BOOK REVIEWS

N. G. GAYLORD, Editor

Ion Exchange Resins, 2nd Ed. ROBERT KUNIN. Wiley, New York, 1959. 466 pp. $11.00

The first edition of this book appeared in 1950. At that time, the synthetic ion exchange resins had assumed their present character—spherical beads with a stable styrene-divinyl benzene structure—and the fundamental properties were well understood. The promise of these new tools for the solution of many industrial problems was recognized, but these applications were only in preliminary development except for the fields of water softening and demineralization. In this second edition, Dr. Kunin highlights the rapid progress throughout the world in the utilization of these new exchange resins in mining, chemical, and process industries. This is a comprehensive survey of the available exchange materials, their properties, and methods for characterization, and the broad range of their applications. It is written clearly in terms readily understood by chemists and chemical engineers with no prior ion exchange experience, and yet so complete in coverage that ion exchange specialists will also find much of interest.

For the uninitiated, the early sections of the book may be slightly too comprehensive and thus confusing. The author has made an honest attempt to tie together all of the proposed theories of ion exchange activity and the varying behavior of all types of cation and anion exchange materials, including crystalline solids. And, in fact, he has achieved a beautifully balanced account of a very complex picture with credit to each investigator. The resulting complexity, however, obscures the relatively simple behavior of the sulfonic cation exchangers and the quaternary anion exchangers, which are by far the most extensively used materials. Simplification might encourage more chemists and chemical engineers to use ion exchangers in process work.

The comprehensive treatment is particularly effective in the central section of this edition, which has been expanded to cover the wide variety of new applications of ion exchange resins. The versatility of resins in aqueous and non-aqueous processing is presented fully and should prove stimulating to chemists in all fields. Sufficient detail is presented on each specific application to show the mode of action of the exchanger, its advantages, and its limitations. An excellent chapter covers the development of electrodialysis with ion exchange membranes and its potential in the desalting of water and natural products and in chemical processing. The wide use of ion exchange in the chromatographic separation and isolation of amino-acids, sugars, antibiotics, protein hydrolysates, rare earths, etc., is presented well. Dr. Kunin has done a monumental job in his revision and extension of this applications section, where the majority of his 1170 references are cited. It furnishes both stimulating reading as well as excellent reference material for any one interested in ion exchange.

The final sections furnish a guide to chemists and chemical engineers in the construction and operation of laboratory and plant equipment for the evaluation and use of ion exchange materials. There is also an excellent discussion of the life of the resin during use, including such factors as fouling, chemical deterioration, and physical breakdown with methods for evaluation in laboratory and field installations. Factors in engineering design are only lightly touched upon, but ample coverage would require another book beyond the scope of this one.

In total, *Ion Exchange Resins* is a thorough, well-written summary of the rapidly advancing ion exchange art. It should prove useful to all those interested in applying these new tools to chemical processing and research.

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Analytical Chemistry of Polymers, Part I. Analysis of Monomers and Polymeric Materials: Plastics, Resins, Rubbers, Fibers (High Polymers Series, Vol. XII). G. M. KLINE, ed. Interscience, New York–London, 1959. xviii + 666 pp. $16.50.

This book deals with methods for analyzing polymeric materials, such as plastics, resins, rubbers, and fibers, and materials which might be associated with the polymeric materials, such as monomers, inhibitors, plasticizers, and catalysts.

The book consists of twenty chapters, each written by a separate author. The following subjects are handled: Acrylic Plastics, Alkyds, Amino Resins, Cellulose Derivatives, Epoxy Resins, Ethylene and Fluoroethylene Polymers, Furan Resins, Natural Resins, Phenolic Resins, Polyamides, Polyesters, Proteins, Rubbers (Elastomers), Silicones, Styrene Monomers and Polymers, Vinyl Polymers and Copolymers, Ion Exchange Resins, Plasticizers, Synthetic and Natural Fibers, and Drying Oils.

Some chapters, I feel, are very complete; other chapters could, in my opinion, be considerably enlarged. This situation cannot be avoided in a book of this type since the opinion of each author would vary as to what was important and what was not.

I would also argue the merits of some of the analytical methods and approaches used, but this also, I feel, is a case of individual experience and preference.

The book is geared to the analyst who has occasion to encounter various polymeric materials during the performance of his services and who needs a quick reference to possible methods and to analytical background information. The reader expert in the analysis of certain of the plastics discussed in the book may well feel that "too much was left out." At the other extreme, the book cannot be considered just a compilation of general information. The book, I feel,

generally hits a happy medium with much detailed information or references to detailed information; yet each chapter is not cluttered with all that exists in each field.

I am sure that all analysts who have to deal with polymers will welcome this text since it presents in a concentrated form background and experience that is available for analyzing polymeric and related materials.

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Adhesive Bonding of Reinforced Plastics. HENRY A. PERRY. McGraw-Hill, New York, 1959. 267 pp. $8.75.

As indicated in the Preface, this book is intended for all persons interested in the design and assembly of structures and products with adhesives, but with special attention to bonding of glass fiber-reinforced plastics to themselves. Bonding such laminates to other materials seems to have been neglected. In general, the author has succeeded in providing a small volume that covers the most important subjects from the advantages and limitations of adhesive bonding to the testing of completed joints. Greatest emphasis is given to the physical and engineering aspects of adhesive joints, both from a theoretical and an applied viewpoint. Relatively little attention is given to the chemistry of the polymeric systems.

Particularly important are chapters on Mechanics of Adhesive Joints and on Design of Adhesive Joints, subjects often neglected in other volumes on adhesives. One might readily question the desirability of separating the two subjects at opposite ends of the book. These subjects are covered rather well both from a fundamental, mathematical standpoint and from a more practical applied viewpoint. A chapter on the Statistical Point of View includes basic information on general statistical principles that could probably have been reduced or omitted. The chapter on Laminating Resins and Adhesives is generally adequate for the few resin systems actually used in the present laminated plastics industry. Only polyester and epoxy-resin adhesives are covered under laminating resins for preparing the adherends. This probably represents the present state of the bonding of laminated glass-fiber base plastics although it limits the usefulness of the book for more general adhesive bonding techniques. Little attention is given to the permanence of the resin systems although extensive data are cited for strength tests at −65, 74, and 160°F.

Rheology of Adhesives is covered rather completely, including techniques for viscometry of non-Newtonian fluids.

Chapters on General Properties of Adhesives and Mechanical Testing of Adhesives include a number of the recent ASTM test procedures plus rather lengthy special treatment of more unusual properties such as electrical properties, and corrosivity of adhesives not generally available in other volumes. Considerable emphasis is given to the butt-joint specimens, which has had extensive study by the author for tensile, torsional shear, impact, and fatigue tests, and to dynamic loading tests of adhesive bonds. Brief attention is also given to ultrasonic bond tests.

The chapter on Adhesive Bonding Process Factors is handled in a brief and general fashion, and lacks data to illustrate the effects of variation in bonding techniques, such as time and temperature in precuring, curing, or in bonding pressures with actual adhesives on laminates. This brief treatment is unfortunate in that the overall content of the volume might suggest to a reader that the mechanical factors on joint design and stresses are much more important in determining final joint performance than the way in which the adhesive is selected and used in bonding. Information on equipment for adhesive bonding, however, is quite extensive and well illustrated, and includes a list of equipment suppliers. Quality Control of Adhesive Bonds includes a rather lengthy discussion of faults in the plastic laminate adherends since such faults may influence bonds to such adherends. Actual quality control of bonds is treated rather sketchily with emphasis largely on tests after bonding instead of control during the bonding process.

A glossary, largely based on ASTM nomenclature, will be helpful. Literature references are generally adequate. In general, the reader will find this book to be a useful source of information on modern adhesive bonding for structural applications, and particularly in bonding reinforced plastics.

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