BOOK REVIEWS

N. G. GAYLORD, Editor

Catalysis. Volume 6. Hydrocarbon Catalysis. PAUL H. EMMETT, Ed. Reinhold, New York, 1958. 640 pp. $19.50.

A fundamental approach to the principles and practice of catalysis distinguishes Professor Emmett's renowned series of books on this subject. Volume 6 is a fitting addition to the series. In six chapters, it continues the fundamental approach of the earlier volumes while extending catalysis to the practical processes of petroleum chemistry.

The theory and practice of catalysis applied to hydrocarbon reactions is the major subject. The acid-catalyzed or carbonium-ion reactions are emphasized: alkylation, isomerization, polymerization to liquids, and cracking. Included also are an excellent chapter on catalytic reforming and a unique chapter on the mechanisms of polymer formation and decomposition.

The chapter on catalytic reforming is a thorough review of the catalysts and processes now in use and includes some previously unpublished material. Catalytic reforming introduces the dual-function catalyst in which hydrogenation-dehydrogenation properties control electronic processes and acidic centers control ionic processes. Because dual-function catalysts are not fully understood, this chapter contains less theoretical and mathematical information than the rest of the book. Dual-function catalysts that produce high-density polyethylenes and stereoregular polymers of higher olefins are as little understood as those used in reforming.

Of special interest to the polymer chemist is the chapter, "Mechanisms of Polymer Formation and Decomposition," by R. Simha and Leo A. Wall. It emphasizes the initiation reaction for polymerization and decomposition. The entire theory of polymerization and initiation is mathematically developed. For such an undertaking, Professor Emmett could not have chosen better authors.

Free-radical polymerization constitutes the largest share of the subject matter. The mathematical treatment of polymerization kinetics—including the measurement of absolute rate constants and control of degree of polymerization—is unusually complete. Specific cases are worked out for photo and thermal initiation, for peroxide initiation, and for promoted peroxide decomposition as related to inhibitor and retarder action. Initiation in redox and emulsion systems, initiation by electronic and biological means, and an excellent review of initiation by atomic radiation are included. The theory of measurement of absolute rate constants by rotating sector techniques is developed in greater detail than has appeared in any other text. A short section discusses polymerization with preformed polymer and includes polymer-induced polymerization and formation of graft and block polymers.

A section on cationic polymerization thoroughly reviews the catalysts and cocatalysts involved. Important cationic polymerization mechanisms are described, including the carbonium-ion mechanism and the effect of the counter-ion. The treatment is less mathematical than that of free-radical initiation because the theory of cationic polymerization has not advanced as far.

The section on anionic polymerization reviews those cases in which involvement of anions is generally recognized; for example, when alkali metals and amides initiate polymerization and when lithium aluminum hydride, aluminum hydride, or aluminum alkyl is used as catalytic initiator. Preparation of crystallizable polymers is arbitrarily included as anionic polymerization. The material on preparing crystallizable polymers with dual-function solid catalysts is sketchy. Apparently the material was written early in the development of the field, judging from the references quoted. Many of the important technical developments as well as information relating to polymerization mechanism were passed over despite recent references added in an attempt to bring the subject up to date. This section does not measure up to the high caliber of the rest of the chapter. It reflects the authors' unfamiliarity with details in this facet of polymerization chemistry.

The remainder of the chapter concerns polymer degradation, which is the authors' major field. The theory of most features of depolymerization and degradation is thoroughly explained. Thermal, atomic, and oxidative degradation are described in both experimental and mathematical terms.

To the polymer chemist interested in a variety of initiation processes and in the problems of polymer stability, the chapter by Simha and Wall will make this book of great value. The rest of the volume on application of catalysis to petroleum processes serves as an extra bonus because of its high quality.

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Emulsions—Theory and Practice. (A.C.S. Monograph No. 135). PAUL BECHER. Reinhold, New York, 1957. ix + 382 pp. $12.50.

The volume of published work in this field is so great that the author's decision to cite only significant early work, to tie in with developments in the past 15 years, and to limit patent references to those properly considered a part of the literature on emulsions, has resulted in a well-balanced presentation.

Necessary to an understanding of the technology is a background on surface activity, and this chapter provides a concise presentation of the theory involved. Because the interfacial film and its physical chemistry plays such an important part in emulsion formation and stability, this discussion has been quite complete.