

Methods for evaluating mineral-collector interactions in froth flotation

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Froth flotation is a solid-solid separation method applied in various industries, being its main application in the mining industry. Flotation is part of many of processes needed to supply us with several of the metallic and non-metallic elements that we use in our daily lives. In flotation, the mineral of interest is separated from the rest of the minerals present in a sample based on the selective adhesion to bubbles in a stirred tank, known as a flotation cell. Selective adhesion can be given by natural properties of the minerals, or it can be induced by the addition of chemical reagents, known as collectors. In most minerals, the addition of at least one collector is necessary. The collector interacts with the mineral surface of interest, adhering to it, and imparting an affinity to the mineral for the bubbles. In this work, the different steps involved in the development of flotation conditions for two minerals: awaruite, a native nickel-iron alloy [1] [2], and calcite, are presented. The steps are described with the aim of illustrating a general methodology for other minerals, emphasizing the multidisciplinary approach required to provide the fundamental explanations of the phenomena involved. The importance of electrochemical tools such as chronopotentiometric studies at open-circuit potential and cyclic voltammetry to the interaction mechanism between the collector and the mineral surface is discussed. The applicability of surface analysis techniques, including optical and electron microscopy, and Fourier-transform infrared spectroscopy (FTIR) is also presented. Furthermore, examples of microflotation and bench scale flotation tests for the two minerals are shown to illustrate the potential challenges that may be faced when scaling up the flotation conditions.

[1] S. Seiler, G. Sánchez, P. Bradshaw, B. Klein. Awaruite, a new large nickel resource: Physicochemical properties and their implication for mineral processing. *Minerals Engineering*. 184 (2022) 107656

[2] S. Seiler, G. Sánchez, E. Teliz, V. Díaz, P. Bradshaw, B. Klein (2022). Awaruite (Ni₃Fe), a new large nickel resource: Electrochemical characterization and surface composition under flotation-related conditions. *Minerals Engineering*. 186 (2022) 107754