

THE HELLYER METALS PROJECT

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ABSTRACT

The Hellyer Metals Project involves the application of the Intec Process to the re-treatment of the tails dam at the former Hellyer mine site. The Hellyer orebody was a volcanic hosted massive sulphide orebody that contained some 15 million tonnes of ore grading 13% zinc, 6.7% lead, 0.4% copper, 158 g/t silver and 2.4g/t gold. The ore was metallurgically complex and despite a state-of-the-art flotation circuit, flotation recoveries of both base and precious metals were low with significant metal value lost to the tails dam. The resource in the tails dam is estimated to be 10.9 million tonnes grading 2.8% zinc, 3.0% lead, 0.16% copper, 88 g/t silver and 2.6 g/t gold.

The proprietary Intec Process is a halide-based hydrometallurgical process that was originally developed for the treatment of copper sulphide minerals but is now applicable to all sulphide base metal minerals, nickel laterite ore, refractory gold ore and environmentally hazardous residues such as electric arc furnace dust.

The application of the Intec Process to the Hellyer polymetallic tails will result in the extraction and subsequent recovery of all five economically valuable metals. The tails will be recovered by dredging and fed directly to the Intec plant without feed preparation. The zinc will be electrowon as special high-grade zinc and then cast into ingots; the dissolved silver and lead will be precipitated as a cement product for sale to a lead smelter; gold will be recovered on carbon columns and electrowon as bullion and copper will be precipitated as a saleable intermediate product in the form of copper oxychloride. All process residues will be disposed of into a newly constructed tails dam on the existing Hellyer mining lease.

A Project pre-feasibility study has been completed using input data derived from laboratory testwork and a four-month pilot plant campaign. The pre-feasibility study also considered an enhanced Project where the Hellyer tails are co-treated with other zinc-bearing residues such as lead smelter slags and electric arc furnace dust. A demonstration plant program and a bankable feasibility study will both be completed in 2005 with first production scheduled for 2007.

INTRODUCTION

Intec Ltd (Intec) has developed and patented innovative halide-based hydrometallurgical processes for the extraction and recovery of base and precious metals from ores, concentrates and waste products (the Intec Process(es)).

Intec acquired the Hellyer mine assets in Tasmania, formerly owned by Aberfoyle Ltd (Aberfoyle) and Western Metals Ltd (Western Metals), in January 2004. The assets acquired include an existing crushing, grinding and flotation mill, and a tails dam, which contains significant quantities of zinc, lead, gold, silver and copper. The Hellyer Metals Project (the Project) involves the application of the Intec Process to recover in saleable form approximately 80% by value of the base and precious metals contained in the Hellyer tails dam.

Bench-scale testwork has been conducted at the Intec laboratory in Sydney and at a laboratory facility in Burnie, Tasmania operated by Ammtec Ltd (Ammtec). The laboratory testwork has

shown that the Intec Process can recover approximately 80% of the metal values from the tails dam at Hellyer. A pilot-scale plant has been built and operated over a period of four months to verify the results of the bench-scale testwork and to establish and optimise the design parameters for a full-scale operation.

A pre-feasibility study completed by H.G. Engineering Ltd of Toronto, Canada (HGE) in August 2004 defined the requirements and costs for a full-scale plant to recover zinc and metallic by-products from the Hellyer tails. Process flow sheets and equipment lists were developed based on information provided by Intec. A plant layout was also developed showing the new plant and its relation to the existing mill and concentrator.

PROJECT BACKGROUND

Aberfoyle discovered the Hellyer volcanic massive sulphide (VMS) orebody in 1983. It was defined as 15 million tonnes at 13% zinc, 6.7% lead, 158 g/t silver and 2.4 g/t gold. Mine development began in 1987 and a one million tonne per annum mill was built in 1988 with production starting in April 1989. The mill produced four products, a copper/silver concentrate, a lead concentrate, a zinc concentrate and a bulk lead/zinc/silver concentrate all shipped to regional smelters.

Mine output and mill throughput rate was increased to 1.5 million tonnes per annum in the mid 1990's. Aberfoyle was taken over by Western Metals, a Western Australian based mining company, in 1998. The Hellyer orebody was exhausted in June 2000 and the mill placed on a care and maintenance program while Western Metals investigated treatment options for the tails.

Due to the complex fine-grained mineralogy and high pyrite associations of the Hellyer orebody, the total metal recoveries to concentrates were low over the life of mine. They averaged 75% zinc, 60% lead, 44% silver and 17% gold. The result is a tails dam that is relatively rich in zinc, lead, silver and gold.

Intec acquired the Hellyer assets from the Receivers and Managers of Western Metals Ltd in January 2004. The assets acquired included the mill, tails resource and prospective mineral leases in the region.

Hellyer Tails Resource

The tails were sub-aqueously deposited in a shallow valley dam, which at the end of mine life covered an area of 50 hectares. The maximum depth of the tails is 19 metres with an average depth of 8 to 10 metres. Water depth ranges from 0.5 to 1 metre.

There have been two drilling programs undertaken on the tails dam, one by Western Metals in 1998 and one by Dominion Mining Ltd in 2000. Both drilling programs used a Vibra-Core technique on a 100-metre grid pattern closing to a 50-metre grid in deeper sections, to calculate contained metals. Both programs confirmed the end of mine life calculations of the tails resource (see Table 1) based on milled ore tonnes and head grades less tonnes of metal in concentrates produced.

Table 1: Hellyer Tails Resource

Tonnes (Millions)	Cu %	Pb %	Zn %	Ag g/t	Au g/t	As %
10.88	0.16	3.00	2.80	88.00	2.58	1.24

Hellyer Tails Mineralogy

The average particle size of the tails is 80% passing (p80) 45 microns, however p80s range between 30 microns and 60 microns. Approximately 70% of the sphalerite in the tails is in the 38 to 7 micron fraction with approximately 50% liberated. The dominant sphalerite composites are sphalerite/pyrite binaries. Less than 10% of the sphalerite is associated with galena.

The galena is fine grained with 50% less than 7 microns. A majority is liberated and moderately oxidised. Approximately 75% of the silver is associated with the mineral tetrahedrite, a copper antimony sulphide. The remaining 25% is associated with galena.

Approximately 10% of the gold is “free” or re-precipitated with 20 to 30% associated with arsenopyrite and 60 to 70% as sub-micron inclusions in pyrite. Approximately 70% of the pyrite is highly crystalline while 15% is in the form of a primitive melnikovite. The pyrite is predominantly liberated but there are simple binaries with sphalerite and some minor complex ternaries. Almost all the arsenopyrite is liberated.

The non-sulphide gangue includes barite (BaSO₄), calcite (CaCO₃), siderite (FeCO₃) and silica. The mineralogy of the Hellyer tails is shown in Table 2.

Table 2: Hellyer Tails Mineralogy

CuFeS₂ Chalcopyrite %	PbS Galena %	ZnS Sphalerite %	FeAsS Arsenopyrite %	FeS₂ Pyrite %	Non – sulphide gangue %
0.46	3.46	4.17	2.69	51.00	38.20

The implications of the mineralogy for leaching are:

- Base metals, particularly lead and zinc, leach quickly with high extraction levels due to their fineness and high degree of liberation.
- Silver in galena is rapidly leached, but is released more slowly from the relatively refractory tetrahedrite.
- Gold extraction is determined by the degree of pyrite oxidation. Pyrite leach kinetics are slower and costly in air (oxygen) input than is the case for the base metals and in addition, acid is produced which requires neutralisation with limestone. The high relative cost of pyrite oxidation coupled with the low gold grade dictate that pyrite oxidation beyond about 40% is not economic.

INTEC POLYMETALLIC LEACH - PROCESS DESCRIPTION

The process flowsheet developed for the treatment of the Hellyer tails is shown in Figure 1. It is based on the Intec Zinc Process (IZP), which consists of a single stage base metal leach with purification of the pregnant liquor stream before zinc electrowinning. To facilitate gold extraction the solids from the base metal leach are subjected to a pyrite leach as practiced in the Intec Gold Process (IGP). Thus the proposed treatment route for Hellyer tails is designed to maximise metal extractions and recoveries in a single closed process.

The Intec technology is unique in its use of a mixed chloride/bromide brine that is the basis of the process liquor. The brine liquor results in the formation of soluble lead, silver and gold complexes

when the host sulphide minerals are oxidised in the leach. This is not the case in the more conventional sulphate medium where such elements have negligible solubility.

The use of a two-stage leach is a consequence of the complex mixture of elements in the Hellyer tails feed. In particular, lead solubility is constrained by the presence of zinc, which consequently limits the solids density of the leach. The base metal leach is designed to extract the majority of base metals, free gold and gold associated with arsenopyrite, which occurs relatively quickly at a temperature of 85°C through reaction with oxidising ferric ions according to reactions 1, 2, 3 and 4:

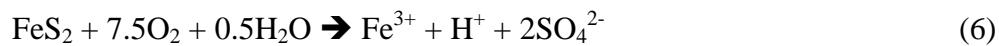


The resulting ferrous ion is re-oxidised to ferric through air addition to maintain the solution Eh >530mV (versus Ag/AgCl) according to reaction 5:



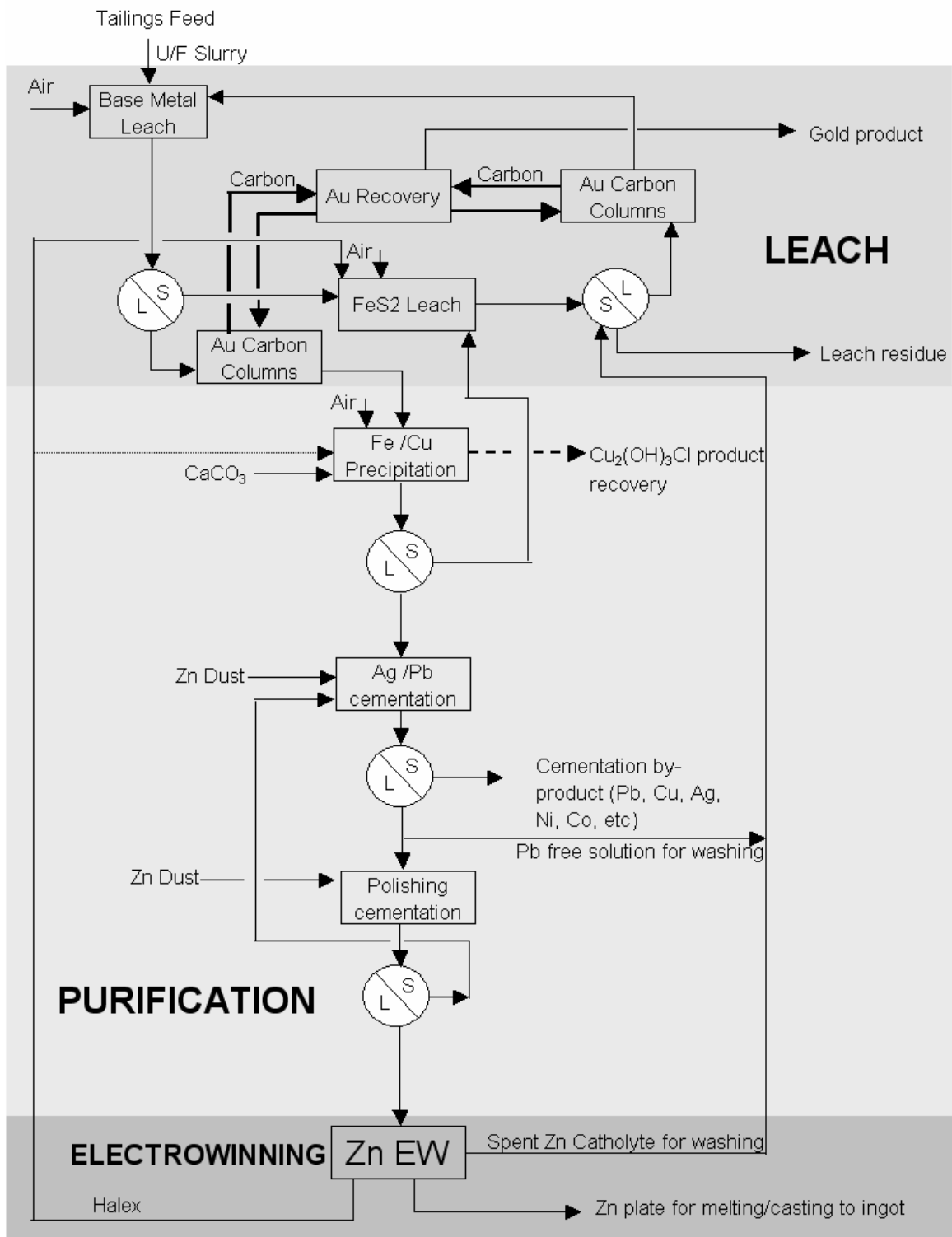
The slurry leaving the base metal leach is thickened with the overflow liquor pumped to Fe/Cu precipitation after gold recovery, with the underflow slurry fed to the pyrite leach.

Metal extraction is maximised in the pyrite leach through the destruction of the pyrite lattice according to reaction 6:



In this way, the sulphide minerals locked in pyrite are available for leaching according to reactions 1 to 4. The ferric ion generated from pyrite oxidation is recycled to the base metal leach. Optimum metal extraction occurs at 30 to 40% pyrite oxidation with limited benefit from higher oxidation levels.

Figure 1: Block diagram of Unit Operations for the Treatment of Hellyer Tails.



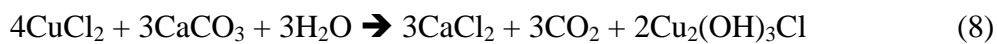
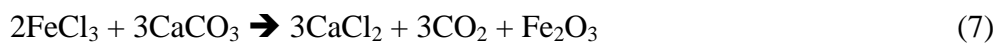
The addition of air for pyrite oxidation results in water evaporation into the spent air, which is an important aspect of the water and heat balance for the plant. In particular, an oxygen uptake efficiency of approximately 50% is required to minimise heat input to the leach. Efficiencies as high as 70% have previously been achieved.

The slurry from the pyrite leach together with the Fe/Cu precipitation thickener underflow and spent wash water (to replenish water evaporated in the pyrite leach) are combined in a surge tank prior to filtration. The resulting slurry is then filtered and washed using vacuum belt filters. A brine wash followed by a six-stage counter-current water wash is used before the filter cake is re-pulped and sent to a tails dam. Spent wash water from the filters is recycled to the surge tank whilst the primary filtrate is pumped to gold recovery.

Gold from the pyrite leach is recovered on a fixed bed of activated carbon contained in columns arranged in series with a similar arrangement to recover gold from the base metals leach thickener O/F liquor. The gold-free solution from the pyrite leach columns is recycled to the base metals leach and the gold-free solution from the base metal leach is pumped to the Fe/Cu precipitation stage.

Once loaded, the first carbon column it is taken off line and stripped with a hot cyanide solution, which is then sent to electro-winning with the resultant gold sludge melted and cast to ingot. The filtrate and wash water are recycled to the cyanide dissolution tank.

The ferric generated from the oxidation of pyrite along with cupric is removed from the liquor in Fe/Cu precipitation with limestone according to reactions 7 and 8:



Sufficient oxidant from the EW circuit is added to raise the Eh to >650mV to ensure that all iron and copper are present as ferric and cupric. The slurry generated overflows to a thickener where a portion of the underflow is recycled to first precipitation reactor for seeding with the remainder sent to leach filtration. The thickener O/F passes to the Ag/Pb cementation stage.

A bleed from the first reactor in Fe/Cu precipitation is treated separately with limestone to selectively precipitate the copper as copper oxychloride. The copper oxychloride by-product is recovered by thickening and filtration with the filtrate and thickener overflow solution returned to the main Fe/Cu precipitation process.

The Ag/Pb cementation stage of purification uses zinc dust to reduce silver and lead in their metallic state according to reactions 9 and 10:



Three reactors in series are used in the primary cementation, with the resulting slurry overflowing to solids liquid separation. The final solids from the primary cementation process are filtered and washed before being sent for refining. The clear liquor is collected in a surge tank with a portion returned to leach filtration and the remainder sent to a polishing cementation step where

supplementary zinc dust is added to remove residual lead and cadmium etc. The solids from polishing are subsequently advanced to the primary cementation step.

The O/F liquor from polishing cementation is sent electrowinning, which takes place in rectangular cells each containing 40 flat plate titanium cathodes and 41 activated titanium mesh anodes. Each anode is housed in a diaphragm bag of conventional filter cloth. Catholyte is pumped through the cells via a network of pipes and overflows to a holding tank from where it is cooled and pumped back to the catholyte supply tank with a portion returning to the base metal leach.

The remaining spent catholyte passes through the diaphragms into the anode chambers where the proprietary Intec oxidant HalexTM is produced in soluble form according to reaction 11:



A network of pipes collects the Halex from the anode bags, which drains into a surge tank under the cell floor. The Halex is then re-circulated to either the Fe/Cu precipitation or the pyrite leach. Half of the cathodes are removed from the cells every 12 hours. These are washed and stripped, and stacked automatically. The stacked cathode zinc is transported by forklift to casting.

The zinc cathodes are melted in an electric furnace with molten zinc pumped to a casting machine, where ingots are produced for sale. A second pump transfers a portion of the molten zinc from the furnace to a zinc atomisation step to produce zinc dust, which is collected in a hopper for use in the cementation step.

EAF DUST AS SUPPLEMENTARY FEED

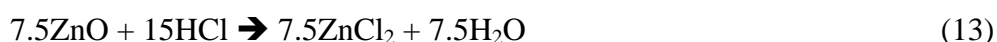
Pyrite oxidation generates acid that can be utilised to leach secondary oxidised zinc-bearing materials such as electric arc furnace (EAF) dusts. When steel is produced using an electric arc furnace, about 15 - 20 kg of dust is formed per tonne of steel. This dust is considered a toxic waste due to its content of heavy metals. It is estimated that the worldwide production of EAF dust could be as high as 4 million tonnes, all of which must be either retreated or sent to land fill.

The EAF dust forms due to vaporisation of volatile metals (like zinc and lead) at furnace operating temperatures. These vapours are oxidized and cooled in the extractive airflow and report to the resulting dust both as free oxides and in the form of composite structures with iron oxides. These latter compounds are notably of the spinel or ferrite type, $\text{MO} \cdot \text{Fe}_2\text{O}_3$ (M = Fe, Zn, Ni, Mn or Cd).

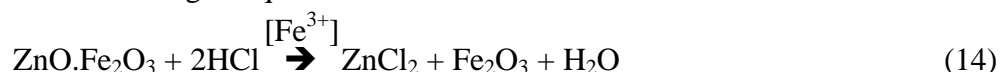
Halex from the electrowinning circuit is predominantly fed to the pyrite leach to oxidise pyrite according to the overall reaction 12:



The HCl generated is then available to leach zinc from EAF dust according to reaction 13:



EAF dusts, as previously explained, are a relatively complex mixture of free oxides as well as ferrites ($\text{ZnO} \cdot \text{Fe}_2\text{O}_3$). The free oxides leach according to reaction 13, however the ferrites are quite refractory, requiring more severe conditions to liberate the zinc. The ferrite reaction can be expressed according to equation 14:



The conditions necessary for the ferrite reaction to occur are present in the pyrite leach section of the Hellyer plant where significant levels of ferric and acid are generated from the leaching of pyrite.

PILOT PLANT RESULTS - HELLYER TAILS & EAF DUSTS

Extensive data was collected throughout pilot plant operations including:

- Daily measurement of plant inputs and outputs;
- Daily measurement of plant conditions (temperature, Eh, pH, solids density, SG, etc.)
- Daily internal liquor assays for Fe, Cu, Zn, Pb and Ag for process control;
- Daily external solid assays for Au, Ca, Fe, Cu, S, Si, Zn, Pb and Ag;
- Weekly external liquor assays for over 30 elements to track minor metal department;
- Campaign analysis of gold collected on activated carbon;
- Campaign testing of solids for environmental stability; and
- Campaign plant air quality monitoring.

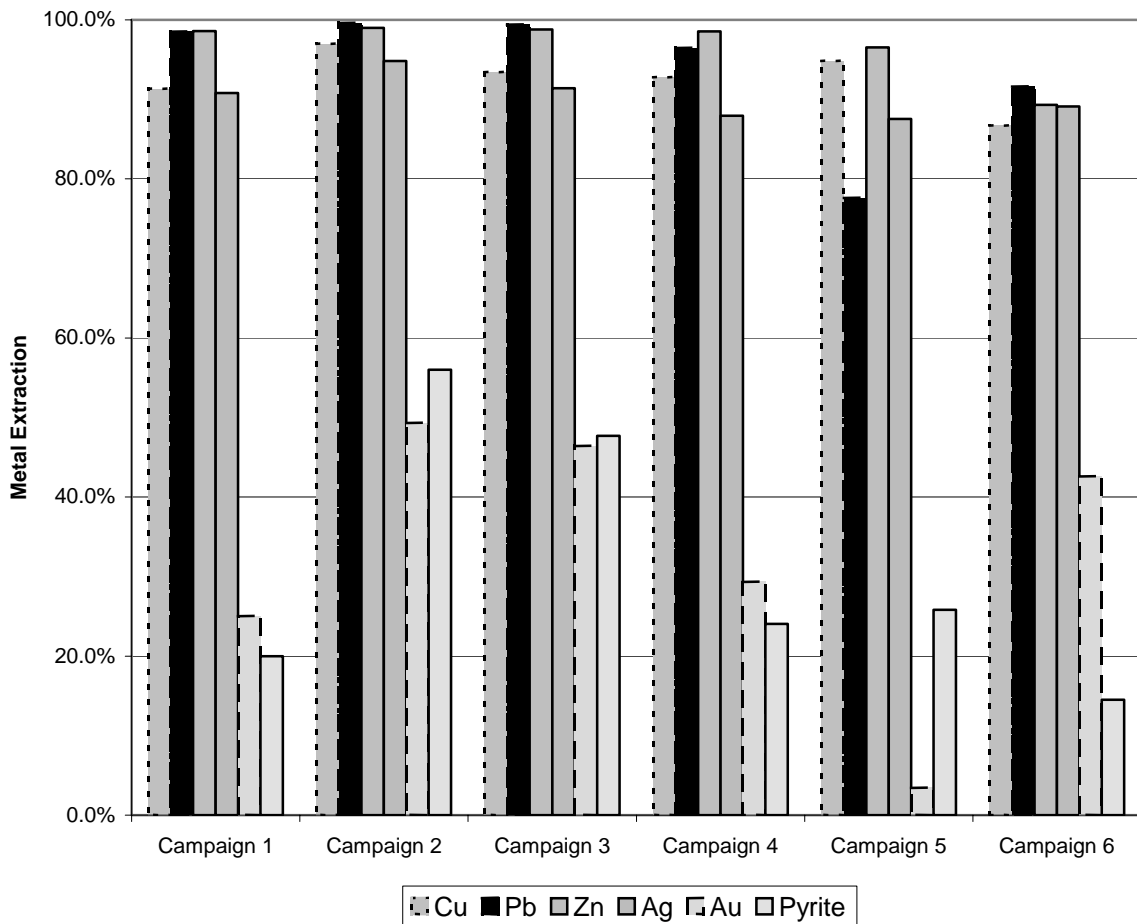
Metal Extractions

Metal extractions achieved for each pilot plant campaign when operating in steady-state conditions are summarised in Table 3 and shown graphically in Figure 2. Individual pilot plant campaigns extended up to eight weeks in length but steady-state conditions were usually maintained for periods of two to three weeks.

Table 3: Pilot Plant Campaign Results

Metal	Campaign 1 (ground)	Campaign 2 (ground)	Campaign 3 (unground)	Campaign 4 (unground)	Campaign 5 (unground +EAF Dust 1)	Campaign 6 (unground + EAF Dust 2)
	19/4-3/5	13/5-24/5	25/5-4/6	2/7-18/7	26/7-29/7	8/8-10/8
Lead	98.5%	99.6%	99.4%	96.5%	77.6%	91.6%
Zinc	98.6%	98.9%	98.7%	98.6%	96.5%	89.3%
Copper	91.3%	96.6%	92.8%	92.8%	94.8%	86.7%
Gold	25%	42.5%	40.1%	29.3%	3.4%	42.6%
Silver	90.8%	94.6%	93.6%	88%	87.5%	89.1%

Figure 2: Pilot Plant Campaign Metal Extractions and Pyrite Oxidation



From the above data, it can be seen that metal extractions were generally above the target of 98% for Pb and Zn, 85% for Cu and Ag and 35% for Au. Thus the performance of the leach in this respect was relatively robust, despite actual conditions during each campaign varying considerably as is evident by the fluctuating level of pyrite oxidation.

Campaigns 5 and 6 examined the impact of supplementary EAF dust addition and were of relatively short duration. These campaigns were primarily designed to establish zinc extraction from the EAF dust. In terms of both gold and pyrite oxidation there was insufficient feed to enable steady operations to be achieved and hence their significant variance from previous campaigns.

Metal Extraction Versus Pyrite Oxidation

During pilot plant operations, solids assays from each of the leach reactors were routinely carried out to enable metal extraction versus pyrite oxidation to be calculated. Lines of best fit were generated from the data and these were then used to calculate metal extractions at 10, 20, 30 and 40% pyrite oxidation as presented in Table 4.

Table 4: Metal Extractions as a Function of Pyrite Oxidation

Metal	Campaign 1 (ground)				Campaign 2 (ground)				Campaign 3 (Unground)			
	Pyrite Oxidation %				Pyrite Oxidation %				Pyrite Oxidation %			
	10	20	30	40	10	20	30	40	10	20	30	40
Lead	97.4	97.5	97.6	97.8	98.2	98.8	99.2	99.5	98	98.7	99.2	99.5
Zinc	95.6	96.1	96.6	97.1	86.7	93.3	97.2	98.9	87.9	93.9	97.3	98.7
Copper	80.4	83.7	86.9	90.2	78.5	89.2	94.8	96.6	73.3	89.2	96.3	97.6
Gold	7.1	7.0	6.9	6.8	6.6	26.3	39.3	46.6	10	27.2	39.3	46.4
Silver	78.9	83.4	87.9	92.4	69.5	81	88.4	92.6	76.5	84.6	89.3	91.6

The relationship between metal extraction and pyrite oxidation is controlled by the mineralogy that is described in the section on the project background.

Approximately 98% of the lead leaches rapidly with the remainder leaching as the pyrite is oxidised. However the most refractory component of the pyrite contains very little lead. Zinc demonstrates the same trend as lead, but has a higher proportion locked in the pyrite.

With 75% of the silver associated with the copper mineral tetrahedrite, both metals should leach together. This is shown in the results, however approximately 10% of the silver is quite refractory.

Gold extraction exhibits a steady increase from the outset without the sharp initial rise displayed by zinc, lead, copper and silver.

For campaign 2, pyrite oxidation as high as 80% was measured, but gold extraction did not rise significantly beyond the level for 40% pyrite oxidation as shown in Table 4. Consequently for gold, and indeed the other metals, the data indicates that only a limited increase in metal extractions occurs when pyrite oxidation is increased beyond 40%. Increased pyrite oxidation results in higher capital and operating costs and analysis indicates that increasing pyrite oxidation beyond 40% has minimal economic benefit.

Pyrite Oxidation Kinetics

The pyrite leach configuration and design is based on the following rate equation that was developed from reconciling laboratory batch testing data:

$$\frac{\partial C_{pyrite}}{\partial t} = -k \times e^{-\frac{E_A}{RT}} \times (C_{Fe^{3+}} + C_{Cu^{2+}}) \times C_{pyrite} \quad (15)$$

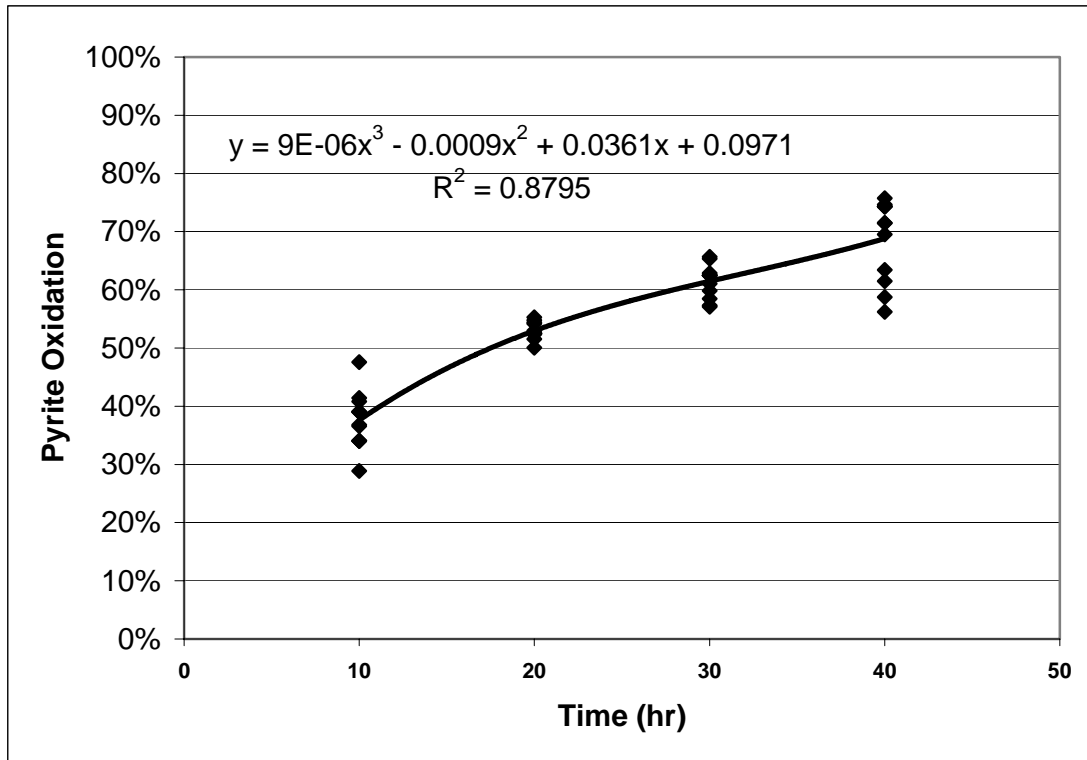
This is complicated by the fact that pyrite oxidation generates ferric ions according to reaction 6. Consequently, the degree of pyrite oxidation is not simply a function of the retention time of the leach. Important parameters influencing the extent of pyrite oxidation are:

- Starting ferric and cupric concentration;
- Temperature
- Solids density.

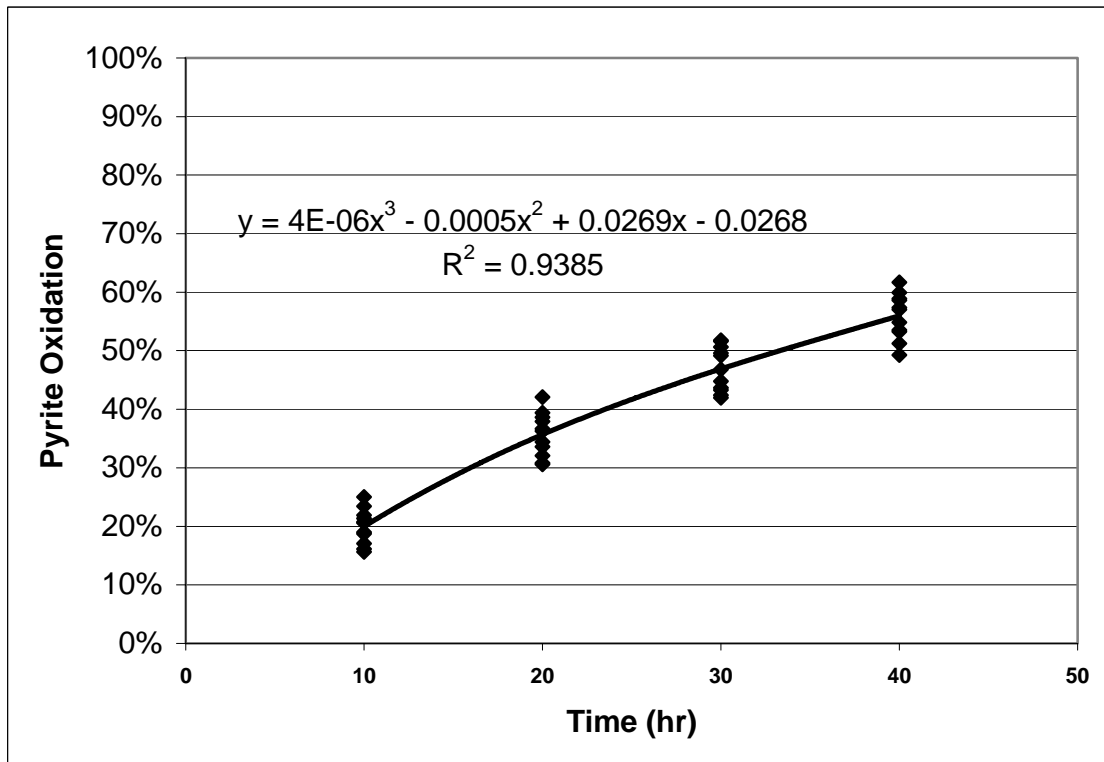
As explained in the previous section, optimal economic metal extractions are achieved in the pyrite oxidation range of 30 to 40%. Current commercial plant design assumes a retention time of approximately 12 hours to reach this level of pyrite oxidation. This level of performance was

achieved during the second pilot plant campaign as demonstrated in Figures 3 and 4 where the level of pyrite oxidation in each reactor (each with ~10h retention time) is shown.

**Figure 3: Pyrite Oxidation for Individual Leach Reactors (~10h retention time)
(Campaign 2: Ground Feed 13/05/2004 - 24/05/2004)**



**Figure 4: Pyrite Oxidation for Individual Leach Reactors (~10h retention time)
(Campaign 2 Unground Feed: 25/05/2004 - 04/06/2004)**



Contaminant Control

Liquor samples were regularly sent for external analysis of 38 elements. At the pilot plant, daily batch precipitation of contaminants by both cementation and alkali addition was practiced. During campaign 3, which lasted a total of 8 weeks, the only elements observed to accumulate were Mg, Mn and Na. Accumulation of Mg and Mn can be managed through slaked lime addition. In the case of sodium its concentration increased from 13g/l to 20g/l during Campaign 3. Up to 50g/l Na can be tolerated in the electrolyte and it can be removed through a periodic bleed of liquor obtained after Mg removal.

Environmental Stability of Leach Residue

The stability of the leach residue in the environment was examined by TCLP (Toxicity Characteristic Leaching Procedure) testing. The results from a composite leach residue from pilot plant operations are shown in Table 5 along with SCC (Specific Contaminant Concentration) data. The results demonstrate that in spite of the relatively high arsenic level, all contaminant leachate levels meet the inert waste category.

Arsenic reports to the leach residue as ferric arsenate, which is particularly stable as is highlighted by the ability to meet the inert waste category under the TCLP procedure. The lower content of arsenic in the leach residue as compared with the content in the feed is due to the mass increase of the residue during the leach. External advice to date indicates an inert waste category for the residue can be achieved given the manner in which arsenic is stabilised.

Table 5: Leach Residue Stability

Element	Hellyer Tails	SCC		TCLP	
		Leach Residue	Inert waste limit	Leach Residue	Inert waste limit
Arsenic (ppm)	11,000	6,600	500	0.1	0.5
Cadmium (ppm)	99	3.5	100	<0.1	0.1
Chromium (ppm)	68.2	29.5	1,900	<0.1	0.5
Copper (ppm)	2,100	188	N/A	0.3	N/A
Nickel (ppm)	30	5.5	1,050	<0.1	0.2
Lead (ppm)	31,000	305	1,500	0.25	0.5
Zinc (ppm)	28,500	275	N/A	2.4	N/A
Selenium (ppm)	<15	8.5	50	<0.1	0.1
Mercury (ppm)	6.2	2.5	50	<0.01	0.02

Pilot Plant Summary

The pilot plant campaigns demonstrated high extractions of base metals and silver at pyrite oxidation levels of 30 to 40%. Gold extraction is limited to 35 to 40% due to the majority of the gold component being locked in sub micron inclusions in pyrite. The pilot plant also partially addressed the filtration of leach residue and the precipitation of iron. Process leach residues were submitted for TCLP environmental testing with a favourable outcome. Laboratory test programs in parallel with the pilot plant program have been successful at identifying process conditions for the following:

- Zinc electrowinning
- Lead/silver cementation

- Iron precipitation
- Settling and filterability.

The pilot plant outcomes and laboratory programs formed the basis for a pre-feasibility study into the construction of a full-scale plant at Hellyer.

HELLYER METALS PROJECT – PRE-FEASIBILITY STUDY

The pre-feasibility study undertaken by HGE and completed in August 2004 evaluated two cases:

1. A “Base Case” that provides for the treatment of Hellyer tails at an annual rate of 1.0 million tonnes per annum for an 11 year project life; and
2. An “Enhanced Case” that provides for the co-treatment of Hellyer tails and zinc-bearing residues such as EAF dusts. The throughput rates for the “Enhanced Case” assume the treatment of 0.5 million tonnes per annum of Hellyer tails and the treatment of 0.1 million tonnes per annum of zinc bearing residues for a 21 year project life

Project Description

The tails are dredged by a contractor and pumped to an Intec Process plant located on the Hellyer mining lease. The existing concentrator and associated facilities will be used for reagent handling, limestone grinding and preparation, maintenance and administration.

The dredged slurry will be pumped at 30% w/w solids through a trash screen above an agitated tank at the shore of the tails dam and then pumped to a thickener located at the plant site. The thickener underflow is filtered on a vacuum belt filter to form a filter cake, which is discharged directly into the base metals leach re-pulp tank. The thickener overflow and the filtrate are used to re-pulp the leach residue prior to discharge to a newly constructed tails dam.

The plant incorporates 2 by 630m³ reactors for base metals leaching followed by 2 trains of 4 by 750m³ reactors for pyrite leaching. Leach reactors are constructed in fibreglass reinforced plastic (FRP) with titanium agitators. Air is blown in to provide oxygen for the leach reactions. After thickening, the leach residue and iron precipitate are filtered on three 180m² belt filters.

Zinc-bearing residues will be railed into Hellyer and removed from rail wagons by an excavator and conveyed to a storage silo. The pyrite leach thickener overflow (high acid) is used to leach the zinc-bearing residues in a separate circuit prior to iron removal.

Dissolved iron is then removed from the thickener overflow and filtrate liquor by the addition of Halex and ground limestone. This iron is precipitated as goethite and forwarded to the pyrite leach for thickening and filtration. The copper is then selectively removed as copper oxychloride.

The dissolved lead and silver are removed from the solution by cementation and the cement product is railed to the port of Burnie and then shipped to a regional smelter. Gold is recovered on carbon columns, electrowon and shipped as sludge in sealed containers. The zinc is electrowon and cathodes are melted in an electric furnace. The molten zinc is pumped to the casting machine, where ingots are re produced for sale.

A pump removes a portion of the molten zinc from the furnace and pumps this to a zinc atomisation step. The zinc dust from the atomisation is collected in a hopper, and is pneumatically conveyed to a dust storage bin, for use in the cementation step.

Leach Residue Disposal

The filter cake from the pyrite leach is re-pulped using tails feed thickener overflow, treated with limestone and pumped to a new tails dam sited near the existing dam. The solids residue settles out in the tails dam and the water overflows from the new tails dam to the existing tails dam to provide feed water for the dredging operation.

For the “Base Case” approximately 1.33 million tonnes per annum of residue will be produced. The residue has a bulk specific gravity of 1.88 tonnes per cubic metre. In the third year of operation a tails dam wall lift will be required to extend the storage capacity for a further 4 years. Beyond that the residue will be deposited into the existing tails dam where space has been made available by dredging the original tails.

Project Production

Forecast annual production for the two flowsheet options are shown in Table 6 below.

Table 6: Forecast Annual Project Production

	Base Case	Enhanced Case
Zinc Ingots tpa	25,500	32,200
Copper Oxychloride tpa	3,000	3,400
Lead in Silver/Lead Cement tpa	29,400	16,660
Silver in silver/lead Cement mozs pa	2.60	1.45
Gold Bullion ozs pa	23,000	17,400

Indicative Project Economics

Intec used the cost parameters established in the HGE pre-feasibility study to evaluate the indicative financial performance of the Hellyer project. Metal prices and the US\$/A\$ exchange rate employed in the evaluation were those prevailing in early September 2004. Table 7 displays the results of the indicative financial analysis.

Table 7: Summary Project Indicative Financial Analysis

Parameter	Base Case	Enhanced Case
Project Life	11 years	21 years
Capital Cost	A\$153 m	A\$137 m
Annual Net Sales Revenue	A\$103 m	A\$85 m
Annual Operating Cost	A\$35 m	A\$28 m
Net Annual Cashflow	A\$67 m	A\$56 m
Net Present Value: Pre-Tax *	A\$258 m	A\$317 m
Net Present Value: Post-Tax *	A\$165 m	A\$205 m
Internal Rate of Return: Pre-Tax	38.6 %	36.6 %
Internal Rate of Return: Post-Tax	30.1 %	29.3 %

* 10% discount rate

The key components of Project operating costs are energy, labour and reagents (including limestone) as shown in Figures 5 and 6 below. Energy is principally used for electrowinning and blowing air (oxidant) into leach reactor vessels. Limestone is the major reagent used and is employed in neutralising acid produced from the oxidation of the pyrite. However, limestone usage is greatly reduced if acid consuming oxide materials such as EAF dust is co-treated with Hellyer tails as shown in the Figures below.

Figure 5: Base Case Operating Cost Components

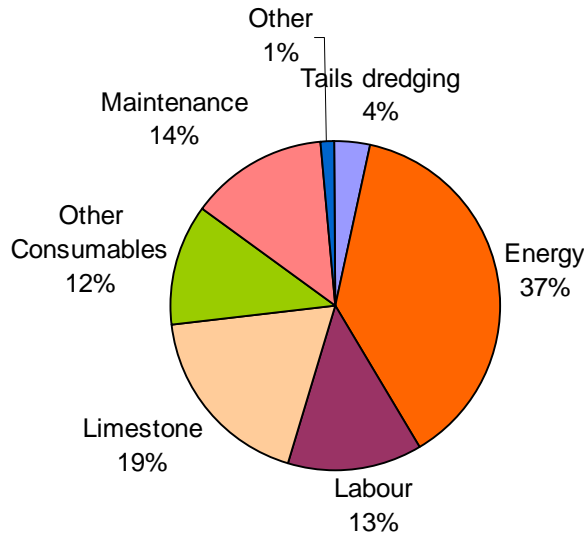
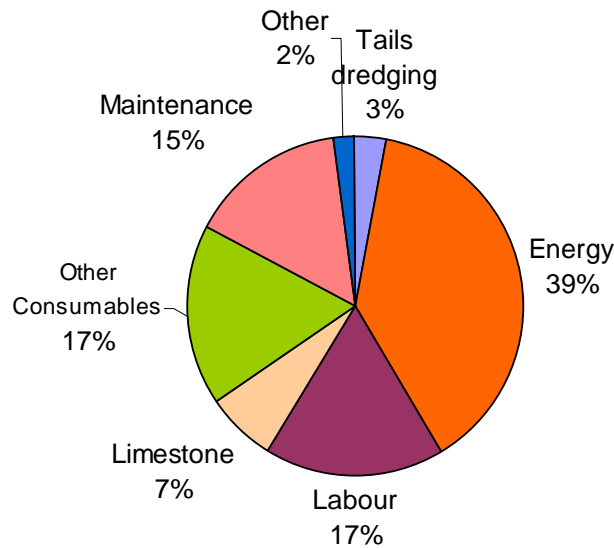


Figure 6: Enhanced Case Operating Cost Components



Project Schedule

The next phase of Project development is to build and operate a 2 tonne per day demonstration plant at the Burnie Research Laboratory in Tasmania to demonstrate the viability of the proposed process and optimise the design parameters for a full-scale plant. It is intended to construct the demonstration plant in early 2005 and operate it from April to July 2005. It is also proposed to complete a bankable feasibility study for the Project by the end of the September quarter 2005.

A decision to proceed with the Project will be made after the bankable feasibility study is complete. Design and construction of the plant will take approximately 18 months from the decision to proceed.

CONCLUSION

The Hellyer Metals Project is an exciting new hydrometallurgical development aimed at maximising value from a finely ground tails resource. Although low grade, the Hellyer tails resource contains a suite of economic metals, which can be extracted and recovered into saleable products using the Intec Process. The advantages of the halide leach system over the sulphate leach system is the improved leach kinetics and oxygen transfer, the ability to extract lead into solution and the ability to recover gold directly without the need for a separate gold recovery circuit such as a carbon-in-pulp plant and the associated cyanide detoxification circuit. The key environmental advantage of the Intec Process by comparison with sulphate-based systems is the almost complete extraction of potentially mobile base metals from the Hellyer tails dam.