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RESEARCH ARTICLE

Beneficiation of Low-Grade Iron Ore Containing Carbonate Through Magnetizing Roasting Followed by Low-Intensity Magnetic Separation

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Abstract

The depletion of high-grade iron resources is a significant concern in the steel and ironmaking industry, which necessitates the upgrading of widely available low-grade and refractory iron ores. In this study, the beneficiation of a low-grade iron ore containing carbonate (38% iron content) was investigated using wet high-intensity magnetic separation, froth flotation, and magnetizing roasting methods to produce a high-grade iron concentrate that meets the feed requirements for the steel industry. The results showed that the process of magnetizing roasting followed by low-intensity magnetic separation (LIMS) produced a high-grade magnetite concentrate with the highest iron grade and recovery. Optimal roasting conditions were obtained at 800 °C with 30 min roasting time, 4% coal addition to the ore, and a particle size of 5–10 mm. In the presence of coal, maximum iron grade and recovery were 67.3% and 85.2%, respectively. While in the presence of gilsonite, both the iron grade and recovery in the concentrate increased to 68.5% and 91.7%, respectively. The higher roasting efficiency of gilsonite could be related to the higher amount of volatile substances, such as hydrogen, which acts as a strong reductant. The roasted samples were characterized by XRD and XRF, which confirmed that the goethite and hematite minerals were dramatically reduced to magnetite. It can be concluded that magnetizing roasting followed by low-intensity magnetic separation is an effective method for upgrading low-grade iron ore containing carbonate. This can be attributed to the formation of a porous structure resulting from the decomposition of carbonates during heat treatment, which enhances gas diffusion.

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