AIChE JOURNAL

VOL.46, NO.9 SEPTEMBER 2000

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



Editor Matthew V. Tirrell

Managing Editor Haeja Lim Han

Associate Editors Mark A. Barteau Edward L. Cussler Julio M. Ottino George Stephanopoulos Charles F. Zukoski

Copy Editor Arthur H. Baulch

Editorial Assistant Jeff Karpinos

Cover Design Fran Fresquez

Consulting EditorsRakesh Agrawal
Separation Processes

Juan de Pablo Computational Research

L. S. Fan

Particle Technology

Alice P. Gast

Materials
Carol K. Hall
Thermodynamics

Eric W. Kaler
Colloidal Phenomena

George E. Keller, II Separations

Michael T. Klein Reaction Engineering

Frederick J. Krambeck Reactor Engineering

Douglas A. Lauffenburger

Bioengineering
Glen H. Pearson

Materials Processing

Ronald W. Rousseau Crystallization

John Seinfeld Environmental Engineering

Michael Shuler Biochemical Engineering

Publisher Stephen R. Smith

Marketing Manager Lois Anne DeLong AIChE Journal (ISSN 0001-1541) is published monthly by the American Institute of Chemical Engineers, Three Park Avenue
New York, NY 10016-5991.

Manuscripts should be submitted to the AIChE Journal Editorial Office Dept. of Chemical Engineering and Materials Science University of Minnesota Minneapolis, MN 55455 Tel 612.625.5823 Fax 612.624.6564.

The statements and opinions in the AIChE Journal are those of the contributors, and AIChE assumes no responsibility for them.

Annual subscription rates are as follows.

Print version:
North America, \$830;
International, \$910;
N. American members, \$99;
International members, \$179;
N. American student members, \$55;
International student members, \$135.

Online version only:
members, \$135;
student members, \$90.

Print version plus Online:
N. American members, \$150;
International members, \$230;
N. American student members, \$110;
International student members, \$100;

Single print copy: North America, \$99; International, \$107; N. American members, \$21; International members, \$29.

For subscription, e-mail: xpress@aiche.org or phone: 1-800-242-4363 (Toll Free) or 1-212-591-8100

Postage for domestic and international mailing paid at New York City and additional mailing offices.

Copyright © 2000 by the American Institute of Chemical Engineers. POSTMASTER: Send change of addresses to AIChE Journal Three Park Avenue New York, NY 10016-5991.

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by AIChE for libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that a fee of \$19.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923.

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 1988 are subject to the same copyright conditions. *AIChE Journal* fee code: 0001-1541/00 \$15.00 per article.