(287) Phosphorus Partitions between Carbon-Saturated Iron Melts and $CaO-CaF_2-SiO_2-MnO$ Slags

○Simeon Ratchev Simeonov and Nobuo Sano

Department of Metallurgy, The University of Tokyo

1. Introduction

Dephosphorization is one of the most important reactions in steelmaking process. Recently some thermodynamic investigations on the dephosphorization of hot metal have been carried out by using soda or lime based slags (1,2). However,so far no thermodynamic investigations have been reported on the dephosphorization of hot metal containing a large amount of manganese by soda or lime based fluxes.

The purpose of this study is to investigate the effects of manganese oxide, slag compositions and temperature on the equilibrium distribution of phosphorus between the molten $CaO-CaF_2-SiO_2-MnO$ system and carbon-saturated iron with high manganese content under reducing conditions.

2. Experimental methods

Two grams of carbon-saturated iron which contains 0.023% phosphorus and 4.60% manganese were equilibrated with two grams of slags containing MnO 1.0-5.0%, SiO_2 11-13%, CaF_2 29-31%, CaO 48-55% in a graphite crucible under carbon monoxide atmospheres. The temperatures were 1250, 1280, 1300, 1350°C and the experimental time was 20h. The final compositions of slags and metals were determined by ordinary chemical analysis methods.

3. Experimental results

Fig.1 shows the effect of manganese oxide content on phosphorus partitions between slag and carbon-saturated iron. The phosphorus distribution ratio slightly decreases with increasing the manganese oxide content in slag. The phosphate capacities defined as

$$C_{PO_4^{3-}} = \frac{(\%PO_4^{3-})}{P_{P_2}^{1/2} \cdot P_{O_2}^{5/4}} \qquad \cdots\cdots\cdots (1)$$

were calculated to be between 2.5×10^{25} and 3.0×10^{25} from the results in Fig.1.

Fig.2 shows the temperature dependency of phosphorus distribution ratio. The heat of reaction:

$$3/2(CaO) + \underline{P} + 5/4O_2 = 1/2(Ca_3(PO_4)_2) \cdots\cdots (2)$$

calculated from the plots in Fig.2 is -130 kcal/mol which is in good agreement with that of Muraki et al (3).

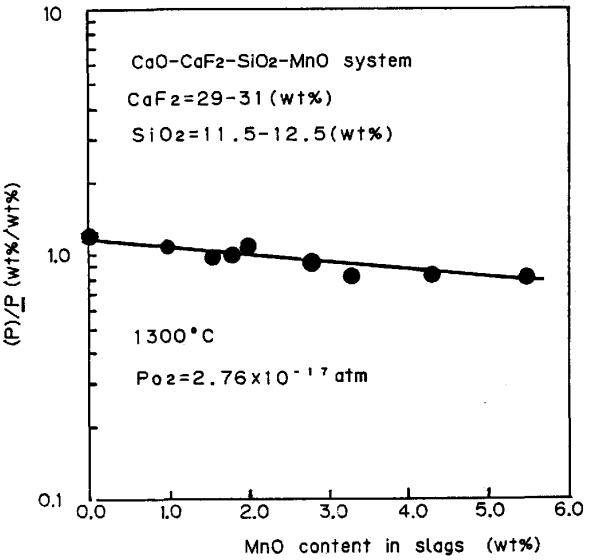

Fig. 1. Influence of MnO content on phosphorus distribution ratio at 1300°C for the $CaO-CaF_2-SiO_2-MnO$ system.

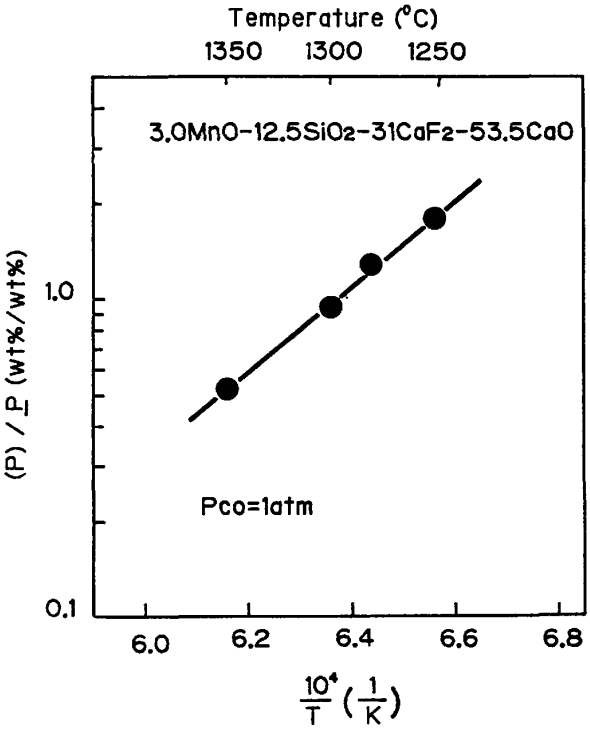

Fig. 2. Temperature dependency of phosphorus distribution between 1250°C and 1350°C for 3%MnO-12.5%SiO_2-31%CaF_2-53.5%CaO.

References
1. F.Tsukihashi, F.Matsumoto and N.Sano: Tetsu-to-Hagane, 69 (1983), No.4, S 175
2. K.Ito and N.Sano : Tetsu-to-Hagane, 69 (1983), No.15, p. 1747
3. M.Muraki, H.Fukushima and N.Sano : Tetsu-to-Hagane, 70 (1984), No.4, S 203