Int. J. Heat Mass Transfer. Vol. 17, p. 390. Pergamon Press 1974. Printed in Great Britain

BOOK REVIEW

The Blast-Furnace Process: The Kinetic-Dynamic Simulation Model of the Verein Deutscher Eisenhüttenleute. Mainly in German. Published 1973 by Verlag Stahleisen mbH., Düsseldorf, Germany. Price DM 58. 194 pages, with 185 diagrams and 11 tables.

DESPITE long-continued searches for alternative ways of winning iron from its ore, the blast furnace remains the major reduction device; and it seems likely to occupy this position for a long time to come. Individual furnaces are now of enormous size; and their modes of operation are being modified by introduction of oxygen-enriched air, of oil and of other hydrocarbon fuels. Since the processes within the blast furnace represent one of the major industrial manifestations of heat and mass transfer, complicated by three-phase effects and chemical reaction, the publication of the book under review should be of considerable interest to readers of this journal who are interested in the industrial applications of their subject.

The book consists of the contributions presented at the conference on "Mathematical Models of the Blast Furnace Process" held at Düsseldorf in December 1971. The authors come from Germany, Japan, Belgium, Italy, Holland, and the United Kingdom. Especial attention is given to the coordinated program of blast-furnace research which is in progress in Germany; but other models and results are also considered. The book is undoubtedly an excellent source of material for anyone wishing to acquaint himself with the progress and plans of an important sector of the world's iron-reduction research at the time of the conference.

In a review for this journal, it seems appropriate to place the models which are being employed in the iron-and-steel industry within the general context of mathematical modelling of heat and mass transfer processes. When this standpoint is adopted, one feature of the blast-furnace models commands immediate attention: the models are *one*-dimensional; but the processes which actually occur in the blast furnace are *two*-dimensional, and even three-dimensional in minor regions. For example the temperature, velocity and composition of the gases are supposed to be uniform, in the model, over each horizontal section through the furnace; yet, as measurements reported in the book make clear, these quantities vary appreciably with radial position. The existing one-dimensional models must be seriously inaccurate in their prediction of overall behaviour; and some of the most practically interesting features lie wholly beyond their predictive powers.

Why is this discrepancy between model and reality allowed to persist? (Perhaps it is allowed no longer, and work which was started too late to appear in the conference has already provided the blast-furnace expert with a two-dimensional model.) Certainly there is no technical reason why one should not, right now and at reasonable expense, compute the variations of conditions with radius as well as with height.

It is true that to do so involves the introduction of hydrodynamic equations which, because compressibility is negligible, do not arise in one-dimensional models. However, there now exist simple and satisfactory procedures for predicting the flow of a gas through a two-dimensionally or three-dimensionally varying porous medium. So perhaps it is merely unfamiliarity with these methods which delays the adoption of two-dimensional models which will surely become widespread in a few years.

It might be feared that the complexity of the chemical processes, and the simultaneous presence of gases, liquids (metal, slag) and solids (coke, ore), all in movement, would render the computer program too expensive to develop or to run. Here one must respond that the aerospace industry is well used to working with problems of equal and greater complexity, and that the cost of a computer run for a two-dimensional model is more likely to be measured in tens of dollars than in hundreds. In comparison with the daily expenditure on blast-furnace operation in any industrial country, the computer costs would be entirely trivial.

The above remarks are not intended as adverse criticism of the book or of the work of its authors. The iron-and-steel industry is a conservative one, into which research-based techniques cannot make rapid inroads. That so much contribution is being made by research already is gratifying; the purpose of the review is to point out that it is time to start building truly realistic computer models on the excellent foundations that the pioneer researchers in this industry have laid.

Imperial College, London S.W.7 D. B. SPALDING