EARTH SYSTEMS
Environment | Water | Sustainability
Australian Business Number 42 120 062 544

GEOCHEMICAL ASSESSMENT OF TAILINGS MATERIALS, 2/5 TAILINGS DAM, MMG ROSEBERY, TASMANIA

Prepared for

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June 2015

1. INTRODUCTION

This report describes the environmental geochemical properties of tailings material sampled from the decommissioned No. 5 tailings dam at the Rosebery Mine in Tasmania.

Two ALS analytical reports (EB1514230, EB1514295) were provided for assessment.

Note the following:

- Samples were collected and selected by others; it is unclear how representative they are of in-situ materials;
- Data is provided for samples from 5 drillholes, completed to a depth of ~10 m, with only selected intervals submitted for analysis;
- Analytical parameters were selected by ATC Williams, and provide only limited information on geochemical risk;
- Analytical work was conducted by ALS;
- Earth Systems provides an interpretation of the geochemical data provided only.

2. GEOCHEMISTRY OF TAILINGS

Geochemical data for the tailings samples are summarised in Table 1, and key average static geochemical parameters are plotted in Table 1.

Table 1: Geochemical data for sampled tailings.

Location / Depth (mbgl)	Parameter / Units													Risk class.
	NAG_{pH}	$NAG_{4.5}$	$NAG_{7.0}$	ANC	S_{KCl}	S_{HCl}	As	Ba	Cd	Cu	Mn	Pb	Zn	
	–	kg H_2SO_4/t			% S		mg/kg							
CPT 4														
0.0–2.0m	2.4	74.9	96.0	57.0	0.22	0.25	1,160	208	16.6	747	25,800	6,150	6,420	PAF
4.0–5.0m	2.6	39.4	68.7	70.1	0.16	0.22	1,630	219	34.2	1,200	32,200	8,120	15,500	PAF
7.0–8.0m	2.2	117	150	55.0	0.12	0.13	1,950	185	30.9	1,070	19,500	1,760	13,300	PAF
CPT 5														
0.0–2.0m	2.3	78.8	99.5	60.8	0.12	0.16	1,330	131	13.2	867	24,600	5,230	5,960	PAF
4.5–6.0m	2.3	100	132	52.1	0.26	0.27	1,710	483	16.8	855	30,000	5,940	7,570	PAF
7.0–8.0m	2.2	110	137	50.0	0.14	0.16	2,230	252	20.1	871	25,400	3,020	9,550	PAF
CPT 6														
0.0–1.5m	2.4	69.0	84.6	55.4	0.06	0.12	1,180	181	16.6	865	23,900	4,720	7,970	PAF
4.0–6.0m*	2.4	62.0	87.6	51.2	0.30	0.30	1,500	503	15.7	916	29,700	6,880	7,010	PAF
9.0–10.5m	2.4	104	149	42.8	0.53	0.54	2,490	17.3	30.9	1,610	15,800	9,970	7,990	PAF
CPT 7														
0.0–1.5m	2.4	78.6	99.2	46.0	0.13	0.15	1,400	13.6	16.4	774	16,800	4,550	5,940	PAF
4.5–6.0m	3.7	2.4	20.6	65.2	0.15	0.17	1,680	19.7	12.8	685	25,300	6,280	4,440	PAF
8.5–10.0m	2.6	57.2	84.5	35.3	0.45	0.46	1,790	30.2	16.0	974	20,200	11,000	5,270	PAF
CPT 8														
0.0–1.5m	2.3	107	141	41.2	0.18	0.18	1,780	9.2	26.0	983	15,200	4,550	8,080	PAF
4.5–6.0m	2.5	73.0	96.6	42.6	0.34	0.35	1,720	20.5	17.0	1,180	18,900	7,900	5,280	PAF
8.5–10.0m	3.3	5.4	22.0	46.0	0.32	0.33	1,640	37.0	11.9	735	21,400	7,210	3,620	PAF

*Sample labelled '9.0–10.5m', but is a duplicate likely to have been mislabelled.

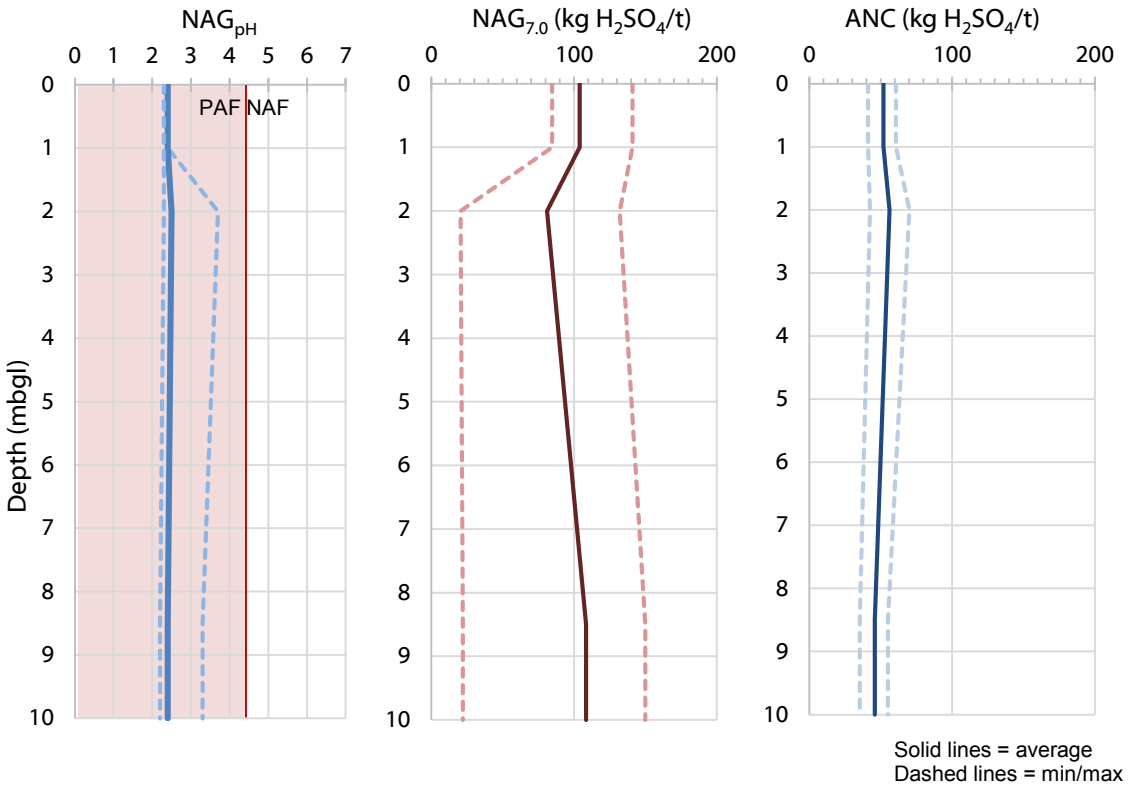

Figure 1: Average NAG_{pH}, $NAG_{7.0}$ and ANC of tailings in No. 5 dam with depth.

3. GEOCHEMICAL RISK

The key characteristics of the sampled tailings with respect to geochemical risk are as follows:

- All of the tailings samples are classified as Potentially Acid Forming (PAF), and have an average net acidity generation (NAG) potential of ~100 kg H_2SO_4/t (range of 20–150 kg H_2SO_4/t), which is in the high risk range for PAF materials.
- ANC is relatively uniform in these samples at ~50 kg H_2SO_4/t, which will provide a significant acid-free 'lag' period for these materials if desaturated. During the lag period, neutral metalliferous drainage (NMD) – comprising soluble zinc, lead, cadmium, manganese and arsenic – and elevated sulfate salinity are likely.
- The duration of the lag period and the subsequent acid generation period is determined by the rate of sulfide oxidation, which is unknown. Kinetic testwork (eg. oxygen consumption) would be required to assess this.
- The total (maximum) potential acidity (MPA) of the material can be estimated by adding the ANC and $NAG_{7.0}$ values. The estimated average MPA is ~150 kg H_2SO_4/t.
- The tailings are highly metalliferous (ie residual sphalerite and galena), containing up to 1.5 wt% Zn and 1.1 wt% Pb.
- Neither sphalerite nor galena are susceptible to decomposition by atmospheric oxidation, but both could oxidise under the acid conditions generated during pyrite oxidation.

- Arsenic concentrations are also very high (for base metal mineralisation), with values up to 0.25 wt%. While it is not clear how the As is bound, it is likely that As release would accompany pyrite oxidation.
- S_{KCl} and S_{HCl} are very similar for all samples, suggesting that this component of sulfur is probably in the form of a highly soluble phase such as gypsum. This is not inconsistent with the relatively low barium content. The gypsum could have formed in the treatment plant and may have been disposed to the tailings stream (in much the same way as it is today).
- Based on the similarity between S_{KCl} and S_{HCl}, the sampled tailings show very little oxidation.
- The manganese content of the tailings is very high (up to 3.2 wt%), indicating that the material contains Mn-rich carbonates (eg. kutnohorite). The Mn component of such carbonates has no net neutralising capacity (ie. does not contribute to ANC).

4. RECOMMENDATIONS

- It is recommended that a database of the geochemical properties and classification of tailings deposited in the 2/5 dam tailings be maintained as important information for the development of closure strategies for the proposed new tailings dam.
- The recommended minimum suite of geochemical parameters for future routine testing of sulfidic materials (tailings and waste rock) at Rosebery are as follows:

Parameter	Unit	Method reference
NAG_{pH}	–	AMIRA 2002
$NAG_{4.5}$	kg H_2SO_4/t	
$NAG_{7.0}$		
ANC		
Total sulfur	wt% S	LECO
Arsenic	mg/kg	USEPA 6020 ICP-MS
Copper		
Lead		
Zinc		