Burnie RESEARCH LABORATORY

INTEC HELLYER METALS
DEMONSTRATION PLANT

FOR

INTEC HELLYER METALS LTD

JUSTIN RESTA

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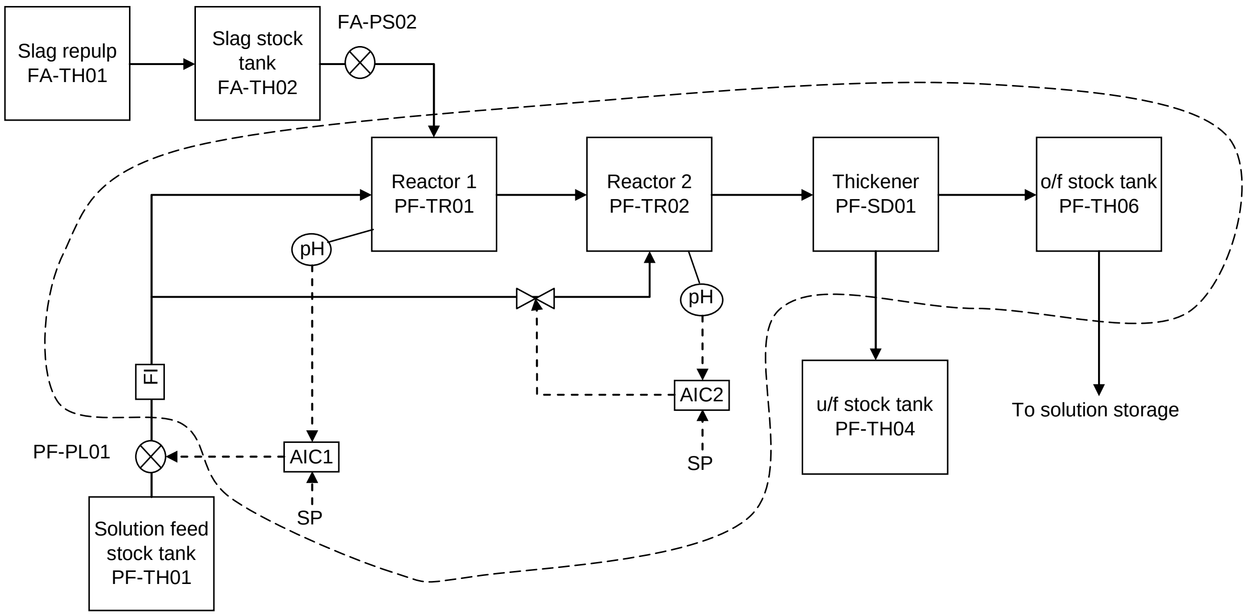
7.15 Zeehan Slag Trial

The Zeehan slag trial was conducted as a separate campaign following completion of Hellyer tails/EAFD steady state run. This consisted of two continuous 4 day runs conducted from the 21-24/8/06 and 28-31/8/06. Solution feed to the circuit was the 'homogenised' solution inventory produced from the steady state period.

Flowsheet for the Zeehan slag trial is shown in figure 1. The dotted line in figure 1 indicates the mass balance boundary considered for the slag trial.

Figure 1: Zeehan slag trial flowsheet



Ground Zeehan slag was repulped in water in FA-TH01, then transferred to the Slag feed stock tank, FA-TH02. This was fed to the first slag leach reactor, PF-TR01, at approximately 30 kg/h (dry solids). Solution feed, from PF-TH01, to reactor 1 was controlled to maintain target pH. Pulp discharging reactor 1, passed to reactor 2, PF-TR02, then to the thickener, PF-SD01. A minor portion of the solution feed to the circuit was dosed to reactor 2 to maintain pH at set point. Thickener o/f passed to the thickener o/f stock tank, PF-TH06. From here the solution was directed to various tankage for storage. Thickener u/f passed to the u/f stock tank, PF-TH04. From here the pulp was filtered on the leach residue belt filter, with filtrate directed to various tankage for storage.

Treatment of zinc silicates, such as the Zeehan slag, is well known to be potentially problematic, due to the strong tendency to form silica gels under acid leach conditions, leading to serious difficulties in subsequent solids/liquor separation.

The aim of this circuit was to achieve reasonable Zn extractions from Zeehan slag, while effectively controlling behaviour of silica leached from the slag, to produce leach residue pulp with acceptable settling and filtration characteristics. To achieve this aim, the circuit was operated under conditions of carefully control pH to simultaneously precipitate Fe and Si from solution in a manageable form. As both settling and filtration properties of the leach pulp were of key concern, standard cylinder settling and vacuum filtration tests were carried out on leach pulp from both reactors 1 and 2 on a daily basis throughout the trial.

The trial clearly demonstrated acceptable solids/liquor separation can be achieved, with silica behaviour effectively controlled. Solids/liquor separation of the pulps produced during the trial are discussed in section 9.15.

Table 1 shows mass balance summary for the 8 days of operation of the slag trial, 21 - 31/8/06. Table 2 shows extraction summary for the same period.

Average grade of the Zeehan slag fed to the circuit during the trial was;

- 13.0% Zn
- 1.94% Pb
- 0.25% Cu
- 51 g/t Ag
- 23.4% Fe
- 8.08% Ca
- 5.26% Mn
- 2.24% Mg

Average metals extractions across the Slag Leach circuit for the entire trial were;

- 78.9% for Zn
- 88.6% for Pb
- -144% for Cu
- 38.2% for Ag
- -55.5% for Fe
- 86.2% for Ca
- 79.5% for Mn
- 90.8% for Mg

In addition to Zn, Pb and Ag, leaching of Zeehan slag contributed significant quantities of Ca, Mn and Mg to solution.

Balance closure for this period was very good, with imbalance between total Zn input and output to the circuit at only 0.5% (100*(expressed as total input – total output)/total input). Balance error for all major metals of interest are also considered to be good for this period.

Tables 3 and 4 show balance and extraction summaries for the period 22-24/8/06, the first 4 days of the trial. Note, the 1st day of this period (21/8/06) was excluded, as mass balance indicated this was clearly unsteady.

Tables 5 and 6 show balance and extraction summaries for the period 28-31/8/06, the final 4 days of the trial.

Table 1:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Mass balance summary

Period/Date: **Period 4** **21-31/8/06**

Slag Feed

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		5834	100%	0.0%
Zn	13.0%	760.6	100%	0.0%
Pb	1.94%	113.1	100%	0.0%
Cu	0.25%	14.6	100%	0.0%
Ag	51g/t	0.30	100%	0.0%
Fe	23.4%	1364	100%	0.0%
Ca	8.08%	471.6	100%	0.0%
Mn	5.26%	306.7	100%	0.0%
Mg	2.24%	130.4	100%	0.0%

Water inputs

	kg
with feed slurry	5834
with floc	2745

Reactor 1 solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		5949	102%	-2.0%
Zn	3.2%	189.4	25%	75.1%
Pb	0.24%	14.5	13%	87.1%
Cu	0.39%	23.2	158%	-58.1%
Ag	24g/t	0.14	47%	52.9%
Fe	35.1%	2088	153%	-53.0%
Ca	1.06%	63.3	13%	86.6%
Mn	1.21%	71.9	23%	76.6%
Mg	0.19%	11.2	9%	91.4%

Reactor 2 solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		6371	109%	-9.2%
Zn	2.6%	167.6	22%	78.0%
Pb	0.20%	13.0	11%	88.5%
Cu	0.41%	26.3	180%	-79.9%
Ag	22g/t	0.14	48%	52.1%
Fe	35.4%	2256	165%	-65.4%
Ca	1.13%	71.7	15%	84.8%
Mn	1.03%	65.6	21%	78.6%
Mg	0.17%	10.7	8%	91.8%

Thickener u/f solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		6228	107%	-6.8%
Zn	2.6%	160.6	21%	78.9%
Pb	0.21%	12.9	11%	88.6%
Cu	0.57%	35.7	244%	-143.6%
Ag	29g/t	0.18	62%	38.2%
Fe	34.1%	2122	156%	-55.5%
Ca	1.05%	65.2	14%	86.2%
Mn	1.01%	63.0	21%	79.5%
Mg	0.19%	12.0	9%	90.8%

Thickener u/f liquor

	Assay	kg	% distribution of total feed
Liquor (kg)		11464	8%
Liquor (l)		8790	
SG		1.30	
Zn	37.3 g/l	327.9	6%
Pb	3.6 g/l	31.3	6%
Cu	.6 g/l	5.6	3%
Ag	7 mg/l	0.06	4%
Fe	11.3 g/l	99	3%
Ca	26.2 g/l	230.4	6%
Mn	4.1 g/l	36.1	6%
Mg	8.8 g/l	77.1	7%

Feed liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		116625		
Liquor (l)		93049		
SG		1.25		
Zn	46.3 g/l	4310.6	0	0.0%
Pb	4.4 g/l	410.8	0	0.0%
Cu	1.8 g/l	167.4	0	0.0%
Ag	13 mg/l	1.22	0.00	0.0%
Fe	18.1 g/l	1684	0	0.0%
Ca	33.7 g/l	3139.9	0	0.0%
Mn	3.4 g/l	318.7	0	0.0%
Mg	11.8 g/l	1097.6	0	0.0%

Reactor 1 liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		131786		
Liquor (l)		101514		
SG		1.30		
Zn	47.8 g/l	4848.1	538	73.9%
Pb	4.8 g/l	485.4	75	83.7%
Cu	1.6 g/l	158.9	-8	-57.9%
Ag	13 mg/l	1.36	0.14	50.6%
Fe	12.5 g/l	1271	-413	-24.6%
Ca	34.2 g/l	3474.5	335	84.1%
Mn	5.2 g/l	523.3	205	74.0%
Mg	11.3 g/l	1142.4	45	79.9%

Reactor 2 liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		131364		
Liquor (l)		101631		
SG		1.29		
Zn	49.2 g/l	5001.7	691	80.5%
Pb	5.0 g/l	505.4	95	87.9%
Cu	1.6 g/l	164.4	-3	-12.9%
Ag	14 mg/l	1.41	0.20	58.1%
Fe	13.0 g/l	1316	-368	-19.5%
Ca	35.6 g/l	3613.3	473	86.8%
Mn	5.2 g/l	532.9	214	76.6%
Mg	11.5 g/l	1170.9	73	87.3%

Combine thickener o/f + u/f liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		134251		
Liquor (l)		102938		
SG		1.30		
Zn	48.0 g/l	4937.8	627	79.6%
Pb	4.9 g/l	502.6	92	87.6%
Cu	1.5 g/l	158.3	-9	-34.5%
Ag	14 mg/l	1.39	0.17	48.8%
Fe	13.7 g/l	1408	-276	-14.9%
Ca	34.3 g/l	3535.3	395	85.9%
Mn	5.0 g/l	518.2	200	76.0%
Mg	11.3 g/l	1159.9	62	83.8%

Thickener o/f liquor

	Assay	kg	% distribution of total feed
Liquor (kg)		122787	87%
Liquor (l)		94148	
SG		1.30	
Zn	49.0 g/l	4609.8	90%
Pb	5.0 g/l	471.2	91%
Cu	1.6 g/l	152.6	79%
Ag	14 mg/l	1.32	84%
Fe	13.9 g/l	1309	37%
Ca	35.1 g/l	3304.8	92%
Mn	5.1 g/l	482.2	83%
Mg	11.5 g/l	1082.8	92%

Calculated feed (Slag feed)

	Assay	kg	% distribution of calc feed
Solids		5834	100%
Zn	13.0%	761	100%
Pb	1.94%	113	100%
Cu	0.25%	15	100%
Ag	51g/t	0.30	100%
Fe	23.4%	1364	100%
Ca	8.08%	472	100%
Mn	5.26%	307	100%
Mg	2.24%	130	100%

Calculated feed (Reactor 1)

	Assay	kg	% distribution of calc feed
Solids		5834	100%
Zn	12.5%	727	100%
Pb	1.53%	89	100%
Cu	0.25%	15	100%
Ag	49g/t	0.28	100%
Fe	28.7%	1675	100%
Ca	6.82%	398	100%
Mn	4.74%	277	100%
Mg	0.96%	56	100%

Calculated feed (Reactor 2)

	Assay	kg	% distribution of calc feed
Solids		5834	100%
Zn	14.7%	859	100%
Pb	1.85%	108	100%
Cu	0.40%	23	100%
Ag	58g/t	0.34	100%
Fe	32.4%	1889	100%
Ca	9.34%	545	100%
Mn	4.80%	280	100%
Mg	1.44%	84	100%

Calculated feed (Thickener)

	Assay	kg	% distribution of calc feed
Solids		5834	100%
Zn	13.5%	788	100%
Pb	1.79%	105	100%
Cu	0.45%	27	100%
Ag	61g/t	0.36	100%
Fe	31.6%	1846	100%
Ca	7.89%	461	100%
Mn	4.50%	263	100%
Mg	1.27%	74	100%

Total input

	kg	Output/total input
Solids+liquor	131038	100.0%
Zn	5071	100.0%
Pb	524	100.0%
Cu	182	100.0%
Ag	1.51	100.0%
Fe	3048	100.0%
Ca	3611	100.0%
Mn	625	100.0%
Mg	1228	100.0%

Reactor 1 Output

	kg	Output/total input
Solids+liquor	137735	105.1%
Zn	5038	99.3%
Pb	500	95.4%
Cu	182	100.0%
Ag	1.50	99.1%
Fe	3359	110.2%
Ca	3538	98.0%
Mn	595	95.2%
Mg	1154	93.9%

Reactor 2 Output

	kg	Output/total input
Solids+liquor	137735	105.1%
Zn	5169	101.9%
Pb	518	99.0%
Cu	191	104.8%
Ag	1.55	102.8%
Fe	3573	117.2%
Ca	3685	102.0%
Mn	599	95.7%
Mg	1182	96.2%

Total output

	kg	Output/total input
Solids+liquor	140480	107.2%
Zn	5098	100.5%
Pb	515	98.4%
Cu	194	106.5%
Ag	1.57	104.0%
Fe	3530	115.8%
Ca	3600	99.7%
Mn	581	92.9%
Mg	1172	95.4%

Table 2:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Period/Date: **Period 4** **21-31/8/06**

Conditions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
pH	-	1.76	1.64	2.28
Eh	-	371	382	266
RT (hours)	0	2.3	4.6	
Liquor consumption per tonne slag:				
Feed liquor Fe grade g/l			**18.1**	
m^3 feed liquor/t slag			**15.9**	
kg feed liquor Fe/t slag			**289**	
Extractions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on solids assays only:				
Solids	0%	-2%	-9%	-7%
Zn	0%	75%	78%	79%
Pb	0%	87%	89%	89%
Cu	0%	-58%	-80%	-144%
Ag	0%	53%	52%	38%
Fe	0%	-53%	-65%	-56%
Ca	0%	87%	85%	86%
Mn	0%	77%	79%	79%
Mg	0%	91%	92%	91%
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on residue solids and liquor assays:				
Zn	0%	74%	80%	80%
Pb	0%	84%	88%	88%
Cu	0%	-58%	-13%	-34%
Ag	0%	51%	58%	49%
Fe	0%	-25%	-19%	-15%
Ca	0%	84%	87%	86%
Mn	0%	74%	77%	76%
Mg	0%	80%	87%	84%

Extraction summary

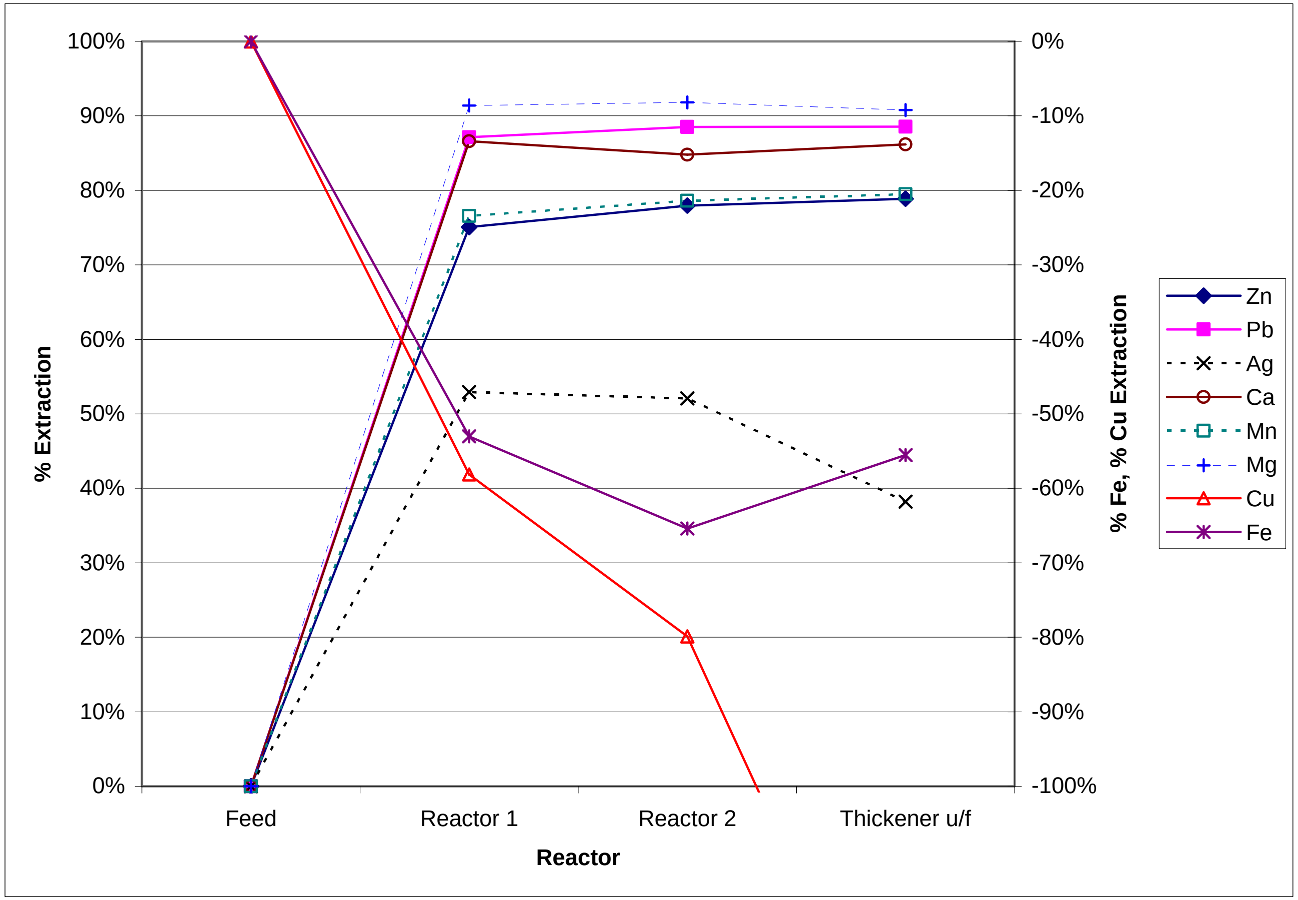


Table 3:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Mass balance summary

Period/Date: **Period 2** **22-24/8/06**

Slag Feed

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		2353	100%	0.0%
Zn	13.1%	308.2	100%	0.0%
Pb	1.77%	41.6	100%	0.0%
Cu	0.25%	5.8	100%	0.0%
Ag	50g/t	0.12	100%	0.0%
Fe	23.1%	543	100%	0.0%
Ca	7.93%	186.7	100%	0.0%
Mn	5.20%	122.3	100%	0.0%
Mg	4.55%	107.1	100%	0.0%

Water inputs

	kg
with feed slurry	2353
with floc	365

Reactor 1 solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		2405	102%	-2.2%
Zn	3.0%	72.4	23%	76.5%
Pb	0.20%	4.9	12%	88.3%
Cu	0.33%	7.9	136%	-35.6%
Ag	20g/t	0.05	41%	59.1%
Fe	36.0%	865	159%	-59.3%
Ca	0.69%	16.7	9%	91.1%
Mn	1.18%	28.4	23%	76.8%
Mg	0.18%	4.4	4%	95.9%

Reactor 2 solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		1984	84%	15.7%
Zn	2.4%	46.9	15%	84.8%
Pb	0.15%	3.0	7%	92.7%
Cu	0.38%	7.5	129%	-28.5%
Ag	19g/t	0.04	32%	68.0%
Fe	35.7%	709	131%	-30.6%
Ca	0.46%	9.2	5%	95.1%
Mn	1.02%	20.3	17%	83.4%
Mg	0.16%	3.3	3%	97.0%

Thickener u/f solids

	Assay	kg	Distribution Solids	Distribution Liquor
Solids		2145	91%	8.9%
Zn	2.3%	50.1	16%	83.8%
Pb	0.17%	3.6	9%	91.4%
Cu	0.46%	9.8	169%	-68.8%
Ag	23g/t	0.05	43%	57.2%
Fe	35.1%	753	139%	-38.7%
Ca	0.59%	12.7	7%	93.2%
Mn	0.98%	20.9	17%	82.9%
Mg	0.19%	4.0	4%	96.2%

Thickener u/f liquor

	Assay	kg	% distribution of total feed
Liquor (kg)		4189	9%
Liquor (l)		3188	
SG		1.31	
Zn	37.3 g/l	118.9	7%
Pb	3.5 g/l	11.1	7%
Cu	.8 g/l	2.7	4%
Ag	9 mg/l	0.03	5%
Fe	14.7 g/l	47	3%
Ca	22.8 g/l	72.8	7%
Mn	3.9 g/l	12.6	6%
Mg	8.9 g/l	28.3	8%

Feed liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		38786		
Liquor (l)		31218		
SG		1.24		
Zn	44.5 g/l	1387.8	0	0.0%
Pb	4.2 g/l	130.7	0	0.0%
Cu	2.0 g/l	62.5	0	0.0%
Ag	14 mg/l	0.42	0.00	0.0%
Fe	25.9 g/l	808	0	0.0%
Ca	27.9 g/l	871.3	0	0.0%
Mn	2.5 g/l	77.1	0	0.0%
Mg	11.7 g/l	366.3	0	0.0%

Reactor 1 liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		41982		
Liquor (l)		32139		
SG		1.31		
Zn	48.3 g/l	1550.7	163	69.2%
Pb	4.8 g/l	155.0	24	83.3%
Cu	1.8 g/l	56.5	-6	-321.6%
Ag	14 mg/l	0.46	0.04	45.8%
Fe	17.3 g/l	557	-251	-40.9%
Ca	29.6 g/l	951.9	81	82.8%
Mn	5.0 g/l	161.5	84	74.8%
Mg	11.2 g/l	359.3	-7	271.1%

Reactor 2 liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		42403		
Liquor (l)		32008		
SG		1.32		
Zn	50.7 g/l	1622.5	235	83.3%
Pb	5.1 g/l	163.9	33	91.6%
Cu	1.8 g/l	58.6	-4	-109.3%
Ag	15 mg/l	0.48	0.06	61.2%
Fe	18.3 g/l	587	-221	-45.1%
Ca	31.3 g/l	1000.9	130	93.4%
Mn	5.2 g/l	167.1	90	81.6%
Mg	11.5 g/l	367.5	1	26.9%

Combine thickener o/f + u/f liquor

	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		42607		
Liquor (l)		32422		
SG		1.31		
Zn	50.3 g/l	1630.5	243	82.9%
Pb	5.1 g/l	166.3	36	90.8%
Cu	1.7 g/l	55.4	-7	-259.9%
Ag	15 mg/l	0.48	0.06	52.8%
Fe	18.1 g/l	587	-220	-41.4%
Ca	31.7 g/l	1028.0	157	92.5%
Mn	5.3 g/l	172.6	96	82.0%
Mg	11.3 g/l	367.1	1	15.9%

Thickener o/f liquor

	Assay	kg	% distribution of total feed
Liquor (kg)		38418	86%
Liquor (l)		29234	
SG		1.31	
Zn	51.7 g/l	1511.5	90%
Pb	5.3 g/l	155.2	91%
Cu	1.8 g/l	52.7	81%
Ag	15 mg/l	0.45	85%
Fe	18.5 g/l	540	40%
Ca	32.7 g/l	955.2	92%
Mn	5.5 g/l	160.1	83%
Mg	11.6 g/l	338.7	91%

Calculated feed

	Assay	kg	% distribution of calc feed
Solids		2353	100%
Zn	13.1%	308	100%
Pb	1.77%	42	100%
Cu	0.25%	6	100%
Ag	50g/t	0.12	100%
Fe	23.1%	543	100%
Ca	7.93%	187	100%
Mn	5.20%	122	100%
Mg	4.55%	107	100%

Calculated feed

	Assay	kg	% distribution of calc feed
Solids		2353	100%
Zn	10.0%	235	100%
Pb	1.24%	29	100%
Cu	0.08%	2	100%
Ag	37g/t	0.09	100%
Fe	26.1%	614	100%
Ca	4.13%	97	100%
Mn	4.79%	113	100%
Mg	-0.11%	-3	100%

Calculated feed

	Assay	kg	% distribution of calc feed
Solids		2353	100%
Zn	12.0%	282	100%
Pb	1.54%	36	100%
Cu	0.15%	4	100%
Ag	41g/t	0.10	100%
Fe	20.8%	489	100%
Ca	5.89%	139	100%
Mn	4.68%	110	100%
Mg	0.19%	4	100%

Calculated feed

	Assay	kg	% distribution of calc feed
Solids		2353	100%
Zn	12.4%	293	100%
Pb	1.66%	39	100%
Cu	0.12%	3	100%
Ag	45g/t	0.11	100%
Fe	22.6%	533	100%
Ca	7.20%	169	100%
Mn	4.95%	116	100%
Mg	0.20%	5	100%

Total input

	kg	Output/total input
Solids+liquor	43858	100.0%
Zn	1696	100.0%
Pb	172	100.0%
Cu	68	100.0%
Ag	0.54	100.0%
Fe	1351	100.0%
Ca	1058	100.0%
Mn	199	100.0%
Mg	473	100.0%

Reactor 1 Output

	kg	Output/total input
Solids+liquor	44387	101.2%
Zn	1623	95.7%
Pb	160	92.8%
Cu	64	94.2%
Ag	0.51	94.7%
Fe	1421	105.2%
Ca	969	91.5%
Mn	190	95.2%
Mg	364	76.8%

Reactor 2 Output

	kg	Output/total input
Solids+liquor	44387	101.2%
Zn	1669	98.4%
Pb	167	96.8%
Cu	66	96.7%
Ag	0.52	96.2%
Fe	1296	96.0%
Ca	1010	95.5%
Mn	187	93.9%
Mg	371	78.3%

Total output

	kg	Output/total input
Solids+liquor	44752	102.0%
Zn	1681	99.1%
Pb	170	98.6%
Cu	65	95.5%
Ag	0.53	98.0%
Fe	1340	99.2%
Ca	1041	98.4%
Mn	194	97.1%
Mg	371	78.4%

Table 4:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Extraction summary

Period/Date: **Period 2** **22-24/8/06**

Conditions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
pH	-	1.65	1.49	2.13
Eh	-	382	395	274
RT (hours)	0	2.7	5.5	
Liquor consumption per tonne slag:				
Feed liquor Fe grade g/l			**25.9**	
m^3 feed liquor/t slag			**13.3**	
kg feed liquor Fe/t slag			**343**	
Extractions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on solids assays only:				
Solids	0%	-2%	16%	9%
Zn	0%	77%	85%	84%
Pb	0%	88%	93%	91%
Cu	0%	-36%	-29%	-69%
Ag	0%	59%	68%	57%
Fe	0%	-59%	-31%	-39%
Ca	0%	91%	95%	93%
Mn	0%	77%	83%	83%
Mg	0%	96%	97%	96%
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on residue solids and liquor assays:				
Zn	0%	69%	83%	83%
Pb	0%	83%	92%	91%
Cu	0%	-322%	-109%	-260%
Ag	0%	46%	61%	53%
Fe	0%	-41%	-45%	-41%
Ca	0%	83%	93%	93%
Mn	0%	75%	82%	82%
Mg	0%	271%	27%	16%

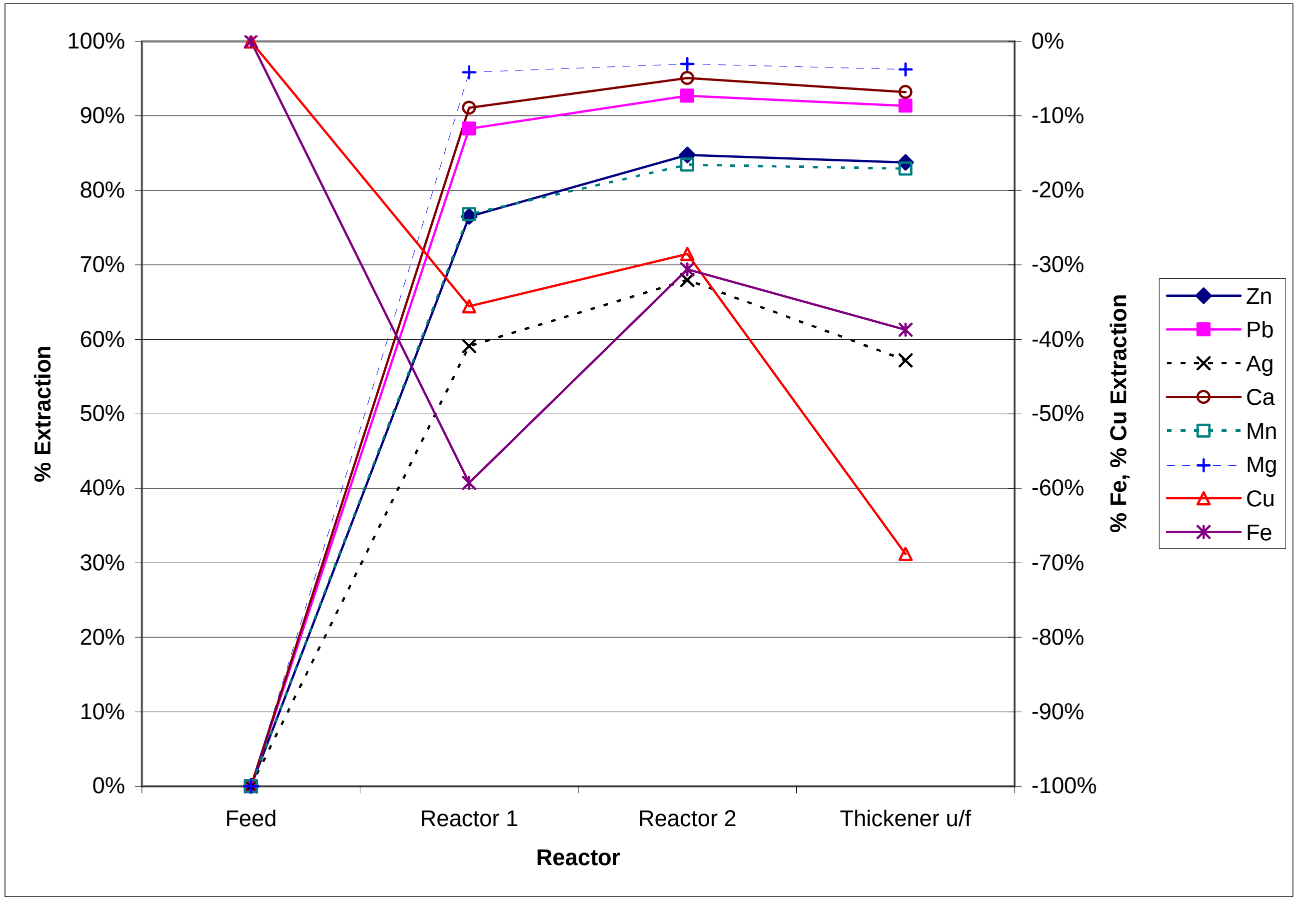


Table 5:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Mass balance summary

Period/Date: **Period 3** **28-31/8/06**

Slag Feed	Assay	kg	Distribution Solids	Distribution Liquor
Solids		2705	100%	0.0%
Zn	13.1%	355.4	100%	0.0%
Pb	2.12%	57.4	100%	0.0%
Cu	0.25%	6.9	100%	0.0%
Ag	51g/t	0.14	100%	0.0%
Fe	23.7%	641	100%	0.0%
Ca	8.21%	222.1	100%	0.0%
Mn	5.33%	144.2	100%	0.0%
Mg	0.67%	18.0	100%	0.0%
Water inputs		kg		
with feed slurry		2705		
with floc		2192		

Reactor 1 solids	Assay	kg	Distribution Solids	Distribution Liquor
Solids		2655	98%	1.9%
Zn	3.7%	99.5	28%	72.0%
Pb	0.32%	8.4	15%	85.4%
Cu	0.49%	12.9	188%	-88.2%
Ag	28g/t	0.08	54%	46.0%
Fe	33.5%	888	139%	-38.7%
Ca	1.15%	30.4	14%	86.3%
Mn	1.39%	37.0	26%	74.3%
Mg	0.21%	5.5	30%	69.7%

Reactor 2 solids	Assay	kg	Distribution Solids	Distribution Liquor
Solids		3168	117%	-17.1%
Zn	3.3%	105.1	30%	70.4%
Pb	0.27%	8.4	15%	85.3%
Cu	0.52%	16.4	239%	-138.5%
Ag	27g/t	0.09	62%	37.9%
Fe	33.4%	1057	165%	-65.1%
Ca	0.93%	29.4	13%	86.8%
Mn	1.25%	39.5	27%	72.6%
Mg	0.19%	5.9	33%	67.2%

Thickener u/f solids	Assay	kg	Distribution Solids	Distribution Liquor
Solids		3561	132%	-31.7%
Zn	2.9%	104.4	29%	70.6%
Pb	0.25%	8.7	15%	84.8%
Cu	0.70%	25.0	365%	-264.7%
Ag	35g/t	0.13	90%	9.6%
Fe	32.5%	1156	180%	-80.5%
Ca	0.98%	34.8	16%	84.3%
Mn	1.12%	39.9	28%	72.3%
Mg	0.21%	7.3	41%	59.4%

Thickener u/f liquor	Assay	kg	% distribution of total feed
Liquor (kg)		6469	8%
Liquor (l)		4955	
SG		1.31	
Zn	38.4 g/l	190.2	6%
Pb	3.7 g/l	18.5	6%
Cu	.5 g/l	2.4	2%
Ag	6 mg/l	0.03	3%
Fe	9.7 g/l	48	3%
Ca	28.3 g/l	140.1	6%
Mn	4.5 g/l	22.3	6%
Mg	8.8 g/l	43.8	6%

Feed liquor	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		75398		
Liquor (l)		59879		
SG		1.26		
Zn	47.5 g/l	2841.8	0	0.0%
Pb	4.5 g/l	272.2	0	0.0%
Cu	1.7 g/l	101.2	0	0.0%
Ag	13 mg/l	0.77	0.00	0.0%
Fe	13.8 g/l	825	0	0.0%
Ca	37.0 g/l	2218.1	0	0.0%
Mn	4.0 g/l	237.0	0	0.0%
Mg	11.8 g/l	708.8	0	0.0%

Reactor 1 liquor	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		79189		
Liquor (l)		61220		
SG		1.29		
Zn	48.1 g/l	2947.3	105	51.4%
Pb	4.8 g/l	296.3	24	74.2%
Cu	1.5 g/l	90.9	-10	-394.2%
Ag	13 mg/l	0.79	0.02	23.0%
Fe	9.8 g/l	599	-226	-34.2%
Ca	37.1 g/l	2268.7	51	62.4%
Mn	5.3 g/l	323.9	87	70.1%
Mg	11.4 g/l	696.5	-12	179.0%

Reactor 2 liquor	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		78675		
Liquor (l)		61511		
SG		1.28		
Zn	49.0 g/l	3015.0	173	62.2%
Pb	5.0 g/l	304.7	32	79.4%
Cu	1.5 g/l	94.4	-7	-70.4%
Ag	13 mg/l	0.82	0.06	39.3%
Fe	10.2 g/l	627	-199	-23.1%
Ca	37.7 g/l	2318.7	101	77.4%
Mn	5.4 g/l	332.1	95	70.7%
Mg	11.6 g/l	711.1	2	27.8%

Combine thickener o/f + u/f liquor	Assay	Total kg	Liquor Gain kg	% distribution of calc feed
Liquor (kg)		80474		
Liquor (l)		61644		
SG		1.31		
Zn	47.6 g/l	2934.0	92	46.9%
Pb	4.9 g/l	299.8	28	75.9%
Cu	1.4 g/l	89.4	-12	-89.2%
Ag	13 mg/l	0.79	0.03	17.3%
Fe	10.8 g/l	664	-161	-16.2%
Ca	36.1 g/l	2227.6	10	21.4%
Mn	5.2 g/l	318.5	81	67.1%
Mg	11.3 g/l	694.5	-14	204.4%

Thickener o/f liquor	Assay	kg	% distribution of total feed
Liquor (kg)		74005	88%
Liquor (l)		56689	
SG		1.31	
Zn	48.4 g/l	2743.8	90%
Pb	5.0 g/l	281.3	91%
Cu	1.5 g/l	87.0	76%
Ag	13 mg/l	0.76	83%
Fe	10.9 g/l	616	34%
Ca	36.8 g/l	2087.5	92%
Mn	5.2 g/l	296.2	83%
Mg	11.5 g/l	650.7	93%

Calculated feed	Assay	kg	% distribution of calc feed
Solids		2705	100%
Zn	13.1%	355	100%
Pb	2.12%	57	100%
Cu	0.25%	7	100%
Ag	51g/t	0.14	100%
Fe	23.7%	641	100%
Ca	8.21%	222	100%
Mn	5.33%	144	100%
Mg	0.67%	18	100%

Calculated feed (Reactor 1)	Assay	kg	% distribution of calc feed
Solids		2705	100%
Zn	7.6%	205	100%
Pb	1.20%	32	100%
Cu	0.10%	3	100%
Ag	36g/t	0.10	100%
Fe	24.5%	662	100%
Ca	2.99%	81	100%
Mn	4.58%	124	100%
Mg	-0.26%	-7	100%

Calculated feed (Reactor 2)	Assay	kg	% distribution of calc feed
Solids		2705	100%
Zn	10.3%	278	100%
Pb	1.51%	41	100%
Cu	0.36%	10	100%
Ag	53g/t	0.14	100%
Fe	31.7%	859	100%
Ca	4.81%	130	100%
Mn	4.98%	135	100%
Mg	0.30%	8	100%

Calculated feed (Thickener)	Assay	kg	% distribution of calc feed
Solids		2705	100%
Zn	7.3%	197	100%
Pb	1.34%	36	100%
Cu	0.49%	13	100%
Ag	56g/t	0.15	100%
Fe	36.8%	995	100%
Ca	1.64%	44	100%
Mn	4.49%	121	100%
Mg	-0.26%	-7	100%

Total input	kg	Output/total input
Solids+liquor	83000	100.0%
Zn	3197	100.0%
Pb	330	100.0%
Cu	108	100.0%
Ag	0.90	100.0%
Fe	1466	100.0%
Ca	2440	100.0%
Mn	381	100.0%
Mg	727	100.0%

Reactor 1 Output	kg	Output/total input
Solids+liquor	81843	98.6%
Zn	3047	95.3%
Pb	305	92.5%
Cu	104	96.1%
Ag	0.86	95.4%
Fe	1487	101.5%
Ca	2299	94.2%
Mn	361	94.7%
Mg	702	96.6%

Reactor 2 Output	kg	Output/total input
Solids+liquor	81843	98.6%
Zn	3120	97.6%
Pb	313	95.0%
Cu	111	102.5%
Ag	0.91	100.4%
Fe	1684	114.9%
Ca	2348	96.2%
Mn	372	97.5%
Mg	717	98.6%

Total output	kg	Output/total input
Solids+liquor	84036	101.2%
Zn	3038	95.0%
Pb	309	93.6%
Cu	114	105.9%
Ag	0.92	101.4%
Fe	1820	124.2%
Ca	2262	92.7%
Mn	358	94.0%
Mg	702	96.6%

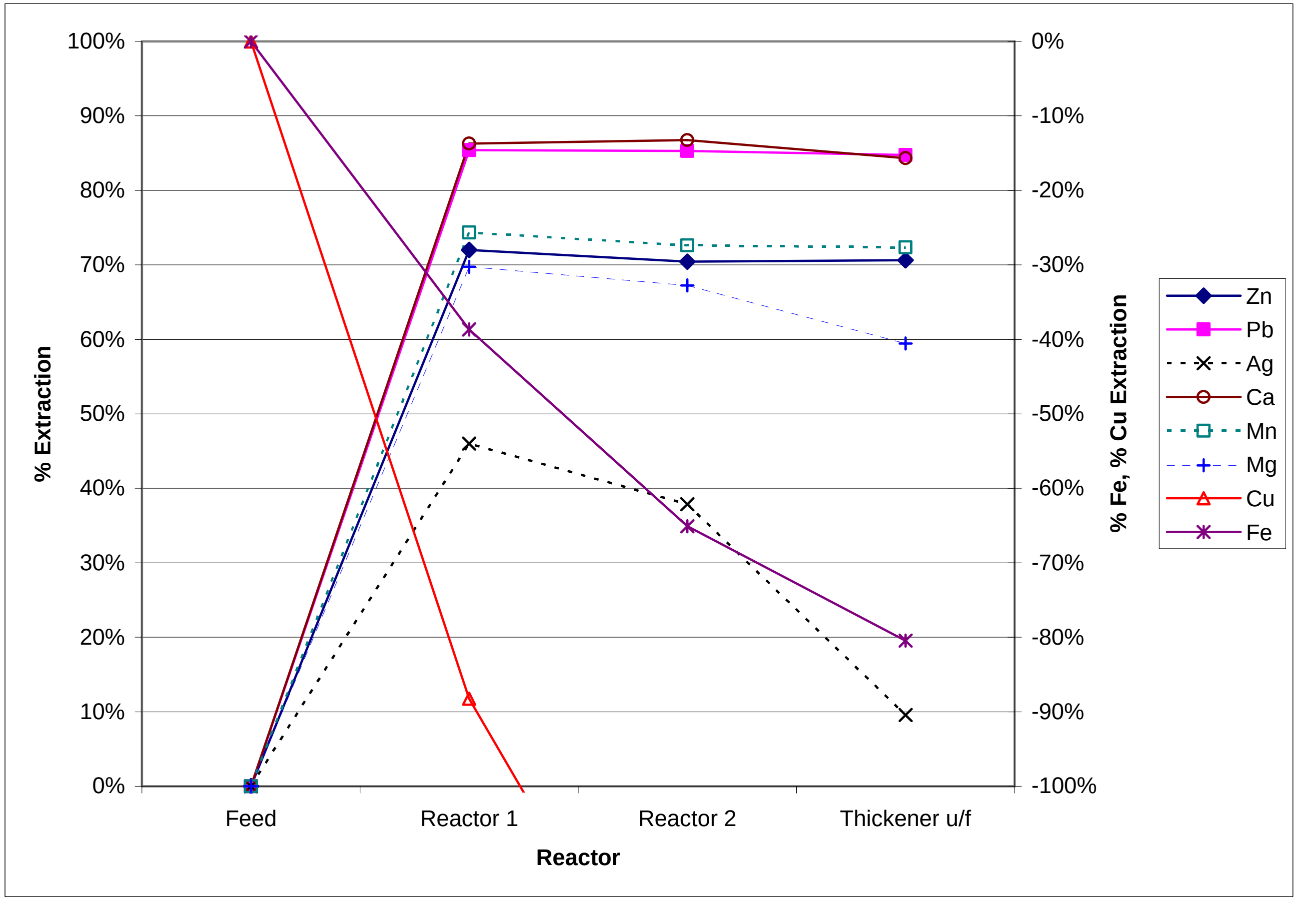
Table 6:

Intec Hellyer Metals Demonstration Plant: Zeehan slag leach trial

Period/Date: **Period 3** **28-31/8/06**

Conditions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
pH	-	1.69	1.61	2.51
Eh	-	377	388	228
RT (hours)	0	1.9	3.8	
Liquor consumption per tonne slag:				
Feed liquor Fe grade g/l			**13.8**	
m^3 feed liquor/t slag			**22.1**	
kg feed liquor Fe/t slag			**305**	
Extractions:				
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on solids assays only:				
Solids	0%	2%	-17%	-32%
Zn	0%	72%	70%	71%
Pb	0%	85%	85%	85%
Cu	0%	-88%	-139%	-265%
Ag	0%	46%	38%	10%
Fe	0%	-39%	-65%	-80%
Ca	0%	86%	87%	84%
Mn	0%	74%	73%	72%
Mg	0%	70%	67%	59%
Position	**Feed**	**Reactor 1**	**Reactor 2**	**Thickener u/f**
Calculated based on residue solids and liquor assays:				
Zn	0%	51%	62%	47%
Pb	0%	74%	79%	76%
Cu	0%	-394%	-70%	-89%
Ag	0%	23%	39%	17%
Fe	0%	-34%	-23%	-16%
Ca	0%	62%	77%	21%
Mn	0%	70%	71%	67%
Mg	0%	179%	28%	204%

Extraction summary



7.15.1 Reagent Inputs

The only reagent input to the Zeehan Slag Leach was flocculant to the thickener feed. Consumption for the trial is summarised in Table 7.

Table 7: Flocculant inputs to Zeehan Slag Leach

Reagent	Consumption	
	Total kg	g/t Slag feed
22-24/8/06	0.370	155 g/t
28-31/8/06	2.19	811 g/t
21-31/8/06	2.74	470 g/t

Flocculant used was Nalco Optimer 83370 plus.

7.15.2 Effect of variables on Metals Extraction

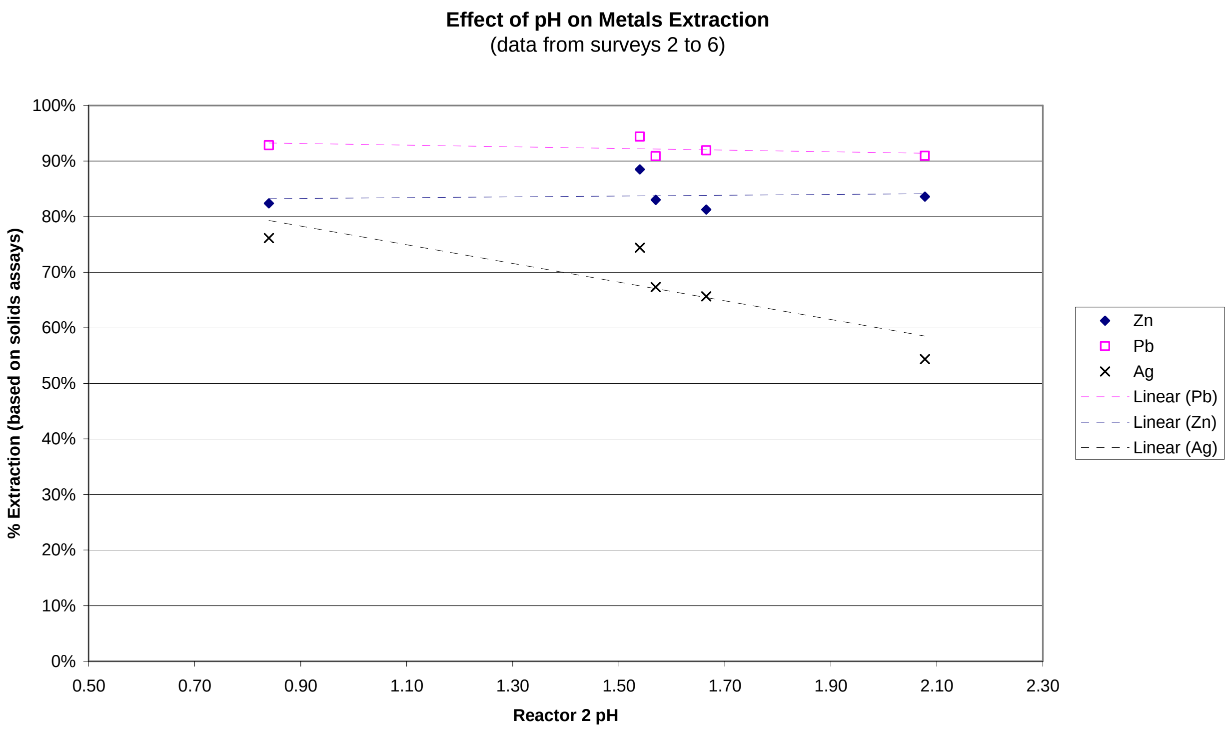
During the first several days of the trial, pH set point in reactors 1 and 2 was progressively decreased until a drop off in solids/liquor separation was observed, to aid in identifying a bottom limit for pH.

Figure 1 shows plots of Zn, Pb and Ag extractions versus pH, with figure 2 showing trends for Fe and Cu.

It appears both Zn and Pb extractions are reasonably insensitive to pH over the operating range for the trial. Zn extraction of 82% was achieved at pH 0.84, compared with 84% at pH 2.08.

pH appears to have some effect on Ag extraction, with extraction generally increasing with decreasing pH.

Figure 1.



Cu was precipitated from the feed solution at all pH's greater than 0.84, with amount of precipitation increasing with increasing pH.

Figure 2.

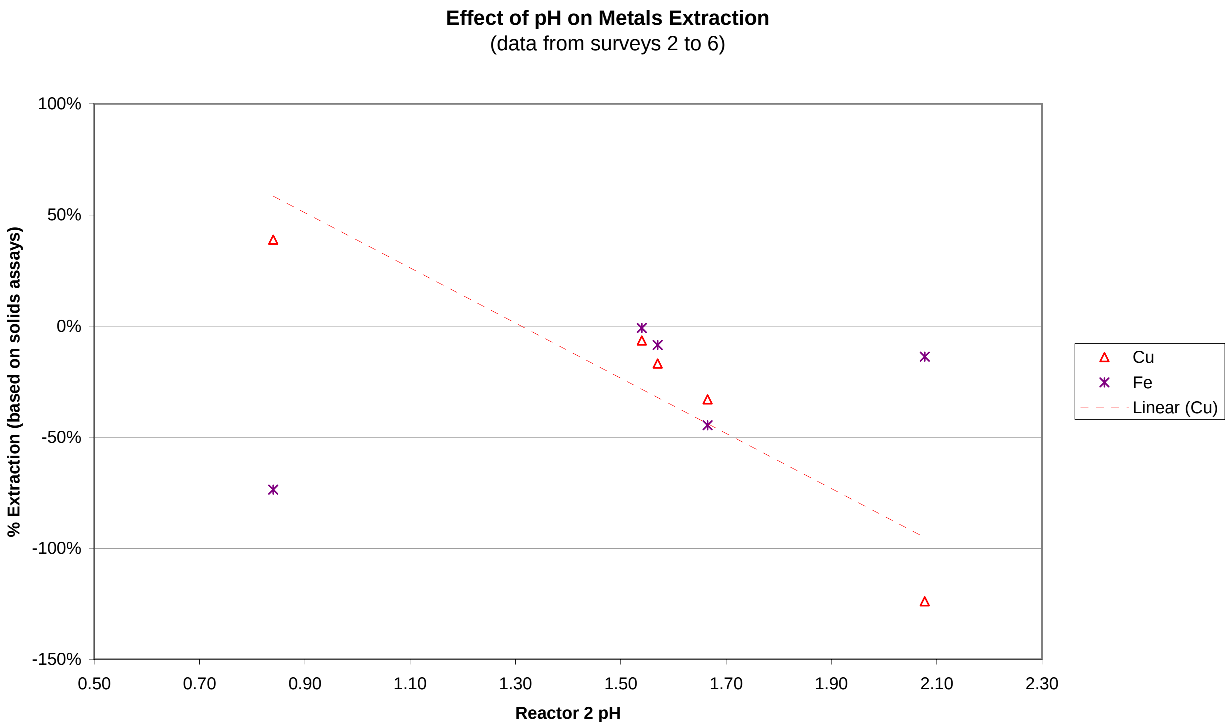
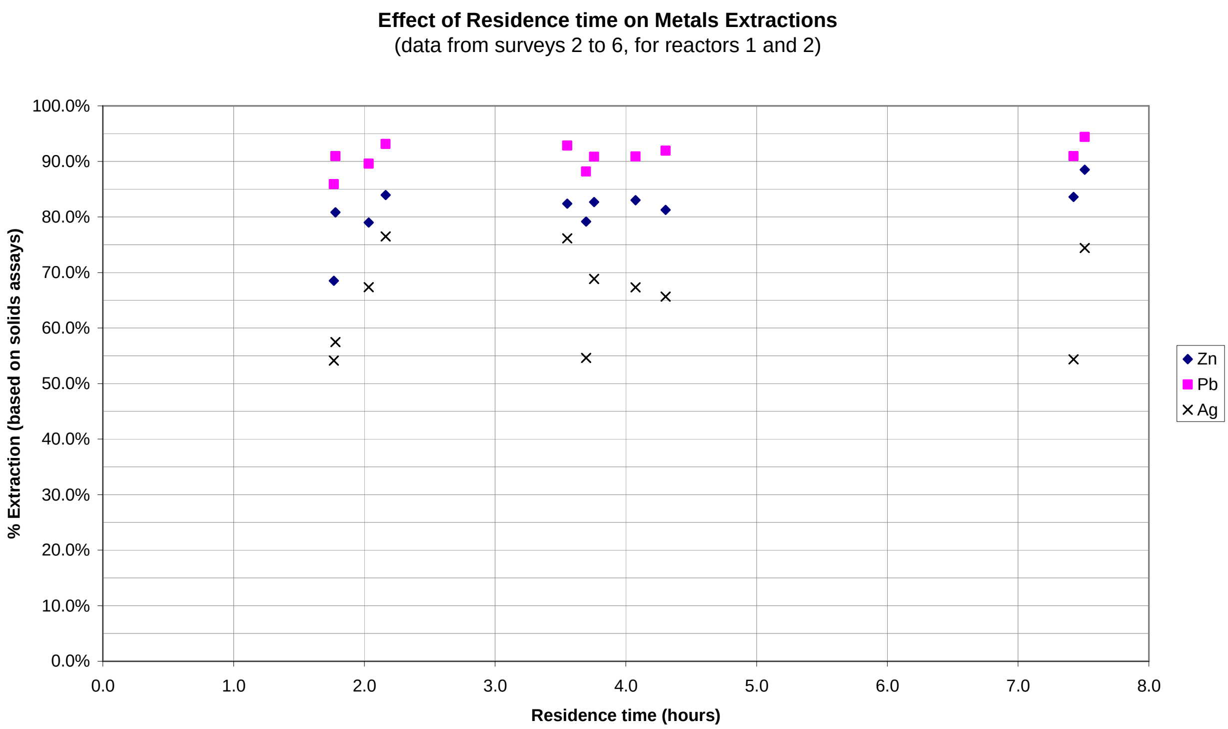


Figure 3 shows plots of Zn, Pb and Ag extractions versus residence time in the leach. Residence times and extractions have been calculated at both reactors 1 and 2.

Figure 3.



It would appear that extractions for Zn, Pb, and Ag are quite insensitive to residence time over the range of ~2 to ~7 hours. It appears approximately 2 hours residence time is sufficient to provide high extractions.

7.15.3 Solids/liquor separation performance

Standard cylinder settling tests were conducted throughout the trial on pulp samples collected from both reactors 1 and 2, with standard vacuum filtration tests carried out on the thickened pulp produced.

Overflow liquor produced from the cylinder tests was syringe filtered through a 0.45 micron membrane filter to give a qualitative assessment of whether silica had been effectively precipitated or was gelling to some extent. Fast/easy filtration (at 0.45 microns) of the liquor indicates silica has been effectively controlled. Increasing difficulty in filtration at 0.45 microns indicates the presence of colloidal silica, and onset of silica gels.

Complete results for all settling and filtration tests carried out are attached in appendix 9.15.

Table 8, and figures 4 and 5 summarise settling and filtration results for pulps collected while operating at a variety of pH's.

Table 8: Summary of Settling and Filtration results at various pH's

reactor 2 pulp, filtration tests consisted of 3 by 100 ml washes + 30 seconds drying time

Test	10	14	17	19	24	27	30
Date	22.8.06	22.8.06	23.8.06	23.8.06	24.8.06	24.8.06	24.8.06
Time	9:00:00 AM	3:00:00 PM	9:00:00 AM	3:00:00 PM	9:00:00 AM	3:00:00 PM	6:00:00 PM
pH	**1.6**	**1.3**	**1.3**	**1.1**	**1.1**	**0.9**	**0.9**
Settling:							
Clarity:	Excellent	Excellent	Excellent	Excellent	Excellent	cloudy silica	cloudy silica
0.45um Filtration	**Fast/easy**	**Fast/easy**	**Fast/easy**	**Fast/easy**	**Slow/Hard**	**slow/hard**	**impossible**
Vacuum Filtration:							
Cake thickness (mm)	10	10	10	10	12	9	8
Form rate ($kg/m^2/h$)	1,564	1,523	1,625	1,322	677	865	199
Filtration rate ($kg/m^2/h$)	**357**	**316**	**345**	**286**	**282**	**288**	**71**
% moisture	32.3	32.8	32.8	35.2	38.7	37.8	38.4

Although settling rates across the range of pH's did not vary markedly, results show a very marked decrease in filtration rates below pH 1.3. At the lower pH's (1.1 and 0.9), 0.45 micron filtration of the overflow liquor became increasingly difficult. At pH 0.9 silica clouds were clearly visible in the supernatant liquor from the settling tests.

These results clearly indicate a bottom limit in operable pH of 1.3. Below this, precipitation of silica in a manageable form becomes uncertain. At pH's of 1.3 and greater, settling was rapid, producing clear overflow liquors, free of colloidal silica. At pH's of 1.3 and greater filtration rates of 350-450 $kg/h/m^2$ (inclusive of 3 washes stages and dry time) were readily achievable.

Figure 4.

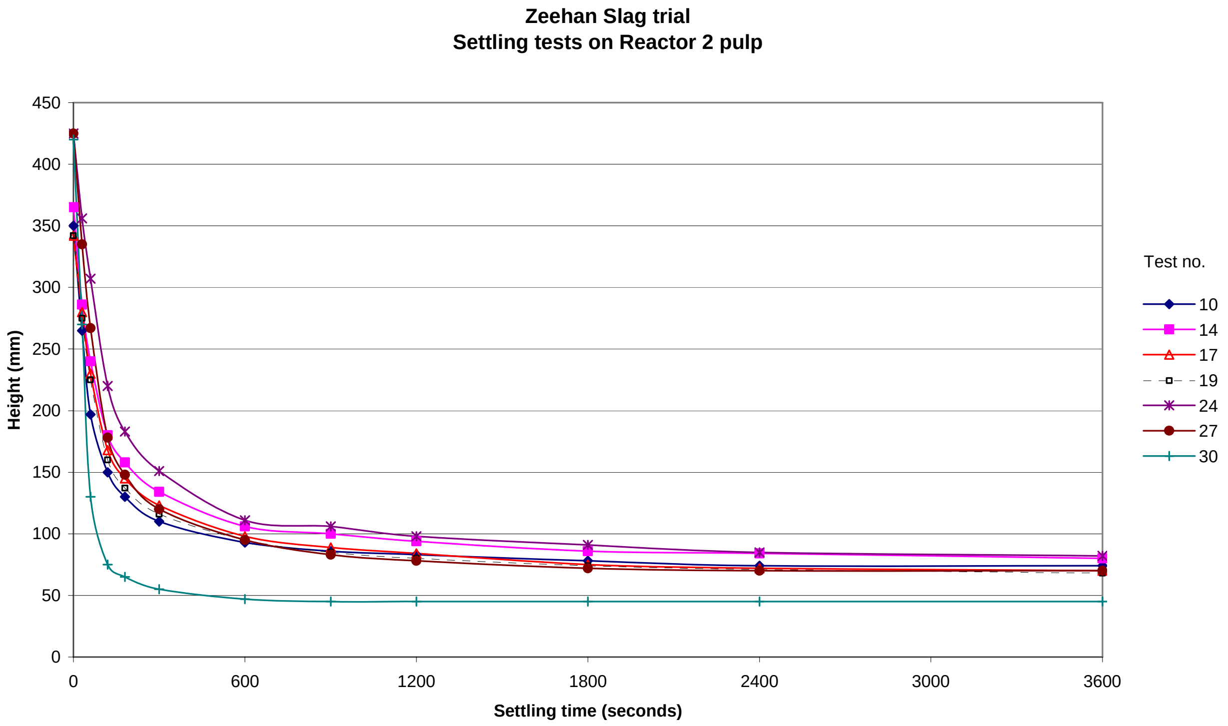
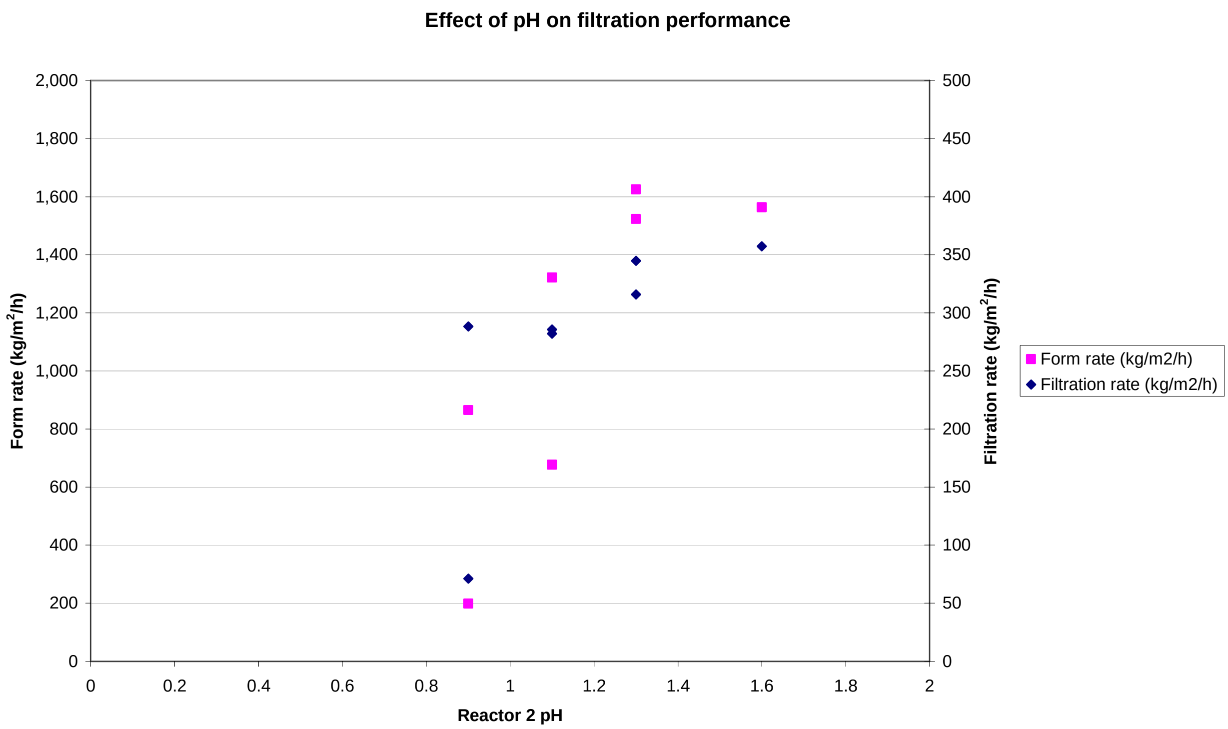


Figure 5.

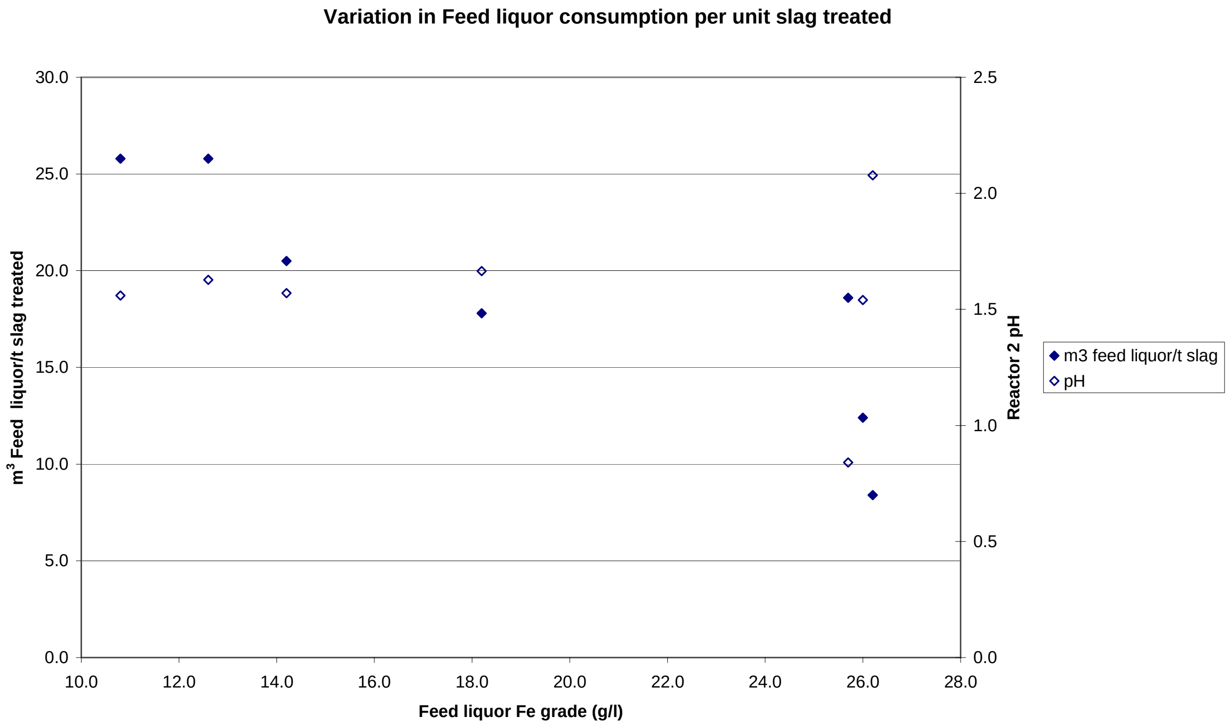


7.15.4 Liquor and soluble iron consumption

Feed liquor input to the slag leach was controlled to maintain the desired pH set point in both slag leach reactors, with slag input controlled to maintain a constant solids input. Liquor input to reactor 1 was controlled via a PID loop from a fixed pH probe in reactor 1, with the loop output driving the feed liquor pump (PF-PL01) speed. A portion of the liquor feed was bled off and dosed to reactor 2, via a control valve driven by a PID loop controlling pH in reactor 2. The amount of liquor fed to reactor 2 represented only a minor portion of the total liquor feed to the circuit.

During the course of the slag trial, feed liquor consumption per unit of slag varied significantly, from a low of 8.4 m^3/t slag to a high 25.8m^3/t slag. From figure 6, it can be seen that liquor consumption has generally increased with decreasing Fe tenor, and decreasing pH.

Figure 6.



Figures 7 and 8 show plots of soluble iron consumption per unit slag (kg Fe contained in feed liquor/t slag), versus pH and feed liquor Fe grade. It can be seen feed liquor iron consumption varies strongly with the pH the slag leach is operated, with consumption decreasing from 478 kg Fe/t slag at pH 0.84 to 220 kg Fe/t slag at pH 2.08.

From figure 8, it can be seen iron consumption per unit slag treated has remained reasonably constant with varying Fe grade of the feed liquor for comparable pH’s.

Figure 7.

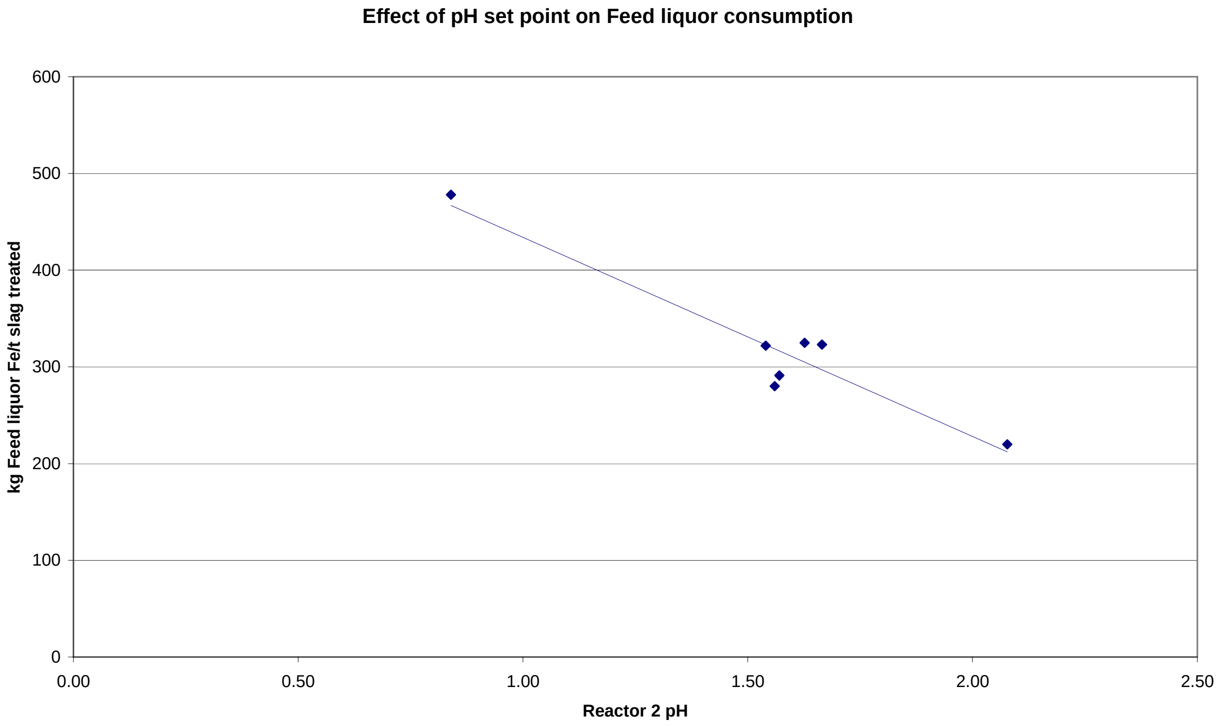
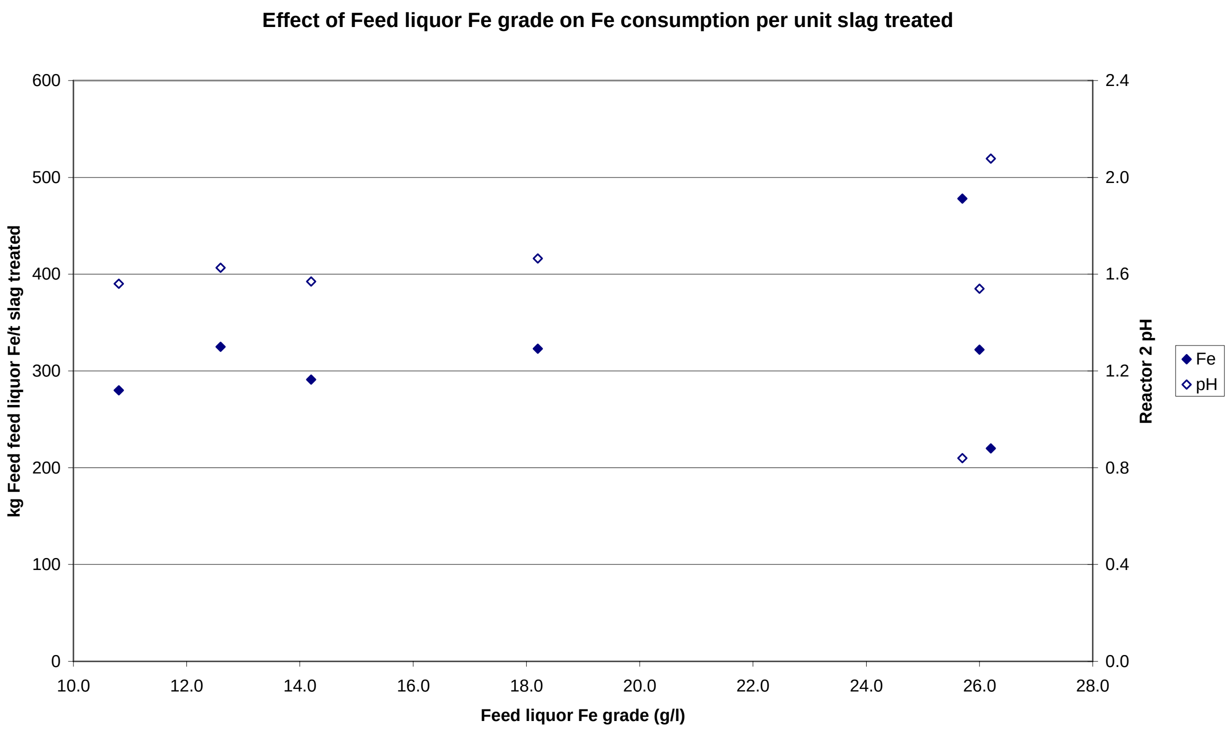


Figure 8.



7.15.5 Indium deportment

Behaviour of indium contained in Zeehan slag was of passing interest during the Zeehan slag trial.

Table 9 below summarises deportment of indium contained in Zeehan slag, achieved during the slag trial.

Table 9: Indium Deportment summary

Period/Date: Period 4 21-31/8/06

Slag Feed			**Distribution**		**Thickener u/f solids**			**Distribution**	
	Assay	kg	Solids	Liquor		Assay	kg	Solids	Liquor
Solids		5834	100%	0.0%	Solids		6228	107%	-7%
In	37g/t	0.216	100%	0.0%	In	9.8g/t	0.061	28%	72%

The slag was quite low grade in indium at only 37g/t. An extraction of 72% indium was achieved, giving an average residue solids grade of 9.8 g/t.

7.15.6 Zeehan slag leach thickener o/f liquor composition

Table 10 shows average feed liquor and thickener o/f liquor composition for the Zeehan Slag trial.

It should be noted that although significant Fe was precipitated from solution across the slag leach, large amounts of ferrous iron remained in solution existing the leach.

Table 10: Average Feed and thickener o/f liquor composition

Zeehan slag trial: Period 4. 21-31/8/06

Element	Feed liquor	Thickener o/f liquor
Zn	46.3 g/l	49.0 g/l
Pb	4.4 g/l	5.0 g/l
Cu	1.8 g/l	1.6 g/l
Ag	13 mg/l	14 mg/l
Fe	18.1 g/l	13.9 g/l
Ca	33.7 g/l	35.1 g/l
Mn	3.4 g/l	5.1 g/l
Mg	11.8 g/l	11.5 g/l
SG	1.25	1.30

7.15.7 Minor elements

Analyses for minor elements present in Zeehan slag feed solids and leach residue solids are shown in tables 11 and 12 for periods 1 and 3 respectively.

Of particular note is the high levels of chloride present in the leach residue solids, averaging 1.58% for the first 4 days of the trial, and 1.05% for the final 4 days of the trial. By comparison chloride in slag feed averaged 0.12% and 0.17% for these two periods respectively. This represents insoluble chloride losses of approximately 12 kg/t of slag feed for both periods.

It does not appear that the Zeehan slag leach has introduced significant amounts of any minor elements not already present from tails and EAFD into solution.

Table 11: Minor Elements Analyses for Zeehan Slag feed solids and leach residue solids

Zeehan slag trial: Period 1. 21-24/8/06

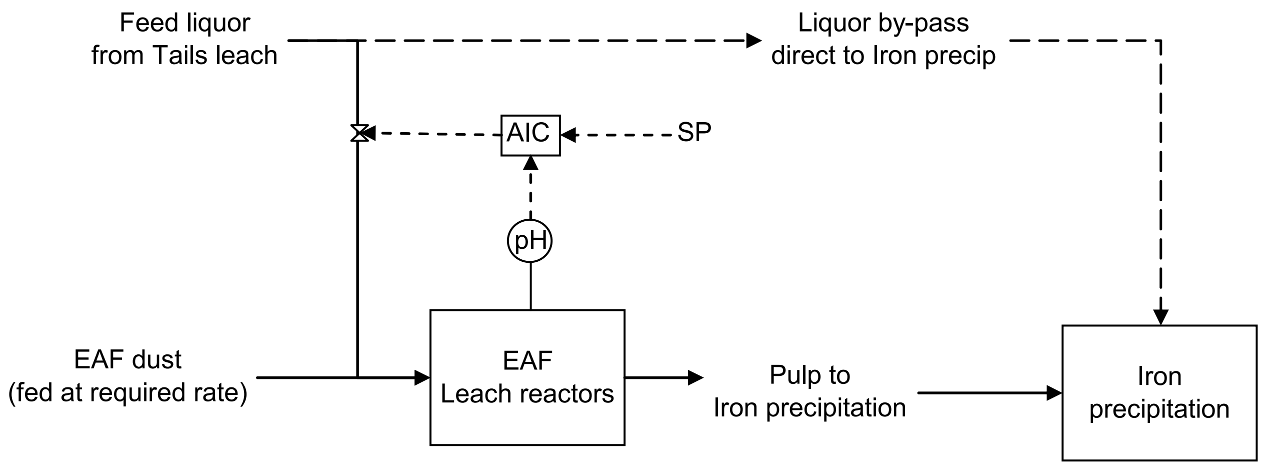
Element				Pb	Zn	Cu	Fe	Ag	As	S	C	Al	Ba	Ca	Cr	Mg	Mn	Na	Tl	V	Sb	Bi	Cd	Co	Ga	In	Mo	Ni	Sr	Te	Se	Cl	Hg	K
UNITS				%	%	%	%	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DETECTION				0.005	0.005	0.005	0.01	2	50	0.01	0.02	10	2	10	2	10	5	10	5	2	5	0.1	0.1	0.2	0.1	0.05	0.1	2	0.1	0.2	0.5	50	0.1	10
METHOD				MET1	MET1	MET1	MET1	MET1	MET1	COMB01	COMB01	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	CL1E	IC2M	IC3E
Sample no.	Description	Shift	Date																															
S3000	Slag feed slurry	DS	21/08/2006	1.74	13.21	0.275	25.09	41	400	2.14	0.04	20300	85	71200	336	7910	51700	2160	0	67	203	0.6	13.3	34.2	17.5	37	17.2	66	181	0	7.6	1900	0.3	6750
S3002	Slag feed slurry	NS	21/08/2006	2.13	16.28	0.33	31.17	48	510	2.48	0.07	19500	85	73500	330	7820	50000	563	0	64	195	0.5	13.9	35.3	18	37.9	17.9	67	190	0	6.9	590	0.3	6920
S3004	Slag feed slurry	DS	22/08/2006	1.71	12.63	0.255	24.56	39	380	2.58	0.04	17500	89	72400	286	7110	45900	492	0	59	171	0.5	13.6	33.9	16.9	36.6	17.3	65	193	0	10.6	490	0.3	5450
S3006	Slag feed slurry	NS	22/08/2006	1.715	12.78	0.245	24.73	39	390	2.6	0.04	19300	124	76500	309	7750	49900	1000	0	65	174	0.5	13.1	34.4	16.7	36.8	16.9	65	188	0	6.6	1430	0.3	6000
S3008	Slag feed slurry	DS	23/08/2006	2.6	15.92	0.275	24.36	46	760	2.8	0.06	20000	89	76300	332	7820	49200	626	0	64	187	0.5	13.5	34	17.1	37.3	17.9	65	185	0	7.1	370	0.3	6800
S3010	Slag feed slurry	NS	23/08/2006	1.935	13.93	0.27	25.58	41	440	2.65	0.1	20000	104	78100	328	7990	51600	560	0	67	187	0.5	13.7	34.5	17.2	37.5	17.8	65	193	0	6.8	650	0.3	5910
S3012	Slag feed slurry	DS	24/08/2006	1.76	13.21	0.25	24.09	37	400	2.95	0.04	18800	101	75800	291	7570	48500	3290	0	63	194	0.6	13.3	34	16.6	36.9	17.6	64	187	0	6.7	3030	0.3	6040
S3014	Slag feed slurry	NS	24/08/2006	1.81	13.23	0.25	24.62	40	420	2.8	0.06	18100	76	72600	313	7360	46600	482	0	61	172	0.6	13.7	33	16.5	36.4	16.7	63	180	0	7.1	830	0	6610
	Slag feed slurry		**Average**	**1.93**	**13.90**	**0.27**	**25.53**	**41**	**463**	**2.63**	**0.06**	**19188**	**94**	**74550**	**316**	**7666**	**49175**	**1147**	**0**	**64**	**185**	**0.5**	**13.5**	**34.2**	**17.1**	**37.1**	**17.4**	**65**	**187**	**0**	**7.4**	**1161**	**0.3**	**6310**
S3001	Slag th U/F	DS	21/08/2006	0.08	0.295	0.03	45.33	5	2420	5.47	0.15	6630	49	43300	306	1400	692	2450	0	25	95	1.5	1.6	2.5	21.5	0.22	12.8	12	41.5	0.4	1.8	9940	0.5	4690
S3003	Slag th U/F	NS	21/08/2006	0.145	1.93	0.325	37.62	11	1130	3.95	0.1	19900	64	8130	451	2120	8120	3310	0	34	158	1.4	1.3	14	22.6	7.06	14.8	18	68.7	0	1.5	11500	1.1	1920
S3005	Slag th U/F	DS	22/08/2006	0.21	2.51	0.63	30.6	24	710	3.77	0.06	23900	79	11300	487	3380	10300	9250	8	37	165	2.5	2.8	16.8	20.5	8.2	13.9	20	86.5	0	2.3	30200	1.6	1660
S3007	Slag th U/F	NS	22/08/2006	0.18	2.28	0.745	31.2	27	690	3.81	0.04	27600	79	5330	550	2420	10400	3460	6	38	184	1.6	1.2	16.2	22.5	9.27	16.1	21	75.6	0	1.1	12000	2	893
S3009	Slag th U/F	DS	23/08/2006	0.24	2.53	0.805	33.54	35	800	3.88	0.03	28200	71	6440	564	2580	10500	3550	12	40	203	4.3	1.3	16.2	23.2	9.33	15.4	21	98.5	0	0.9	9350	2.9	1280
S3011	Slag th U/F	NS	23/08/2006	0.305	1.91	0.45	34.55	15	670	4.02	0.05	22400	76	3450	559	2250	9380	3630	0	39	201	2.1	0.4	15.3	24.9	7.01	16.3	18	82.3	0	1.1	10000	1.5	677
S3013	Slag th U/F	DS	24/08/2006	0.18	2.1	0.395	33.04	19	640	3.86	0.03	18700	58	6810	499	2690	8840	7820	5	35	174	2.3	1.9	16.1	23.2	6.76	15.2	18	87	0	5.1	27100	0	1020
S3015	Slag th U/F	NS	24/08/2006	0.105	2.12	0.035	43.08	5	990	4.58	0.05	6500	78	2380	569	2240	10600	1880	0	46	199	0.3	0.2	18.2	30.4	5.3	18.3	21	52.3	0	1.3	15900	0.2	526
	Slag th U/F		**Average**	**0.18**	**1.96**	**0.43**	**36.12**	**18**	**1006**	**4.17**	**0.06**	**19229**	**69**	**10893**	**498**	**2385**	**8604**	**4419**	**3.88**	**37**	**172**	**2.0**	**1.34**	**14.4**	**23.6**	**6.64**	**15.4**	**18.6**	**74.1**	**0.05**	**1.9**	**15749**	**1.2**	**1583**

Table 12: Minor Elements Analyses for Zeehan Slag feed solids and leach residue solids

Zeehan slag trial: Period 3. 28-31/8/06

Element				Pb	Zn	Cu	Fe	Ag	As	S	C	Al	Ba	Ca	Cr	Mg	Mn	Na	Tl	V	Sb	Bi	Cd	Co	Ga	In	Mo	Ni	Sr	Te	Se	Cl	Hg	K
UNITS				%	%	%	%	ppm	ppm	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DETECTION				0.005	0.005	0.005	0.01	2	50	0.01	0.02	10	2	10	2	10	5	10	5	2	5	0.1	0.1	0.2	0.1	0.05	0.1	2	0.1	0.2	0.5	50	0.1	10
METHOD				MET1	MET1	MET1	MET1	MET1	MET1	COMB01	COMB01	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3E	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	IC3M	CL1E	IC2M	IC3E
Sample no.	Description	Shift	Date																															
S3016	Slag feed slurry	DS	28/08/2006	1.91	13.17	0.255	25.04	41	440	2.73	0.04	18700	85	73300	310	7530	47200	423	0	62	187	0.8	14.4	34.3	17.2	37.5	17.5	72	189	0	7.1	520	0	6320
S3018	Slag feed slurry	NS	28/08/2006	2.23	15.54	0.32	28.33	53	510	2.91	0.04	17000	137	66900	301	7280	43300	540	0	58	190	0.8	13.9	33.8	16.9	37.5	18	64	200	0	8.6	360	0	5950
S3020	Slag feed slurry	DS	29/08/2006	1.74	13.01	0.255	25.14	38	400	2.8	0.04	18200	171	75000	319	7730	48100	436	0	64	190	0.9	14	33.1	16.6	36.6	17.1	65	192	0	6.7	480	0	6690
S3022	Slag feed slurry	NS	29/08/2006	2.74	19.54	0.41	38.24	70	660	2.83	0.04	18700	77	72800	303	7540	47700	453	0	63	191	0.8	14.5	33.7	16.7	37.1	17.4	64	183	0	7.2	260	0	7020
nsr	Slag feed slurry	DS	30/08/2006																															
S3026	Slag feed slurry	NS	30/08/2006	1.6	11.51	0.24	21.57	34	370	2.92	0.03	19000	88	72700	306	7460	47400	460	0	62	193	0.7	14.3	33.2	16.7	37.1	16.8	71	183	0	6.8	320	0	6620
S3028	Slag feed slurry	DS	31/08/2006	1.76	12.98	0.245	24.67	39	420	2.86	0.06	19500	97	75200	297	7780	48500	479	0	65	198	0.9	14.2	33.7	16.5	36.9	17	66	185	0	7.3	630	0	6640
S3030	Slag feed slurry	NS	31/08/2006	0.275	3.12	0.625	32.79	24	1030	4.15	0.08	25000	64	9550	418	2540	12100	1880	0	36	173	2.1	2.9	16.7	17.2	12.4	17.1	24	66.8	0	2.3	9100	0.2	1920
	Slag feed slurry		**Average**	**1.75**	**12.70**	**0.34**	**27.97**	**43**	**547**	**3.03**	**0.05**	**19443**	**103**	**63636**	**322**	**6837**	**42043**	**667**	**0**	**59**	**189**	**1.0**	**12.6**	**31.2**	**16.8**	**33.6**	**17.3**	**60.9**	**171**	**0**	**6.6**	**1667**	**0.0**	**5880**
S3017	Slag th U/F	DS	28/08/2006	0.16	2.41	1.11	32.8	29	520	4.38	0.07	29800	62	3210	478	2330	9110	2500	0	33	193	4.6	0.2	22.4	19.6	16.5	16.2	25	81.3	0	7.1	4320	0.4	638
S3019	Slag th U/F	NS	28/08/2006	0.195	2.49	0.665	31.66	26	430	4.29	0.05	20000	72	6010	419	2280	9420	5880	7	30	161	2.3	1.8	17.7	18	10.6	14.7	23	79.9	0	1.9	14400	0.3	941
S3021	Slag th U/F	DS	29/08/2006	0.19	2.12	0.71	33.58	37	500	3.77	0.06	24800	82	5450	499	2430	10000	4490	6	34	173	16.1	1.3	17.8	19.3	11.7	14.7	21	74.6	0	1.6	4450	1	954
S3023	Slag th U/F	NS	29/08/2006	0.21	2.44	0.635	33.25	26	470	3.96	0.06	20500	75	7640	441	2440	9340	7030	7	30	167	4.3	2.3	17.3	18.2	10.2	14.2	21	75.1	0	1.1	15500	0.4	1090
nsr	Slag th U/F	DS	30/08/2006																															
S3027	Slag th U/F	NS	30/08/2006	0.24	2.7	0.635	31.48	31	690	3.63	0.09	26100	73	10300	445	2830	11800	8200	8	35	157	3.4	3.2	16.7	17.4	11	14.4	21	73.5	0	1.5	19800	0	1480
S3029	Slag th U/F	DS	31/08/2006	0.275	2.98	0.715	31.37	30	630	3.81	0.05	24800	67	10600	421	2900	12100	5940	0	35	184	3.2	3.7	17.7	17.2	12.1	15	23	73.9	0	2	14700	0	1500
S3031	Slag th U/F	NS	31/08/2006	1.715	12.52	0.25	24.33	38	420	2.8	0.03	19200	72	74100	288	7750	46400	492	0	62	189	0.7	13.7	31.9	16	35.9	16.9	59	173	0	7	310	0.2	7370
	Slag th U/F		**Average**	**0.43**	**3.95**	**0.67**	**31.21**	**31**	**523**	**3.81**	**0.06**	**23600**	**72**	**16759**	**427**	**3280**	**15453**	**4933**	**4**	**37**	**175**	**4.9**	**3.74**	**20.2**	**18**	**15.4**	**15.2**	**27.6**	**90.2**	**0**	**3.2**	**10497**	**0.3**	**1996**

Figure 1: Suggested alternative circuit for EAFD leach



2. Combine EAFD leaching with tails leaching. When EAFD treatment in the demonstration plant commenced, this was done by mixing EAFD with the tails feed, and feeding directly to Base Metals Leach. It is thought this approach yielded approximately 80% Zn extraction from the EAF dust component of the feed to the circuit. However, operability of the Base Metals/Pyrite leach circuit was decreased compared to treating tails only, due to the tendency to precipitate Fe from solution, resulting in slowed Pyrite leach kinetics.

Both suggested alternative circuits require further testwork to better quantify operating conditions and performance. The author is aware testwork examining pressure oxidation of Hellyer tails combine with EAFD, in Intec brine, has provided promising results.

8.4 ZEEHAN SLAG LEACH

Performance over the Zeehan slag trial was good, demonstrating reasonable Zinc extraction can be achieved from the slag, while effectively controlling silica issues, allowing a leach residue which can be readily thickened and vacuum filtered to be produced.

Extraction for the trial averaged 78.9% Zn, 88.6% Pb and 38.2% Ag. Some Cu was seen to precipitate from solution fed to the circuit at all pH's where silica was effectively controlled (at pH 0.9 net Cu extraction occurred across the circuit. However, at this pH solids/liquor separation characteristics had deteriorated significantly).

Leach residue pulps produced during the Zeehan slag trial flocculated and settled readily, producing thickened u/f which vacuum filtered at rates of 350 $kg/m^2/h$ (inclusive of form, 3 washes, plus dry) and greater.

Leaching of Zeehan slag contributed significant quantities of Ca, Mn and Mg to solution. In particular, Mn extraction from slag was high at an average of 79.5% for the trial, from an average feed grade of 5.26% Mn. The impacts of Zeehan slag upon the overall Mn removal requirement of a circuit treating this must be carefully accessed.

Insoluble loss of chloride in Zeehan slag leach residue was significant at approximately 12 kg chloride / t slag treated.

8.4.1 Operating parameters

Recommended operating parameters for the Zeehan slag leach are summarised in table 3.

Table 3: Recommended operating parameters for Zeehan slag leach

Parameter	**Value**
Temperature	80 – 85^{O}C
Residence time	~2 hours
pH target (all reactors)	1.6
Feed liquor Fe consumption	300 – 320 kg Fe / t slag
Slag feed Grind size	P80 ~ 53 microns

8.5 IRON PRECIPITATION

Iron precipitation generally performed quite robustly, providing consistently good removal of Fe from solution. Iron precipitation discharge liquor was frequently <200 mg/l Fe on a weekly average basis. On a shift to shift basis, Fe concentrations of around 50 mg/l were regularly achieved.

Control of the circuit was quite simple, with the key parameters being maintenance of sufficiently high Eh to ensure iron was oxidised to Fe^{3+} to allow precipitation, and control of pH.

Although Iron residue was low grade in the major metals of interest, this represented the second largest solids mass output from the circuit, and consequently represented a major source of loss of metals and chloride from the circuit.

Miss-reporting of EAFD leach residue fines resulted in significant contamination of Iron residue with high grade Zn solids. It is estimated this contamination amounted to approximately 80% of the Zn units contained in Iron residue. If this is taken into account an adjusted Iron residue grade of 0.4% Zn is calculated, indicating Zn losses via Iron residue would be significantly lower if this contamination had not occurred. However, it should be kept in mind that the combine insoluble Zn losses as EAFD leach residue and Iron residue do represent the actual losses from these circuits combine.

Iron precipitate generally flocculated and settled readily, with the precipitate readily vacuum filterable.

Iron precipitation was a large contributor of new water inputs to the overall circuit, on account of the large consumption of reagents (limestone, and flocculant) and wash water in this circuit. These represented 23.6% of total water input to the circuit.

Limestone utilisation in Iron precipitation was very high. Limestone utilisation, calculated based on masses of Zn, Pb, Cu and Fe precipitated from solution averaged approximately 100% for the steady state period.

Iron precipitate represented a large insoluble chloride loss from the circuit, at 15.4 kg chloride / t precipitated solids, or 2.8 kg chloride / t tails + EAFD feed. This was due to precipitation of significant quantities of Akaganeite across the circuit. Quantitative XRD carried out on samples of iron precipitate produced during the steady state period average 6.4% Akaganeite, with 47.8% hematite. It is recommended further testwork be carried out aimed at identifying conditions which minimise Akaganeite precipitation and insoluble loss of chloride.