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Thermodynamic modeling of reduction of metals from B_2O_3-CaO-Ni(Zn,Pb,Cu)O melts carbon monoxide

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Abstract

Thermodynamic modeling technique is used to describe the metal reduction from oxide melt by carbon monoxide. The B_2O_3-CaO-MeO (Me – Ni, Zn, Pb, Cu) system, was used with periodic output of the metal phase and gases from the working body. The approach originality is that the equilibrium is determined for each single portion of the gas injected into the working body, and the metal oxides content being reduced in each calculation cycle is taken from the previous data. This approach gives qualitative possibility to make simulated processes closer to real ones. The proposed method calculations allow determining, such parameters as the oxide melt and metal phase compositions, degree of elements reduction, oxide and metal phases mass ratio, equilibrium composition of the gas, reducing ability of gas utilization degree, and others, depending on the introduced gas quantities. Reducing process modeling of Nickel, Copper, Lead and Zinc from B_2O_3-CaO-MeO melts gives opportunity to determine the process for each metal. Copper reducing from CuO, goes with intermediate oxide ($CuO \rightarrow Cu_2O \rightarrow Cu$) formation. Reduction of Nickel ($NiO \rightarrow Ni$), Lead ($PbO \rightarrow Pb_s + Pb_g$) and Zinc ($ZnO \rightarrow Zn_g$) proceeds in one stage. The temperature dependence of the non-ferrous metals content in the oxide melt, its reduction degree and reducing agent quantity introduced are described by the second-order polynomial equations. The information obtained may be useful for thermo-extraction processes prognosis during the Nickel, Copper, Lead, and Zinc extraction from non-ferrous metallurgy slag in bubbling process of oxide melt by reducing gases.

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