Electrochemical study of the effect of Pb(II) on the mechanism of gold oxidation in thiosulfate solutions

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The effect of Pb(II) species on the gold thiosulfate leaching from two different ores was investigated. The ores were pre-treated by pressure oxidation (POX) in acidic or alkaline medium, so called acidic POX discharge or alkaline POX discharge, respectively. In this study, electrochemical methods including open circuit potential (OCP) and cyclic voltammetry (CV) were utilized as main experimental methods to determine the gold thiosulfate leaching behavior in the presence of the ores and the lead species. The tests were conducted in 100 g/L of slurry at 0.2 M thiosulfate. Air was injected into the slurry at the flowrate of 0.07 L/min 15 minutes in advance of each test to keep dissolved oxygen concentration constant. The added Pb²⁺ concentration was varied as 5, 10, 25, 50 and 100 mg/L Pb²⁺ from leach nitrate or other soluble lead salts.

The OCP measurement showed an increase with the addition of Pb²⁺ regardless of the type of ore added, which seemed that lead ion acted as an oxidant for gold thiosulfate leaching. Furthermore, CV measurements indicated the significant changes especially onset of the improved anodic peaks between -0.1 and +0.1 V. The improvement on the peak current density was more significant in the presence of the alkaline POX discharge than the acidic POX discharge, where the peak current density had increased from 0 to 3×10⁻² mA/cm² in the presence of the alkaline POX discharge and from 0 to 1×10⁻² mA/cm² in the presence of the acidic POX discharge with increasing Pb²⁺ concentration from 0 to 100 mg/L. This peak enhancement was related to the reaction between lead ion and metallic gold in thiosulfate solution.

Keywords: Gold thiosulfate leaching, electrochemical oxidation, lead catalysis of gold oxidation, gold oxidation chemistry, thiosulfate thermodynamics.