## AICHE JOURNAL

JULY 1981 • VOL. 27, NO. 4

The AIChE Journal, a publication of the American Institute of Chemical Engineers, is devoted to fundamental research and developments having immediate or potential value in chemical engineering.

**PUBLISHER** 

J. C. Forman

**PUBLICATIONS DIRECTOR** Larry Resen

**EDITOR** 

Robert H. Kadlec

MANAGING EDITOR Maura Mullen

**TECHNICAL EDITOR** Haeja L. Han

**EDITORIAL ASSISTANT** Barbara T. Lynn

**EDITORIAL BOARD** R. Dale Biggs Coleman B. Brosilow K. C. Chao James M. Douglas L. Louis Hegedus Robert L. Kabel Maurice A. Larson Daniel D. Perlmutter Joseph A. Polack Roger A. Schmitz W. R. Schowalter Stephen Whitaker

Publication Office, 215 Canal Street, Manchester, New Hampshire, Published in January, March, May, July, September, and November by the American Institute of Chemical Engineers, 345 East 47 Street, New York, New York 10017. (ISSN 0001-1541) Manuscripts should be submitted to Robert H. Kadlec, Editorial Offices, Room 3036, East Engineering Building, The University of Michigan, Ann Arbor, Michigan A8109. Statements and opinions in the AIChE Journal are those of the contributors, and the American Institute of Chemical Engineers assumes no responsibility for them. Subscription one year, \$70; special member rate, \$12; additional yearly postage, Canada \$4.00, Pan American Union \$5.00, other foreign \$5.00 (foreign subscriptions payable in advance). Single copies: \$16.50. Single copies more than one year old: \$17.50. Second-class postage paid at New York, N. Y. and additional mailing offices. Copyright 1981 by the American Institute of Chemical Engineers. National headquarters of AIChE is concerned about nondelivery of copies of the AIChE 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.

Postmoster: Please send form 3579 to AIChE Journal, 345 East 47 Street, New York, N. Y. 10017.

## AIChE Symposium Series

## Recent Studies

S-204. Tutorial Lectures in Electrochemical Engineering and Technology. This volume consists of a series of lectures in key areas of fundamental and applied electrochemical engineer-

1981. 284 pp.

AIChE members \$17.50; others \$35.

S-205. Recent Advances in Fluidization and Fluid Particle Systems. The papers in this volume deal with various aspects of fluidization and fluid particle systems. It also includes papers on a centrifugal fluidized bed, a spouted bed and standpipe operation.

1981. 200 pp.

AIChE members \$17; others \$34

S-206. Controlled Release Systems. This volume focuses on the polymer/mass transport aspects of controlled release technology. It deals with a variety a design concepts applicable to the pharmaceutical, agricultural and environmental areas.

1981. 92 pp.

AIChE members \$10; others \$20

New Prepayment Policy: Effective January 1, 1981.

Check or money order must accompany all U.S. orders for less than 10 books. We will honor bill-and-ship invoices and purchase orders on U.S. orders for 10 or more books only. There will be no charge for postage or handling on U.S. orders when shipped book rate. All foreign orders (regardless of quantity) must be accompanied by remittance and must be paid in U.S. dollars. Include \$1.00 per book to cover postage and handling. Proforma invoice on request. All publication sales are final.

Order from Publications Sales, Dept., M, American Institute of Chemical Engineers, 345 East 47 Street, New York, New York 10017.

ASK FOR THE AICHE PUBLICATIONS CATALOG.

## Reproducing copies

The appearance of the code at the bottom of the first page of an article in this journal indicates the copyright owner's consent that for a stated fee copies of the article may be made for personal or internal use or for the personal or internal use of specific clients. This consent is given on the condition that the copier pay the per-copy fee (appearing as part of the code) through the Copyright Clearance Center, Inc., P. O. Box 765, Schenectady, N.Y. 12301, for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to copying for general distribution, for advertising or promotional purposes, for inclusion in a publication, or for resale.

Articles published before 1978 are subject to the same copyright conditions, except that the fee is \$2.00 for each article.