# A.I.Ch.E. OURNAL MARCH, 1962 • VOL. 8, NO. 1

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

#### MANAGING EDITOR

Sylvia Fourdrinier

MANUSCRIPT EDITOR Barbara Z. Goldsamt

## ADVERTISING MANAGER

P. A. Jolenvar

### **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 Vermeulen W. R. Marshall, Jr. R. R. White

R. H. Wilhelm

Publication Office, 215 Canal Street, Manchester, New Hampshire. Published in March, May, July, September, and November by the American Institute of Chemical Engineers, 345 East 47 Street, New York 17, 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, 225 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. Subican Institute of Chemical Engineers assumes no responsibility for them. Subscriptions: one year, member \$6.00; nonmember \$25.00; additional yearly postage, Canada 50 cents, Pan American Union \$1.50, other foreign \$2.00 (foreign subscriptions payable in advance). Single copies: \$6.00. Second-class mail. Postage paid at Manchester, New Hampshire. Copyright 1962 by the American Institute of Chemical Engineers. National headquarters of A LCh E. is concerned. 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

Postmaster: Please send form 3579 to A.I.Ch.E. Journal, 345 East 47 Street, New York 17, N. Y.

Two Innovations	3
Temperatures and Partial Pressures at the Surfaces of Catalyst Particles  Fumitake Yoshida, D. Ramaswami, and O. A. Hougen	5
Heat Radiation Between Simply-Arranged Surfaces Having Different Temperatures and Emissivities E. M. Sparrow	12
Prediction of Pressure Drop in Two-Phase Single-Component Fluid Flow  M. R. Hatch and R. B. Jacobs	18
Skin Friction Patterns for Transitional Flow in Annuli  E. J. Croop and R. R. Rothfus	26
Heat Transfer from the Surface of a Steam Bubble in Turbulent Subcooled  Liquid Stream	30
Mass, Heat, and Momentum Transfer in the Flow of Gases Past Single Spheres  Yin-chao Yen and George Thodos	34
An Experimental Study of Three Component Gas Diffusion  J. B. Duncan and H. L. Toor	38
Rates of Reaction in a Recycling System—Dehydration of Ethanol and Diethyl Ether Over Alumina John B. Butt, Harding Bliss, and C. A. Walker	42
Kinetics of Reduction of Iron Oxide With Carbon Monoxide and Hydrogen  Edwin Kawasaki, Jack Sanscrainte, and Thomas J. Walsh	48
Kinetics of Particle Growth in a Fluidized Calciner  B. S. Lee, Ju Chin Chu, A. A. Jonke, and Stephen Lawroski	53
The Viscosity of Pure Substances in the Dense Gaseous and Liquid Phases  John A. Jossi, Leonard I. Stiel, and George Thodos	59
A Note on Latent Heat Transport in Nucleate Boiling S. G. Bankoff	63
Physical and Chemical Forces in Solvent Selectivity for Hydrocarbons  Ralph Anderson, Ronald Cambio, and J. M. Prausnitz	66
Mass Transfer in Dilute Turbulent and Nonturbulent Systems with Rapid Irreversible Reactions and Equal Diffusivities	70

(Continued on 2.)