

Measuring Cyanide in Precious Metal Mining Wastewater

Description:

AN #: 04_008_05_001

Subcategory: Mining & Metals

Market: Industrial

Product: HI4109, HI4001-00

Gold and silver are highly valued precious metals that are found in underground deposits called ore, where they exist alongside other metals and minerals. In order for use, the precious metals must be mined from the ore. There are various methods used but one of the most commonly used methods for the extraction of gold and silver in mining is called cyanidation. Cyanide is one of the few chemical reagents that allows for dissolution



of gold (and silver) in water. Cyanide is a chemical compound that contains a cyano group, which consists of a carbon and nitrogen atom. Several forms of cyanide occur naturally in the environment such as fungus, algae, and bacteria. Cyanide is used on the fabrication of metal parts, in the production of plastics and synthetic fabrics as well as in herbicides and mining. Industrially, gaseous hydrogen cyanide is dissolved in aqueous sodium hydroxide to produce sodium cyanide (NaCN). Due to economic efficiency, dilute solutions of sodium cyanide are used to extract gold from ore. However, due to environmental concerns and its hazardous nature, the use of cyanide calls for strict remediation processes and effluent analysis. There are several compounds formed during the cyanidation process, including free cyanide and various metal-cyanide complexes. The free cyanide can be present as hydrocyanic acid (HCN) and cyanide ion (CN⁻) depending on pH; these are considered to be highly toxic and require strict monitoring and removal.

Application:



A mining company was looking for a way to measure cyanide in their treated wastewater to ensure their remediation processes were working correctly. They wanted a solution that was highly accurate, worked in very low ranges, and was not affected by color interferences. Hanna Instruments offered the **HI4109** cyanide ion selective electrode (ISE) to determine the concentration of free cyanide in their effluent. This electrode will work with any ISE meter with a BNC connection and measures free cyanide in its ionic form of CN⁻. At low pH values of less than 8, free cyanide exists mainly in the form HCN. At higher pH values, the free cyanide exists in the form of CN⁻. The cyanidation process is kept at a pH over 11, which allows for the ISE to measure free cyanide in the form of CN⁻ as well as reducing the likelihood that cyanide gas is formed. The customer appreciated that the required **HI4001-00** ionic strength adjuster (ISA) necessary for cyanide measurement included a build-in pH adjuster ensuring the pH of the sample is buffered at pH 11, the optimal pH for the cyanide ISE. To measure the free cyanide ions, a sufficient volume of solution must be used to submerge the electrode and provide a representative sample. However, due to its high toxicity, the cyanide sample volume should not be in excess. The HI4109 uses a silver halide pellet to determine the potential generated in the sample. The customer appreciated that the cyanide ion selective electrode technique is an approved standard method to detect low concentrations of cyanide (Standard Methods 4500-CN-F; ASTM D-2036-91). The high stability and accuracy of the ISE ensured their cyanide concentrations were below their limits and environmental standards were properly met. The mining company found the HI4109 provided a fast and precise way of measuring the cyanide concentration in all of their samples.