Dry beneficiation of low-grade goethite-rich iron ore fines by air classification, reduction roasting and magnetic separation

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The decrease in available high grade iron ores has generated a need to develop alternative beneficiation processes for processing impure, low-grade iron ores. Current approaches have limitations in the reduction of impurities because of finely disseminated mineralogical assemblages largely dominated by goethite. The need for complete utilisation of low-grade reserves coupled with increasing market pressure for improved product quality necessitates a re-examination of existing process flow sheets through an evaluation of alternative or supplemental processing routes. In this paper we propose this may be achieved through implementing novel dry beneficiation applications.

A diagnostic circuit simulation study involving the development and assessment of dry processing technologies for producing an improved product from low grade, goethite rich iron ores was conducted. The dry processing technology options examined included:

1. A continuous classification using a circulating air classifier with optimised parameters
2. Thermal roasting (advanced microwave-assisted magnetising roasting) of the air classifier coarse product with optimised parameters
3. Dry magnetic separation of the roast product using IRMS

Combined, the dry process technologies produced a high-grade magnetic product of 62.00% Fe from a raw feed containing 54.55% Fe and yielded 71.56% by mass with around 82% iron units. This was achieved considering 16.11% by mass was rejects (air classifier fines and IRMS non-magnetics

products) which included the main impurity units such as SiO_2 (24.13%), Al_2O_3 (22.68%), TiO_2 (23.64%), and P (18.70%).

The diagnostic circuit simulation study culminated in the development of a prospective dry processing flowsheet that can produce an improved product from low-grade goethite abundant iron ores. The conceptual process flow sheet presented in this study may become the prelude to a process flow sheet for commercialisation.