

Removal of Silicon, Aluminum and Phosphorus Impurities from Low-grade Iron Ore by Reverse Froth Flotation and Alkaline Roasting

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In this paper, the removal processes for silicon (Si), aluminum (Al) and phosphorus (P) impurities from low-grade iron ore, in which hematite (Fe_2O_3), goethite ($\text{FeO}(\text{OH})$), and quartz (SiO_2) are the main mineral constituents, have been presented. The reverse froth flotation process was applied to remove silicon and aluminum impurities from the iron ore using dodecyltrimethylammonium bromide (DTAB) and dodecylamine acetate (DAA) cationic collectors at a broad slurry pH ranging from 2 to 12. Whereas alkaline roasting followed by a water washing process was employed to remove phosphorus impurity from the iron ore under the various sodium hydroxide concentrations, different roasting temperatures, and prolonged varying times. Results showed that the maximum removal rate of SiO_2 and Al_2O_3 achieved were 58.3% and 31.0% via reverse froth flotation using DTAB collector at pH 12, whereas 38.7% SiO_2 and 10.0% Al_2O_3 with DAA collector. The level of total ($\text{SiO}_2 + \text{Al}_2\text{O}_3$) impurities in the tailing as iron ore product from the reverse flotation was reduced from 7.4 mass% to 4.4 mass% as the initial level. On the other hand, about 61% of phosphorus in the iron ore was removed by the combined alkaline roasting and water washing at the conditions optimized as 50 g/kg-ore NaOH at 300°C for 0.5 h. The grade of phosphorus impurity reached 0.04 mass% from 0.09 mass% (initial grade). Simultaneously, the iron grade and level of $\text{SiO}_2 + \text{Al}_2\text{O}_3$ impurity in the iron ore product from reverse flotation of the low-grade iron ore with DTAB collector reached 60.0 mass% and 4.4 mass%, which are acceptable levels for ironmaking.

Keywords : Iron ore, Quartz, Phosphorus, Reverse flotation, Alkaline roasting