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The effect of the chemical and phase composition on the slag viscosity of the CaO-SiO_2-B_2O_3, system containing 8% MgO and 15% Al_2O_3

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Abstract

Simplex is a lattice method of experiment planning that allows obtaining mathematical models describing the dependence of the property on the composition as a continuous function. The effect of the chemical and phase composition on the slag viscosity of the CaO – SiO_2 – B_2O_3 system containing 15% Al_2O_3 and 8% MgO (in this expression and further in the text are indicated by % mass.). Mathematical models describing the relationship between the temperature of a given viscosity and the composition of the oxide system were constructed using experimental data. Then the set of isolines of viscosity was obtained by combining the obtained composition-temperature diagrams of the given viscosity by the isothermal section of the composition-viscosity diagram. The phase composition of the slag samples of the CaO-Al_2O_3-SiO_2-MgO-B_2O_3 system was studied on a Shimadzu 7000 X-ray diffractometer in Cu Kα radiation. The generalization of the results of experimental studies presented in the form of composition-property diagrams made it possible to quantify the effect of the chemical and phase composition of the slag on the viscosity of the oxide system under study.

Slag is characterized by a practically constant concentration of gelenite, reaching 38-40% regardless of the basicity of the slag of the chemical composition studied. In this case, the influence of the basicity of slag and the content of boron oxide on the concentration of the remaining phases formed in the solid slag, which explain the nature of the change in the viscosity of the slags under study, is clearly traced. So slag basicity 2 units, containing 4% B_2O_3, is characterized by a sufficiently high fluidity despite the achieved high concentration of Ca_2SiO_4, due to the increased content of $Ca_3B_2O_6$ and the absence of free CaO. The viscosity of such a slag does not exceed 1.4 Ps at a temperature of 1500 °C and slightly increases, reaching 2.2-3.4 Ps when the temperature drops to 1450 and 1400 °C, respectively. The displacement of the slag into the region of increased to 5 basicity is accompanied, along with an increase in the content of free CaO to 28-36%, a decrease to 12% Ca_2SiO_4 and an increase to 14% $Ca_3B_2O_6$ and, as a result, the preservation of a sufficiently high liquid mobility. An increase in temperature to 1500 °C is accompanied by a significant decrease in the viscosity of slag reaching 3.5-4.0 Ps with a basicity 5 and 2.5-3.5% B_2O_3 content.

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