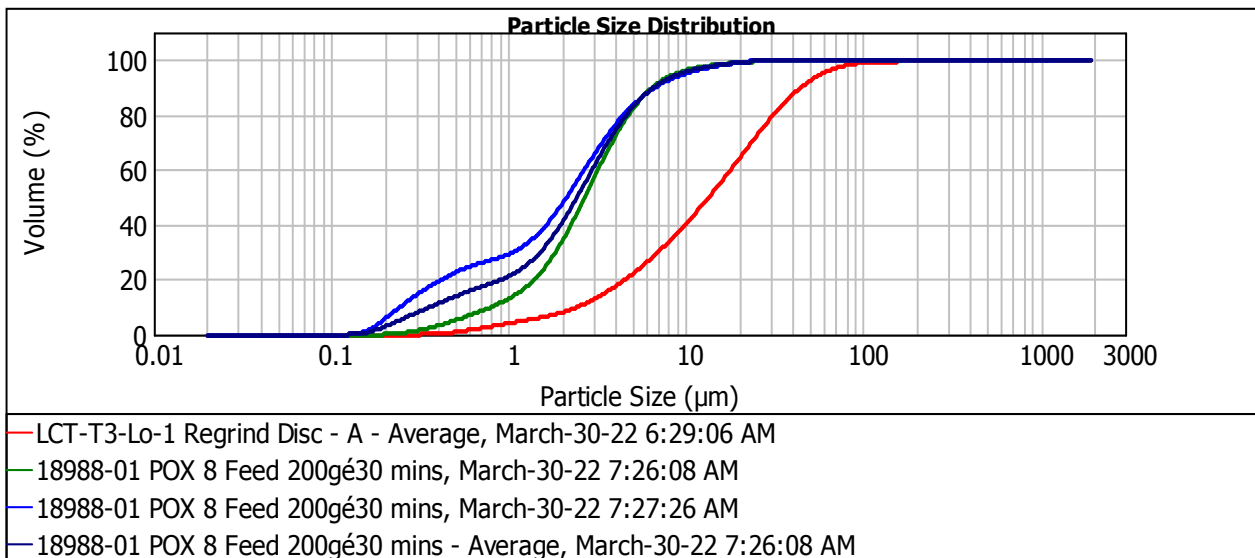
Measured:
March-30-22 7:26:08 AM

Analysed:
March-30-22 7:26:09 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 23.00 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.977 %	Result Emulation: Off

Concentration: 0.0072 %Vol	Span : 2.555	Uniformity: 0.861	Result units: Volume
Specific Surface Area: 5.56 m ² /g	Surface Weighted Mean D[3,2]: 1.080 um	Vol. Weighted Mean D[4,3]: 3.293 um	

d(0.1): 0.361 um **d(0.5): 2.430 um** **d(0.8): 4.613 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	22.50	11.482	96.69	120.226	100.00	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	25.14	13.183	97.47	138.038	100.00	1445.440	100.00
0.013	0.00	0.138	0.12	1.445	28.65	15.136	98.11	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.64	1.660	33.13	17.378	98.64	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	1.78	1.905	38.58	19.953	99.09	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	3.24	2.188	44.84	22.909	99.44	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	4.93	2.512	51.67	26.303	99.71	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	6.67	2.884	58.71	30.200	99.87	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	8.38	3.311	65.64	34.674	99.97	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	10.06	3.802	72.12	39.811	100.00	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	11.71	4.365	77.92	45.709	100.00	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	13.32	5.012	82.87	52.481	100.00	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	14.84	5.754	86.92	60.256	100.00	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	16.27	6.607	90.11	69.183	100.00	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	17.62	7.586	92.55	79.433	100.00	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	18.98	8.710	94.35	91.201	100.00	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	20.53	10.000	95.69	104.713	100.00	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 2.5 mins per 150 g - Average

Sample Source & type:
13086-08

Sample bulk lot ref:
DA

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

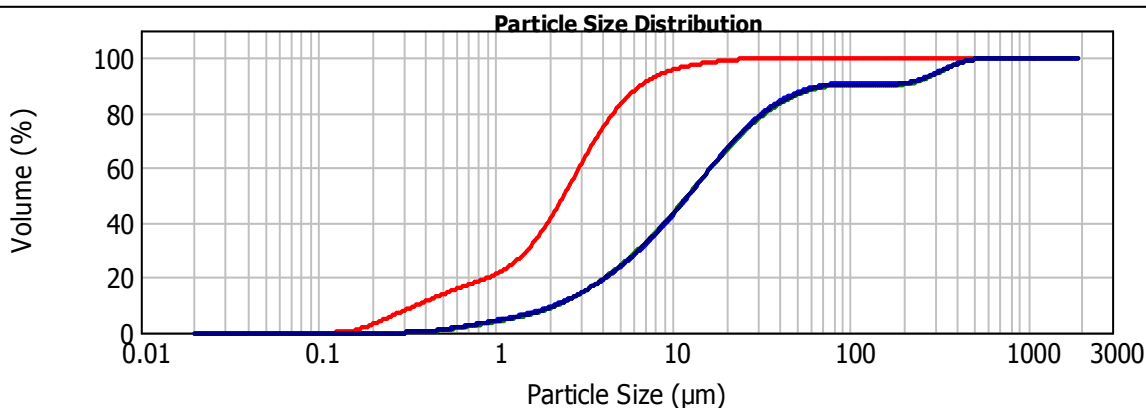
Measured:
March-30-22 8:37:58 AM

Analysed:
March-30-22 8:38:00 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 13.77 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.606 %	Result Emulation: Off

Concentration: 0.0115 %Vol	Span : 5.865	Uniformity: 3.28	Result units: Volume
Specific Surface Area: 1.2 m ² /g	Surface Weighted Mean D[3,2]: 4.994 um	Vol. Weighted Mean D[4,3]: 45.570 um	

d(0.1): 2.192 um **d(0.5): 12.210 um** **d(0.8): 32.548 um**



— 18988-01 POX 8 Feed 200g 30 mins - Average, March-30-22 7:26:08 AM

— 18988-01 2.5 mins per 150 g, March-30-22 8:37:58 AM

— 18988-01 2.5 mins per 150 g, March-30-22 8:39:16 AM

— 18988-01 2.5 mins per 150 g - Average, March-30-22 8:37:58 AM

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	4.63	11.482	47.89	120.226	90.38	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	5.39	13.183	52.65	138.038	90.38	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	6.25	15.136	57.45	158.489	90.38	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	7.28	17.378	62.18	181.970	90.41	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	8.51	19.953	66.73	208.930	90.80	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	9.98	22.909	70.99	239.883	91.78	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	11.69	26.303	74.87	275.423	93.27	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	13.65	30.200	78.32	316.228	95.07	3311.311	100.00
0.030	0.00	0.316	0.01	3.311	15.85	34.674	81.31	363.078	96.85	3801.894	100.00
0.035	0.00	0.363	0.12	3.802	18.31	39.811	83.83	416.869	98.33	4365.158	100.00
0.040	0.00	0.417	0.39	4.365	21.02	45.709	85.90	478.630	99.33	5011.872	100.00
0.046	0.00	0.479	0.80	5.012	24.01	52.481	87.56	549.541	99.88	5754.399	100.00
0.052	0.00	0.550	1.32	5.754	27.27	60.256	88.82	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	1.92	6.607	30.84	69.183	89.70	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	2.57	7.586	34.70	79.433	90.24	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	3.24	8.710	38.86	91.201	90.38	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	3.92	10.000	43.27	104.713	90.38	1096.478	100.00		

Operator notes:

Appendix E – Tests 9 to 11

Appendix E – Tests 9 and 11

Project: 18988-01 Date: May 5, 2022
 Client: Technologist: Chris Silva

Test: POX-9a

Purpose: To conduct a POX test on a blend of BL 801-24 Final Tails and BL 801-25 Final Tails in duplicate to produce enough feed for downstream testing.

Sample: Blend of BL 801-24 Final Tails and BL 801-25 Final Tails

Target K80: - μm
 Actual K80: 20.6 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 200 g of a blend of BL 801-24 Final Tails and BL 801-25 Final Tails (dry equivalent) was added to the mixture.
 13.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.
 Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp weighed and then mixed.
 1/2 of the pulp (by weight) was removed and combined with half of the POX weight removed from POX 9B, mixed and filtered.

Note: Have to do procedure this way as volume would be too much for one 2 L autoclave vessel to contain
 The remaining half of POX 9a pulp was combined with the remaining half of POX 9b pulp in the autoclave vessel.
 The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.
 The Time 0 sample was filtered and the products submitted for analysis.
 Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min combined POX 9a + 9b sample was filtered and the residue washed with 1 x 150 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 350 mL's with deionized water.
 The POX residue ground to a target of 15 μm and then split in half for CN leaching 1/2 with oxygen sparging and the 2nd half with air sparging.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.
 The pulp was then combined with the Hot Cure pulp from 9b.
 The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.
 The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
 The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.
 The residue was then further displacement washed with 3 x 250 mL of D.I.
 The Hot Cure residue ground to a target of 15 μm and then split in half for CN leaching 1/2 with oxygen sparging and the 2nd half with air sparging.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 POX Residue: Not Submitted Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions:	Feed Moisture (%):	0.00	
	Target Pulp Density (%):	10.0	
	Feed Weight (dry equiv.) (g):	200.0	
	Feed Weight Wet Req'd (g):	200.0	
	H_2O Weight Added:	1300	
	H_2O Weight Req'd (g):	1300	
	Pre-acidulation H_2SO_4 added (g):	22.246	
	2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	13.08	
	Total Pulp Weight with reagents (g):	1513	(Actual Pulp weight)
	Pulp Density (% solids w/w):	13.2	(w/w)
	Temperature (°C):	220	
	O_2 Over Pressure (psi):	100	Total = 422 psi
	Time (at temperature) (min):	90	

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:38	0	19.9	7.45	-93		0	Add Feed
5:38	0	19.9	4.71	154		0	Ad Fe
6:05	0	22.7	2.04	374	22.246	22.246	Add Acid, froths
6:10	5	22.5	2.01	368	0.746	22.992	froth
6:15	10	22.2	2.01	364		22.992	froth
6:20	15	21.8	2.00	359	0.234	23.226	froth
						116.1	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
6:35		21		-	-	-				Start Heat
7:29	0.0	220	427	322	105	0	4.8		250	Start test
7:39	10.0	220	427	322	105	99	37.6	94	250	Operating with Cooling Pulse
7:49	10.0	221	426	328	98	94	64.6	96	250	
7:59	10.0	218	428	309	119	112	93.6	94	250	
8:09	10.0	221	419	328	91	85	98.7	94	250	
8:19	10.0	219	435	315	120	115	105.5	96	300	
8:29	10.0	220	425	322	103	97	111.6	94	250	
8:39	10.0	221	423	328	95	89	117.0	94	250	
8:49	10.0	220	434	322	112	106	122.3	94	250	
8:59	10.0	219	434	315	119	112	130.1	94	300	
9:00		220								
9:06		140								
9:10		95								
AVG. 0:240	90	220	428	321	107	101	130	94	260	

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
POX 9a Pulp	808	1.22	1484.6	-	-	-	-	-	-	-	-	-	-	-	-	-
POX 9b Pulp	854	1.17	1514.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Comb 9a+9b POX Pulp	715	1.43	2998.8	2335.4	2131	1.0961	2425	516.3	341.2	33.9	green	red	fast	11.4%	670	1.41
Comb 9a+9b POX Pulp Filtered			1471.4	1171.5	1069	1.0961	1186	259.0	171.2	33.9	green	red	fast	11.6%	670	1.41
Comb 9a+9b POX Pulp for Hot Cure			1461.8	1163.9	1062	1.0961	1178	257.3	170.1	33.9	green	red	fast	11.6%	670	1.41

denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman ##):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: red

% Moisture
 % Weightloss:

Temp of POX 9a Pulp:	83.2	°C
Temp of POX 9b Pulp:	85.5	°C
Temp of POX 9a + 9b Pulp:	54.8	°C
Temp of POX PLS:	38.7	°C
Note: Frothed through off gas system		
Condensate =	83.2	g

Hot Cure Data:

POX pulp weight for Hot Cure: 1461.8 g wt. not transferred to Hot Cure 0.0 g POX Residue to HC: 170.1 g

Time	Time mins	Temp	pH	ORP	Observations
9:43	0	60	1.43	715	Back in Mantle
9:54	0	95			Start Test
10:54	60	95			
11:54	120	94			
12:54	180	96			
13:54	240	95	1.06	687	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst / slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	687	1.06	192.1	157.8	140	1.1237	155	27.6	18.3	33.7	dk grn	orange	fast	9.5%	514	1.65
Comb HC Pulp	687	1.06	1449.0	1186.4	1056	1.1237	1167	212.6	138.0	35.1	dk grn	orange	fast	9.5%	514	1.65
HC Pulp After Sample	687	1.06	1256.9	1028.6	915	1.1237	1012	185.0	119.7	35.3	dk grn	orange	fast	9.5%	514	1.65

Temp of Hot Cure 240 min Pulp:	81.7 °C
Temp of Hot Cure 240 min PLS:	48.5 °C
Notes:	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
Blend of BL 801-2	400	25.2		3640	13.2	7330	33700	23.0	22.2			13.7	60	< 0.05	0.15	
90 min PLS	1186	9380	85	384	2140	15	4450				98400		0.49			32800 66

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
240 min Filtrate	1167	16200	2200	418	4320	7	5010				111900		< 0.6			
240 min Residue	138	18.4		1630	14.6	9450	7660	4.49	0.20	12.9			71			37300 55
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP								
Final HC		43%		68%	20%	1%	85%	99.7% % Sulphide oxidation based on HC residue								

14.7 % POX Weight loss Overall
 18.8 % Hot Cure Weight loss Overall

Weight for CIL: 119.7 g
 POX Feed Eq.: 140.4 g

Project: 18988-01
Client:

Date: May 5, 2022
Technologist: Chris Silva

Test: POX-9b

Purpose: To conduct a POX test on a blend of BL 801-24 Final Tails and BL 801-25 Final Tails in duplicate to produce enough feed for downstream testing.

Sample: Blend of BL 801-24 Final Tails and BL 801-25 Final Tails

Target K80: - μm
Actual K80: 20.6 μm
(Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
200 g of a blend of BL 801-24 Final Tails and BL 801-25 Final Tails (dry equivalent) was added to the mixture.
13.08 g Ferric Sulphate was then added to the mixture.
The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
Once the sample was at temperature 100 psi oxygen over pressure was applied.
An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.
Once at 95°C, the autoclave was removed from the mantle, the head removed, the pulp weighed and then mixed.
1/2 of the pulp (by weight) was removed and combined with half of the POX weight removed from POX 9B, mixed and filtered.

Note: Have to do procedure this way as volume would be too much for one 2 L autoclave vessel to contain
The remaining half of POX 9a pulp was combined with the remaining half of POX 9b pulp in the autoclave vessel.
The head was then placed back onto the vessel, secured and placed back into the mantle and heated to 95°C.
The Time 0 sample was filtered and the products submitted for analysis.
Once the pulp was back at 95°C it was then held for 240 minutes.

The 90 min combined POX 9a + 9b sample was filtered and the residue washed with 1 x 150 mL pH 2 sulphuric acid deionized water.
The residue was then further displacement washed 3 x 350 mL's with deionized water.
The POX residue ground to a target of 15 μm and then split in half for CN leaching 1/2 with oxygen sparging and the 2nd half with air sparging.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.
The pulp was then combined with the Hot Cure pulp from 9a.
The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.
The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.
The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.
The residue was then further displacement washed with 3 x 250 mL of D.I.
The Hot Cure residue ground to a target of 15 μm and then split in half for CN leaching 1/2 with oxygen sparging and the 2nd half with air sparging.

Analysis: POX PLS: Fe, Fe^{2+} , As, ICP Scan and S
POX Residue: Not Submitted
Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
Hot Cure Residue: S(t), S^{2-} , Fe, As and ICP Scan

Conditions: Feed Moisture (%): 0.00
Target Pulp Density (%): 10.0
Feed Weight (dry equiv.) (g): 200.0
Feed Weight Wet Req'd (g): 200.0
 H_2O Weight Added: 1300
 H_2O Weight Req'd (g): 1300
Pre-acidulation H_2SO_4 added (g): 18.346
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g): 13.08
Total Pulp Weight with reagents (g): 1513 (Actual Pulp weight)
Pulp Density (% solids w/w): 13.2 (w/w)
Temperature (°C): 220
 O_2 Over Pressure (psi): 100 Total = 422 psi
Time (at temperature) (min): 90

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:40	0	18.4	7.50	-174		0	Add Feed
5:40	0	18.5	4.63	105		0	Ad Fe
6:10	0	21.0	1.96	349	18.346	18.346	Add Acid, froths
6:15	5	20.8	1.95	339	0.394	18.740	froths
6:20	10	20.6	1.95	329	0.431	19.171	froths
6:25	15	20.3	1.95	320	0.313	19.484	froths
						97.4	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂ %	O ₂ Flow	
			meas	calculated						
6:45		20		-	-	-				Start Heat
7:49	0.0	221	419	328	91	0				Start test
7:59	10.0	219	431	315	116	108		93	250	Operating with Cooling Pulse
8:09	10.0	219	435	315	120	116		97	250	
8:19	10.0	218	439	309	130	127		98	300	
8:29	10.0	221	439	328	111	109		98	250	
8:39	10.0	221	434	328	106	104		98	300	
8:49	10.0	219	437	315	122	119		98	250	
8:59	10.0	219	434	315	119	116		98	250	
9:09	10.0	221	443	328	115	112		98	300	
9:19	10.0	220	440	322	118	116		98	250	
AVG. 0:240	90	220	437	320	117	114	0	97	267	

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
POX 9a Pulp	808	1.22	1484.6	-	-	-	-	-	-	-	-	-	-	-	-	-
POX 9b Pulp	854	1.17	1514.2	-	-	-	-	-	-	-	-	-	-	-	-	-
Comb 9a+9b POX Pulp	715	1.43	2998.8	2335.4	2131	1.0961	2425	516.3	341.2	33.9	green	red	fast	11.4%	670	1.41
Comb 9a+9b POX Pulp Filtered			1471.4	1171.5	1069	1.0961	1186	259.0	171.2	33.9	green	red	fast	11.6%	670	1.41
Comb 9a+9b POX Pulp for Hot Cure			1461.8	1163.9	1062	1.0961	1178	257.3	170.1	33.9	green	red	fast	11.6%	670	1.41

denotes calculated value
denotes calculated value

Final Sample Filtration:

Diameter of filtration paper: mm
 type of paper (Whatman ##):
 Filtration time: min
 Washing time:
 Volume of wash: mL
 Cake thickness: cm

Clarity of filtrate: clear
 Colour of filtrate: green
 Clarity of wash: clear
 Colour of wash: light green
 Colour of residue: red

% Moisture:
 % Weightloss:

Temp of POX 9a Pulp:	83.2	°C
Temp of POX 9b Pulp:	85.5	°C
Temp of POX 9a + 9b Pulp:	54.8	°C
Temp of POX PLS:	38.7	°C
Note: Frothed through off gas system		
Condensate = 69.4 g		

Hot Cure Data:

POX pulp weight for Hot Cure: 1461.8 g wt. not transferred to Hot Cure 0.0 g POX Residue to HC: 170.1 g

Time	Time mins	Temp	pH	ORP	Observations
9:43	0	60	1.43	715	Back in Mantle
9:54	0	95			Start Test
10:54	60	95			
11:54	120	94			
12:54	180	96			
13:54	240	95	1.06	687	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	687	1.06	192.1	157.8	140	1.1237	155	27.6	18.3	33.7	dk grn	orange	fast	9.5%	514	1.65
Comb HC Pulp	687	1.06	1449.0	1186.4	1056	1.1237	1167	212.6	138.0	35.1	dk grn	orange	fast	9.5%	514	1.65
HC Pulp After Sample	687	1.06	1256.9	1028.6	915	1.1237	1012	185.0	119.7	35.3	dk grn	orange	fast	9.5%	514	1.65

Temp of Hot Cure 240 min Pulp:	81.7 °C
Temp of Hot Cure 240 min PLS:	48.5 °C
Notes:	

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
Blend of BL 801-2	400	25.2		3640	13.2	7330	33700	23.0	22.2			13.7	60	< 0.05	0.15	
90 min PLS	1186	9380	85	384	2140	15	4450				98400		0.49			32800 66

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ²⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
240 min Filtrat	1167	16200	2200	418	4320	7	5010				111900		< 0.6			
240 min Resid	138	18.4		1630	14.6	9450	7660	4.49	0.20	12.9			71			37300 55
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP								
Final HC		43%		68%	20%	1%	85%	99.7% % Sulphide oxidation based on HC residue								

14.7 % Weight loss Overall
 18.8 % Hot Cure Weight loss Overall

Weight for CIL: 119.7 g

POX Feed Eq.: 140.4 g

Project: 18988-01
Client:

Date: May 6, 2022
Technologist: Chris Silva

Test: POX-10a

Purpose: To conduct a POX test on a blend of BL 801 Bulk Conc 1 and BL 801 Bulk Conc 2 i to produce enough feed for downstream testing.

Sample: 100 g of BL 801 Bulk Conc. 1 and 100 g of BL 801 Bulk Conc. 2

Target K80: - μm
Actual K80: 27.5 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 100 g each of BL 801 Bulk Conc. 1 and BL 801 Bulk Conc. 2 (dry equivalent) was added to the mixture.
 13.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once the pulp was at 95°C it was then held for 240 minutes.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 10b.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then sent to SSW.

Analysis: POX PLS: -
 POX Residue: -

Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), $\text{S}^{=}$, Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	200.0
Feed Weight Wet Req'd (g):	200.0
H ₂ O Weight Added:	1300
H ₂ O Weight Req'd (g):	1300
Pre-acidulation H ₂ SO ₄ added (g):	0.000
2 g /L Fe ³⁺ added as Fe ₂ (SO ₄) ₃ ·9H ₂ O (g):	13.08
Total Pulp Weight with reagents (g):	1513 (Actual Pulp weight)
Pulp Density (% solids w/w):	13.2 (w/w)
Temperature (°C):	220
O ₂ Over Pressure (psi):	100
Time (at temperature) (min):	90

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H ₂ SO ₄ Add'n (g)	H ₂ SO ₄ Add'n (Cum g)	Observations
5:10	0	19.5	7.14	-97		0	Add Feed
5:10	0	19.5	4.67	248		0	Ad Fe
5:18	0	22.2	2.01	385		0	Add Acid, froths
5:23	5	22.2	2.00	372		0	froths
5:28	10	22.2	1.99	364		0	froths
5:33	15	22.2	1.98	350	18.818	18.818	froths
						94.1	kg/t H ₂ SO ₄ Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:50		22		-	-	-				Start Heat
6:41	0.0	221	427	328	99	0				Start test
6:51	10.0	220	429	322	107	77	31.4	72	250	Operating with Cooling Pulse
7:01	10.0	221	429	328	101	93	62.5	92	300	
7:11	10.0	220	430	322	108	100	94.1	92	200	
7:21	10.0	219	432	315	117	107	112.2	92	300	
7:31	10.0	220	431	322	109	100	118.0	92	250	
7:41	10.0	218	430	309	121	111	120.5	92	200	
7:51	10.0	220	423	322	101	93	124.9	92	250	
8:01	10.0	219	426	315	111	102	128.4	92	300	
8:11	10.0	221	436	328	108	99	133.8	92	250	
8:12		217								
8:17		140								
8:22		95								
AVG. 0:240	90	220	430	320	109	98	134	90	256	

Note:

Condensate = 45.3 g

Hot Cure Data:

POX pulp weight for Hot Cure: 1513.1 g wt. not transferred to Hot Cure 0.0 g POX Residue to HC: #REF! g

Time	Time mins	Temp	pH	ORP	Observations
8:22	0	95			Start Test
9:22	60	95			
10:22	120	95			
11:22	180	94			
12:22	240	96	1.38	680	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS dk grn	Residue yellow			ORP	pH
HC Pulp Sample	680	1.38	215.9	179.8	160	1.1206	175	29.1	19.8	32.0	dk grn	yellow	med	9.2%	611	1.51
HC 10a Pulp	677	1.36	1552.7	1303.1	1163	1.1206	1259	-	142.4	-	-	-	-	9.2%	-	-
HC 10b Pulp	707	1.41	1544.2	1296.0	1157	1.1206	1252	-	141.6	-	-	-	-	9.2%	-	-
Comb HC Pulp	680	1.38	3096.9	2599.1	2319	1.1206	2510	418.1	284.0	32.1	dk grn	yellow	med	9.2%	611	1.51
HC Pulp After Sample	680	1.38	2881.0	2419.3	2159	1.1206	2335	389.0	264.2	32.1	dk grn	yellow	med	9.2%	611	1.51

Temp of Hot Cure 10a 240 min Pulp:	51.1 °C
Temp of Hot Cure 10b 240 min Pulp:	53.0 °C
Temp of Hot Cure 10a + 10b 240 min Pulp:	47.4 °C
Temp of Hot Cure 10a + 10b 240 min PLS:	26.8 °C

Notes: Some scale at interface, thicker by cooling coils

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)														S Bromine	FA, g/L H ₂ SO ₄									
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC											
Conc 1	200	30.8			20.6			27.3	27.0			25.5	41.0													
Conc 2	200	28.4			18.0			23.7	23.0			20.7	40.6													
240 min Filtrat	2510	13100	204	160	6470	10	7490	3.49	0.64	8.6	109200	22.3	< 0.4			36400	71									
240 min Resid	284	25.2		523	20.9	28300	13400																			
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP																		
Final HC		31%		73%	21%	0%	83%	98.2% % Sulphide oxidation based on HC residue																		

29.0 % Weight loss Overall

Weight for CIL: 264.2 g

POX Feed Eq.: 372.1 g

Project: 18988-01
Client:

Date: May 6, 2022
Technologist: Chris Silva

Test: POX-10b

Purpose: To conduct a POX test on a blend of BL 801 Bulk Conc 1 and BL 801 Bulk Conc 2 i to produce enough feed for downstream testing.

Sample: 100 g of BL 801 Bulk Conc. 1 and 100 g of BL 801 Bulk Conc. 2

Target K80: - μm
Actual K80: 27.5 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 100 g each of BL 801 Bulk Conc. 1 and BL 801 Bulk Conc. 2 (dry equivalent) was added to the mixture.
 13.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.

Once the sample was at temperature 100 psi oxygen over pressure was applied.

An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once the pulp was at 95°C it was then held for 240 minutes.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 10a.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then sent to SSW.

Analysis: POX PLS: -
 POX Residue: -

Hot Cure PLS: Fe, Fe^{2+} , As, ICP Scan and S
 Hot Cure Residue: S(t), $\text{S}^{=}$, Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	200.0
Feed Weight Wet Req'd (g):	200.0
H_2O Weight Added:	1300
H_2O Weight Req'd (g):	1300
Pre-acidulation H_2SO_4 added (g):	0.000
2 g /L Fe^{3+} added as $\text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$ (g):	13.08
Total Pulp Weight with reagents (g):	1513 (Actual Pulp weight)
Pulp Density (% solids w/w):	13.2 (w/w)
Temperature (°C):	220
O_2 Over Pressure (psi):	100
Time (at temperature) (min):	90

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H_2SO_4 Add'n (g)	H_2SO_4 Add'n (Cum g)	Observations
5:15	0	18.2	6.95	-140		0	Add Feed
5:15	0	18.2	4.26	239		0	Ad Fe
5:23	0	20.0	2.01	335		0	Add Acid, froths
5:28	5	20.1	1.95	314		0	froths
5:33	10	20.1	1.95	294		0	froths
5:38	15	20.1	1.96	281	10.384	10.384	froths
						51.9	kg/t H_2SO_4 Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
5:52		20		-	-	-				Start Heat
6:55	0.0	220	422	322	100	0				Start test
7:05	10.0	221	424	328	96	86		90	250	Operating with Cooling Pulse
7:15	10.0	220	436	322	114	110		96	250	
7:25	10.0	219	436	315	121	116		96	250	
7:35	10.0	220	442	322	120	115		96	250	
7:45	10.0	220	443	322	121	116		96	300	
7:55	10.0	219	440	315	125	120		96	200	
8:05	10.0	220	441	322	119	114		96	250	
8:15	10.0	220	442	322	120	115		96	300	
8:25	10.0	220	443	322	121	116		96	300	
8:26		219								
8:30		140								
8:33		95								
AVG. 0:240	90	220	439	321	117	112	0	95	261	

Note:

Condensate = 65.0 g

Hot Cure Data:

POX pulp weight for Hot Cure: 1513.1 g wt. not transferred to Hot Cure 0.0 g POX Residue to HC: #REF! g

Time	Time mins	Temp	pH	ORP	Observations
8:33	0	95			Start Test
9:33	60	96			
10:33	120	94			
11:33	180	96			
12:33	240	96	1.38	680	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	680	1.38	215.9	179.8	160	1.1206	175	29.1	19.8	32.0	dk grn	yellow	med	9.2%	611	1.51
HC 10a Pulp	677	1.36	1552.7	1303.1	1163	1.1206	1259	-	142.4	-	-	-	-	9.2%	-	-
HC 10b Pulp	707	1.41	1544.2	1296.0	1157	1.1206	1252	-	141.6	-	-	-	-	9.2%	-	-
Comb HC Pulp	680	1.38	3096.9	2599.1	2319	1.1206	2510	418.1	284.0	32.1	dk grn	yellow	med	9.2%	611	1.51
HC Pulp After Sample	680	1.38	2881.0	2419.3	2159	1.1206	2335	389.0	264.2	32.1	dk grn	yellow	med	9.2%	611	1.51

Temp of Hot Cure 10a 240 min Pulp:	51.1 °C
Temp of Hot Cure 10b 240 min Pulp:	53.0 °C
Temp of Hot Cure 10a + 10b 240 min Pulp:	47.4 °C
Temp of Hot Cure 10a + 10b 240 min PLS:	26.8 °C

Notes: Some scale at interface, thicker by cooling coils

Metallurgical Balance Hot Cure

Metallurgical Balance For Core																	
Product	Amount (mL, g)	Assay (mg/L, % g/t)														S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC		
Conc 1	200	30.8		1350	20.6			27.3	27.0			25.5	41.0				
Conc 2	200	28.4			18.0			23.7	23.0			20.7	40.6				
240 min Filtrate	2510	13100	204	160	6470	10	7490				0		< 0.4			71	
240 min Residue	284	25.2		523	20.9	28300	13400	3.49	0.64	8.6		22.3	54				
Dissolution		Fe		Cu	As	Pb	Zn	†SO ₄ in solution calculated from S by bromine ICP									
Final HC		31%		73%	21%	0%	83%	98.2% % Sulphide oxidation based on HC residue									

29.0 % Weight loss Overall

Weight for CIL: 264.2 g

POX Feed Eq.: 372.1 g

Project: 18988-01
Client:

Date:
Technologist: Chris Silva

Test: POX-11a

Purpose: To conduct a POX test on a blend of BL 801-24 Final Tails and BL 801-25 Final Tails in duplicate to produce enough feed for downstream testing.

Sample: Blend of BL 801-24 Final Tails and BL 801-25 Final Tails

Target K80:

-

 μm
Actual K80:

20.6

 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 200 g of a blend of BL 801-24 Final Tails and BL 801-25 Final Tails (dry equivalent) was added to the mixture.
 13.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once the pulp was at 95°C it was then held for 240 minutes.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 11b.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split into 2 halves and each half ground to a target of 15 μm .

The residue was then sent to Environmental Technologies in BC.

Analysis: POX PLS: - Hot Cure PLS: Fe, Fe²⁺, As, ICP Scan and S
 POX Residue: - Hot Cure Residue: S(t), S²⁻, Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	200.0
Feed Weight Wet Req'd (g):	200.0
H ₂ O Weight Added:	1300
H ₂ O Weight Req'd (g):	1300
Pre-acidulation H ₂ SO ₄ added (g):	0.000
2 g /L Fe ³⁺ added as Fe ₂ (SO ₄) ₃ ·9H ₂ O (g):	13.08
Total Pulp Weight with reagents (g):	1513 (Actual Pulp weight)
Pulp Density (% solids w/w):	13.2 (w/w)
Temperature (°C):	220
O ₂ Over Pressure (psi):	100
Time (at temperature) (min):	90

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H ₂ SO ₄ Add'n (g)	H ₂ SO ₄ Add'n (Cum g)	Observations
5:50	0	19.4	7.36	-85		0	Add Feed
5:50	0	19.4	4.37	258		0	Ad Fe
6:05	0	22.8	2.01	410		0	Add Acid, froths
6:10	5	22.8	2.00	395		0	
6:15	10	22.8	2.00	386		0	
6:25	15	22.8	2.01	382	22.912	22.912	
						114.6	kg/t H ₂ SO ₄ Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
6:36		23		-	-	-				Start Heat
7:30	0.0	220	428	322	106	0				Start test
7:40	10.0	221	429	328	101	81	25.3	80	250	Operating with Cooling Pulse
7:50	10.0	220	432	322	110	106	53.1	96	250	
8:00	10.0	219	432	315	117	112	80.5	96	200	
8:10	10.0	216	432	297	135	130	99.0	96	250	
8:20	10.0	220	434	322	112	108	103.1	96	200	
8:30	10.0	221	422	328	94	90	108.1	96	200	
8:40	10.0	220	437	322	115	111	112.6	96	300	
8:50	10.0	219	434	315	119	114	118.1	96	250	
9:00	10.0	220	436	322	114	110	122.6	96	250	
9:01		218								
9:06		140								
9:11		95								
AVG. 0:240	90	220	432	319	113	107	123	94	239	

Note:

Condensate = 79.1 g

Hot Cure Data:

POX pulp weight for Hot Cure: 1513.1 g wt. not transferred to Hot Cure #REF! g POX Residue to HC: #REF! g

Time	Time mins	Temp	pH	ORP	Observations
9:11	0	95			Start Test
10:11	60	95			
11:11	120	96			
12:11	180	94			
13:11	240	96	1.13	632	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	632	1.13	219.0	183.2	164	1.1159	179	29.7	19.6	34.0	green	orange	med	8.9%	583	1.14
HC 11a Pulp	656	1.19	1499.3	1249.5	1120	1.1159	1223	-	134.2	-	-	-	-	8.9%	-	-
HC 11b Pulp	628	1.17	1536.1	1280.1	1147	1.1159	1253	-	137.5	-	-	-	-	8.9%	-	-
Comb HC Pulp	632	1.13	3035.4	2529.6	2267	1.1159	2477	405.4	271.7	33.0	green	orange	med	8.9%	583	1.14
HC Pulp After Sample	632	1.13	2816.4	2346.4	2103	1.1159	2298	375.7	252.1	32.9	green	orange	med	8.9%	583	1.14

Temp of Hot Cure 11a 240 min Pulp:	53.3 °C
Temp of Hot Cure 11b 240 min Pulp:	53.9 °C
Temp of Hot Cure 11a + 11b 240 min Pulp:	49.2 °C
Temp of Hot Cure 11a + 11b 240 min PLS:	32.3 °C

Notes:

Metallurgical Balance Hot Cure

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
Blend of BL 801-2	400	25.2		3640	13.2	7330	33700	23.0	22.2			13.7	60	< 0.05	0.15	
240 min Filtrate	2477	19100	615	392	3910	12	4530				106500		0.37			
240 min Residue	272	18.0		1660	14.6	9430	8270	4.26	0.17	12.3		16.8	73			35500
Dissolution		Fe		Cu	As	Pb	Zn	99.5% % Sulphide oxidation based on HC residue								
Final HC		49%		68%	20%	1%	83%									

†SO₄ in solution calculated from S by bromine ICP

32.1 % Weight loss Overall

Weight for CIL: 252.1 g

POX Feed Eq.: 371.1 g

Project: 18988-01
Client:

Date:
Technologist: Chris Silva

Test: POX-11b

Purpose: To conduct a POX test on a blend of BL 801-24 Final Tails and BL 801-25 Final Tails in duplicate to produce enough feed for downstream testing.

Sample: Blend of BL 801-24 Final Tails and BL 801-25 Final Tails

Target K80:

-

 μm
Actual K80:

20.6

 μm
 (Screen + Malvern)

H&S: Review MSDS for H_2SO_4

Procedure: The target amount of R.O. water was weighed out in a 2 L titanium vessel less 100 g.
 200 g of a blend of BL 801-24 Final Tails and BL 801-25 Final Tails (dry equivalent) was added to the mixture.
 13.08 g Ferric Sulphate was then added to the mixture.
 The pH was then adjusted with concentrated sulphuric acid to pH 2 and held for 15 minutes.
 The pH and ORP was recorded during the 15 minutes.

After 15 minutes the vessel was sealed and heat up begun.
 Once the sample was at temperature 100 psi oxygen over pressure was applied.
 An off gas bleed was started once at temperature and pressure.

At the end of the 90 mins the pulp was cooled to 95°C.

Once the pulp was at 95°C it was then held for 240 minutes.

After 240 minutes (4 Hours) the vessel was removed from the heating mantle.

The pulp was then combined with the Hot Cure pulp from 11a.

The Combined pulp was agitated by an overhead mixer the pH and ORP measured and a sample (~150 mL) removed.

The 240 min sample (150 mL) was filtered and the residue washed with 1 x 50 mL pH 2 sulphuric acid deionized water.

The residue was then further displacement washed 3 x 50 mL's with deionized water.

The remaining pulp was then filtered and the residue washed with 100 mL of pH 2 water.

The residue was then further displacement washed with 3 x 250 mL of D.I.

The residue was then split into 2 halves and each half ground to a target of 15 μm .

The residue was then sent to Environmental Technologies in BC.

Analysis: POX PLS: - Hot Cure PLS: Fe, Fe²⁺, As, ICP Scan and S
 POX Residue: - Hot Cure Residue: S(t), S²⁻, Fe, As and ICP Scan

Conditions:

Feed Moisture (%):	0.00
Target Pulp Density (%):	10.0
Feed Weight (dry equiv.) (g):	200.0
Feed Weight Wet Req'd (g):	200.0
H ₂ O Weight Added:	1300
H ₂ O Weight Req'd (g):	1300
Pre-acidulation H ₂ SO ₄ added (g):	0.000
2 g /L Fe ³⁺ added as Fe ₂ (SO ₄) ₃ ·9H ₂ O (g):	13.08
Total Pulp Weight with reagents (g):	1513 (Actual Pulp weight)
Pulp Density (% solids w/w):	13.2 (w/w)
Temperature (°C):	220
O ₂ Over Pressure (psi):	100
Time (at temperature) (min):	90

Total = 422 psi

Acidulation Data:

Time	Time (mins)	Temp (°C)	pH (units)	ORP (mV)	H ₂ SO ₄ Add'n (g)	H ₂ SO ₄ Add'n (Cum g)	Observations
5:55	0	18.4	7.39	-137		0	Add Feed
5:55	0	18.4	4.22	237		0	Ad Fe
6:10	0	21.4	1.95	366		0	Add Acid, froths
6:15	5	21.4	1.96	354		0	
6:20	10	21.3	1.95	346		0	
6:25	15	21.2	1.95	334	20.034	20.034	
						100.2	kg/t H ₂ SO ₄ Addition

Autoclave Leach Data:

Elapsed Time min	D time	Temp °C	Pressure (psi)				Off-Gas			Remarks
			Total	Steam	Over	O ₂	O ₂ Total	O ₂	O ₂	
			meas	calculated			L	%	Flow	
6:41		21		-	-	-				Start Heat
7:43	0.0	220	408	322	86	0				Start test
7:53	10.0	221	425	328	97	83		86	250	Operating with Cooling Pulse
8:03	10.0	220	440	322	118	114		96	300	
8:13	10.0	217	449	303	146	140		96	250	
8:23	10.0	219	439	315	124	119		96	250	
8:33	10.0	221	447	328	119	114		96	300	
8:43	10.0	221	434	328	106	102		96	250	
8:53	10.0	219	438	315	123	118		96	200	
9:03	10.0	221	439	328	111	106		96	300	
9:13	10.0	219	442	315	127	124		98	250	
9:14		219								
9:17		140								
9:20		95								
AVG. 0:240	90	220	439	320	119	113	0	95	261	

Note:

Condensate = 56.6 g

Hot Cure Data:

POX pulp weight for Hot Cure: 1513.1 g wt. not transferred to Hot Cure #REF! g POX Residue to HC: #REF! g

Time	Time mins	Temp	pH	ORP	Observations
9:20	0	95			Start Test
10:20	60	94			
11:20	120	95			
12:20	180	96			
13:20	240	94	1.13	632	End Test, Sample, Filter
		95			

Sampling Data:

Sample #	Pulp		Weights		Volume PLS, mL	SG g/mL	Calc PLS Vol, mL	Wet res, g	Dry res, g	%H ₂ O	Colours		Filtration fst /slw	Pulp % solids	PLS	
	ORP	pH	pulp, g	PLS, g							PLS	Residue			ORP	pH
HC Pulp Sample	632	1.13	219.0	183.2	164	1.1159	179	29.7	19.6	34.0	green	orange	med	8.9%	583	1.14
HC 11a Pulp	656	1.19	1499.3	1249.5	1120	1.1159	1223	-	134.2	-	-	-	-	8.9%	-	-
HC 11b Pulp	628	1.17	1536.1	1280.1	1147	1.1159	1253	-	137.5	-	-	-	-	8.9%	-	-
Comb HC Pulp	632	1.13	3035.4	2529.6	2267	1.1159	2477	405.4	271.7	33.0	green	orange	med	8.9%	583	1.14
HC Pulp After Sample	632	1.13	2816.4	2346.4	2103	1.1159	2298	375.7	252.1	32.9	green	orange	med	8.9%	583	1.14

Temp of Hot Cure 11a 240 min Pulp:	53.3	°C
Temp of Hot Cure 11b 240 min Pulp:	53.9	°C
Temp of Hot Cure 11a + 11b 240 min Pulp:	49.2	°C
Temp of Hot Cure 11a + 11b 240 min PLS:	32.3	°C

Notes:

Metallurgical Balance POX

Product	Amount (mL, g)	Assay (mg/L, % g/t)													S Bromine	FA, g/L H ₂ SO ₄
		Fe	Fe ²⁺	Cu	As	Pb	Zn	S	S ⁻	SO ₄	SO ₄ ⁺	Au	Ag	C (g)	TOC	
Blend of BL 801-2	400	25.2		3640	13.2	7330	33700	23.0	22.2			13.7	60	< 0.05	0.15	
240 min Filtrate	2477	19100	615	392	3910	12	4530				106500		0.37			
240 min Residue	272	18.0		1660	14.6	9430	8270	4.26	0.17	12.3		16.8	73			35500
Dissolution		Fe		Cu	As	Pb	Zn	99.5% % Sulphide oxidation based on HC residue								
Final HC		49%		68%	20%	1%	83%									

*SO₄ in solution calculated from S by bromine ICP

32.1 % Weight loss Overall

Weight for CIL: 252.1 g

POX Feed Eq.: 371.1 g

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 mm	Pre-acid pH Target	Acid Add'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.
POX 9	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2.0	107	220	90

Test	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas	POX Pulp pH units	POX Pulp ORP mV	POX PLS pH units	POX PLS ORP mV	POX PLS FAT g/L H ₂ SO ₄
POX 9	220	432	263	96	1.20	831	1.41	670	66.2

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 9	BL 801-24 Final Tails + BL 801-25 Final Tails	4	95.0	1.06	687	1.65	514	55.2	orange

Test	POX PLS Fe mg/L	POX PLS As mg/L	POX PLS S by Bromine mg/L	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 9	9380	2140	32800	16200	4320	37300	18.4	14.6	71	0.20	99.7	33.5

Test	Feed	LB, CN / CIL Test Number	Feed	Ground for CN	Oxygen / Air Sparging	Size K80 mm	Reagent Addition kg/t of Cyanide Feed		Reagent Consumption kg/t of Cyanide Feed		Final Free CN mg/L
POX 9a + POX 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-11	POX 9a + 9b	Yes	Oxygen	12.24	68.2	41.9	47.1	41.9	1150
POX 9a + POX 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-12	POX 9a + 9b	Yes	Air	12.73	78.7	38.0	65.3	38.0	741
HC 9a + HC 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-13	HC 9a +9b	Yes	Oxygen	13.03	33.4	6.1	8.8	5.8	1398
HC 9a + HC 9b Residue	BL 801-24 +BL 801-25 Final Tails	CN-14	HC 9a +9b	Yes	Air	13.24	39.9	6.0	17.1	6.0	1365

Test	LB, CN / CIL Test Number	Au Assay mg/L	Residue Au Assay g/t	Barren /PLS Ag Assay mg/L	Residue Ag Assay g/t	Au Extraction %	Ag Extraction %	Calc Head Au	Calc Head Ag	Direct Head Au	Direct Head Ag
POX 9a + POX 9b Residue	CN-11	1.42	0.19	1.42	46.2	98.8	24.6	15.3	61.3	13.7	60
POX 9a + POX 9b Residue	CN-12	1.46	0.21	1.46	49.1	98.6	23.7	15.4	64.3	13.7	60
HC 9a + HC 9b Residue	CN-13	1.74	0.38	1.74	78.8	98.0	18.8	18.7	97.1	13.7	60
HC 9a + HC 9b Residue	CN-14	1.83	0.33	1.83	58.1	98.3	24.0	18.7	76.4	13.7	60

Test	Feed	Pulp Density % solids w/w	Ground for POX	Feed K80 µm	Pre-acid pH Target	Acid Addi'n H ₂ SO ₄ kg/t	POX Temp. °C	POX Time at Temp. mins.	POX Average Temp. °C	POX Average Total psi	POX Average off gas flow mL/min	POX Average O ₂ % in offgas
POX 10a	Blend of Bulk Conc. 1 and Bulk Conc. 2	13.2	No	27.5	2	94	220	90	220	430	256	90
POX 10b	Blend of Bulk Conc. 1 and Bulk Conc. 2	13.2	No	27.5	2	52	220	90	220	439	261	95
POX 11a	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2	115	220	90	220	432	239	94
POX 11b	BL 801-24 Final Tails + BL 801-25 Final Tails	13.2	No	20.6	2	100	220	90	220	439	261	95

Test	Feed	Hot Cure Time at Temp. hours	Hot Cure Average Temp.	Hot Cure Pulp pH units	Hot Cure Pulp ORP mV	Hot Cure PLS pH units	Hot Cure PLS ORP mV	Hot Cure PLS FAT g/L H ₂ SO ₄	Hot Cure Residue Colour
POX 10a	Blend of Bulk Conc. 1 and Bulk Conc. 2	4	95.0	1.36	677	-	-	-	-
POX 10b	Blend of Bulk Conc. 1 and Bulk Conc. 2	4	95.4	1.41	707	-	-	-	-
	Hot Cure 10a + 10b Combined	-	-	1.38	680	1.51	611	71.3	yellow
POX 11a	BL 801-24 Final Tails + BL 801-25 Final Tails	4	95.2	1.19	656	-	-	-	-
POX 11b	BL 801-24 Final Tails + BL 801-25 Final Tails	4	94.8	1.17	628	-	-	-	-
	Hot Cure 11a + 11b Combined	-	-	1.13	632	1.14	583	50.9	orange

Test	HC PLS Fe mg/L	HC PLS As mg/L	HC PLS S by Bromine mg/L	Hot Cure Residue Fe %	Hot Cure Residue As %	Hot Cure Residue Ag %	Hot Cure Residue S ⁼ %	Hot Cure Residue S ⁼ Oxd'n %	Weightloss % Overall
POX 10a	-	-	-	-	-	-	-	-	-
POX 10b	-	-	-	-	-	-	-	-	-
HC 10a + 10b Comb	13100	6470	36400	25.2	20.9	54	0.64	98.2	29.0
POX 11a	-	-	-	-	-	-	-	-	-
POX 11b	-	-	-	-	-	-	-	-	-
HC 11a + 11b Comb	19100	3910	35500	18.0	14.6	73	0.17	99.5	32.1

Result Analysis Report

Sample Name:
18988-01 Comb. HC 11a+11b Residue

SOP Name:
Defaultar

Measured:
May-10-22 7:46:35 AM

Sample Source & type:

Measured by:
lr_malvern1

Analysed:
May-10-22 7:46:37 AM

Sample bulk lot ref:

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
14.69 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
1.231 %

Result Emulation:
Off

Concentration:
0.0092 %Vol

Span :
2.419

Uniformity:
0.782

Result units:
Volume

Specific Surface Area:
1.74 m^2/g

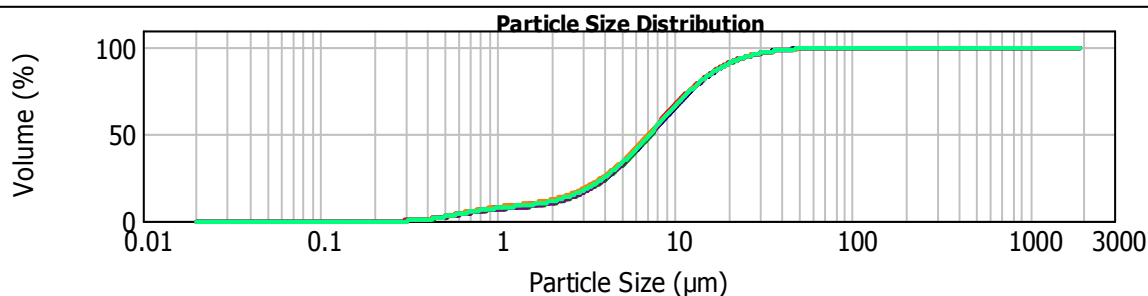
Surface Weighted Mean D[3,2]:
3.442 μm

Vol. Weighted Mean D[4,3]:
9.455 μm

d(0.1): 1.726 μm

d(0.5): 7.197 μm

d(0.8): 13.720 μm



- 18988-01 HC 11a+11b Residue Grind 1 - Average, May-10-22 7:02:31 AM
- 18988-01 HC 11a+11b Residue Grind 0.8 mins, May-10-22 7:33:39 AM
- 18988-01 HC 11a+11b Residue Grind 0.8 mins, May-10-22 7:34:56 AM
- 18988-01 HC 11a+11b Residue Grind 0.8 mins - Average, May-10-22 7:33:39 AM
- 18988-01 Comb. HC 11a+11b Residue Grinds, May-10-22 7:46:35 AM
- 18988-01 Comb. HC 11a+11b Residue Grinds, May-10-22 7:47:53 AM
- 18988-01 Comb. HC 11a+11b Residue Grinds - Average, May-10-22 7:46:35 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	7.81	11.482	72.72	120.226	100.00	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	8.41	13.183	78.48	138.038	100.00	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	9.01	15.136	83.46	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	9.75	17.378	87.60	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	10.75	19.953	90.91	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	12.13	22.909	93.48	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	14.01	26.303	95.41	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	16.46	30.200	96.83	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.02	3.311	19.58	34.674	97.86	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.39	3.802	23.42	39.811	98.60	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.03	4.365	28.00	45.709	99.12	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.93	5.012	33.32	52.481	99.47	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	3.00	5.754	39.29	60.256	99.71	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	4.15	6.607	45.79	69.183	99.86	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	5.27	7.586	52.63	79.433	99.94	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	6.27	8.710	59.57	91.201	99.99	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	7.11	10.000	66.35	104.713	100.00	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 HC 11a+11b Residue Grind 1

SOP Name:
Defaultar

Measured:
May-10-22 7:02:31 AM

Sample Source & type:

Measured by:
lr_malvern1

Analysed:
May-10-22 7:02:33 AM

Sample bulk lot ref:
ar

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 um

Obscuration:
15.94 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
1.225 %

Result Emulation:
Off

Concentration:
0.0100 %Vol

Span :
2.437

Uniformity:
0.784

Result units:
Volume

Specific Surface Area:
1.76 m²/g

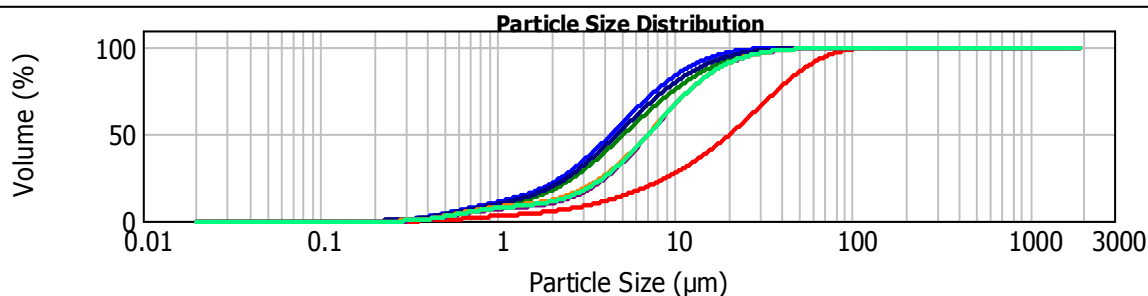
Surface Weighted Mean D[3,2]:
3.414 um

Vol. Weighted Mean D[4,3]:
9.323 um

d(0.1): 1.745 um

d(0.5): 7.061 um

d(0.8): 13.510 um



— 18098-01 CIL 16 Res - Average, May-10-22 6:36:19 AM
— 18098-01 CIL 15 Res, May-10-22 6:49:31 AM
— 18098-01 CIL 15 Res, May-10-22 6:50:48 AM
— 18098-01 CIL 15 Res - Average, May-10-22 6:49:31 AM
— 18988-01 HC 11a+11b Residue Grind 1, May-10-22 7:02:31 AM
— 18988-01 HC 11a+11b Residue Grind 1, May-10-22 7:03:49 AM
— 18988-01 HC 11a+11b Residue Grind 1 - Average, May-10-22 7:02:31 AM

Size (µm)	Vol Under %
0.010	0.00
0.011	0.00
0.013	0.00
0.015	0.00
0.017	0.00
0.020	0.00
0.023	0.00
0.026	0.00
0.030	0.00
0.035	0.00
0.040	0.00
0.046	0.00
0.052	0.00
0.060	0.00
0.069	0.00
0.079	0.00
0.091	0.00

Size (µm)	Vol Under %
0.105	0.00
0.120	0.00
0.138	0.00
0.158	0.00
0.182	0.00
0.209	0.00
0.240	0.00
0.275	0.00
0.316	0.04
0.363	0.41
0.417	1.07
0.479	1.98
0.550	3.06
0.631	4.22
0.724	5.34
0.832	6.34
0.955	7.17

Size (µm)	Vol Under %
1.096	7.84
1.259	8.42
1.445	8.99
1.660	9.69
1.905	10.66
2.188	12.02
2.512	13.91
2.884	16.42
3.311	19.64
3.802	23.62
4.365	28.39
5.012	33.90
5.754	40.06
6.607	46.70
7.586	53.61
8.710	60.55
10.000	67.26

Size (µm)	Vol Under %
11.482	73.50
13.183	79.09
15.136	83.90
17.378	87.90
19.953	91.11
22.909	93.61
26.303	95.51
30.200	96.92
34.674	97.94
39.811	98.67
45.709	99.18
52.481	99.52
60.256	99.74
69.183	99.87
79.433	99.95
91.201	99.99
104.713	100.00

Size (µm)	Vol Under %
120.226	100.00
138.038	100.00
158.489	100.00
181.970	100.00
208.930	100.00
239.883	100.00
275.423	100.00
316.228	100.00
363.078	100.00
416.869	100.00
478.630	100.00
549.541	100.00
630.957	100.00
724.436	100.00
831.764	100.00
954.993	100.00
1096.478	100.00

Size (µm)	Vol Under %
1258.925	100.00
1445.440	100.00
1659.587	100.00
1905.461	100.00
2187.762	100.00
2511.886	100.00
2884.032	100.00
3311.311	100.00
3801.894	100.00
4365.158	100.00
5011.872	100.00
5754.399	100.00
6606.934	100.00
7585.776	100.00
8709.636	100.00
10000.000	100.00

Operator notes:

Result Analysis Report

Sample Name:
18988-01 HC 9 Residue 2.1 min per 120

SOP Name:
Defaultar1

Measured:
May-09-22 8:36:36 AM

Sample Source & type:

Measured by:
lr_malvern1

Analysed:
May-09-22 8:36:38 AM

Sample bulk lot ref:

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
18.45 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
1.351 %

Result Emulation:
Off

Concentration:
0.0101 %Vol

Span :
2.887

Uniformity:
0.946

Result units:
Volume

Specific Surface Area:
2.09 m^2/g

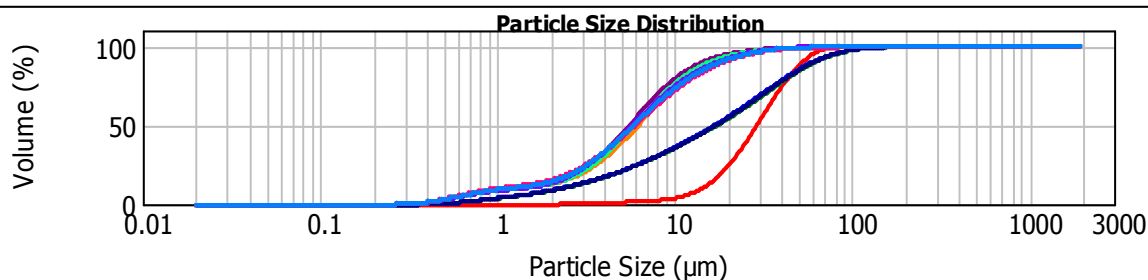
Surface Weighted Mean D[3,2]:
2.871 μm

Vol. Weighted Mean D[4,3]:
8.576 μm

d(0.1): 1.160 μm

d(0.5): 5.824 μm

d(0.8): 12.044 μm



- 17617-01A Moly Con UF - Average, May-06-22 2:16:09 PM
 - 13086-08 LCT-K3 Hi-1 Re grind Disch F , May-06-22 3:12:44 PM
 - 13086-08 LCT-K3 Hi-1 Re grind Disch F , May-06-22 3:14:02 PM
 - 13086-08 LCT-K3 Hi-1 Re grind Disch F - Average, May-06-22 3:12:44 PM
 - 18988-01POX 9 Residue 3.6 min per 171 g, May-09-22 8:03:33 AM
 - 18988-01POX 9 Residue 3.6 min per 171 g, May-09-22 8:04:51 AM
 - 18988-01POX 9 Residue 3.6 min per 171 g - Average, May-09-22 8:03:33 AM
 - 18988-01 HC 9 Residue 2.1 min per 120 g - Average, May-09-22 8:36:36 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	9.70	11.482	78.46	120.226	99.86	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	10.43	13.183	82.70	138.038	99.90	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	11.20	15.136	86.31	158.489	99.93	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	12.20	17.378	89.34	181.970	99.96	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	13.62	19.953	91.85	208.930	99.98	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	15.62	22.909	93.90	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	18.34	26.303	95.55	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.02	2.884	21.83	30.200	96.85	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.16	3.311	26.13	34.674	97.84	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.68	3.802	31.17	39.811	98.57	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.52	4.365	36.85	45.709	99.07	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	2.64	5.012	43.01	52.481	99.39	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	3.96	5.754	49.44	60.256	99.58	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	5.34	6.607	55.91	69.183	99.69	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	6.68	7.586	62.22	79.433	99.75	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	7.88	8.710	68.16	91.201	99.79	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	8.88	10.000	73.61	104.713	99.82	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 HC 11a+11b Residue Grind

Sample Source & type:

Sample bulk lot ref:

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

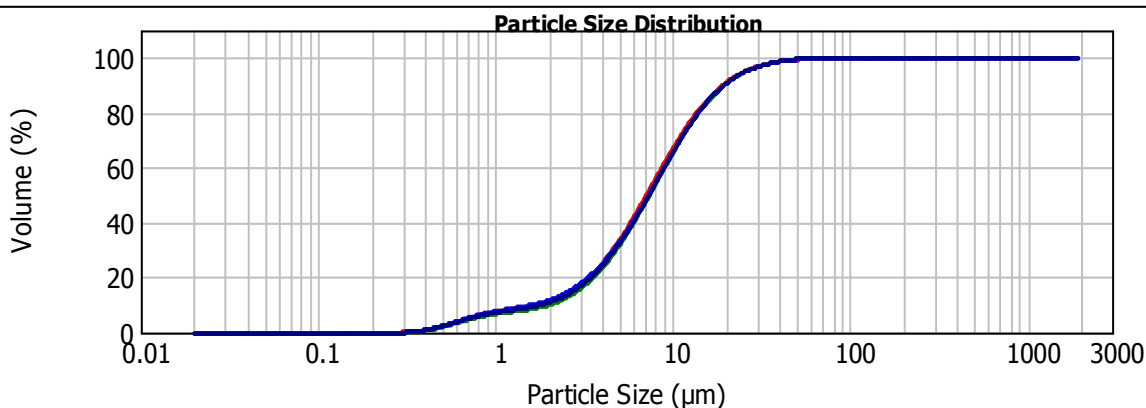
Measured:
May-10-22 7:33:39 AM

Analysed:
May-10-22 7:33:41 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 15.14 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.208 %	Result Emulation: Off

Concentration: 0.0097 %Vol	Span : 2.394	Uniformity: 0.766	Result units: Volume
Specific Surface Area: 1.72 m ² /g	Surface Weighted Mean D[3,2]: 3.498 um	Vol. Weighted Mean D[4,3]: 9.506 um	

d(0.1): 1.793 um **d(0.5): 7.319 um** **d(0.8): 13.882 um**



— 18988-01 HC 11a+11b Residue Grind 1 - Average, May-10-22 7:02:31 AM

— 18988-01 HC 11a+11b Residue Grind 0.8 mins, May-10-22 7:33:39 AM

— 18988-01 HC 11a+11b Residue Grind 0.8 mins, May-10-22 7:34:56 AM

— 18988-01 HC 11a+11b Residue Grind 0.8 mins - Average, May-10-22 7:33:39 AM

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	7.63	11.482	72.14	120.226	100.00	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	8.21	13.183	78.00	138.038	100.00	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	8.79	15.136	83.08	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	9.50	17.378	87.32	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	10.46	19.953	90.73	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	11.80	22.909	93.38	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	13.61	26.303	95.38	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	16.00	30.200	96.87	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.02	3.311	19.03	34.674	97.95	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.38	3.802	22.79	39.811	98.72	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.01	4.365	27.29	45.709	99.26	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.89	5.012	32.53	52.481	99.61	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	2.95	5.754	38.46	60.256	99.83	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	4.07	6.607	44.94	69.183	99.94	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	5.16	7.586	51.80	79.433	99.99	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	6.14	8.710	58.79	91.201	100.00	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	6.96	10.000	65.66	104.713	100.00	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 POX 9 Feed 1 min Grind -

Sample Source & type:

Sample bulk lot ref:
CK

SOP Name:
Defaultar1

Measured by:
lr_malvern1

Result Source:
Averaged

Measured:
May-06-22 6:45:23 AM

Analysed:
May-06-22 6:45:25 AM

Particle Name:
Default

Particle RI:
1.520

Dispersant Name:
Water

Accessory Name:
Hydro 2000G (A)

Absorption:
0.1

Dispersant RI:
1.330

Analysis model:
General purpose

Size range:
0.020 to 2000.000 μm

Weighted Residual:
0.967 %

Sensitivity:
Enhanced

Obscuration:
14.18 %

Result Emulation:
Off

Concentration:
0.0102 %Vol

Span :
2.639

Uniformity:
0.932

Result units:
Volume

Specific Surface Area:
1.32 m^2/g

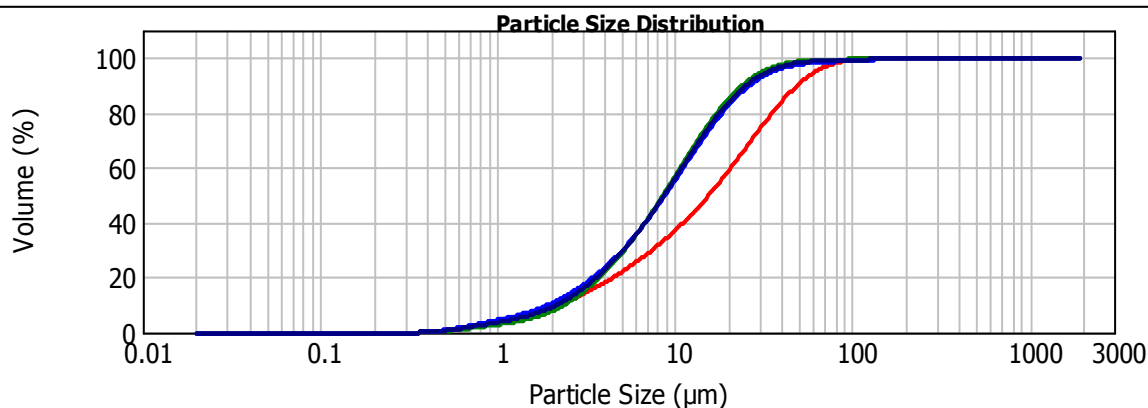
Surface Weighted Mean D[3,2]:
4.535 μm

Vol. Weighted Mean D[4,3]:
12.500 μm

d(0.1): 2.145 μm

d(0.5): 8.666 μm

d(0.8): 17.765 μm



— 13086-08 LCT-K3-Hi-1 Re grind Discharge A - Average, May-06-22 5:33:37 AM
 — 18988-01 POX 9 Feed 1 min Grind, May-06-22 6:45:23 AM
 — 18988-01 POX 9 Feed 1 min Grind, May-06-22 6:46:41 AM
 — 18988-01 POX 9 Feed 1 min Grind - Average, May-06-22 6:45:23 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	4.14	11.482	62.28	120.226	99.41	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	4.93	13.183	68.26	138.038	99.61	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	5.87	15.136	73.96	158.489	99.81	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	7.03	17.378	79.22	181.970	99.94	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	8.48	19.953	83.87	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	10.28	22.909	87.85	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	12.45	26.303	91.10	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	15.01	30.200	93.66	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.00	3.311	17.96	34.674	95.57	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.01	3.802	21.32	39.811	96.94	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.21	4.365	25.09	45.709	97.86	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	0.55	5.012	29.30	52.481	98.44	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	1.00	5.754	33.93	60.256	98.77	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	1.55	6.607	38.99	69.183	98.95	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	2.15	7.586	44.44	79.433	99.06	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	2.78	8.710	50.22	91.201	99.14	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	3.44	10.000	56.21	104.713	99.25	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 POX 9 Feed 2 min Grind -

Sample Source & type:
13086-08

Sample bulk lot ref:
DA

SOP Name:
Defaultar1

Measured by:
lr_malvern1

Result Source:
Averaged

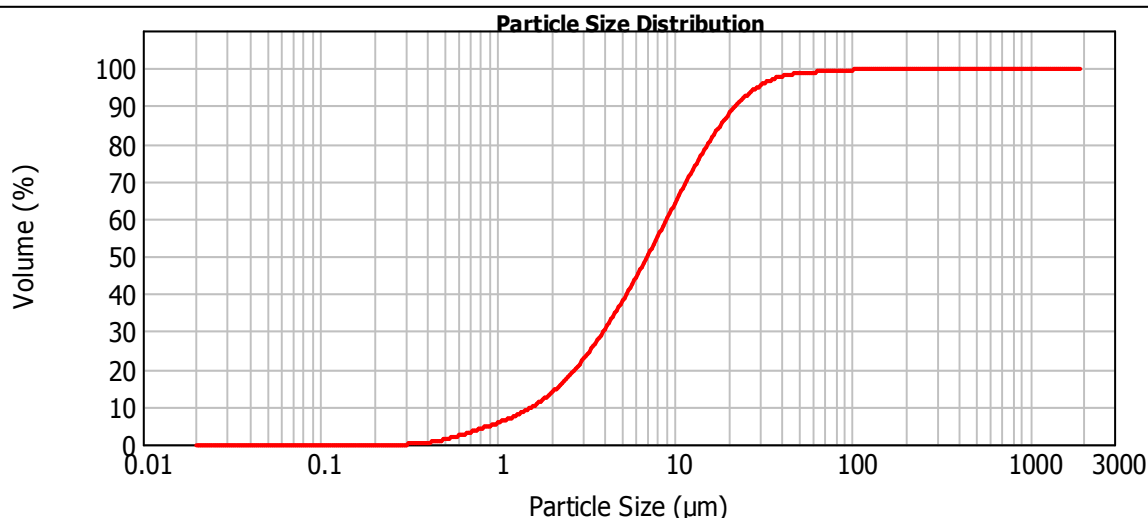
Measured:
May-06-22 8:56:04 AM

Analysed:
May-06-22 8:56:06 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 16.46 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.941 %	Result Emulation: Off

Concentration: 0.0098 %Vol	Span : 2.924	Uniformity: 1	Result units: Volume
Specific Surface Area: 1.68 m ² /g	Surface Weighted Mean D[3,2]: 3.563 um	Vol. Weighted Mean D[4,3]: 10.464 um	

d(0.1): 1.578 um d(0.5): 6.990 um d(0.8): 15.350 um



— 18988-01 POX 9 Feed 2 min Grind - Average, May-06-22 8:56:04 AM

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	6.36	11.482	69.55	120.226	99.79	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	7.55	13.183	74.72	138.038	99.93	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	8.96	15.136	79.53	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	10.65	17.378	83.88	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	12.71	19.953	87.67	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	15.16	22.909	90.85	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	18.01	26.303	93.42	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	21.26	30.200	95.39	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.01	3.311	24.87	34.674	96.82	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.15	3.802	28.84	39.811	97.80	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.51	4.365	33.14	45.709	98.41	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.04	5.012	37.76	52.481	98.77	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	1.72	5.754	42.67	60.256	98.97	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	2.51	6.607	47.83	69.183	99.11	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	3.39	7.586	53.19	79.433	99.25	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	4.31	8.710	58.67	91.201	99.41	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	5.30	10.000	64.16	104.713	99.60	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 POX 9 Feed 3 min Grind -

SOP Name:
Defaultar1

Measured:
May-06-22 7:24:28 AM

Sample Source & type:

Measured by:
lr_malvern1

Analysed:
May-06-22 7:24:30 AM

Sample bulk lot ref:
CK

Result Source:
Averaged

Particle Name:
Default

Accessory Name:
Hydro 2000G (A)

Analysis model:
General purpose

Sensitivity:
Enhanced

Particle RI:
1.520

Absorption:
0.1

Size range:
0.020 to 2000.000 μm

Obscuration:
15.03 %

Dispersant Name:
Water

Dispersant RI:
1.330

Weighted Residual:
0.807 %

Result Emulation:
Off

Concentration:
0.0081 %Vol

Span :
3.030

Uniformity:
1.03

Result units:
Volume

Specific Surface Area:
1.83 m^2/g

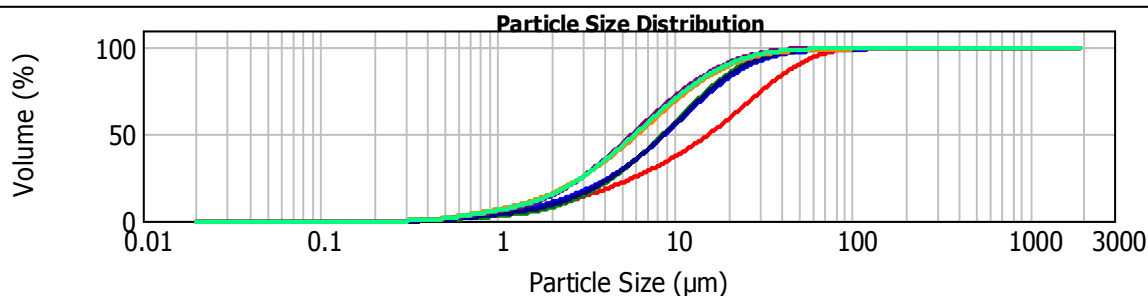
Surface Weighted Mean D[3,2]:
3.281 μm

Vol. Weighted Mean D[4,3]:
9.164 μm

d(0.1): 1.479 μm

d(0.5): 5.928 μm

d(0.8): 13.160 μm



- 13086-08 LCT-K3-Hi-1 Regrind Discharge A - Average, May-06-22 5:33:37 AM
- 18988-01 POX 9 Feed 1 min Grind, May-06-22 6:45:23 AM
- 18988-01 POX 9 Feed 1 min Grind, May-06-22 6:46:41 AM
- 18988-01 POX 9 Feed 1 min Grind - Average, May-06-22 6:45:23 AM
- 18988-01 POX 9 Feed 3 min Grind, May-06-22 7:24:28 AM
- 18988-01 POX 9 Feed 3 min Grind, May-06-22 7:25:45 AM
- 18988-01 POX 9 Feed 3 min Grind - Average, May-06-22 7:24:28 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	6.79	11.482	75.55	120.226	99.76	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	8.12	13.183	80.05	138.038	99.87	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	9.70	15.136	84.07	158.489	99.95	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	11.64	17.378	87.56	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	14.02	19.953	90.51	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	16.88	22.909	92.94	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	20.24	26.303	94.87	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.00	2.884	24.07	30.200	96.36	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.02	3.311	28.35	34.674	97.47	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.17	3.802	33.03	39.811	98.26	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	0.54	4.365	38.05	45.709	98.79	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	1.11	5.012	43.33	52.481	99.12	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	1.82	5.754	48.80	60.256	99.32	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	2.66	6.607	54.38	69.183	99.44	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	3.58	7.586	59.95	79.433	99.51	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	4.57	8.710	65.40	91.201	99.58	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	5.63	10.000	70.64	104.713	99.66	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01POX 9 Residue 3.6 min per

Sample Source & type:

Sample bulk lot ref:

SOP Name:
Defaultar1

Measured by:
lr_malvern1

Result Source:
Averaged

Measured:
May-09-22 8:03:33 AM

Analysed:
May-09-22 8:03:35 AM

Particle Name:
Default

Particle RI:
1.520

Dispersant Name:
Water

Accessory Name:
Hydro 2000G (A)

Absorption:
0.1

Dispersant RI:
1.330

Analysis model:
General purpose

Size range:
0.020 to 2000.000 μm

Weighted Residual:
1.420 %

Sensitivity:
Enhanced

Obscuration:
16.10 %

Result Emulation:
Off

Concentration:
0.0089 %Vol

Span :
2.471

Uniformity:
0.844

Result units:
Volume

Specific Surface Area:
2.05 m^2/g

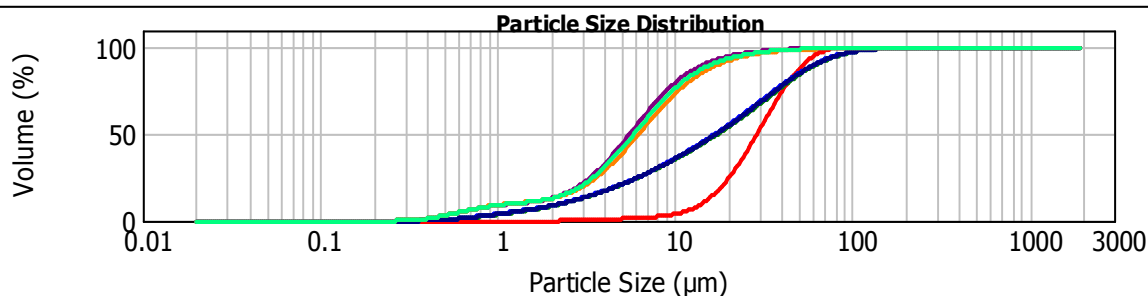
Surface Weighted Mean D[3,2]:
2.932 μm

Vol. Weighted Mean D[4,3]:
8.158 μm

d(0.1): 1.208 μm

d(0.5): 5.852 μm

d(0.8): 10.913 μm



— 17617-01A Moly Con UF - Average, May-06-22 2:16:09 PM
— 13086-08 LCT-K3 Hi-1 Re grind Disch F , May-06-22 3:12:44 PM
— 13086-08 LCT-K3 Hi-1 Re grind Disch F , May-06-22 3:14:02 PM
— 13086-08 LCT-K3 Hi-1 Re grind Disch F - Average, May-06-22 3:12:44 PM
— 18988-01POX 9 Residue 3.6 min per 171 g, May-09-22 8:03:33 AM
— 18988-01POX 9 Residue 3.6 min per 171 g, May-09-22 8:04:51 AM
— 18988-01POX 9 Residue 3.6 min per 171 g - Average, May-09-22 8:03:33 AM

Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	9.58	11.482	81.77	120.226	99.86	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	10.17	13.183	85.96	138.038	99.90	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	10.73	15.136	89.29	158.489	99.94	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	11.42	17.378	91.88	181.970	99.98	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	12.45	19.953	93.86	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	14.00	22.909	95.38	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	16.28	26.303	96.53	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.01	2.884	19.44	30.200	97.42	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.12	3.311	23.59	34.674	98.10	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.62	3.802	28.76	39.811	98.62	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.44	4.365	34.87	45.709	99.01	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	2.56	5.012	41.74	52.481	99.29	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	3.89	5.754	49.09	60.256	99.49	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	5.30	6.607	56.59	69.183	99.63	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	6.66	7.586	63.89	79.433	99.72	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	7.85	8.710	70.66	91.201	99.78	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	8.83	10.000	76.67	104.713	99.83	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Residue - Average

Sample Source & type:
CN 11

Sample bulk lot ref:
KS

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

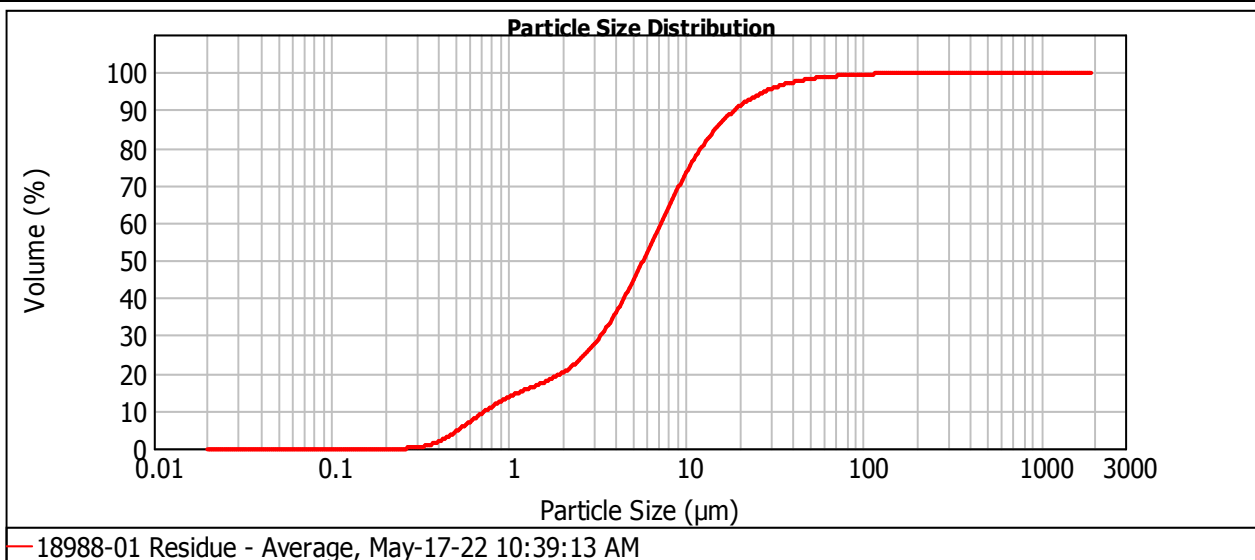
Measured:
May-17-22 10:39:13 AM

Analysed:
May-17-22 10:39:15 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 μm	Obscuration: 14.76 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.617 %	Result Emulation: Off

Concentration: 0.0071 %Vol	Span : 3.158	Uniformity: 1.16	Result units: Volume
Specific Surface Area: 2.51 m^2/g	Surface Weighted Mean D[3,2]: 2.386 μm	Vol. Weighted Mean D[4,3]: 9.334 μm	

d(0.1): 0.746 μm d(0.5): 5.736 μm d(0.8): 12.240 μm



Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %	Size (μm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	14.48	11.482	78.00	120.226	99.60	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	15.66	13.183	82.14	138.038	99.72	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	16.76	15.136	85.64	158.489	99.82	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	17.95	17.378	88.54	181.970	99.90	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	19.37	19.953	90.90	208.930	99.95	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	21.18	22.909	92.81	239.883	99.98	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	23.48	26.303	94.34	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.03	2.884	26.36	30.200	95.57	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.24	3.311	29.89	34.674	96.55	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.97	3.802	34.10	39.811	97.32	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	2.13	4.365	38.94	45.709	97.92	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	3.70	5.012	44.34	52.481	98.37	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	5.56	5.754	50.14	60.256	98.72	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	7.58	6.607	56.15	69.183	98.97	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	9.60	7.586	62.14	79.433	99.16	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	11.46	8.710	67.90	91.201	99.32	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	13.10	10.000	73.23	104.713	99.47	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Residue - Average

Sample Source & type:
CN 12

Sample bulk lot ref:
KS

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

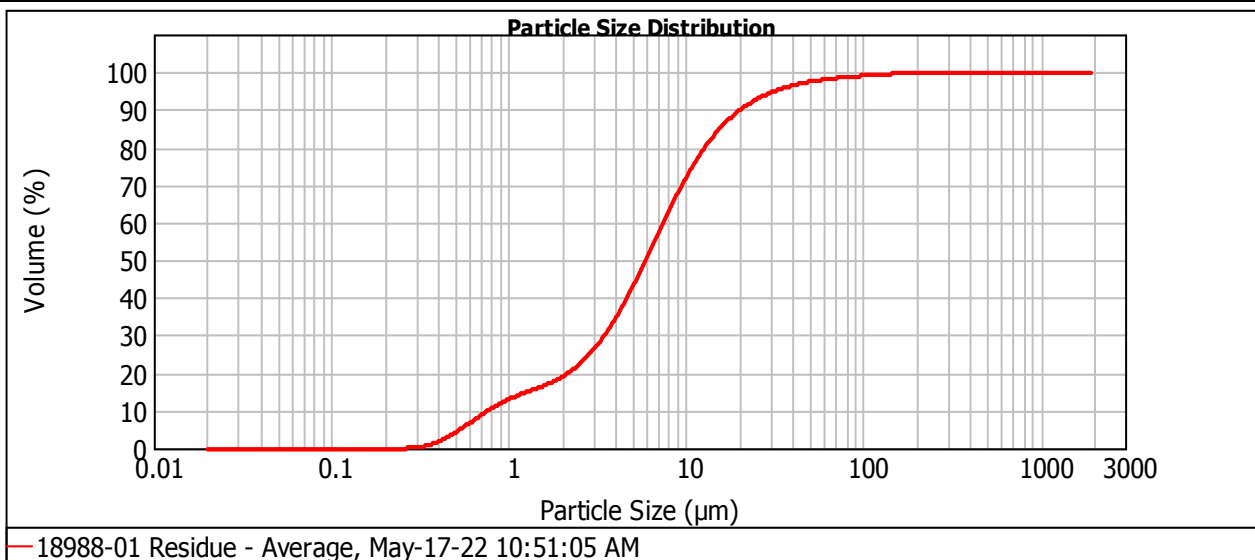
Measured:
May-17-22 10:51:05 AM

Analysed:
May-17-22 10:51:07 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 16.36 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.557 %	Result Emulation: Off

Concentration: 0.0082 %Vol	Span : 3.279	Uniformity: 1.27	Result units: Volume
Specific Surface Area: 2.43 m ² /g	Surface Weighted Mean D[3,2]: 2.465 um	Vol. Weighted Mean D[4,3]: 10.332 um	

d(0.1): 0.768 um **d(0.5): 5.909 um** **d(0.8): 12.732 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	13.81	11.482	76.81	120.226	99.33	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	14.90	13.183	80.99	138.038	99.51	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	15.93	15.136	84.53	158.489	99.66	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	17.03	17.378	87.46	181.970	99.78	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	18.39	19.953	89.85	208.930	99.87	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	20.12	22.909	91.79	239.883	99.94	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	22.36	26.303	93.35	275.423	99.98	2884.032	100.00
0.026	0.00	0.275	0.03	2.884	25.20	30.200	94.61	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.24	3.311	28.69	34.674	95.63	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.95	3.802	32.86	39.811	96.45	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	2.08	4.365	37.68	45.709	97.11	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	3.59	5.012	43.06	52.481	97.63	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	5.38	5.754	48.86	60.256	98.05	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	7.31	6.607	54.87	69.183	98.40	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	9.22	7.586	60.87	79.433	98.68	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	10.99	8.710	66.65	91.201	98.92	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	12.53	10.000	72.01	104.713	99.13	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Residue - Average

Sample Source & type:
CN 13

Sample bulk lot ref:
KS

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

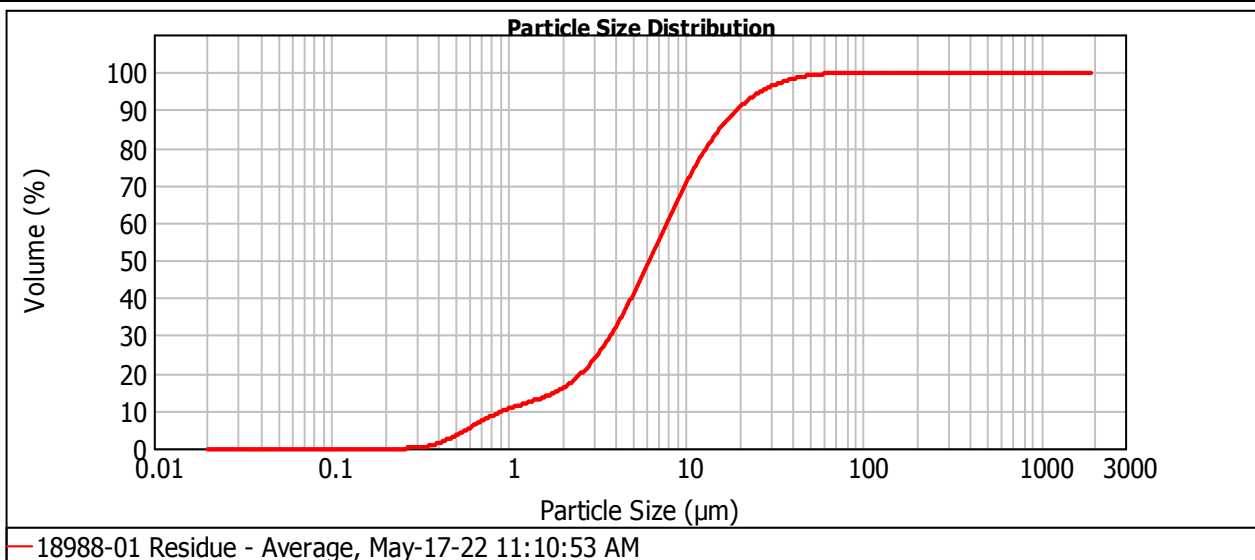
Measured:
May-17-22 11:10:53 AM

Analysed:
May-17-22 11:10:55 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 13.78 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.467 %	Result Emulation: Off

Concentration: 0.0073 %Vol	Span : 2.953	Uniformity: 0.948	Result units: Volume
Specific Surface Area: 2.17 m ² /g	Surface Weighted Mean D[3,2]: 2.771 um	Vol. Weighted Mean D[4,3]: 8.983 um	

d(0.1): 0.944 um **d(0.5): 6.216 um** **d(0.8): 13.034 um**



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	11.12	11.482	75.72	120.226	99.95	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	12.01	13.183	80.36	138.038	99.97	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	12.89	15.136	84.38	158.489	99.99	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	13.93	17.378	87.80	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	15.28	19.953	90.63	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	17.08	22.909	92.94	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	19.44	26.303	94.79	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.02	2.884	22.41	30.200	96.26	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.16	3.311	26.05	34.674	97.39	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.72	3.802	30.35	39.811	98.24	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.64	4.365	35.28	45.709	98.87	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	2.88	5.012	40.74	52.481	99.30	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	4.35	5.754	46.61	60.256	99.58	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	5.92	6.607	52.71	69.183	99.75	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	7.47	7.586	58.86	79.433	99.84	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	8.88	8.710	64.86	91.201	99.89	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	10.10	10.000	70.53	104.713	99.92	1096.478	100.00		

Operator notes:

Result Analysis Report

Sample Name:
18988-01 Residue - Average

Sample Source & type:
CN 14

Sample bulk lot ref:
KS

SOP Name:
Defaultar

Measured by:
lr_malvern1

Result Source:
Averaged

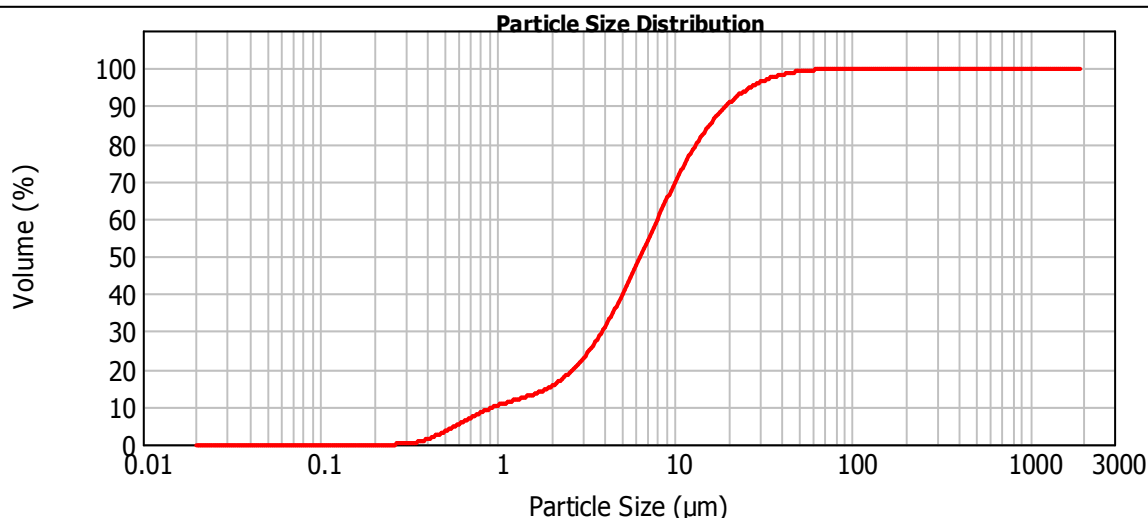
Measured:
May-17-22 11:22:09 AM

Analysed:
May-17-22 11:22:11 AM

Particle Name: Default	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.520	Absorption: 0.1	Size range: 0.020 to 2000.000 um	Obscuration: 14.37 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 1.453 %	Result Emulation: Off

Concentration: 0.0078 %Vol	Span : 2.890	Uniformity: 0.927	Result units: Volume
Specific Surface Area: 2.12 m ² /g	Surface Weighted Mean D[3,2]: 2.826 um	Vol. Weighted Mean D[4,3]: 9.111 um	

d(0.1): 0.969 um **d(0.5): 6.392 um** **d(0.8): 13.240 um**

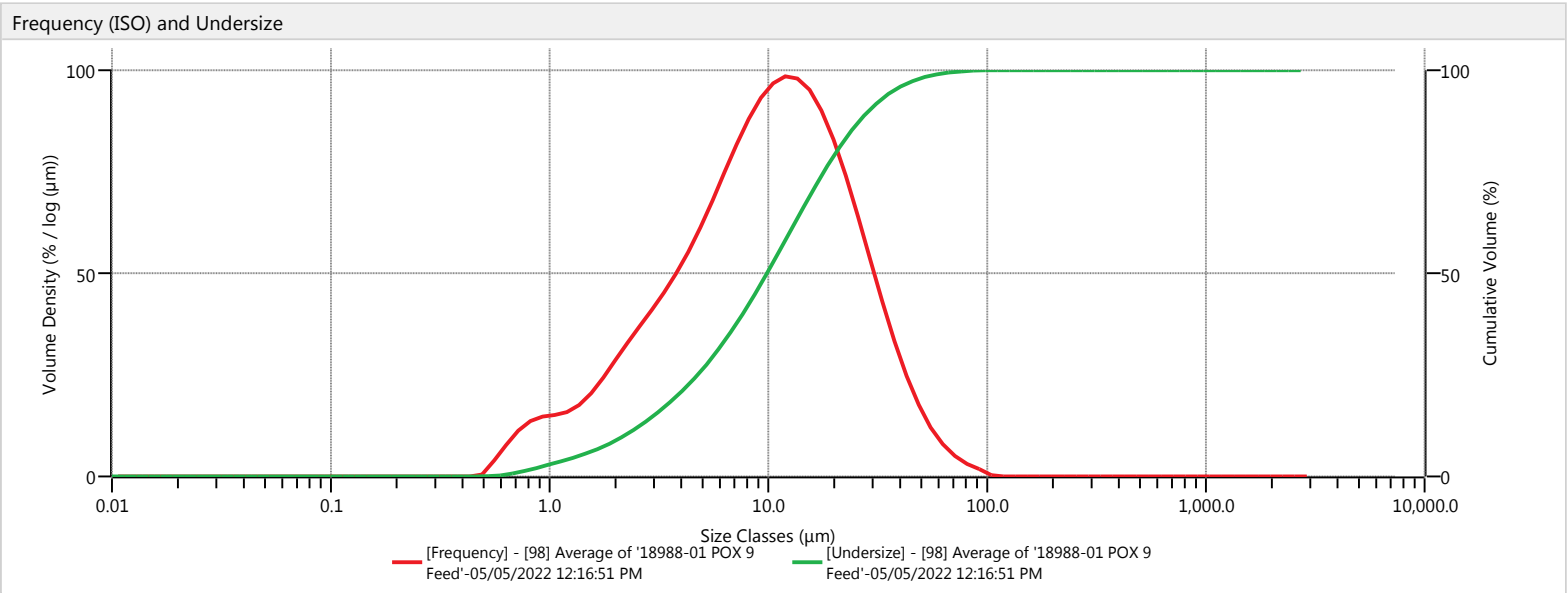


— 18988-01 Residue - Average, May-17-22 11:22:09 AM

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.010	0.00	0.105	0.00	1.096	10.87	11.482	75.06	120.226	99.96	1258.925	100.00
0.011	0.00	0.120	0.00	1.259	11.72	13.183	79.86	138.038	99.99	1445.440	100.00
0.013	0.00	0.138	0.00	1.445	12.55	15.136	84.03	158.489	100.00	1659.587	100.00
0.015	0.00	0.158	0.00	1.660	13.53	17.378	87.57	181.970	100.00	1905.461	100.00
0.017	0.00	0.182	0.00	1.905	14.80	19.953	90.51	208.930	100.00	2187.762	100.00
0.020	0.00	0.209	0.00	2.188	16.50	22.909	92.90	239.883	100.00	2511.886	100.00
0.023	0.00	0.240	0.00	2.512	18.73	26.303	94.80	275.423	100.00	2884.032	100.00
0.026	0.00	0.275	0.02	2.884	21.57	30.200	96.29	316.228	100.00	3311.311	100.00
0.030	0.00	0.316	0.16	3.311	25.07	34.674	97.42	363.078	100.00	3801.894	100.00
0.035	0.00	0.363	0.72	3.802	29.25	39.811	98.26	416.869	100.00	4365.158	100.00
0.040	0.00	0.417	1.62	4.365	34.08	45.709	98.86	478.630	100.00	5011.872	100.00
0.046	0.00	0.479	2.84	5.012	39.48	52.481	99.27	549.541	100.00	5754.399	100.00
0.052	0.00	0.550	4.28	5.754	45.34	60.256	99.54	630.957	100.00	6606.934	100.00
0.060	0.00	0.631	5.82	6.607	51.49	69.183	99.72	724.436	100.00	7585.776	100.00
0.069	0.00	0.724	7.33	7.586	57.73	79.433	99.83	831.764	100.00	8709.636	100.00
0.079	0.00	0.832	8.71	8.710	63.86	91.201	99.89	954.993	100.00	10000.000	100.00
0.091	0.00	0.955	9.89	10.000	69.69	104.713	99.93	1096.478	100.00		

Operator notes:

Measurement Details	Measurement Details
<div><div>Project Number</div>Project #18988-01</div> <div><div>Sample Name</div>Average of '18988-01 POX 9 Feed'</div> <div><div>Operator</div>initials</div>	<div><div>Measurement Date Time</div>05/05/2022 12:16:51 PM</div> <div><div>Result Source</div>Averaged</div> <div><div>SOP File Name</div>RheoDefault - Manual Clean.msop</div> <div><div>Record Number</div>98</div>
Analysis	Result
<div><div>Particle Name</div>Default</div> <div><div>Particle Refractive Index</div>1.520</div> <div><div>Particle Absorption Index</div>0.100</div> <div><div>Dispersant Name</div>Water</div> <div><div>Dispersant Refractive Index</div>1.330</div> <div><div>Scattering Model</div>Mie</div> <div><div>Analysis Model</div>General Purpose</div> <div><div>Weighted Residual</div>0.43 %</div> <div><div>Laser Obscuration</div>15.77 %</div>	<div><div>Concentration</div>0.0114 %</div> <div><div>Span</div>2.704</div> <div><div>Uniformity</div>0.857</div> <div><div>Dv (10)</div>2.19 μm</div> <div><div>Dv (50)</div>9.86 μm</div> <div><div>Dv (80)</div>20.6 μm</div>



Result											
Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under
0.0100	0.00	0.0606	0.00	0.367	0.00	1.96	8.56	11.9	57.79	63.2	99.24
0.0114	0.00	0.0689	0.00	0.418	0.00	2.23	10.24	13.5	63.28	71.8	99.59
0.0129	0.00	0.0784	0.00	0.475	0.01	2.53	12.15	15.3	68.68	81.7	99.81
0.0147	0.00	0.0891	0.00	0.540	0.08	2.88	14.30	17.4	73.87	92.9	99.94
0.0167	0.00	0.101	0.00	0.614	0.35	3.27	16.67	19.8	78.72	106	99.99
0.0190	0.00	0.115	0.00	0.699	0.84	3.72	19.30	20.0	79.01	120	100.00
0.0216	0.00	0.131	0.00	0.795	1.50	4.23	22.20	22.6	83.11	137	100.00
0.0246	0.00	0.149	0.00	0.904	2.28	4.82	25.42	25.7	86.98	155	100.00
0.0280	0.00	0.170	0.00	1.00	2.92	5.48	28.99	29.2	90.27	177	100.00
0.0318	0.00	0.193	0.00	1.03	3.11	6.23	32.94	33.2	92.96	201	100.00
0.0362	0.00	0.219	0.00	1.17	3.96	7.08	37.28	37.7	95.09	229	100.00
0.0412	0.00	0.250	0.00	1.33	4.88	8.06	42.00	42.9	96.70	260	100.00
0.0468	0.00	0.284	0.00	1.51	5.91	9.16	47.04	48.8	97.88	296	100.00
0.0533	0.00	0.323	0.00	1.72	7.12	10.4	52.34	55.5	98.70	337	100.00