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Using of simplex lattices method for diagramming composition-viscosity of the slag system $CaO-SiO_2-Al_2O_3-MgO-B_2O_3$

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Abstract

One of the objectives of physical-chemical analysis is diagramming structure-property. In this work, using the simplex lattices method of experiment planning are made diagrams composition-viscosity of system $CaO–SiO_2–Al_2O_3–MgO–B_2O_3$ basicity 5-8 containing 15-30% Al_2O_3, 8% MgO and 4% B_2O_3. For each viscosity values were obtained by appropriate mathematical models as a given polynomial of degree III, describing the relationship given viscosity temperature with the composition of the oxide system. Mathematical modeling results are shown in the graphs, the composition viscosity at a fixed temperature. Experimental studies in combination with mathematical method of simplex lattices planning allowed to obtain new data on the viscosity of $CaO–SiO_2–Al_2O_3–MgO–B_2O_3$ system with minimal cost in the temperature range 1400-1600 °C. It was found that the slag with a minimum viscosity of 0.8 Pa·s at 1400 °C located in a narrow area of the basicity 5.0-5.6 and 57.7-61.3% CaO, 10.2-12.0% SiO_2 and 15-20% Al_2O_3. The viscosity increased to 2.0 Pa·s in a wider range of the slag basicity (5.0-6.3) containing 56.0-62.8% CaO, 9.2-12.0% SiO_2 and 15-23% Al_2O_3. Minimum slag viscosity of 0.8 Pa·s is observed in the wider area of the main chemical composition and when the temperature rises to 1500 °C. For example, slag characterized a viscosity of 0.8 Pa·s at basicity 5.0-6.3 and 23% Al_2O_3, which is maintained by increasing the basicity to 7.1 and content of Al_2O_3 up to 28%. At a temperature 1600 °C minimum slag viscosity of 0.8 Pa·s is saved in broader region of the basicity at 5.0-7.1 and 15.0-26.5% Al_2O_3. The viscosity of the slag containing 18.5-25.0% Al_2O_3 is not more than 1.2 Pa·s at increasing basicity to 8.0. Slag of the studied composition have high refining properties and can be recommended for the formation in the ladle furnace.

References

[1] V.A. Kim, E.I. Nicholas, A.A. Akberdin and etc. Experiment planning in the study of physical and chemical properties of metallurgical slags. Toolkit. *Alma-Ata: Science.* **1989**. 116p.
[2] V.A. Kim, A.A. Akberdin, I.S. Kulikov and etc. The use of simplex lattices for constructing of composition-viscosity diagrams. Proceedings of the universities. *Ferrous Metallurgy.* **1980**. No.9. P.167.
[3] A.G. Upolovnikova, A.A. Babenko. Thermodynamic modeling of boron recovery from boron-containing slag. *Butlerov Communications*. **2016**. Vol.48. No.10. P.114-118. ROI: jbc-02/16-48-10-114
[4] W. Hongming, Z. Tingwang, Z. Hua. Effect of B_2O_3 on Melting Temperature, Viscosity and Desulfurization Capacity of CaO – based Refining Flux. *ISIJ International*. **2011**. Vol.51. No.5. P.702-708.