Int. J. Heat Mass Transfer. Vol. 20, pp. 1429–1432. Pergamon Press 1977. Printed in Great Britain

BOOK REVIEWS

Selected Papers on Chemical Science, edited by D. W. VAN KREVELENS, Elsevier, Oxford (1976). 385 pp.

THIS valedictory volume, which derives from Dr D. W. Van Krevelen's long association with the Fuel and Polymer industries, marks the end of some forty years as an active researcher. It contains reprints of thirty papers in the field of Chemical Engineering Science covering Gas Absorption, the Drying of Solids, Bubble Formation in Liquids, Fluidization, Chemical Reaction Engineering and Specific Chemical Reaction Processes. Considerations of space make it possible here to mention only a few aspects of this wide range of subjects.

After graduating at Leiden and Delft Universities, Dr Van Krevelen began his industrial career as a research chemist in the Dutch State Mines, becoming Head of the Department of Chemical Engineering in 1943 and Director of Research in 1948. Later, in 1959, he was appointed Vice President of AKZO where polymeric substances played an important role in the extentsion of his interests.

It was during the early part of his career that he became one of a distinguished group of young chemical engineers who broke away from the original concept of Unit Operations which had long dominated chemical engineering teaching, and laid the foundations for a chemical engineering science based upon the fundamental principles of classical physics and physical chemistry. In this work he had the advantage of day-to-day contact with the problems of large scale operations; a circumstance which is evident by the link between theory and practice to be found in all his researches.

Gas absorption. Until recent years, in Europe, domestic and industrial gases were produced almost entirely from coal and coke; and one of the important stages in the manufacture was the removal of gaseous impurities such as ammonia, hydrogen sulphide, carbon dioxide and carbon monoxide by scrubbing with solvents of various kinds. To the improvement of the efficiency of industrial scrubbers, Dr Van Krevelen made many significant contributions. In a group of seven papers included in this volume he demonstrated *inter alia* that, when a gaseous component is absorbed by a liquid, with simultaneous reaction with a component of the liquid, the overall rate of reaction can be expressed as a dimensionless function of the maximum rate of diffusion of the liquid component through the liquid film, the limiting rate of reaction with the liquid film and the maximum rate of reaction with the main body of liquid. A graphical representation of the theoretical relationship enables a prediction to be made of the overall rate of interphase mass exchange as soon as reaction velocity and mass-transfer coefficients are available; this prediction was later verified by experimental data on the absorption of carbon dioxide in alkali and ammoniacal solutions.

Since mass transfer is the essential element in gas absorption processes combined in some instances with chemical reaction, a large contact area is necessary for efficiency. In practice this is achieved by films in wetted wall columns, by liquid drops in spray columns and by gas bubbles. In a summary of his work in this field the author points out that a number of other variables which effect the efficiency of absorption require further investigation, as for example the influence of Reynolds and Schmidt numbers and the kinetics of the more complicated reaction mechanisms.

Fluidization. The technique of fluidization first developed by the oil industry has many potential applications in other industries making use of exothermic reactions, and there is a rapidly growing body of literature on the characteristics of the fluidized state. Dr Van Krevelen's work in this field is described in a group of four papers dealing with the determination of the critical mass velocity and with the mechanism of heat transfer. He first demonstrated that the resistance to gas flow may be calculated from the kinematic viscosity, the number of particles per unit volume of the bed, the effective diameter of the particles and a generalized shape factor. In reviewing previous work on heat-transfer coefficients he drew attention to the large number of variables which are to be found in the various empirical correlations put forward by M. Leva, W. Dow and M. Jakob and others, leading to widely divergent results. He concluded that a better understanding of the mechanism by which high rates of heat transfer are achieved should provide a useful guide in the selection of the relevant correlating variables. One fact which has not always been taken into account by previous workers is that the heat capacity of the solid particles per unit volume of bed is about one hundred times greater than that of the interstitial gas whilst the mean particle velocity is only about ten times lower than the gas velocity. Thus the convective transport of heat by the moving particles largely outweighs all other means of heat transport.

The high transfer rates have been attributed by Leva and others to the scouring action of particles moving downwards along the wall, preventing the formation of a laminar boundary layer of gas and giving rise to high values of the eddy conductivity of the gas in close proximity to the heat transfer surface. Based upon a relation between the eddy conductivity and the mixing rate, proposed by Leva, van Krevelen shows by a simple calculation that the interstitial gas only provides the particle suspension with a thermal conductivity of the same order of magnitude as the effective thermal conductivity of granular material in stationary gas. The rapid heat exchange between different parts of the bed can be attributed to the turbulent motion of the particles which is equivalent to the high eddy diffusivity of a well stirred liquid. The gas flow is assumed to be everywhere virtually laminar and the interstitial gas only serves as a medium for heat transfer from particle to particle and from particle to wall exclusively by normal conduction in the steady state. This proposed mechanism finds support from measurements of heat and mass-transfer coefficients in fluidized beds of coke, iron oxide and carborundum in a variety of gases.

Specific Chemical Reaction Processes and Chemical Reaction Engineering

The fifteen papers included under these headings cover a range of disconnected topics which bear witness to the author's wide scientific interests. Amongst these mention may be made of process Optimization Principles and Methods, Oxidations carried out with Vanadium Oxide Catalysts and Selectivity in Consecutive Reactions.

A complete list of the authors publications is given in appendix.

D. M. NEWITT

Turbulente Scherströmungen, Teil I, Grenzschichten. W. SZABLEWSKI, Akademie, Berlin, (1976), 196 pp.

THIS book, written in German, is the first part of a monograph on turbulent shear layers and deals with incompressible, constant-property wall boundary layers, including channel flows. Part 2 on free shear layers will be published later.