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Objectives and relevance of the study

2.1.
General objective

Assess the potential of the crude biosurfactant extracted from the bacteria *Rhodococcus opacus* as a bioreagent in hematite flotation.

2.2.
Specific objectives

- Develop a protocol for the extraction of the *Rhodococcus opacus*' cell associated and intracellular biosurfactants.

- Characterize the crude biosurfactant by surface tension measurements and infrared spectroscopy (FTIR).

- Model the electric double layer of the hematite particles before and after interaction with the crude biosurfactant.

- Throughout infrared spectroscopy, analyze the effect of the biosurfactant onto the hematite surface.

- Test the bacteria *Rhodococcus opacus* and the crude biosurfactant as hematite reagents by microflotation experiments.

2.3.
Relevance of the study

This study will be a significant endeavor in the bioflotation field. Along the introduction of a biochemical background, a new perspective of the mechanisms by which the bacteria interacts with the mineral will arise. The use of biosurfactants, which are more stable and more chemically active than the synthetic ones, will give new insights in the treatment of low grade ores (Mulligan *et al.*, 2014).

The advantages of bioprocessing ores and concentrates over more conventional approaches such as pyrometallurgy have been described elsewhere and include the potential for processing low- grade deposits and re-processing earlier metal-containing wastes, the production of less chemically-active tailings, lower energy inputs and other environmental benefits (Johnson *et al.*, 2009).

With the increasing demand for minerals and the depletion of high grade mineral deposits, mineral research is increasingly focusing on the beneficiation of low grade ores to produce material suitable for a global market (Dwyer *et al.*, 2012).

The study of an environmental friendly substance, which has potential characteristics as substitute of synthetic collector reagents, may be the starting point of a green sustainable process: "The invention, design and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances" (Anastas and Warner, 1998).

Biosurfactants, surface-active compounds of biological origin, are of increasing interest for many industries because of their chemical diversity, multifunctional characteristics, and low toxicity in comparison to synthetic petrochemical-derived surfactants (Maier 2003).

The production of biosurfactants is derived from bio-based feedstocks which present several advantages over petroleum-based sources. Biomass-derived carbohydrates are more highly functionalized than hydrocarbon sources, minimizing the need for oxidative chemistry that often requires the use of toxic heavy metals (Mulligan *et al.*, 2014). Although, it should be noted that, at present, the industrial use of biosurfactants is not generally competitive with synthetic surfactants because of their higher production cost (Kuyukina *et al.,* 2010).

The bacteria *Rhodococcus opacus* can metabolize long chain hydrocarbons (Kuyukina *et al.,* 2010). Therefore, it gives a new insight at the treatment of petroleum polluted soils and effluents giving as a byproduct biosurfactants which have an economical value.

They are much less toxic than synthetic surfactants. Kuyukina *et al.,* 2007 studied the toxicity of a glycolipid biosurfactant from *Rhodococcus ruber* against outbred male albino mices; no effect on central nervous system or weight loss was found during the 14-day observation.

Biosurfactants present a good specifity. They have complex organic molecules with specific functional groups that are specific in their action (Mulligan *et al.,* 2005).

It was examined the biodegradability of rhamnolipids, which are glycolipidic biosurfactants. The degradation rate was slow initially, but 92% of rhamnolipid was found to be mineralized in both kinds of soil at the end of the week (Pei *et al.*, 2009).

Among biogenic surfactants, the products of microbial synthesis are the most promising candidates for biotechnological applications because of simple mineral media and available carbon sources used in fermentation processes as well as a shorter generation time compared to animal or plant growth (Lang 2002).