Application Note

INGOLD
Leading Process Analytics

Safety and High Yield in Gold Production

pH and DO Control in Cyanide Leaching

Background

Gold has been one of the most important metals worldwide throughout history. Due to its low reactivity, resistance to most acids and high conductance while being a solid under standard conditions, it is used in many industrial applications as well as being a valuable metal for jewelry and monetary standards. Although it can be found in elemental form, the majority of world gold is produced from ore extraction.

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Process

Gold-containing ore is mined and crushed before it undergoes flotation or gravity concentration (depending on the grade of the ore), where a solvent is added to produce a slurry for leaching. In the cyanide leaching process, the gold in the ore is converted to a water soluble complex using sodium cyanide (or potassium cyanide or calcium cyanide) and oxygen according to equation 1. This process consumes 13 % of the cyanide produced worldwide.

$$4Au_{(s)} + 8NaCN_{(aq)} + O_{2(g)} + 2H_2O_{(l)} \rightarrow 4Na(Au(CN)_2)_{(aq)} + 4NaOH_{(aq)} \quad (1)$$

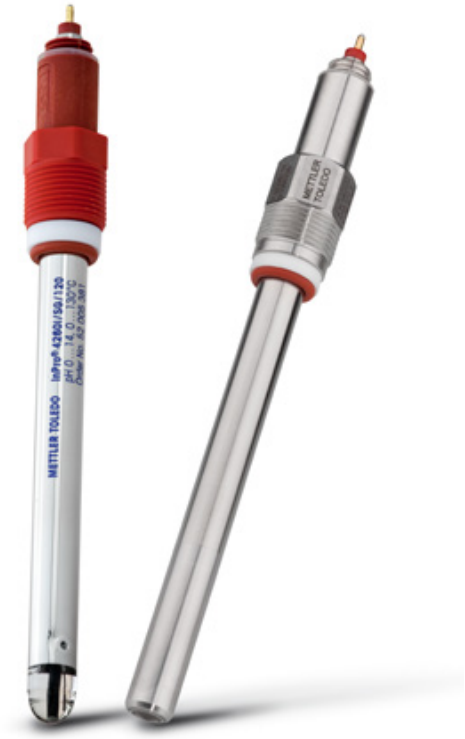
The gold in solutiuon can then be recovered to a high purity through processes such as the Merrill-Crowe, Carbon in Pulp, or Electrowinning for example.

The first step in the reaction is electron removal from each gold atom by oxygen, thus the oxygen content of the solution is vital for leaching the gold into solution. This is commonly encouraged through air or oxygen purging into the solution or the addition of hydrogen peroxide to ensure the gold cyanide complex can form.

As cyanic species are extremely toxic, special considerations must be made. To remedy the creation of hydrogen cyanide (HCN), the solution must be kept highly basic at a pH greater than 10.5. This is accomplished through the addition of slaked lime (calcium hydroxide) or caustic soda (sodium hydroxide).

METTLER TOLEDO solution

In order to produce a high yield, the dissolved oxygen content of the solution is a vital measurement. This is best accomplished through in-line dissolved oxygen measurements. Real-time control will ensure maximum profitability by high yield leaching. For safe operation, pH control is



InPro 4260i pH Sensor

- Solid polymer electrolyte
- Clog-free open junction
- Fully digital ISM technology

InPro 6850i Sensor

- Amperometric dissolved oxygen sensor
- Full digital ISM technology
- Fast response time

also very critical. If the pH level falls, the production of toxic HCN can pose a severe risk to workers and the environment. An in-line pH measurement system can detect a drop in pH immediately and remedy it with the dosing of a pH increaser before any HCN is produced.

METTLER TOLEDO digital Intelligent Sensor Management (ISM®) sensors are the best solution for these applications due to their self-diagnostic abilities. The InPro® 6850i is a high accuracy amperometric dissolved oxygen sensor designed for harsh environments. With ISM self-diagnostics, operators know exactly when and what maintenance is required. This brings significant confidence in the measured values and thus the state of the process.

For pH, the InPro 4260i is specifically designed for slurry applications. It has an open reference junction that withstands clogging in such applications. Self-diagnostics in the sensor predict when maintenance or calibration is needed long before inaccurate measurement could cause hazardous situations to develop.

Both sensors can be installed in InTrac® 777 e retractable housings. This model features an integrated cleaning chamber, limiting workers exposure to the toxic cyanic process. The measurement loop is completed with an M400 digital transmitter, which is able to read all sensor diagnostics and transmit them to the control center.

For more information, visit:
www.mt.com/pH

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