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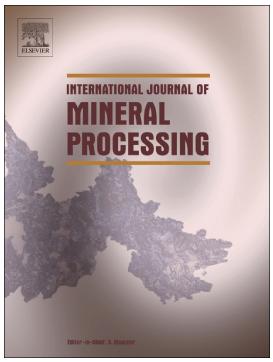

Performance evaluation of optical sorting in mineral processing – A case study with quartz, magnesite, hematite, lignite, copper and gold ores

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Performance evaluation of optical sorting in mineral processing – A case study with quartz, magnesite, hematite, lignite, copper and gold ores

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Abstract

Optical sorting is increasingly playing an important role in mineral processing. Therefore, a better understanding of this method is required concerning general properties and mineral sorting applications. To date, optical sorting has been widely studied in terms of industrial applications and performance evaluation particularly in mineral processing. Nevertheless, process optimization requires better understanding of qualitative and quantitative figures based on real life sorting applications.

In this study, the relationship between feed rate and separation efficiency of a gravity type and visible light responsive sensor mounted optical sorter (VIS sorter) was investigated. In addition to the feed rate, the effect of particle size on separation performance was also discussed. Laboratory studies included a selection of material, sample preparation, and optical sorting tests with magnesite, quartz, lignite, hematite, copper and gold ore samples. Experimental studies performed with different size fractions at varying feed rates were followed by evaluation of results with ROC (receiver operating characteristics) graphs. Recovery, grade, and capacity indicators are important to define the efficiency of the optical sorting. Alternatively, ROCs highlight missing particles and false alarm rates, which are used to characterize set points and detectability of the equipment/operation. In the tests performed with quartz and magnesite samples, % weights of valuable (white) and non–valuable (colored) particles in products were directly used to express the performance of optical sorting with ROC. Additionally, % Fe content, % dry ash content, % copper recovery and % gold recovery figures were used to define the ROC parameters for hematite, lignite, copper and gold ore samples.

Results showed that the performance of the VIS type optical sorter mainly depends on correctly sorted amounts of valuable and non–valuable particles. Alongside with the evaluation of change in sorting performances in accordance with feed rate, ore type, and particle size; pre–concentration of copper and gold ores, concentration of hematite from alkaline waste, dry cleaning of lignite and market quality magnesite and quartz sorting applications with VIS type optical sorter were also discussed.

Keywords: optical sorting; minerals; lignite; ROC