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Book Reviews

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Book Review

ADHESION OF LIQUIDS AND WETTING, by A. D. Zimon, Khimiya, Moscow, 1974, 416 pp.

ADHESION OF DUST AND POWDERS, second edition, by A. D. Zimon, Khimiya, Moscow, 1976, 432 pp.

ADHESION OF FILMS AND COATINGS, by A. D. Zimon, Khimiya, Moscow, 1977, 352 pp.

AUTOHESION OF DRY MATERIALS, by A. D. Zimon, E. I. Andrianov, Metallurgiya, Moscow, 1978, 287 pp.

In some years four books written by Dr. A. Zimon have appeared dedicated to generalization of our knowledge about adhesion of particles, liquids, films, as well as of autohesion of various particles. These books are comprehensive reviews of experimental and theoretical data concerning different branches of technique dealing with adhesion and autohesion phenomena. On the basis of consideration of adhesion as a physical phenomenon the distribution of adhesion processes in practice is shown and the ways of improvement of adhesion characteristics are described in many cases in a quantitative or semi-quantitative manner.

Each of the books mentioned has its own meaning and may be recommended separately and independently of the others.

In *Adhesion of Liquids and Wetting* the nature of interaction between solid and liquids is discussed and methods of adhesion evaluation are presented using different characteristics. Special attention is paid to the very important question of hysteresis in the adhesion of drops, bubbles and liquid films in static and dynamic conditions. The wetting of powders and rough surfaces, adhesion of melts, and wetting in the course of flotation are discussed as well as adhesion interaction by lubrication and oil-return, in polygraphy, by using polymeric coatings and other materials, are paid essential attention.

An attractive feature of the book is simultaneous consideration of both theoretical and practical problems of adhesion.

Adhesion of Dust and Powders is the second edition, revised and improved. The first edition was translated by Plenum Press and published in the U.S.A. in 1969.

In the second edition, on the basis of some concepts developed by the

author, various methods of evaluating adhesion of particles are given. The reasons for their adhesion in gaseous and liquid media and the conditions for particle adhesion for various shapes of particles and roughness of solids are discussed. The dependence of adhesion on particle size has been also analyzed. Special attention is paid to the quantitative estimation of adhesion strength and conditions for the predicted change in adhesion interaction are considered and proved. Of special interest is the analysis of adhesion and tearing-off of particles adhered under the influence of an electric field. The condition of tearing-off and precipitation of particles on a surface from flowing air and water are given with an accounting for the presence of particles in the boundary layer over a wide range of flow rates (some cm/sec-500 m/sec). Some practical aspects of particle adhesion in processes of filtration, mineral concentration, electrography, soil erosion and others are described taking into account elementary steps involved in the processes.

The tensile strength of many dry materials, powders and other dispersed systems are the main subject of *Autohesion of Dry Materials*. From the consideration of interaction between two particles depending on their nature, shape, size, presence of moisture, etc., and calculation of number of contacts between particles of dry materials, the mechanical properties of materials are considered. Some ways of changing tensile strength by variation in properties and size of particles, pressure, amounts of admixtures and other factors are presented. Of importance is the clearing-up of the mechanism of granulation, deterioration in storage, dust absorption, dry materials transfer, pseudoliquification and related processes, based on autohesion of particles.

Adhesion of Films and Coating, as distinct from some other books (see, for example, *Adhesion of Solids* by B. V. Deryagin *et al.*, Plenum Press Publ. Co., 1978; *Fundamentals of Polymer Adhesion* by A. A. Berlin and V. B. Basin, Khimiya, Moscow, 1974), deals with adhesion of films as a function of the mode of their preparation by solidification of a liquid layer and after adhesion of adherent particles. In all cases adhesion is characterized by adhesive joint strength which can be determined experimentally and does depend on the conditions of peeling and film dimensions. Not only polymer adhesion is discussed but metal films, enamels and other materials. The consideration is based on the distinction between two definitions—of adhesion as a physical phenomenon and adhesion strength as a kinetic characteristic, the necessity of such distinction between emphasized in our paper in this *Journal* in 1974 (vol. 6, p. 165). After analyzing adhesion types, a critical review of methods of estimating adhesion are given and the reason for adhesion of films in air and liquid media, under the action of electric field and internal stresses are thoroughly considered.

The content of all the monographs is based mainly on the investigations made by the author and his collaborators and therefore is not quite well

known to readers of this *Journal*. At the same time in all the books there are given numerous references to the original works of many authors.

In spite of many positive features and interest of all the books, they suffer from some misleadings, shortness of description of many important problems (for example, thermodynamics of surface phenomena, influence of drop sizes on adhesion, influence of surface roughness, adhesion of liquid mixtures and some others).

Some criticism was given not long ago by L. M. Shcherbakov and A. A. Rusanov [*Koll. Zh.* **39**, 217 (1977)] and it was pointed out that there is no general idea covering all the phenomena. In many cases there is a lack of criticism of some works, and the bibliography in no way may be considered as all-embracing. However, as has been said, "He that is without sin among you, let him cast a stone." That is to say, the fact that there are defects should not obscure the main result, namely, that for the first time, from one point of view, numerous types of adhesion interactions are discussed, which enables us to recommend these books to all who have an interest in adhesion and its practical application.

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