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Thermodynamic modeling of metals reduction from B_2O_3-CaO-FeO-NiO melts by carbon monoxide and hydrogen

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Abstract

Thermodynamic modeling method have been used to describe the process of Iron and Nickel joint reduction from oxide melt of the B_2O_3-CaO-FeO-NiO system by Carbon monoxide and Hydrogen. Fractional inducing of reducing agent and periodic removal of metal gases from working body composition are applied in the method. The equilibrium states are determined for each unit portion of gas, and oxide component composition of the working body in each calculation cycle is taken from the previous data. Such approach is originality of the method. The approach gives possibility to bring the simulated processes closer to real technologies as well as to estimate reactions completeness in pyrometallurgical aggregates.

The calculations were carried out accounting disproportionation of FeO into Fe and Fe_3O_4. It was shown that as a result of FeO disproportionation under neutral conditions (Ar), the resulting metallic Iron interacts with Nickel oxide to form ferronickel. As a result, the initial composition of the B_2O_3-CaO-FeO-NiO system variation, take place. Additionally, Fe_3O_4 appears in the working body. The relationship of Iron and Nickel oxides contents in oxide melt, degrees of its reducing and composition of ferronickel formed depending on temperature and induced reducing agent are revealed. The Hydrogen quantity consumed for metal reducing, at which the same degree of Nickel metallization is achieved, is much less comparing to CO. However, the resulting ferroalloy has less Nickel content, which is associated with increase of reduced Iron content. The obtained information is useful for prognoses of thermal extraction processes acting during useful components extraction from oxide melts, for example, nonferrous metallurgy slag.

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