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ALTA Metallurgical Services

COPPER SX/EW – ANY RIVALS IN SIGHT?

Since it burst onto the world's metallurgical scene in the late 1960s, copper SX/EW has gone from strength to strength and seemingly blitzed all comers. But it does have some drawbacks, which offers a ray of hope to would-be rivals.

***World's First Commercial Copper SX Plant at Ranchers Exploration, Ari*zona**

ADVANTAGES COME AT A PRICE

The attractions of copper SX/EW are now well known – produces high purity cathode at site, can treat highly impure dilute solutions, is suitable for both large and relatively small projects, and can be successfully applied by "rookie" companies as well as the majors. However, there is another side to the coin. For example, the initial capital cost can be relatively high, especially for a small company trying to minimise initial project investment. Also, the EW step is highly power intensive, which makes the economics sensitive to unit power cost. This can have a decisive effect in remote locations where power has to be generated at site – a familiar situation in many Australian mining regions! A less obvious issue is the regeneration of the sulphuric acid associated with the copper in the leach solution. While this is usually regarded as a major advantage, it is not always true. For example, if the leaching circuit is acid generating, as can happen in heap leaching of sulphides, the recycled acid may have to be neutralised. This requires a reagent such as limestone, and poses the problem of how to avoid losing associated copper in the acid bleed stream. Acid regeneration can also be an embarrassment for ammonia leach systems for obvious reasons.

SO WHAT ARE THE OPTIONS?

Precipitation

Cementation with scrap iron may be worth a look in some situations. This long established process met its demise with the advent of SX/EW. Major factors included the diminishing supply and therefore rising cost of suitable scrap iron for precipitation, the consumption of acid to form iron which could precipitate and block heap or dump leaching systems, the relatively low value cement copper product which was generally fed to smelters, and the labour intensive nature of the operation. This last issue was significantly alleviated by the introduction of the Kennecott cone. The attractions of cementation remain valid today, namely low capital cost and low power consumption. An excellent example of an innovative approach is at Adchem's Mt Gunson heap leaching operation in South Australia, which produces cement copper for refining into high value copper oxide at the Burra Ammonia leach facility. One of the Gunson Kennecott style cones was leased by Mt Leyshon in Queensland to remove copper heap leached from gold/copper ore. Other precipitation methods offering the possibility of reduced capital cost include using lime to yield a hydroxide and hydrogen sulphide or sodium sulphide to precipitate a sulphide. The hydroxide precipitate is generally impure, and requires further refining. Also, any acid in solution is neutralised, increasing operating cost and precipitating gypsum, which dilutes the hydroxide. However, lime precipitation can be useful for treating copper bearing bleed streams and mine waters. Sulphide precipitation also generally results in an impure product, has relatively high operating cost, and involves operator safety and health issues. Its main applications have been in removing copper when it is an impurity, and in the leach-precipitation-flotation process for mixed copper sulphide/oxide ores. Recently Paques of the Netherlands have developed a biological method for precipitating base metals, including copper, from mine waters as a sulphide

SX/Copper Sulphate

In this option, the capital and power intensive EW step is replaced by copper sulphate production from the copper loaded strip solution. One approach is to employ a vacuum crystalliser as was practised for many years at Cockle Creek, NSW. Another, lower capital, method practised in Chile is to precipitate copper sulphate by "salting out" in the SX stripping mixer-settler. Apart from supplying the flotation reagent market, copper sulphate can be produced at a number of satellite leach/SX operations feeding a central EW plant. Alternatively, it could be transported to an EW plant at a site with a lower power unit cost. In these cases, the sulphuric acid consumed to make the copper sulphate, then released during EW, has to be taken into account.

Direct Electrowinning

This was the traditional route to cathode copper prior to the advent of SX. Drawbacks included the problems in coping with impurities such as iron, which led to low current efficiencies and inferior quality cathodes. However,

direct EW has re-emerged with the EMEW cell design under development by Electrometals in QLD. This cell type can cope with dilute impure solutions because of the rapid solution flow pattern across the tubular cathode, and lends itself to a modular relocatable arrangement. It can also be coupled with SX where its ability to cope with organic entrainment and totally enclosed construction can be significant advantages. So far it has been limited to relatively small production rates, though advances are being made. Direct electrowinning from chloride solution is a feature of the Intec Process for treating copper sulphide concentrates being developed in Sydney. Chloride solution EW requires a lower power input than the more conventional sulphate EW.

Ion Exchange.

There appears to be a revival of interest in IX as a possible replacement for SX, especially for more dilute leach solutions, copper bearing mine waters, copper/cobalt solutions and copper/gold cyanide leach solutions. Potential advantages include low capital cost, elimination of organic entrainment and ability to treat unclarified solutions or even slurries in a similar manner to resin-in-pulp for gold. Organisations active in this area include I.B.C (USA), Purity Systems (USA), Clean Teq (Australia) and Oretek (Australia). Previous work was done by Dow Chemicals (USA). Generally, the aim has been to develop resins with a good degree of selectivity for copper, though some form of initial purification may be needed. An alternative approach is to use a cheaper, less selective resin, to concentrate the copper, then apply a small SX circuit for purification, as used in the Eluex Process for uranium extraction. Another approach to pre-concentration technique, in which there is current activity, is to employ membranes.

The Future?

Given the current level of interest and development activity, alternatives to conventional SX/EW are likely to find greater application than in the past. Of course, there is also plenty of activity aimed at improving conventional SX/EW, including better organic extractants and alternative contactors such as pulsed columns, which will help to ward off the challengers

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