(143) Metal-Slag Equilibria Using The Levitation Melting

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I. Introduction

To verify the temperature control model[1] of the levitation melting, the study on the dephosphorization equilibria between molten iron and the lime based slag was performed at 1,600°C,1,650°C and 1680°C.

II. Experimental procedure

The same levitation apparatus and temperature control technique was applied. Chemical compositions of the slag are shown on Table 1.

III. Experimental results

The necessary experimental time to achieve a slag-metal equilibrium of phosphorus was only one minute with CaO-FeO_n-P_2O_5-SiO_2 slags as shown in Fig.1. The metal temperature were 1,600, 1,650 and 1,680°C, and the temperatures at the slag surface were 10-20 °C lower than at the top surface of the metal. Oxygen potential was controlled by adjusting the iron oxide contents in the slag. Helium gas was used in the experiments.

Figures 2 and 3 show the experimental results compared to those of previous works[2-6]. The data in this study agree with those of previous works. The temperature dependence of the equilibrium constant K_P is observed in Fig.2. Applying Healy's equation[7], the phosphorus distribution between metal and CaO-FeO_n-P_2O_5 slag was closer to equilibrium than in the previous investigations. In the case of CaO-FeO_n-P_2O_5-SiO_2 slags the approach to the equilibrium is the same as in the previous studies.

IV. Conclusion

The experimental technique for the study of slag-metal equlibria using the levitation melting was established.

V. References

1) Katohgi et al : to be published, Tetsu to Hagané, 70(1984) No.12
2) Balajiva et al: JISI,153(1946)p115
3) Ibid.: JISI, 155(1947)p563
4) Oeters et al : Stahl u.Eisen, 81(1961)p1437
5) Trömel et al ; Arch. Eisenhüttenwes., 32(1961)p353
6) Ibid.: Ibid, 33(1962)p745
7) Healy et al : JISI, 208(1970)p664

Table 1. Chemical composition of slag (premelted)

System	No.	Chemical composition (wt.%) CaO	Σ Fe	P_2O_5	SiO_2
CaO-FeO_n P_2O_5-SiO_2	#1	31.9	32.4	4.9	18.9
	#2	29.8	37.1	5.0	14.4
	#3	30.0	40.3	5.0	9.6
CaO-FeO_n-P_2O_5	#4	49.0	21.2	23.7	-

Symbols

a :radius of droplet [m]
D :diameter of droplet [m]
d :inner diameter of cylindrical glass tube [m]
I :coil current [A]
k_f :thermal conductivity of gas at film temperature [J/m·s·deg]
m_M :mass of metal [kg]
Pr :Prandtl number [-]
p :penetration ratio [-]
Re :Reynolds number [-]
T :temperatures
z :height from top direct loop [m]
ε_M :hemispherical total emmisivity of metal [-]
ρ :electrical resistivity of metal [Ω m]

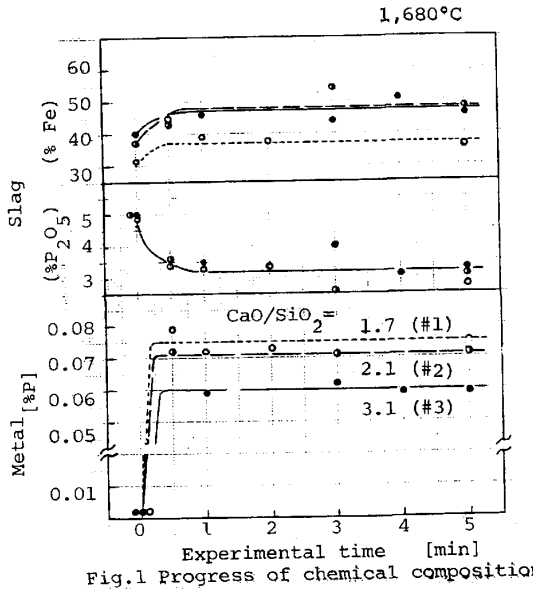

Fig.1 Progress of chemical compositions

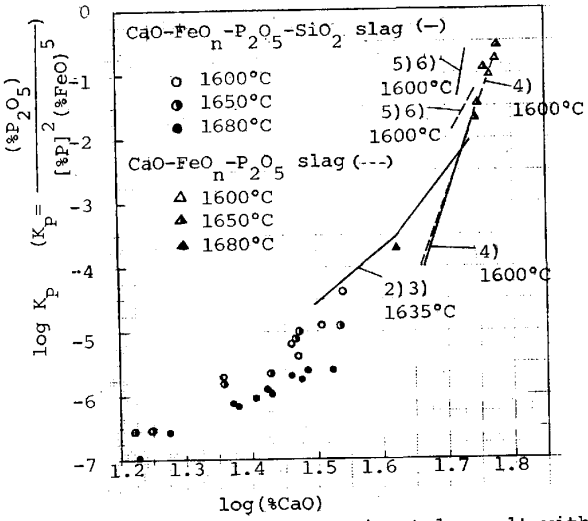

Fig.2. Comparison of experimental result with previous works according to Balajiva's analysis method

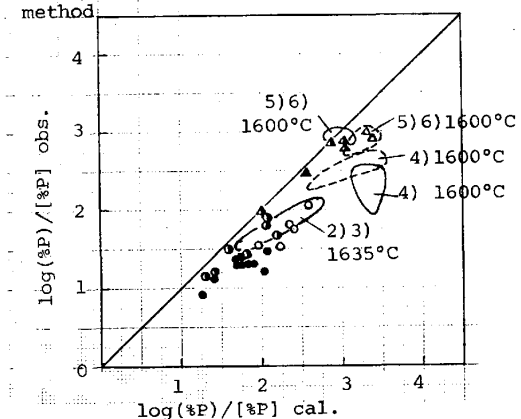

Fig.3. Comparison of experimental result with previous works according to Healy's analysis method