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Abstract

Full Text

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THE EFFECT OF SULFUR ON THE SOLUBILITY OF OXYGEN IN LIQUID IRON

In studying the process of desulfurization after the introduction of silicon and aluminum into unoxidized metal, it was established that deoxidation and desulfurization proceed simultaneously.

When the metal was deoxidized with carbon in vacuum, it was found that the final sulfur content in the metal is determined by the oxygen concentration ([1]).

Taking into account the similar role of oxygen in the process of desulfurization, it was necessary to establish the effect of sulfur on the solubility of oxygen in liquid iron.

The experimental effect of sulfur on the solubility of oxygen was studied by Hilty and Crafts ([2]), who carried out melts in magnesite crucibles, in a rotating furnace, and in an argon atmosphere. Electrolytic iron was used as the charge. Pure iron sulfide and ferrous oxide were added to the molten metal. The results of this work, however, are questionable. Sulfur and oxygen are metalloids; the solubility of sulfur in liquid iron is high, and for this reason alone it may be expected that sulfur (at least in the region of low concentrations) should not exert a noticeable influence on the solubility of oxygen in liquid iron. The break in the oxygen-solubility curves is also unclear.

We investigated the effect of sulfur on the solubility of oxygen in liquid iron at 1550 and 1600°. Electrolytic iron containing $< 0.01\%$ C, $< 0.01\%$ Mn, 0.002% S, 0.01% P, and traces of Si was used as the charge. The interaction between liquid iron containing sulfur and a steam–hydrogen mixture was studied. Since the melts were carried out according to the procedure used in determining the activity of oxygen in pure liquid iron ([3]), and in the same apparatus, the solubility of oxygen in pure liquid iron was not determined; instead, we limited ourselves to establishing the effect of sulfur on the solubility of oxygen. The ratio $P_{H_2O} : P_{H_2}$ in the gas mixture was equal to unity. A 15-minute holding of the liquid metal under a mixture of this composition guaranteed saturation of the metal with oxygen, as we judged from the appearance of a film of ferrous oxide at the walls of the crucible.

The results of determining the solubility of oxygen in liquid iron containing sulfur at 1550 and 1600° are shown in Fig. 1.

Fig. 1

Figure 1: Fig. 1

As follows from the data obtained, sulfur, within the limits of experimental accuracy, has no effect on the solubility of oxygen in liquid iron.

The experimental points obtained, which fix the solubility of oxygen in iron-sulfur melts, agree well with the values of the maximum solubility of oxygen in pure liquid iron at 1550 and 1600°.

In other words, the temperature dependence of the solubility of oxygen in an iron-sulfur melt is satisfactorily described by the equation that determines the influence of temperature on the solubility of oxygen in pure liquid iron ([4]), namely:

$$\lg[\%O] = -\frac{6320}{T} + 2.734.$$

In determining the oxygen content in the metal, the usual vacuum-melting method was used. However, there are data ([5]) showing that, at high sulfur concentrations in the metal, compounds of the type CS and CS_2 are formed (during the reduction of oxides by carbon in vacuum); their presence leads to overestimation of the results of determining the oxygen content. Therefore, the results obtained by us may be somewhat overestimated in comparison with those that would possibly have been obtained if the carbon monoxide had been purified of carbon sulfides.

Fig. 1

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Note: Figure translations are in progress. See original paper for figures.