

The viscosity of slags in the CaO-SiO₂-B₂O₃-15%Al₂O₃-8%MgO system depending on basicity and content of B₂O₃

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Abstract

In this paper the effect of chemical composition on the viscosity of slags of the CaO-SiO₂-B₂O₃ system containing 15% Al₂O₃ and 8% MgO (hereinafter in wt %) was studied using the simplex-lattice method of experiment design. The method allows to obtain mathematical models that describe the dependence of a property on a composition in the form of a continuous function. Based on the experimental viscosity data of the slags of interest obtained using the oscillatory viscometer the mathematical models have been constructed in the form of a reduced third-degree polynomial describing the relationship between the temperature at given viscosity and the composition of the oxide system. Further, by combining the corresponding isotherms taken from all diagrams of constant viscosity, the composition-viscosity diagrams were obtained for temperatures of 1550 and 1600°C. The generalization of the experimental study results, presented in the form of composition-property diagrams, allowed to quantify the influence of slag chemical composition on viscosity in the oxide system under study. It is believed that to ensure the deep metal desulfurization, the viscosity of the slag is advisable to maintain at the level of 0.15-0.30 Pa·s (1.5-3.0 Poise). The experimental data given in the composition-property diagrams show that the addition of B₂O₃ to slag significantly expands the composition range of slags with low viscosity. Slags with the basicity of 2-3, containing 1-6% B₂O₃, are characterized by viscosity not exceeding 2 Poise at the temperature of 1550°C. The slags shifted into the area of increased up to 3-4 basicity still maintain their fluidity even at reduced to 1-4% boron oxide concentration. The viscosity of such slags practically does not exceed 2.5 Poise. Slags formed in the basicity area of 4-5 are characterized with increased up to 3.5 Poise viscosity at content of 1-2% B₂O₃. At the same time, in a number of studies, it is noted that slags with basicity of 3-4 containing 1-4% B₂O₃ are characterized by high refining properties that provide sulfur content in the metal at the level of 0.002% at the initial concentration of 0.027%.

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