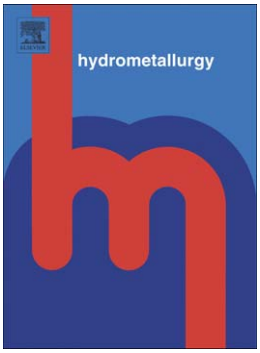

Improving Gold Recovery from Refractory Gold Ores Through Biooxidation using Iron-Sulfur-Oxidizing/Sulfur-Oxidizing Mixotrophic Bacteria

M.Z. Mubarok, R. Winarko, S.K. Chaerun, I.N. Rizki, Z.T. Ichlas

PII: S0304-386X(16)30756-3
DOI: doi:10.1016/j.hydromet.2016.10.018
Reference: HYDROM 4454

To appear in: *Hydrometallurgy*

Received date: 2 April 2016
Revised date: 20 September 2016
Accepted date: 17 October 2016

Please cite this article as: Mubarok, M.Z., Winarko, R., Chaerun, S.K., Rizki, I.N., Ichlas, Z.T., Improving Gold Recovery from Refractory Gold Ores Through Biooxidation using Iron-Sulfur-Oxidizing/Sulfur-Oxidizing Mixotrophic Bacteria, *Hydrometallurgy* (2016), doi:10.1016/j.hydromet.2016.10.018

Improving Gold Recovery from Refractory Gold Ores Through Biooxidation using Iron-Sulfur-Oxidizing/Sulfur-Oxidizing Mixotrophic Bacteria

M.Z. Mubarok[a]*, R. Winarko[a], S.K. Chaerun[a,b], I.N. Rizki[c] and Z. T. Ichlas[a]

a) Department of Metallurgical Engineering, Faculty of Mining and Petroleum Engineering, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung 40132, Indonesia

b) Geomicrobiology-Biomining & Biocorrosion Laboratory, Microbial Culture Collection Laboratory, Biosciences and Biotechnology Research Center, Institut Teknologi Bandung, Jl. Ganesha 10, Bandung 40132, Indonesia

c) GeoAssay Metallurgical Laboratory, Geoservices Company, Cikarang Barat 17530, Indonesia

*Corresponding author: zaki@mining.itb.ac.id, +62 (22) 2502239

Abstract

The effect of biooxidation (BIOX) pre-treatment of refractory gold concentrates using mixotrophic and chemolithotrophic bacteria on the gold extraction during cyanidation of the concentrates at neutral pH was studied. A series of biooxidation and cyanidation of the biooxidized concentrates was carried out using three strains of bacteria; two mixotrophic bacteria of SKC1 and SKC2 and a chemolithotrophic bacteria *Acidithiobacillus ferroxidans* (AC). Two distinct types of refractory gold concentrates with high sulfur content (i.e. S>20%) and low sufur content (i.e. S<5%) were used. The experimental results showed that biooxidation with any of the three bacteria generally showed positive effect on the gold extraction. The highest gold extraction (91.4%) from high sulfur-concentrate was achieved by BIOX with SKC2 for 14 days. It was 18% higher than the extraction level of direct cyanidation of the untreated concentrate. Biooxidation with AC, on the other hand, resulted in only slight increase of gold extraction from both concentrates due to the high solution pH of >5.0 which is not a suitable living environment for the bacteria. Cyanide consumption for cyanidation of the biooxidized concentrates with both mixotrophic bacteria was significantly increased due to reactions of sulfur and iron species that were precipitated during the biooxidation step with cyanides to form thiocyanate and ferrocyanide ions.

Keywords: biooxidation, mixotrophic bacteria, gold, refractory ore, preg-robbing, neutral pH

Introduction

Cyanidation is the most common method for gold extraction from its ore or concentrate. However, direct cyanidation is only effective for treating non-refractory ores. Direct cyanidation of refractory ores would result in inadequate gold recoveries due to various reasons. The inadequate recoveries can be associated with the presences of fine gold entrapped within sulfide minerals and/or carbonaceous materials in the ores (Aylmore and Jaffer, 2012, Yang et.al., 2015). The fine gold particles which are locked inside non-porous sulfide minerals cannot be extracted due to hindrance of the reaction between gold and cyanide ions, while the presence of naturally occurring carbonaceous matters (i.e. elemental