PRODUCTION OF MINERAL BIOLEACHING EFFLUENT IN FLUIDIZED-BED BIOREACTORS

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Introduction. Metal extraction from mineral ore assisted by microorganisms is called bioleaching. Some bioleaching bacteria have the capacity to *i)* use atmospheric CO_2 as carbon source, *ii)* fix atmospheric nitrogen, and *iii)* synthesize ATP by oxidizing Fe(II) to Fe(III)[(1)]. Fe(III) ions can attack the mineral ore, oxidizing the sulphide metal [(2)]. Mining companies have been using these microorganisms for the recovery of metals from low-grade ores in industrial heap, dump, and *in situ* leaching processes [(3)]. Bioleaching microorganisms have shown growth rate and Fe(III) production decrease in mineral ore incubation, due that microorganisms create a biofilm around the solids.
The aims of this research were: *i)* show the feasibility of continuous production of Fe(III) ions and *ii)* the capacity of native bacteria to achieve high Fe(III) ion productions rates.

Methods. Mine native bacteria was spread in 500 mL Erlenmeyer flask with 100 mL 9K medium [(4)] at the following conditions: pH 2, 10% mineral density, 30 °C and 160 rpm. Two lab scale (3.5 L, operation volume) mesophilic, fluidized bed bioreactors (FBB) were implemented. Activated carbon (700 g) with average diameter ≤ 1 mm was utilized as fluidized bed. FBB were inoculated with 300 mL of 9K media with spread native bacteria with the following characteristics: *i)* oxidation-reduction potential (ORP): 680 mV *ii)* 1.80 pH *iii)* 27.5 x 10^4 cel/mL. The response variables were ORP, pH and Fe(III) ion production[(4)]. Period 1 corresponds to batch operation. Period 2 and 3 correspond to 11.6 and 1.75 days of hydraulic retention time (HRT), respectively. The bioreactor set up and analyzes were performed by triplicate. Preliminary results are presented below.

Results. In Period 1, FBB was operated in batch conditions to improve the activated carbon colonization (Fig. 1). As a result, excellent bacteria attachment to the activated carbon was observed. FBB at the end of Period 2, showed the following average results: ORP 644.2 (±13.12) mV, pH 2 (± 0.12) and 8.65 (±0.04) gFe(III)/L. In Period 3, FBB showed the following average results: ORP 663.25 (± 12.88) mV; pH 2.07 (± 0.10); and 8.89 (± 0.07) gFe(III)/L. FBB showed a productivity of 0.75 gFe(III)/h, according to the HRT in Period 3 and Fe(III) effluent concentration.

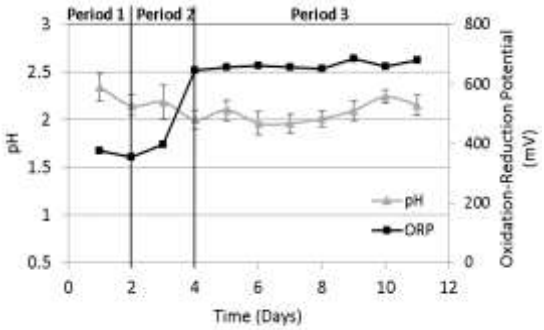

Fig.1 Time course of pH and Oxidation-Reduction Potential in fluidized bed bioreactor.

Conclusions. FBB showed a pseudo stable state in a short period of time, 4 days before inoculation. Results showed the possibility to maintain a high Fe(III) production in the conditions previously described. Also, these results allow us to decrease HRT.

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