## DECEMBER, 1959 ● VOL. 5, NO. 4

# A.I.Ch.E. JOURNAL

The A.I.Ch.E. Journal, an official publication of the American Institute of Chemical Engineers, is devoted in the main to theoretical developments and research in chemical engineering and allied branches of engineering and science. Manuscripts should be submitted to the New York office.

#### PUBLISHER

F. J. Van Antwerpen

#### **EDITOR**

Harding Bliss

#### **ASSISTANT PUBLISHER**

L. T. Dupree

#### MANAGING EDITOR

Sylvia Fourdrinier

#### **ADVERTISING MANAGER**

P. A. Jolcuvar

### ADVISORY BOARD

C. M. Cooper	R. H. Newton
O. E. Dwyer	R. L. Pigford
W. C. Edmister	E. L. Piret
E. R. Gilliland	J. M. Smith
A. N. Hixson	Theodore Vermeuler
H. F. Johnstone	R. R. White
W. R. Marshall, Jr.	R. H. Wilhelm

Publication Office, 1407 Sherwood Avenue, Richmond 22, Virginia. Published quarterly in March, June, September, and December by the American Institute of Chemical Engineers, 25 West 45 Street, New York 36, New York Manuscripts and other communications should be sent to the New York office. Correspondence with the editor may be addressed to him at Yale University, 22 Prospect Street, New Haven 11, Connecticut, Statements and opinions in the A.I.Ch.E. Journal are those of the contributors, and the American Institute of Chemical Engineers assumes no responsibility for them. Subscriptions: one year, member \$6.00, nonmember \$12.00; additional yearly postage, Canada 50 cents, Pan American Union \$1.50, other foreign \$2.00 (foreign subscriptions payable in advance). Single copies: \$4.00. Second-class mail. Postage paid at Richmond, Virginia. Copyright 1959 by the American Institute of Chemical Engineers. National headquarters of A.I.Ch.E. is concerned about nondelivery of copies of the A.I.Ch.E. Journal and urgently requests subscribers to give prompt notification of any change of address. Sixty days must be allowed for changes to be made in the records.

Conservation and Engineering: II. Utilization of Land	411
Evaporation Rates of Liquids to Flowing Gas Streams D. E. Severson, A. J. Madden, and Edgar L. Piret	413
Solid-catalyzed Reaction in a Fluidized Bed W. K. Lewis, E. R. Gilliland, and Werner Glass	419
Void Fractions in Two-Phase Flow H. S. Isbin, H. A. Rodriguez, H. C. Larson, and B. D. Pattie	427
Transition from Laminar to Turbulent Flow in Pipes N. W. Ryan and M. M. Johnson	433
Some Properties of Polar Substances: A Survey  R. Byron Bird and James R. Brock	436
Expansion and Contraction of an Air-Water Mixture in Vertical Flow Michael Petrick and Bernet S. Swanson	440
Performance of a Reciprocating-Plate Extraction ColumnAndrew E. Karr	446
Kinetics of the Hydrogenation of Ethylene (On a Nickel Catalyst)  A. C. Pauls, E. W. Comings, and J. M. Smith	453
Vaporization of Superheated Drops in Liquids	458
Heat Transfer by Radiation through Porous Insulations  Bert K. Larkin and Stuart W. Churchill	467
The Economic Design of Mixer-Settler Extractors	474
An Experimental Study of Diffusion-controlled Reactions in a Laminar Boundary Layer	483
Radiative and Conductive Heat Transfer in a Quiescent Gas-solid Bed of Particles: Theory and ExperimentF. B. Hill and R. H. Wilhelm	486
The Vapor-Phase Catalytic Hydration of Ethylene Oxide to Glycols  A. B. Metzner and J. E. Ehrreich	496
Transfer Resistance and Fluid Mechanics Robert J. McCarter and Leroy F. Stutzman	502
Studies on Entrainment	506
Interfacial Resistance Due to Thin Films of Alcohols and Its Effect on the Rate of Evaporation of WaterLalit H. Udani and Kenneth F. Gordon	510
Interfacial Turbulence: Hydrodynamic Instability and the Marangoni Effect  C. V. Sternling and L. E. Scriven	514
Automatic Control of Fluid Flow	524
The Mechanics of Vertical Moving Liquid-Liquid Fluidized Systems:  I. Interphase Contacting of Droplets Passing Through a Second  Quiescent FluidRobert E. C. Weaver, Leon Lapidus, and J. C. Elgin	533
Reaction Rates in the Synthesis of AmmoniaA. K. Mills and C. O. Bennett	539
Heterogeneous Phase Equilibria of the Hydrogen Sulfide-Carbon Dioxide System	545
The Enthalpy of Water in the Liquid StateRobert Byrne and George Thodos	551
Index	557
Abstracts	561
Communications to the Editor Liquid Mixing on Bubble Trays—A Correction	564
Unsteady Pseudoplastic Flow Near a Moving Wall	565
Center-Line Value of the Eddy Viscosity	
Reply	5D
Books	412