Full Paper _____ *Thematic Section:* Research into New Technologies.
Reference Object Identifier – ROI: jbc-02/17-52-11-102 *Subsection:* Metallurgy.
Publication is available for discussion in the framework of the on-line Internet conference "*Butlerov readings*".
http://butlerov.com/readings/
Submitted on November 08, 2017.

The use of the simplex lattice method for constructing the composition-concentration diagram of slag saturation of the $CaO-SiO_2-Al_2O_3-MnO-P_2O_5-FeO$ system with magnesium oxide

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Keywords: magnesium oxide, saturation concentration, slag, experiment planning, thermodynamic modeling, composition-property diagrams, local simplex, basicity.

Abstract

One of the tasks of physicochemical analysis is the construction of composition-property diagrams. In this paper, a mathematical modeling of saturation concentration with magnesium oxide of slags of the $CaO-SiO_2-Al_2O_3-MnO-P_2O_5-FeO$ system in a wide range of chemical composition at temperatures of 1550 and 1650 °C was carried out. Variables of the system were restricted: CaO/SiO_2 = 1.5-3; 25-40% FeO; 4% Al_2O_3; 0.3% P_2O_5; 7% MnO. Using the simplex-lattice planning method, adequate mathematical models were obtained for two temperatures of 1550 and 1650 °C in the form of a degree III polynomial, describing the saturation concentration with the magnesium oxide of the slag, depending on its composition. The results of mathematical modeling are presented graphically in the form of composition-concentration saturation diagrams at a fixed temperature. The results of mathematical modeling in combination with the mathematical method of simplex-lattice planning allowed to obtain new data on the dependence of saturation concentration of magnesium oxide in the slag of the $CaO-SiO_2-Al_2O_3-MnO-P_2O_5-FeO$ system in a wide range of chemical composition at temperatures of 1550 and 1650 °C. It can be seen from the diagrams that the influence of the slag basicity on the saturation concentration of MgO and the practical absence of FeO influence on the saturation concentration are clearly traced in the studied region of slag compositions. The maximum concentration of MgO slag saturation is observed in the slag basicity interval 1.5-2.0 and 25-40% FeO concentration, reaching 8.5-10% at 1550 °C and increasing to 9.5-11.5% at 1650°C. An increase in the basicity of the slag to 2.5-3.0 is accompanied by a decrease in the saturation concentration of MgO slag to 6.5-7.5% and to 7.5-8.0% at temperatures of 1550 and 1650°C, respectively. The generalization of the results of modeling and chemical composition of slags of current production made it possible to identify areas (shaded areas) corresponding to the chemical composition of the slag from the melting and oxidizing period, from the analysis of which it follows that during the melting period at 1550 °C, basicities 2.0-2.5 and 20.0-30.0% FeO concentration in slag, the concentration of MgO is sufficient to maintain at a level of 7.5-9.2%, and 8.2-9.5% MgO in the oxidation period at 1650 °C, basicity 2.5-3,0 and 30-40% FeO concentration in slag.

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