Proposed Project 7: Flowsheet Development for Low-Grade Ores

Justification

With the increasing demand for iron production worldwide, there is new incentive for extraction of iron from low-grade sources that had previously been ignored. In particular, fully oxidized hematite (Fe_2O_3) and goethite (FeOOH) ores are frequently not utilized, due to the fact that they are not easily separated from silicate gangue minerals by magnetic separations. These ores occur not only as natural mineral deposits, but also as tailings impoundments that may contain more than 20% iron, but were discarded in the process of magnetically separating the more easily recovered magnetic iron oxide (magnetite, Fe_3O_4). Some technologies have been developed for upgrading these non-magnetic iron ores, such as the selective flocculation/reverse-flotation process that is in use at the Tilden concentrator in Ishpeming, MI, but there has not been much success in transferring this technology to other ore bodies. The reason for this lack of success is that the process used at Tilden was empirically developed without a fundamental understanding of how it actually works, and so there is no theoretical basis available for determining why it might work for one ore body, but not for another.

Objectives

The objective of this project is to improve our understanding of the surface properties of nonmagnetic iron ores, so that methods for separating them can be generalized to all ore bodies, and not simply restricted to the few ore bodies where methods have been empirically developed. This will not only allow the production of iron from new ore bodies that are not currently being exploited, but will also make it possible to recover iron from the material that existing mines are losing to their tailings, and to extend the life of mines by allowing them to exploit portions of their ore bodies that are not currently amenable to separation.

Description of Proposed Work

The project will result in the development of novel flowsheets specifically for low-grade, non-magnetic ore, with a theoretical framework that determines which ore properties are critical to the separation, and an understanding of how to adapt the flowsheet to any given ore type with minimal development work. This will be accomplished by study of the surface chemistry of iron oxides through measurements of zeta potential, examination of flocculation behavior, flotation experiments, and mineralogical studies.