Full Paper _____ *Thematic Section:* Thermodynamic Research.
Reference Object Identifier – ROI: jbc-02/16-48-10-114 *Subsection:* Inorganic Chemistry.
Publication is available for discussion in the framework of the on-line Internet conference "*Butlerov readings*".
http://butlerov.com/readings/
Submitted on December 08, 2016.

Thermodynamic modeling of boron recovery from boron-containing slag

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Keywords: boron, metal, slag, phase distribution, design of experiments, thermodynamic modeling, structure-property diagrams.

Abstract

Using the software package HSC 6.1 Chemistry (Outokumpu) carried out thermodynamic modeling of the boron equilibrium distribution between iron containing 0.2% C, 0.35 Si, 0.028% Al (in the terms and hereinafter indicated mass. %) and the slag 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 and at temperatures 1550 and 1600 ^oC. Using the simplex-lattice planning obtained adequate mathematical models in the form of III degree polynomial which describes the equilibrium distribution of boron between slag and metal, depending on the composition of the slag. Mathematical modeling results are presented graphically in the form of diagrams composition - boron equilibrium distribution. It is shown the effect of slag basicity on the boron distribution coefficient. Thus, increasing the slag basicity from 5 to 8 at a temperature 1550 ^oC reduces the boron distribution coefficient from 160 to 120 and, as a consequence, increase the boron content in the metal from 0.021% at LB = 159 to 0.026% at LB = 121, that is, growth slag basicity is beneficial to the development of boron recovery process. The positive effect of the slag basicity on boron recovery process is explained in the slag phase composition and thermodynamics of boron reduction reactions in the study range of the chemical composition. The temperature growth of the metal negatively affects the boron recovery. Equilibrium boron distribution coefficient increases by an average of 10 units with an increase in temperature to 1600 °C. In the diagrams are marked field of slag chemical composition containing 53-58% CaO, 8.5-10.5% and SiO_2 20-27% Al_2O_3, providing boron distribution coefficients at a level 140-170 at a temperature range 1550 and 1600 °C and allowing to expect boron concentration in the metal at the level of 0.020% at LB = 168% and 0.023% at LB = 139 at the 4% B_2O_3 in the slag initial.

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