(21) The Structure and Permeability of Bell-Less Charged Sinter Layers

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I. Introduction

The burden distribution at the top of the blast furnace is one of the most important factors controlling furnace operation. Therefore, much research has been done, on full and reduced scale, into radial size segregation, O/C distribution and mixed layer thickness. But the layer structure also involves vertical segregation which in the main has been ignored in most segregation studies. The purpose of the paper is therefore to present some results of vertical segregation and permeability of P-W charged sinter layers.

II. Experiment

Both full size and reduced scale experiments were performed. The reduced scale model (600φ) of a P-W top furnace was charged with coke (-6.3+2mm) and sinter (-2.5+0.5mm) as $C_{765}O_{987}$ pattern to give a V-profile. Initial vacuum, wax and resin sampling was later substituted by a jelly technique which gave high sampling accuracy. In full scale tests, again with a P-W top, core samples of the top sinter layer were taken by a modified technique that enabled mechanically strong core samples to be obtained so they could be withdrawn under industrial conditions without damaging them. The important aspect of the developed technique was that the material being sampled was in no way disturbed by the sampling. In other words, the actual structure existing in the layer was absolutely preserved in the sample. The sampling technique was also quick, inexpensive, accurate and non-polluting.

III. Results

Figure 1 is an example of a full size sinter core sample taken 1m from centre showing the vertical size distribution and pressure gradients. (NB the latter are not calculated results but the actual measured pressures on the same undisturbed sample). By inspection, it is clearly seen how the mixed layer has been preserved and also the angle of repose at the sampling point concerned. The results in Fig.1 show considerable vertical size segregation and the obvious opposite course of pressure variation and therefore permeability. The result that the mixed layer is responsible for some 65% of the overall layer pressure loss highlights again its importance in the total pressure energy equation of the furnace[1]. Finally, an indication of vertical segregation in other radial positions examined is shown in Fig.2 which also includes some model results and, for comparison, those of Chiba No.6 at filling-in[2]. By inspection they all show the same general vertical segregation and any differences that exist are almost certainly due to differences in charging, size consist and the P-W hopper discharge segregation paths[3].

IV. Concluding Remarks

The vertical size segregation shown here is bad for permeability and bad for chemical reduction as the hot rich gas exiting from the coke layer contacts small sinter first, and the resulting impoverished gas then contacts large sinter. For high reduction rates it should be the other way round. Charging different sizes separately, as is already done in some Japanese, European and other plants, is a practice well worth considering. The two-fold problem of the mixed layer, viz: the wasteful pressure energy loss and the question, recently also considered by other workers,[4] of what L_p and L_c should be used to obtain O/C values, could be practically eliminated by using the versatility of the existing bell-less tops to lay down proper flat profiles for which Redcar core samples have shown little or no mixed layer presence. The bad experience with flat profile operations in the past has really been due to insufficient knowledge and control technology - both now considerably improved and at a stage clearly ready for properly controlled flat profile operations.

REFERENCES

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3) N.Standish: Ironmaking Steelmaking,9(1982),207.
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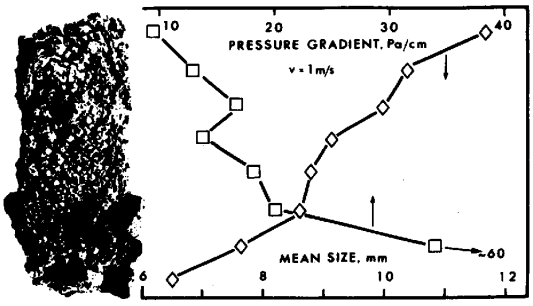

Fig.1. Full size sinter core sample results.

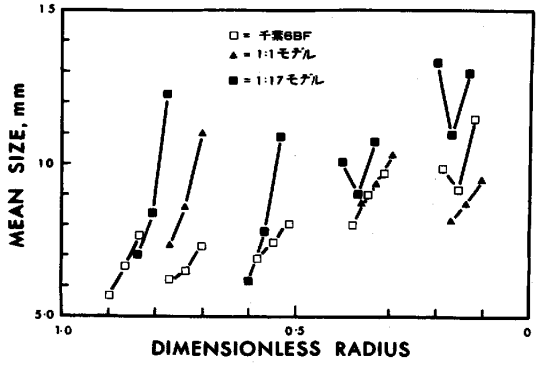

Fig.2. Sinter layer vertical segregation.