



COPPER HYDROMET GAINING GROUND FOR SULPHIDE ORES

Hydrometallurgical processes for treating copper sulphide ore and concentrates are gaining ground, with significant new projects under construction and in the pipeline. The following is a brief review of current developments involving pressure oxidation, bio-oxidation, chloride leaching and ferric leaching technology.

Pressure Oxidation

Phelps Dodge are constructing a commercial medium pressure oxidation plant at Morenci, Arizona, to produce 68,000 t/a copper from chalcopyrite concentrates at a cost of US\$210 million. It is reported that the in-house process uses a surfactant catalyst. Copper recovery is via direct electrowinning without the use of solvent extraction. Production is expected to start in mid-2007.

CVRD are building a prototype plant at the Sossego mine in Brazil using the CESL medium pressure oxidation process to produce 10,000 t/a copper cathode from sulphide concentrates at a cost of US\$58 million. This plant is due to start up later this year, and is intended as a precursor to a much larger plant, to produce 250,000 t/a copper due in 2010–2011. CESL has recently modified its copper process to recover gold and silver which will give the process general applicability to copper–gold concentrates.

LionOre have announced the first commercial application of the Activox[®] low pressure oxidation process at Tati Nickel Mining Company in Botswana. It will treat nickel/copper concentrates to produce 22,000–25,000 t/a nickel per annum and 12,000–16,000 t/a copper per annum for a capital cost of US\$482 million. Commissioning is scheduled for 2009.

Pressure oxidation circuits have also been installed at Oxiana's Khanong copper operation in Laos and First Quantum's Kensanshi operation in Zambia.

Bacterial Oxidation

Pacific Ore are building a 4,500 tonne pilot heap in China as a part of the feasibility study for what should be the first commercial chalcopyrite BioHeap in the world, and there are several other projects that are being considered in places such as Indonesia and Chile. The process was successfully demonstrated in the Radio Hill pilot heap operation in Western Australia which treated nickel sulphide/chalcopyrite ore, and at the more recent large scale column tests at Erdenet in Mongolia for leaching a chalcopyrite/pyrite ore.



BioHeap Pilot Plant Under Construction in China

GeoBiotics are currently undertaking column testwork on-site at Punte del Cobre in Chile with the view to constructing and operate a 2,500 ton GEOCOAT process demonstration heap to treat copper sulphide concentrate in the 3rd quarter of 2007. Column testwork is also underway for a major copper operation in Chile with a view to constructing and operating a 26,000 ton GEOHEAP in the second part of 2007. The GeoCoat process involves the heap bio-leaching of sulphide concentrate mixed with an inert substrate to improve percolation.

Mintek have been operating three 20,000 tonne bio-leaching pilot heaps with NICICO at Sar Cheshmeh in Iran to treat chalcopyrite ores, and are currently building a fourth heap. A commercial operation is being seriously considered. Mintek's approach is to maximize the generation and preservation of heat and to utilize in-heap instrumentation and computerised advisory system to optimize operating conditions.

Alliance Copper, a JV of Codelco and BHP Billiton, have operated a prototype bio-oxidation facility to treat arsenic bearing chalcopyrite concentrates using BHPB's BioCop tank bio-leach technology near Chuquicamata, Chile. Although the operation was said to be a technical success, plans for a 153,000 t/a commercial operation have been abandoned due to unfavourable economics.

Chloride Leaching

Erdenet have entered into an agreement with Outokumpu Technology for the engineering of a plant using the HydroCopper® process to produce 50,000 t/a of copper wire rod at the mine site in Mongolia. This will be the first commercial application of this technology. The new hydrometallurgical plant is scheduled to be operational in 2009.

Intec is planning the construction of a 10,000 t/a Intec Process plant, designed to produce zinc primary products, with copper, lead, silver, gold and possibly other metalliferous by-products. This follows the successful operation of a demonstration plant which proved the viability of the Intec Process for polymetallic feedstocks.

Ferric Leaching

Inmet is constructing a plant near Seville in Spain to treat high grade chalcocite rich ore using atmospheric pressure ferric leaching to produce 72,000 t/a copper for a

capital cost of 380 million Euros. Leaching is to be carried out in agitated tanks with steam and oxygen injection.

Xstrata plan to use the Albion Process for the expansion of the smelter dust leach plant at Mount Isa in 2007. The process was developed by Xstrata to treat concentrates produced from refractory base and precious metals ores. It incorporates the IsaMill horizontally stirred bead mill to produce an activated, finely ground, concentrate at relatively low specific energy inputs. Leached is at atmospheric pressure in conventional agitated tanks. Core Resources are now marketing the process and are doing testwork and discussing licensing with a number of companies.

University of British Columbia have introduced the Galvanox Process which takes advantage of the galvanic couple between pyrite and chalcopyrite to ensure rapid oxidation of chalcopyrite at atmospheric pressure and 80°C in acidic iron (ferric sulphate) solution, without the need for microbes, ultrafine grinding, or chemical additives such as chloride, nitrate, or surfactants. UBC have granted an exclusive marketing license in about 20 countries to Bateman Engineering.

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