Agitated Tank Bioleaching of Dirty Chalcopyrite Concentrate

One application to which agitated tank bioleaching has been found particularly suitable is the treatment of dirty concentrate produced from mixed copper and zinc ore (which is also contaminated with lead, silver and other metals). It is not possible to produce clean flotation concentrates of copper and zinc separately, due to the complex mineralogy of these types of ores – the one is always contaminated by the other, leading to significant losses and consequent smelter penalties. Such ores are found, for example, in parts of Mexico.

In the treatment of these concentrates, interference in the leach process by the lead content is a significant challenge, which can only be overcome within a limited window of operating parameters, including a leach temperature within the moderately thermophilic range of 42 to 48 °C. Undissolved and re-precipitated copper losses occur at higher temperatures. Bioleaching is therefore viewed as the only hydrometallurgical processing route for such concentrate, since it provides the only means for maintaining the required oxidative redox potential at these moderate temperatures with an economical oxygen utilisation. An economic rate of extraction can be obtained despite the moderate temperature, by regrinding of the concentrate prior to leaching. This, in combination with the silver content – which is typically high in these concentrates – prevents chalcopyrite passivation.

Pilot plant

A pilot plant was constructed and operated between 2000 and 2002. It consisted of feed preparation and milling of 4 tonnes per day of concentrate, bioleaching with a six-day residence time, solid-liquid separation followed by solvent extraction and electrowinning (SX-EW), where commercial-size cathodes of LME A-Grade quality were produced. While an essential part of the project was to demonstrate the successful leaching of the feed concentrate, it was equally important to test the bulk iron-removal process by co-precipitation of gypsum and ferric hydroxide as a product that could be settled and filtered with negligible
copper losses. The process further included the recovery of the zinc content by precipitation, while about 85 percent of the silver was recoverable from the bioleach residue by hot lime treatment and cyanidation, although a silver recovery section was not built as part of the demonstration plant.

**Feasibility study**
A feasibility study showed that the major drivers of the process economics were limestone availability and cost, electricity cost and the cost of the disposal area. The study indicated that it would be a profitable process.