

## ALTA Metallurgical Services

### GOLD ORE PROCESSING TECHNOLOGY NOT STANDING STILL

Recent gold industry news has understandably focused on the meteoric price rise. However, although processing technology has been out of the limelight, it has not been standing still, and developments have been occurring in a number of key areas. Some of the main developments are identified below.

#### Application of High Pressure Grinding Rolls (HPGR)

Following successful application in the copper industry, high pressure grinding rolls are making inroads into gold ore treatment, typically to supplement or replace SAG milling. The main attraction is higher energy efficiency, especially if operated in closed circuit with fine screening. Other advantages include reduced grinding media consumption and greater flexibility. A recent example is the massive Boddington Expansion Project in Western Australia, designed to treat 35 mtpa of copper/gold ore. The flowsheet involves primary and secondary crushing, HPGR (Polysius), flotation of a saleable copper concentrate, and cyanidation of the flotation tailings to produce gold bullion. High pressure grinding rolls are also being considered for fine crushing in gold heap leach projects where micro-fracturing of the ore has the potential to increase the leaching rate and gold recovery.

#### Ore Upgrading

Gekko Systems have introduced the Python Underground Processing Plant which is designed to upgrade run-of-mine ore underground resulting in savings in haulage, ventilation, back fill, grinding, staffing, tailings disposal and environmental costs. The system typically consists of jaw crusher, vertical shaft impactor (or HPGR), in-line pressure jig circuit and flash flotation. The concentrate representing 5-35% of the feed weight is either pumped or dewatered and placed in skips or trucks for cartage to the surface for further processing. A prototype 20 tph system has operated at the Central Rand Goldfield in South Africa, and two 50 tph units are being added

Optical ore sorting has been tested in an 82 tph pilot plant by CommodosUltraSort for upgrading a low grade waste rock dump at Kloof Gold Mine in South Africa. About 70% of the gold in the plus 16 mm material was recovered into a concentrate of 5–10% of the feed weight. CommodosUltrasort have also tested XRT sorting on rejects from the DMS treatment of sulphide ore at Simmer and Jack's TGME operation in South Africa

#### Cyanide Control, Destruction and Replacement

On-line cyanide analysis and automatic control are being increasingly used to optimize cyanide addition.  $CN_{WAD}$  on-line analyzers are also becoming more common as an increasing number of operations adopt the International Cyanide Management Code.

In the field of cyanide destruction, CyPlus of Germany have introduced the CombinOx Process which takes advantage of the synergies between the  $SO_2$ /air and peroxide processes. Another recently development is the SART Process (Sulphidization–Acidification–Recycle–Thickening) in which a reagent such as sodium hydrosulphide (NaHS) is used to precipitate copper and zinc as sulphides and convert cyanide to HCN. The precipitate is removed for possible sale or further processing, and the solution is

neutralized with sodium hydroxide or lime and recycled back to the leaching process to re-use the cyanide. An operation was established at Telfer in WA in 2006.

In the field of non-cyanide lixiviants, the CSIRO's Parker Centre in Perth is developing ion exchange technology for recovering gold from thiosulphate leach solution.

### **Treatment of Ores Containing Soluble Sulphides and Copper**

Outotec's Copper Sulphide Precipitation Process is being installed at the Pueblo Viejo operation in the Dominican Republic, owned by Barrick and Goldcorp. The process treats precipitates copper as sulphide using Outotec OKTP reactors. H<sub>2</sub>S gas for the reaction is generated biologically by the Paques THIOTEQ Process.

Meanwhile Anglo Asian Mining has adopted Mintek developed IX technology using DOWEX MINIX resin at the Gedabek gold-copper heap leaching operation in Azerbaijan. This is the first application of the resin which is very selective for gold in the presence of high copper levels.

The AngloAshanti Morila Mine in Mali reports that the addition of lead nitrate for treating ore containing the reactive sulphide pyrrhotite improves gold recovery, enhances leach kinetics and reduces cyanide consumption. Also, METS in Australia, report improved leach performance with the addition of lead nitrate when testing a gold-silver ore.

### **Treatment of High Silver Ores**

CANMET in Canada have introduced the CELP (CANMET Enhanced Leaching Process) aimed at reducing cyanide consumption and leaching time for high silver ores. The first installation came on stream in 2008 at Kupol in Far East Russia, now owned by Kinross Gold.

### **Treatment of Refractory Ores**

Maelgwyn Mineral Services (MMS) in the UK have introduced the Leachox Process as a low capital and operating cost treatment method aimed particularly at lower grade deposits. It involves G-Cell centrifugal pneumatic flotation or gravity concentration followed by ultra-fine grinding in Deswick mills then low pressure partial oxidation in Aachen Reactors™ and MMS Leach Reactors. The process has been applied at two refractory gold operations in South Africa and is being used for the Vasilkovski project in Kazakhstan.

The Albion Process has been selected for two refractory gold projects - Enviro Gold at Las Lagunas in the Dominican Republic and European Goldfield at Certej in Romania. It is a relatively low capital cost process using a combination of ultrafine grinding with Isamills to produce an activated finely ground concentrate then oxidative leaching at atmospheric pressure with oxygen sparging in conventional agitated tanks. The technology is owned by Xstrata and Highlands Pacific/OMRD (a Japanese consortium), with CORE Resources, Queensland, as the exclusive global marketing agent.

Meanwhile the more established roasting, pressure oxidation and bio-oxidation processes continue to find favour. Resolute Mining, Perth, commissioned the Syama Project in Mali in 2009 which uses roasting, and Agnico-Eagle of Canada brought the

Kitilla pressure oxidation operation in northern Finland on stream in 2009. In the field of bio-oxidation the Kokpatas plant in Uzbekistan came into operation in 2008 using Gold Field's BIOX technology, while the rival BacTech technology was used for the expansion of the BioGold operation in China in 2007.

### **In-Place Leaching**

CSIRO's Parker Centre in Australia is undertaking initial investigations for the in-place treatment of weathered gold deposits. Lixiviant systems tested include thiosulphate-thiourea-EDTA (in which thiourea is a catalyst and EDTA an oxidant) and iodide-iodine (in which iodine is an oxidant). Blasting and hydraulic fracturing are under consideration for permeability enhancement.

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