(214) INFLUENCE OF LANCE DESIGN AND OPERATING VARIABLES ON POST COMBUSTION IN THE CONVERTER WITH SECONDARY FLOW NOZZLES

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1. INTRODUCTION

Post combustion comes up as an important technique in order to increase scrap ratio or smelting reduction of ores charged in the converter. Secondary flow lance practice is one of the most popular methods to increase the post combustion ratio. However, its design and operation is not as yet determined from the dynamical stand point.

Thus, after theoretical analysis for an inclined oxygen jet with combustion, the effects of the design and operational factors of the secondary flow nozzles have been calculated.

2. METHOD FOR CALCULATION

Equations of continuity, conservations for momentum, enthalpy and gas species inside the jet shown in Fig. 1 can be derived from quasi-one dimensional assumption. The numerical calculation by using Runge-Kutta method enables to describe the jet trajectory, velocity, temperature and mass fractions at the interface between gas jet and metal hath.

On the other hand, the total post combustion ratio, γ (%), in the converter is written by eq.(1),

$$\gamma = \frac{Q_M \alpha/(100+\alpha) + Q_{pc}\beta/100}{100\, Q_M/(100+\alpha) + Q_{pc}(100-\beta)/100} \times 100 \quad (1)$$

and oxygen balance of the secondary nozzle becomes

$$\frac{Q_{pc}(100-\beta)}{100} = 42\, k.a\, (x_{O_2} + \frac{16}{44} x_{CO_2}) \quad (2)$$

where, Q_M, Q_{pc} is the oxygen flow rate of main and secondary flow rate (Nm^3/min) ; α, the post combustion ratio of main nozzles (%) ; β, the percentage of oxygen supplied to combustion of CO in the secondary jet (%) ; k.a, the capacity coefficient (kg/s) ; and x_j, the mass fraction of component j(-).

γ can be estimated from eqs (1) and (2), when, for example a statistical relation between k.a and the calculated physical quantities are found by means of the previous date1),2),3)

3. RESULTS

Fig. 2 shows the influences of the secondary oxygen fow rate and lance height, H(m) on total post combustion ratio , where the calculated conditions are as follows : $Q_M = 140$ Nm^3/min, $\alpha = 10$ %, $r_i = 0{,}008$m, $\Phi_i = 20°$ and N (Number of holes) = 5. The optimal secondary flow rate for each height is shown in order to obtain the maximum post combustion ratio. The maximum vertical distance, Zmax, of the jet axis at $Q_{pc}/Q_M = 0{,}32$ is longer than H = 5 m. It means that the inclined jet impinges upon the metal bath.

1) H. NAKAJIMA et al. : Trans ISIJ, 26 (1986) p.40
2) K. TAOKO et al. : Tetsu-to-Hagané, 70 (1984) S. 1027
3) T. SOEJIMA et al. : Tetsu-to-Hagané, 71 (1985) S 1042

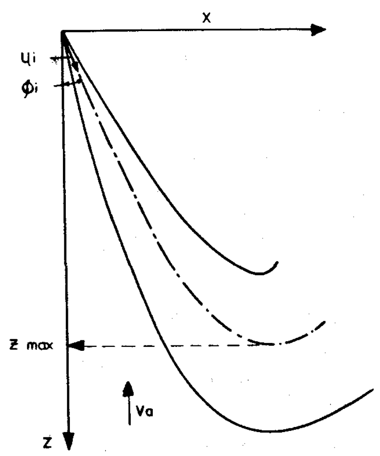

Figure 1 Schematic representation of an inclined free jet

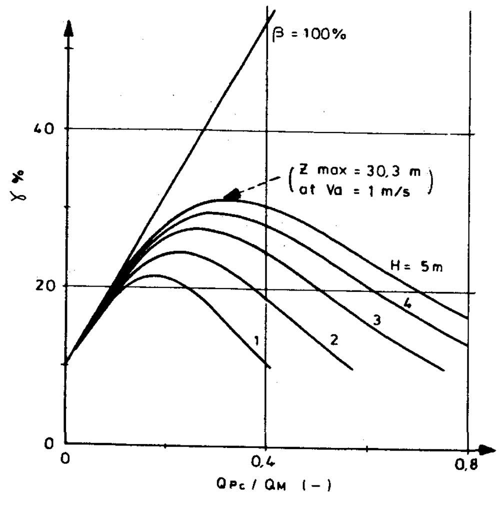

Figure 2 Influence of secondary O_2 flow rate and lance height on post combustion ratio ($Q_M = 140$ Nm^3/min, $\alpha = 10$ %, $r_i = 0{,}008$ m, $\Phi_i = 20°$, N = 5)