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Thermodynamic modeling carbothermic reduction of chromium from poor raw materials

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Abstract

The main task of metallurgists always has been to increase the transition degree of the leading elements to the melting product. At present, the transition degree of chromium to the alloy varies within wide limits and is 75-92% for different types of chromic ore in obtaining high-carbon ferrochromium. In this regard, the study of carbothermic reduction process of chromium ore materials elements from poor domestic ore raw materials is of considerable interest. Thermodynamic modeling of carbothermic reduction processes for obtaining high-carbon ferrochromium from ores of Saranovskoye deposit and Kempirsai massif was carried out with the approbation of the results obtained under laboratory conditions. Calculations were performed by minimizing thermodynamic potentials using the Chemistry HSC-6.1 software package (Outokumpy). The equilibrium compositions of the interaction products in investigation systems are determined taking into account the most probable chemical reactions determined by the magnitude of the Gibbs energy increment. The results of thermodynamic calculations showed that the degree of chromium recovery from poor and rich ore materials are almost equal and exceed 99% with an increase in temperature > 1450 °C. At a temperature of ≥ 1050 °C, the interaction reaction of chromium oxide with carbon is intensively developed with the formation of Cr_3C_2 carbide, and at reaching 1100 °C – Cr_4C. A high rate of increase in the reduction degree of chromium with an increase in temperature from 1050 to 1450 °C indicates a good reducing ability of the elements of the investigated chromium ore materials. Approbation of the thermodynamic calculations results was carried out high-temperature thermogravimetric method followed by chemical analysis of the smelting products. Experimental studies have shown that the reduction degree of chromium from both samples at a temperature of 1600 °C exceeds 95%. Qualitatively, the nature of the smelting products for the Saranovskoye and Kempirsai ores is monotonous, only the quantitative values are different. In the high temperature region, poor chromium ores are not inferior to rich ores in recovery degree of the basic element, all other things being equal.

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