BOOKS

Block and Graft Copolymers, R. J. Ceresa, Butterworths, Washington (1962).

Block and graft copolymers are occupying the attention of an ever-increasing number of chemical engineers. Since polymerization of any sort is covered at best sketchily in the majority of chemical engineering curricula, an engineer who acquires any interest in the field is largely up to his own devices in mastering it. Hence, a book with the objective expressed by Dr. Ceresa of collecting the bulk of available information on block and graft copolymers under one cover is laudable.

There can be no doubt that he has succeeded in accumulating a great deal of interesting and useful information. With contents organized principally by method of synthesis and with separate indexes provided for authors, copolymers and general subject matter, pertinent information is rather readily recoverable. However, the individual who approaches this source in search of more than a qualitative understanding of the phenomena involved will be disappointed. It must be pointed out that this unfortunate circumstance is not particularly due to the purview of the author but rather to the rapid development and current state of the art.

It is appropriate that the general reader will come face to face with the inchoate state of the field in the initial chapter. After first describing the plethora of conceivable polymeric structure the author points out the necessity of a systematic polymer nomenclature encompassing block and graft copolymers. A "simple" notation of his own design is presented.

Synthesis of block and graft copolymers is dealt with principally. It is il-

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ERRATUM

The five equations on page 340 of the article "Agitation of Liquid Systems Requiring a High Shear Characteristic" by Philip L. Fondy and Robert L. Bates, which appeared on page 338 of the May, 1963, issue of the *A.I.Ch.E. Journal,* should be preceded by μ_t before the equal sign.

INFORMATION RETRIEVAL

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Analytical solution of equilibrium-stage operations—application to rectification with varying saturated enthalpies and to liquid-lquid extraction, Martin, Joseph J., **A.I.Ch.E. Journal, 9,** No. 5, p. 646 (September, 1963).

Key Words: Stage Operations-8, Separations Processes-8, Distillation-8, Extraction-8, Absorption-8, Stripping-8, Rectification-8, Leaching-8, Analytical Solution-10, Riccati Equation-10, Bilinear Equation-10.

Abstract: Analytical solution is developed for equilibrium stages in separations processes when operating and equilibrium lines are not straight. Resulting solutions of a Riccati difference equation are applied to the examples of distillation and extraction.

Thermal diffusion of liquids in columns, Hoffman, David T., Jr., and Alden H. Emery, Jr., **A.I.Ch.E. Journal, 9,** No. 5, p. 653 (September, 1963).

Key Words: Thermal Diffusion-8, Mass Transfer-8, Thermal Diffusion Column-10, Temperature-6, Temperature Difference-6, Annular Spacing-6, Mass Separation-7, Cumene-9, Cetane-9, Tetrachloroethane-9, Tetrabromoethane-9.

Abstract: The phenomenological constants Y and H, arising from the transport equation occurring in the theory of the thermal diffusion column, were found to be the same for continuous flow tests and transient batch tests in the same annular thermal diffusion columns. The theory correctly accounts for the effect of average column temperature on Y and H, but there are deviations from the theoretical prediction of the effect of temperature difference and annular spacing. Some earlier literature data, similarly analyzed, also show significant deviations in these last two, sometimes overlooked. For one liquid system, the theory gives absolute values of Y and H in agreement with experiment.

Thermal diffusion in a packed column, Emery, Alden H., Jr., and Maurice Lorenz, **A.I.Ch.E. Journal, 9,** No. 5, p. 660 (September, 1963).

Key Words: Thermal Diffusion—8, Mass Transfer—8, Thermal-Diffusion column—10, Packing, Glass Wool—10, Packed Thermal-Diffusion Column—10, Plate spacing—6, Packing Permeability—6, Mass Separation—7, Cumene—9, Cetane—9.

Abstract: The effects of plate spacing and packing permeability on the behavior of packed thermal-diffusion columns were tested. The trends with these variables are given correctly by the theory, but the absolute magnitudes of the constants in the operating equations are not. The situation is thus similar to that of the thermal-diffusion column without packing.

The interrelation of geometry, orientation, and acceleration in the peak heat flux problem, Costello, C. P., and J. M. Adams, **A.I.Ch.E. Journal, 9,** No. 5, p. 663 (September, 1963).

Key Words: Peak Heat Flux-8, Pool Boiling-8, Liquid Water-1, Steam-2, Graphite Heaters-10, Accelerations-4, Heater Orientation-4, Flat Plate Heaters-10, Semi-cylindrical Heaters-10, Capillary Forces-6, Peak Heat Flux-7, Viscous Forces-6, Peak Heat Flux-7, Buoyant Forces-6, Peak Heat Flux-8.

Abstract: The results of over 2,000 tests conducted to determine the peak heat flux in nucleate pool boiling of distilled water are presented and analyzed. Accelerations between one and 100 times the local acceleration of gravity have been imposed on the system by centripetal action, and heaters have been so oriented that the acceleration effect could be appraised. Three separate geometrics (cylinders, semicylinders and flat plates) have been used in the tests. It is shown that correlations based solely on hydrodynamic theories are inadequate to explain all of the system behavior, but that the gross behavior can be characterized when the effects of capillary, viscous, buoyant, and inertial forces are included.

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lustrative to recount the methods of synthesis mentioned in chapter titles. They are transfer and addition, chemical, radical and radiation, mechanico-chemical, condensation, and ionic. To the chemical engineer in industry it may be disappointing to note that the most extensive coverage, 32 pages, is devoted to mechanico-chemical syntheses, and only four pages are devoted to ionic syntheses. Only the most cursory recognition is given to the existence of stereo block polymers. An additional chapter entitled "Industrial Synthesis" actually consists of a tabulation of patents assigned to various industrial firms and gives no clue as to whether any of these have in fact been reduced to industrial practice.

From all points of view the chapter covering characterization of block copolymers is one of the most interesting and important in the book. The difficulties inherent in characterization are well illustrated by the fact that of the 1,200 polymer syntheses described in the book less than five per cent of the polymers have been isolated with any degree of purity and less than twenty completely characterized. The author perceptively states, "There is not, therefore, a universal procedure for isolating sequence copolymers from their associated homopolymers and each system has, in general, to be attacked in a different manner." But, he then assumes a severe and unnecessary limitation by restricting his coverage of characterization to techniques suitable for preparing sufficient material for subsequent physical or chemical analysis. While extensive treatment is given to several precipitation and elution techniques, no mention is made of the potential of double gradient chromatographic procedures. This is unfortunate, but it is no more so than the omission of various techniques which appear to offer promise of characterization without fractionation such as nuclear magnetic resonance, differential thermal analysis, and various other procedures for the elucidation of solid phase structure.

The final chapter which treats properties is brief and general but provides a valuable point of departure for the engineer interested in applications.

It is to be expected that this book will prove helpful to those seeking entree to the study of block and graft copolymers and a useful source book outside the specialty of those already at work in the field.

IDE P. TROTTER, JR.
HUMBLE OIL AND REFINING COMPANY

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It may be shown for the other components in the reaction mixture that according to Equation (24)

$$c_{i\lambda_1} = c_{i\Lambda} + c_{A\Lambda}\left(\frac{w_i}{a}\right) \frac{1}{\cosh\left(\sqrt{\frac{k}{D_{A\Lambda}}}\Lambda\right)} \left[\cosh\left(\sqrt{\frac{k}{D_{A\Lambda}}}\lambda_1\right) - \cosh\left(\sqrt{\frac{k}{D_{A\Lambda}}}\Lambda\right)\right] \quad (25)$$

The compositions and mole fractions at point λ_1, computed from (24) and (25), are used to determine a value of $D_{A\lambda_1}$; α and β corresponding are computed from (5), and F, A, and B are determined from (12). Center line values ($\lambda_1 = 0$) may be used for this procedure, although it is preferable in later application not to use them.

The concentration distribution of all components may now be estimated using the values of F, A, and B in Equation (11) (for component A) and in the following expression, similar to (25), for the other components:

$$c_{i\lambda_1} = c_{i\Lambda} + \left(\frac{w_i}{a}\right) \left[\frac{c_{A\Lambda}}{FI_o(A) + k_o(A)}\right] \int_{\Lambda}^{\lambda_1} \left(\frac{D_{A\lambda}}{D_{i\lambda}}\right) \{F(g_\lambda)[I_1(h_\lambda)] - (g_\lambda)[K_1(h_\lambda)]\}d\lambda \quad (26)$$

where

$$g_\lambda = \sqrt{\frac{k}{D_{A\lambda}}}$$

$$h_\lambda = \frac{2}{\alpha}\sqrt{k\,D_{A\lambda}}$$

The values of c_A, c_B, c_i determined from (11) and (25) at the point λ_1, are used to recompute $D_{A\lambda_1}$. All the parameters corresponding are determined, and the procedure is repeated until successive computations agree. Point λ_1 should be located close to the surface since it is the concentration gradient at that point which determines the catalytic effectiveness.

NUMERICAL EXAMPLE

The dehydration of ethanol to ethylene and water on pelleted alumina at 200°C. will be used to illustrate the method of computation.

The following conditions are typical:

Pressure = 1 atm.
Total concentration of gas phase

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