(200) Measurement of Activity of Ferrous Oxide in Soda-based Slag

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1.Introduction: In the past few years, the industrial method of dephosphorization of hot metal with sodium carbonate has been developed in Japan. However, the basic data are still lacking on thermodynamics of slag systems containing sodium oxide. Recently, Goto et al (1) have reported the activity of Na_2O in Na_2O-SiO_2-P_2O_5 melts. On the other hand, ferrous oxide has also an important role in dephosphorization of hot metal by sodium carbonate. In the present work, the activity of FeO in Na_2O-SiO_2-Fe_tO liquid slag equilibrated with pure iron was measured by the EMF method with ZrO_2-MgO solid electrolyte.

2.Experiment: The composition of the slag was 2.0-30 mol% Fe_tO with the fixed ratios of Na_2O to SiO_2 of 1:2 and of 1:1. The slag premelted before the experiment was put into the pure iron crucible. The temperatures were adjusted at 1000°C,1100°C and 1200°C by the automatic-control instrument. During the experimental run, the purified argon with oxygen partial pressure of 10^{-15}-10^{-17} atm was supplied through the sealed tube of the furnace. The sensor was made by ZrO_2-MgO solid electrolyte tube with mixture of Ni-NiO as the reference electrode. The values of the EMF were recorded by the recorder. Then, the activity of ferrous oxide in slag was calculated from the EMF (2).

3.Results and Discussion: Fig. 1 shows the relation between the EMF's values and time with different temperatures. The time of the sensor immersion in slag was more than 2.0-3.5 hours continuously. The ZrO_2-MgO tube had satisfactory resistance to the corrosion by Na_2O-SiO_2-Fe_tO system containing high Fe_tO in liquid state. A series of stable EMF have been obtained, when the temperatures of slag were stabilized. The reproducibility of the EMF's values is very good, when the temperatures were increased or decreased, or the same composition of slag has been used. The activity of FeO is shown in Fig.2. The relations between the ^aFeO and ^NFe_tO show the negative deviation from Raoult's law in $Na_2O{\cdot}2SiO_2$-Fe_tO slag at the experimental temperatures. Contrarily, the positive deviation is obtained in $Na_2O{\cdot}SiO_2$-Fe_tO slag at 1200°C.

The above results are in agreement with Ohtani et al's work (3). However, the concentrations of Fe_tO in their slag were only lower than 1.5 mol% and the gas was with oxygen partial pressures of 10^{-10}-10^{-12} atm in their studies. The effect of temperature on ^aFeO is the other important point. It was not shown clearly by Ohtani et al in the range of the lower Fe_tO mol%. In Fig.2, if the temperature is increased, the negative deviation of ^aFeO to ^NFe_tO becomes smaller.

The present results show the large effect of the ratio of Na_2O to SiO_2 on the value of ^aFeO. When the ratio was changed from 1:2 to 1;1, the negative deviation from Raoult's law changes to the positive deviation. In this aspect, it seems in good agreement with Sano's work (4).

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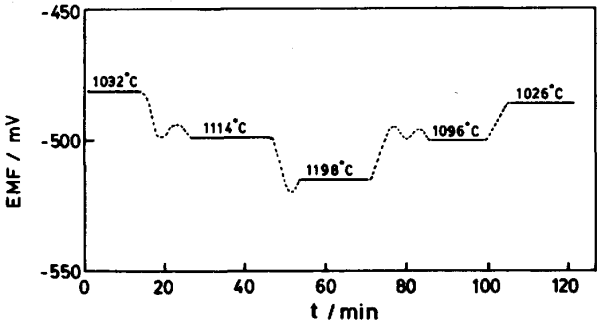

Fig.1 The relation between EMF and time with different temperatures

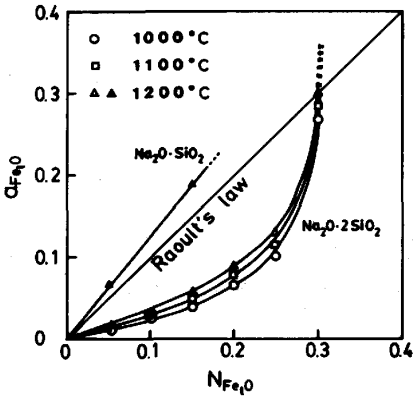

Fig.2 The activity of FeO in Na_2O-SiO_2-Fe_tO liq. slags