



Leslie Yasmin López Olivares

**Fundamental aspects of hematite flotation using the
bacterial strain *Rhodococcus ruber***

Dissertação de Mestrado

Thesis presented to the Programa de Pós-graduação em Engenharia de Materiais e Processos Químicos e Metalúrgicos, PUC-Rio as partial fulfilment of the requirements for the degree of Mestre em Engenharia de Materiais e Processos Químicos e Metalúrgicos.

Advisor: Prof. Mauricio Leonardo Torem
Co-advisor: Dr. Antonio Gutierrez Merma

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Abstract

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In the recent years, research has been developed in the application of microorganisms in mineral technology, acting as environmental friendly collectors, depressors and/or frothers and inducing hydrophobic properties, since they can be selectively adhere onto the surface of the mineral. This research work deals with the fundamental aspects of hematite flotation using the bacterial strain *Rhodococcus ruber*. The aim of this research was to study and evaluate the behavior of *Rhodococcus ruber* strain before and after interaction with hematite particles. The sample was conditioned with the biomass suspension by stirring under specific conditions such as particle size, biomass concentration, pH solution and conditioning time. Among the studies conducted are the microbial adhesion to the mineral surface, zeta potential measurements and analysis of infrared spectra before and after interaction of *Rhodococcus ruber* with hematite, as well as microflotation studies. The results showed a change in hematite zeta potential profile after interaction with *Rhodococcus ruber*, and its adhesion onto the mineral surface was higher at pH 3 and at concentration of 0.60 g.L^{-1} (10^9 cells). Flotation studies were carried out in a 0.23L modified Partridge-Smith flotation cell, and the highest floatability (84%) was achieved at size fraction -53+38 μm . Also, floatability studies were performed using frother Flotanol D24 combined with the *Rhodococcus ruber* biomass, concluding with interesting results in function of the particle size range. This work aims to evaluate the efficiency of bioflotation of minerals, particularly hematite, and the potential use of *Rhodococcus ruber* as biocollector, projecting its future application in mineral flotation industry.

Keywords:

Hematite; *Rhodococcus ruber*; Flotanol D24; Partridge-Smith cell.

Resumo

López Olivares, Leslie Yasmin; Torem, Mauricio Leonardo. **Aspectos fundamentais da flotação de hematita empregando a cepa bacteriana *Rhodococcus ruber***. Rio de Janeiro, 2014. 107p. Dissertação de Mestrado - Departamento de Engenharia de Materiais, Pontifícia Universidade Católica do Rio de Janeiro.

Nos últimos anos, vários estudos têm sido realizados na aplicação dos microrganismos na biotecnologia mineral, atuando como coletores, depressores ou espumantes amigáveis com o meio ambiente, e induzindo propriedades hidrofóbicas, uma vez que eles podem-se aderir seletivamente sobre a superfície do mineral. O objetivo deste trabalho é estudar e avaliar o comportamento da cepa *Rhodococcus ruber* com a hematita. Entre os estudos efetuados estão à adesão microbiana à superfície mineral, medida do potencial zeta e análise no infravermelho antes e após interação do biorreagente com a hematita, assim como o estudo dos ensaios de microflotação. A amostra foi condicionada com a suspensão de biomassa por meio de agitação sob condições específicas, tais como tamanho das partículas, concentração da biomassa, pH da solução e tempo de condicionamento. Os resultados mostraram uma mudança no perfil do potencial zeta da hematita após interação com a *R.ruber*, e sua adesão na superfície do mineral foi maior ao redor do pH 3, e na concentração de 0.60g.L^{-1} (10^9 células). Estudos de flotação foram realizados na célula de flotação modificada Partridge-Smith de 0.23L, e a maior valor de flotabilidade (84%) foi atingido na fração -53+38 μm . Estudos complementários de flotabilidade foram realizados utilizando o espumante comercial Flotanol D24 combinado com a biomassa *R.ruber*, encontrando resultados interessantes em função do tamanho de partícula. Assim esta pesquisa visa avaliar a eficiência da bioflotação de minerais, particularmente da hematita, e do uso potencial do *Rhodococcus ruber* como biocoletor, projetando-se a uma futura aplicação na indústria da flotação mineral.

Palavras-chave:

Hematita; *Rhodococcus ruber*; Flotanol D24; célula Partridge-Smith.

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“Gutta cavat lapidem non vi sed saepe cadendo.”/ “A water drop hollows a stone not by force, but by falling often.”

Latin proverb