SART technology coming of age for cyanide recycling

By Brad Marchant

BioteQ's application of the SART process recovers up to 95% of cyanide for recycle back to the gold extraction process, improving the environmental performance of the gold operation.

Cyanide was first used as a means to extract gold from ore in the late 1880s. Fast-forward to the present day and it is currently the most common process for gold extraction, accounting for up to 13% of global cyanide consumption, according to Barrick Gold.

A highly toxic substance, cyanide has come under intense scrutiny in recent years, as environmental awareness grows and regulations governing the usage, disposal and destruction of cyanide-laden waste have tightened.

In the mining industry, cyanidation is a process in which sodium cyanide solution is applied to a gold heap leach. As it trickles through the crushed ore, the cyanide dissolves gold and other cyanide-soluble base metals. Gold is then recovered from the cyanide solution, and the solution is re-applied to the heap leach. As cyanide degrades over time into less effective leaching compounds, it is then sent to a tailings pond, or to some form of approved destruction process.

Gold cyanidation has presented a number of obvious concerns, including the environmental and safety impacts of working with a toxic material. The presence of leachable copper and other base metals in gold ore can create a metallurgical challenge by consuming the cyanide. Increased quantities of cyanide are then needed, leading to significant destruction costs.

Additionally, the presence of copper in tailings supernatant tends to stabilize cyanide in a form that is harmful to wildlife and less amenable to natural degradation processes, thereby demanding specific and expensive disposal processes.

In the past decade and a half, a technology known as SART (sulphidization acidification recycle thickening) has been developed that enables high recycling rates for cyanide. Like any new technology that carries a higher perceived implementation risk than long-established technologies, the process met with resistance at the beginning.

However, with successful implementation in the past several years at sites in Mexico and Turkey, SART is now viewed as a viable means to increase gold yields safely and efficiently, reduce associated disposal requirements for cyanide, and improve the environmental footprint of gold operations that generate cyanide waste.

Digging deeper for gold

The high cost of raw materials and cyanide disposal technologies have traditionally deterred mine operators from developing ore bodies in which gold occurs with cyanide-leachable base metals. There is now a wealth of un-mined gold deposits in areas rich with cyanide-soluble base metals (e.g., copper and zinc) in North and South America, Asia and Australia. With gold prices at historic highs, mining operations are now taking a second look at options for processing these ore bodies. Part of this reconsideration includes the application of the SART process.

SART technology was developed in 1997 by SGS Lakefield and Teck Corporation as a way to reduce the metallurgical interference of copper (and sometimes zinc) in the gold recovery process. It recovers copper from pregnant or barren cyanide leach solution and regenerates the cyanide for reapplication to the gold heap leach. This process can be repeated many times. Its stages are:

1. Sulphidization, to precipitate the copper as copper sulphide.

2. Acidification, to break the copper-cyanide coordination complex and liberate the cyanide.

3. Re-neutralization, to raise the pH of the solution with lime to the safe operat-

ing range (pH 10 – 11) prior to re-application to the heap leach.

4. Thickening, to densify the resulting solid products (copper sulphide and gypsum), further maximizing the cyanide recovery.

When applied successfully, SART can remove up to 99% of the base metal, producing a saleable high-grade concentrate, while regenerating up to 95% of cyanide for recycling to the gold extraction process. It can also improve gold yields and reduce costs for the mine operator.

Previously, its use has been limited by two main factors. Additional capital costs are typically associated with SART. These must be balanced with the cost savings of cyanide regeneration, plus the incremental revenue from increased gold yields and the new revenue stream generated from copper recovery. Secondly, early attempts with SART applications met with limited success, due to the complexity of the sulphide precipitation stage of the process.

Solving the sulphide precipitation factor

While all stages of the SART process are important in removing copper and recovering cyanide for recycle back to the gold operation, the sulphide precipitation circuit and its control are particularly critical, and require specialized know-how in sulphidization. Precipitating metals into a high-grade sulphide product, with good settling and filtration characteristics, has often been a challenge.

Specialists such as BioteQ Environmental Technologies, a Vancouver-based water treatment company, have successfully applied their knowledge of sulphide precipitation technologies to SART projects. BioteQ designed and operated the first SART plants in North America and western Asia, and was recently awarded two new projects.

The sulphidization process works by introducing a chemical source of sulphide reagent in a contactor tank that contains feed solution to be treated. The conditions in the tank are adjusted to selectively precipitate individual metals as solid metal sulphide particles. These solids are then separated from the treated solution in a clarifier and filtered to remove excess water.

By applying a sulphide reagent to precipitate the copper from the leach solution, gold operations can eliminate copper cyanide complexes in leach residues by recovering the copper as a high-grade concentrate. This removes any potential copper contaminants from the environment. In addition, the process minimizes the amount of waste copper-cyanide solution to be destroyed.

There is no question that cyanide will continue to play a significant role in the gold mining process. Therefore, the onus is on the mining industry to demonstrate responsible use when handling, recycling and disposing of cyanide waste.

Investment in SART is in its relatively early stages. It is currently being deployed in a small but growing number of projects in South America, Eastern Europe and Asia. However, given its recycling capacity and stability, it promises to play a critical role in enabling gold operations to improve yields, reduce cyanide consumption and waste and mitigate the risks associated with handling and disposal of cyanide.

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