(212) RECIRCULATING GAS FLOW WITH COMBUSTION IN A 300 KG CONVERTER WITH A TOP BLOWING LANCE

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1. INTRODUCTION

Investigation of heat and mass transfer in the space of the converter is an important subject in order to understand the behavior of post combustion. However, conventional theoretical studies were restricted to a free jet without reaction between gas and metal bath. In this case, gas flow must be treated as a recirculating flow, because the downward oxygen jet, transfering heat and mass, impinges upon metal bath and the reacted gas escapes upwards.

A theoretical analysis of two dimensional recirculating gas flow with combustion has been carried out and compared with experiment on a 300 kg converter at IRSID in Maizières-lès-Metz.

2. CALCULATION AND EXPERIMENT PROCEDURES

The schematic representation of heat and mass transfer in the converter is shown in fig.1. Equations of continuity, momentum, enthalpy and gas species are derived under the following assumptions.

(1) Both of turbulent Prandtle and Lewis numbers are equal to 1.

(2) Reaction rate at the interface between gas and liquid (fire spot) is controlled by gas phase diffusion.

(3) Equilibrium reaction of $CO + 1/2\ O_2 \rightleftharpoons CO_2$ proceeds in gas flow.

The differential equations are changed to difference equations and solved numerically[1].

On the other hand, time change of gas components in the high frequency furnace are measured with a mass spectrometer. Weight of metal charged is about 200 kg and its compositions are $2.8 \leqslant$ [% C] $\leqslant$ 4,0 and [% Si] $\leqslant$ 0,036. Oxygen blowing time is about 4 min. Effects of oxygen flow rate and lance height on post combustion are investigated.

3. RESULTS

Fig. 2 shows an example of calculated results of constant stream function, ψ, mass fractions of O_2 and CO, X_{O_2}, X_{CO}, and normalized enthalpy, $\bar{h}$.

The constant stream function lines express existence of a recirculating zone. The decrease of X_{O_2} and the increase of X_{CO} along the depressed surface result from the reaction of $CO_2 + \underline{C} \rightarrow 2\ CO$ and $O_2 + 2\ \underline{C} \rightarrow 2\ CO$ at the interface between gas and metal liquid.

The decrease of enthalpy along the depressed surface and side wall is caused by heat transfer from the gas to the surroundings.

The comparisons between the calculated and the experimental post combustion ratio at (Z, r) = (0.3, 0.1) are shown in fig. 3, where a factor of mass transfer coefficient for Q_{O_2} = 0.5 Nm³/min is determined so that the calculated and experimental values of post combustion agree, and it is fixed under the other conditions. It is known that the calculated results agree well with the measured ones.

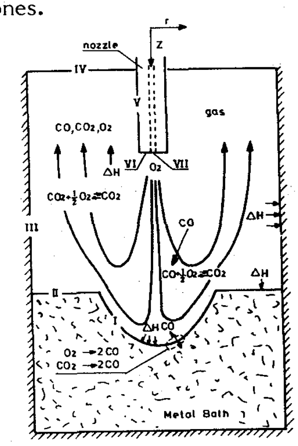

Fig. 1 - Schematic representation of heat and mass transfer and boundaries in a furnace

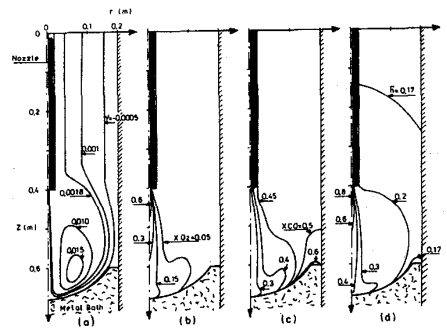

Fig. 2 - Constant stream function (a), mass fraction of O_2(b), CO (c), and normalized enthalpy lines (d) in the high frequency furnace (Q_{O_2} = 0.5 Nm³/min, L.H = 0.2 m)

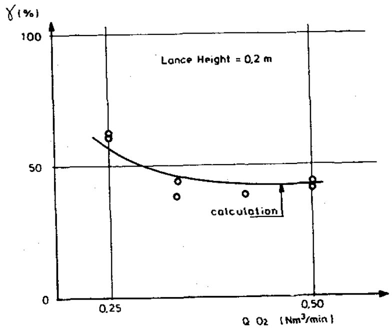

Fig. 3 - Relation between post combustion ratio and oxygen flow rate (experiment and calculation)

REFERENCE

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