THIOSULPHATE LEACHING – AN ALTERNATIVE TO CYANIDATION IN GOLD PROCESSING

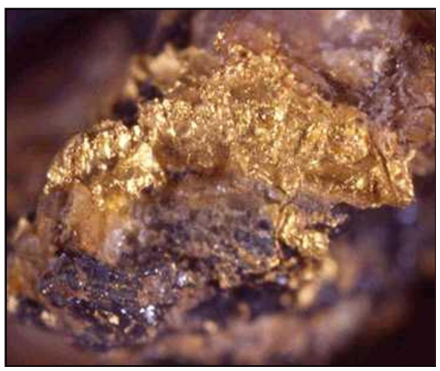
ALTERNATIVES TO CYANIDE IN GOLD PROCESSING

THIOSULPHATE LEACHING

Thiosulphate leaching is a process that removes gold from gold bearing ores without the use of cyanide. Although not as aggressive a leaching agent as cyanide, thiosulphate offers several technological advantages including its lower toxicity and greater efficiency with gold deposits associated with preg-robbing ores. The thiosulphate leaching process, followed by resin-in-pulp gold extraction, has been developed by SGS to the point where it is a technically and economically viable alternative to cyanidation for some gold bearing ore bodies.

Whether the leaching is performed in stirred tank reactors or heaps, the size and type of equipment needed for a thiosulphate leaching flowsheet is very similar to a conventional cyanide leach.

SGS is a global technical leader in the field of thiosulphate leaching, and our laboratory and industry experts have spent years designing and developing the technique into a viable alternative to cyanide for some gold-bearing ores. SGS technical experts will work with you to ensure your flowsheet development is optimized and your environmental and financial risk is minimized.



ADVANTAGES

Like cyanide, thiosulphate leaching is an alkaline process (usually operated in the pH 8 to 10 range) so there are no concerns with corrosion and materials used in construction, and the process can be applied to heaps and dumps, or to stirred tanks. The thiosulphate process offers advantages over cyanide leaching in the following situations:

- Thiosulphate leaching yields similar gold recovery as cyanide in some cases, while in cases such as preg-robbing ores (naturally occurring carbonaceous material that preferentially absorbs the gold cyanide complex but not the gold thiosulphate complex), it can yield substantially better recovery than cyanide.
- The thiosulphate leaching of gold ores has great potential to reduce the impact on the environment compared to the cyanidation process. Unlike cyanide, which is highly toxic, the chemicals used in the thiosulphate leaching process are benign, and there is great potential to apply the technology in those jurisdictions of the world where the use of cyanide is banned outright, or is subject to intense negative publicity for environmental reasons. The main chemical components of the leaching process (ammonium thiosulphate and ammonium sulphate) are common fertilizers, which opens up the additional possibility of using mine tailings solutions in agricultural applications, in regions of the world where the local infrastructure and environmental regulations are favourable.

TECHNICAL LIMITATIONS

The chemistry involved in the thiosulphate leaching process is more complex and less robust than the cyanide leaching process, and is therefore more difficult to optimize and more sensitive to operate. The leach process involves a chemical reaction between metallic gold and the thiosulphate anion, with oxygen as the oxidant, and ammonium and copper ions as unconsumed catalysts in the reaction. One possible scheme for the overall reaction is presented below:

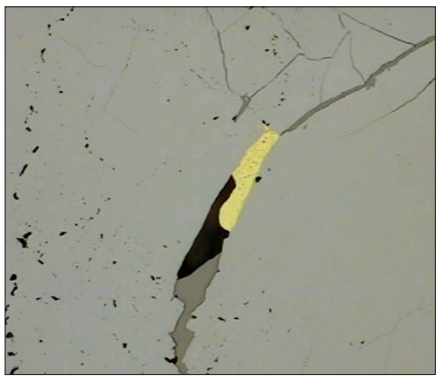
$$4Au + 8S_2O_3^{2-} + O_2 + 2H_2O \rightarrow 4Au(S_2O_3)_2^{3-} + 4OH^-$$

While it is relatively easy, in just a few tests, to establish the amenability of an ore to cyanide leaching and optimize the process, the thiosulphate chemistry presents technical challenges and requires careful optimization. Thiosulphate leaching is a sensitive process that requires both dependent and independent optimization of each of the chemical components of the leach reaction, as well as physical parameters such as pulp density and temperature, in order to maximize gold recovery and minimize reagent losses.

The sensitivity of the thiosulphate leaching reaction stems from the fact that the reaction thermodynamics are less favorable than the cyanide leach reaction. Consequently, higher concentrations of thiosulphate are needed to achieve equivalent rates of gold leaching, and a typical thiosulphate leach solution will have a reagent concentration of 5 to 20 g/L versus a cyanide concentration of only 0.25 to 1 g/L. The higher concentration of thiosulphate required leads to higher reagent consumption, which is at least

partially offset by the significantly lower cost of thiosulphate, which could be as little as one fifth the cost of cyanide. It will generally still be important either to recycle the thiosulphate tailings solution back to the leach plant to minimize thiosulphate losses and new thiosulphate make up requirements, or use the tailings solution productively as a fertilizer.

The gold thiosulphate complex is very poorly adsorbed by activated carbon, negating the use of the traditional carbon-in- pulp (CIP) or carbon-in-leach (CIL) processes for the recovery of gold directly from leach pulps. Instead, SGS will evaluate the following gold recovery options for your project:



- Resin-in-pulp technology involving direct recovery of gold thiosulphate from the leach pulp by adsorption on strong-base anion exchange resin. This process was developed by SGS, and includes techniques for eluting the gold off the resin and restoring the resin for recycle back to the adsorption circuit.
- Cementation of gold from thiosulphate leach solution onto copper metal powder, or some other reductant, following separation of solids and liquids in the leach slurry by filtration or counter current decantation.

Use of the resin-in-pulp method is limited to those deposits requiring mild thiosulphate leaching conditions, since strong thiosulphate leach conditions result in competitive adsorption on the resin by the polythionate anions that are produced during leaching. SGS experts will work with you to ensure the thiosulphate leaching and recovery technology chosen is the right one for your operation.

THE NEXT STEPS

Early in the planning and proposal preparation stages, SGS encourages you to discuss your timing, anticipated project scope, environmental concerns, and financial requirements. This allows SGS to develop the best bench or pilot plant testing program for you, be it a phased program with a number of milestones that will help you maximize your financing options, or an intensive program that quickly establishes the technical and economic viability of the technology for your application.

Contact SGS for all your thiosulphate leaching needs and let us help you optimize your flowsheet and reduce your operational and environmental risk and liability. We have the experience and the technical expertise to provide you with the most efficient and affordable methods of managing your mineral processing requirements.

CONTACT INFORMATION

Email us at minerals@sgs.com
www.sgs.com/mining