JOURNAL OF CATALYSIS 9, 313-314 (1967)

# BOOK REVIEW

**Adsorption, Surface Area and Porosity.** By S. J. GREGG AND K. S. W. SING. Academic Press, London and New York, 1967. xi + 371 pp. Price 95sh.

The fact that many of the most frequently used catalysts and support materials in heterogeneous catalysis are highly porous solids, often consisting of agglomerates of very finely divided particles, has led many workers to the investigation of the porous character of their materials. The subject of surface area determination and no less of the determination of the porosity of the solid, still attracts attention, as may be seen from the increasing number of publications especially occupied with the calculation of pore-size distributions from nitrogen sorption isotherms. Most of these papers are occupied with mathematical refinements of existing procedures, giving the impression that such refinements will lead to more accurate and trustworthy data. Seldom is it realized, that the approximate character of the fundamental concepts underlying the methods of surface area and pore-size distribution calculations from sorption isotherms hardly justifies the application of more refined calculation methods, unless refinements are made in the fundamental concepts underlying each method of calculation.

Starting from similar considerations, Gregg and Sing have set out to write a book intended for those scientists who want to become acquainted with the procedures for the determination of the textural properties of finely divided porous solids as well as with the limitations of each of the procedures, in each case stressing the practical usefulness of the method under discussion rather than the soundness of its fundamental concepts.

Keeping this aim in mind, we may say that the authors have succeeded in giving a very clear picture of the many aspects of the determination of surface areas and textural properties. After a short introduction on the origin of the adsorption forces and on the characteristics of very finely divided solids, the second chapter of the book contains an extensive treatment of the application of the BET theory to the determination of surface areas from adsorption data. Ample evidence of the usefulness of the BET procedure in the case of the adsorption of nitrogen, has been collected. The possibilities and limitations for the applications of other adsorbates are discussed in detail, stressing the peculiar fact that the success of the BET method for the determination of surface areas seems to depend to some extent on the popularity of the use of nitrogen as an adsorbate.

As could be expected from a treatise of this scope and character, the discussion of the theoretical shortcomings of the BET theory is rather short. As a consequence, the treatment of stepwise adsorption isotherms, as found on energetically homogeneous adsorbents, in the referee's opinion, is not completely satisfactory. There is no sense in applying the BET equation or the B-point method to isotherms, which as a consequence of their special properties deserve a treatment taking into account lateral interactions between the adsorbed molecules.

In the third chapter, an extensive discussion is presented on the application of Kelvin's equation to the analysis of the desorption branch of a nitrogen sorption isotherm in order to obtain a pore-size distribution. A clear picture is given of the classification of different types of hysteresis loops and the connection with the shape of the capillaries. As the authors clearly distinguish between the different types of pores possibly present in porous materials, it is somewhat surprising that the actual calculation of the pore distribution is only discussed for the model of cylindrical pores, and that a discussion of the interpretation of the cumulative surface area as compared to the BET surface area in connection with the pore shape is lacking. Nevertheless, the examples given will make clear the procedure of the actual calculation of pore distribution data from sorption isotherms as well as the limitation of such a procedure. A critical discussion of Kelvin's equation and its application to pore-size distribution calculations is given, but it is a pity that a discussion of Deryaguin's classical work on the validity of Kelvin's equation in pores is lacking. In the referee's opinion, Deryaguin's work on the subject deserves more attention than hitherto has been paid to it.

It is a very good idea to include a separate discussion on the physical adsorption in microporous substances, drawing special attention to the work of Dubinin and co-workers on the subject in recent years. Also, special chapters are

devoted to the application of chemisorption and adsorption from solution to the determination of surface areas, drawing attention to the fact that the interpretation of gas adsorption data is by no means the only way to obtain surface area data.

Methods based on the interpretation of the adsorption isotherm by means of Gibbs's adsorption equation are discussed from the practical point of view, in agreement with the character of the book. It is to be regretted that the derivation of Gibbs's adsorption equation itself as given here is not completely consistent.

To conclude, we may say that this book is an excellent introduction to the art of the determination of surface area and porosity data from sorption isotherms, while the fact that the weakness of many of the fundamental concepts underlying most of the methods make them more of an art than (at present) a science is not concealed to the reader. Quite justifiably, the practical importance and usefulness of the methods discussed rather than their fundamental weaknesses is stressed. The book may be recommended to all those workers interested in this field of surface chemistry.

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Statement of ownership, management and circulation required by the Act of October 23, 1962, Section 4369, Title 39, United States Code; of

Journal of Catalysis

Published bimonthly at Exchange Place, Hanover, Pa. 17331 for Academic Press Inc., 111 Fifth Avenue, New York, N. Y. 10003. Editors: J. H. deBoer, Technological University of Delft, The Netherlands; P. W. Selwood, University of California, Santa Barbara, California 93106.
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