

2.5 Static and Kinetic Analytical Program

2.5.1 Analytical Methods

The methods utilised in this geochemical work program are in **Table 2-3**.

Table 2-3: Analytical methods

Tailings Samples	ALS Code	Method Reference
Moisture Content	EA055	
Miscellaneous Preparation (e.g. Crushing / Chopping / Splitting)	N/A	
Ion Exchange Properties		
Exchangeable Cations (Ca, Mg, Na, K, Al) + ECEC – Exchangeable Cations– with pre-treatment	ED008	Rayment & Lyons 2011 15A2
Exchangeable Cations (Ca, Mg, Na, K, Al) + ECEC – Exchangeable Cations– with pre-treatment + exchangeable metals by ICPMS		Rayment & Lyons 2011 15A3
Sulfate, Sulfur, Sulfide		
Sulfate – Total as SO ₄	ED040T	0.5M HCl digest/ ICP/AES
Sulfate - Water Soluble S as SO ₄	ED040S	ICP/AES
Miscellaneous		
pH plus EC (1:5)	IN-4S	See above
Particle Sizing		
Particle Sizing plus Hydrometer to 1-5 µm ¹	EA150-H	AS 1289 3.6.3
Acid Base Accounting		
Chromium Reducible Sulfur (CRS)	EA026	AS 4969.7 (2008)
Net Acid Producing Potential (NAPP) (includes ANC, Total S)	ASS-1	Coastech Research
Net Acid Generation (NAG)	EA011S	I. AMIRA (2002)
Acid Buffering Characterisation Curves (ABCC)	EA046	I. AMIRA (2002)
2 Acid Elemental Analysis		
Environmental Minerals suite (26 elements)	ME-MS41	ICPAES/MS
Geochemical Testing		
XRD Quantitative Mineralogy	NA	
Kinetic Leach Tests		
Based on AMIRA (2002) Guideline	NA	I. AMIRA (2002)

2.5.3 Kinetic Leach Testing and Oxygen Consumption Sample Names and Analyses

The kinetic testing program undertaken by RGS includes:

- kinetic leach cell testing
- oxygen consumption testing

It was initially intended to utilise core from the drilling program for the kinetic tests. However, due to low core recovery from surface samples in the TSF due to the higher water content, RGS would have needed to composite a number of surface samples from a number of drill holes to yield sufficient sample mass for the kinetic testing. For this reason bulk surface samples were obtained for RGS by PaS during a third field sampling campaign for samples (1) and (2) below. Samples utilised for these tests included the following.

1. **Coarse grained tailings** (RGS ID_BT01) from towards the edge of the TSF from **surface** to 0 to 75 cm using an unsaturated leach testing method (wet and dry cycles) simulate surface conditions
2. **Fine grained tailings** (RGS ID_BT02) from towards the centre of the TSF from **surface** to 0 to 75 cm using an unsaturated leach testing method (wet and dry cycles) to simulate surface conditions
3. **Composite sample of tailings from to 7.2 to 12.1 m** (RGS ID_RA01) in BH06 that was leached under fully saturated conditions to simulate permanent inundation below the phreatic surface; saturated conditions were attained by keeping the sample covered with 10 cm of water at all times.

2.5.3.1 Kinetic Leach Cells

Samples (1) and (2) above were sent to RGS in Brisbane for kinetic leach testing. Sample (3) was obtained from core samples at ALS. Splits of the each bulk sample were sent to ALS for the static analyses in **Table 2-6** to characterise the geochemistry of the samples before kinetic leach testing commenced.

Table 2-6: Static screening methods used on kinetic samples

Tailings Samples	ALS Code	Method Reference
Moisture Content	EA055	
Miscellaneous Preparation (e.g. Crushing / Chopping / Splitting)	N/A	
Ion Exchange Properties		
Exchangeable Cations (Ca, Mg, Na, K, Al) + ECEC – Exchangeable Cations– with pre-treatment	ED008	Rayment & Lyons 2011 15A2
Exchangeable Cations (Ca, Mg, Na, K, Al) + ECEC – Exchangeable Cations– with pre-treatment + exchangeable metals by ICPMS (26 elements)		Rayment & Lyons 2011 15A3
Sulfate, Sulfur, Sulfide		
Sulfate – Total as SO ₄	ED040T	0.5M HCl digest/ ICP/AES
Sulfate - Water Soluble S as SO ₄	ED040S	ICP/AES
Miscellaneous		
pH plus EC (1:5)	IN-4S	See above
Particle Sizing		
Particle Sizing plus Hydrometer to 1-5 µm ₁	EA150-H	AS 1289 3.6.3
Acid Base Accounting		

CRS	EA026	Ahern et al 2004
NAPP (includes ANC, Total S)	ASS-1	Coastech Research
NAG	EA011S	I. AMIRA (2002)
ABCC	EA046	I. AMIRA (2002)
2 Acid Elemental Analysis		
Environmental Minerals suite (26 elements)	ME-MS41	ICPAES/MS
Geochemical Testing		
XRD Quantitative Mineralogy		
Kinetic Leach Tests		
Based on AMIRA Guideline		

2.5.3.2 Kinetic Oxygen Consumption Cells

The oxygen consumption test method and results is included in **Attachment A2**. The samples selected for testing were the fine and coarse grained surface samples.

Table 2-7: Oxygen Consumption Parameters

Sample Collection Method	Sample Location	Description	Gravimetric Surface Water Content (%)
Grab	Surface	Coarse grained	As received
Grab	Surface	Coarse grained	Saturation
Grab	Surface	Fine grained	Partial drying
Grab	Surface	Fine grained	Saturation

3.5 Tailings Characterisation

A summary of the static characterisation of the tailings samples is provided in this section. Complete datasets and raw data from ALS are included in the **Attachment B1 to B7**.

3.5.1 pH and EC

The 1:5 pH of the 30 tailings samples collected from four bore holes to a depth of 12 m was 7 to 9.2. This verifies that the tailings are pH neutral. The EC of the tailings samples was 219 to 571 $\mu\text{S}/\text{cm}$.

3.5.2 Acid Base Account

Maximum potential acidity (MPA) was calculated using Pyrite S (S_{PYRITE}). A summary of the S data is provided below.

- The total sulfur in the tailings samples measured by Leco (TS%) was 7.3 to 15.3 % with a median value of 11.3%.
- The sulfide sulfur in the embankment samples measured by the CRS method was 5.4 to 12.3 % with a median value of 8.3 %. There was a strong correlation between TS and CRS ($r^2 = 0.91$), and when plotted on a 1:1 axis it is clear that in the order to 70 to 80% of the TS is present as CRS (**Attachment F1**).

- The moderate to high proportion of other S species including soluble S infers the oxidation products being retained within the tailings due to the assumed low permeability of the tailings at depth where the tailings are consolidated.
- The S_{PYRITE} in the embankment samples was 4.9 to 11.6 % with a median value of 7.7 %.
- The MPA calculated using the S_{PYRITE} concentration was 166 to 376 kg H_2SO_4 /tonne with a median concentration of 254 kg H_2SO_4 /tonne.
- The water soluble S fraction (S_{SO_4}), was measured as was the 0.5M HCL fraction to measure sparingly soluble HCL minerals ($S_{0.5\text{M}\text{HCl}}$). The outcome of the S fractionation is summarised below and shown in **Figure 3-3**.
 - S_{PYRITE} calculated as $\text{CRS (measured)} - S_{\text{GALENA}} \text{ and } S_{\text{SPHALERITE}}$
 - S_{GALENA} and $S_{\text{SPHALERITE}}$ (calculated)
 - S_{INSO_4} (calculated and assumed to be present as minerals such as Barite, Melanterite, Schwertmannite and Jarosite)
 - $S_{0.5\text{M}\text{HCl}}$ (measured)
 - S_{WSOL} (measured)
- The total acid neutralising capacity (T_{ANC}) was measured by ALS using the modified Sobek method. The T_{ANC} was low to moderate at 16 to 44 kg H_2SO_4 /tonne equivalent with a median value of 31 kg H_2SO_4 /tonne equivalent. These ANC values are consistent with, but lower than, the data obtained in 2006 by Earth Systems 42 to 74 kg H_2SO_4 equivalent in **Section 3.1.2.1**.

A plot of MPA and T_{ANC} shows that the tailings samples all have Neutralisation Potential Ratios (NPR) of < 1:1 (**Figure 3-3**).

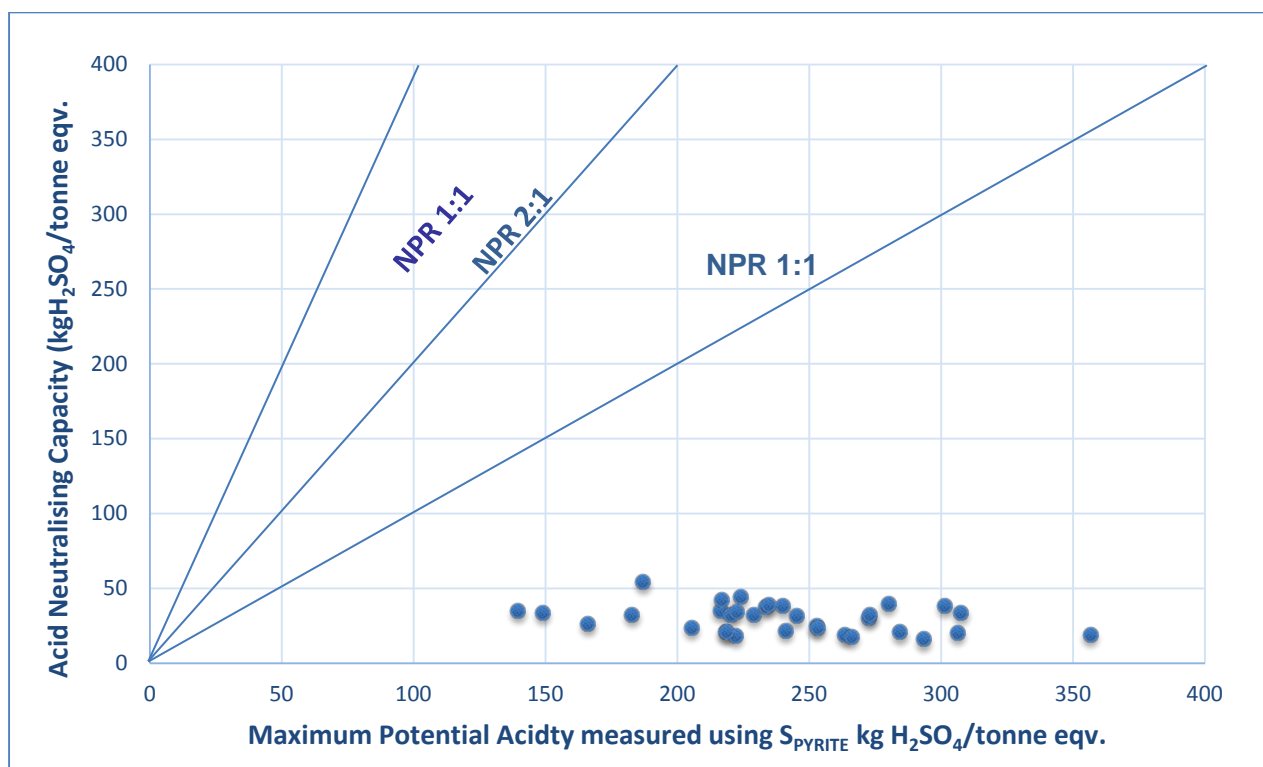


Figure 3-3: MPA to ANC Ratio and Tailings Classification

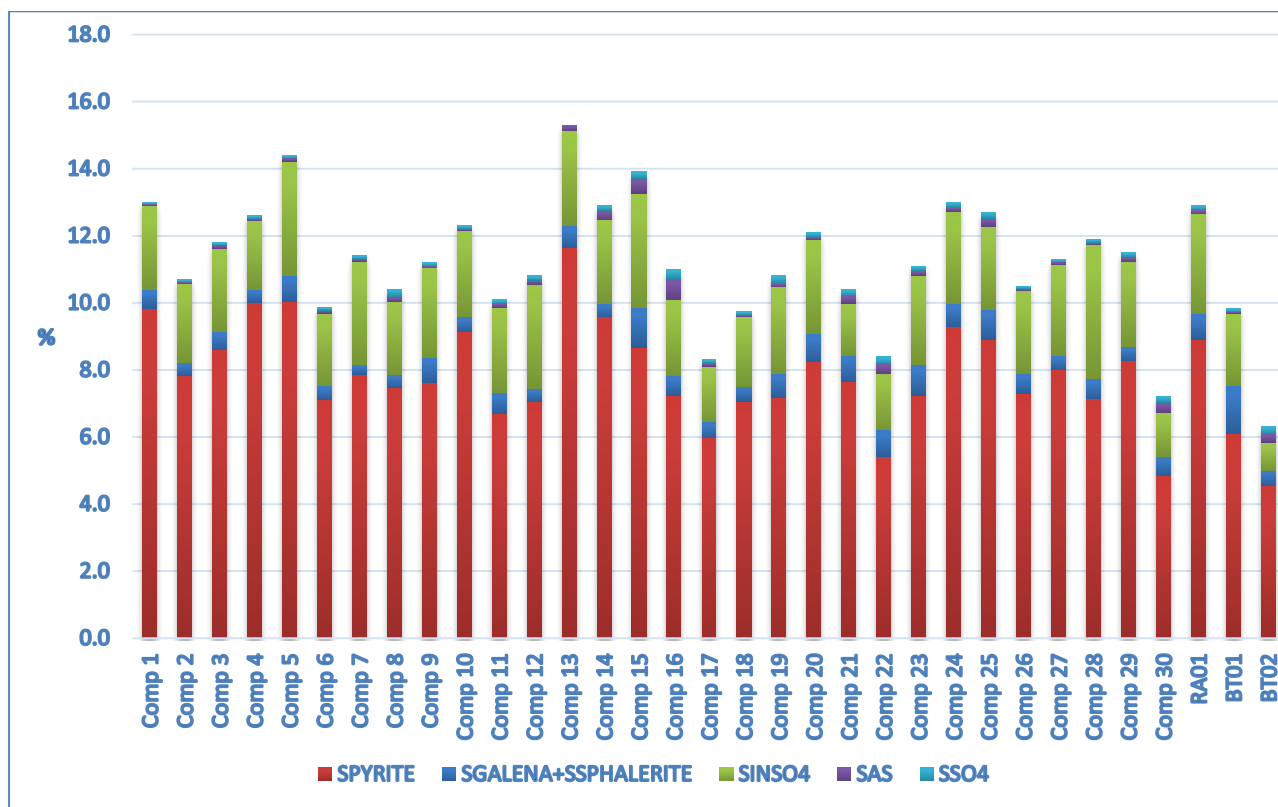


Figure 3-4: S Fractionation of Tailings Samples

3.5.3 Net Acid Generation

The NAG results for the tailings samples were consistent with NAG_{pHOX} values of 2.2 to 3. One sample had a NAG_{pHOX} of 8.6. The **standard NAG method has limitations** for materials with concentrations of Pyrite at concentrations of > 1%. At > 1% S_{PYRITE} not all Pyrite may be oxidised and the resultant titrated acidity at pH 4.5 and 7 may be lower than expected (AMIRA, 2002). The use of sequential NAG tests on these samples would verify that this is occurring. Regardless of the limitations of the NAG method the NAG_{pHOX} of the samples verifies their high acid forming potential.

3.5.4 Elemental Concentrations and Leachability

A total of 30 major, minor and trace elements were measured using a two acid regia digest and analysis by ICPMS and ICPAES to measure the “total” elemental fraction on nine tailings samples in BH06 from surface to 12 m depth (**Table 3-7**).

Table 3-7: 2 Acid Total ICPMS Elemental Results for BH06

ALS Code	Depth Interval (m)			ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	From	To	Depth	Al	As	Cd	Cu	Fe	Pb	Mn	S	Zn
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg
Comp 17	0.0	0.3	0.30	6790	483	22	439	85700	26800	3110	6.5	8810
Comp 18	0.3	1.0	0.70	6640	459	20	402	93500	27500	2950	7.5	7930
Comp 19	1.0	5.0	4.00	6230	540	32	639	79600	13800	5340	7.9	12600
Comp 20	5.0	5.8	0.80	5230	997	40	352	117000	20400	5050	9.1	15400
Comp 21	5.8	6.9	1.10	11300	766	38	946	91700	17200	5940	8.5	14200
Comp 22	6.9	7.2	0.30	9300	763	36	1010	79800	16200	7130	6.2	13800
Comp 23	7.2	10.3	3.10	7090	639	45	795	145000	17000	6760	8.2	16100
Comp 24	10.3	11.0	0.70	11000	807	33	641	143000	14700	5040	10.0	12600
Comp 25	11.0	12.1	1.10	16800	622	49	1100	139000	13000	5500	9.8	16600

The elemental results, that used composited samples, verify that there are vertical variations in the data. The XRF data in **Attachment F** provides more detailed elemental down-hole data and shows that there are clear lateral and horizontal variations in elemental chemistry within the TSF. This is considered to be due to variations in the processing and composition of the tailings stream (that is a function of the composition of the ore) and segregation of the tailings based on particle size distribution with coarser fractions settling around the perimeter of the TSF and a greater proportion of finer fractions towards the centre of the TSF. The MMG metallurgical data in **Figure 3-1** confirms the trends associated with particle size distribution and elemental concentrations.

The geochemical abundance indices method was used to evaluate the degree of mineralisation in the samples and verifies that Ag, As, Be, Bi, Cd, Cu, Mo, Mn, Pb, Tl and Zn have GAI values of > 3 ie. concentrations of these elements are 12 to 24 times greater than median soil data sourced from Bowen (1973) (**Attachment B4**). Of these elements Ag, As, Bi, Cd, Cu, Mo, Pb, and Zn are present at 48 to 96 times greater than median soil data (Bowen, 1973; INAP, 2009).

In order to evaluate the potential mobility of the major, minor and trace elements in the tailings the “exchangeable” fraction of nine BH06 tailings samples was measured. The basis of this method is to utilise the supernatant from a standard cation exchange capacity method to measure the soluble and exchangeable fraction of the samples. The exchangeable fraction includes elements that may be readily adsorbed or desorbed due to changes in pH, Eh or solute concentrations.

The exchangeable elemental data indicate that there are “substantial” pools of Cd, Cu, Pb, and Zn that are potentially mobile (**Table 3-8**). The data indicate that:

- the proportion of readily mobile elements increases with depth in the tailings for Cd, Cu and Zn which could be due to leaching and accumulation of soluble elements into the tailings profile or differences in ore quality and processing methods
- Cu has a high exchangeable fraction with an average of 20% of the total Cu mass in the exchangeable fraction
- for elements such as Cd and Zn there is weaker relationship between the total and exchangeable fractions or the accumulation of soluble ions at depth in the tailings with an average of 10% and 8% of the total Cd and Zn mass in the exchangeable fraction
- for elements such as Pb there is weaker relationship between the total and exchangeable fractions or the accumulation of soluble ions at depth in the tailings with an average of 3.5% and of the total mass in the exchangeable fraction.

The proportion of soluble and exchangeable elements is primarily a function of the solubility of these cations under reducing pH.

Regardless of the cause of increasing proportions of soluble and exchangeable elements with depth in the tailings, it does suggest that the hydraulic gradient in the TSF should be controlled to stop pore water draining through the tailings. Additional alkalinity may be required within the tailings to assist in precipitation of these elements.

Table 3-8: 2 Exchangeable ICPAES Elemental Results for BH06

ALS Code	Depth Interval (m)			Exch.	Exch.	Exch.	Exch.	Exch.	Exch.
	From	To	Depth	Cd	Cu	Fe	Pb	Mn	Zn
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Comp 17	0.0	0.3	0.30	1	59	< 50	12	139	514
Comp 18	0.3	1.0	0.70	1	64		42	139	545
Comp 19	1.0	5.0	4.00	2	117		28	193	922
Comp 20	5.0	5.8	0.80	2	49		18	221	633
Comp 21	5.8	6.9	1.10	5	229		30	164	1620
Comp 22	6.9	7.2	0.30	7	313		34	227	2220
Comp 23	7.2	10.3	3.10	3	150		21	216	1090
Comp 24	10.3	11.0	0.70	4	150		20	155	916
Comp 25	11.0	12.1	1.10	5	202		22	132	1110
% of Total Mass									
Comp 17	0.0	0.3	0.30	6.0	13.4		0.0	4.5	5.8
Comp 18	0.3	1.0	0.70	7.0	16.0		0.2	4.7	6.9
Comp 19	1.0	5.0	4.00	7.5	18.3		0.2	3.6	7.3
Comp 20	5.0	5.8	0.80	4.7	13.9		0.1	4.4	4.1
Comp 21	5.8	6.9	1.10	12.3	24.2		0.2	2.8	11.4
Comp 22	6.9	7.2	0.30	19.7	31.0		0.2	3.2	16.1
Comp 23	7.2	10.3	3.10	7.6	18.9		0.1	3.2	6.8
Comp 24	10.3	11.0	0.70	10.8	23.4		0.1	3.1	7.3
Comp 25	11.0	12.1	1.10	10.6	18.4		0.2	2.4	6.7

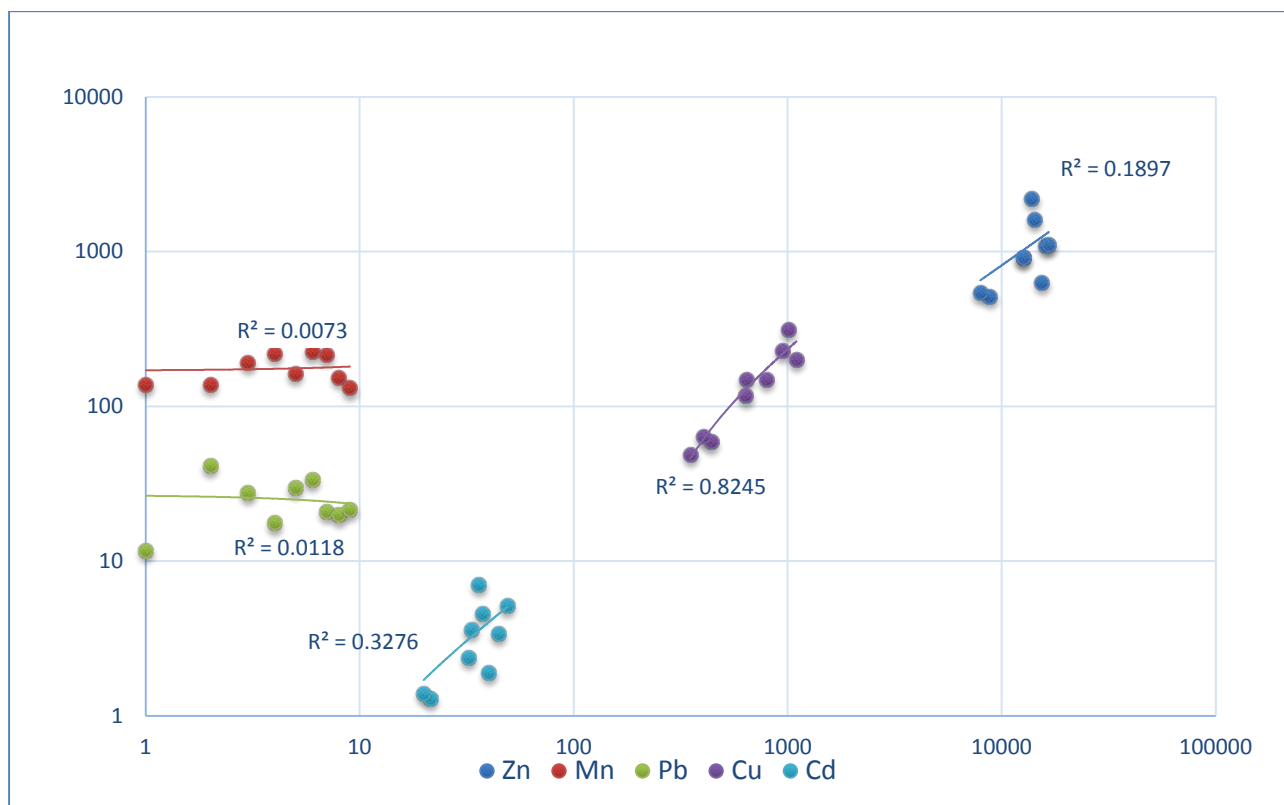


Figure 3-5: Correlations between total and exchangeable Cd, Cu, Mn, Pb and Zn

3.6 Tailings Classification

Based on the NPR results, NAG results and elevated mineralisation of the samples, the tailings materials are classified as **PAF-High Risk**.

Previous kinetic NAG test work completed by EGi (2008) suggests that the tailings **may be net acid forming (i.e. AF) within one to three years**; this is assumed to be for unsaturated surface tailings.

The EGi 2008 lag period is considered realistic by RGS and provides a short window of opportunity to MMG to initiate corrective actions that will reduce potential longer term issues related to AMD.

3.7 Kinetic Testing

Kinetic testing is currently being completed on three samples of tailings which include a coarse fraction of surface tailings, a fine fraction of surface tailings and a composite sample from BH06. The three samples are being subjected to kinetic leach cell tests to measure acid production and neutralisation rates and rates of major, minor and trace element leachability over time. The two surface samples are being subjected to oxygen consumption testing to measure the rate at which oxygen is consumed, which is then used to calculate the sulfide oxidation rate.

The outcomes of these kinetic tests provide some of the key data required to evaluate the effectiveness of potential cover systems on the TSF.

3.7.1 Characterisation and Classification

The samples submitted for oxygen consumption and leach cell testing were characterised for pH, EC, TS, CRS, T_{ANC}, NAG, ABCC, XRD, and PSD before commencement of the kinetic tests. A summary of the properties of each of the samples is in **Table 3-9**. Supplementary information is included in **Attachment B1 to B7**.

Based on the elevated sulfide and major, minor and trace element data, NAG pH results, and the ANC: MPA ratio, the three tailings samples are classified as **PAF-High Risk**.

Table 3-9: Static Chemistry and Physical Properties of Kinetic Samples

Hole ID		RA01	BT01	BT02
Sample Type		Composite Tailings (Hole BH06)	Bulk Tailings	Bulk Tailings
Depth Interval (m)	From	7	Surface	Surface
	To	12		
	Depth	5		
Moisture Content (%)		21	10	34
pH (1:5)		8	9	10
EC (1:5)	($\mu\text{S}/\text{cm}$)	320	339	497
Total S	(%)	13	10	6
CRS		10	8	5
Acid (0.5M HCl) Soluble Sulfur mg/kg		1300	500	2400
Water Soluble Sulfur (as SO ₄) in mg/kg		1190	860	2260
Pyrite S	%	9	6	5
MPA	(kg H ₂ SO ₄ /t)	296	231	153
ABCC (pH 6)		7	13	12
ANC		33	54	35
ABCC (pH 2.5)		87	132	102

Hole ID	RA01	BT01	BT02
NAPP	264	177	118
ANC: MPA Ratio	0.1	0.2	0.2
NAG pH	2.3	2.8	8.4
Geochemical Classification	PAF-High Risk	PAF-High Risk	PAF-High Risk
PSD Median particle size (mm)	0.026	0.126	0.01

3.7.1.1 Mineralogy

A summary of the XRD analyses is in Table 3-10. The major sulfide producing mineral is Pyrite at 10.6 to 21.2 %. Barite is present at 0.6 to 6.4%. Rhodochrosite ($MnCO_3$) is an acid consuming mineral and was detected at 4.1 to 7.1%. The analytical report is in **Attachment B7**.

Table 3-10: XRD Analyses of Kinetic Samples

XAF9050	RA01	BT01	BT02
Quartz	40.7	35.2	26.2
Pyrite	21.2	12.9	10.6
Sphalerite (iron)	2.2	3.7	0.8
Barite	6.4	0.6	1.2
Rhodochrosite	4.1	7.1	5.6
Albite	1.8	6.3	3.6
Muscovite 2M1	22.6	25.7	46.8
Phlogopite 1M Mica	-	4.4	-
Chlorite IIb	0.9	4.2	5.2

3.7.2 Leach Cell Tests

The leach cell test methods for the samples include the following.

- The two surface samples are being subjected to monthly leach cycles using the AMIRA (2002) method. The cells are being retained in a fridge at 15°C between leach cycles to reflect the ambient temperature at the site (refer to **Table 2-1**). The objective of this leach method is to simulate oxic, unsaturated conditions of tailings exposed at surface on the tailings beach.
- The sample from BH06 (a composite of samples from 7.2 to 12 m depth) are being tested under saturated conditions. This method utilises a leach cell with 3 kg of tailings (10 cm depth) covered with 10 cm of laboratory grade water. This cell is kept at 15°C between leach cycles to reflect the ambient temperature at the site. At each leach cycle the cell is drained of 1 L of water and the volume is replaced with new water to maintain the volume and depth over the tailings. The objective of his leach method is to simulate tailings maintained under sub-oxic saturated conditions.

No leach data is currently available for the kinetic leach cell tests.

3.7.3 Oxygen Consumption

Oxygen consumption testing was completed by Graham Campbell and Associates in Western Australia. The data report from GCA is in **Attachment C**.

Table 3-11: XRD Analyses of Kinetic Samples

Sample Details	Coarse-T	Fine-T Run-1	Fine-T Run-2
Total-S %)	9.83	6.32	6.32
LOCC No.	B	D	D
Test Specifications and Conditions			
Damp-Solids (kg)	1.90	2.29	2.29
GWC (%) [approx.]	8.0	24.2	24.2
VWC (% v/v) [approx.]	7.3	23.1	23.1
Dry-Solids [DS] (kg)	1.76	1.84	1.84
Bed-Ht (cm)	8.5	8.5	8.5
Bed-Volume (L)	1.93	1.93	1.93
Bed-DBD (g/cm ³)	0.91	0.96	0.96
Dry-Solids-SG	3.07	3.06	3.06
Bed-Porosity (% v/v)	70.3	68.8	68.8
Bed-Gas-Filled-Void Volume (L)	1.22	0.88	0.88
LOCC-Volume (L)	4.58	4.68	4.68
Bed-Vol. + WC-Vol. (L)	1.99	1.99	1.99
Inert-Spacer-Volume (L)	0.69	0.67	0.67
LOCC-Head-Space (L)	1.90	2.02	2.02
Total-Gas Volume [TGV] (L)	3.12	2.90	2.90
TGV/DS Ratio (L/kg)	1.77	1.57	1.57
Temperature (oC) [+/- 1-2]	20	20	20
Measurement with Quantek 901			
Reaction-Time (days)	2.8	1.6	0.3
Reaction-Time (hrs)	68	39	7.0
Measured O ₂ -Conc. (%) [+/- 0.1]	18.6	4.3	17.9
O ₂ -Consumption (%) [+/- 0.2]	2.3	16.6	3.0
O ₂ -Consumption (mg O ₂)	95.3	640.6	115.8
OCR (kg O ₂ /kg/s)	2.22E-10	2.47E-09	2.49E-09

4 CONCLUSIONS

4.1 Material Classification and Risk Evaluation

The primary objectives of the work program, the characteristics and classification of the samples and the RGS evaluation of risk posed by the tailings and embankment materials is presented in this section of the report.

4.3 Tailings Sulfide Oxidation Rate

Objective

Calculate the pyrite oxidation rate of the tailings.

Calculate the ancillary sulfide mineral oxidation rates in the tailings.

Purpose

Understand how long it may take for the tailings to go from PAF to AF.

Used to estimate the residual AMD risk of the TSF.

Results

Oxidation of the sulfide minerals in the tailings is likely to commence directly after placement of the tailings in the TSF if they are under oxidised non saturated conditions.

The oxygen consumption tests were utilised to measure rates of oxygen consumption by the sulfide minerals that include acid generating Pyrite and non-acid producing minerals such as

Galena and Sphalerite. Partitioning of O₂ consumption between sulfide minerals was not accounted for in this testing or the results.

The O₂ and sulfide oxidation rates of the surface samples tested under unsaturated conditions and saturated conditions are summarised below.

The oxygen consumption rates are calculated to be:

- Coarse grain tailings – unsaturated (2.22E-10)
- Coarse grain tailings – saturated (results to be provided in a subsequent data report)
- Fine grain tailings – unsaturated (2.47E-09 for Run 1 and 2.49E-09 for Run 2)
- Fine grain tailings – saturated (results to be provided in a subsequent data report).

Whilst acid generation rates are of relevance to evaluate the acid drainage potential, including AMD generation rates, the exchangeable elemental data verify the presence of an existing and substantial pool of soluble and readily exchangeable cations (Cd, Cu, Pb and Zn) that could be leached from the tailings to surface water and groundwater at neutral pH. The mobility of oxyanions such as As, Mo and Sb cannot be adequately defined using a cationic method. But these elements are also likely to be present and potentially mobile under the range of pH conditions in the TSF. Kinetic leach tests are used to obtain rates and concentrations of major, minor and trace elements.

Conclusions

Oxidation of sulfide minerals commences directly after placement in the TSF. The rate of oxidation is dependent on the density, grain size of the materials and minerals and the degree of saturation. Oxidation leads to localised acid production at the mineral surfaces of acid producing minerals such as Pyrite, Chalcopyrite and Pyrrhotite. Acid is neutralised by the acid consuming minerals in the tailings.

The oxidation and neutralisation reactions can lead to the precipitation of a wide group of secondary minerals in the tailings within exchangeable, carbonate or other mineral fractions (ie. Barite, Gypsum, Melanterite, Schwertmannite and Jarosite). Some of these minerals can be a potential source of long term acidity even under anoxic conditions.

At the neutral to mildly alkaline pH within the tailings, there is currently a pool of soluble and readily exchangeable elements (eg. Cd, Cu, Pb and Zn) that could be mobilised from the tailings into the receiving environment, if tailings pore water movement is not minimised and controlled.

The low concentration of the measured ANC in the tailings infers that the tailings have a low (and continually decreasing) potential to buffer ongoing acid generation.

Once the ANC has been consumed, the tailings will become Acid Forming (AF) at surface. Kinetic NAG tests by EGi in 2008 indicated that the lag period prior to acid generation of a tailings /sludge sample would be at least one year and possibly two or more years (EGi, 2008); ie. a relatively short period of time. With the generation of acid conditions at surface, an acid and oxidation front would then move into the bulk tailings from surface, compounding the management issue. Sulfide oxidation would be driven by oxidation from O₂ availability and ferric iron.