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AIRBORNE ULTRASOUND APPLICATION IN IRON ORE REVERSE FLOTATION – BENCH STUDIES

Partial Report Project Efficiency Improvement of Hematite Recovery in Iron ore Flotation Process

Flávia Silvas[1]
Geriane Rocha[2]

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[2] Instituto SENAI de Inovação Mineral

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EXECUTIVE SUMMARY

The sustainability of the flotation iron ore concentration process has been constantly assessed in terms of the process efficiency and the amount of tailings generated, which differs from site to site. The growing demand for the reduction of iron losses to the tailings should occur concomitantly with the development of new technologies, since the flotation process efficiency is multi-variable dependent, including not only on the characteristics of the minerals but also on the pulp and froth. Previous studies[1] showed that the vibration of mechanical waves from an ultrasonic power transducer promoted the reduction and suppression of the three-phase froth of iron ore reverse flotation increasing metallurgical recovery and, consequently, reducing the iron loss to the tailings, especially in fine and ultrafine size fractions. In this context, this technical report conveys the study of applying airborne ultrasound to the iron ore reverse flotation, starting with the characterization of sample from Viga (Vale, Congonhas - MG), followed by the project and fabrication of high-power piezoelectric ultrasound transducers - HPUT, and its application in bench-scale flotation tests. Different configurations (type of transducers and distance) and ultrasound powers were studied. The efficiency of ultrasound application in flotation is related to the solids content of the pulp in each stage since the solids content increase contributes to the froth stability. The best results were obtained for tests RG0-SCV40 and RG60-SCV60 with 50% and 40% of solids content, respectively. The application of the tip transducer at 45 mm of distance from the froth resulted in 0.72% and 1.13% of reduction of iron loss to the tailings when compared with standard tests (Rec. Met. Fe in tailing = 16.70% ± 0.19 and 13.40% ± 0.37, respectively). However, there was a reduction in concentrate quality due to the rise in SiO_2 grade - 0.53% and 0.61% - when compared with standard test (SiO_2 grade in global concentrate = 3.09% ± 0.16 and 3.85% ± 0.46, respectively), which probably has detached from the particle-bubble aggregate due to the vibration caused by the ultrasonic waves, since, 20.8% of SiO_2 is present in the coarse fraction. Moreover, the SiO_2 is not well released (LG 95 between 74% and 36%). The achievements showed a tendency in the reduction of iron loss to the tailings, however, minor differences were found between the results. In this sense, it is suggested to continue the study to corroborate the results and strengthen the knowledge and understanding of the subject.

[1] Patent application number BR 10 2021 009571 7, 2021; Silvas et al., 2019; Buiochi and Braga, 2018; Buiochi, Silvas and Faustino, 2020.

ABSTRACT

Brazilian iron ore from Quadrilátero Ferrífero, Minas Gerais, is mainly concentrated by cationic reverse flotation and its efficiency is dependent not only on the characteristics of the minerals but also on the pulp and froth. In this context, this study aims to evaluate the effect of applying airborne ultrasound to the iron ore reverse flotation to modify the froth stability and thereby reduce iron losses to tailing. A sample of iron ore flotation feed from Viga's Plant was characterized by particle-size distribution, chemical composition and mineral morphology and liberation. Also are discusses the results from the ultrasound application study in the bench-scale flotation tests utilizing different configurations (type of transducers and distance) and ultrasound powers. The sample is composed of 41.4% of fine and ultrafine particles (- 45 μm), 40.5% of intermediate particles (-106+45 μm) and 18.1% of coarse particles (+106 μm). The iron present comes from different morphologies and concentrates in the fine and ultrafine fraction (47.5%) followed by the intermediate fraction (36.1%) and the coarse fraction (16.4%). LG 95 are greater than 90% for fractions between -106+45 μm, the other fractions are between 88% and 78%. The Si present is manly from quartz but was found other Si bearing minerals as kaolinite and goethite. SiO_2 are distributed 48.8% in the intermediate fraction, 30.4% in the fine fraction and 20.8% in the coarse fraction. LG 95 are between 74% and 36% for all size fractions. The flotation tests without ultrasound application presented the highest Gaudin's selectivity index. The best results were obtained with the application of the tip transducer at 45 mm of distance from the froth for tests RG0-SCV40w and RG60-SCV60w with 50% and 40% of solids content, respectively. It was verified 0.72% and 1.13% of reduction of iron loss to the tailings when compared with standard tests (Rec. Met. Fe in tailing = 16.70% ± 0.19 and 13.40% ± 0.37, respectively). However, there was a reduction in concentrate quality due to the rise in SiO_2 grade - 0.53% and 0.61% - when compared with standard test (SiO_2 grade in global concentrate = 3.09% ± 0.16 and 3.85% ± 0.46, respectively), which probably has detached from the particle-bubble aggregate due to the vibration caused by the ultrasonic waves. The results obtained in this study showed a tendency in the reduction of iron loss to the tailings, however, minor differences were found between the results and it is suggested to continue the study to corroborate the results and strengthen the knowledge and understanding of the subject.

Keywords: Iron ore. Reverse flotation. Airborne ultrasound. Mechanical cell flotation.