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Plotting the equilibrium cerium content in metal under the slag of the $CaO-SiO_2-Ce_2O_3-15\%Al_2O_3-8\%MgO$ system

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Abstract

Using the HSC 6.1 Chemistry (Outokumpu) software package in combination with simplex-lattice planning, we performed thermodynamic modeling of the equilibrium cerium content in a metal containing 0.06% C, 0.25 Si, 0.05% Al (in this expression and further on the text indicates mass%), under the slag of the $CaO – SiO_2 – Ce_2O_3 – 15\% Al_2O_3 – 8\%$ MgO system in a wide range of chemical composition at temperatures of 1550 °C and 1650 °C. For each temperature, adequate mathematical models have been obtained in the form of a reduced polynomial of degree III, describing the equilibrium content of cerium in the metal depending on the composition of the slag. The results of mathematical modeling are presented graphically in the form of diagrams of the composition – the equilibrium content of cerium. A marked effect of slag basicity on the distribution of cerium is noted. An increase in slag basicity from 2 to 5 at a temperature of 1550 °C leads to an increase in the equilibrium cerium content in the metal from 0.1 to 7 ppm, i.e. the increase in slag basicity favorably affects the development of cerium recovery process. An increase in metal temperature has a positive effect on cerium recovery. As the temperature rises to 1650 °C, the equilibrium cerium content in the metal increases on average from 0.3 to 10 ppm. In the diagrams of the chemical composition of slags containing 56-61% CaO, 12-14% SiO_2 and 15% Al_2O_3 in the temperature range of 1550 and 1650 °C, we can expect a concentration of cerium in the metal at a level of 7-10 ppm at a content of 4% to 7% Ce_2O_3 in the original slag. The positive effect of the basicity of the formed slag in the studied range of chemical composition on the cerium reduction process is explained from the standpoint of the phase composition of the slag and the thermodynamics of cerium reduction reactions.

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