Application

ABB Analytical – pH/ORP
Bacterial action on low-grade ores

Industry: Mining

The process of bacterial oxidation recovers metals from low-grade sulfitic ore deposits. Certain bacteria catalyze the oxidation of elements such as ferrous iron and reduced sulfur. As a result the mineral – iron sulfide (pyrite) or iron arsenic sulfide – breaks down.

One principal application of bacterial oxidation is the liberation of gold encapsulated in iron sulfide. By working on the pyrite's crystalline structure, the bacteria gradually cause it to break down and open up, releasing the gold. The gold-bearing ore is then processed through a conventional cyanidation process.

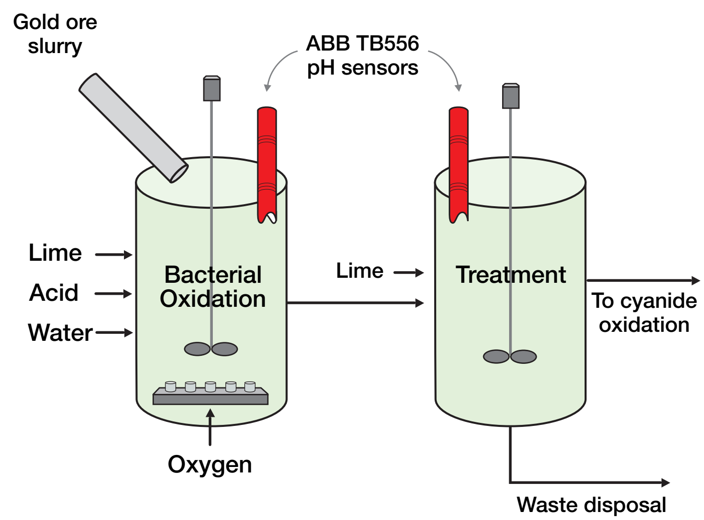
Biological oxidation is relatively new, but as surface oxide reserves become depleted, it will see increasing use in processing deeper refractory sulfitic gold ores and ores of other metals, such as copper and nickel.

Liberating gold

Several different methods are available to carry out bacterial oxidation on a commercial scale. One of the most common is processing in an agitated tank (stirred reactor).

A typical bacterium useful for the stirred reactor process, thiobacillus ferrooxidan, thrives in the pH range 1.0 to 6.0. The optimum pH for growth ranges between 2.0 and 2.5. It survives in the temperature range of 2 to 40C, but prefers temperatures between at 28 to 35C for greatest growth. Survival also depends on an adequate supply of oxygen, which tends to deplete as bacterial action occurs.

If iron arsenic sulfide is present, the bacteria will also liberate arsenic in the form of arsenic acid. The arsenic must be removed in a second treatment tank via a neutralization process that requires higher pH levels.



The higher pH levels are generally attained with additions of lime. After sufficient time as passed, the treated ore will be ready for further processing by cyanide oxidation. As expected, major control variables are pH, temperature, and dissolved oxygen. In the agitated bacterial oxidation reactor, the plant monitors and controls pH and dissolved oxygen to maintain optimum acidic conditions for the microbes. The plant generally adds sulfuric acid or lime to control the pH of the slurry to a value between 2 and 2.5.

The ABB Solution:
TB556 for pH measurement

The process represents harsh conditions for the pH sensor. The agitated slurry contains ore particles that can abrade the glass measurement electrode and coat the sensor. The lime additions for pH control can also coat the pH sensor with scale. Generated sulfur compounds can eventually penetrate the reference electrode, affecting measurement accuracy.

ABB TB556 pH sensor

ABB TB556 pH sensor with hydraulic cleaner

For this application, ABB recommends the ABB TB556 pH sensor. This sensor has an integral, patented Next Step Solid State reference. The sensor‘s large annular liquid reference junction provides added surface area that‘s less susceptible to plugging. The solid state reference design minimizes reference contamination, resulting in a more stable and accurate measurement. And a flush flat-glass pH electrode surface reduces the adherence of particles, abrasion, and breakage. A hydraulic cleaner is often useful to prevent a buildup of scale on the sensor by dousing it with a periodic jet of fluid.

Contact

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