Fe(III) bio-reduction kinetics in stirred tank reactors operated in batch and continuous mode

Agathe Hubau[1*], Douglas Pino-Herrera[1], Catherine Joulian[1], Hafida Tris[1], Camille Becquet[1], Anne-Gwénaëlle Guezennec[1]

[1] BRGM - Water, Environment, Processes and Analyses Division - 3, Avenue Claude Guillemin – BP36009 – 45060 Orléans CEDEX 2 - FRANCE

*Correspondence: a.hubau@brgm.fr (Agathe Hubau).

Abstract: In the framework of the H2020 project CROCODILE, the recovery of Co from oxidized ores by reductive bioleaching has been studied. The objective is to reduce Fe(III) into Fe(II) to enhance the dissolution of Co from New-Caledonian limonites, mainly composed of goethite and Mn oxides. This study focused on the Fe(III) bioreduction which is the rate-limiting mechanism of this process. In a first step, biomass growth was sustained by aerobic bio-oxidation of elemental sulfur. In a second step, the biomass anaerobically reduced Fe(III) into Fe(II). This study aims at optimizing the biomass growth on elemental sulfur and assessing the influence of the biomass concentration on the second step, i.e. the Fe(III) bioreduction rate and yield, both in batch and continuous mode. Parameters, such as pH, nutrient medium composition and sulfur concentration, were optimized. Kinetics of S biooxidation followed by Fe(III) bioreduction were determined in stirred tank reactors (STR) operated at 35 °C. The consortium was mainly composed of *Acidithiobacillus ferrooxidans*, *Acidithiobacillus ferriphilus*, *Acidithiobacillus ferridurans* and *Sulfobacillus thermosulfidooxidans*. In batch mode, the increase in numbers of bacteria from 4.10^8 cell/mL to 3.10^9 cell/mL resulted in an increase of the mean Fe(III) bioreduction rate from 2 to 10 mg/L/h (compared to 0.13 mg/L/h in the abiotic control). In continuous mode, after the optimization of the nutrient medium composition, the bioreduction rate reached up to 20 mg/L/h.

Keywords: cobalt, iron bioreduction, limonite, reductive bioleaching, sulfur biooxidation

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