'83− S 734

(22) Model Studies of Liquid Flow in Blast Furnace Hearths

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1. Introduction

Proper drainage of the blast furnace hearth is essential for smooth furnace operations. To assist the understanding of hearth conditions RI tests and model studies have been carried out in Japan.[1-4] The latter involved spherical particles of essentially uniform size, and both uniform and non-uniform irrigations were examined. Later, coke-free layer effects were also studied. As dissected furnace data show hearth coke is neither spherical nor uniform in size, model investigations were carried out with beds of irregular particles and size spectrum to investigate how these conditions might influence hearth drainage.

2. Experimental

The apparatus and experimental procedure was almost identical to that used by Hara et al[3], but the model hearth (470ϕ) was provided with three TH and a number of tuyere ports to model PK No.5 BF. Packings used were crushed stone of wide size range and both uniform and segbegated beds were studied. Average Reynolds numbers were 2-10. Results were analysed both by the residence time theory[4] and a dispersed flow model.

3. Results

Uniform bed results followed the residence time theory. However, coke-free layer beds produced two Xp^* points as shown in Fig.1. This phenomenon, not previously reported, was also reproduced in the coke-free layer segregated bed as shown in Fig.2. These results would be important in assessing the degree of channelling in BF hearths. Tests with tuyere port injections agreed with the RI curves of Shimomura et al[1]. However, the equation was different, viz;

$$C_{max} = KL^{-\frac{1}{2}}$$

where C_{max}; radiation peak value
K; constant
L; tuyere to TH distance

The equation agreed well with the dispersion theory. Likewise, Nakamura's[2] curves were well reproduced also. However, based on the dispersion theory, a new explanation was given which does not involve small size coke. Port Kembla No.5 BF RI results on switching TH were also reproduced and analysed.

The results indicate that more than one Xp^* point may exist in BF hearths. This would influence channelling degree, and here dye experiments in a 2D model suggest channelling decrease. Reported RI curves from operating BF were reproduced in the study and results analysed by the dispersion model. In some cases this led to different explanations from those given by the original authors.

REFERENCES

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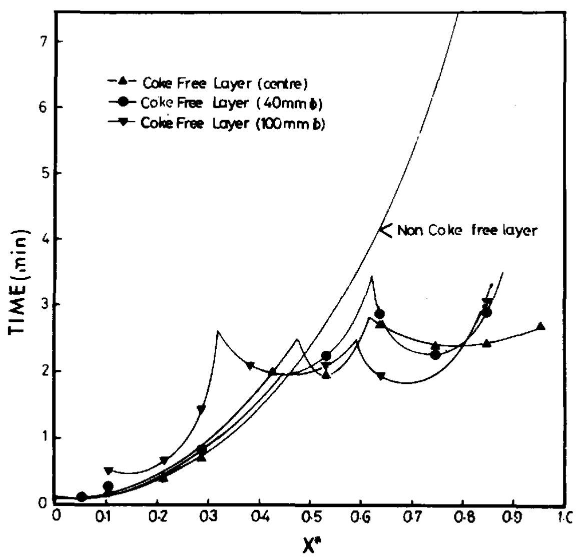

FIG.1. Experimental residence time curves.

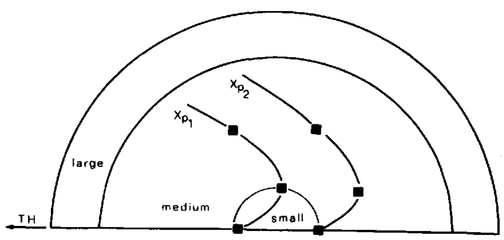

FIG.2. Lines of Xp^* in the segregated bed of small, medium and large particles.