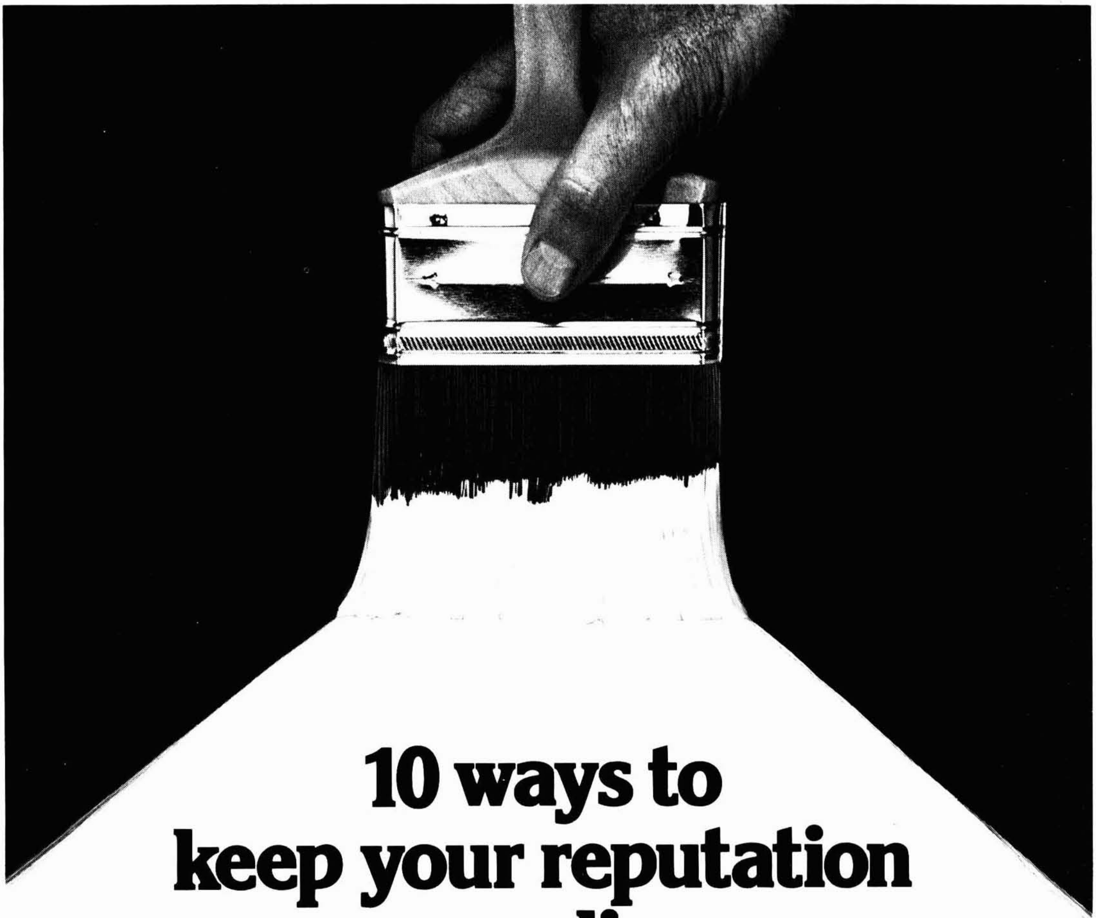
jct JOURNAL OF COATINGS TECHNOLOGY

JCTAX 51 (654) 1-98 (1979)

JULY 1979

Latex-Based All-Surface Primers



JULY 1979

JOURNAL OF COATINGS TECHNOLOGY

Volume 51 Number 654

Features

Federation Activities

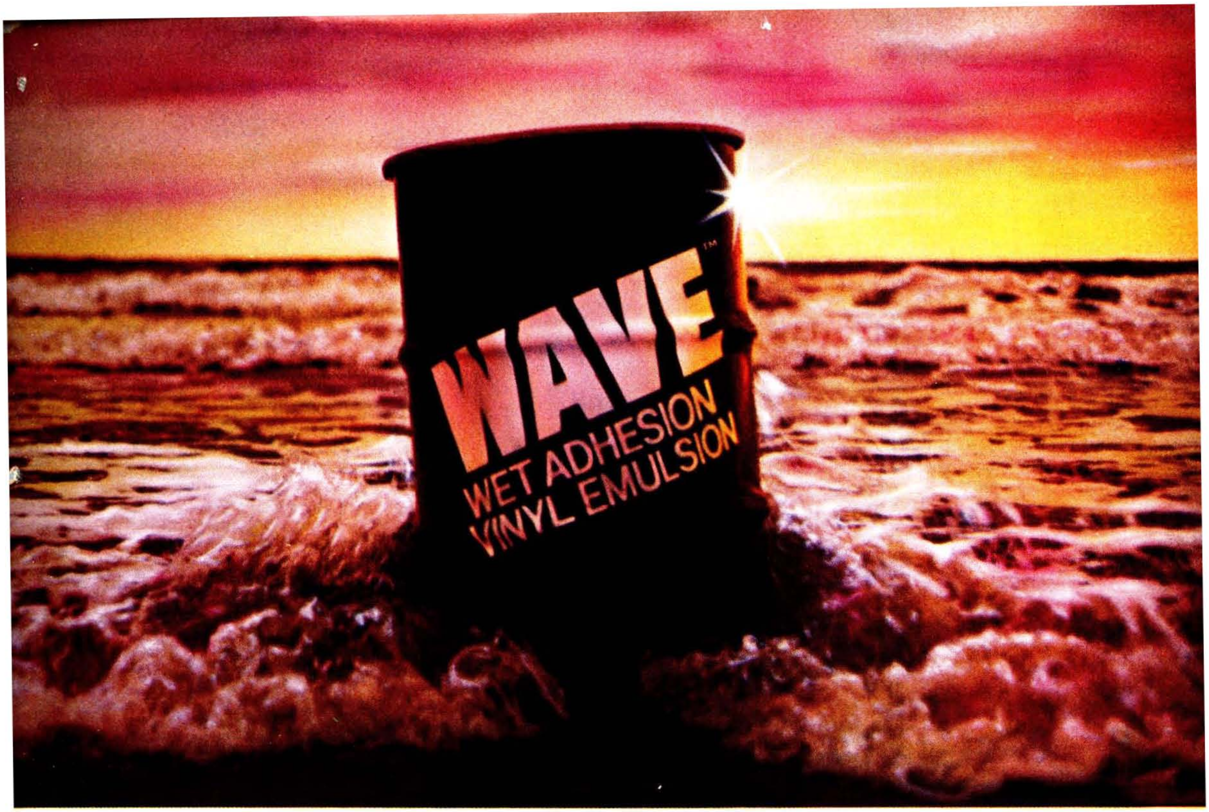
Departments

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology at Crescent & Mulberry Streets, Harrisburg, Pa. 17104. Editorial and executive offices are located at 1315 Walnut St., Philadelphia, Pa. 19107. Phone: (215) 545-1507.

Second class postage paid at Philadelphia, Pa. and at additional mailing offices.

Subscriptions U.S. and Canada—1 year, $20; 2 years $37; 3 years, $52. Europe (Air Mail)—1 year, $30; 2 years; $52; 3 years, $72. Other Countries—1 year, $26; 2 years, $48; 3 years, $68.


Wet Paint


WAVE™
WET ADHESION
VINYL EMULSION

JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., Pa. 19107

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology at 1315 Walnut St., Philadelphia, Pa. 19107. Phone: (215) 545-1507.

Annual dues for members of the Federation of Societies for Coatings Technology, $15.00, includes a subscription to this publication. Membership in the Federation is obtained through prior affiliation with, and payment of dues to, one of its 26 Constituent Societies. Non-member subscription rates are:

	U.S. and Canada	Europe (Air Mail)	Other Countries
1 Year	$20.00	$30.00	$26.00
2 Years	$37.00	$52.00	$48.00
3 Years	$52.00	$72.00	$68.00

When available, single copies of back issues of the JOURNAL OF COATINGS TECHNOLOGY are priced as follows: $3.00 each for current calendar year issues; $4.00 each for all other issues.

Staff

FRANK J. BORRELLE .... PUBLISHER
THOMAS A. KOCIS .... DIR. OF COMMUNICATIONS
THOMAS J. MIRANDA .... TECHNICAL EDITOR
ROSEMARY FALVEY .... SENIOR EDITOR
ROBERT F. ZIEGLER .... MANAGING EDITOR
LORRAINE LEDFORD .... ASSOCIATE EDITOR
PATRICIA M. DRISCOLL .... ASSISTANT EDITOR
RICHARD D. GROSS .... MGR. ADV./GRAPHICS

Publications Committee

THOMAS J. MIRANDA, Chairman
FRANK J. BORRELLE
JOHN A. GORDON, JR.
HERBERT E. HILLMAN
RUTH JOHNSTON-FELLER
THOMAS A. KOCIS
SIDNEY LAUREN
PERCY E. PIERCE

Editorial Review Board

THOMAS J. MIRANDA, Chairman
H.S. BENDER
R. DOWBENKO
F.L. FLOYD
J.L. GARDON
P.R. GUEVIN
H.E. HILLMAN
S.J. HUEY
R. JOHNSTON-FELLER
J.V. KOLESKE
L. KUTIK
S.S. LABANA
M.J. McDOWELL
I.H. McEWAN
A. MERCURIO
K.L. MITTAL
P.E. PIERCE
J.H. SAMPLE
H. SKOWRONSKA

The JOURNAL OF COATINGS TECHNOLOGY has first rights to the publication of papers presented at the Annual Meeting of the Federation and at local and regional meetings of the Federation's Constituent Societies.

A Guide for Authors is published in each January issue.

The JOURNAL OF COATINGS TECHNOLOGY is available on microfilm from University Microfilms, a Xerox Co., Ann Arbor, Mich. 48106.

The Federation of Societies for Coatings Technology assumes no responsibility for the opinions expressed by authors in this publication.

Copyright 1979 by the Federation of Societies for Coatings Technology. All rights reserved. No portion of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system without permission in writing from the publisher.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY BOARD OF DIRECTORS

PRESIDENT

*JAMES A. McCORMICK
Inland Leidy
900 S. Eutaw St.
Baltimore, Md. 21230

VICE-PRESIDENT

*ELDER C. LARSON
Shell Development Co.
P.O. Box 1380
Houston, Tex. 77001

TREASURER

*WILLIAM H. ELLIS
Chevron Research Co.
P.O. Box 97
El Segundo, Ca. 90246

ANTONIO PINA ARCE
Sherwin-Williams S.A.
Mexico 16, D.F., Mex.

CHARLES ARONSON
Beacon Paint Works
Jamaica Plain, Mass. 02130

JOHN C. BALLARD
Kurfees Coatings, Inc.
Louisville, Ky. 40202

JOSEPH A. BAUER
Porter Paint Co.
Louisville, Ky. 40201

JAMES A. BOHLEN
Sherwin-Williams Co.
Greensboro, N.C. 27410

A. CLARKE BOYCE
Nacan Products Ltd.
Toronto, Ont. M6P 3P1, Can.

*WILLY C. P. BUSCH
PPG Industries, Inc.
Houston, Tex. 77001

ALEX CHASAN
GSA-FMBP
Washington, D.C. 20406

S. LEONARD DAVIDSON
N L Industries, Inc.
Hightstown, N.J. 08520

CARLOS DORRIS
Jones-Blair Co.
Dallas, Tex. 75235

NEIL S. ESTRADA
Reichhold Chemicals, Inc.
S. San Francisco, Ca. 94080

JOHN A. J. FILCHAK
General Services Adm.
Auburn, Wash. 98003

DAVID M. HEATH
Arthur Holden & Sons
Birmingham B9 4TQ, England

*HOWARD JEROME
Vane-Calvert Paint Co.
St. Louis, MO. 63102

St. Louis, Mo. 63102

*TERRYL F. JOHNSON
Cook Paint & Varnish Co.
Kansas City, Mo. 64141

J. RICHARD KIEFER, JR.
McCloskey Varnish Co.
Philadelphia, Pa. 19136

EUGENE LeVEA
Pratt & Lambert, Inc.
Buffalo, N.Y. 14240

HARRY B. MAJCHER
Standard Detroit Paint Co.
Detroit, Mich. 48238

THOMAS J. MIRANDA
Whirlpool Corp.
Benton Harbor, Mich. 49022

WILLIAM MIRICK
Battelle Memorial Institute
Columbus, Ohio 43201

J. D. MULLEN
J. D. Mullen Co.
Denver, Colo. 80202

*JOHN J. OATES
Troy Chemical Corp.
Newark, N.J. 07105

HORACE S. PHILIPP
Sherwin-Williams Co.
Montreal, Que. H3C 2T4, Can.

J. T. ROBERTSON
Southern Coatings & Chem. Co.
Sumter, S.C. 29150

A. GORDON ROOK
Napko Corp.
Fremont, Ca. 94538

FRED G. SCHWAB
Coatings Research Group, Inc.
Cleveland, Ohio 44114

JOHN T. VANDEBERG
DeSoto, Inc.
Des Plaines, Ill. 60018

WILLARD W. VASTERLING
Morton-Myers Co., Inc.
Kansas City, Mo. 66118

GERALD WARD
Royston Laboratories
Blawnox, Pa. 15238

GERALD L. WEST
Ameritone Paint Corp.
Long Beach, Ca. 90801

LOWELL WOOD
Frost Paint & Oil Corp.
Minneapolis, Minn. 55413

*Executive Committee Members

EXECUTIVE VICE-PRESIDENT

FRANK J. BORRELLE
FSCT Headquarters Office
1315 Walnut St.
Philadelphia, Pa. 19107

Comment

The More Things Change . . .

A good meeting, a fine meal, a little golf, and, all the while, the enjoyment of fellowship with your peers and colleagues.

The photo and the story below come from the year 1935—44 years ago. However, by simply replacing the names and adjusting the style of dress, this could be today—and that is the important item. Names change, people come and go, styles no sooner come into fashion then they leave, but the idea—the concept—of people coming together to exchange thoughts, to discuss problems, to enjoy one another's company is one of the basic rocks upon which society stands.

That concept is also one of the cornerstones of the Federation—as it is of almost all groups and associations. The past 44 years have seen the Federation grow not only in numbers but also in stature. At the same time the industry's problems have become more complex, more numerous, and certainly more frustrating. However, through the association there are still some difficulties which may be overcome at a good meeting with a fine meal and, perhaps, a little golf. The more things change—the more they remain the same.—RFZ

BALTIMORE CLUB: Meeting of September 13, 1935:

The meeting was held as a week-end trip to Wilmington, the club being the guests of the Krebs Pigment Company jointly with the New England Club and the Philadelphia Club.

Breakfast was served to the entire delegation Saturday morning and the company divided into groups to inspect the Krebs Pigment Company plant and test fences. Lunch was had at the Concord Country Club, some of the party remaining to participate in a golf tournament.

A business meeting was called to order at 7 P.M. at the du Pont Hotel for the Baltimore Club, and it was announced that the club would act as host for the National Paint, Varnish and Lacquer Convention scheduled for the latter part of October, to be held in Washington, D.C.

The committee appointed consists of the following members: Messrs. G. Sutherland, C.M. Athey, D.N. Finck, S. Levy, H. Shugar, G.B. Heckel, A.A. Eisenberg and N. Gatker. The registration will be supervised by Messrs. Mann, Schaeffer, Rollins and Gatker; the music by H. Shugar and the banquet by S. Sutherland.

At 8 P.M. a very fine banquet was served for the entire group of visitors.

Sunday lunch was again served at the Concord Country Club, followed by golf and other sports.

In all, it was a very educational and entertaining meeting, and greatly appreciated by all the visitors.

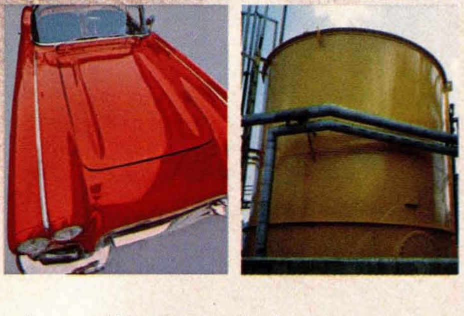
A. A. EISENBERG, *Secretary*.

[Taken from the *Official Digest*,
November 1935.]


52

NEW EPONEX RESISTS CHALKING!

Coatings based on Shell's new Eponex™ resins provide traditional epoxy benefits plus weatherability to resist chalking and yellowing in the sun.



New Eponex resins provide the chemical and corrosion resistance and the adhesive qualities that you expect from epoxy...plus weatherability that helps to retain gloss and resist chalking. Eponex epoxy-based coatings shine and keep on shining in applications ranging from consumer products to industrial maintenance.

Versatile Eponex resins can be formulated into high bake, low bake or ambient cured coating systems. And because these new resins have extremely low viscosities of approximately 20-25 poise at 25°C, they are suitable for both high solids and solventless systems.

Potential cost savings over urethanes. Best of all, Eponex actually costs less than urethane. In one industrial maintenance cost comparison, an Eponex system with 64% volume solids was matched against a polyester urethane coating with 47.5% solids. On a per gallon basis, the Eponex system was 8% lower in raw material cost than the urethane. *But on an application cost basis (per square foot per mil thickness) Eponex was actually 48% less expensive.*

Eponex resins are now available from Shell in market development quantities. For complete technical data comparing Eponex applications, economics and weatherability to conventional epoxies and acrylics, please write: Shell Chemical Company

Manager, Chemical Communications
One Shell Plaza
Houston, Texas 77002.

Come to Shell for answers

Shell Chemical Company
Our 50th Year

(Your Customers see this ad in their trade publications)

"These water based coatings* perform like solvent based ones...

even on plow blades. ...changeover was easy!"

"We switched to water to get a jump on regulations . . . to do it our way . . . at our speed. And we got more than we bargained for: performance as good or better than solvent based coatings; safer working conditions; minimal changeover problems (we lengthened the distance from the dip tank to the line's end, and we added a few fans for faster air drying.)"

So says the manager of Production for an Eastern cutting edge manufacturer. Other users point to reduced insurance rates, and saving the high cost of plant modification to protect against the hazards of standard solvent systems.

Why wait any longer when you can have what you want in water based coatings *now.* Whatever your application: spray, dip/flow, electrodep, coil, or brush.

Spencer Kellogg makes the resins not the paint. But we'll send you a chart of what is available in our Kelsol® resin line. Then contact your coatings supplier and he'll help you with a formulation that's best for you. Write Spencer Kellogg Division of Textron, Inc., Box 807, Buffalo, New York 14240.

---

*Formulated with Spencer Kellogg's Kelsol 3904 resin by the Jamestown Paint & Varnish Co., Jamestown, Pa.

Spencer Kellogg TEXTRON

Spencer Kellogg Division of Textron Inc.

Abstracts of Papers in This Issue

LATEX-BASED ALL-SURFACE PRIMERS—A. Mercurio and R. Flynn

Journal of Coatings Technology, 51, No. 654, 45 (July 1979)

Recent advances in the design of latex polymers and pigment dispersants make it possible to formulate latex primers with good performance on problematical surfaces, especially metallic substrates and staining woods. Latex primer failures on these substrates are divided into two categories: those that occur early, during paint drying, and those that occur in the longer term. The early failures are related to water soluble or water sensitive species in the latex paint. Long term failures are related to the degree of coalescence of the latex film. The performance of model latex paints which overcome these deficiencies to serve as "All-Surface Primers" is illustrated.

POLY(ESTER-AMIDE-URETHANE) WATER-DISPERSIBLE RESINS—W.J. Schneider and L.E. Gast

Journal of Coatings Technology, 51, No. 654, 53 (July 1979)

Research at the Northern Center on water-based coatings has been aimed at developing low-energy-consuming and more environmentally desirable products from renewable agricultural raw materials. Water-dispersible poly(ester-amide-urethane) resins were readily synthesized from vegetable oils, diethanolamine, anhydrides, and diisocyanates. The short times and mild conditions of the alkyd-type procedure developed involves the following steps: (a) aminolysis of vegetable oil with diethanolamine (100°C, 0.5 hr), (b) half-ester formation (85-115°C, 0.5-1.5 hr), (c) neutralization of carboxy acids with triethylamine, and (d) urethane formation (50°C, 2 hr). Film properties varied depending on the oil, anhydride, or diisocyanate components of the resin used. Products synthesized from linseed or soybean oil, various dianhydrides, and aliphatic or aromatic anhydrides were readily dispersed in water-butyl Cellosolve® solutions. Cationic poly(ester-amide-urethane) resins suitable for emulsion systems have also been developed. Data indicate rapid-drying hard coatings are formed similar to those from the carboxyl-amine neutralized system.

VISCOSITY OF COSOLVENT/WATER SOLUTIONS OF AMINE NEUTRALIZED ACRYLIC COPOLYMERS—L.W. Hill and B.M. Richards

Journal of Coatings Technology, 51, No. 654, 59 (July 1979)

Water dilution of a series of amine neutralized acrylic copolymers differing in level of solubilizing acidic monomer produces anomalous variations in viscosity. For low levels of solubilizing monomer, a pronounced maximum in viscosity occurs on dilution followed by a precipitous drop in viscosity. Shear thinning is observed in the region of the maximum on dilution curves. Increasing the level of solubilizing monomer eliminates the viscosity maximum at intermediate polymer concentrations, but causes an increase in the viscosity at higher concentrations. The variations in viscosity caused by altering cosolvent/water ratio, extent neutralization, and molecular weight are also reported. Aggregation and the effect of aggregate crowding on viscosity are discussed.

AUTOMATION OF THE PERCENT NONVOLATILES ANALYSIS—P.W. Fletcher

Journal of Coatings Technology, 51, No. 654, 69 (July 1979)

An automated system has been developed for the determination of Percent Nonvolatiles. The system is composed of a programmable calculator interfaced to an electronic digital balance through the Binary-Coded-Decimal (BCD) output of the balance. The calculator is programmed to accept weights as required and to do all necessary calculations. An added advantage of this system is the ability to do automatic error checking.

The automated system has resulted in a 50% reduction in technicians' time required to run the Percent Nonvolatiles analysis. Mathematical and transpositional errors normally encountered in this calculation are virtually eliminated.

The principles involved in this automated system can be applied to any determination in which the weight change or total weight of a sample is the parameter of interest.

Pfizer's
Superb Research
Generates Premier
Products for
the Paint
and Coatings
Industry

COLORS

The majority of Pfizer's iron and chromium oxide pigments are high purity uniform synthetics. They have exceptional hiding power, tinting strength, permanence, abrasion and chemical resistance. All have good dispersibility—and some yield full color development and high Hegmans quickly enough to result in marked energy, time and labor savings.

EXTENDERS

Pfizer produces—with controlled properties—ground limestone, dolomite, and talc in grades that are highly effective formulation components for the majority of all types of paints and coatings—contributing notably to their performance and durability. Pure and uniform, white and bright, they have many other significant and useful characteristics.

—PLUS GREAT TECHNICAL SUPPORT

Pfizer's dedication to the paint & coatings industry is evidenced in many ways—but perhaps most notably in technical back-up support to our customers in it. This is in the main provided through the problem-solving services of our incomparable Research Center.

**For more information of possible interest and value,
write for a free copy of our new product brochure.**

Pfizer

MINERALS, PIGMENTS & METALS DIVISION

8CX-10 • 235 East 42nd. Street • New York, N.Y. 10017

Abstracts of Papers in This Issue (Continued)

INFLUENCE OF FLOW DIRECTION ON WATER VAPOR PERMEABILITY THROUGH ORGANIC COATING—POROUS BUILDING MATERIAL SYSTEMS—D.Y. Perera and D. Vanden Eynde

Journal of Coatings Technology, 51, No. 654, 74 (July 1979)

The influence of the flow direction on the water vapor permeability, under stationary conditions, for composite systems made from organic coating and porous building substrate is discussed. Four different organic coatings and two types of concrete were investigated. The measurements were carried out with modified permeability cups in order to prevent the formation of an over-pressure during sealing and a vacuum during measurements. The results obtained showed that the total permeability through a composite system cannot be correctly calculated from

$$L/P = \sum_{1}^{n} Li/Pi,$$

a commonly used equation, if the permeability of even one layer is dependent on water concentration (or vapor pressure) and/or an interaction between layers occurs. The composite system will become more permeable if the layer for which permeability increases more strongly with increasing water concentration is exposed at the upstream boundary.

FLASH PHOTOLYSIS OF POTASSIUM PEROXYMONOSULFATE ($KHSO_5$) WITH GENERATION OF SULFATE RADICAL ANION AND QUENCHING BY VINYL MONOMERS—V.D. McGinniss and A.F. Kah

Journal of Coatings Technology, 51, No. 654, 81 (July 1979)

Flash photolysis of potassium peroxymonosulfate ($KHSO_5$) produces sulfate radical anion ($SO_4^{-}\cdot$) and hydroxyl radicals ($\cdot OH$). The sulfate radical anion reacts with carbonate or bicarbonate anions to produce the long-lived carbonate radical anion ($CO_3^{-}\cdot$). This intermediate ($CO_3^{-}\cdot$) can be easily measured as it absorbs strongly at 600 to 630 nm ($\epsilon \cong 1875\ M^{-1}\ cm^{-1}$). Unsaturated monomers can intercept the $SO_4^{-}\cdot$ and the corresponding decrease in $CO_3^{-}\cdot$ absorption provides a tool for the study of all the components of a water soluble or emulsion polymerization system. The concentration of solute required to quench the reaction is a measure of the rate constant for interaction with the sulfate radical anion. Rates of interaction for $SO_4^{-}\cdot$ with unsaturated molecules were correlated with ionization potential of the monomers.

Papers to be Published in August Issue

"Study of Organic Titanates as Adhesion Promoters"—Cleveland Society for Coatings Technology (1978 Annual Meeting Paper)

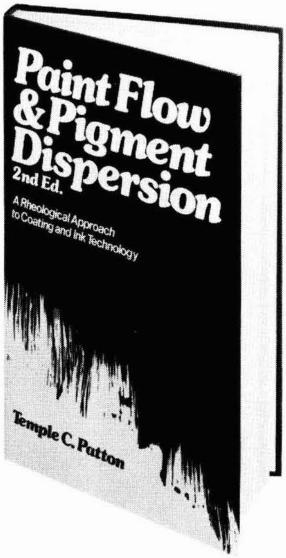
"Surface Analysis of Interfacial Chemistry in Corrosion-Induced Paint Adhesion Loss"—J.W. Holubka, J.S. Hammond, and R.A. Dickie, of Ford Motor Co.

"Pigment-Polymer Interaction and Technological Properties of Pigmented Coatings and Plastics"—G. Kaempf, of Bayer AG

"Importance of Diffusion in Electrochemical Action of Oxidizing Pigments"—M. Piens, of Laboratoire de la Profession, Belgium (1978 Annual Meeting Paper)

"Growth of *Aureobasidium pullulans* in Artificially Weathered Paint Films"—R.E. Crang and D.G. Pechak, of Bowling Green State University (PRI Proceeding)

Now Available in a New, Revised and Expanded Edition



PAINT FLOW & PIGMENT DISPERSION, 2nd Ed.

A Rheological Approach to Coating and Ink Technology

By Temple C. Patton

This new Second Edition presents researchers and engineers in the fields of coatings and inks with a practical, up-to-date, and comprehensive overview of the current rheological and related aspects of these two industries.

The text systematically discusses the diverse rheological factors affecting the preparation and application properties of coatings and ink, and reviews and analyzes—with worked-out problems—many recent developments in current technology. It is ideal for both the professional and the student.

Some of the areas covered in this book include:

- viscosity and viscosity measurement
- pigment/binder geometry and its practical applications
- critical pigment volume concentrations (solvents, latex, reduced, ultimate)
- surface tension, measurement and associated phenomena (including wetting, penetration, spreading, retraction, crawling, and beading up)
- pigment dispersion and pigment dispersants
- solubility, compatibility, and related interaction parameters
- evaporation and volatility relationships
- coating rheology (viscosity profiles)
- assessment of dispersion
- dispersion (grinding) equipment
- film applicators
- mill base formulation and letdown
- application rheology including brushing, roller-coating setting, leveling, cratering, foaming, sagging, slumping, spattering, and draining.

631 pp. 1-03272-7 **1979** $42.00

Available at your bookstore, or write to Nat Bodian, Dept. 092-07158

Please send the books indicated for 15-DAY FREE EXAMINATION.
(Restricted to the continental U.S. and Canada.)
Mail to: WILEY-INTERSCIENCE
P.O. Box 092
Somerset, N.J. 08873

☐ Patton(1-03272-7)	$42.00
☐ Patton(1-67127-4)..3-Volume Set	$230.00
☐ Payne(1-67286-6).Vol. 1	$35.50
☐ Payne(1-67353-6).Vol. 2	$35.95

☐ Payment enclosed, plus sales tax. Wiley pays postage/handling. We normally ship within 10 days. If shipment cannot be made within 90 days, payment will be refunded.

☐ Bill me. ☐ Bill firm or institution.

NAME____________________

AFFILIATION____________________

ADDRESS____________________

CITY____________STATE/ZIP____________

Prices subject to change without notice. 092 0-7158

PIGMENT HANDBOOK

Vol. 1: Properties and Economics
Vol. 2: Applications and Markets
Vol. 3: Characterization and Physical Relationships
Edited by Temple C. Patton

A unique set that presents a systematic organization of material covering pigment technology, application, and theory. Examines the nature of individual pigments; major commercial applications; pigment use in various situations; which pigments are required and where, as well as how proper pigmentation, formulation techniques, and other methods affect pigment properties; particle size; pigment geometry; esthetic appeal; rheology; and corrosion inhibition. More than 700 graphs and figures clarify vital points.

3-Vol. Set 1,978pp. (1-67127-4)
1973 $230.00

ORGANIC COATING TECHNOLOGY

Vol. 1: Oils, Resins, Varnishes and Polymers
Vol. 2: Pigments, and Pigmented Coatings for Architectural and Industrial Applications
Henry F. Payne

Provides a concise and compact treatment of the chemistry, manufacture, and applications for the raw materials and finished products of the paint industry.

Vol. 1: 674 pp. 1-67286-6
1954 $35.50
Vol. 2: 725 pp. 1-67353-6
1961 $35.95

WILEY-INTERSCIENCE
a division of John Wiley & Sons, Inc.
605 Third Avenue
New York, N.Y. 10016
In Canada: 22 Worcester Road, Rexdale, Ontario

Now–proven water resistance in coatings for plastics with NEOCRYL A-622, a fast dry, water-borne polymer.

Don't take our word for it. Test it yourself. Results prove NEOCRYL A-622 has superior water resistance for coating plastics.

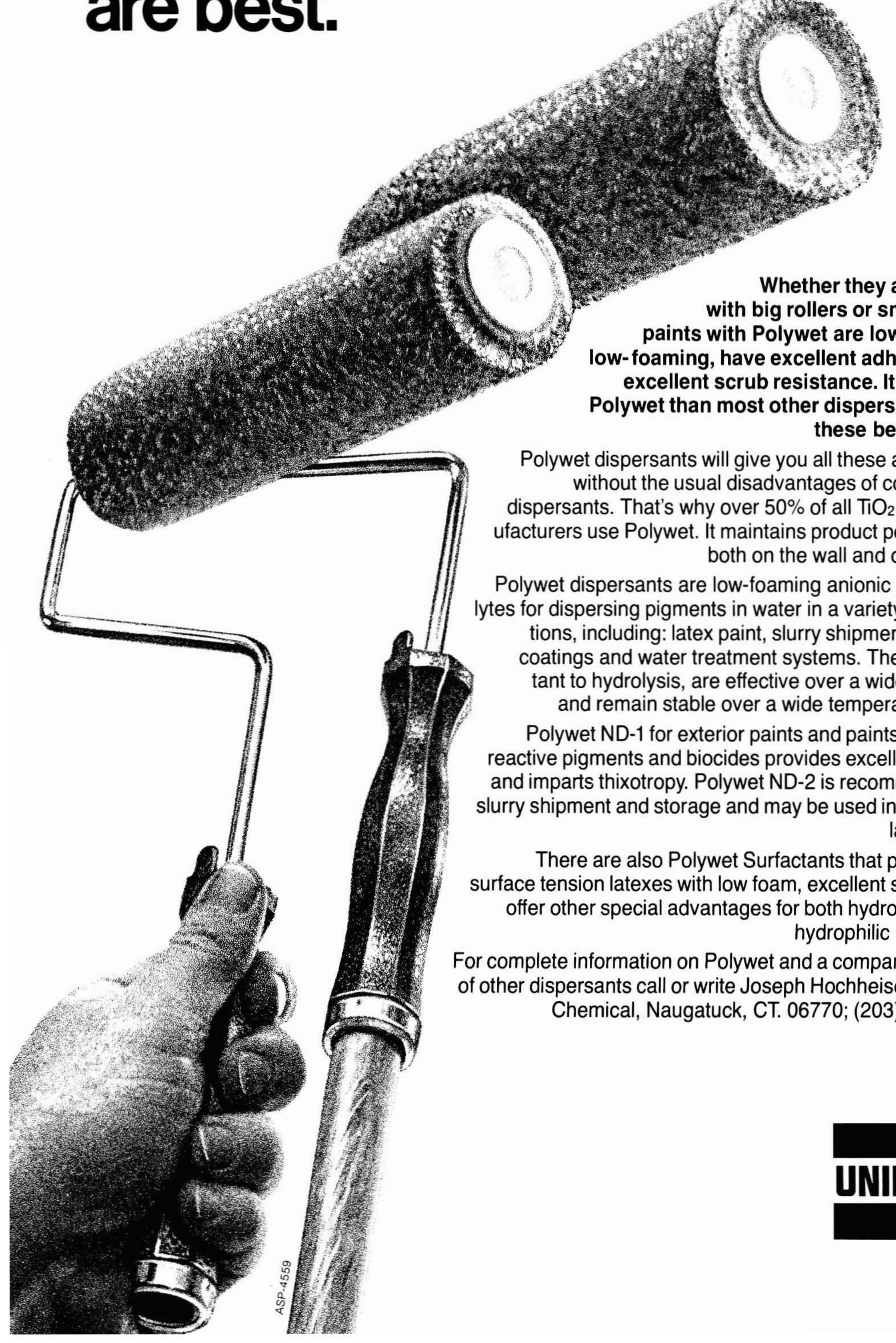
We placed plastic panels and parts in a water tank at 100°F for 200 hours. They showed no discoloration, no blistering and no loss of adhesion.

NEOCRYL A-622, an acrylic copolymer, dries approximately twice as fast as a water-borne alkyd. It is precoalesced to make formulating easier for airless or conventional air spray equipment.

Because of its versatility, NEOCRYL A-622 can be used clear, or it can be formulated by conventional techniques to obtain high gloss pigmented films. Either way, it has excellent flow and leveling properties. It is suggested for use on such plastic parts as automotive components, computer cabinets, toys, sporting goods and furniture.

If you'd like more data, write or call us. We'll be happy to provide samples or technical assistance.

Polyvinyl Chemical Industries
Dept. 11, 730 Main Street, Wilmington, Mass. 01887 (617) 658-6600
A Beatrice Chemical Co./A Division of Beatrice Foods Co.


ASP-4559

NUMBER 81 JULY 1979

FEDERATION newsletter

Federation of Societies for Coatings Technology
YE OLDE PAINT STONE 1737

FEDERATION SIGNS AGREEMENT WITH UNIV. SO. MISS. TO DEVELOP COATINGS CORRESPONDENCE COURSE

The Federation has signed an agreement with the University of Southern Mississippi for the sponsorship and development of a Correspondence Course on Surface Coatings Science and Technology. The agreement was signed (on May 18) by President James A. McCormick, of the Federation, and Drs. B. George Bufkin and Gary C. Wildman, of the Polymer Science Dept. of USM.

The course will be designed for persons who have the equivalent of junior undergraduate level study, and will require a background in general, organic, analytical, and physical chemistry, along with the mathematics and physics normally taken in preparation for these courses.

A strong cooperative effort between academia and industry will insure that the science of coatings will be presented successfully. The USM faculty will be assisted in the course development by experienced industry people who will serve as an Editorial Board for the Federation, providing technical and practical expertise in given specialty areas.

The course, to be offered through the Polymer Science Dept. and the Div. of Extension and Public Service at the University of Southern Mississippi in Hattiesburg, will be divided into two sections, tuition to be $300 each.

A grade will be given on completion of each section, and a certificate on completion of the entire course. Successful completion of the course will also entitle the student to eight semester hours of undergraduate credit at USM.

Two textbooks consisting of about 27 chapters each will be prepared for the course, and produced by the Federation.

The two comprehensive exams will be administered by proctors who will be appointed by the Constituent Society of the Federation in whose area the student resides. On passing the final exam, the student will be awarded the certificate.

The course will be available about September 1, 1981. Further details will be announced in this Newsletter and in the JCT.

WILLIAM ELLLIS AND HOWARD JEROME NOMINATED TO FEDERATION OFFICER POSITIONS

William H. Ellis, of Chevron Research Co., El Segundo, Calif., has been nominated to be President-Elect of the Federation. Mr. Ellis, currently Treasurer, is a Past-President of the Los Angeles Society. He was General Chairman of the 1974 West Coast Societies' Symposium, and has served as Society Representative and on numerous Society committees. At the Federation level, he has been on the Board of Directors and a member of several committees, including Program and the Ad Hoc Committee on Restructuring the Federation.

Howard Jerome, of Spatz Vane Calvert Paint Co., St. Louis, Mo., has been nominated to the post of Treasurer. Mr. Jerome, currently the St. Louis Society Representative on the Federation Board of Directors and member of the Executive Committee, is Chairman of the Federation's By-Laws Committee and a Past-President and Honorary Member of the New England Society.

The Nominating Committee also submitted the names of candidates for Board of Directors/Executive Committee positions:

Board of Directors as Members-at-Large -- (two nominees for 2-year terms each):

Ruth Johnston-Feller, Industry Consultant, Pittsburgh, Pa. She chairs the Federation's Bruning Award Committee and is a member of the Inter-Society Color Council Committee, which she previously chaired.

Colin D. Penny, of Hampton Paint Mfg. Co., Hampton, Va. He is a Past-President of the Baltimore Society and currently chairs the Federation's Technical Advisory Committee. He has also served on the Finance Committee.

Board of Directors as Past-President Member -- (2-year term): Milton A. Glaser, Industry Consultant, Glencoe, Ill. He was President of the Federation in 1957 and is currently Chairman of the Federation's Liaison Committee.

Society Representative to the Executive Committee -- (3-year term): A. Clarke Boyce, of Nacan Products Ltd., Toronto, Ont., Canada. He is a Past-President and current Society Representative of the Toronto Society.

Society Representative to the Executive Committee -- (two years, completing the unexpired term of Treasurer-Nominee Jerome): William Mirick, of Battelle Memorial Institute, Columbus, Ohio. He serves on the Federation's Program Committee and is the CDIC Society Representative.

Elections will take place on October 2 during the Annual Meeting in St. Louis.

FEDERATION PUBLISHES REVISED EDITION OF "PICTORIAL STANDARDS OF COATINGS DEFECTS"

The Federation has completed publication of the revised and updated version of the "Pictorial Standards of Coatings Defects."

The manual (previously titled "Exposure Standards Manual"), was compiled in conjunction with the ASTM and includes definition, description, and photographic standards for each of the following: Blistering Resistance, Chalking Resistance, Checking Resistance, Cracking Resistance, Erosion Resistance, Filiform Corrosion Resistance, Flaking Resistance, Mildew Resistance, Print Resistance, Rust Resistance, Traffic Paint Abrasion and Chipping Resistance.

Also included is reference information on supplementary standards, along with sample record sheets for compiling exposure records.

The Standards are bound in a handsome 10" x 11-1/2" x 1-1/2" three-ring, vinyl-covered binder. This loose-leaf, open-end format readily accommodates additional material as it is developed. The manual is priced at $75, plus shipping charges.

ACTIVITIES OF FEDERATION'S CONSTITUENT SOCIETIES

BALTIMORE--About 340 attended the "Coatings Show" on March 16, featuring 45 booths. A record-breaking 220 were at the regular meeting the evening prior......Manufacturing Committee presented program of the evening, "Bacterial Problems in Manufacturing and Handling of Latex Emulsions," in April......Technical Committee Symposium in May was titled, "Formulating Within the Law." Speakers were W.W. Spencer, of du Pont; N.S. Estrada, of Reichhold; G. Sprinkle, Jr., of Eastman Chemical; C.A. Burger, of Interstab; and L. Thomas, of NPCA......Scholarship awards will be presented to Asad Sheikh and Eileen Grumbine in November......Harry Schwartz, of Dutch Boy Paint, is now in office as 1979-80 President.

BIRMINGHAM--The wife of President Dave Heath recently became an Active member, making Dave & Elaine the third married couple (that we know of) who are members of the Federation. Both will attend Annual Meeting in St. Louis.....1979-80 marks Club's 50th anniversary year......John Hitchin, of W. Canning & Co. Ltd., will assume Presidency in October......Putting final touches to its A/V program on the Setaflash Tester.

CHICAGO--Two-semester coatings course at Elmhurst College concluded in May...... Federation staff at work on Society's "Infrared Spectroscopy Atlas" which is expected to be available in the fall......Technical Committee (under Joe Boatwright) and Manufacturing Committee (headed by Marv Tomberg) are stimulating activity with suggestions for projects......Bud Bartelt, of Rust-Oleum, is now in office as 1979-80 President.

CDIC--Bob Broerman, of Tenneco, becomes President in September.

CLEVELAND--Recently completed a very thorough compilation of "Duties of Society Officers and Committee Chairmen." Federation sent copies to all Societies......Voting privileges have been extended to Associate and Educator members.....The April meeting was held at the Perry Nuclear Power Plant in North Perry, Ohio......Continuing its Matching Fund Program for contributions to the Paint Research Institute. Total contributions to PRI last year from the Society and Cleveland-area individuals amounted to $795......Paul Houck, of Morgan Adhesives, will assume Presidency in October.

DALLAS--Will host Southwestern Paint Convention at Hilton Inn, April 17-19, 1980... Bill Holmes, of DeSoto, becomes President in September.

DETROIT--Will present paper at AM in St. Louis......May "FOCUS" Seminar was on "Recent Advances in Automotive Coatings"......Congressman Dana Wilson was speaker at May joint meeting with local PCA......Walt Stuecken, of Grow Chemical, will assume Presidency in September.

GOLDEN GATE--Will present paper at AM in St. Louis......Tom Dowd, of E.T. Horn Co., received special plaque for the company's contributions (classroom space, chairs, blackboards) to the coatings course sponsored by Society and PCA......Frank Liebold, retired from Sherwin-Williams, was elected an Honorary Member......The coatings course for 1979-80 will consist of various qualified industry representatives who will cover both technical and business topics......Manufacturing Committee's 1979 conference, "Mixing Time," in June was successful......Fred Apfel, of International Paint, will become President in October.

HOUSTON--About 300 attended Southwestern Paint Convention in April......Dallas and Houston members participated in the panel discussion on "The Technical/Production

Interface" at the May meeting......Technical Committee planning a project on "Measurement of Water Vapor Transmission of High Build/High Solids Coatings"...... Charlie Lundquist is now in office as 1979-80 President.

KANSAS CITY--Will celebrate 50th anniversary in 1980......John Ormsby, retired from Farmland Industries, was made an Honorary Member......Bill Smith, of Conchemco, becomes President in September.

LOS ANGELES--Eleven Past-Presidents attended the April meeting......Recognized for 25-year membership were: W.F. Benson, M.P. Eisner, C.W. Finegan, H.W. George, A.D. Giordano, E.A. Gross, J.A. Harris, F.T. Hawlish, F.D. Holmes, T.C. Jenson, G.M. Kashmer, B. Krantz, E.D. Marberg, W.D. Meadows, W.C. Metcalf, H.J. Miles, J. Misity, C.W. Nelson, R.E. Nemzek, R.L. Price, L.F. Smith, J.R. Snell, C.F. Springer, L.E. Starke, F.E. Steward, and G.J. Western......Preceding the May meeting was a Manufacturing Seminar on "Use of Computers in the Coatings Field. More than 70 attended......The Los Angeles "Paint Manufacturing Bowling League" is now in its 45th year......First dues notices for payment of 1980 dues were mailed in June. (LA does a great job in both collecting dues and issuing its Yearbook early) ......A two-year course in Paint Manufacturing Technology will begin this fall. Trev Whittington is instructor......Al Seneker, of Ameron, will assume Presidency in September.

LOUISVILLE--Will present paper at AM in St. Louis......Society, local PCA and University of Louisville are involved in project attempting to identify contents of logjam of drums that have floated down the Ohio River and settled along a stretch of land near the city. Area is known as the "Valley of the Drums"......May meeting was held jointly with PCA......Gary Gardner, of Porter Paint, will become President in September.

MONTREAL--Erik Krayer received 25-year pin in April......Changed dinner at monthly meetings to buffet style and attendance jumped about 15%......Mrs. Esther Fong was outstanding student in coatings course......A third Technical Subcommittee is studying "Cold Check Testing"......May meeting was series of workshops on Dispersion, Color Matching, Metrification, Quality Control, and Technical Service......Bob Snyder, of International Paints, is now in office as 1979-80 President.

NEW ENGLAND--Will present paper at AM in St. Louis......Associate members have been extended full voting privileges......Has established a Study Grant which will permit one member to attend a key coatings seminar or symposium. Maximum grant is $1,000 (Golden Gate initiated a similar program several years ago)......Coatings program at University of Lowell this fall will feature three courses: Polymer Structure, Properties & Applications; Man-Made Fibers; and Rheology......25-year pins were presented to W. Roemelt, L. Liebman, E.F. Joyce, and R.H. Green, Jr.......George Mulvey, of M&M Paint, will be President in September.

NEW YORK--March meeting featured workshop sessions on Paint Technology for the Beginner, Filling Out a Material Safety Data Sheet, Physical Chemistry of Surface Phenemona, and Material Waste Disposal......Arranged a meeting of Baltimore, Philadelphia, and New York Society officers at Federation office in March (New England also invited but unable to attend)......Manufacturing Committee sponsored tour of Benjamin Moore plant in April......16 Past-Presidents were at April meeting......Moe Coffino, Society Past-President and current Chairman of the Federation's Program Committee, was presented the coveted PaVaC Award at May meeting......New York and Philadelphia Societies sponsored second joint Technical Seminar on May 30 and 31, in Hightstown, N.J. Subject was "Maintaining Quality Under Pressure"......Sid Rubin, of Greenpoint Paint, becomes President in September.

NORTHWESTERN--More than 100 attended annual symposium, "Application Technology of Paint and Coatings, an Update," in March......Al Heitkamp, of Cargill, will become President in September.

PACIFIC NORTHWEST--Has established "James A. Leider, Jr. Outstanding Service Award," in honor of long-time permanent Administrative Secretary of Society, recently retired from Preservative Paint Co.....More than 300 attended annual symposium in Vancouver. Athletic competition turned out to be dodging raindrops as "boating regatta" was drowned out by super torrential downpour......1980 Symposium is May 1-3 in Portland ......Walt Clyde, of Glidden, is now in office as 1979-80 President.

PHILADELPHIA--March meeting was held jointly with Philadelphia Printing Ink Makers ......Technical Committee enjoying much success presenting speakers at meetings..... Now incorporated......All members can now vote and Associate members can hold office ......Technical Committee Service Award presented to Wayne Kraus, of Lawrence-McFadden Co. (He initiated idea of speakers at Technical Committee meetings)...... One-day seminar on "Liquid and Solid Waste Disposal" planned for October 18...... 25-year pins presented to M. Abriss, B. Chatzinoff, M. Hanrahan, E. Barrett, Sr., D. Engler, and W. Strobel......Carl Fuller, of Reichard-Coulston, will become President in September.

PIEDMONT--Plans to supply furniture-finishing terms for next edition of Federation's "Paint/Coatings Dictionary"......John Hajnos, of Spencer Kellogg, will assume the Presidency in November.

PITTSBURGH--Sponsored symposium on "Controlling Corrosion With Organic Coatings" in May......Technical Committee considering two new projects: Flash Rusting and Evaluation of New Zahn Cups......Will present two $25 awards at high school science fair ......Bob Marcus, of PPG Industries, is now in office as 1979-80 President.

ROCKY MOUNTAIN--Frank H. Meyers, of Kwal Paints, will become President in October.

ST. LOUIS--May meeting featured a panel discussion on "Problems Building a Paint and Resin Plant in the St. Louis Area"......Plans to invite local high school chemistry teachers to AM & PS in St. Louis......Herb Rosenblatt, of Steelcote, will become President in September.

SOUTHERN--Atlanta will be site of 1980 annual meeting, March 12-14......Al Hendry, of A.L. Hendry Co., will assume the Presidency in September.

TORONTO--Recently prepared a detailed listing of "Duties of Officers and Committees." Federation mailed them, and similar material from Cleveland, to all Societies...... Produced a professional-quality A/V program on "Introduction to Resin Operations" and turned it over to Federation. Will be made available soon......Celebrated its 60th anniversary in April......Awarded 25-year pins to E. Gremell, I. McLean, A. Jones, T. Bird, G.R. Bailey, J.F. Brydon, J.F. Orr, W.J. Griffen, J.W. Suggitt, and C.E. Johnson......Will present paper at AM in St. Louis......Has issued membership cards. On reverse side is meeting schedule for year......Sponsoring joint symposium with Montreal on "Coatings Technology Economics." In Toronto on September 19th; Montreal the next day......Exchanges meeting visitation with Western New York Society on annual basis......Two advanced courses in Coatings Technology being sponsored at George Brown College, both day and evening. Graduates will be presented certificates at monthly meeting dinner......Jan Grodzinski, of Toronto Coppersmithing, will become President in September.

WESTERN NEW YORK--Tom Popovec, of National Gypsum Co., is now in office as 1979-80 President.

SYMPOSIUM ON R & D MANAGEMENT TO HIGHLIGHT OPENING-DAY PROGRAMMING AT 1979 ANNUAL MEETING

A three-hour Symposium on coatings industry R & D Management will be featured on the opening day of the 1979 Federation Annual Meeting, to be held in the St. Louis Convention Center, October 3-5.

Program Chairman Morris Coffino, of D.H. Litter Co., New York, has announced the Symposium will focus on the following topics:

> "Innovation -- Barriers and Incentives" -- Milton Glaser, Consultant, Ill.
>
> "Strategy of Experimentation" -- F. L. Chromey, of E.I. duPont de Nemours & Co., Inc., Wilmington, Del.
>
> "How to Choose Projects" -- J. M. Butler, of DeSoto, Inc., Des Plaines, Ill.
>
> "Managing R & D -- Using All Available Resources" -- E.B. Euchner, of Glidden Coatings & Resins Div., SCM Corp., Strongsville, Ohio.
>
> "Impact of Governmental Regulations on Product Safety Development" -- Roy T. Gottesman, of Tenneco Chemicals, Saddle Brook, N.J.

The program, geared to the theme of "Progress Through Innovation," will also feature the following papers which have thus far been selected for presentation:

> "A Reactive Solvent-Diluent for Coating Systems" -- W. D. Emmons, K. Nyi, P. R. Sperry, R. J. Wiersema, and J. P. Shelley, of Rohm and Haas Co., Spring House, Pa.
>
> "Condensation Polymer Formulation in the Age of Oligomers" -- L. H. Brown, of Dow Corning Corp.
>
> "Hydrogen Bonding -- Key to Dispersion" -- Hilton G. Stephen, of Kemrez Chemicals, Cheltenham, Victoria, Australia.
>
> "Application of Photochemistry to Coating Problems" -- Claude Loucheux, of Laboratoire de Chemie Macromoleculaire, Villenueve d'Asco, France.
>
> "Dispersion of TiO_2 in Water-Borne Industrial Finishes" -- J. M. Rackham, of BTP Tioxide Limited, Stockton-on-Tees, England.

The Mattiello Lecture, to be delivered by Charles Kumins, of Tremco Incorporated, Cleveland, Ohio, on Friday, October 5, will discuss "Physical Chemical Models for Organic Protective Coatings."

Other featured presentations include:

- Keynote Address by Newcaster/TV Commentator Howard K. Smith
- Constituent Society Papers
- Roon Awards Papers
- Paint Research Institute Seminar on Aqueous Coatings
- Panel Discussion on Waste Disposal
- Manufacturing Seminar on "Media Milling"
- Educational Seminar on "Continuing Education"

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY **NO. 81**
1315 Walnut St., Philadelphia, Pa. 19107 **July 1979**

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

1979 ANNUAL MEETING and PAINT INDUSTRIES' SHOW

St. Louis Convention Center
St. Louis, Missouri
October 3, 4, 5

"PROGRESS THROUGH INNOVATION"

Three days of technical sessions geared to the theme "Progress Through Innovation" . . . More than 135 supplier companies will have on hand their top technical representatives, making this the largest Paint Show ever . . . Opportunity for face-to-face interchange with Executives, Purchasing Agents, Chemists, Engineers, and Research, Development, and Production Personnel of the Coatings Industry.

Plan NOW to attend the Major Coatings Event of the Year . . . Save time and money by registering in advance . . . Housing and Registration Forms are on pages 27 through 31 THIS ISSUE. Advance registration and Housing forms are also available from Federation Headquarters Office.

October 3
Keynote Speaker
HOWARD K. SMITH

Award-Winning Newsman
and
Commentator

October 5
Mattiello Lecturer
CHARLES A. KUMINS
of Tremco, Inc.

"Physical Chemical Models
for Organic Protective Coatings

Symposium on R & D Management to Highlight Opening-Day Programming at 1979 Annual Meeting

A three-hour Symposium on coatings industry R & D Management will be featured on the opening day of the 1979 Federation Annual Meeting, to be held in the St. Louis Convention Center, October 3-5.

Program Chairman Morris Coffino, of D. H. Litter Co., New York, has announced the Symposium will focus on the following topics:

"Innovation—Barriers and Incentives"—Milton A. Glaser, Consultant, Glencoe, Ill.

"Strategy of Experimentation"—F. L. Chromey, of E. I. duPont de Nemours & Co., Inc., Wilmington, Del.

"How to Choose Projects"—J. M. Butler, of DeSoto, Inc., Des Plaines, Ill.

"Managing R & D—Using All Available Resources"—E. B. Euchner, of Glidden Coatings & Resins Div., SCM Corp., Strongsville, Ohio.

"Impact of Governmental Regulations on Product Safety Development"—Roy T. Gottesman, of Tenneco Chemicals, Saddle Brook, N.J.

•

The program, geared to the theme of "Progress Through Innovation," will also feature the following papers which have thus far been selected for presentation:

"A Reactive Solvent-Diluent for Coating Systems"—W. D. Emmons, K. Nyi, P. R. Sperry, R. J. Wiersema, and J. P. Shelley, of Rohm and Haas Co., Spring House, Pa.

"Condensation Polymer Formulation in the Age of Oligomers"—L. H. Brown, of Dow Corning Corp.

"Hydrogen Bonding—Key to Dispersion"—Hilton G. Stephen, of Kemrez Chemicals, Cheltenham, Victoria, Australia.

"Application of Photochemistry to Coating Problems"—Claude Loucheux, of Laboratoire de Chemie Macromoleculaire, Villenueve d'Asco, France.

"Dispersion of TiO_2 in Water-Borne Industrial Finishes"—J. M. Rackham, of BTP Tioxide Limited, Stockton-on-Tees, England.

The Mattiello Lecture, to be delivered by Charles Kumins, of Tremco Incorporated, Cleveland, Ohio, on Friday, October 5, will discuss "Physical Chemical Models for Organic Protective Coatings."

Other featured presentations include:

- Keynote Address by Newscaster/TV Commentator Howard K. Smith
- Constituent Society Papers
- Roon Awards Papers
- Paint Research Institute Seminar on Aqueous Coatings
- Panel Discussion on "Waste Disposal"
- Manufacturing Seminar on "Media Milling"
- Educational Seminar on "Continuing Education"

Concurrent sessions will be held throughout the three-day meeting, but papers will be scheduled so as to avoid conflicting presentations.

Paint Industries' Show

To be held in conjunction with the Annual Meeting, the Paint Industries' Show is the only national exhibit of raw materials and equipment used in the formulation, testing, and manufacture of coatings. Top technical representatives from participating supplier companies will be manning booths to discuss developments with personnel of the coatings manufacturing industry from around the world.

A total of 126 exhibitors will occupy 339 booth spaces in the 1979 Show, the largest in history.

Show hours will be: Noon to 5:30 pm on Wednesday, October 3; 10:00 am to 5:30 pm on Thursday, October 4; 10:00 am to 4:00 pm on Friday, October 5.

Headquarters Hotel

The Sheraton St. Louis will be headquarters hotel, and Stouffer's Riverfront Towers will be co-headquarters. Other hotels with blocks of rooms set aside for the Annual Meeting are Bel Air Hilton, Breckenridge Pavilion, Holiday Inn Riverfront, Lennox, Mayfair, Rodeway Inn, and St. Louisian.

Shuttle bus service will be provided between participating hotels and the Convention Center.

Room Reservations

All requests for rooms and suites must be sent to the Federation Housing Bureau on the official form provided by the Federation. These have been mailed to all members. The form is included in this issue (see pages 27-28), and additional copies are available from Federation headquarters.

Registration Fees

Regular "on-site" registration fees will be $40 for Federation members and $55 for non-members. Advance registration will be available for $35 for members and $50 for non-members.

There will again be a special $15 advance registration fee each for retired Federation members and their spouses.

An advance registration form is included in this issue (see pages 30-31).

Luncheon

The Federation Luncheon will be held Friday, October 5 at the Sheraton St. Louis.

Presentations will be made to recipients of the George Baugh Heckel Award (outstanding individual who has contributed to the advancement of the Federation) and the Flynn Awards (firms judged to have the best exhibit booths in the 1979 Paint Industries' Show).

Featured speaker will be Dr. James H. Boren, President of the International Association of Professional Bureaucrats (known as INATAPROBU) who is the author of the bestselling "When In Doubt Mumble."

Program Committee

In addition to Mr. Coffino, the following members are serving on the FSCT Program Steering Committee:

Vice-Chairman—Hugh Lowrey, of Indurall Coatings, Inc., Birmingham, Ala.; Umberto Ancona, of McCloskey Varnish Co., Philadelphia, Pa.; Thomas Ginsberg, of Union Carbide Corp., Bound Brook, N.J.; William Mirick, of Battelle Memorial Institute, Columbus, Ohio; Colin D. Penny, of Hampton Paint Mfg. Co., Inc., Hampton, Va.; and Richard E. Wolf, of DeSoto, Inc., Des Plaines, Ill.

Meetings Committee

Members of the Kansas City and St. Louis Societies are serving on the Meetings Committee under General Chairman Howard Jerome, of Vane Calvert Paint Co. Chairing the various subcommittees are: Information Services—William Fitzpatrick, of Cook Paint & Varnish Co.; Operations—John Folkerts, of Plas-Chem Coatings; Luncheon—William Smith IV, of Conchemco, Inc.; Publicity—Herman J. Lanson, of Poly Chem Resins, Inc.; Busing—Floyd Thomas, Jr., of Thomas & English, Inc.

Mrs. Howard (Gene) Jerome is in charge of the Spouses' Program.

William Ellis, of Los Angeles, and Howard Jerome, of St. Louis Are Nominated to Federation Officer Positions

William H. Ellis, of Chevron Research Co., El Segundo, Calif., has been nominated to be President-Elect of the Federation of Societies for Coatings Technology. Mr. Ellis, currently Treasurer, is a Past-President of the Los Angeles Society. He was General Chairman of the 1974 West Coast Coatings Societies' Symposium, and has served as Society Representative and on numerous Society committees, including Education, Environmental, Membership, Program, and Publicity. At the Federation level, he has been on the Board of Directors, and was a member of several committees, including Program, and the Ad Hoc Committees on Education and Restructuring of the Federation.

Howard Jerome, of Spatz Vane Calvert Paint Co., St. Louis, Mo., has been nominated to the post of Treasurer. Mr. Jerome, currently the St. Louis Society Representative on the Federation Board of Directors and member of the Executive Committee, is Chairman of the FSCT By-Laws Committee and is a Past-President and Honorary Member of the New England Society.

The Nominating Committee also submitted the names of candidates for Board of Directors/Executive Committee positions:

Board of Directors as Members-at-Large—(two nominees for 2-year terms each):

Ruth Johnston-Feller, Industry Consultant, Pittsburgh, Pa. She chairs the Federation's Bruning Award Committee, and is a member of the Federation's Inter-Society Color Council Committee, which she previously chaired.

Colin D. Penny, of Hampton Paint Mfg. Co., Hampton, Va. He is a Past-President of the Baltimore Society and currently chairs the Federation's Technical Advisory Committee. He is also a member of the Federation's Finance Committee.

Board of Directors as Past-President Member—(2-year term):

Milton A. Glaser, Industry Consultant, Glencoe, Ill. A Past-President of the Federation, he is currently Chairman of the Federation's Liaison Committee.

Society Representative to the Executive Committee—(3-year term):

A. Clarke Boyce, of Nacan Products Ltd., Toronto, Canada. Currently Toronto Society Representative on the Federation Board of Directors, he is a Past-President of the Toronto Society.

Society Representative to the Executive Committee—(2-year term—completing the unexpired term of Treasurer-Nominee Howard Jerome):

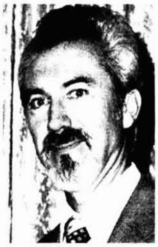
William Mirick, of Battelle Memorial Institute, Columbus, Ohio. He is currently C-D-I-C Society Representative on the Federation Board of Directors and is a member of the 1979 Annual Meeting Program Committee.

Voting will take place on October 2 during the 1979 Federation Annual Meeting in St. Louis, Mo.


W.H. Ellis


H. Jerome


R. Johnston-Feller


C.D. Penny


M.A. Glaser


A.C. Boyce


W. Mirick

Proposed Amendments To Federation By-Laws

The following proposed amendment to Article III of the Federation By-Laws will be presented for first reading at the Federation Board of Directors meeting on October 2, 1979, in St. Louis.

If passed at that time, it will be presented for adoption at the Board of Directors meeting of May 17, 1980, in Minneapolis.

ARTICLE III—ORGANIZATION

WHEREAS counsel has recommended that a By-Law be adopted authorizing the Federation to indemnify its Officers and Directors, and

WHEREAS the Board of Directors at its January 28, 1978 meeting requested the By-Laws Committee to offer a resolution which would provide such a statement, be it

RESOLVED that a new section "F" be added to Article III of the By-Laws which shall read as follows:

> "F. INDEMNIFICATION OF DIRECTORS, OFFICERS AND OTHERS
>
> The Federation shall indemnify, to the extent determined by the Board of Directors, any person who, by reason of serving as a director, officer, employee, or agent of the Federation is made a party to any legal, administrative, investigative or similar proceeding. Indemnification may be against all or a portion of any amounts such person is required to pay (including expenses) as a result of such a proceeding. This right of indemnification shall not deprive such person of any other rights of indemnification to which a person may be entitled and shall inure to the benefit of such person's heirs, executors and administrators."

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

1979 ANNUAL MEETING AND PAINT INDUSTRIES' SHOW

CONVENTION CENTER, ST. LOUIS, MISSOURI

OCTOBER 3, 4, 5, 1979

"PROGRESS THROUGH INNOVATION"

MAIL TO: Coatings Federation Housing Bureau
1375 Highway Drive
St. Louis, Mo. 63026

APPLICATION FOR ACCOMMODATIONS

Please indicate below the type of accommodations requested and your choice of hotels. Room reservations cannot be guaranteed unless this form is received by September 14, 1979. All reservation requests must be in writing and processed through the Housing Bureau: Phone requests are not accepted.

TYPE OF ACCOMMODATION	NUMBER	RATE REQUESTED
Single (1 person)		
Double (2 persons)		
Twin (2 persons)		
Suite (parlor and 1 bedroom)		
Suite (parlor and 2 bedrooms)		

CHOICE OF HOTELS:
Please use the three-letter code shown after each hotel listing on rate page.
1st
2nd
3rd
4th

Hotel placement will be made in the order received. Your first choice will be assigned, if rooms are available. Otherwise, you will be assigned to hotels of your other choices. Confirmation will be sent to you directly by the hotel. Please make all changes with the Housing Bureau by phoning 314-421-1166. All reservations will be held until 6:00 p.m., unless a later arrival time is indicated below.

Please fill in the names and addresses of all occupants of the rooms you have reserved. (Bracket those rooming together). Incomplete information will delay assignment of rooms.

Type of Room	Name	Address	Times and Dates of Arrival	Departure

SEND CONFIRMATION TO: NAME____________________

PLEASE PRINT OR TYPE ➧

COMPANY____________________

ADDRESS____________________

CITY____________STATE____________ZIP________

IMPORTANT NOTICE

ANYONE REQUESTING ACCOMMODATIONS AT THE SHERATON ST. LOUIS HOTEL WILL BE LIMITED TO A MAXIMUM OF FIVE ROOMS (A PARLOR COUNTS AS ONE ROOM). ADDITIONAL ROOM RESERVATIONS WILL BE ASSIGNED TO OTHER COOPERATING HOTELS. PAINT SHOW EXHIBITORS WILL RECEIVE PREFERENCE IN ALLOCATION OF SUITES.

HOTEL INFORMATION AND RATES

Ten hotels in St. Louis have reserved blocks of rooms specifically for the 1979 Annual Meeting and Paint Industries' Show of the Federation. Please refer to map below.

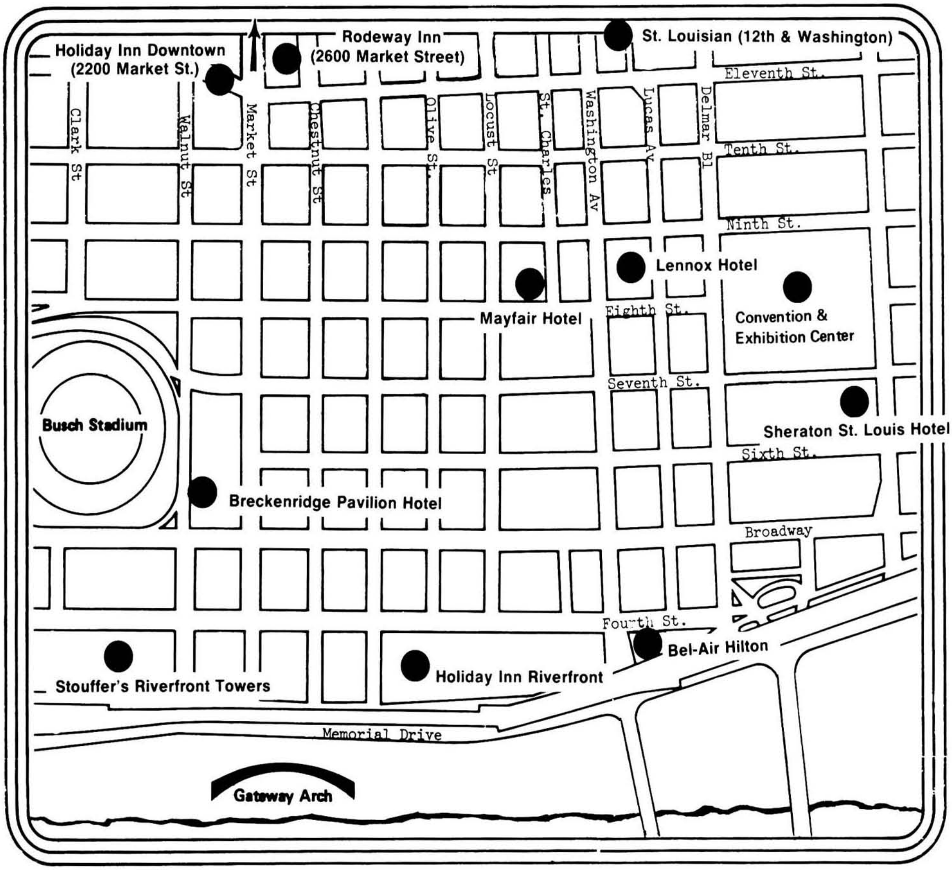
All room rates are subject to an additional 7.5% charge — a St. Louis tax.

Confirmation will be sent to you directly by the hotel. Please make any changes by phoning the Housing Bureau 314-421-1166.

IMPORTANT NOTICE: Anyone requesting accommodations at the Sheraton St. Louis Hotel will be limited to a maximum of five rooms (a parlor counts as one room). Additional room reservations will be assigned to other cooperating hotels. Paint Show exhibitors will receive preference in allocation of suites.

Hotel	Singles	Doubles	Twins	1 Bedroom & Parlor	2 Bedrooms & Parlor
BEL AIR HILTON (BAH)	$44	$52	$52	$180	—
BRECKENRIDGE PAVILION (BPH) (this hotel requires a one night's deposit)	49	59	59	135 & 195	150 & 225
HOLIDAY INN RIVERFRONT (HIR) (this hotel requires a one night's deposit)	39	47	47	65	75
LENNOX (LXH)	30	34	38	50 & 75	125 & 150
MAYFAIR (MFH)	36	44	44	65 & 90	—
ST. LOUISIAN (SLH)	23	30	30	40	78
SHERATON ST. LOUIS (SSL)	41	51	51	100 & 175	—
STOUFFER'S TOWERS (SRT)	40	50	50	115 & 175	225 & 250
RODEWAY INN (RWD)	28	32	35	60	—
HOLIDAY INN DOWNTOWN (HID)	30	37	37	—	—

The Sheraton and Stouffer's are serving as co-headquarters hotels. . . .Only one suite is available at the Hilton. . . .The suite rates for the Holiday Inn, Mayfair, Rodeway Inn, and St. Louisian are for occupancy by one person. Additional charge for second person.



SAVE TIME AND $$$, TOO!!

REGISTER NOW

Annual Meeting and Paint Show

October 3 - 5, 1979

St. Louis, Missouri

USE ADVANCE REGISTRATIONS FORMS ON THE NEXT TWO PAGES

You and your spouse can pre-register for the 1979 Annual Meeting and Paint Show by completing the advance registration forms and mailing them with your check to FSCT headquarters. Your registration badges can be picked up at the Advance Registration desks in the St. Louis Convention Center.

REGISTRATION FEES

	Member	Non-Member	Spouses Activities
Advance*	**$35**	**$50**	**$20**
On-Site (Full-Time)	**$40**	**$55**	**$25**
On-Site (One-Day)	**$20**	**$30**	**—**

Note: You save $5.00 by registering in advance.

***Special registration for Retired Federation Members and their spouses $15.00 each in advance only.**

PLEASE PRINT EXACTLY as you wish registration badge prepared

FIRST NAME LAST NAME

BUSINESS AFFILIATION

STREET

CITY STATE *(U.S. only)*

ZIP (U.S. or CANADA) COUNTRY (OTHER THAN U.S.)

Your title or Position ______________________

Name of the Federation Society
Of which you are a paid member ______________________

Hotel at which you are staying ______________________

FSCT Annual Meeting and Paint Show Registration Fees

Federation Member	**ADVANCE REGISTRATION**	**NON-Member**
$35.00	**St. Louis, Mo.** **October 3 - 5, 1979**	**$50.00**

PLEASE CHECK ONE BLOCK IN EACH CATEGORY

YOUR COMPANY *(Check One):*

A ☐ Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants, etc.
B ☐ Manufacturers of Raw Materials
C ☐ Manufacturers of Equipment and Containers
D ☐ Sales Agent for Raw Materials and Equipment
E ☐ Government Agency
F ☐ Research/Testing/Consulting
G ☐ Educational Institution/Library
H ☐ Paint Consumer
J ☐ Other

YOUR POSITION *(Check One):*

A ☐ Management/Administration
B ☐ Manufacturing and Engineering
C ☐ Quality Control
D ☐ Research and Development
E ☐ Technical Sales Service
F ☐ Sales and Marketing
G ☐ Consultant
H ☐ Educator/Student/Librarian
J ☐ Other

Annual Meeting and Paint Show

Convention Center
St. Louis, Missouri
October 3 - 5

To register in advance for the 1979 Annual Meeting and Paint Show, please fill in the adjacent form and return with your remittance, to:

Federation of Societies for Coatings Technology
Suite 832
1315 Walnut Street
Philadelphia, Pa. 19107

Forms must be received by September 12.

Federation Awards Luncheon

Friday, October 5
Sheraton St. Louis Hotel

Purchase of Luncheon tickets is optional, and is not part of the Advance Registration fee. If you wish to attend please fill in Luncheon Ticket Order Form below and include an additional $10.00 per person with your registration payment. Price of the luncheon ticket is NOT included in Spouses' Registration fee. Humorist Dr. James Boren will be the guest speaker.

Dr. James Boren

Luncheon Ticket Order Form

Number of tickets ($10.00) required ________.

Complete payment in amount of ______ is enclosed.

Tickets are for:

NAME

COMPANY

ADDRESS

CITY & STATE ZIP

NOTE: Tickets may be picked up with your badge during Paint Show registration hours at advance registration desk in the St. Louis Convention Center.

Spouses Activities $20.00 Advance Registration

PLEASE PRINT EXACTLY as you wish registration badge prepared.

NAME

ADDRESS

CITY & STATE ZIP

COUNTRY (Other than U.S.)

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

Spring 1979 Board of Directors Meeting

Thirty-three members attended the Spring Meeting of the Board of Directors of the Federation of Societies for Coatings Technology on May 18, 1979, at the New Orleans Hilton Hotel, New Orleans, La.

The following were present:

Officers

President	James A. McCormick
President-Elect	Elder C. Larson
Treasurer	William H. Ellis

Society Representatives

Baltimore	Alex Chasan
Birmingham	John Hitchin
Chicago	John Vandeberg
C-D-I-C	William Mirick
Cleveland	Fred Schwab
Dallas	Carlos E. Dorris
Detroit	Harry Majcher
Golden Gate	A. Gordon Rook
Houston	Willy C.P. Busch
Kansas City	Terryl F. Johnson
Los Angeles	Gerald L. West
Louisville	Joseph A. Bauer
Mexico	Tony Pina Arce
Montreal	Horace Philipp
New England	Charles Aronson
New York	S. Leonard Davidson
Northwestern	Lowell Wood
Pacific Northwest	John A.J. Filchak
Philadelphia	J. Richard Kiefer, Jr.
Piedmont	James Bohlen
Pittsburgh	Gerry Ward
Rocky Mountain	Bruce Regenthal
St. Louis	Howard Jerome
Southern	J. Tommy Robertson
Toronto	A. Clarke Boyce
Western New York	Eugene LeVea

Other Members

John Ballard	Louisville
Neil S. Estrada	Golden Gate
Thomas J. Miranda	Chicago
John J. Oates	New York

Guests

Jorge Hijuelos (and Mrs. Hijuelos), President of the Mexico Paint and Ink Manufacturers Association.

Larry Thomas, Executive Director of the National Paint and Coatings Association.

Dr. Orin Keplinger and Dr. Raymond R. Myers, President and Research Director, respectively, of the Paint Research Institute.

John A. Gordon, Jr., Chairman of the Federation's Educational Committee.

Dr. Gary Wildman and Dr. George Bufkin, of the University of Southern Mississippi.

The following Society officers who attended the orientation meeting the previous day: Gordon Allison, of Baltimore; Roger Anderson, of Northwestern; Curtis Bailey, of Pacific Northwest; Thad Broome, of Southern; William Cunane, of Piedmont; Ted Favata, of Golden Gate; Rick Hille, of Chicago; Donald Jordan, of Los Angeles; Barry Oppenheim, of Philadelphia; Emilio Santillan, of Mexico; G.M. Sastry, of Detroit; Marvin Schnall, of New York; Dick P. Stewart, of Pacific Northwest; and Gil Sullivan, of New England.

Staff

Frank J. Borrelle, Executive Vice-President; Thomas A. Kocis, Director of Field Services and Communications; Rosemary Falvey, Director of Administration.

Mr. Borrelle called the roll of members and reported all present except Past-President Willard W. Vasterling. The report of the Fall 1978 Council/Board of Directors meeting was approved as published in the January 1979 JOURNAL OF COATINGS TECHNOLOGY.

Reports of Officers And Staff

PRESIDENT McCORMICK

The first half of my term as President has been an especially busy time.

Through Society visits, we have become aware of diminishing involvement in Society activities on the part of our membership, particularly the new members. The first step has been taken to counteract this. We need better programming for our monthly meetings, and the Federation has begun a speakers' aid program. In the future, a local program chairman will be able to enlist the aid of staff to assist in his program needs.

The Federation has also begun to play a more positive role in generating committee action at the local level. The Education, Technical Advisory, Environmental Control, and Manufacturing Committees are under new leadership and are instituting new efforts to augment local committee activities.

A new program to aid educational efforts for our membership will be available in the near future. The Federation, in conjunction with the University of Southern Mississippi, Polymer Science Department, will develop a correspondence course on "Surface Coatings Science and Technology." When completed, the course will mark the first educational effort of this magnitude designed specifically for Federation members.

The Technical Advisory Committee has been working to stimulate technical efforts at the Society level by introducing interesting new project suggestions, designed to have a wide range of interest. The projects include corrosion studies and polymers coupled with fungicides.

The Environmental Control Committee was assigned the task of disseminating to our membership information on regulatory actions by state and Federal legislative bodies that affect the coatings industry. This committee published its first newsletter early in 1979.

The Manufacturing Committee will shortly be announcing new programs to establish or reestablish active local Manufacturing Committees.

Plans for our Annual Meeting, centering around the theme, "Progress Through Innovation," are complete. Our keynote speaker will be Howard K. Smith, internationally known news commentator. So mark the dates October 3, 4, and 5 on your calendar . . . "We will see you in St. Louis."

JAMES A. MCCORMICK,
President

PRESIDENT-ELECT LARSON

It has been a busy and interesting experience to follow the executive activities of the Federation since the 1978 Annual Meeting in Chicago. In the interim I have been a guest at two meetings of the Trustees of the Paint Research Institute.

In officer/staff visits, I helped tell the Federation Story at the C-D-I-C, Cleveland, Toronto, Montreal, and Piedmont Societies.

Other visitations included: Western Coatings Societies' Biennial Symposium in San Francisco; and attending a meeting of the Executive Officers of the Los Angeles, Golden Gate, Pacific Northwest, and Rocky Mountain Societies—these are truly active Societies; Southwestern Paint Convention, and meeting with the Executive Officers of the Houston and Dallas Societies.

On March 25-26 I joined Jim McCormick and Frank Borrelle in representing the Federation at a regular meeting of the Joint Paint Industry Coordinating Committee in Washington, D.C. This was also a rewarding and worthwhile meeting.

I am in the process of selecting FSCT Committee Chairmen and representatives for the coming year and expect to have this task accomplished at the time of the Annual Meeting in St. Louis.

ELDER C. LARSON,
President-Elect

TREASURER ELLIS

A primary duty of the Treasurer is to monitor the finances of the organization. Thanks to the dedication and competence of the Federation staff, this is an easy task.

The budget is approaching one million dollars annually. This year it is $925,000. Most budget items are relatively constant, except for inflation. Each year, however, there are a few noteworthy entries. In 1979, income from the Paint Show and the new Dictionary promise to bring increased income. Conversely, preparation and publication of the new Infrared book and correspondence course will be unusual expenses, as the Dictionary and Color Aptitude Test sets were last year.

Although at this moment the Federation contribution to the Paint Research Institute is in limbo, the PRI budget will also balance if the formal PRI request for $45,000 from the Federation is honored. Being PRI Treasurer is a trying assignment for a fiscal conservative, as it would be in any organization wholly dependent upon contributions. While expenses can be estimated quite accurately, the income estimate can only be based on hope, prayers, and experience. And the income is critical because the starting bank balance is less than 10% of projected expenses.

The office of Treasurer provides a valuable learning experience, for the financial transactions are a clear window for viewing in detail the many worthwhile activities of the Federation. It's enlightening and rewarding.

With other officers, I officially represented the Federation this year at the Western Societies' Symposium and at the February meeting of the Los Angeles Society.

I trust the Federation's finances will look at least as good at the end of 1979 as they do now and that we will all benefit from the judicious yet creative expenditure of our funds.

WILLIAM H. ELLIS
Treasurer

EXECUTIVE VICE-PRESIDENT BORRELLE

The year 1978 was a good one for the Federation and 1979 has already shown signs of being the same. This report will reflect Federation and staff activities since the 1978 Annual Meeting.

PUBLICATIONS

JCT: Advertising page sales in 1978 fell 6% below the previous year. We will bounce back in 1979. Editorial matter is in bountiful supply. The front covers continue to be among the best of industry publications.

Year Book: The 1979 edition (296 pages—largest ever) was released on April 18. It includes the names of 6,527 members, an increase of 26 Active and 65 Associate. Advertising page sales were 10% over 1978.

Federation Series: Number 27 on "Anti-Corrosive Barrier and Inhibitive Primers" by Clive Hare was published in April. The Publications Committee has okayed the preparation of two new units: "Statistics for the Coatings Industry" by H.E. Hill, of Hughson Chemical Co.; and "Color and Appearance" by Dr. Robert Marcus, of PPG Industries, Inc. The Executive Committee has set a new price of $2.50 per unit (increase of $1.00), effective July 1.

Newsletter: Two editions (January and March) were issued this year. We continue to direct-mail it to key Federation and Society personnel. In addition, the Newsletter is now inserted into the JCT, greatly increasing its circulation. This new procedure has met with wide acceptance.

Paint/Coatings Dictionary: Sales of this magnificent volume are going very well—nearly 1200 to date.

Handbook: This 20-page compilation of Federation Committee Chairmen, Board, Executive Committee and Society Officers and Committee Chairmen was introduced in November 1978—in response to a request from the Society Representatives. It will be prepared annually.

Pictorial Standards of Coatings Defects: This binder will become available in June.

Infrared Spectroscopy: In February, the Chicago Society delivered to staff the complete manuscript for the new and enlarged "Infrared Spectroscopy Atlas for the Coatings Industry." It will feature twice as many spectra (1500) as the 1969 edition. We hope to have copies for display at the Annual Meeting.

ANNUAL MEETING AND PAINT SHOW

Registered attendance at the 1978 AM&PS was 5761 (regular—3197, exhibitors—1688, NPCA—474, and spouses—402), the second largest in our history. Paid exhibit space in the Paint Show, 28,900 net square feet, also was a new high.

The 1979 Paint Show in St. Louis now becomes a record-breaker with paid net square feet presently at 32,700 . . . clearly an indication of the rising acceptance and importance of this outstanding industry exhibit.

Moe Coffino and his Program Committee are lining up a most interesting program with the theme, "Progress Through Innovation."

Rosemary Falvey, as our new Convention & Meetings Manager, is handling many of the details and arrangements for the Annual Meeting, and Spring Meeting as well.

COLOR-MATCHING APTITUDE TEST

Three hundred sets were produced in May 1978 and more than one-third have been sold to date.

OFFICER/STAFF VISITS TO SOCIETIES

Continuing the practice of visiting most Societies every other year, we have (in the current administrative year) met with the Executive Committees and attended monthly meetings of: Rocky Mountain, Chicago, Philadelphia, Los Angeles, CDIC, Cleveland, Toronto, Montreal, and Piedmont.

Executive Committee meetings only were held with Baltimore and St. Louis.

We also attended the West Coast Symposium, Southern Annual Meeting, and Southwestern Paint Convention.

The slide show on Federation activities was presented to most of the above.

PAINT RESEARCH INSTITUTE

Staff has been assigned the responsibility to issue and coordinate the distribution of letters of solicitation for contributions to PRI. We also attended the December and February meetings.

FSCT EXHIBITS

The Federation had a single-booth exhibit in the West Coast Show and it was manned by Tom Kocis and yours truly. The space was donated by the Golden Gate Society and the Titanium Div. of NL Industries.

Dick Gross and Bob Ziegler attended to our double-booth in the Corrosion/79 Show sponsored by the National Association of Corrosion Engineers in Atlanta. The space was donated by NACE.

COOPERATION BETWEEN NEIGHBORING SOCIETIES

The growing spirit of cooperation among neighboring Societies was noted in this report one year ago. The latest example of this encouraging trend was a meeting of two officers each from Baltimore, New York, and Philadelphia at the Federation office on March 28. New England was invited, too, but was unable to send a representative. The meeting was suggested by the New York Society.

This interest in joint cooperation is a sign that our Societies are in good health and being directed by capable leaders.

OTHER ACTIVITIES

Staff has been involved in these other areas of Federation activities:

(1) *Correspondence Course at University of Southern Mississippi*—The Federation's attorney prepared the formal agreements and all is in readiness for the signing during the Board meeting.

(2) *Society Officers' Meeting*—The special meeting binder, including much reference material, was prepared and mailed to Society third-ranking officers on April 19.

(3) *File of Monthly Meeting Programs*—We prepared a special form whereby Society Program Chairmen can record pertinent details of speakers and their presentations at Society monthly meetings. The forms will be submitted to the Federation office where we will maintain a continuing file. Information on speakers/subjects will be sent to Program Chairmen upon request.

I extend my thanks to these members of staff for their good work and team effort: Tom Kocis, Rosemary Falvey, Dick Gross, Kathryn Ferko, Bob Ziegler, Dolores Giovanetti, Ronna Righter, Lorraine Ledford, Mary Sorbello, Dottie Robinson, and Patricia Driscoll.

FRANK J. BORRELLE,
Executive Vice-President

DIRECTOR OF FIELD SERVICES KOCIS

Although involvement continues in various areas, major efforts in recent months have been in committee liaison, particularly Environmental Control, Manufacturing, and Technical Advisory, all committees which have been reorganized.

COMMITTEE LIAISON

Educational—The Educational Steering Committee met March 21 in Louisville to pursue discussion of current and proposed programs.

One of the key agenda items was the correspondence course. The committee expressed its pleasure at hearing that the course was about to become a reality, and offered its assistance in helping develop the course content and promoting interest in and support of the course.

Other major topics of discussion were: need for revising and updating the Federation Series on Coatings Technology and compiling a suggested list of people to assist in this effort; Educational Committee presentation at the Annual Meeting in St. Louis—this will be a panel discussion on the value of continuing education, and will feature industry personnel and educators; stimulation of management support for coatings courses offered by Societies; production of audio/visual programs for the Training Series on Test Methods; and promoting career opportunities in the coatings industry among high school students.

Reports on Society educational activities, current and proposed, were published in the February JCT, and annual update of "Guide to Coatings Courses" was published and distributed in January.

Environmental Control—This committee's basic aim is to disseminate information to FSCT members on matters of government regulatory actions as they apply to field of environmental control impacting on the coatings industry.

Major effort will be publication of a Newsletter. The first issue, published in January and mailed to the entire membership, focused on hazardous waste disposal and TOSCA Pre-Manufacture Notification requirements. The second edition is scheduled to be published in the July JCT.

The committee also plans to develop "tutorial essays" for the JCT on environmental control regulations pertinent to the industry, as well as to answer inquiries and act as a clearing house for basic information on environmental matters.

The Newsletter will be most useful to the membership if Societies cooperate in sending to Federation headquarters any and all information on proposed hearings and impending regulations in their areas.

Manufacturing—Initial meeting of the reorganized Manufacturing Steering Committee was held on February 21 in Toronto.

Principal agenda topic was the review of existing projects and steps to be taken to bring them to completion.

A key project to be pursued is the production of slide/tape programs. A number of these have been developed over the past five or six years, but require revision and updating before they can be reproduced for distribution. The Steering Committee is undertaking this review effort and is hopeful that it will be completed shortly and the programs added to the Federation library of slide/tape presentations.

In its discussions of a proposal for Annual Meeting programming, the committee agreed on a panel presentation on "Media Milling."

The committee agreed that the current duties of the Federation Manufacturing Committee, as published in the Year Book, are in need of updating. Accordingly, a suggested revision of the duties will be submitted for Executive Committee/Board approval.

Program—Close contact is being maintained with the Program Steering Committee in development of presentations for the 1979 Annual Meeting. As speakers are scheduled for participation, responsibility for subsequent communications and arrangements are passed on to staff.

The early start which the committee initiated has resulted in an overabundance of submissions, and preliminary indications are that the program will offer a full complement of top quality presentations.

Technical Advisory—This committee met in Philadelphia on December 8 to develop project recommendations for Society technical activity, and to address the problem of how best to help revitalize lagging technical work at the local level.

A subsequent meeting of the TAC was held with Society Technical Committee Chairmen on March 30 in Atlanta, to review programs underway and discuss the proposed new projects.

Representatives from 22 Societies took part in the discussions in Atlanta. The recommended projects which generated the most interest were those on mildew and corrosion, with half a dozen participants expressing interest in each. The Societies were offered the assistance of the Technical Advisory Committee and the FSCT Director of Field Services in development of these projects.

A tabulation of Society Technical Committee work currently underway, and planned, is being compiled and will be printed in a forthcoming issue of JCT.

AUDIO/VISUAL PROGRAMS

Review has been completed of the Birmingham Club's presentation on "The Setaflash Tester" (Go/No Go Method—Ambient to 100°C). Review has also been completed on the scripts for supplementary presentations—Go/No Go, 0°C to Ambient; Definitive, Ambient to 110°C; and Definitive, 0°C to Ambient.

The complete program should be ready for reproduction as part of the Federation Training Series on Test Methods later this year.

PUBLICATIONS

"*Pictorial Standards of Coatings Defects*"—Work on this project of the Philadelphia Society is in the final production stages, and the manual will be available in the next few weeks.

PRI LIAISON

Assistance was provided in the writing and distribution of letters of solicitation for contributions to the Paint Research Institute, as well as in making arrangements for Trustees' meetings in June (Philadelphia) and November (San Francisco).

SOCIETY VISITS

Visits were made to the Baltimore, C-D-I-C, Cleveland, and Philadelphia Societies, as part of the officer/staff visitation schedule.

Also attended was the Western Coatings Societies' Symposium and Show, to assist in setting up and manning the Federation booth, as well as to meet with the Executive Committees of the Los Angeles, Golden Gate, Pacific Northwest and Rocky Mountain Societies.

On these visits, as at the various committee meetings, those attending are reminded of the availability of staff support to assist in local efforts, as required and requested.

THOMAS A. KOCIS,
Director of Field Services

Paint Research Institute

Trustees Meetings were held on December 15 and February 21. A number of budgetary questions were acted upon, and a budget submitted for 1979. As a result of the delays in assembling budgetary information, the enablement of a number of projects has been in question. Our next meeting will have to deal with the budgetary problems for 1980, and we will attempt to match the budget to our needed research.

The Mildew Consortium is our major activity and is now supported by six companies. Troy Chemical Corp. joined during April for the last half of 1979 and will participate fully during 1979-1980. The program includes work at University of Alabama, Ohio State University, State University of New York, University of Missouri-Rolla. Dr. Eveleigh is the program coordinator and Milton A. Glaser is the program liaison.

The Aqueous program is being pursued by Kent State University, Case Western Reserve University, Ecole Polytechnique, and North Dakota State University.

No current effort on Corrosion is being made. A suggested program on Oligomers has been considered and Dr. Myers is currently assembling opinions from several of the trustees. It has not yet been implemented although the need for such research is becoming more and more evident as we attempt to produce high solids coatings.

Meetings are now scheduled for June 21, 22 at Philadelphia and November 1 and 2 at San Francisco. There will be a Paint Research Institute dinner on October 2, during the Annual Meeting in St. Louis.

O. KEPLINGER,
President

[During the meeting, contributions to PRI were presented by the Baltimore, C-D-I-C, Cleveland, and St. Louis Societies. Contributions were made earlier this year by the Golden Gate, Montreal, Pacific Northwest, and Toronto Societies.]

Orin Keplinger (second from left), President of the Paint Research Institute, accepts Society contributions in support of PRI research programs from: Alex Chasan (Baltimore), Howard Jerome (St. Louis), Bill Mirick (C-D-I-C), and Fred Schwab (Cleveland)

Review of Financial Statement

During a review of the Federation's financial statement for the first quarter 1979, members of the Board noted that the "Income" page reports sales for the period rather than actual cash receipts. Claiming this long-established method of reporting to be misleading, the Board requested that the first quarter report, and all future reports, be amended so that the former "Income" page will report sales and also cash receipts for the period.

Amendments To By-Laws

The following By-Law resolutions are offered for first reading in accordance with Article XI. The By-Laws Committee recommends both resolutions and urges their adoption.

ARTICLE III—ORGANIZATION
PARAGRAPH B, SECTION (1)

WHEREAS through an oversight an important duty of the Board of Directors was omitted from this paragraph, and

WHEREAS this duty has been in actual practice for some time, be it

RESOLVED that a new sub-paragraph (f.) be added as follows:

> "To serve as the stockholders (or members) of the Paint Research Institute and attend the annual meeting of the stockholders to elect Trustees of PRI."

The balance of this By-Law remains unchanged except that each succeeding sub-paragraph will advance by one letter.

ARTICLE V—COMMITTEES
PARAGRAPH A, SECTION (1)

WHEREAS the Society Representatives have requested that the make-up of the Nominating Committee be modified, and

WHEREAS the intent of the By-Laws Committee in their revision was to assure representation on the Nominating Committee from the Constituent Societies, be it

RESOLVED that the wording in Article V, Paragraph A. (1) be amended as follows: (proposed change in *italics*)

> "The President shall appoint a Nominating Committee consisting of the immediate Past-President or the most recent available Past-President as Chairman; one other Past-President; and three members of the Board of Directors who are not officers, *at least two of whom shall be Society Representatives.*"

The balance of this By-Law remains unchanged.

HOWARD JEROME,
Chairman

[The above two amendments were put to a vote and approved by the Board of Directors. (Mr. Davidson requested that the record indicate his negative vote to the latter.)

These amendments will now be presented for adoption at the Board of Directors meeting of October 2, 1979, in St. Louis.]

Nominations

The Nominating Committee presents the following slate as candidates for Federation office, 1979-1980:

President-Elect—William H. Ellis, of the Los Angeles Society (Chevron Research Co.). He is currently Treasurer.

Treasurer—Howard Jerome, of the St. Louis Society (Vane Calvert Paint Co.).

Society Representative to the Executive Committee (three-year term)—A. Clarke Boyce, of the Toronto Society (Nacan Products Ltd.)

Society Representative to the Executive Committee (two years - completing the unexpired term of Treasurer Nominee Howard Jerome)—William Mirick, of the C-D-I-C Society (Battelle Memorial Institute).

Members-at-Large on the Board of Directors (2) (two-year term each)—Ruth Johnston-Feller, of the Pittsburgh Society (Industry Consultant) and Colin D. Penny, of the Baltimore Society (Hampton Paint Mfg. Co.).

Past-President on the Board of Directors (two-year term)—Milton A. Glaser, of the Chicago Society (Industry Consultant).

Members of the Nominating Committee are: Terryl Johnson, J. Richard Kiefer, Jr., J.C. Leslie, Horace S. Philipp, and your Chairman.

JOHN J. OATES,
Chairman

Review of Actions Of Executive Committee

One of the duties of the Board of Directors is to approve or disapprove all actions of the Executive Committee.

The actions of the Executive Committee (at its meetings of November 4, 1978 and January 20, 1979) were included with the minutes mailed previously to the Board of Directors.

These actions are as follows:

NOVEMBER 4, 1978

That the Federation again hold a Friday Luncheon at the Annual Meeting in 1979.

That the USM proposal for a Correspondence Course on Surface Coatings be accepted and that the Finance Committee be requested to include the sum of $22,000 in the 1979 budget for the preparation of this course.

That Dr. Thomas Miranda be reappointed Technical Editor of the JCT for 1978-79.

That in keeping with the year-end change, the Trustees of the Federation Pension Plan for the coming year be President-Elect Larson, Treasurer Ellis, and Executive Vice-President Borrelle.

That the First-Quarter budget for 1979 be set at one-quarter of the 1978 budget for operational purposes only.

That the Federation continue to pay transportation expenses for the Board, Executive Committee, committee members, and Federation Past-Presidents in accordance with conditions specified in the minutes.

That the Federation continue to pay complete transportation expenses (within the budget) of Federation officers on matters of official Federation business, and that spouses accompany the officers on certain travel at Federation expense.

That the Executive Committee approve the actions of the 1977-78 Board of Directors.

That JCT advertising rates be increased by 10% in 1979.

That Paint Show exhibit rates be increased by 5% in 1979.

That the Federation attorney be instructed to explore in-depth the consequences of opening a Canadian Bank account.

That the Federation's Pension Plan be amended and restated under the Prototype Defined Benefit Pension Plan of PMLIC, as approved by the Internal Revenue Service.

That the Federation Office prepare guidelines for papers to be presented to overseas organizations, on behalf of the Federation.

That the complete travel expenses for the Immediate Past-President be paid by the Federation beginning 1979-80.

That the Executive Committee recommend to the Board of Directors (for Board approval) that the 1984 Annual Meeting and Paint Show be held in Chicago.

That educational scholarship funds for the 1979-80 academic year be approved as follows: USM—$6,000; NDSU—$4,000; Detroit—$2,000; Kent State—$2,000; and Missouri-Rolla—$1,000.

That appropriations for 1978-79 Federation committees be approved by the Executive Committee as recorded in the minutes.

That the Executive Committee approve the action of the PRI Trustees in submitting a pre-proposal to the NSF which may lead to a planning grant.

That an item entitled "Society Business" be included on the agenda for future Board of Directors meetings.

That staff salaries be increased in 1979 and that one more employee be added to the publications staff.

[The above actions of the Executive Committee were approved by the Board of Directors.]

JANUARY 20, 1979

That although funds are available, now is not the time to return $28,500 (the cost of 750 sets of chips for the CAT) to our investment trust.

That the 1978 Statement of Estimated Income ($880,765) and Expense ($869,303) be accepted.

That an appropriation of $25,000 be made from the FSCT to PRI for 1979, in the absence of a formal budget request and until such budget has been approved by and received from the PRI Trustees.

That the PRI Trustees annually prepare a formal budget in time for consideration at the FSCT Finance Committee meeting in January.

That the PRI Trustees clearly establish that funds designated for specific purposes be assigned and expended solely for these purposes.

That the FSCT President appoint three representatives to attend the PRI Trustees meeting in February to seek clarification of the 1978 financial statement of PRI and to reflect the FSCT concern and confusion in PRI budgeting.

That the FSCT President appoint an Ad Hoc Committee to investigate the relationship of PRI to the FSCT in light of the many changes occurring in PRI.

That a committee conclude arrangements with USM re the Correspondence Course after satisfactory completion of the contract.

That the Executive Committee respectfully deny the option of attendance by the Birmingham Club Third-Ranking Officer to the Annual Meeting when he is President.

That the Montreal and Toronto Societies be granted permission to delay payment of 1979 dues until September 30, 1979.

That the price of the booklets in the Series on Coatings Technology be increased from $1.50 to $2.50 effective July 1, 1979.

That the Federation respectfully decline the request of the ISCC Committee to publish special booklets of color terms from the Dictionary at this time.

That the Annual Meeting advance registration fee for retired members and spouses be $15.00 each.

That the price of the Federation Luncheon ticket in 1979 be set at $10.00 each for men and women.

That the Executive Committee initiate liaison between the Federation and the NPCA.

[The above actions of the Executive Committee were approved by the Board of Directors.]

May 18, 1979

The Executive Committee convened at a special meeting during the Board meeting to review the request of the Paint Research Institute that the Federation appropriate $45,000 to PRI in 1979. (The Executive Committee had approved a tentative budget of $25,000 to PRI at its January 20, 1979 meeting).

The Executive Committee unanimously approved the appropriation of $45,000 to PRI and advised the Board of Directors of these budgetary adjustments:

Income: Increase income from the 1979 Paint Show from $228,000 to $248,000.

Expense: Increase the appropriation to PRI from $25,000 to $45,000.

[The appropriation of $45,000 to the Paint Research Institute was approved by the Board of Directors.]

[The Board then approved the Federation's operating budget for 1979 as follows: Income — $945,500; Expense — $944,500.]

[The Board also approved the Paint Research Institute's operating budget for 1979 as follows: Receipts — $120,200; Disbursements — $120,225.]

Correspondence Course

During the meeting, the contractual agreement between the Federation and the University of Southern Mississippi was signed. President McCormick signed for the Federation and Dr. B. George Bufkin, signed for USM.

Society Business

BIRMINGHAM CLUB

Earlier this year, the Birmingham Club requested that the Club be given the option of sending the Club's third-ranking officer to either the Spring Meeting for Third-Ranking Officers or the Annual Meeting during the year when that officer is President of the Club. The Executive Committee denied the request and this action is reported in the minutes of the Executive Committee meeting of January 20, 1979.

Mr. Hitchin appealed to the Board for a reversal of the decision, stating that the Club shall be restricted for choice of good Presidents if member companies can see no advantage in sponsoring Presidents in terms of attendance at the Annual Meeting and Paint Show, and consequent contact with American manufacturers and suppliers. From the standpoint of the Birmingham Club, it is far more important for the officer to attend the Annual Meeting when he is President than the Spring orientation meeting when he is a lower-ranking officer.

Mr. Hitchin stated that the Club will appoint one person to serve as a member of the Federation Board of Directors for three consecutive years, beginning 1980, and every three years thereafter. However, this person will attend the Spring meetings only.

For representation at the Fall Board meetings (held during the Annual Meeting) the Club will appoint an alternate member of the Board each year. That person will be the Club's retiring President (at the time of the Board meeting).

Mr. Hitchin asked the Board to approve the special request of the Birmingham Club and to recommend it for acceptance by the Executive Committee.

The motion to do so was made by Mr. Davidson, seconded by Mr. Filchak, and so ordered.

TORONTO AND MONTREAL

Upon request from Mr. Boyce, the Board recommended to the Executive Committee that the Montreal and Toronto Societies be granted permission to delay payment of 1980 dues until September 30, 1980. (The Executive Committee had previously granted both Societies a similar delay in payment of 1979 dues. See actions of Executive Committee, January 20, 1979 meeting).

GOLDEN GATE

Upon request from Mr. Rook, the Board recommended to the Executive Committee that the Federation investigate a blanket liability and indemnification insurance policy for both the Federation and the Constituent Societies. Full report to be made at next meeting of Board.

Handshake between President McCormick and Dr. B. George Bufkin, of University of Southern Mississippi, concludes signing ceremony of agreement between the Federation and USM for the development of a coatings correspondence course. Looking on are Educational Committee Chairman John A. Gordon, Jr. (standing) and Dr. Gary Wildman, of USM

Old Business

BIRMINGHAM CLUB INVITATION

The Birmingham Club had invited the Board of Directors (now Executive Committee) to hold its 1980 spring meeting in Birmingham, on the occasion of the Club's 50th Anniversary, in June.

The Executive Committee instructed Mr. Borrelle to check transportation expenses and he reported that it would cost about $12,000 in airfares to send the Executive Committee, officers wives, and staff. About half of that amount would be required to transport only the Executive Committee, the President's wife, and Mr. Borrelle. (These would be additional costs as the Executive Committee will still have to attend the May Board of Directors meeting in Minneapolis).

Mr. Borrelle said that the Executive Committee appreciated the Birmingham invitation but after careful consideration, and because of high costs of transportation, the committee decided that President-Elect Elder Larson and his wife will represent the Federation next year in Birmingham.

Upon motion by Mr. Davidson, seconded by Mr. Rook, the decision of the Executive Committee was approved.

New Business

YEAR BOOK

Several members commented on the late publication of the 1979 Year Book and discussed with staff members ways in which the publication date can be advanced to February. One suggestion was to establish an earlier deadline date for staff receipt of Society membership rosters. Mr. Kiefer moved that, beginning in 1980 (for the 1981 Year Book), the deadline date become November 15 and, furthermore, any Society not submitting a roster by that time will have its previous year's membership published in the next edition. Seconded by Mr. Johnson and so ordered.

1984 ANNUAL MEETING

Mr. Borrelle reported that the Executive Committees of both the Federation and the NPCA had approved Chicago as the site for their 1984 Annual Meetings.

He therefore requested formal Board approval of Chicago, October 31, November 1, 2, 1984. Moved by Mr. Davidson, seconded by Mr. Johnson and so ordered.

AWARDS

For informational purposes only at this time, Mr. Borrelle reported that Union Carbide Corp. has proposed the establishment of an award, to be presented at the Annual Meeting, for "extraordinary achievement." Details are being worked out. Also, Morehouse Industries has established "The Golden Impeller Award" for achievement in the field of dispersion technology. Arrangements are being made to present this during the Manufacturing Program Session at the Annual Meeting.

MEETINGS SCHEDULE, 1980

After going through the first meeting of the new Board of Directors it was obvious that coordination and timing will be improved if the Executive Committee met prior to the Board meeting, rather than after as is the case this year. Therefore, the May 1980 meetings should be as follows: Friday morning—Executive Committee; Friday afternoon and Saturday morning—Board of Directors; Saturday morning (if need be)—Executive Committee. This was recommended to the Executive Committee for approval.

Committee Reports

A.F. VOSS/AMERICAN PAINT JOURNAL AWARDS

Notification of earlier deadlines for Society papers has been made in both the *American Paint & Coatings Journal* and the *Journal of Coatings Technology*. Taking into consideration the advanced date of the Federation Annual Meeting, the Committee is nevertheless looking forward to a positive response from the Constituent Societies.

Deadlines are: Notification of intent to compete—May 1, 1979; Receipt of papers in *Philadelphia*—July 30, 1979.

H.S. PHILIPP,
Chairman

DEFINITIONS

Work continues on a second edition of the *Paint/Coatings Dictionary*. We are recruiting specialists to edit the definitions in each of the major categories, such as solvents, pigments, polymers, etc. Our plan is to make the definitions more encyclopedic, update and add to our definitions, and develop a more extensive, selected bibliography for each category. Volunteers should contact me at Rohm and Haas Research Laboratories, Spring House, Pa. 19477.

The postcards soliciting suggestions for corrections and additions enclosed in the first edition of the *Paint/Coatings Dictionary* resulted in a limited, but very helpful response.

STANLEY LESOTA,
Chairman

EDUCATION

The Education Committee plans to maintain liaison and provide input during the preparation of the correspondence course material as has been requested, and assumes the task of promoting the course to industry, both at home and internationally.

The compilation of currently available courses, symposia, and seminars has been completed and is available from the Federation office. It is somewhat surprising to see the numbers and depth of educational opportunities being offered at the present time. Each Constituent Society is urged to take advantage of this excellent list and is asked to help us keep it up to date.

We are continuing the areas of emphasis outlined in the meeting of the entire Education Committee at Kansas City in September 1978: support of our universities that have coatings courses by encouraging more high school graduates to enroll in these schools as chemistry majors, by continuing scholarship support by FSCT and by individual Societies, and by sharing successful techniques developed by various Societies to help in these endeavors. There seems to be no reduction in the need for more trained technical people in the Coatings Industry.

A prime continuing project is the revision of the *Federation Series on Coatings Technology*. Each Society is asked to seek volunteers of proven capability to undertake the task of updating one or more of these helpful booklets.

For the last three years, an informal, loosely arranged meeting of the educators from the five universities that receive scholarship money from FSCT has been held during the Annual Meeting. This will be expanded to include members of the Steering Committee and will be more vigorously pursued this year at St. Louis.

The slide-tape series is being expanded with completion of new ones by the Birmingham and Golden Gate Societies. There are several more in various stages of completion by other Societies. Any Society with an idea for a slide-tape presentation is requested to contact their regional Education Committee Chairman so their efforts can be more productive.

Remember, send your high school graduates and community college transferees to a school with a coatings course, so they can come back to you trained coatings technologists.

JOHN A. GORDON,
Chairman

ENVIRONMENTAL CONTROL

The basic aim of the committee is to disseminate information to members of the Federation on matters of government regulatory actions as they apply to the field of environmental control impacting on the coatings industry.

This will be accomplished by: (1) Publication of Newsletters; (2) Answering inquiries (acting as a clearing house for basic information); and (3) Developing tutorial essays for the Journal of Coatings Technology—these would be review-type articles on legislative activities.

The publication of a Newsletter in January 1979 was the initial effort to meet the aims of the Committee. The subjects covered were "Hazardous Waste Disposal," "Premanufacture Notification as Required by the Toxic Substances Control Act proposed by the Environmental Control Administration," and "Volatile Organic Compound Emission Control Seminars." A second Newsletter will be prepared as an insert in the JOURNAL OF COATINGS TECHNOLOGY. This will cover the State Implementation Programs for Control of Volatile Organic Compound Emissions with an update of the activities of the California Air Resources Board and the State Programs on Control of Solid Waste. In line with these programs to be developed by the various states, the committee will act as a clearing house on legislation under consideration, working with the National Paint and Coatings Association. This cooperation was a success in the matter of banning the marketing of paint thinners of certain composition by the State of California.

While matters of waste disposal and solvent emissions were of primary concern during this period, the committee is waiting for "the other shoe to drop" when the Environmental Protection Agency publishes its Inventory of Chemical Substances with a scheduled publication date of June 1, 1979.

The Coatings Industry will be very concerned for a period of 210 days insuring that all of their raw materials are listed. With the publication of the Inventory, the committee will start to consider Premanufacture Notification procedures.

We have contacted all of the Societies to send us information on activities of the states to regulate the actions or products of the coatings industry. It's easier to comply with laws based on sound information than to comply with regulations that were issued as a result of laws that were based on misinformation.

S. LEONARD DAVIDSON,
Chairman

INTER-SOCIETY COLOR COUNCIL

The Inter-Society Color Council recently held two important functions: the Judd Memorial Conference on Color Metrics on February 11-14 in Williamsburg, Va. and the ISCC Annual Meeting on April 23-24 in New York City.

Several items from the Judd Conference might be of interest to the Federation members. Boynton, of the University of Rochester, indicated that evaluating color differences with colored lights might involve a different visual mechanism than viewing real samples. Since the FMC-II color difference equation, which is widely used in the coatings industry, was based on viewing colored lights, a different visual mechanism could mean that the coatings industry should be propagating a color difference equation based on real samples. Carroll, of Bell Labs, found that 10% of the colors he worked with needed more than three (up to seven) variables to describe them. D. Rich, of Rensselaer, found that Ingling's proposed color difference equation (based on colored lights) did not appear to give good results for real samples. And lastly, Indow's work may help bridge the gap for those people evaluating color differences with lights and real samples.

Several items from the ISCC Annual Meeting are worth highlighting. The verification work comparing the 1978 version of the "Color-Matching Aptitude Test" with the 1964 version was given to the committee with copies available on request; overall, scores for both were comparable, but those for individual colors showed significant trends. A joint task force was set up with the "Colorimetry of Fluorescent Materials" task force to obtain usable standards for fluorescent materials which include some paints. In the "Determination of the Strength of Colorants: Pigments Section," experimental data is being analyzed for a prospective test method. Preliminary experiments will be conducted by the "Color Difference Problems" project on samples with different textures and glosses.

The possibility of holding another Symposium on Color Appearance and Instrumentation (SCAI) was discussed. A formal proposal will be prepared in the near future.

This year we will probably have a recipient for the Dry Color Manufacturers Award and a nomination for the ISCC Macbeth Award.

ROBERT T. MARCUS,
Chairman

MANUFACTURING

The Federation Manufacturing Steering Committee met February 21 in Toronto.

The Steering Committee agreed that the current duties of the Manufacturing Committee are in need of updating. A proposed revision of these duties has been drawn up and submitted for Executive Committee approval.

A presentation on behalf of the Steering Committee has been planned for Incoming Society Officers' Meeting May 17, in New Orleans re the activities of the committee and the role of the Society Manufacturing Committee.

A presentation on "Media Milling" is scheduled for the Annual Meeting in St. Louis.

A new slide-tape presentation of the Manufacturing Committee of the Toronto Society has been reviewed. This is a top quality effort on "Introduction to a Resin House Operation." Five other previously prepared programs are being collected and will be reviewed for final polishing or re-submission.

Efforts are underway to finalize two papers for publication: "Caustic Cleaning in a Small Paint Plant" and "Equipment Utilization Formula."

DONALD FRITZ,
Chairman

MEMBERSHIP

In reviewing the Federation membership rolls, it was found that only eight societies had membership increases in all categories which were studied. They are: Dallas, Detroit, Houston, Los Angeles, New England, Piedmont, Pittsburgh, and St. Louis.

Special recognition is due the C-D-I-C, Dallas, Pittsburgh, and Piedmont Societies for achieving more than a 10% increase in total membership.

JOHN J. KENNY,
Chairman

METRIC SYSTEMS

Very little activity has taken place recently. Further detailed progress is held up until NPCA's Metric Task Force settles the matter of physical paint can dimensions, a decision which now is long overdue.

In Canada, the Canadian Paint Industry will soft-convert at the end of 1979. One Montreal firm has already converted. Soft conversion does not entail any major activity on the committee's part, other than some publicity, because it is merely a matter of expressing imperial weights and volumes in metric terms. Everything else stays the same. Hard conversion in the Canadian Paint Industry is also held up by the matter of the physical can dimensions referred to, because CPMA wishes to adopt the same cans as the American paint industry, to standardize both countries on the same containers.

Liasion with NPCA, CPMA, and the Canadian Metric Commission has been kept up. Contribution to Metric Corner in JCT has been continued.

E.L. HUMBURGER,
Chairman

PROGRAM

The theme for this year's meeting is "Progress Through Innovation." We have been fortunate to have received an abundance of papers, and expect to finalize our program and scheduling very shortly.

The featured program sessions will include: Keynote Speaker—Howard K. Smith; Mattiello Memorial Lecture—Charles A. Kumins, of Tremco, Inc.; Roon Awards Competition; Society Papers; Paint Research Institute Seminar; Manufacturing Committee Seminar; Laboratory Management Seminar; Environmental Control Seminar on Waste Disposal; and 14 papers on the theme topic, covering such varied subjects as ecology, high performance and photo-responsive coatings.

Concurrent sessions are expected to be held on several days. We expect to present a very interesting, and very informative program.

MORRIS COFFINO,
Chairman

PUBLICATIONS

A meeting of the Publications Committee was held at the Federation office on March 6.

A featured topic was Society Papers, and suggestions were made for improving the quality of these papers. The Publications Committee stands ready to offer assistance to Technical Committees in the preparation of papers.

A discussion of the advisability of inserting advertising between technical articles was reviewed and approved by the Publications Committee. The advantages of this will be to add color to the text pages at no additional expense and avoid running many consecutive pages of advertising.

Review procedures for papers was discussed, and some suggestions made for improving the time between which a manuscript is reviewed and submitted, as well as the suggestions to authors provided by the reviewers. We will redo the review form as well as upgrade the "Guide for Authors," particularly in terms of the manuscript references, so that they will reflect the title of the paper as well as the *Journal* reference.

Other suggestions include the incorporation of light features and anecdotes or one-liners at the end of technical articles, and for this, we will encourage contributions from our readers.

The "Back to Basics" section will be renamed "Technology Review." The Technical Information Systems Committee will be asked to supply more key words for the Annual Index.

The Federation has published several special issues, including the "Paint/Coatings Dictionary." The Series units will be upgraded; we have two future units to be written and authors have been obtained. These will be on *Statistics of the Coatings Industry*, and *Color and Appearance*.

THOMAS J. MIRANDA,
Chairman

PUBLIC RELATIONS

The Public Relations Committee has been engaged in the finalization of a Society Monthly Meeting Presentation Report. These reports are to be filled out by the Society Program Chairman and returned to the Federation office for filing and distribution to the other Society Program Chairmen upon request. Hopefully, this will eliminate poor program presentations and encourage wider distribution of presentations of value.

A letter has been sent to industry suppliers, giving them the opportunity to have current presentations listed in the new booklet, "Talks Available to Constituent Societies," which will be sent to Society Program Chairmen.

HARRY POTH,
Chairman

ROON AWARDS

Ten people indicated that they intend to enter the Roon Awards competition. Eight of these papers originate with industry and two with Universities.

The response is limited but it is the same as in 1978. The Program Chairman will be advised as soon as practicable of the papers qualifying for presentation.

UMBERTO ANCONA,
Chairman

TECHNICAL INFORMATION SYSTEMS

TECHNICAL ARTICLES IN OTHER PUBLICATIONS (TAOP)

Early in 1979 this project lost the assistance of TISCO's European committee member. American committee members continue to select suitable articles (chiefly from European periodicals) for inclusion in TAOP, but the additional time required for delivery of European periodicals to the United States has created a greater time lapse between the publication of the article and its listing in TAOP.

AVAILABILITY OF PERIODICALS COVERED IN TAOP

At an informal committee meeting during the 1978 Federation Annual Meeting, TISCO members in attendance suggested that JCT readers might benefit from information regarding the availability of foreign periodicals in American libraries. Mention was made that the NPCA's compilation of such information, and its subsequent publication in *Abstract Review* at intervals, served this purpose for FSCT members who received the *Abstract Review*.

In lieu of compilation similar to that of the NPCA, the inclusion of the following statement at the top or bottom of each TAOP column was suggested:

> "Please consult the *Union List of Serials* or *New Serials* at your nearest public or college/university library for location of the listed periodicals in American libraries."

JCT KEYWORD/SUBJECT INDEX

Following last year's practice, the committee compiled the Keyword/Subject Index for 1978 issues of JCT.

INFRARED SPECTROSCOPY ATLAS

At the request of the Chicago Society, an index was prepared for the text of the Infrared Atlas.

HELEN SKOWRONSKA,
Chairman

DELEGATE TO NACE

The NACE Symposium this year, March 13-16, was chaired by Tom Bauer of Southern Imperial Coatings. The papers, which were very informative, were as follows:

"Maintenance-free Service of Weathering Steel by Rust Stabilization Accelerating Treatment," T. Sokai, of Nippon Steel and S. Tokunaga, of Parkerizing Co.

"Design Features that Reduce Corrosion Problems on Offshore Structures," J. L. Thompson, of Phillips Petroleum.

"Heat Resistant Protective Coatings," A. R. Mersberg and J. Nee, of Briner Paint.

"Metal Spray Linings," Gene Warner, of Akron Sandblast.

"Guide to Cost Comparisons of Protective Coating Systems," G. Brevoort, of International Paint and Al Roebuck, of Fluor Engineering.

"Vinyl Ester Coatings for Pollution Control Equipment," A. Hendricks, G. Wauters, and W. Singleton, of Wisconsin Protective Coatings.

"Atlas Test Cell Evaluations of Coating Materials for SO_2 Scrubber Service," D. M. Berger, of Gilbert/Commonwealth.

"Practical Aspects of Coating Repair," C. G. Munger.

"Testing Wet Scrubber Lining Materials," H. L. Lomasney, of Imperial Professional Coatings.

Lively discussions and audience participation followed each speaker. With half of the papers devoted to lining materials or SO_2 Scrubber Service, it was significant that the panel discussion lasted over one hour.

In the Corrosion Show, Volumair displayed new spraying systems using either electric or gasoline powered lightweight turbines. These turbines come in various sizes to produce air directly and continuously to the various areas. This spinning of air results in a temperature increase of 110° to 240°F, thus coatings dry faster and a heavier coat is obtained in one pass. The system also reduces the relative humidity of the air by 40%. Enamels as well as textured finishes can be applied.

Newco displayed a rod lens borescope with light attachment. These borescopes have flexible cables capable of examining surfaces 15 feet away. An interesting application would be the inspection of in-service tank linings. Olympus Corp. also has camera attachments available. The cables can be handled like mandibles to protrude into pockets or difficult to reach areas for microscopic examination. The surface condition could be examined in this manner. The instruments might be particularly useful for examining the condition of coatings of suppression pools within nuclear power plants.

T6A Coatings for Immersion Service Committee heard a talk by D. A. Bayliss, of BIE. Utilizing epoxy coal tar enamels which were applied by brush, air spray, and airless spray, it was determined that greater porosity was noted in the airless spray films. The radioisotope C136 was used to trace the porosity of these films. Coatings were applied in the laboratory and these were compared to field applied films. Similar results were also detected by a German scientist. Observations such as this are rather disturbing, particularly when coal tar epoxy coatings are normally airless sprayed as one of the preferred methods of application.

T6H15 again reviewed their 11-year exposure study. Committee Chairman H. Tarlas, of Carboline, reported the need to relocate some of the test panels. Another report will be written after final inspection of these panels. T-6 and NACE are funding this effort again in 1979.

Parker Young, of Sherwin-Williams, provided a report on compatibility of topcoats and this document will be reviewed by T6. Repair procedures are a part of this document. A new subcommittee on coating systems for original equipment manufacturers was formed.

T6Q met with Parker Helms, Chairman. It was voted that T6Q-8 Scanning Election Microscope Analysis will not be a standing committee. This instrument is believed to be used more for failure analysis rather than inspection per se.

Bill Wood, of Porter Coatings, was appointed chairman of T6Q-10a General Exposure Techniques and T6Q-2 Economics of QA. A new group will update NACE reports under T6Q-3. Rick Sline was appointed Chairman of T6Q-10c on field testing.

Jim Bennett and Fred Licktenstadter convened T6-G on surface preparation. NACE has been sold out of their standard coupons and new ones are being produced. T6G-19 Field Measurement of Surface Profile Committee has been conducting round robin testing. Conflicting data to date precludes a report at this time. John Montle, of Carboline, expects this committee will have more complete information next year.

T6-G-23 Surface Preparation of Galvanized Surfaces, Tom Wilhelm, of Glidden, Chairman. One of the most lively committee meetings discussed the multiple facets of preparing galvanized surfaces for painting. Both shop and field techniques were discussed. Chemical cleaning and means to identify the galvanized surface are being reviewed. Chromate treatments and other protective systems interfere with paint adhesion.

A movie was shown on the failure of the epoxy-polyamide paint system which was applied to the Newport R. I. Bridge in 1970. Significant loss of adhesion was noted.

TOM GINSBERG,
Delegate

DELEGATE TO NATIONAL FIRE PROTECTION ASSOCIATION

Since the October 1978 meeting of the Federation Council, there have been no requests from Federation members for assistance with NFPA which have been brought to the attention of the Federation Liaison member.

Melvin V. Harris, Director of Engineering Services for Verlan Limited, has authored a chapter in the NFPA book on the coatings industry, along with contributions from other industries. This booklet, which is soon to be published, is directed toward NFPA members to familiarize them with various industries. Your representative reviewed the manuscript along with others and made suggestions and recommendations which, hopefully, will project an accurate image of our industry.

No progress has been made on the revision of Standard 35 of NFPA.

HOWARD J. HORTON,
Delegate

DELEGATE TO IUPAC

Since the 1978 Annual Meeting in Chicago, the Analytical Section of the Supported Polymer Films group continued its active program on amino resin analysis. G. Christensen, of Sadolin and Holmblad, is the leader of this activity.

A cooperative exercise involving the analysis of a group of standard samples by the participating laboratories has made considerable progress, although not all participating laboratories have carried out all the tests at this time.

The test methods are: (1) Solvent removal from amino resins; (2) Analysis of urea and melamine resins by proton nuclear magnetic resonance spectroscopy; (3) Analysis of alkoxy groups in amino resins by transetherification followed by gas chromatography; and (4) Analysis of alkoxy groups in amino resins by Zeisel cleavage followed by gas chromatography.

In addition, one laboratory; PPG Industries, Inc., Dr. G. P. Cunningham; has carried out an additional test procedure: (5) Analysis of urea and melamine resins by C^{13} nuclear magnetic resonance spectroscopy.

It is hoped that the other participants will soon complete their test methods so that the results may be shared and analyzed.

PERCY E. PIERCE,
Delegate

The next Board of Directors Meeting will be held on Tuesday, October 2, 1979, at the Sheraton St. Louis Hotel, in St. Louis.

Latex-Based All-Surface Primers

Andrew Mercurio and Roy Flynn
Rohm and Haas Company*

Recent advances in the design of latex polymers and pigment dispersants make it possible to formulate latex primers with good performance on problematical surfaces, especially metallic substrates and staining woods. Latex primer failures on these substrates are divided into two categories: those that occur early, during paint drying, and those that occur in the longer term. The early failures are related to water soluble or water sensitive species in the latex paint. Long term failures are related to the degree of coalescence of the latex film. The performance of model latex paints which overcome these deficiencies to serve as "All-Surface Primers" is illustrated.

INTRODUCTION

The Trade Sales coatings markets have experienced a steady replacement of oil-based paints by latex-based products with greater ease of application, water clean-up, low odor, low flammability, fast-dry, and good performance properties. More recently, additional pressures for conversion to water-based paints have appeared in the form of legislation to reduce air pollution and toxicity associated with use of solvent systems.

The conversion has been particularly troublesome in primers for problematical surfaces such as chalky repaint, fresh cement, staining woods, knots, graffiti/water stained old paint, steel nail heads, and metallic surfaces in general. Indeed, alkyds have been the workhorses of the industry for so long because they are so effective on these diverse substrates. Fortunately, there has been a vigorous research and product development effort with latex vehicles for many years, with many problems already solved and the need for only a few more advances to permit design of latex-based "All-Surface Primers."

Once the problems with latex primers are solved, an additional major bonus is outstanding long term durability for the latex vs. alkyds. This is brought about by the stable, high molecular weight nature of the latex vs. the continuous oxidative-hardening/embrittling that is experienced by the alkyd and that eventually leads to cracking and flaking failures.

LATEX PROBLEMS AND POTENTIAL SOLUTIONS

The development of latex coatings has followed the normal course for new coatings vehicles. First, laboratory and field evaluations uncover a serious problem; next, lab tests are designed to study and quantify the problem; then solutions are sought, initially by paint formulation modifications and later by a more sound redesign of the latex vehicle. *Table* 1 presents a capsule review of this process with acrylic latex vehicles over the past 25 years. Note that hydrolysis problems on cementitious surfaces, poor adhesion to wood/old paint/chalk and instability of latex paints in the presence of reactive pigments are all problems that have been solved, at least individually, first by formulation modification and, subsequently, by latex design. Furthermore, a number of reactive pigments have been identified which upgrade rust resistance on steel substrates and stain resistance on woods, such as cedar and redwood. Unfortunately, the most effective of these have been lead compounds (wood stain inhibitors) and chromates (rust inhibitors) whose continued use is not possible due to toxicological concerns. But additional improvements in design of latex vehicles/pigment dispersants/formulations, discussed later, make it possible to produce in one package a latex primer with good "All-Surface Primer" performance without the toxic pigments.

The formulational approaches to improved performance are not necessarily abandoned once the feature is built into the latex. Rather, they represent fortifying agents for the new latex vehicles that can be used with freedom to select type and level of additives that minimize negative side effects. For example, chalk adhesion of conventional latices can be noticeably up-

---

Presented by Dr. Mercurio at the 56th Annual Meeting of the Federation of Societies for Coatings Technology in Chicago, Ill., November 1, 1978.

*Research Laboratories, Spring House, Pa. 19477.

Table 1 — Latex Primer Problems and Potential Solutions

Problem	Paint Formulation Solution	Latex Design Solution
Stability on cement	None	Hydrolysis resistant acrylics
Adhesion to wood/ old paint	Oil modification	Specific adhesion functionality
Adhesion to chalk	Oil modification	Chalk penetrating latex
Paint stability with reactive pigments	Surfactant stabilizers	Highly stabilized latex
Staining on wood	Reactive pigments	Subject of paper^{a,b}
Rusting on steel	Flash rust inhibitors, reactive pigments	Subject of paper^{a,b}

Note - Advances in latex technology are exemplified by:
(a) Rhoplex MV-23 and Experimental Dispersant QR-681.
(b) Experimental Latex to be scaled-up.

Table 3 — Classification of Failures on Steel and Wood

Early Failures	On Steel	On Wood
Aggravating Conditions	Thin coating Slow dry-high humidity and/or low temp. Active steel-sandblasted and/or fresh rust	Thin coating Slow dry-high humidity and/or low temp. Juicy wood
Problems	Flash rusting Early rusting	Uniform staining Streak staining
Long Term Failures	**On Steel**	**On Wood**
Aggravating Conditions	Thin coating Salt fog environment Acidic environment	Thin coating Under eave exposure Moisture vapor pressure
Problems	Underfilm corrosion Rust bleed through Undercutting	Spotty staining Stain rundown

graded by modification with 15 to 30% alkyd; but dry speed, mildew resistance, and long term durability are degraded. When latex vehicles with built-in improved chalk adhesion were developed, they permitted use of less alkyd (or none) and fewer associated problems. Similarly, modest levels of reactive pigments such as ZnO and barium metaborate or other reactive pigments can be used with inherently corrosion/stain resistant latices to provide equal or better rust/stain resistance than previously achieved with toxic pigments.

EXISTING ADVANCED LATEX VEHICLES

The most advanced commercial acrylic latex vehicles represent our point of departure for design of "All-Surface Primers." These fall into two general classes, as enumerated in *Table* 2. One class is supplied at moderate solids (40-45%) with high surface area, fair chalk adhesion, and fair flow/build brushing rheology when formulated with conventional thickeners; this class has the highest pigment binding ability and potential for excellent corrosion resistance on metal. Another class is supplied at higher solids (55-60%) with good chalk adhesion and good brushing rheology when thickened conventionally; this class will not provide as good corrosion resistance under severe conditions, e.g., salt spray testing; but it is favored where a broad balance of properties is appropriate. The hardness of either class can be varied over wide limits; but a minimum film-forming temperature (MFT) of 5 to 15°C generally optimizes ease of film formation, crack resistance and hardness.

Table 2 — Characteristics of Commercial Advanced Latex Vehicles

Feature	Small Particle Size Acrylic Latices, Supplied At 40-45% Solids	Chalk Penetrating Acrylic Latices, Supplied At 55-60% Solids
Spraying (sag resistance)	V. Good	Good
Brushing (flow/ build)	Fair	Good
Chalk adhesion	Fair	Good
Wood stain resistance potential	V. Good	V. Good
Corrosion resistance potential	Excellent	Good

EARLY AND LONG TERM FAILURES

Latex primer failures on steel and wood substrates are conveniently divided into two categories: those that occur during the paint application and paint drying stages (several hours to several days) and those that occur in the longer term (many weeks to many months). The application, drying and aging conditions which promote failures and the specific failures produced are listed in *Table* 3.

Early failures on steel substrates include flash rusting and early rusting, a spotty type appearance that is randomly distributed over the surface of the dried latex coating. Specific differences between flash and early rusting are described elsewhere.[1] Most of these spots have no "roots" to the substrate and they are not as bad as they appear so far as metal protection is concerned.* They can be removed from the surface by acid rinse or other means and they sometimes have been topcoated after primer is fully dry without serious problems. In contrast, long term failures are more pervasive and take the form of underfilm corrosion, rust bleedthrough - from substrate - through coating - to surface and under-

---

*Avoidance of the problem does alleviate anxieties.

Table 4 — Early Failures and Water Sensitive Species

Latex Impurities
Surfactants
Stabilizers
Initiator fragments
Soluble polymers

Adverse Paint Formulation Additives
Surfactants
Dispersants
Thickeners
Glycols
Glycol ethers

Beneficial Formulation Additives (Except for Toxicity)
Chromates
Nitrites
Phosphates
Borates
Amines
Lead salts

cutting from such ruptures. In all cases, thin primers (<2 mils) or thin spots are undesirable because they offer inadequate protection. Environmental conditions which promote early rust are those that extend film drying, i.e., high humidity and low temperatures. Furthermore, substrates that have high soluble iron salts (fresh rust) or a surface that easily forms them (freshly sandblasted steel) are especially prone to this failure. Once the primers are fully dried, conditions that produce corrosion are humid, salty, and acidic environments.

Early failures on bare wood include uniform staining and streak staining along particularly juicy grain boundaries. As with early rusting, the appearance of these defects in the prime coat is not necessarily a failure. The real test is whether the stains pass through to applied topcoats. Again, thin primer coats and slow dry conditions aggravate the problem. Long term staining failures are less frequent with latex coatings on wood. When they do occur, they tend to be found under eaves or in situations where moisture vapor is trapped behind the wood and permeates through under positive pressure.

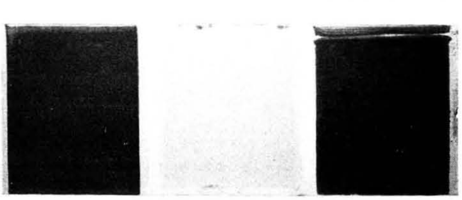


Figure 1 — Slow dry test for clear latex coatings on steel: Left — original latex; Center — dialyzed latex; Right — dialyzed latex +0.5% NaCl

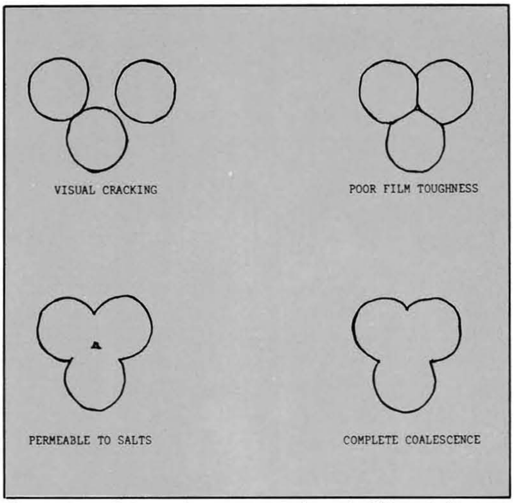


Figure 2 — Schematic representation of different degrees of coalescence

EARLY FAILURES AND WATER SENSITIVE SPECIES

Adverse substrate and environmental conditions are not the only factors that promote early rust/stain failures. The latex paint itself is unavoidably water-borne and gives the substrate a good drenching during application. Yet, a number of hygroscopic ingredients in the paint can be reduced or eliminated with beneficial results. Some of the undesirable impurities that originate from the latex itself or that are added in paint formulation are presented in *Table* 4, along with soluble species that serve as stain inhibitors.

The latex manufacturer has a multitude of polymerization processes at his disposal, but specific details are frequently proprietary and beyond the scope of this discussion. Let it suffice to conduct an academic experiment to illustrate how deleterious low level impurities can be. *Figure* 1 is a photograph of three clear latex coatings drawn down on clean cold rolled steel and allowed to dry slowly overnight in a horizontal position at very high (~95%) relative humidity. The coating on the left is a commercial latex made with sodium persulfate initiator; it has suffered flash rusting. The middle coating is an aliquot of the same latex vehicle that has been subjected to vigorous dialysis treatment to remove solubles; note there is little flash rusting. The coating on the right is the dialyzed coating to which 0.5% NaCl has been added and flash rusting is reintroduced. The experiment is academic because dialysis is not a commercially viable method of removing solubles from latex vehicles; moreover, the latex may be destabilized by the procedure.

We proceed with latex polymers that are prepared by practical proprietary processes that minimize early failures, and we will couple these with sound paint formulation ingredients.

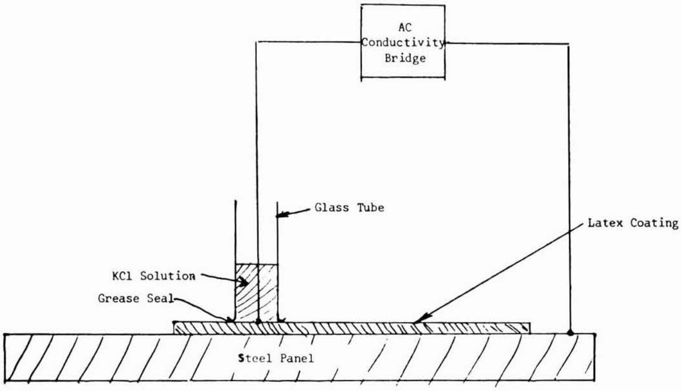


Figure 3 — Details of conductivity test for degree of coalescence

LONG TERM FAILURES AND INCOMPLETE FILM COALESCENCE

The cause of long term failures in latex coatings on steel and wood is basically different from that responsible for early failures, even though certain paint ingredients are detrimental in both areas. For example, unacceptable latex coatings can be dried in the laboratory for weeks, force-dried in ovens and exposed outdoors for many months in environments that insure full drying/consolidation of the coating while avoiding early failures. Subsequent evaluation of these well dried coatings in severe tests, e.g., the 5% salt spray test, will produce serious failures. Incomplete coalescence of the latex film was identified as the culprit. This does not refer to inadequate coalescence by the gross measures of film formation that can be seen with the naked eye (cracking) or that are revealed by coating toughness measurements (knife toughness, abrasive scrub resistance). Rather, it is an incomplete coalescence that is indicated by salt permeability tests. (Note: this is to be distinguished from water vapor permeability, which is a fundamental polymer property.)

Figure 2 is a schematic representation of different degrees of coalescence of latex particles. This is an obvious oversimplification of the problem because it is usually not the unformulated latex which offers coalescence difficulties. Rather, it is the ability of the latex to coalesce around and encapsulate paint formulation ingredients that is limiting. Nonetheless, the schematic is a useful model if we focus on the presence of paint formulation ingredients in the interstices of coalescing latex particles and the need to minimize or optimize these ingredients.

The salt permeability of various latex films was measured using a simple method called the Bratt Conductivity Cell[2] and utilizing a 0.1N KCl solution that previously was found to be useful with latex films.[3] *Figure* 3 presents the details of the test, which involves measurement of conductivity of the salt solution through a given surface area of latex coating that is sandwiched between the salt solution and the underly-

Table 5 — Conductivity Values for Latex Formulations

Formulation Parameter	Conductivity (μmhos/cm)
Soft Latex	~ 0
+ 10% Nonionic surfactant	~20
Hard Latex + Coalescent	Variable, Frequently >1
Soft Latex + TiO_2 + $CaCO_3$ + ZnO	
Copolymer Pigment Dispersant (Non-Stable Paints)	
35% PVC	~ 0
45% PVC	~ 2
Polymethacrylic Acid Pigment Dispersant (Stable Paints)	
35% PVC	~ 8
45% PVC	~15
KTPP Pigment Dispersant (Stable Paints)	
35% PVC	~12
45% PVC	~22

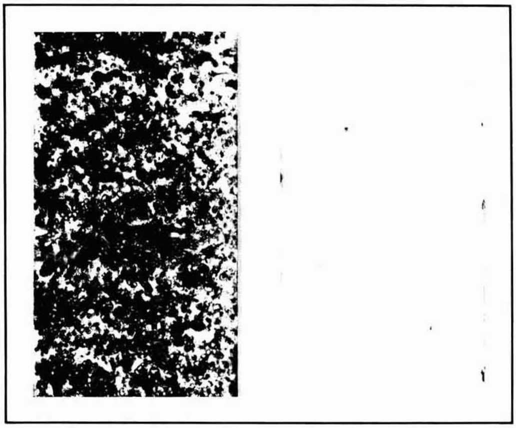


Figure 4 — 5% salt spray test on steel panels with latex coatings (1-1.5 mils). Left: Latex coating made with polymethacrylic acid dispersant (Conductivity = ~4 μmhos/cm). Right: Latex coating made with experimental dispersant, QR-681 (Conductivity = ~0)

Table 6 — Necessary Paint Formulation Ingredients

Ingredient	Function	Examples	Typical Lb/100 Gallons
Prime pigment	Hiding, color	TiO_2	100-250
Extender	Cost (–), hardness (+), H_2O resistance (+)	$CaCO_3$	to 20-35% PVC
Reactive pigment	Stop rust, stain	ZnO	10-25
Pigment dispersant	Disperse pigment	Exp. Disp. (Poly-MAA)	2-5% on Pigment (1-2% on Pigment)
Defoamer	Defoam paint	Proprietary	1-10
Thickener	Provide viscosity	Exp. thick. (HEC)	3-10 (1-3)
Can preservative and mildewcide	Inhibit bacteria and mildew	Isothiazolone	1-4

ing steel substrate. With knowledge of the latex film thickness and specific surface area, one can calculate the film conductivity in units of μmhos/cm. Results of these measurements on a variety of latex paints are presented in *Table* 5. Note that gross amounts of hydrophilic impurities, e.g., 10% nonionic surfactant, cause a soft latex film to exhibit high conductivity relative to the neat latex film. Moreover, hard latex polymers which require coalescing solvent for film formation offer variable conductivity, depending on how well the coalescent has done its job before it evaporates. Coalescent evaporation, in turn, depends on latex film thickness, coalescent volatility, relative humidity during drying, and air circulation over the drying film. Despite these factors, it is usually relatively easy to obtain good coalescence from unformulated latex vehicles.

The other data in *Table* 5 are for latex coatings formulated with a combination of TiO_2, $CaCO_3$, and ZnO. The first important observation is that all of the 45% PVC coatings have measurable conductivity, a result the authors interpret as meaning that the critical PVC has been exceeded and requiring lower pigment levels to achieve low conductivity. Also note that potassium tripolyphosphate and polymethacrylic acid pigment dispersants provide paints with good stability, but with high conductivity even at 35% PVC. A lower acid number copolymer dispersant provides non-conducting paints at 35% PVC; but, unfortunately, the paints have unsatisfactory stability.

CONDUCTIVITY TESTS VS. SALT SPRAY TESTS

The conductivity tests could be extended to cover other formulation ingredients and to answer questions about permeability changes with time, temperature, water leaching, and so on. In lieu of this an expedient was found, namely, the use of salt spray data as a proxy for conductivity tests. These data are of direct practical interest and they are routinely gathered in any event.

Interpretation of salt spray data is uncomplicated, as shown in *Figure* 4. Two mil latex coatings on cold rolled steel or pretreated steel will show severe rusting in the 5% salt spray test after one or at most a few days of exposure when their conductivity is more than one or two μmhos/cm. Only coatings with conductivity approaching zero offer good salt spray resistance for one to two weeks or more. Furthermore, since good salt spray resistance signals well-coalesced tight films, it may be anticipated that these will be good performers on staining woods, knots, nail heads, and other surfaces requiring good barrier properties in the primer. Indeed, even latex coatings with marginal salt spray resistance (a few μmhos/cm of resistance) can provide very respectable performance on the other surfaces.

FORMULATION DEVELOPMENT

The recognition that paint formulation ingredients have negative effects on latex film coalescence may, on first impulse, lead one to consider simple formulations with minimum components. Unfortunately, the multiple requirements of paint making, storage, application, and performance require complex formulations. *Table* 6 lists seven ingredients which represent an absolute minimum in formulating "all-surface" latex primers. Salt spray testing of various kinds and levels of these ingredients has demonstrated acceptability of the specific examples at the levels listed. Among these, the most disruptive have been reactive pigments, pigment dispersants, and thickeners. The authors have found that ZnO is a uniquely effective reactive pigment at low levels, and it is included in all of their primers for steel and wood. None of the tested commercial pigment dispersants have provided both good salt spray resistance and good paint stability with reactive pigment (ZnO), requiring the design of an experimental dispersant with these features. In the same vein, a specially designed experimental thickener is listed which overcomes the

Table 7 — Helpful Paint Formulation Additives

Ingredient	Function	Example	Typical Lb/100 Gallons
Surfactant	Pigment wetting	Polyglycol	½-2% on Pigment
Coalescent	Film-forming aid	TBP	2-5% on Polymer
Glycol	Freeze-thaw stability	Ethylene glycol	25-50
Oil modifier	Chalk, metal adhesion	Alkyd + Cobalt	10-20% of Binder
2nd Reactive pigment	Additional rust, stain resistance	Ba Metaborate	25-50
		CA-Zn Molybdate	25-50
		Zn Phospho oxide	25-50

negative effect on salt spray caused by conventional thickeners. In most formulations a low level of hydroxyethyl cellulose can be tolerated (0.5-1 lb/100 gal) in conjunction with the experimental thickener; in some formulations, even full thickening with HEC is acceptable.

Having succeeded with "bare bones" formulations for all-surface primers we proceed to five other ingredients, listed in *Table* 7, that provide very helpful or sometimes essential additional functions. For example, only primers for tropical or guaranteed temperate climates may avoid coalescing aid or glycol freeze-thaw stabilizer. Also, few paint manufacturers can substitute dispersion time/energy for surfactants that expedite pigment wetting and dispersion on high speed dispersing equipment. But inclusion of these ingredients has not caused significant degradation of performance. Only glycol, oil modifier and second reactive pigment components require substantial use levels to be effective and their optimization is the focus of continuing formulation studies.

PERFORMANCE OF MODEL "ALL-SURFACE PRIMERS"

While formulation development is a continuously evolving process, enough insight has been gained to design specific formulations with a very respectable balance of properties. Formulations utilizing two new acrylic latex vehicles of the type described earlier appear in *Table* 8. The generalized performance behavior of these formulations is compared to performance of conventional latex paints and of solvent-based alkyd

Table 8 — Model All-Surface Primer Formulations

	43% Solids Latex		58% Solids Latex	
Cowles Grind	**Lbs.**	**Gals.**	**Lbs.**	**Gals.**
Water	42.0	5.04	Same Cowles Grind	
Pigment dispersant (Exptl. QR-681) .	26.3	2.89		
Surfactant (Triton® CF-10)	2.0	0.2		
Defoamer (Nopco® NDW)	1.7	0.22		
Prime pigment (TiPure® R-960)	150.0	4.56		
Extender (Atomite®) ...	155.0	6.82		
Reactive pigment (Kadox® 515-ZnO) ...	12.0	0.26		
Letdown				
Latex vehicle (Rhoplex® MV-23 or Exptl.)	646.0	73.64	470.0	53.11
Ammonium hydroxide (28%)	5.0	0.7	3.0	0.42
Defoamer (Foamaster® VL)	4.0	0.44	4.0	0.44
Glycol (Ethylene glycol)	30.0	3.23	30.0	3.23
Coalescent (Texanol®)	5.7	0.72	13.1	1.65
Mildewcide (Skane® M-8)	2.1	0.25	2.1	0.23
Thickener/water	25.0	2.87	174.4	20.93
	1106.8	100.41	1085.6	100.00

PVC 28.5%
Volume solids 40.8%
Viscosity .... 78 KU
pH 9.5

Table 9 — Performance of Model All-Surface Primers vs. Controls

Paint Stability Tests	Conventional Latex	Universal Primer #1	Universal Primer #2	Solvent Alkyd
Room temp. - pigment settling	OK	OK	OK	Some
Heat aging at 140°F	OK	OK	OK	Trace Skin
Freeze-thaw test	OK	OK	OK	OK
Roller test	OK	OK	OK	OK
Heat age + roller	OK	OK	OK	OK
Paint Application Tests				
Sagging on vertical	V. Good	V. Good	Good	Fair
Leveling/build when brushed	Fair	Fair	Good	Excellent
Flash rust (steel)	Fair	V. Good	V. Good	Excellent
Early rust (steel)	Poor	V. Good	V. Good	Excellent
Early wood stain (staining wood)	Poor	V. Good	V. Good	Excellent
Stain blocking (stained repaint)	Fair	Good	Good	V. Good
Long Term Tests				
Humidity test (steel)	Poor	V. Good	Good	Good
Salt spray test (steel)	Poor	Excellent	Fair-Good	Excellent
Under eaves test (staining wood)	Fair	Expect - VG	Expect - G	V. Good
Blister box test (staining wood)	Fair	Good	Good	Blisters
Chalk adhesion (chalky repaint)	Fair	Fair	Good	Excellent
Hydrolysis resistance (hot cement shingle)	V. Good	V. Good	V. Good	Poor
White rust resistance (galvanized)	Poor	Expect - VG	Expect - G	Peeling
Embrittlement/flaking resistance (wood &metal)	Excellent	Expect - E	Expect - E	Poor

primers in *Table* 9. Reported here are qualitative judgement ratings of performance, to reflect the subjective nature of many of the tests. Details of the tests and ratings are available.[4] The relative performance ratings should transcend subjectivity, however. A decreasing order of performance would be excellent, good, fair, poor. Judged here, properties rated poor represent unacceptable performance, and they are highlighted by solid frames. Properties rated fair are considered to have marginal performance and are highlighted by dotted frames. Obviously, each paint manufacturer and user must evaluate these formulations in their own tests and in comparison to their own controls in order to calibrate our judgements.

A quick glance at the results indicates that conventional latex paints have good storage stability, but many serious performance failings on problematical surfaces. Even the venerable solvent-alkyds are less than perfect, showing poor hydrolysis resistance on cement and galvanized steel or zinc rich primers, long term embrittlement/flaking failures and marginal storage stability, as well as marginal sag resistance when applied on vertical surfaces. One of the model latex primers provides good performance throughout, except for marginal brushing rheology (leveling/build) and marginal adhesion to heavily chalked repaint surfaces. The other model primer even overcomes these deficiencies, but with reduced salt spray resistance. Our continuing formulation efforts aim to improve on these areas through modification with alkyds and additional reactive pigments.

CONCLUSION

Conventional trade sales latex paints are inadequate as primers to inhibit rusting and staining on steel, staining woods and related substrates. Solvent-based alkyd primers give very good performance on these surfaces in the short term, but they eventually fail by peeling and flaking. New acrylic latex vehicles in conjunction with a new pigment dispersant, new latex thickener and optimized paint formulations offer promise of providing greatly improved water-based primers that may even surpass the performance of the workhorse alkyds.

ACKNOWLEDGMENT

The latex primer developments at Rohm and Haas Co. have involved many coworkers who are too numerous to mention. The authors must, however, acknowledge the major contributions of Messrs. R. E. Harren, B. B. Kine, A. Kowalski, E. Lewandowski, J. D. Scott, M. G. Young, Ms. M. Cassidy and Drs. M. Grourke, K. Kronberger, K. Rozkuszka, R. Wiersema, R. Wu, and E. Zaganiaris.

Trademark References

Atomite	Thompson-Weinman & Co., Inc.
Kadox	New Jersey Zinc Co.
Nopco, Foamaster	Diamond Shamrock Chemical Co.
Rhoplex, Skane, Triton	Rohm and Haas Co.
Texanol	Eastman Chemical Products, Inc.
TiPure	E.I. du Pont de Nemours & Co., Inc.

References

(1) Grourke, M.J., JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 632, 69 (1977).

(2) Oil & Colour Chemists' Association, "Paint Technology Manual," Vol. 5, Reinhold Publishing, 1965, p 115.

(3) Isaacs, P.K., *J. Macromol. Chem.*, *1*, 163 (1966).

(4) Rohm and Haas Co., Bulletin 815B, February 1978.

Poly(ester-amide-urethane) Water-Dispersible And Emulsifiable Resins

Wilma J. Schneider and Lyle E. Gast†
United States Department of Agriculture*

Research at the Northern Center on water-based coatings has been aimed at developing low-energy-consuming and more environmentally desirable products from renewable agricultural raw materials. Water-dispersible poly(ester-amide-urethane) resins were readily synthesized from vegetable oils, diethanolamine, anhydrides, and diisocyanates. The short times and mild conditions of the alkyd-type procedure developed involves the following steps: (a) aminolysis of vegetable oil with diethanolamine (100°C, 0.5 hr), (b) half-ester formation (85-115°C, 0.5-1.5 hr), (c) neutralization of carboxy acids with triethylamine, and (d) urethane formation (50°C, 2 hr). Film properties varied depending on the oil, anhydride, or diisocyanate components of the resin used. Products synthesized from linseed or soybean oil, various dianhydrides, and aliphatic or aromatic anhydrides were readily dispersed in water-butyl Cellosolve® solutions. Cationic poly(ester-amide-urethane) resins suitable for emulsion systems have also been developed. Data indicate rapid-drying hard coatings are formed similar to those from the carboxyl-amine neutralized system.

INTRODUCTION

Technological changes are beginning to affect the coatings industry primarily as a result of California's Rule 66 on solvent vapor emissions and energy conservation measures. Other key concerns of the coatings industry are energy, governmental regulations, petroleum alternatives, and the need to reinvestigate the utilization of raw materials that are renewable.[1] Pryde[2] has presented information on energy forms, cost, and use in relation to oilseed crop production and has shown that increased attention must be paid to fats and oils as important annually renewable resources. Princen[3] has reviewed renewable resources with respect to the future needs of the coatings industry, price trends, the present status of plant-derived chemicals for industrial applications, recent chemical developments in conventional vegetable oils, and the creation of new industrial oilseed crops. Gerhart[4] has advocated the need to return to the use of renewable commodities as an alternative to the problem of petrochemical shortages.

Recent technologies such as high solids, water-base, and radiation-cured systems appear to be promising ways to replace the present low-solids solvent systems.[5] Efforts at NRRC have been directed toward the development of water-soluble, water-dispersible, or emulsion systems to utilize renewable resources and conserve energy. Poly(ester-amide-urethanes) represent a potentially useful approach toward meeting some of these goals.

Previous papers described the preparation of poly(ester-amide) protective coating vehicles from linseed and soybean oils,[6,7] their urethane modification,[8] an alkyd-type preparative procedure,[9] and scanning electron microscopic and durability studies.[10] These poly(ester-amide-urethanes) have good film properties, particularly with respect to drying times, hardness, chemical resistance, and exterior durability on wood. They become dispersible in water-butyl Cellosolve® by introduction of carboxyl groups into the polymer via the half ester of phthalic anhydride. Such modified resins are easily dispersed, yield films that air-dry rapidly, and have good hardness and physical properties.[11] However, their dispersion stability is somewhat limited. The objective of this work was to develop water-dispersible resins with improved stability. This paper describes the

---

Presented at the Federation of Societies for Coatings Technology Annual Meeting, Chicago, Illinois, Nov. 1-3, 1978.

*Northern Regional Research Center, Agricultural Research, Science and Education Administration, Peoria, Ill. 61604.
†Retired

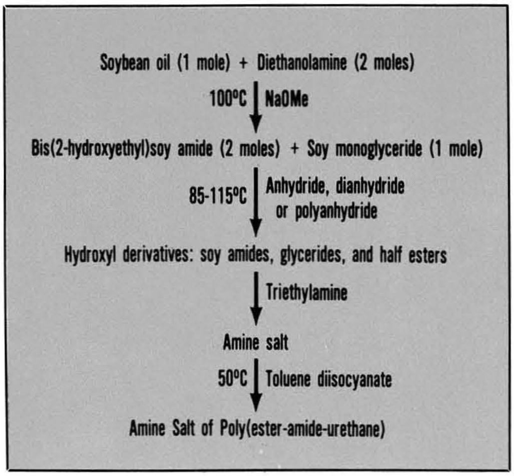


Figure 1—Preparation of dispersible poly(ester-amide-urethanes)

synthesis and film properties of improved water-dispersible anionic poly(ester-amide-urethanes). Information on some cationic resins indicates that satisfactory emulsions from these systems are also possible.

EXPERIMENTAL

Alkali-refined soybean and linseed oils were obtained from Archer-Daniels-Midland and Central Soya, respectively. Anhydrides and dianhydrides used as received included: pyromellitic, trimellitic, and succinic (Eastman); phthalic and maleic (Fisher); glutaric and 3,3′, 4,4′-benzophenonetetracarboxylic (Aldrich); PA-18 polyanhydride (1:1 octadecene-1 and maleic anhydride copolymer, Gulf Oil Chemical Co.); Arco SMA® resin (1:1 styrene-maleic anhydride copolymer, ARCO Chemical Company). Tolylene diisocyanate (TDI) was obtained from Wyandotte Chemical Co.

Anionic Resin Preparations

The synthesis of these water-dispersible poly(ester-amide-urethanes) has been described.[11] Shown in *Figure* 1 is the reaction sequence for their preparation. The base-catalyzed aminolysis of soybean oil with diethanolamine at 100°C provides the diol intermediates, N,N-bis(2-hydroxyethyl) soy amide (HESA), and soy monoglyceride. The 2:1 mole ratio of diethanolamine to oil yields a mixture of two-thirds HESA and one-third monoglyceride. All anhydrides were added directly to the HESA/monoglyceride mixture and reaction at 85-115°C with the above hydroxy components forms the half ester. The PA-18 polyanhydride was added as a 50% toluene solution. Reaction temperatures and times for the various anhydrides were: phthalic, glutaric, and succinic (85°C, 30 min); maleic and the 1:1 maleic copolymers (100-115°C, 1 hr); trimellitic, pyromellitic, and benzophenonetetracarboxylic (115°C, 1.5 hr). Experimental acid values (A.V. = mg KOH/g sample) were consistent with half ester formation. By varying the amount of anhydride added, products of different acid values were obtained. Sufficient triethylamine* was then added to form the salt of the free carboxyls. Toluene was added to the reaction mixture for a final 50 to 60% resin concentration and the temperature lowered to 50°C. Theoretical quantities of TDI* (a mixture of 80% 2,4 and 20% 2,6 isomers) in toluene were added to react with the remaining hydroxyls and form the urethane derivative. The reaction was complete in 2 hr as determined by the disappearance of the NCO band in the infrared at 2270 cm^{-1}.

Cationic Resin Preparations

The reaction sequence in *Figure* 2 illustrates a polymer molecule that contains only the dihydroxyamide units; however, monoglyceride units would also be present. Chain extension reactions provide a convenient means of incorporation of either amine or carboxyl solubilizing groups into the poly(ester-amides). Azeotropic esterification of the aminolysis reaction mixture with dibasic acids yielded hydroxyl terminated polyesteramides (HTPA), which were then reacted with excess TDI (NCO/OH = 2) at 105°C for 3 hr to yield an isocyanate terminated prepolymer. Methyldiethanolamine (NCO/OH = 1) was added and the reaction was stirred and heated at 105°C for 24 hr. Reactions again were followed by the disappearance of the NCO band.

Aqueous Dispersions and Emulsions

Butyl Cellosolve (bp 170.6°C) or 2-propanol (bp 82.3°C) was used as cosolvent. Butyl Cellosolve was added to the carboxyl-containing polymers in toluene solution. The toluene (bp 110.8°C) was preferentially removed by distillation under reduced pressure. When 2-propanol was used, the toluene was first removed from the polymer, which was then dissolved in 2-propanol. Deionized water was added and the polymer was dispersed by either stirring or shaking, followed by pH adjustment to 7.2 with triethylamine.

The amine-containing poly(ester-amide-urethanes) were readily emulsified with an ultrasonic disintegrator. The resin was added to 3 parts water containing sufficient acetic acid to form the salt and then sonicated for 10 min.

Film Preparation and Testing[9,11]

Chemical, solvent, and water resistance, hardness, impact, and drying tests were run on approximately 0.8 mil thick films cast on cold rolled steel Q-Panels® from either solvent solutions of resins or the aqueous dispersions. Films were prepared without drier and air dried at 25°C and 50% relative humidity. Chemical, solvent, and water resistance was measured by placing a 3.8 cm diameter watch glass, convex side down, on the surface of the film and by introducing the reagent between the watch glass and film surface. Periodic examination was

---

*Caution is advised when handling triethylamine and TDI.

Q-Panel is a registered trademark of the Q-Panel Co.

conducted until the film showed evidence of softening or other deterioration.

RESULTS AND DISCUSSION

Water-Dispersible Resins

PRODUCT STABILITY: The poly(ester-amide-urethane) resin dispersions were stored at room temperature and visually examined for precipitation of the polymers. In periodic measurements, the pH was found to decrease very slowly. It was maintained at approximately 7.2 by additions of triethylamine. The rate of hydrolysis of our products was directly related to structural variations of the anhydrides and their influence on the anchimeric effect.[12] The dispersions were judged unstable when the settled polymer could no longer be redispersed. Resin dispersion times increased in the order: maleic, <2 months; trimellitic, 3.5 months; benzophenone, 5-6 months; pyromellitic, 6.5 months; succinic, 7-8 months; glutaric, 10 months; and PA-18 1:1 maleic copolymer, >13 months. The anchimeric effect is the intramolecular catalytic action between neighboring carboxylate ion and ester group that assists in the nucleophilic attack of water through a cyclic intermediate. The anchimeric effect is greatly enhanced in compounds in which the carboxyl and ester groups are geometrically fixed in space such as in aromatic ring compounds, cycloaliphatics, or the *cis* isomer of an unsaturated acid, i.e., maleic. In the 1:1 maleic copolymers, maleic anhydride has lost its identity as maleic and has taken on a succinic structure that is much less prone to the anchimeric effect. This change would account for the improved stability of these resins. The polymeric anhydrides may also increase stability by their bulkiness, which provides steric hindrance to the system, another factor advocated for good hydrolysis resistance. Diols also influence the anchimeric effect. The N,N-bis(2-hydroxyethyl)amide, one of the polyol components, may be less susceptible than other diols to the anchimeric effect, since the hydroxyls are separated by four carbons plus a nitrogen atom and have a bent structure that may also contribute to steric hindrance. If this is true, bis-hydroxyamides prepared from the aminolysis of vegetable oils and bis-(2-hydroxypropyl)amine would provide a diol with

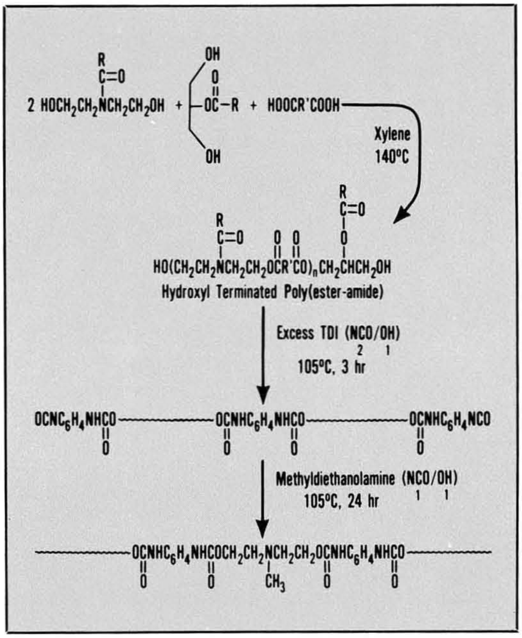


Figure 2—Reaction sequence for chain extended poly(ester-amides). R is derived from linseed, soy; R′ is derived from dibasic acid

Table 1—Film Properties of Poly(ester-amide-urethane) Dispersions

Formulation	Resin, Acid Value	Resin: Butyl Cellosolve	Resin, % Concentration	Tack Free Time, min	Rocker Hardness, Days Aging[a]					Spic and Span Resistance, hr	Water Sensitivity, hr	Xylene Resistance, hr	Impact inch pounds	
					1	4	7	14	21				Direct	Reverse
A	Pyromellitic, 50	75:25	30	4	28	30	38	61	64	—	—	—	Brittle	
B	Succinic, 48	75:25	30	32	4	7	16	20	24	<0.25	<0.17	>200	40	<10
C	Succinic, 48	85:15	40	20	6	6	8	16	20	<0.25	<0.17	>200	20	<10
D	Succinic, 29	75:25	30	17	23	25	32	42	50	0.25	0.15	>200	20	<10
E	Succinic, 29	85:15	30	12	20	26	25	26	30	0.25	0.10	>200	30	20
F	Succinic, 29	75:25	40	15	26	28	34	46	55	0.25	0.25	>200	30	<10
G	Glutaric, 27	75:25	30	21	20	—	38	46	45	1.0	0.42	>200	30	<10
H	Glutaric, 27	75:25	40	24	20	—	39	48	46	1.25	0.50	>200	20	<10
I	Glutaric, 27	85:15	40	20	14	—	27	28	31	1.25	0.75	>200	20	<10
J	Maleic, 37	75:25	30	21	16	19	27	34	35	7.0[b]	>25.0[b]	>200[b]	80[b]	10[b]
K	Maleic, 34	80:20[c]	30	7	14	14	16	16	16	0.25[b]	1.0[b]	0.25[b]	80[b]	<10[b]
L	PA-18, 45	60:40[c]	30	5	14	16	17	18	20	24[b]	31[b]	<0.5[b]	>160[b]	>160[b]
M	PA-18, 36	70:30[c]	30	4	18	22	24	24	27	>25[b]	23[b]	1.5[b]	60[b]	80[b]
N	PA-18, 28	80:20[c]	30	15	8	9	12	14	18	24[b]	>31[b]	>200[b]	20[b]	<10[b]

(a) Cured at 25°C, 50% relative humidity.
(b) Film aged six months.
(c) 2-propanol cosolvent.

Table 2—Cationic Emulsions

	Mole Ratio of Reactants[a]				Reaction Conditions		Film Properties[b]		Emulsion Data[c]	
Formulation	HTPA Hydroxyl	Alkylhydroxyamine	TDI	Polymer:Toluene Ratio	Temp., °C	Time, hr	DTT, min	TF, min	Type	Particle Size, microns Comments
P	2	3	5	1:1	25	>240	—	—	—	—
Q	2	3	5	1:2	25	144	20	60	—	—
R	2	3	5	1:1	105	1	15-20	35-50	—	—
S	2	3	5	1:3	105	10	<8	8	—	—
T	2	2	4	1:3	105	24	57	67	OW	1.7-3.4 very uniform
U	2	1	3	1:3	105	21	<90	90	OW	<3.4 heterogeneous
V	3	1	4	1:3	105	22	<1080	1080	WO	—
W	1	3	4	1:3	105	21	19	37	OW	1.7-2.5 fairly uniform
X	2	2	4	1:3	105	13	<27	27	OW	3.4-8.4 heterogeneous

(a) HTPA = hydroxy terminated poly(ester-amide); TDI = tolylene diisocyanate.
(b) Air dried, no driers, cast from toluene; DTT = dry to touch; TF = tack free.
(c) OW = oil in water emulsion.

a branched methyl group, an even more sterically hindered component that may impart improved stability to these water-dispersible polyesteramide systems.

FILM PROPERTIES: Polyurethane coatings and poly(ester-amides) have numerous outstanding film properties, including fast drying times, high hardness and gloss, and good resistance to chemicals and solvents. *Table* 1 lists film property data of some of the dispersions prepared.

All dispersions, regardless of composition, yield films that air-dry rapidly to very glossy coatings. Considerable variation in drying times and film hardness was observed. Tack-free times of a half hour or less were common. Initial rapid drying was undoubtedly due to the urethane groups, while the increased hardness on aging resulted from oxidative crosslinking of the soy acyl groups. This rapid drying may be very advantageous since coated articles may be handled very soon with no film damage. Aromatic rings are known to contribute to hardness, whereas long hydrocarbon chains are softer and lend flexibility (compare A and L). Low acid value resins dry faster, have better initial hardness, and ultimately cure to harder films, i.e., compare properties of the succinic 48 vs 29 A.V. resins. Solvent may be trapped in the films by their rapid drying and may account for the differences in hardness after the relatively short aging period of only three weeks. No major differences were observed in detergent resistance, water sensitivity, xylene resistance, and impact data.

Poor resistance of films to a 1% Spic and Span® solution (pH 9.9) involves hydrolysis of ester linkages. A correlation may exist between anhydride anchimeric effect as related to dispersion stability and resistance to Spic and Span, since both systems involve hydrolysis. Improved Spic and Span resistance was observed with the glutaric resin films G, H, and I (*Table* 1).

Flexibility of films was widely varied by choice of anhydride. Most films were somewhat brittle and could not withstand reverse impact of 10 or less in.-lb, but they passed 20-30 in.-lb direct impact as measured by the Gardner impact tester, catalog no. IG-1120 (10 in.-lb = 11.5 cm-kilo).

Excellent xylene resistance was shown by most samples. Long hydrocarbon chain compounds are generally susceptible to softening by aromatic solvents. This effect was shown by the most flexible sample, L. Lowering the A.V. indirectly increased the TDI content and resulted in improved xylene resistance; but at the same time, brittleness was also increased (compare L and N).

The choice of cosolvent influences film properties. Maleic anhydride polymers of nearly the same A.V. have different drying times, hardness value after three weeks aging, and widely different resistances to water, detergent, and solvent after six months aging. Again, the softer film lacks xylene resistance (J and K).

NRRC products are water-cosolvent dispersions of completely reacted condensation polymers of low to medium molecular weight isocyanate modified poly(ester-amides). Excessive crosslinking of products during preparation was avoided by reacting only difunctional components, and mostly linear polymers resulted. The unsaturated fatty acyl groups derived from soybean or linseed oil have the potential to react further by air oxidation and crosslinking to form the complex polymeric network. Thus, the oustanding properties of these products are expected to be more fully realized after an extended curing period. After six months aging, the most noticeable change is the significant improvement in detergent resistance and water sensitivity. Initially, the maleic films clouded, puckered, and softened almost immediately when exposed to water or detergent solution, and permanent film damage resulted. Three-week-old glutaric films, subjected to the water test, clouded in <1 hr; but even after contact at room temperature for 24 hr, they recovered to their original

---

Spic and Span is a registered trademark of Procter and Gamble.

clarity after water removal and drying. Film damage such as clouding, haziness, or whiteness appears to be of a temporary nature. Maleic films aged six months show no clouding or softening after 25 hr contact with water. Even more resistance was shown by six-month-old glutaric and succinic films, which were unaffected after 48 hr. These more fully cured films of poly(ester-amide-urethanes) are very water insensitive.

Cationic Resins and Film Properties

Suskind[13] described the preparation of polyurethane latices from polyester- and polyether-based materials. Poly(ester-amides) were used in the chain extension technique to develop polymers for other water-borne coatings. Dibasic acids known to be resistant to hydrolysis were chosen as components to improve resin stability in aqueous systems. Again, the diol portion of the polymers was derived from the aminolysis of linseed oil and diethanolamine. Soybean or safflower oils may also be used. This mixture of bis-hydroxyamide and monoglyceride is esterified with isophthalic acid by refluxing in xylene and azeotropic removal of water. Hydroxy-terminated poly(ester-amide) (HTPA) prepolymers resulted when less than stoichiometric quantities of dibasic acids were used.

Many variables of the TDI reactions are possible, i.e., hydroxyl content of the HTPA, amount of hydroxyalkylamine needed for emulsification, polymer-to-solvent ratio, reaction times, and temperatures. Some compositions are shown in *Table* 2, but no extensive investigation has been carried out to determine conditions to develop the best products or film properties.

Reactivity rates of the HTPA and methyldiethanolamine with TDI are quite different. Formation of a fine, white solid insoluble in the polymer solution resulted when all the reactants were mixed together. This solid was the reaction product of TDI and methyldiethanolamine, confirmed by independent synthesis. This competing reaction prevents the amine from being incorporated into the polymer, but this problem was avoided by stepwise reactions. Reaction of TDI first with HTPA (NCO/OH = 2) formed an isocyanate-terminated polymer, which was then extended by the methyldiethanolamine-TDI reaction (NCO/OH = 1).

Drying times and hardness data are from films deposited on Q-Panels from 25% toluene solutions to give 1 mil dry film thickness. Resins were cast from solvent only to determine if continuous films would form and if they would air dry.

Isophthalic prepolymers with 10-30% molar excess hydroxyl were chosen to study the effect of linseed acyl groups on the rate of film drying. Acyl content is inverse to the residual hydroxyl content, i.e., low excess hydroxyl polymers have high acyl content. In reactions P and Q, (*Table* 2), the excess hydroxyl content of polymers was 30 mole percent, that of R was 20%, and reactions S through X, 10%. The influence of higher acyl content on drying is quite pronounced as the tack-free time was shortened from 60 to 8 min (compare Q, R, and S). Although different temperatures and polymer-to-solvent ratios were used, all the isocyanate had reacted at the end of the given time.

Results of hydroxyalkylamine level, its effect on drying and emulsification are represented by reactions S, T, and U. Retardation of drying might be expected in samples with high amine content. However, the slower drying observed may be influenced more by less TDI in the resin than by the reduced amine level (compare S and U). A faster drying polymer resulted in W when the amine content was high (S and W). Through drying appears to be related to amine level. With the lowest amine level and the highest acyl content, V is slower drying but cures to the hardest film. Sample W clearly shows the adverse effect on drying of the high amine content. Sward rocker values of 52 (T), 63 (V), and 22 (W) were obtained immediately after the films were tack-free.

These resins emulsify readily by use of an ultrasonic disintegrator. Emulsions were examined under 440× magnification and particle sizes were estimated from a calibrated scale on the microscope eyepiece. All samples formed oil in water emulsions except V, which, due to the low amine level, did not emulsify properly. Particle sizes from emulsions T and W were fairly uniform, whereas those of X and W were heterogeneous. Emulsion uniformity appears to depend on the distribution of the amine emulsification sites along the polymer chain.

SUMMARY

Energy conservation, pollution reduction, and use of renewable resources are objectives that have been met in the design and preparation of poly(ester-amide-urethanes) for water-dispersible and emulsion systems. These resins are easily prepared in conventional equipment by standard procedures and yield hard, glossy, chemically resistant films that dry rapidly without the aid of additional driers. A variety of resin components, i.e., vegetable oils, anhydrides, or diisocyanates, can be used in the compositions to attain the properties needed.

References

(1) Miranda, T.J., JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 628, 66 (1977).
(2) Pryde, E.H., Hacklander, D.D., and Doty, H.O., Abstracts of Papers, 173rd ACS National Meeting, New Orleans, Louisiana, March 20-25, 1977, Abstract #79.
(3) Princen, L.H., JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 635, 88 (1977).
(4) Gerhart, H.L., *Prod. Finish., March,* 74 (1976).
(5) *Chemical Week, 122,* No. 24, 49 (1978).
(6) Gast, L.E., Schneider, W.J., and Cowan, J.C., *J. Am. Oil Chem. Soc., 43,* 418 (1966).
(7) Gast, L.E., Schneider, W.J., and Cowan, J.C., *ibid., 45,* 534 (1968).
(8) Gast, L.E., Schneider, W.J., McManis, G.E., and Cowan, J.C., *ibid., 46,* 360 (1969).
(9) Schneider, W.J., Gast, L.E., Sohns, V.E., and Cowan, J.C., JOURNAL OF PAINT TECHNOLOGY, *44*, No. 575, 58 (1972).
(10) Gast, L.E., Schneider, W.J., and Baker, F.L., JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 624, 57 (1977).
(11) Schneider, W.J. and Gast, L.E., *ibid., 50,* No. 646, 76 (1978). U.S. Patent 4,094,838 (1978).
(12) Turpin, E.T., JOURNAL OF PAINT TECHNOLOGY, *47*, No. 602, 40 (1975).
(13) Suskind, S.P., *J. Appl. Polymer Sci., 9,* 2451 (1965).

Min-U-Sil® just sits there. Saving you money.

You could call Min-U-Sil a lazy crystalline silica paint filler. Because it's inert.

Min-U-Sil just sits there in your interior or exterior latex paint, making your pigment and polymers go further. Without inter-acting with your paint's components. So you get dependable color stability and easy color acceptance. More trouble-free make-down, too.

You'll also find that Min-U-Sil, despite its laziness, works harder than any non-silica functional extender to improve your paint's wear properties. It increases burnish resistance, scrubbability, and even improves sanding characteristics.

But unlike other silica fillers that only come in 30 and 15 micron grades, Min-U-Sil is available in the finer 10 and 5 micron sizes. Which gives your paint a smoother, more even film, whether applied with roller or brush.

And Min-U-Sil is *very* economical. It's one of the most frugal fillers you'll find.

To show you how well Min-U-Sil works, we'll send you a free sample. Plus some impartial test results. Just write to Pennsylvania Glass Sand, Dept. A-24, Three Penn Center, Pittsburgh PA 15235. Or call (412) 234-7500.

Then test Min-U-Sil for yourself. In your paint. You'll find Min-U-Sil is the lazy way to make your paint work harder. And make profits come easier.

PGS

A Subsidiary of ITT

PG-903

Viscosity of Cosolvent/Water Solutions Of Amine Neutralized Acrylic Copolymers

Loren W. Hill and Bradley M. Richards†
North Dakota State University*

Water dilution of a series of amine neutralized acrylic copolymers differing in level of solubilizing acidic monomer produces anomalous variations in viscosity. For low levels of solubilizing monomer, a pronounced maximum in viscosity occurs on dilution followed by a precipitous drop in viscosity. Shear thinning is observed in the region of the maximum on dilution curves. Increasing the level of solubilizing monomer eliminates the viscosity maximum at intermediate polymer concentrations, but causes an increase in the viscosity at higher concentrations. The variations in viscosity caused by altering cosolvent/water ratio, extent neutralization, and molecular weight are also reported. Aggregation and the effect of aggregate crowding on viscosity are discussed.

INTRODUCTION

Polymers containing relatively low levels of solubilizing groups are used as binders for many types of waterborne coatings. The viscosity variation observed on dilution of these binders differs markedly from that observed for either conventional polymers dissolved in organic solvents or latexes. Anomalous viscosity variations have been reported for water soluble alkyds,[1,2] styrene/acrylate copolymers,[3] oil free polyesters,[4] and partially butylated styrene/maleic anhydride electrodeposition resins.[5] The unusual viscosity variation has been attributed to the formation of polymer aggregates, sometimes referred to as micelles.[2,4,6] Other small particle size dispersions of polymers in water have been called "microemulsions,"[7] and it is possible that the systems considered here fall within this classification.

The anomalous viscosity variation can potentially result in a number of problems such as: (a) difficult resin handling at intermediate concentrations due to high viscosity, (b) requirement of extensive dilution to reach application viscosity resulting in low solids levels and, therefore, thin films, and (c) extreme sensitivity of viscosity to slight variations in polymer concentration or other composition variables near application viscosity.

The purpose of this study is to use viscosity results as a basis for describing changes that occur in solution morphology during dilution. Results of previous dilution studies, especially those of McEwan,[2] Lin,[3] and Dörffel,[4] are combined with results of this work to arrive at the proposed description. This study differs from previous dilution studies by including shear rate dependence and by using a series of model acrylic copolymers of nearly equal polydispersity and similar molecular weight but with a broader range of acid group content. The effect of crowding of polymer aggregates is considered in terms of the Mooney equation which has been used previously for analyzing viscosity changes in colloidal dispersions and latexes.[8,9]

EXPERIMENTAL

Properties determined for the five copolymers used in this study are given in *Table* 1. In all cases the copolymers were prepared by radical polymerization in t-butanol using azo-bis-isobutyronitrile (AIBN, Eastman Chemical Products, Inc.) as the initiator. Monomers used were industrial grade and stabilized (10-200 ppm methoxy hydroquinone) as obtained from the manufacturer (Rohm and Haas Co.). The mixture of monomers and initiator was slowly added to refluxing t-butanol over a period of three hours with agitation. The resulting solution was maintained at reflux for an additional hour to complete polymerization. Initiator levels were adjusted to obtain samples having similar molecular weights. The results in *Table* 1 were obtained with initiator concentrations ranging from 2.89 to 4.44 wt % based on monomer weight. Higher initiator levels were used for the copolymers having higher AA con-

---

*Dept. of Polymers and Coatings, Fargo, N.D. 58105.

†Mr. Richards is now associated with Inmont Corp., Automotive Development Center, 6125 Industrial Pkwy., Whitehouse, Ohio 43571.

Table 1 — Copolymer Compositions and Properties

Composition (Mole %)		Nonvolatile	Weight Avg.	Polydispersity[d]	Acid
AA[a]	BMA[b]	(%)	Molecular Wt, M_w[d]	(M_w/M_n)	Number (mg KOH/g)
10 (5.3)[c]	90 (94.7)	59.6	18,900	2.41	39.3
10 (5.3)	90 (94.7)	60.2	11,200	2.95	39.0
20 (11.2)	80 (88.8)	60.9	24,100	2.82	82.5
30 (17.8)	70 (82.2)	63.1	21,400	2.93	129.1
50 (33.6)	50 (66.4)	50.4	26,700	2.55	237.1

(a) Acrylic acid.
(b) Butylmethacrylate
(c) Corresponding wt %
(d) Obtained by Gel Permeation Chromatography using polystyrene standards without corrections for variations in coil dimensions.

tents and to obtain the low molecular weight 10/90 AA/BMA copolymer. As can be seen in *Table* 1, the polydispersities are similar (2.41 to 2.93), and $\overline{M}_w$ values range from 18,900 to 26,700, except for the second 10 mole % AA copolymer ($\overline{M}_w = 11{,}200$) which was used to study the effect of molecular weight.

The solution non-volatile concentration for each polymer was determined by weight loss on heating 1.0 g samples in an aluminum dish at 105°C for three hours. The weight average and number average molecular weights ($\overline{M}_w$ and $\overline{M}_n$) and the polydispersities ($\overline{M}_w/\overline{M}_n$) were determined by gel permeation chromatography (GPC). For the molecular weight determinations the GPC columns were packed with Styragel (Waters Associates), and tetrahydrofuran (THF) was the mobile phase. Styrene molecular weight standard samples were used to calibrate the chromatographic system.

The acid numbers (mg KOH/g polymer) reported in *Table* 1 were obtained by titration using conditions slightly modified from those recommended for oils.[10] Experimental acid numbers were used for amine neutralization calculations to avoid uncertainties in calculated values resulting from initiator incorporation, loss of unreacted monomer, and variation in the acid number of the acrylic acid monomer used. Neutralization in the range of 50 to 100% EN was achieved by addition of N,N-dimethylaminoethanol (DMAE, Eastman Chemical Products, Inc.). The term "extent neutralization" (EN) indicates the ratio of equivalents of amine added to the equivalents of carboxyl groups in the copolymer, expressed as a percentage.

Viscosities were determined with a Wells-Brookfield RVT cone and plate viscometer (Brookfield Engineering Laboratories, Inc.) or with a Ferranti-Shirley cone and plate viscometer (Ferranti Electric, Inc.). The Brookfield instrument was used in the majority of the work (e.g., *Figures* 1-5 and 7) since it has an enclosed sample compartment which the available Ferranti-Shirley does not. However, the range of viscosities that can be measured at any one shear rate with the Brookfield is limited. The wide range of viscosities encountered in dilution curves required shear rate changes which were made by changing the revolutions per minute (rpm) settings and by changing cones. Shear rates for various viscosity ranges are given in *Table* 2. In analyzing the data, changes in shear rate should be considered. While comparisons in *Figures* 1-5 and 7 at equal viscosities are at equal shear rates, comparisons made at equal polymer concentrations may be at different shear rates.

The Ferranti-Shirley instrument was used to study shear rate dependence over a higher and broader range of shear rates (*Figures* 8 and 9). Extrapolation of these results indicates that the viscosities are not greatly effected by the changes in shear rates used with the Brookfield. (At high viscosities the viscosities seem to require higher rates of shear than those used to exhibit

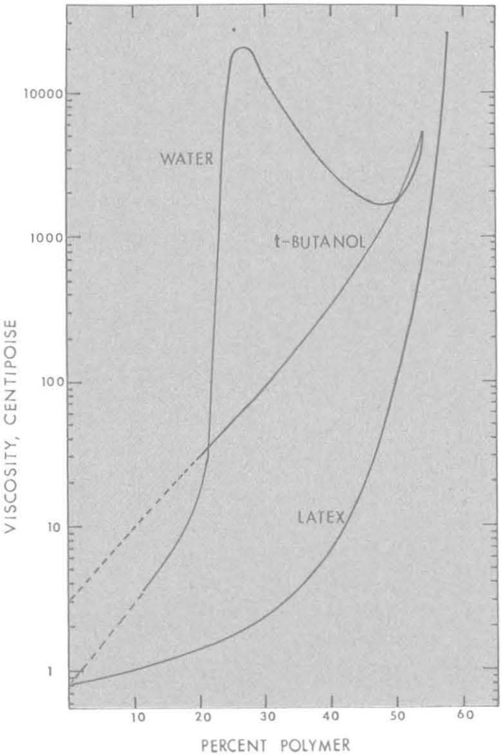


Figure 1 — Viscosity dependence on concentration for a latex (see Appendix) and for a 10 mole % AA copolymer, 75% neutralized with DMAE, diluted with water or with t-butanol

significant shear thinning, and at low viscosities, the systems are not very shear thinning at any rate of shear.)

RESULTS

Figure 1 provides a comparison of water dilution of a latex, organic solvent dilution of an acrylic copolymer, and water dilution of the same copolymer. The copolymer contains 10 mole % acrylic acid (AA) and 90 mole % butylmethacrylate (BMA), and is 75% neutralized with N, N-dimethylaminoethanol (DMAE). The plot for the latex was calculated using an equation given by Smith.[9] (See Appendix.) It is evident that the viscosity variation for the water dilution of the copolymer is very different from that observed for either organic solvent dilution or dilution of a thickener-free latex. The plot for t-butanol addition is typical of dilution of nonionic polymers in organic solvents.[11] Although the solvent contains a slight amount of amine (DMAE), the extrapolation of the linear portion gives an intercept that is very close to the viscosity of pure t-butanol (3.14 cps at 30°C).

Cosolvent/Water Ratio

The effects of increasing the t-butanol/water ratio are a sharp reduction of the viscosity in the peak region and a slight shift of the peak and the rapidly decreasing portion of the plot to lower values of polymer concentration as indicated in *Figure* 2. The cosolvent/water ratio was varied by adding enough pure cosolvent to the 54% polymer solution to reach 48% polymer in the first case and 42% polymer in the second case before water was added. After dilution to 20% polymer, the cosolvent/water ratios were 27.1/72.9, 32.7/67.3, and 40.6/59.4 (vol/vol) for dilutions initiated at 54%, 48%, and 42% polymer, respectively. Dörffel reported similar effects for dilution of a water soluble oil-free polyester.[4]

Table 2 — Shear Rate for Various Viscosity Ranges Using the Brookfield Viscometer

Viscosity Range (cps)	Shear Rate (sec^{-1})
5 to 25[a]	750
15 to 75[b]	200
75 to 200[b]	100
200 to 600[c]	200
600 to 1700[c]	100
1700 to 4000[c]	40
4000 to 8000[c]	20
8000 to 16000[c]	10
16000 to 30000[c]	5

(a) 0.8°/4.8 cm cone
(b) 3°/4.8 cm cone
(c) 3°/2.4 cm cone

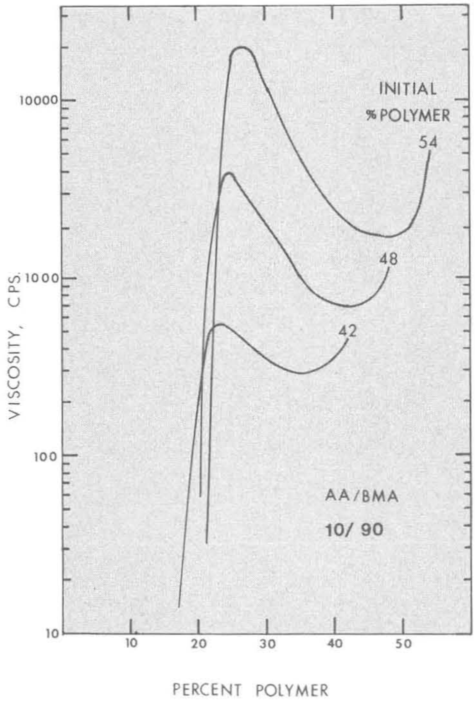


Figure 2 — Viscosity variations with water dilution of a 10 mole % AA copolymer, 75% neutralized with DMAE, for the indicated three initial levels of cosolvent

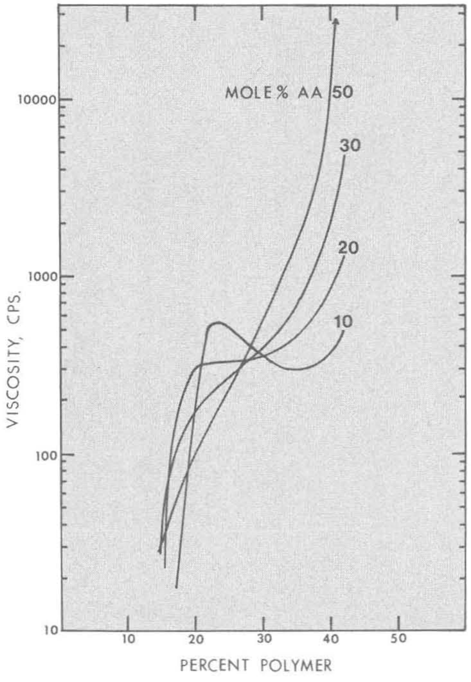


Figure 3 — Viscosity variations with water dilutions initiated at 42% polymer for four copolymers having mole % AA levels of 50, 30, 20, and 10, neutralized at 75% EN with DMAE

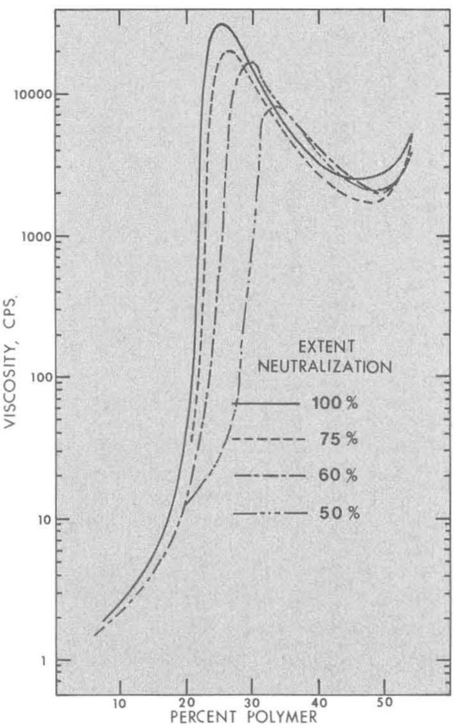


Figure 4 — Viscosity dependence on extent neutralization with DMAE for a 10 mole % AA copolymer; water dilutions initiated at 54% polymer

Copolymer Composition

The effects of increasing the level of solubilizing groups in the copolymer are evident in *Figure* 3. The pronounced maxima observed for the copolymer containing 10 mole % AA (*Figure* 2) are reduced substantially as the solubilizing group content increases. Water addition for all four curves was initiated at the same polymer concentration, 42.0%. As the AA content increases, the dilution curve shape progressively changes in the 22% to 27% range from a maximum, to a plateau, to an inflection point, to a reasonably linear plot. The 50 mole % AA curve has a shape similar to those observed for organic solvent dilution of nonionic polymers; however, the viscosity is higher at comparable solids levels and molecular weights.

Neutralization and pH

The effects of variations in extent neutralization on dilution behavior for the 10 mole % AA copolymer neutralized with DMAE are indicated in *Figure* 4. Increasing EN causes an increase in the viscosity at the maximum and a shift of the maximum and rapidly decreasing portion of the curves to lower polymer concentrations.

The effects of EN variations on dilution curves for the 20 mole % AA copolymer are shown in *Figure* 5. In the rapidly decreasing portion of the curves, the relative positions are the same as for the 10 mole % AA copolymer. The peak position also shifts to lower % polymer with increasing EN as for the 10 mole % AA case. However, in the peak region the lowest EN results in the highest viscosity, whereas for the 10 mole % AA copolymer, the lowest EN results in the lowest peak viscosity. Curves obtained for the 30 mole % AA copolymer at 50, 75, 100% EN (not shown) are similar to those for the 20 mole % AA copolymer except that the viscosities in the peak region were all lower.

Variations in pH with dilution were determined for all of the copolymers. Examples are given in *Figure* 6. Dilution plots are presented as pH versus percent cosolvent because the pH is expected to depend on solvent composition even in polymer-free solutions. For polymer-free systems, the measured pH decreases as the water content increases apparently as a result of dilution or solvent effects either on base strength or on the behavior of glass electrodes in mixed solvent systems. In contrast, the pH of copolymer containing systems increases as the water content increases.

Molecular Weight

The effect of molecular weight on dilution curves is indicated in *Figure* 7. The higher molecular weight copolymer has a higher viscosity at high polymer concentrations and in the region of the maximum as expected. However, in the region of rapidly decreasing

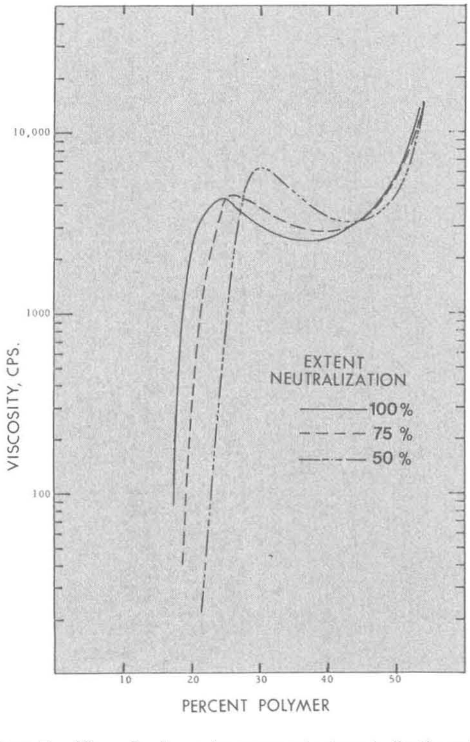


Figure 5 — Viscosity dependence on extent neutralization with DMAE for a 20 mole % AA copolymer; water dilutions initiated at 54% polymer

viscosity, the dilution curves appear to be remarkably insensitive to molecular weight. McEwan[2] reports a similar molecular weight effect in the peak region, but the comparison was not continued into the region of the precipitous drop. A more extensive study of molecular weight dependence would be desirable to establish the generality of the observed insensitivity of viscosity to molecular weight in the rapidly decreasing part of the curve.

In a related study in this laboratory, dilution curves for multi-component acrylics were determined using constant cosolvent/water mixtures for dilution and a somewhat similar insensitivity to molecular weight was noted in the rapidly decreasing part of the curves.[12]

Shear Rate Dependence

In the dilution curves presented above, the shear rate was varied to obtain nearly midscale readings using the Brookfield instrument. In contrast, *Figure* 8 shows results obtained with the Ferranti-Shirley instrument when viscosities are determined at constant shear rate throughout the dilution. The dependence of curve shape on the shear rate selected is illustrated.

Shear rate dependence observed at higher shear rates is indicated in *Figure* 9. In this case, both shear rates and the corresponding viscosities are given on logarithmic scales for selected compositions.

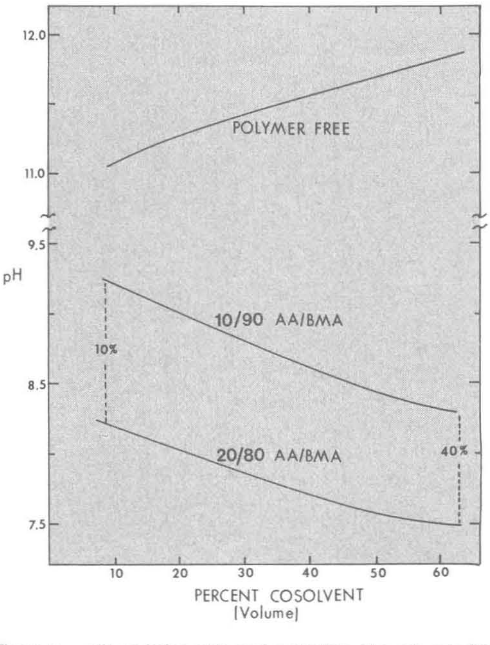


Figure 6 — pH variation with water dilution of a polymer free DMAE solution (initially 7.21 wt % DMAE) and solutions of 10 mole % AA and 20 mole % AA copolymers, neutralized with DMAE at 75% EN. Polymer concentrations (wt %) are indicated by the dashed vertical lines. The X-axis indicates percent of total solvent that is cosolvent (polymer excluded)

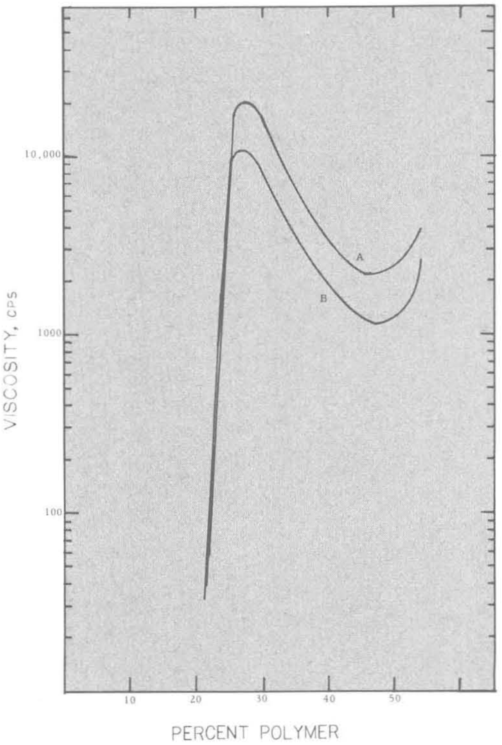


Figure 7 — Viscosity dependence on molecular weight (A, $\bar{M}_w$ = 18,900 and B, $\bar{M}_w$ = 11,200) for 10 mole % AA copolymers neutralized with DMAE at 75% EN

Appearance

Before water dilution, polymer solutions were clear in all cases. For solutions neutralized at 100% EN with DMAE, the solutions remained clear throughout the dilution. However, at lower EN's the solutions prepared from copolymers having low levels of AA became turbid as water was added. In *Table* 3 the polymer concentrations corresponding to the initial appearance of the indicated characteristic are given. Hazy, as used here, indicates a bluish hue which varies in intensity with the angle of observation. This effect has been referred to elsewhere as a Tyndall effect.[4] Cloudy indicates a translucent (but not blue) appearance, and "white" indicates an opaque, milky appearance. Since visual observation is subjective, the same author (B.M.R.) made all observations. Despite the subjective nature of these observations a rather consistent pattern is evident in *Table* 3. The viscosities determined for the seven dilutions considered in *Table* 3 are given in *Figures* 4 and 5.

DISCUSSION

Modification of acrylic copolymers by inclusion of carboxyl containing monomers and neutralization of the carboxyl groups by amines result in several types of strong secondary interactions that are not possible for

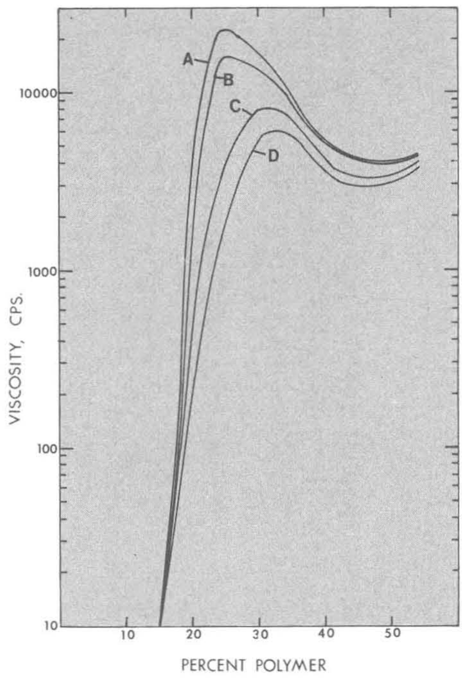


Figure 8 — Viscosity dependence on shear rate for a 10 mole % AA copolymer, neutralized with DMAE at 100% EN. Each curve was obtained with a different shear rate, held constant throughout the dilution. (For A $\dot{\gamma}$ = 174 sec^{-1}; B $\dot{\gamma}$ = 374 sec^{-1}; C $\dot{\gamma}$ = 1736 sec^{-1}; D $\dot{\gamma}$ = 3472 sec^{-1})

the unmodified analogues. These interactions, as well as the solvent properties of water/cosolvent mixtures, must be considered to explain the observed viscosity variations. Interactions and solvent properties will be considered in relation to the dilution curves beginning at the right and proceeding to the left as water dilution increases.

Before Water Addition

Initially, the solution contains polymer, neutralizing amine, and cosolvent. The viscosity is higher than that of a polymer of comparable molecular weight that does not contain solubilizing groups. The high viscosity is attributed to some unknown combination of hydrogen bonding of unneutralized carboxyl groups, dimerization or association of ion pairs formed from amine salts of carboxyl groups, and dipole interactions. The contributions of these interactions to viscosity are expected to increase with increasing carboxyl content. This effect on initial viscosities is evident in *Figure* 3.

The strong effect of amine for high mole % AA copolymer solutions is indicated by a comparison of an amine free and an amine containing solution of the 50 mole % AA copolymer in t-butanol. At 42% polymer the amine free solution has a viscosity of 2900 cps., but replacing 12 wt % t-butanol by DMAE (75% EN) gives a viscosity of 71,800 cps (off-scale in *Figure* 3). This large viscosity increase and the observation of pronounced shear thinning for these systems are the main reasons for proposing a network forming amine related interaction such as dimerization (or higher association) of ion pairs.[13]

Variations in amine content for the low mole % AA copolymers have a much smaller effect on initial viscosity, and shear thinning is slight for the initial condition.

Dilution to the Peak Region

Addition of small amounts of water to the 10 mole % AA copolymer solution causes a greater reduction in viscosity than addition of equal amounts of t-butanol (See *Figure* 1). This effect is attributed to replacement of polymer-polymer hydrogen bonds by polymer-water hydrogen bonds, reduction in ion pair association as the polarity increases, and adoption of compact polymer conformations due to intramolecular hydrophobic interactions.[14] The relative importance of these effects undoubtedly depends on the mole % AA in the copolymer and other variables such as EN and initial cosolvent/water ratio.

Further additions of water to the low mole % AA copolymer solutions cause an increase in viscosity. This reversal is attributed to formation of polymer aggregates. Aggregation is thought to result from intermolecular hydrophobic interactions so that non-polar chain segments are in the interior and ionized or polar groups are preferentially at the periphery. The aggre-

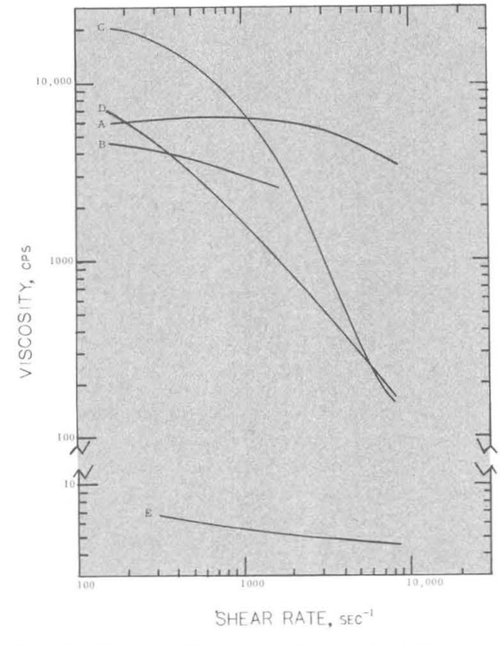


Figure 9 — Shear rate dependence of selected solution compositions from the dilution curve given in *Figure* 1 for a 10 mile % AA copolymer neutralized in DMAE at 75% EN. (A) 54% polymer (initial); (B) 40% polymer; (C) 30% polymer; (D) 25% polymer; (E) 15% polymer

gates are swollen mainly by cosolvent so that at relatively high polymer concentrations they occupy a large fraction of the total volume. Lin[3] has suggested that for styrene/acrylic acid systems, bridges between particles are formed by hydrophobic segments that have not collapsed into the interior. Bridging, if it occurs in the systems considered here, would be more likely to result from polar segments extending from particle to particle in the relatively polar continuous phase.

Flow during viscosity determinations requires deformation or destruction of swollen aggregates and breaking of bridging segments if the latter exist. The result is an increase in viscosity which produces the maximum in dilution curves. Shear thinning is extensive in this region for low mole % AA copolymer systems as indicated in *Figures* 8 and 9 (curve C). Shear thinning in this region is interpreted as an indication of deformation or destruction of aggregates and, possibly, breaking of interparticle bridges.

The viscosity at the maximum is determined, in part, by the rigidity of the particles or, in other words, by the viscosity of the internal phase. Increases in cosolvent/water ratio decreases the viscosity at the maximum (See *Figure* 2), presumably because a higher cosolvent/water ratio causes more swelling which results in less rigid particles.

Another variable that affects viscosity at the maximum is the extent of aggregation. As the fraction of polymer molecules contained in aggregates decreases, the volume occupied by aggregates would also be expected to decrease. This effect is seen most directly in *Figure* 3 where, for the 50 mole % AA system, there is no indication of aggregation on the dilution curve. For this system the relatively low proportion of hydrophobic segments is consistent with the absence of a detectable particle crowding effect.

Region of the Precipitous Drop

The precipitous drop in viscosity observed when water dilution is continued beyond the maximum is attributed to reduction of aggregate crowding contributions to viscosity. Although aggregates are still present, sufficient total solvent is also present so that viscosity is determined primarily by the viscosity of the continuous phase. The drop for these water soluble systems occurs for the same reason as for the latex system (See *Figure* 1). For the water soluble systems the drop occurs at a much lower weight percent polymer because aggregates are swollen, primarily by cosolvent, while latex particles are not swollen. Other explanations of the precipitous drop, such as collapse of a network structure or inversion of a water-in-oil dispersion to an oil-in-water dispersion, would be difficult to reconcile with the observed consistent change in pH (See *Figure* 7) over the concentration range corresponding to the precipitous drop.

The variations in position on the % polymer axis where the precipitous drops occur are consistent with expected changes in volume fraction occupied by aggregates. As volume fraction occupied or, in other words, as swelling increases, the drop is shifted to the left. Increased cosolvent/water ratio causes more swelling because more cosolvent is absorbed by aggregates (See *Figure* 2). Increasing the extent neutralization increases swelling because higher EN's result in greater charge repulsion at the periphery which expands the aggregate causing solvent absorption. It is also possible that at higher EN's some amine penetrates into the aggregate to form ion pairs which are solvated by water thus increasing the water uptake (See *Figures* 4 and 5).

Table 3 — Appearance During Dilution

	Wt % Polymer Corresponding to Initial Observation					
	10 Mole % AA			20 Mole % AA		
EN (%)	Hazy	Cloudy	White	Hazy	Cloudy	White
50	49	46	42	43	36	33
60	44	38	29	n.a.[b]	n.a.[b]	n.a.[b]
75	41	27	[a]	38	23	[a]
100	[a]	[a]	[a]	[a]	[a]	[a]

(a) The effect was not observed at any concentration.
(b) n.a. = not available (the 20 mole % AA copolymer was not studied at 60% EN).

In contrast, reducing the molecular weight has no detectable effect on swelling, as indicated in *Figure* 7. This result is interpreted as indicating that aggregate volume does not depend on whether the segments in the interior are linked together in short chains or in long chains. *Figure* 7 also indicates that the fraction of molecules not contained in aggregates is negligible for the 10 mole % AA system. If there were an appreciable polymer concentration in the continuous phase, the viscosity of the continuous phase would be higher for the lower molecular weight polymer due to greater solubility, and the position of the drop would be shifted to the left.

The Mooney equation given in the appendix permits calculation of viscosities from knowledge of the volume fraction dispersed phase, viscosity of the continuous phase, and a constant representing packing efficiency. This equation was used to test the hypothesis that particle crowding can account for the viscosity that is observed in the region of the precipitous drop. The calculation was applied to the 10 mole % AA copolymer (75% EN) at 22% polymer as shown in *Table* 4. Additivity of volumes was assumed. Partitioning ratios were estimated and then adjusted to determine if such adjustments could bring the calculated viscosity into agreement with the observed value. *Table* 4 indicates that $\phi = 0.457$ and that the volume % cosolvent in the continuous phase is 8.7% [(4.7/54.3) × 100]. An experimental determination of the viscosity of a t-butanol/water mixture of this composition gave $\eta_s = 1.06$ cps. Using $\phi = 0.457$, $\eta_s = 1.06$, and $k = 1.63$ (as for the latex), the viscosity calculated from the Mooney equation is 93 cps. It is evident that a slight reduction in either the 85/15 or 20/80 partioning ratios could produce a calculated value of 100 cps. Thus, reasonable partitioning assumptions indicate that crowding could account for the observed viscosity in the region of the precipitous drop.

Table 4 — Estimation of Volume Fraction of Particles for a 10 mole % AA Copolymer (75 % EN) at 22 wt % Polymer for which η = 100 cps (See *Figure* 1)

	Composition			
	Water	**Cosolvent**[a]	**Polymer**	**Total**
Weight %	59.3	18.7	22.0	100
Density (30°C) (g/ml)	0.996	0.775	1.20[b]	—
Volume (ml/100 g)	59.5	24.1	18.3	101.9
Volume %	58.4	23.6	18.0	100.0
	Assumed Partitioning (continuous phase/particles)			
Volume (% / %)	**85/15**	**20/80**	**0/100**	—
Continuous Phase (Volume %)	49.6	4.7	0	54.3
Particles (Volume %)	8.8	18.9	18.0	45.7

(a) Includes a small amount of DMAE.
(b) Assumed value.

The low polarity of hydrophobic segments in the aggregate interior would favor cosolvent absorption which is consistent with the 20/80 partitioning of t-butanol between continuous phase and aggregates assumed in *Table* 4. Water is considered to prefer the continuous phase (85/15).

pH Variations

The variation in pH with dilution (*Figure* 6) suggests that some of the carboxyl groups are located in the interior of aggregates. Since the interior is considered to have a low polarity, the amine molecules do not penetrate aggregates effectively. Thus, the carboxyls in the interior will not be neutralized and some of the amine will be unreacted, resulting in higher pH levels. Dilution of the polymer solutions results in an *increase* in pH which suggests that a greater proportion of carboxyls are trapped within aggregates as water is added.

Turbidity

Turbidity, as reported in *Table* 3, is consistent with light scattering by aggregates. However, in some systems maxima or plateau regions are attributed to aggregate formation even though no turbidity was observed. Failure to detect light scattering visually should not be interpreted as indicating the absence of aggregates. Scattering could be weak because very little continuous phase is present in a crowded system or because the difference in refractive index between continuous phase and aggregates is too small for effective scattering. It has been reported that oil-in-water microemulsions frequently appear transparent at 10 to 25% oil but scatter strongly when diluted to 1 to 0.1% oil.[7]

Application to Formulation

The nearly linear semi-log plot of viscosity versus polymer concentration observed for organic solvent-borne polymers has made it possible for formulators to get by with only a few viscosity determinations at several solids levels approximately corresponding to the desired application viscosity. The more complex behavior for water dilution of water soluble polymers suggests that determination of dilution curves, as described here, would help avoid unpleasant surprises when water-borne replacements are developed. For example, if the ability to reduce viscosity is used as a criterion for amine[4] or cosolvent[2,4] selection, the viscosity determinations should be carried out over a wide range of polymer concentrations. One point determinations are likely to be misleading because reversals of effectiveness for viscosity reduction are to be expected depending on polymer concentration.

Several generalizations related to development of water-borne coatings can be drawn from this study and other papers in the reference list. In the rapidly decreasing region of the dilution curve, the viscosity is affected only slightly by molecular weight. This observation is probably related to the success of "colloidal dispersions" or "aqueous dispersions" which are reported to contain polymer molecules having molecular weights in the 10,000 to 50,000 range.[15,16] If such polymers contain relatively low levels of solubilizing groups, the rapid decrease in viscosity will occur at relatively high polymer concentrations which results in higher solids levels at application viscosity. The advantages of high molecular weight and a favorable viscosity-volume solids relationship must be balanced against an increased tendency to undergo macroscopic phase separation.

Altering composition variables to alleviate one viscosity related problem often intensifies another viscosity related problem. For instance, changes which reduce the peak viscosity and, thereby, facilitate resin handling, frequently shift the rapidly decreasing portion of the curve to lower solids content at application viscosity which results in thin films. Variations that produce this combination of effects include increasing the cosolvent/water ratio, increasing the solubilizing group content, and according to Dörffel,[4] increasing the length of the alkyl segment on the cosolvent. McEwan[2] carried out water dilutions of resins dissolved in six organic solvent mixtures, and his results also indicate that solvents which produce low peak viscosity shift the region of rapid viscosity drop to lower solids levels.

The pronounced shear thinning observed for water soluble polymers can be exploited if the application method involves high shear rates. For example, it is now generally accepted that water-borne systems can be "sprayed at higher viscosities" than solvent-borne systems. Actually the viscosity in the spray gun is probably similar; it is only in low shear rate devices such as efflux cups that the apparent viscosities of the water-borne systems are higher.

The shear rate dependence shown in *Figure* 9 is consistent with use of "higher spray viscosities" for water-borne systems; however, the highest shear rate in *Figure* 9 is 10,000 sec^{-1}. Schoff[17] reports that spraying, brushing, and roller coating can involve shear rates up to 40,000 sec^{-1}. Of course, viscosity at the application shear rate is far from the only property that must be considered in analyzing application behavior. For example, leveling and sagging will depend on the rate of recovery of viscosity after shearing and on the solvent loss rate during and immediately following application. For paints containing cosolvent/water mixtures, rheological properties during application will depend on changes in the cosolvent/water ratio (See *Figure* 2) as well as on the rate of increase in non-volatile content. Changes in ambient relative humidity will affect the cosolvent/water ratio during application. Work on several of these factors controlling application behavior is currently underway.

Preliminary results indicate that pigmented waterborne coatings produce dilution curves that have shapes similar to the pigment-free curves,[6] but study of pigmented systems has not reached an advanced stage.

SUMMARY

Acrylic copolymers prepared with varying AA/BMA ratios but nearly equal molecular weights and polydispersities have been studied as models for water soluble polymers used in coatings. The viscosity variations observed during water dilution of the amine neutralized copolymers have been determined. In addition to copolymer composition (AA/BMA ratio), parameters investigated included cosolvent/water ratio, extent neutralization, and molecular weight. The turbidity and pH changes observed during dilutions have also been described.

For low levels of solubilizing monomer, a maximum in viscosity occurred on dilution followed by a precipitous drop in viscosity. Pronounced shear thinning was observed in the region of the maximum. The effects of changes in various parameters on the viscosity versus wt % polymer plots can be explained in terms of strong interactions involving solubilizing groups at high polymer concentrations and aggregation caused by hydrophobic interactions at lower polymer concentrations. The results of this work and results reported previously have been used to develop a description of the changes in solution morphology that occur during water dilution.

Some of the implications of anomalous viscosity variations on coatings formulation with water soluble polymers are discussed.

ACKNOWLEDGMENT

The suggestions and advice of Dr. Zeno W. Wicks, Jr., are gratefully acknowledged.

References

(1) Korf, C., Snelderwaard, C. and Beljaards, *Proc. VIIIth FATIPEC Congr.*, Scheveningen, p 111 (1966).

(2) McEwan, I.H., Journal of Paint Technology, *45*, No. 583, 33 (1973).

(3) Lin, O.C.C., in "Structure-Solubility Relationships in Polymers," F.W. Harris and R.B. Seymour, Eds., Academic Press, New York, 1977, p 165.

(4) Dörffel, J., *Farbe Lack*, *81*, 10 (1975).

DR. LOREN W. HILL, Professor of Polymers and Coatings at North Dakota State University, received his B.S. Degree from NDSU in chemistry in 1961, and his Ph.D. Degree from Pennsylvania State University in 1965. He was on the physical chemistry faculty at NDSU for six years before joining the Polymers and Coatings Dept. in 1971.

BRADLEY M. RICHARDS, Research Chemist, is employed by Inmont Corp. at the Automotive Development Lab, Whitehouse, Ohio. He received a Masters degree in Polymers and Coatings at North Dakota State University in 1977 and a B.S. Degree in chemistry also at NDSU in 1975.

(5) Saatweber, D. and Vollmert, B., *Angew. Makromol. Chem.*, *8*, 1 (1969).

(6) Hill, L.W. and Brandenburger, L.B., *Prog. Org. Coat.*, *3*, 361 (1975).

(7) Prince, L.M., "Microemulsions," Academic Press, New York, 1977.

(8) Brendley, W.H. and Haag, T.H., *ACS Div. Org. Coat. Plast. Chem. Pap.*, *32*, No. 2,350 (1972).

(9) Smith, T.L., Journal of Paint Technology, *44*, No. 575, 71 (1972).

(10) Gallagher, E.C., in "Paint Testing Manual," G.G. Sward, Ed., Thirteenth Edition, ASTM, Philadelphia, Pa., 1972, p 55.

(11) Sperry, P.R. and Mercurio, A., *ACS Div. Org. Coat. Plast. Chem. Pap.*, *39*, 427 (1978).

(12) Brandenburger, L.B., personal communication.

(13) Grunwald, E., Highsmith, S., Ting-Po, I., in "Ions and Ion Pairs in Organic Reactions," Vol. 2, M. Szwarc, Ed., John Wiley and Sons, Inc., New York, 1974, p 469.

(14) Dubin, P.L. and Strauss, U.P., *J. Phys. Chem.*, *74*, 2842 (1970).

(15) Wildman, G.C. and Bufkin, B.G., *Am. Paint J.*, *59*, No. 57, 18 (1975).

(16) Mock, J.A., *Materials Engineering*, *82*, No. 2, 55 (1975).

(17) Schoff, C.F., *Prog. Org. Coat.*, *4*, 189 (1976).

APPENDIX

The viscosities for the latex plotted in *Figure* 1 were calculated using equation (20) from Smith's[9] publication:

$$\frac{\eta}{\eta_s} = \exp\left(\frac{2.5\phi}{1-k\phi}\right)$$

where η = viscosity of the dispersion
η_s = viscosity of the medium (0.801 cps)
ϕ = volume fraction of dispersed material
k = crowding factor

For calculation of the volume fraction, ϕ, corresponding to any value of weight fraction on the plot, a density of 1.2g/ml was assumed for the latex particles. The value used for the crowding factor, k, was 1.63 which corresponds to the average of the reciprocals of the packing factors for simple cubic ($\phi_{max} = 0.524$) and face centered cubic ($\phi_{max} = 0.74$) packing of spheres. Variations in these assumptions would tend to shift the latex plot left or right without other major changes in the shape of the plot. The calculation also assumed a monodisperse system, but the equation has been generalized for application to polydisperse systems.[9]

Automation Of the Percent Nonvolatiles Analysis

Peter W. Fletcher
PPG Industries, Incorporated*

An automated system has been developed for the determination of Percent Nonvolatiles. The system is composed of a programmable calculator interfaced to an electronic digital balance through the Binary-Coded-Decimal (BCD) output of the balance. The calculator is programmed to accept weights as required and to do all necessary calculations. An added advantage of this system is the ability to do automatic error checking.

The automated system has resulted in a 50% reduction in technicians' time required to run the Percent Nonvolatiles analysis. Mathematical and transpositional errors normally encountered in this calculation are virtually eliminated.

The principles involved in this automated system can be applied to any determination in which the weight change or total weight of a sample is the parameter of interest.

INTRODUCTION

The "Percent Nonvolatiles" or "Percent Solids" test is quite possibly the most common analytical test in the coatings industry. Several methods exist for this analysis,[1-4] but all methods basically measure the loss of weight in a sample due to the evaporation of volatile components. The calculation of results from the weights obtained is also simple and is given by the equation

$$\% \text{ Nonvolatiles} = \frac{W_f - W_p}{W_i - W_p} \times 100$$

where W_i is the initial weight of the sample and container, W_f is the final weight of the sample and container, and W_p is the weight of the container. The method used in the PPG laboratory involves weighing each sample into disposable aluminum pans which are numbered sequentially and have been dried to constant weight. The weight of the pan is recorded, as is the total weight of the pan and sample. A volatile solvent is added to this pan to aid in spreading the sample. This helps avoid entrapment of volatile material in the sample during the analysis. This procedure is repeated until a convenient number of wet samples have accumulated, and then this "batch" is placed on a tray in an oven (105° or 150°C) for two hours. The samples are then removed from the oven and allowed to cool, then weighed to obtain the final weight. Usually duplicate determinations are made on each sample and the results compared to check for experimental errors.

Due to the volume of samples involved in this analysis, the calculation of results can often be extremely tedious and time-consuming, and particularly susceptible to mathematical errors. As technology has advanced, most laboratories have been quick to take advantage of new equipment to help alleviate this problem. Slide rules were replaced by electromechanical calculators, which were in turn replaced with electronic calculators, which were themselves replaced in some instances by programmable calculators. Recent advances in instrumentation have resulted in the appearance of digital balances and programmable calculators capable of being interfaced. The combination of these two instruments has made possible the development of a sophisticated automated system. With this approach, all handwritten notes used in the analysis are eliminated, as are the associated errors which arise from recopying numbers and calculating results. Since note-taking and calculations consume a good portion of the operator's time, the elimination of these steps via an automated system results in considerable time-saving. Several operators were asked to estimate the time saved by this system over a previous system in which hand-copied weights were subsequently entered into a programmable calculator. The

---

*P.O. Drawer 9, Allison Park, Pa. 15101

Decimal Digit	Lines 1	2	3	4
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
These combinations are not used	1	0	1	0
	1	0	1	1
	1	1	0	0
	1	1	0	1
	1	1	1	0
	1	1	1	1

Figure 1—*Binary-Coded-Decimal.* Each decimal digit is coded by four binary lines. Since four lines provide 16 possible combinations and there are only 10 digits to be coded, the remaining six combinations are undefined

operators consistently found a time-saving of 50% over the previous method.

EXPERIMENTAL

The hardware used for the system involves a Hewlett-Packard HP9815 Programmable Calculator and a Mettler PL-200-02 Balance interfaced through a HP98133A BCD Interface. For higher precision results (or smaller samples) a Mettler HL-32 or A-30 Balance may be used.

In digital logic, only two states are allowed, usually represented by 0 and 1. In common TTL logic, these states are represented as 0 being less than +0.4 volts and 1 being +2.4 to +5.5 volts relative to some common ground. Therefore, n digital lines can code for 2^n states—one line for two states (0 or 1), two lines for four states (00, 01, 10, or 11), etc. To code for the 10 decimal digits (0 through 9) four lines are needed which can code for a maximum of 16 states. Six of these states are not used and, in most applications, are undefined. (See *Figure* 1).

To code the six decimal digits of the PL-200-02 Balance (seven digits in the HL-32) requires 24 data lines (28 for the HL-32). In addition to these lines, one also needs a line to indicate the sign (+ or –), and two lines to control the transfer of information (See *Figure* 2). The first of these control lines, CTL, is initiated by the calculator to signal the balance that the calculator desires a weight reading. The balance then ensures that the data lines correspond to the weight reading and that the lines are stable; the balance signals the calculator to accept the weight through the second control line, FLG, and maintains the data on the data lines until the calculator has finished reading them and deactivates the CTL line (See *Figure* 3). One of the advantages to the Mettler balance over similar balances is that this balance has a stability indicator which indicates the weight reading is stable—and the balance will not trigger the FLG line until stability is achieved. This transfer process is carried out automatically by the balance and the calculator interface; the programmer need only request a weight.

DISCUSSION

The programming language of the HP9815A permits the development of sophisticated software programs; the availability of a tape cartridge, large display, and alphanumeric printer make the unit adaptable to a wide range of applications (See *Figure* 4). Development of software for the Percent Solids analysis has resulted in a highly flexible system designed to be operated easily by an operator with no programming experience. The printer and display are used to ask questions and inform

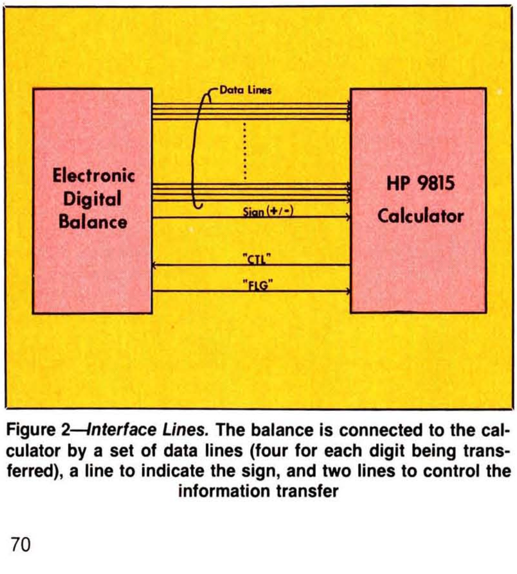


Figure 2—*Interface Lines.* The balance is connected to the calculator by a set of data lines (four for each digit being transferred), a line to indicate the sign, and two lines to control the information transfer

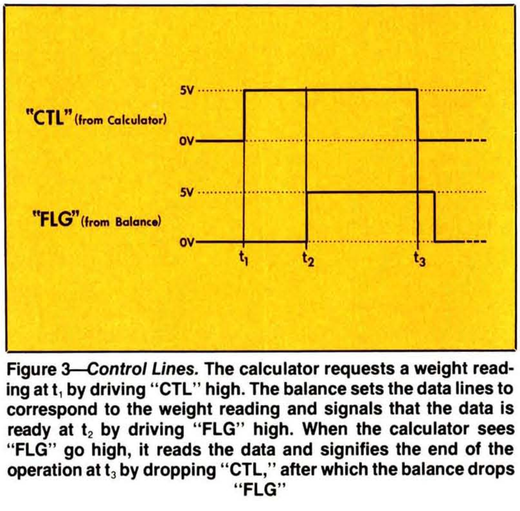


Figure 3—*Control Lines.* The calculator requests a weight reading at t_1 by driving "CTL" high. The balance sets the data lines to correspond to the weight reading and signals that the data is ready at t_2 by driving "FLG" high. When the calculator sees "FLG" go high, it reads the data and signifies the end of the operation at t_3 by dropping "CTL," after which the balance drops "FLG"

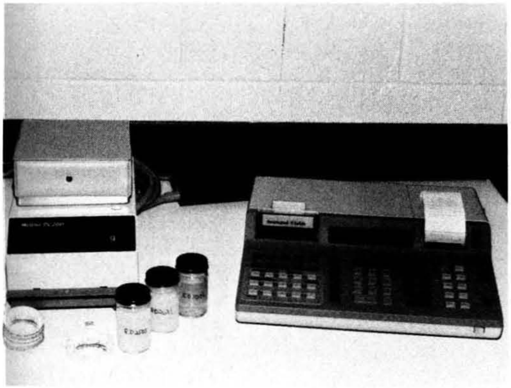
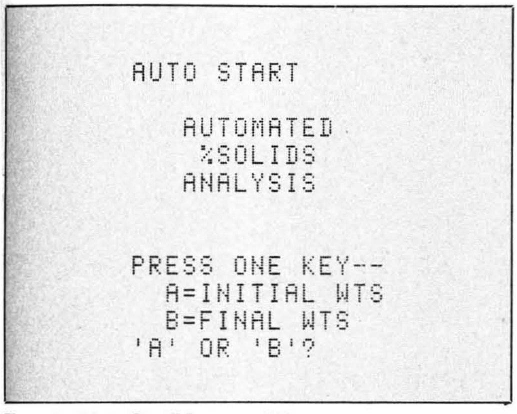


Figure 4—***Equipment.*** **The Hewlett-Packard HP9815A Calculator is shown here interfaced to a Mettler PL-200-02 Balance**

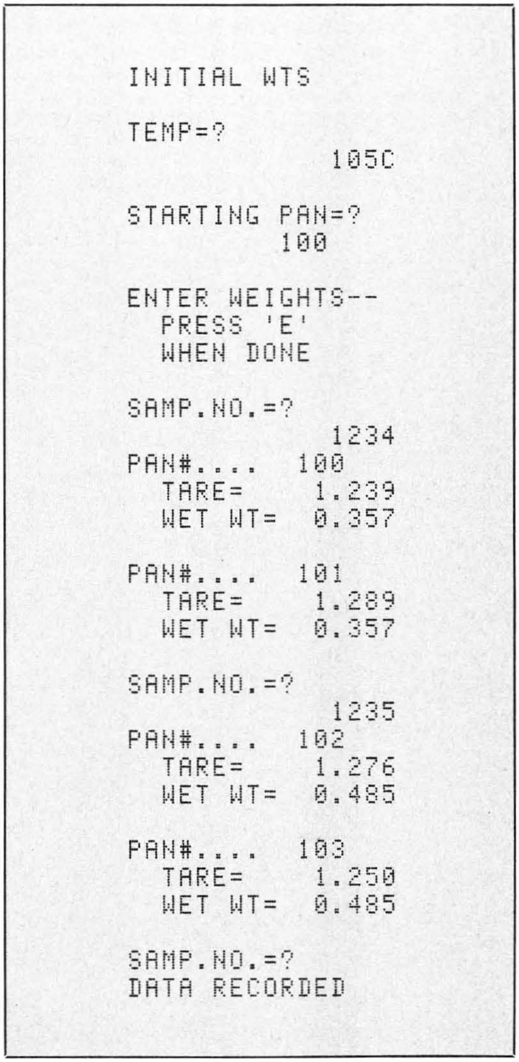
the operator of the status of the program and the tape cartridge is used to protect data and programs from accidental erasure. An "Error" key enables the operator to correct mistakes.

When the calculator is turned on, an Auto-Start feature automatically loads the first program and begins execution. This program asks the operator whether he wishes to record initial sample weights or final weights (See *Figure* 5). The operator indicates his choice by pressing either "A" or "B." The calculator will accept initial weights in batches of 1 to 50 samples (2 to 100 pans) and each batch is recorded on tape under the "starting pan number," which is requested (and subsequently recorded) when the operator presses "A." The operator then enters the temperature of the oven and begins to enter weights by pressing "Run" after placing the pan on the scale. During the weighing procedure, the calculator prompts the operator and lists the weights on the printer (see *Figure* 6). This provides a copy of all weights, should some unforeseen circumstance (e.g., a power failure) prevent these weights from being recorded on the cartridge. After the last sample is weighed the operator indicates the end of the batch by pressing "E"; at this point the data is stored on the tape cartridge and is protected against the calculator being turned off or a power failure. Up to 25 batches can be stored in this fashion and, since 50 samples per batch are allowed, the capacity of the system is 1250 samples (2500 pans). This is well beyond the expected demand on the system.



```
AUTO START

   AUTOMATED
    %SOLIDS
   ANALYSIS


PRESS ONE KEY--
   A=INITIAL WTS
   B=FINAL WTS
'A' OR 'B'?
```

Figure 5—***"Auto-Start" Program.*** **This program is automatically loaded when the calculator is turned on. The printer built into the calculator is used to guide the operation through the procedure**

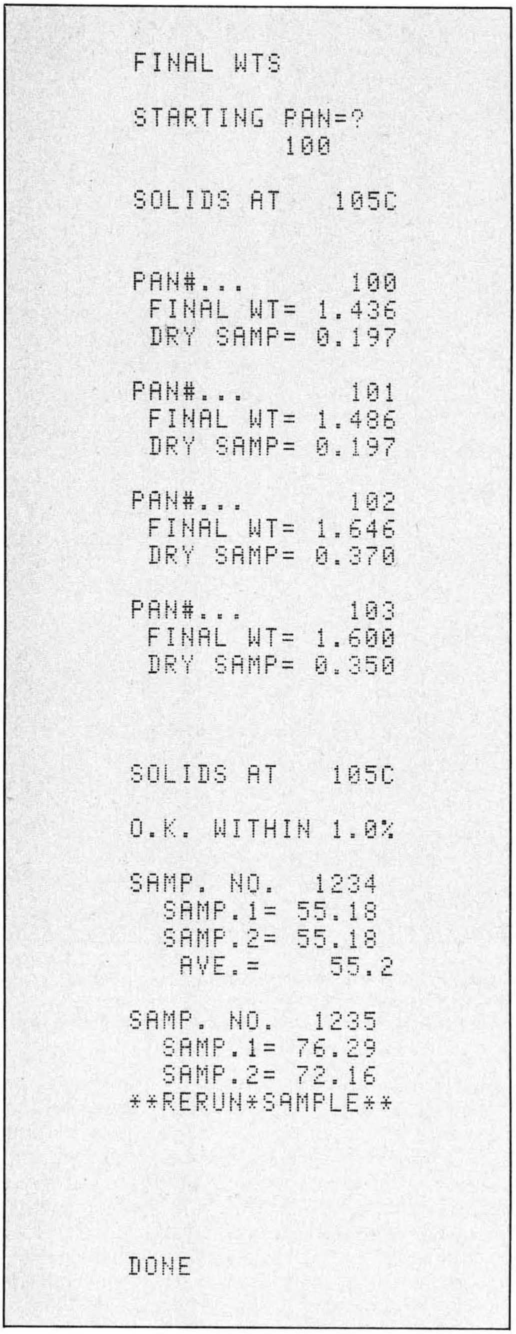


```
INITIAL WTS

TEMP=?
             105C

STARTING PAN=?
          100

ENTER WEIGHTS--
   PRESS 'E'
   WHEN DONE

SAMP.NO.=?
             1234
PAN#....   100
   TARE=     1.239
   WET WT=   0.357

PAN#....   101
   TARE=     1.289
   WET WT=   0.357

SAMP.NO.=?
             1235
PAN#....   102
   TARE=     1.276
   WET WT=   0.485

PAN#....   103
   TARE=     1.250
   WET WT=   0.485

SAMP.NO.=?
DATA RECORDED
```

Figure 6—***"Initial Wts" Program.*** **This program is loaded when the operator presses "A." The initial weights of the sample and the weights of the pan are recorded and stored on the tape cartridge**

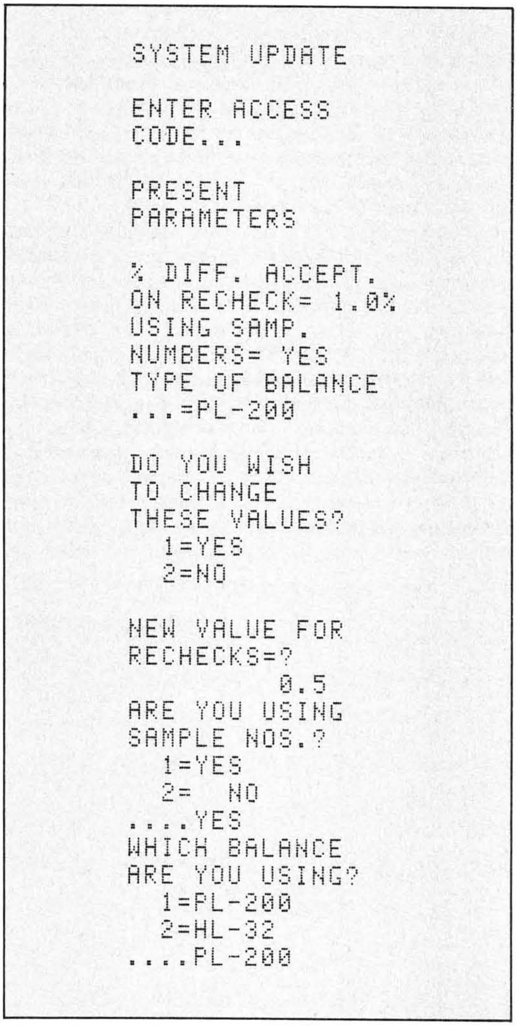
After a batch is removed from the oven and cooled, the operator selects the final weight program by pressing "B." The calculator asks for the starting pan number of the batch and then searches the tape cartridge to find and recall the data. This process takes about 5-7 sec. The calculator prints the oven temperature and asks for the first final weight. The operator places each pan on the balance in order and presses "Run" and the calculator prints the final weight and dry sample weight. At the end of the batch, the calculator prints a summary of results which can be used as a permanent record, if desired. The calculator also compares the results from the two pans of each sample. If they differ by more than some preset value (e.g. 1%), the calculator will instruct the operator to rerun that sample (see *Figure* 7). When all results have been printed, the calculator deletes the batch from memory.

The programs have three options which can be specified by the lab supervisor. The program which selects these options is activated by pressing "C" while in the Auto-Start program. This command will load the "System Update" program, but no changes can be made until the operator enters a code number. This



```
FINAL WTS

STARTING PAN=?
         100

SOLIDS AT    105C


PAN#...        100
 FINAL WT= 1.436
 DRY SAMP= 0.197

PAN#...        101
 FINAL WT= 1.486
 DRY SAMP= 0.197

PAN#...        102
 FINAL WT= 1.646
 DRY SAMP= 0.370

PAN#...        103
 FINAL WT= 1.600
 DRY SAMP= 0.350



SOLIDS AT    105C

O.K. WITHIN 1.0%

SAMP. NO.  1234
  SAMP.1= 55.18
  SAMP.2= 55.18
   AVE.=    55.2

SAMP. NO.  1235
  SAMP.1= 76.29
  SAMP.2= 72.16
**RERUN*SAMPLE**




DONE
```

Figure 7—*"Final Wts" Program.* **This program recalls the initial weights from the tape cartridge, records the final weights, and calculates the results**



```
SYSTEM UPDATE

ENTER ACCESS
CODE...

PRESENT
PARAMETERS

% DIFF. ACCEPT.
ON RECHECK= 1.0%
USING SAMP.
NUMBERS= YES
TYPE OF BALANCE
...=PL-200

DO YOU WISH
TO CHANGE
THESE VALUES?
  1=YES
  2=NO

NEW VALUE FOR
RECHECKS=?
         0.5
ARE YOU USING
SAMPLE NOS.?
  1=YES
  2=  NO
....YES
WHICH BALANCE
ARE YOU USING?
  1=PL-200
  2=HL-32
....PL-200
```

Figure 8—*"System Update" Program.* **This program enables the lab supervisor to change the operation parameters of the system**

code number should remain confidential to the supervisor, since operation of the other programs is dependent on the option selected (see *Figure* 8). These options are:

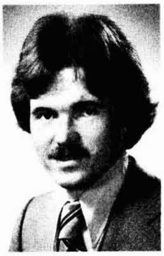
(1) PERCENT DIFFERENCE ON RECHECKS: This parameter is the Percent Difference by which the two pans from a sample are allowed to differ. If they differ by an amount greater than the value specified, the operator is instructed to rerun the sample.

(2) SAMPLE NUMBER OPTION: If the lab is using a sample numbering system, this option can be selected. If selected, this option will request a sample number for each sample during the recording of initial weights and will list sample results using the sample numbers. If not selected, pan numbers will be used and a list of corresponding sample names must be kept separately.

(3) BALANCE SELECTION: The program will work with most Mettler balances. The PL-200-02 is a three place (0.001g) balance and is recommended for most applications. If greater accuracy is desired or smaller sample weights are used, the program will operate with the HL-32 or the A-30-02, which are four-place (0.0001g) balances.

SUMMARY

The interfacing of an electronic balance to a programmable calculator provides a means of automating the calculations involved in simple analytical tests. The example presented here dealt with the determination of Percent Nonvolatiles, but the principles involved can be applied equally well to other determinations in which the weight change on total weight of the sample is the parameter of interest. These determinations would include "Percent Ash,"[5-7] "Weight Per Gallon,"[8] "Moisture Content," etc. The savings in time and reduction of errors obtained from this project easily outweigh the costs involved when the equipment is used in a busy laboratory.



PETER W. FLETCHER received the B.S. Degree in Chemistry in 1976 from Carnegie-Mellon University and the M.S. Degree in Colloids, Polymers and Surfaces in 1979, also from Carnegie-Mellon. He has been employed since 1976 at the Coatings and Resins Research Center of PPG Industries, in Allison Park, Pa., where he currently holds the position of Research Chemist. His research interests include Nuclear Magnetic Resonance and Computer Applications to Analytical Chemistry.

ACKNOWLEDGMENTS

The author wishes to thank Dr. P.E. Pierce, Dr. G.P. Cunningham, and Mr. J. Shutak for their support and cooperation during this project.

References

(1) ASTM test method D2832, "Determining Nonvolatile Content of Paint and Paint Materials."

(2) ASTM test method 1644, "Tests for Nonvolatile Content of Varnishes."

(3) ISO 1515, "Paints and Varnishes—Determination of Volatile and Nonvolatile Matter."

(4) DIN 53 216, "Testing of Paints, Varnishes, and Similar Products; Determination of Nonvolatile Matter at Elevated Temperatures."

(5) ASTM test method D482, "Test for Ash from Petroleum Products."

(6) ASTM test method D1951, "Test for Ash in Drying Oils and Fatty Acids."

(7) ISO 1270, "Plastics-PVC Resins—Determination of Ash and Sulfated Ash."

(8) ASTM test method D1475, "Density of Paint, Varnish, Laquer, and Related Products."

Influence of Flow Direction On Water Vapor Permeability Through Organic Coating—Porous Building Material Systems

Dan Y. Perera and D. Vanden Eynde
Laboratoire I.V.P.*

The influence of the flow direction on the water vapor permeability, under stationary conditions, for composite systems made from organic coating and porous building substrate is discussed. Four different organic coatings and two types of concrete were investigated. The measurements were carried out with modified permeability cups in order to prevent the formation of an over-pressure during sealing and a vacuum during measurements. The results obtained showed that the total permeability through a composite system cannot be correctly calculated from

$$L/P = \sum_{1}^{n} Li/Pi,$$

a commonly used equation, if the permeability of even one layer is dependent on water concentration (or vapor pressure) and/or an interaction between layers occurs. The composite system will become more permeable if the layer for which permeability increases more strongly with increasing water concentration is exposed at the upstream boundary.

INTRODUCTION

The water vapor flux through coated porous materials is an integral part of hygric properties.[1] (The hygric properties describe the characteristics of a material with respect to moisture, for example, the coefficients of permeability, diffusion, solubility, water vapor resistance, the different critical moisture contents, etc.) These properties have to be known in order to formulate adequately organic coatings used to protect porous substrates.

The mathematical expression generally used to calculate the water vapor permeability through composite materials, under steady state, is:

$$\frac{L}{P_c} = \frac{L_1}{P_1} + \frac{L_2}{P_2} + \ldots\ldots = \sum_{1}^{n} \frac{Li}{Pi} \qquad (1)$$

or in terms of flux:

$$F_c = \frac{\Delta p_v}{\frac{L_1}{P_1} + \frac{L_2}{P_2} + \ldots\ldots} = \frac{\Delta p_v}{\sum_{1}^{n} \frac{Li}{Pi}} \qquad (2)$$

where L, P_c and F_c are, respectively, the total thickness, permeability coefficient, and flux; L_1, L_2, ... Li are the thicknesses of the different layers and P_1, P_2, ... Pi are the permeability coefficients of the corresponding layers; Δp_v is the difference in water vapor pressure.

These equations can correctly predict P_c or F_c only for layers having the diffusivity independent of concentration, (Fick's law); solubility proportional to the vapor pressure, (Henry's law); and no interaction taking place between different layers. Unfortunately, these ideal situations are rarely met in practice.

However, when the dependance of F (or P) on concentration (or vapor pressure) is known separately for each layer, F_c (or P_c) can be predicted from a graphical method developed by Rogers, et al.[2] These cases have been discussed in a previous paper.[3]

On the basis of data obtained by Rogers, et al., one can deduce that a system composed of layers having different dependence of F (or P) on water concentration (or p_v) will be more permeable when the layer, which

---

*Belgium Paint Research Institute, Avenue Pierre Holoffe, BE, 1342 Limelette, Belgium.

has F (or P) increasing more strongly with the concentration, is exposed at the upstream boundary (the side exposed to the higher p_v). It follows that the water vapor permeability will depend on the flow direction. This principle has been verified for some systems composed of different plastic[2] or organic coating[4] layers.

This paper is concerned with the influence of the flow direction on the water vapor permeability through composite systems made from organic coatings and porous building substrates (two types of concrete). The use of the equations previously described is also discussed.

EXPERIMENTAL

Materials

The organic coatings (C′) investigated in this study are listed in *Table* 1. Two types of concrete were used as substrate (S): an ordinary (O_c) and a cellular (C_c). The properties of O_c were given in a former publication.[5] Briefly, this concrete was made from Portland cement, gravel, and sand; water/cement ratio = 0.45, age before painting = 2 yrs, density ≃ 2.2, thickness ≃ 20 mm and diameter = 80 mm. The cellular concrete, known under the trade names of Ytong, Durox, Siporex, etc., had a density ≃ 0.68, a thickness ≃ 20 mm and a diameter = 80 mm.

Specimen Preparation

Organic coatings were applied on the two substrates and on tin foils with the "I.V.P. filmograph," a modified doctor blade, in two layers with an interval of 24 hr. The free films were obtained by amalgamation of tin. All the measurements were started after drying the paints four months at a temperature of 22 ± 1 (°C) and a relative humidity (RH) of 60 ± 2%. This long period of drying was necessary in order to obtain relatively stable organic coatings.

Measurement Of Water Vapor Permeability

Water vapor permeability measurements were carried out at 22 ± 1 (°C) with modified permeability cups by maintaining a RH = 93% in the cups and a RH = 52% in ventilated dessicators. Saturated solutions[6] of sodium dichromate cryst. ($Na_2Cr_2O_7 \cdot 2H_2O$) and ammonium dihydrogen phosphate cryst. ($NH_4H_2PO_4$) were used to obtain the RH of 52% and 93%, respectively. The flux at steady state was determined by measuring the loss of weight of cups at various time intervals until stationary state was reached.

Table 1—Organic Coatings Investigated

Coating	PVC[a]
A. Vinyltoluene acrylic resin	57
B. Acrylic resin	41
C. Styrene acrylic resin (textured paint)	75
D. Copolymer (vinyl chloride, vinyl acetate, maleic acid) + copolymer (vinyl chloride, vinylacetate)	33

(a) PVC = pigment volume concentration.
A and D are solvent-based paints and B and C are water-based paints.

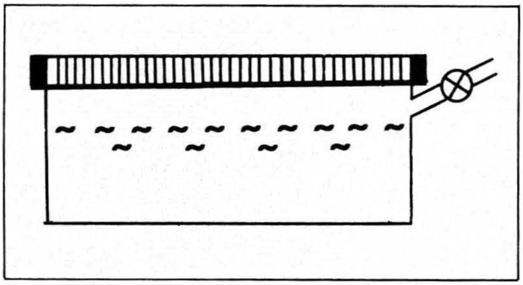


Figure 1—Schematic drawing of the modified permeability cup

The difference between the permeability cup usually described in the literature[7] and the modified cup used in this study (see *Figure* 1) lies in the small narrow lateral tube equipped with a stop-cock. The advantage of this cup is that it enables one to adjust the pressure in the cup to that of the atmosphere by rapidly opening and closing the stop-cock. After each opening-closing manipulation, the cups were always reweighed. In general, no significant changes were ever observed.

This manipulation is especially advisable when highly permeable samples are investigated in order to prevent the formation of a significant vacuum in the cup. Many workers have probably noted a deformation of paint films during permeation measurements. This deformation is mostly observed with films having a marked hydrophilic character (which induces a high water sorption) and a low mechanical resistance to swelling. When these conditions are met, the presence of even a small vacuum may increase the deformation and, consequently, affect the results.

This modified cup is also suitable when (warm) waxes or paraffins are used as sealing materials. Thus, by keeping the stop-cock open during the sealing operation, an over-pressure, which might develop in the cup as a result of the increase in the temperature and which would deform the film, is prevented.

In order to maintain the saturated solution at as constant a level as possible in the cup, whenever a decrease of about 2 mm was observed, an additional amount of the solution was poured into the cup through the lateral tube.

RESULTS AND DISCUSSION

To determine the influence of the flow direction on the water vapour permeability, two series of tests were carried out. In the first series, the coated side of the specimen was placed at the upstream boundary (RH = 93%) and the non-coated side at the downstream boundary (RH = 52%): C′(93)/S(52). Once the steady state was reached, the specimen position was changed in such a way that the coated side was at the downstream boundary: C′(52)/S(93). The flux F_1 was

Table 2—Flux Values (Kg/h.m^2) for Organic Coating/Ordinary Concrete Systems at 22 ± 1°C and ΔRH(%) = 93-52

	$F_c \times 10^4$	$F_1 \times 10^4$	$F_2 \times 10^4$
A.	1.45(0.09)[a]	0.70(0.05)	0.75(0.05)
B.	1.84(0.10)	1.65(0.07)	1.30(0.07)
C.	1.72(0.10)	1.27(0.07)	0.87(0.07)
D.	0.58(0.09)	0.26(0.07)	0.25(0.07)

(a) The values in parenthesis are the mean square deviations.

Table 3—Flux Values (Kg/h.m^2) for Organic Coating/Cellular Concrete Systems at 22 ± 1°C and ΔRH(%) = 93-52

	$F_c \times 10^4$	$F_1 \times 10^4$	$F_2 \times 10^4$
A.	3.30(0.20)[a]	3.20(0.15)	3.70(0.15)
B.	8.00(0.50)	9.20(0.23)	7.50(0.23)
C.	7.50(0.90)	8.70(0.22)	4.20(0.22)
D.	0.86(0.08)	0.85(0.05)	0.90(0.05)

(a) The values in parenthesis are the mean square deviations.

measured in the first case and the flux F_2 in the second case. In the second series of tests the order of measurement was changed: the coated side was first placed at the downstream boundary and then at the upstream boundary. These tests are shown schematically in *Figure* 2.

The two series of experiments showed that the steady state flux values, F_1 and F_2, are not affected by the order of measurement; only the time necessary to reach the steady state is different.

In *Tables* 2 and 3, the mean values of flux calculated (F_c) from equation (2) and those determined experimentally (i.e. F_1 and F_2) are presented. F_c was calculated from permeability coefficient values of free films and of substrates, values determined under the same experimental conditions as those described above (i.e., ΔRH(%) = 93-52). The thickness of coatings applied on the substrates was calculated from values of density, area, and weight, while the thickness of the substrate was measured with a micrometer. Each measurement was made seven times.

From *Tables* 2 and 3, it can be seen that, independent of the nature of the substrates, the organic coatings can be divided in two groups: (1) for A and D . . . . . $F_1 \simeq F_2$; and (2) for B and C . . . . . $F_1 > F_2$. Similar results to those described in (2) were found for some coatings applied on gypsum[8] and on light concrete.[9]

In order to see if these results can be explained in the light of principles discussed in the Introduction, the dependence of the permeability coefficient (P) on the water concentration was determined. The procedure used has been described previously.[10] Briefly, this consists of measuring the flux for different situations by maintaining a constant high RH on one side of the sample and various lower RH on the other side. The mean water concentration, $\bar{c}$, was calculated from isotherm sorption curves:

$$\bar{c} = \frac{\int_{RH_2}^{RH_1} c \, d\,(RH)}{RH_1 - RH_2} \qquad (3)$$

The dependence of P on $\bar{c}$ for the four organic coatings and the two substrates is shown in *Figures* 3 and 4. The arrows indicate the experimental conditions under consideration, namely those corresponding to RH of 52% and 93%.

An examination of *Figures* 3 and 4 shows that, for these conditions, P of the two substrates and coatings A and D is almost independent of $\bar{c}$ (i.e., P increases only 1.15 times). For coatings B and C, the dependence of P on $\bar{c}$ is significant (an increase of about 2.4 times).

From considerations already mentioned, it follows that the flow direction will not affect the permeability in the case of systems based on coatings A and D. However, it will affect the permeability in the case of systems based on coatings B and C.

These conclusions are in agreement with the permeability results, namely that $F_1 \simeq F_2$ for systems based on coatings A and D; and $F_1 > F_2$ for those based on

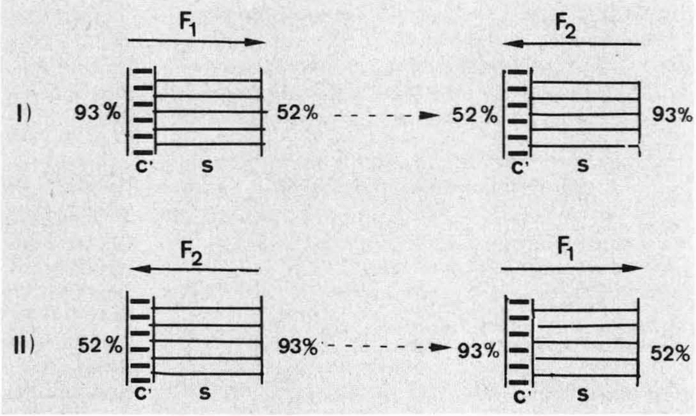


Figure 2—Schematic description of the water vapor permeability tests

coatings B and C. $F_1 \geq F_2$ for the latter systems because the increase of P on $\bar{c}$ for the two coatings is stronger than that of the two substrates.

It should be mentioned that, by changing the experimental conditions, a different behavior can be expected. For example, if the water vapor transport is taking place from RH = 100% to RH = 75%, F_2 will be higher than $F_1 (F_2 > F_1)$ for coatings A and D applied on both substrates, a result anticipated and proved experimentally.[9] This is due to the fact that P of the two substrates increases strongly at high RH (see *Figure* 4).

Another aspect considered was the relationship between F_c and experimentally determined fluxes (F_1 and F_2). An analysis of the results presented in *Tables* 2 and 3 shows that:

(1) $F_c > F_1$ and F_2 for all coatings applied on O_c;

(2) F_c is between F_1 and F_2 for coatings B and C applied on C_c; and

(3) $F_c \simeq F_1$ and F_2 for coatings A and D applied on C_c.

As already mentioned, for systems made of layers for which P is dependent on the water concentration, the equation (1) or (2) is invalid and, consequently, no correlation between the values of F_c and those of F_1 or F_2 can be expected.

Thus, the only unexpected results are those described in point (1). Since P is practically independent of $\bar{c}$ for O_c and coatings A and D, it was expected that for systems A/O_c and D/O_c, $F_c \simeq F_1 \simeq F_2$.

In order to see if this result is not due to the fact that paint was applied to a substrate, additional measurements were carried out with systems made of free films laid down on the substrate (C′ + S). The upstream boundary was at the substrate side. From *Table* 4 it can be seen that for such systems, the results obtained agree relatively well with the theory. This may indicate that the anomaly mentioned above is mainly due to a possible coating-substrate interaction (e.g., to a penetration-filtration effect as described by Lindberg[11])

Table 4—Flux Values ($Kg/h.m^2$) for Free Coating Films Laid Down On Ordinary (O_c) and Cellular (C_c) Concretes

C′ + O_c		C′ + C_c	
$F_c \times 10^4$	$F'_2 \times 10^{4a}$	$F_c \times 10^4$	$F'_2 \times 10^4$
A. 1.50(0.09)[b]	1.56(0.06)	4.60(0.21)	5.30(0.15)
B. 1.70(0.09)	1.55(0.07)	8.50(0.50)	6.00(0.23)
C. 1.68(0.09)	1.50(0.06)	9.70(0.90)	6.60(0.22)
D. 0.40(0.07)	0.38(0.05)	0.71(0.08)	0.74(0.05)

(a) F'_2 = experimental flux values for C′(52%) + S(93%) — conditions.
(b) The values in parenthesis are the mean square deviations.

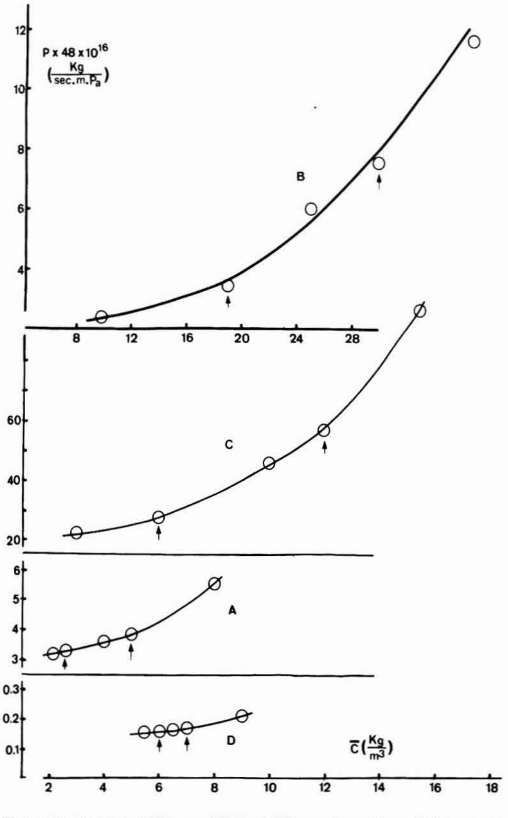


Figure 3—Permeability coefficient (P) as a function of the mean water concentration ($\bar{C}$) for the organic coatings investigated

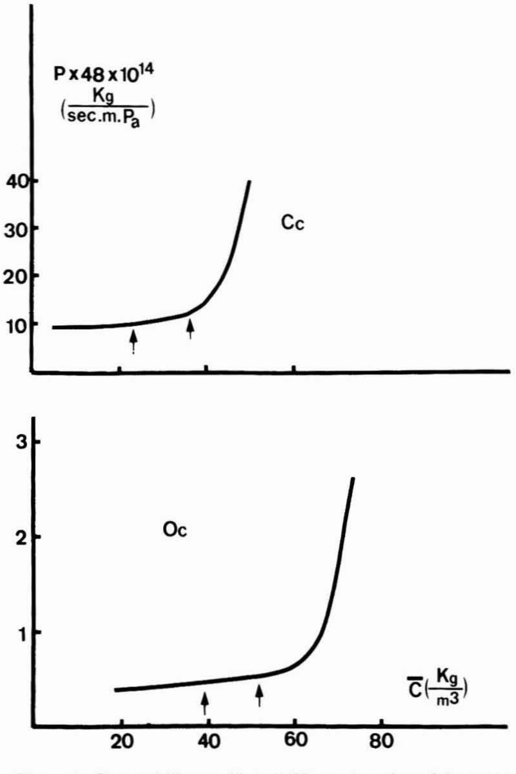


Figure 4—Permeability coefficient (P) as a function of the mean water concentration ($\bar{C}$) for the two substrates investigated (O_c = ordinary concrete; C_c = cellular concrete)

and/or to difficulties in determining correctly the coating thickness from values of weight, density, and area. For paints applied on C_c, due to the larger pore size of the substrate, the effect of filtration is probably negligible. This may explain the relatively good agreement between the calculated and the experimentally determined fluxes. Another factor which can affect the results, but was not considered here, is the existance of the boundary layer resistance.[12]

SUMMARY

Equation $L/P = \sum_{1}^{n} Li/Pi$ is often used in practice to calculate the water vapor permeability of a composite system under steady state conditions. This equation requires only that the permeability coefficients and the thickness of the system components be known. However, this equation can be used correctly only if the laws of Fick and Henry are obeyed by each component. The present study shows that these observations are also valid for composite systems made from organic coatings and porous building materials.

When the above laws were not obeyed, the permeability was dependent on the flow direction. In such cases, a system was more permeable when the component for which permeability increased more strongly with increasing the water concentration (or vapor pressure), was exposed at the upstream boundary (i.e., the side exposed to the higher relative humidity).

By taking into consideration the permeability coefficient dependence on concentration, one could also explain the reason why the equation, under some experimental conditions, might correctly predict the flow, while failing to do so under other experimental conditions. This approach also suggests the possibility that, if under one set of experimental conditions the flux in one direction (e.g., F_1) is higher than the flux in the opposite direction (e.g., F_2), under different experimental conditions the contrary might occur, i.e., $F_2 > F_1$.

The present study also shows that, even if each separate component behaves ideally, if an interaction (physical or chemical) between components occurs, the above equation cannot be used. In the present work, this was noted for the coatings applied on the ordinary concrete and is probably due to a penetration-filtration effect of the paints. These findings demonstrate that the flow direction cannot be ignored in permeability measurements.

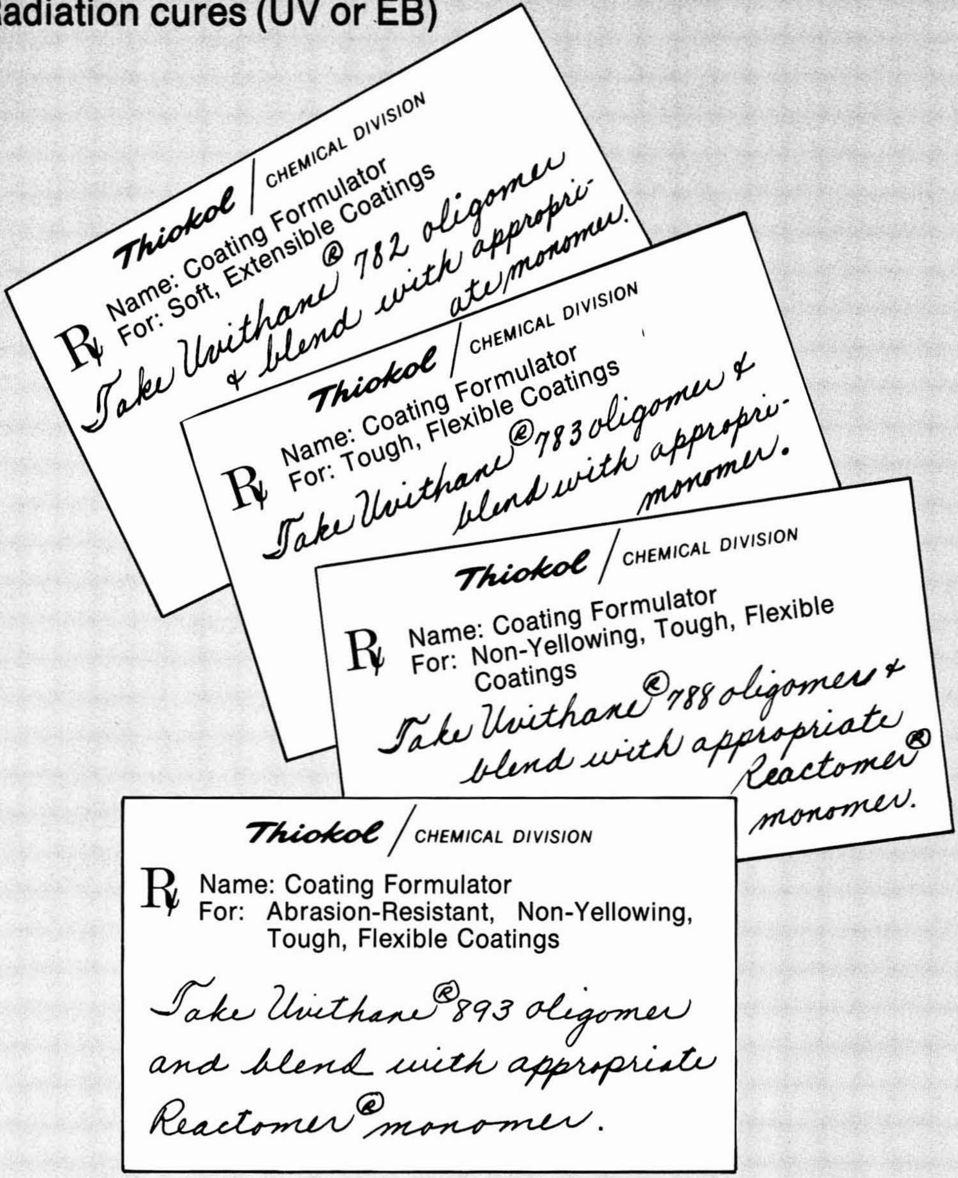
ACKNOWLEDGMENTS

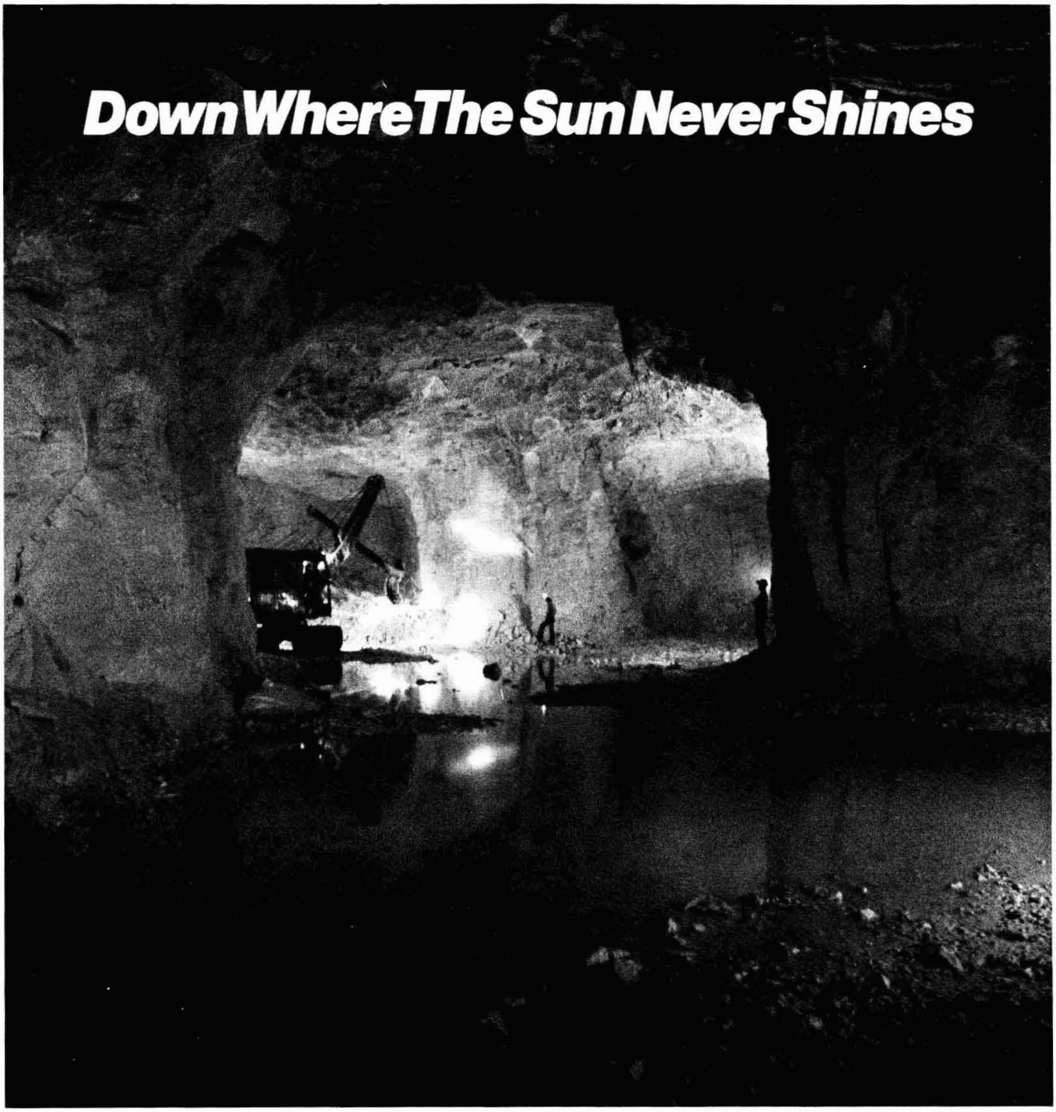
The authors wish to thank Dr. P. Janssen Bennynck, Director of "Laboratoire I.V.P.," for helpful discussions during the writing of this paper and to Mr. B. Lindberg, of the Scandinavian Paint and Printing Ink Research Institute, for permission to consult his unpublished results.

This work was supported by "l'Institut pour l'Encouragement de la Recherche Scientifique dans l'Industrie et l'Agriculture" (I.R.S.I.A.).

Reference

(1) Perera, D.Y., *J. Oil & Colour Chemists' Assoc.*, *61*, 309 (1978).
(2) Rogers, C.E., Stannett, V., and Szwarc, M., *Ind. Eng. Chem.*, *49*, 1933 (1957).
(3) Perera, D.Y. and Selier, P., *Progr. Org. Coatings*, *1*, 57 (1973).
(4) Funke, W., *DFBO-Mitteilungen*, *4*, 82 (1972).
(5) Perera, D.Y. and Vanden Eynde, D., *Double Liaison et Chimie des Peintures 22*, No. 243, 545 (1975).
(6) DIN-Method 52615 (1975).
(7) AFNOR-T-30-018, ASTM-D-1653-62, DIN-53-122, ISO-R-1195.
(8) Lindberg, B., (Scandinavian Paint and Printing Ink Research Institute), Unpublished Results.
(9) Perera, D.Y., Unpublished Results.
(10) Perera, D.Y. and Heertjes, P.M., *J. Oil & Colour Chemists' Assoc.*, *54*, 313 (1971).
(11) Lindberg, B., *ibid.*, *57*, 100 (1974).
(12) Hansen, C.M., *XIV FATIPEC Congress*, Budapest, 97 (1978).




Down Where The Sun Never Shines

Flash Photolysis Of Potassium Peroxymonosulfate ($KHSO_5$) With Generation of Sulfate Radical Anion And Quenching by Vinyl Monomers

Vincent D. McGinniss[†] and Ann F. Kah
Glidden Coatings & Resins, Division of SCM Corporation[*]

Flash photolysis of potassium peroxymonosulfate ($KHSO_5$) produces sulfate radical anion ($SO_4^{\bar{}}\cdot$) and hydroxyl radicals (•OH). The sulfate radical anion reacts with carbonate or bicarbonate anions to produce the long-lived carbonate radical anion ($CO_3^{\bar{}}\cdot$). This intermediate ($CO_3^{\bar{}}\cdot$) can be easily measured as it absorbs strongly at 600 to 630 nm ($\epsilon \cong 1875\ M^{-1}\ cm^{-1}$). Unsaturated monomers can intercept the $SO_4^{\bar{}}\cdot$ and the corresponding decrease in $CO_3^{\bar{}}\cdot$ absorption provides a tool for the study of all the components of a water soluble or emulsion polymerization system. The concentration of solute required to quench the reaction is a measure of the rate constant for interaction with the sulfate radical anion. Rates of interaction for $SO_4^{\bar{}}\cdot$ with unsaturated molecules were correlated with ionization potential of the monomers.

INTRODUCTION

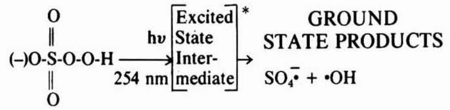
Sulfate radical anions ($SO_4^{\bar{}}\cdot$) and peroxide radicals are common initiator systems used in emulsion polymer recipes.[1,2] Previous studies have indicated that, when $SO_4^{\bar{}}\cdot$ is generated by the flash photolysis of $K_2S_2O_8$, the rate of quenching by various components used in emulsion polymerization reactions depends primarily upon the ionization potential of the dissolved material.[3] In this work, it was of interest to examine the flash photolysis of potassium peroxymonosulfate ($KHSO_5$ - Oxone), which is capable of producing both $SO_4^{\bar{}}\cdot$ and • OH, to see if mechanisms similar to those proposed for $K_2S_2O_8$ might apply to this system. Oxidation reactions with organic substrates and oxone have been detailed.[4]

EXPERIMENTAL

The experimental details of the flash photolysis techniques and apparatus used in these experiments have been published elsewhere.[3] Potassium peroxymonosulfate (Oxone® - Dupont Industrial Chemicals Dept.) was used as received and solutions were freshly prepared immediately before irradiation. Commercial monomers were used as received. All reactions in the absence or presence of monomers in solution were carried out at constant $[CO_3^{=}] = 0.058M$ and $[KHSO_5] = 0.013M$.

RESULTS AND DISCUSSION

Direct photolysis of water soluble peroxymonosulfate ($\lambda_{254\ nm}$, $\epsilon \cong 11\ M^{-1}\ cm^{-1}$) can result in several decomposition pathways:



$$(-)O-\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle O}{\|}}{S}}-O-O-H \xrightarrow[254\ nm]{h\nu} \boxed{\begin{matrix}\text{Excited}\\\text{State}\\\text{Inter-}\\\text{mediate}\end{matrix}}^{*} \rightarrow \begin{matrix}\text{GROUND}\\\text{STATE PRODUCTS}\\ SO_4^{\bar{}}\cdot + \cdot OH\end{matrix} \qquad (1a)$$

$$(-)\ SO_5H + \cdot OH \longrightarrow SO_5^{\bar{}}\cdot + H_2O \qquad (1b)$$

$$SO_4^{\bar{}}\cdot + H_2O \rightleftharpoons HSO_4^{\bar{}}\cdot + \cdot OH \qquad (2)$$

$$2\cdot OH \longrightarrow H_2O + 1/2\ O_2 \qquad (3)$$

$$SO_4^{\bar{}}\cdot + SO_4^{\bar{}}\cdot \longrightarrow \text{Short-lived (30 to 40}\mu\text{ sec) bimolecular decay process} \qquad (4)$$

and in the presence of carbonate ion

$$SO_4^{\bar{}}\cdot + CO_3^{=} \longrightarrow CO_3^{\bar{}}\cdot + SO_4^{2-} \qquad (5)$$

$$CO_3^{\bar{}}\cdot + CO_3^{\bar{}}\cdot \longrightarrow \text{Long-lived (10-30 m sec) bimolecular decay process} \qquad (6)$$

---

[*] 16651 Sprague Rd., Strongsville, Ohio 44136.

[†] Dr. McGinniss is now associated with Battelle Columbus Laboratories, 505 King Ave., Columbus, Ohio 43201.

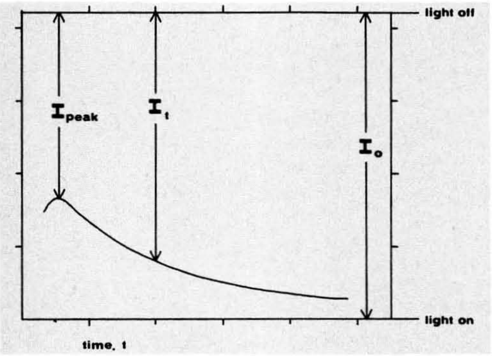


Figure 1—Oscilloscope trace from which O.D. is measured. This decay curve represents $CO_3^{\overline{\cdot}} + CO_3^{\overline{\cdot}}$ bimolecular interaction (λ = 600 nm)

An example of the generation of $CO_3^{\overline{\cdot}}$ (via peroxymonosulfate flash photodecomposition) and the observable bimolecular decay of $CO_3^{\overline{\cdot}}$ [equation (6)] is given in *Figure* 1. In the ideal case, a plot of 1/O.D. vs. time should be exactly linear. *Figure* 2, however, shows a high degree of curvature, indicating that this decay is not a simple bimolecular process (ideal behavior can be observed with flash photolysis of $K_2S_2O_8/HCO_3^-$ ($CO_3^=$) and subsequent $CO_3^{\overline{\cdot}}$ formation.)[3,5,6] A first order plot (*Figure* 3) also shows curvature indicating complications in the deactivation of the excited state transients.[7] At this time a simple mechanism cannot be proposed to explain these observations.

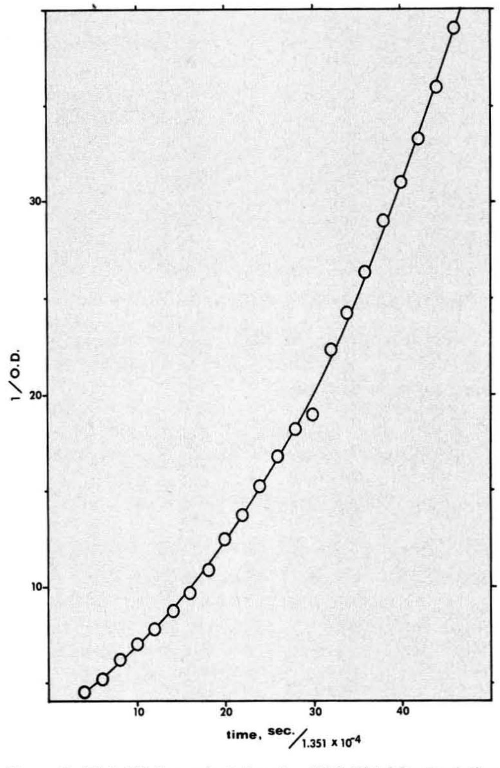


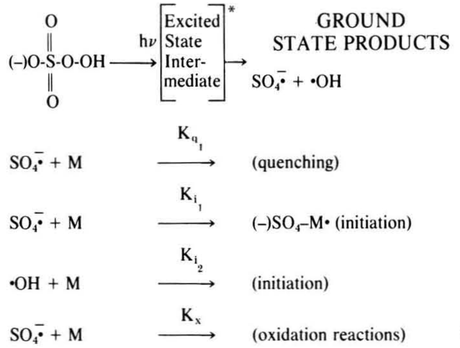
Figure 2—Plot 1/O.D. against time for KSO_5H/K_2CO_3: Deviation from linearity indicates a more complicated deactivation process

Identification of the $CO_3^{\overline{\cdot}}$ spectrum is given in *Figure* 4. An Optical Density vs. wavelength plot for this transient absorption shows $\lambda_{max.}$ at 600 to 630 nm. Experimentally determined points agree well with literature values for the shape of the curve associated with the carbonate radical anion.[5,6]

Interaction of Monomers With $SO_4^{\overline{\cdot}}$

In emulsion polymerization reactions, the monomer can be initiated from the aqueous phase by the sulfate radical anion ($SO_4^{\overline{\cdot}}$). If the emulsion contains negatively charged monomer-polymer droplets (anionic emulsifier), then the negatively-charged particle-water interface repels the sulfate-ion radicals and initiation takes place primarily with the dissolved monomer fraction (homogeneous solution) resulting in oligomeric radical formation.[8] It is this initial stage of reaction and the relative rate of quenching of $SO_4^{\overline{\cdot}}$ by different types of monomers with regard to their chemical structure that are of primary concern.

Direct observation of the quenching of $SO_4^{\overline{\cdot}}$ with various monomers could not be followed with our present equipment, but the competition between $CO_3^=$, $SO_4^{\overline{\cdot}}$ and monomers [M] could be monitored as shown by the following equations:



$$(-)O\text{-}\overset{\overset{\displaystyle O}{\|}}{\underset{\underset{\displaystyle O}{\|}}{S}}\text{-}O\text{-}OH \xrightarrow{h\nu} \left[\begin{array}{l}\text{Excited}\\ \text{State}\\ \text{Inter-}\\ \text{mediate}\end{array}\right]^* \rightarrow \begin{array}{c}\text{GROUND}\\ \text{STATE PRODUCTS}\\ SO_4^{\overline{\cdot}} + \cdot OH\end{array}$$

$$SO_4^{\overline{\cdot}} + M \xrightarrow{K_{q_1}} \text{(quenching)} \qquad (7)$$

$$SO_4^{\overline{\cdot}} + M \xrightarrow{K_{i_1}} (-)SO_4\text{–}M\cdot \text{ (initiation)} \qquad (8)$$

$$\cdot OH + M \xrightarrow{K_{i_2}} \text{(initiation)} \qquad (9)$$

$$SO_4^{\overline{\cdot}} + M \xrightarrow{K_x} \text{(oxidation reactions)} \qquad (10)$$

$$SO_4^{\overline{\cdot}} + CO_3^= \xrightarrow{K_r} CO_3^{\overline{\cdot}} + SO_4^{2-} \qquad (11)$$

$$SO_4^{\overline{\cdot}} + SO_4^{\overline{\cdot}} \xrightarrow{K_{q_2}} \text{(bimolecular quenching - } \textit{non-observable}\text{)} \qquad (12)$$

$$CO_3^{\overline{\cdot}} + CO_3^{\overline{\cdot}} \xrightarrow{K_{q_3}} \text{(bimolecular quenching - } \textit{observable}\text{)} \qquad (13)$$

Figure 5 gives the change in initial OD (λ = 600 nm) as a function of monomer concentration [M] and monomer chemical structure. These linear semi-logarithmic plots measure relative interaction of monomers and $CO_3^=$ with the sulfate radical anion. When a monomer is present, its unsaturation competes for the sulfate radical anion. Hence, the initial O.D. readings decrease in a predictable manner with increasing monomer concen-

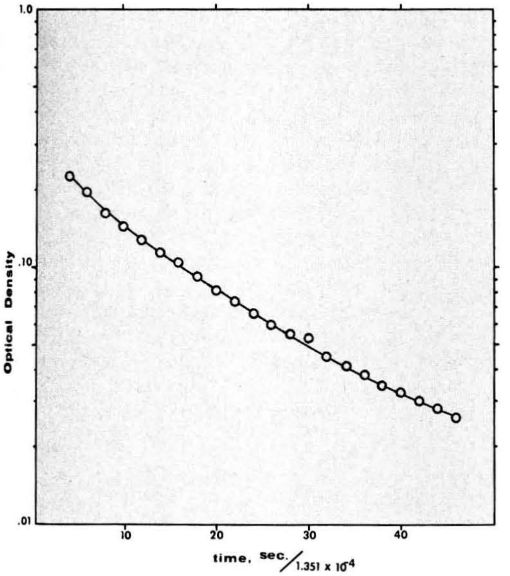


Figure 3—Plot log O.D. against time for KSO_5H/K_2CO_3: Deviation from linearity indicating complications for deactivation of excited state transients

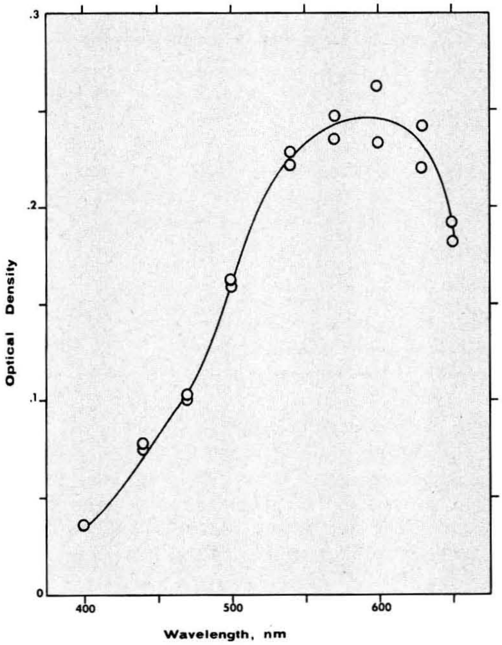
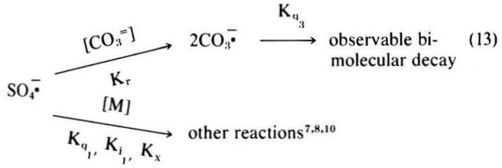


Figure 4—Spectrum of $CO_3^{\overline{\cdot}}$ transients observed; it is consistent with reference (6)

trations as qualitatively depicted in the following scheme:



$$SO_4^{\overline{\cdot}} \begin{array}{l} \xrightarrow[K_r]{[CO_3^{=}]} 2CO_3^{\overline{\cdot}} \xrightarrow{K_{q_3}} \text{observable bimolecular decay} \\ \xrightarrow[K_{q_1}, K_{i_1}, K_x]{[M]} \text{other reactions}^{7,8,10} \end{array} \quad (13)$$

In *Figure* 5, the computer generated slopes (all with greater than 0.94 correlation) for the change in O.D. versus log [M] are mostly parallel, except for VA and MMA, and do not indicate any obvious significance to the rate of quenching for each different class of monomers studied. These monomers (*Figure* 5) do, however, distribute themselves into discrete concentration ranges as an effective measure of molecular structure for this type of reaction.[3]

In order to determine the approximate bimolecular rate constants for $SO_4^{\overline{\cdot}} + M$, the following competitive reactions were examined:

$$SO_4^{\overline{\cdot}} + HCO_3^- \xrightarrow{Kr = 9.1 \times 10^6 \ M^{-1}\ sec^{-1}} \text{products } (CO_3^{\overline{\cdot}})$$

$$SO_4^{\overline{\cdot}} + M \xrightarrow{K'} \text{polymer formation, oxidation or quenching}$$

where K′ is a composite approximate rate constant involving and related to Kq_1, Ki, and Kx.* The extrapolated intercept value for monomer concentration

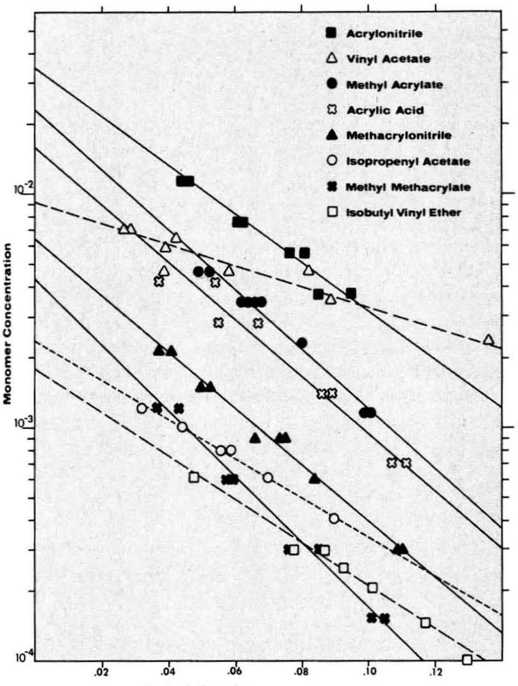


Figure 5—Quenching of $SO_4^{\overline{\cdot}}/CO_3^{\overline{\cdot}}$ absorption as a function of the concentration of the added monomers

---

*At this time it is not possible to distinguish or separate the individual rate constants Kq_1, Ki, and Kx from a composite reaction rate constant K′.

Table 1—Approximate Values of Monomers

Monomer	Ionization Potential (eV)	K′ (from $[M]_{intercept}$)	K′ (from $[M]_{1/2}$)
VoAc, iBVE, iPPAc	8.74-9.74	0.057, 0.30, 0.23×10^9 M^{-1} sec^{-1}	0.185, 1.10, 0.88×10^9 M^{-1} sec^{-1}
MMA	10.23 (est)	0.125×10^9	0.73×10^9
MAN	10.37	0.082×10^9	0.459×10^9
Acrylates	10.41-10.52 (est)	0.33×10^8	0.137×10^9
MA	10.72	0.23×10^8	0.108×10^9
AN	10.92	0.15×10^8	0.064×10^9

Monomer concentration values taken from *Figure* 5.

at OD = O (*Figure* 5) indicates almost complete interaction of $SO_4\bullet$ and M, while the $[HCO_3^-]$ remains essentially constant ($SO_4^{-}\bullet + M >> SO_4^{-}\bullet + HCO_3^-$). When the monomer concentration is sufficient to quench 50% of the reaction with HCO_3^-, the two major competing reactions are equivalent, therefore

$$K' \alpha \frac{[HCO_3^-]\ [Kr]}{[M]}$$

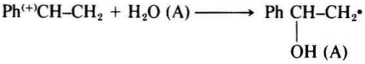
There is always some finite proportion of the $SO_4^{-}\bullet$ decaying bimolecularly, but this is not measured, and is disregarded in these calculations. For the monomers studied in *Figure* 5, K′ was calculated using both $[M]_{intercept}$ and $[M]_{1/2}$ to give a range of approximate values (*Table* 1).

The monomer concentration intercept values (monomer concentration at O.D. = 0) or single monomer concentration points taken at O.D. = 0.06 (*Figure* 5), can be strongly correlated with ionization potential (I.P.) for several of the monomers used in this study (*Figure* 6). This correlation (correlation coefficient 0.99) for the semi-logarithmic plot of *Figure* 6 indicates that the ratio K_r/K_{i_1}, K_{q_1}, K_x, etc., depends not only on monomer availability in solution, but also on its chemical structure. Solutions containing vinyl monomers with low I.P. values [isobutyl vinyl ether (8.74 eV) and isopropenyl acetate (9.74 eV)] show approximately the same degree of quenching efficiency (change in O.D./[M]. Only slight structural distinction for interaction efficiency (*Figure* 5), with gradual increase in monomer concentrations, is shown. This is an indication that the rates of $SO_4^{-}\bullet$ quenching for low I.P. valued monomers (up to I.P. values of 10 eV) may be near or at diffusion controllable limits. Monomers having I.P. values greater than 10 eV [methacrylonitrile (10.37 eV), methyl acrylate (10.72 eV), acrylonitrile (10.91 eV)] show distinct changes in O.D./[M] (*Figure* 5) and strong correlations between chemical structure (I.P.) and O.D./[M] (*Figure* 6). (Ionization potential values for vinyl monomers were obtained from references 9, 10 and 11).

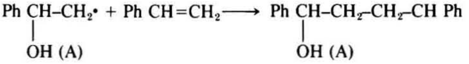
The intercept monomer concentrations (O.D. = 0, *Figure* 5) for complete quenching of $SO_4^{-}\bullet$, generated via flash photolysis of KSO_5H, are directly correlatable with intercept monomer concentrations for the complete quenching of $SO_4^{-}\bullet$, generated via flash photolysis of $K_2S_2O_8$, (*Figure* 7, correlation coefficient 0.98). These results indicate similar mechanisms are operable for $SO_4^{-}\bullet$ quenching in the presence, or absence, of hydroxyl radicals.

Rates of $SO_4^{-}\bullet$ quenching with substituted aromatic compounds follow similar mechanistic pathways in that electron donating substituents (low I.P. values 8.22 to 9.55 eV) show large rate constants for $SO_4^{-}\bullet$ interaction and electron withdrawing substitutes (high I.P. values 9.7 to 9.92 eV) give rate constants of 10^6 to 10^8 M^{-1} sec^{-1}. These constants for $SO_4^{-}\bullet$ interaction with aromatic substrates and quenching dependence on electron donating or withdrawing substituents are consistent with an electron transfer mechanism from the aromatic ring to the sulfate radical anion.[12] Another electron transfer mechanism was shown to be important for reaction involving $SO_4^{-}\bullet$ and styrene (I.P. = 8.47 eV).[13]

$$SO_4^{-}\bullet + PhCH{=}CH_2 \longrightarrow SO_4^{=} + Ph^{(+)}CH{-}CH_2 \qquad (14)$$



$$Ph^{(+)}CH{-}CH_2 + H_2O\ (A) \longrightarrow Ph\ \underset{\substack{|\\ OH\ (A)}}{C}H{-}CH_2\bullet \qquad (15)$$



$$Ph\ \underset{\substack{|\\ OH\ (A)}}{C}H{-}CH_2\bullet + Ph\ CH{=}CH_2 \longrightarrow Ph\ \underset{\substack{|\\ OH\ (A)}}{C}H{-}CH_2{-}CH_2{-}CH\ Ph \qquad (16)$$

where A = anions such as $C1^-$, $SO_4^=$, etc. These equations (14-16) offer possible explanation for hydroxyl and sulfate endgroup functionality on emulsion polymer particles, derived from low I.P. valued monomers, other than direct radical addition mechanisms.[8]

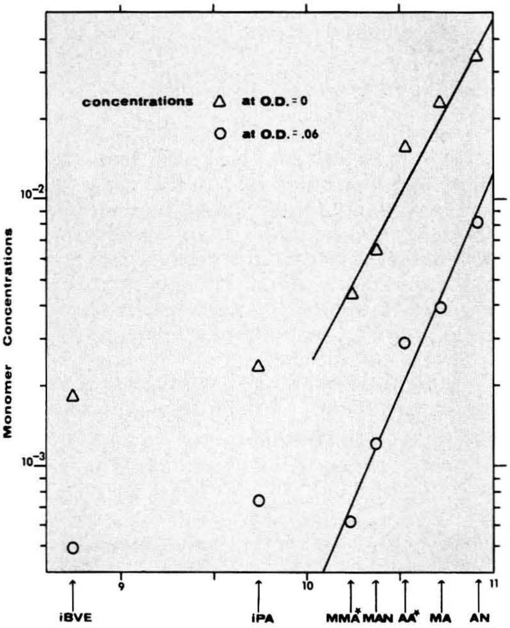


Figure 6—Concentration of monomers (at a constant O.D.) as a function of ionization potential. Estimated values for ionization potential are taken from references (3) and (11)

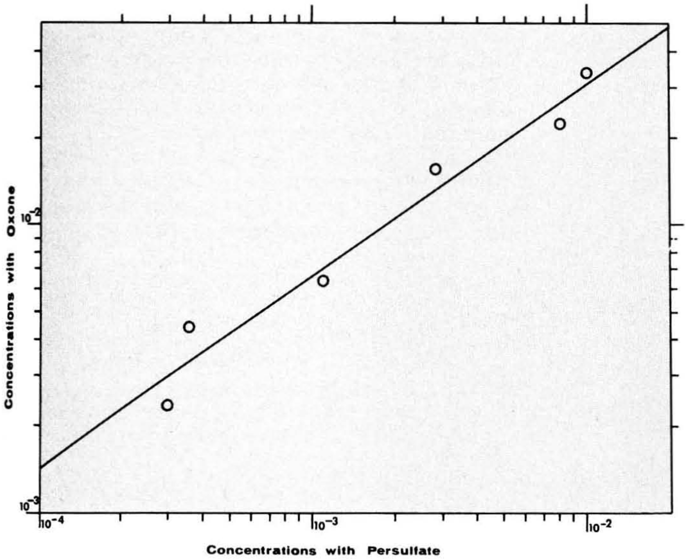


Figure 7—Correlation between intercept monomer concentrations for the complete quenching of $SO_4^{-}\cdot$ generated via flash photolysis of $K_2S_2O_8$[3] and intercept monomer concentrations of *Figure* 5 for quenching of $SO_4\cdot$ generated from flash photolysis of KSO_5H.

The only exception to this trend of low I.P. valued monomers quenching $SO_4^{-}\cdot$ at a greater rate or lower monomer concentrations than higher I.P. valued monomers was vinyl acetate (I.P. = 9.19 eV). This behavior was observed only with $KHSO_5$ and not $K_2S_2O_8$ flash generated $SO_4^{-}\cdot$ transients. It is possible that another interaction mechanism, specific to vinyl acetate, is occurring but the difference between $KHSO_5$ and $K_2S_2O_8$ photogeneration and subsequent quenching of $SO_4\cdot$ by vinyl acetate cannot be explained at this time.

In this study absolute values for the individual rate constants associated with the consumption of $SO_4^{-}\cdot$ were not able to be specified. Hence, changes in $SO_4\cdot$ concentration were expressed in the following manner:

$$-\frac{d[SO_4^{-}\cdot]}{dt} = K'[SO_4^{-}\cdot][M],$$

where

$$K' = K_q + K_i + K_x.$$

It is possible, however, to approximate values for these individual rate constants from previous experiments involving $SO_4^{-}\cdot$ oxidation and quenching reactions of organic molecules.[3,12]

Average values for combined rate constants ($K_q + K_x$) associated with $SO_4^{-}\cdot$ oxidation of methanol, ethanol, and isopropanol (ionization potential values range between 10.85 and 10.16 eV) are between 1.98 and 45 × 10^7 M^{-1} sec^{-1}.[3] The average composite rate constant K′ values determined in this study for monomers having ionization potential values in the range of 10.92 and 10.23 eV (acrylonitrile, methyl acrylate, etc; see *Table* 1) are between 1.5 and 73 × 10^7 M^{-1} sec^{-1}. The difference between K′ values and ($K_q + K_x$) values obtained for a general class of oxidation reaction, within a similar ionization potential category, results in an approximate value range for K_i between 4.8 × 10^6 M^{-1} sec^{-1} and 28 × 10^7 M^{-1} sec^{-1}. This is in good agreement with other published initiating radical-monomer interaction systems having second order K_i values between 10^5 and 10^7 M^{-1} sec^{-1}.[14,15]

If, in an emulsion polymerization system, a given component (monomer, surfactant, or stabilizer) has a larger K_q, K_x value than K_i for the polymerizing monomer, then a severe reduction in reaction efficiency would be expected. If for a given monomer $K_i >> K_q$, K_x for other components or different monomer species, then the polymerization reaction should be very efficient. If there are large differences in K_i values between different monomer components in a mixed feed, one might expect partial depletion of one monomer over the other during the initial stages of the reaction.

PRACTICAL IMPLICATIONS OF KINETIC ANALYSIS

In a commercial emulsion polymerization system, utilizing $KHSO_5$ as the initiator, the following factors become important for consideration:

(1) Water Phase Initiation ($K_{i_{1,2}}$)—complete or efficient encounter of $SO_4^{-}\cdot$ and •OH with solubilized monomer to produce oligomeric materials which then propagate into surfactant stabilized polymeric particles.

(2) Oxidation (K_x)—unwanted side reactions involving $SO_4^{-}\cdot$ with monomers, surfactants, or colloid stabilizers leading to inefficient reaction pathways.

(3) Quenching ($K_{q_{1,2}}$)—ground state interactions of $SO_4\cdot$ with other radical species, monomers, surfactants, and colloid stabilizers leading to reactions other than those associated with initiation or oxidation.

(4) HYDROXYL RADICAL REACTIONS—hydroxyl radicals are probably subject to the same types of inefficient deactivation reaction pathways as observed for $SO_4^{\overline{\bullet}}$, such as quenching ($K_q$) and oxidation ($K_x$), but were neglected in this study as they could not be observed either directly or indirectly under these experimental conditions. Even solutions of hydrogen peroxide (H_2O_2) did not generate observable transients as are reported for $K_2S_2O_8$ and $KHSO_4$.

$$H_2O_2 \xrightarrow[254\text{ nm}]{h\nu} 2\,HO\bullet \qquad \text{not observable}$$

$$\begin{array}{ll} HO\bullet + CO_3^{=} \longrightarrow & \text{no observable transients} \\ \left.\begin{array}{l} HO\bullet + HO\bullet \text{ or } M \longrightarrow \\ HO\bullet + M \xrightarrow{K_x} \end{array}\right\} & \left.\text{products}\right\} \text{ not observable} \end{array}$$

In this discussion, possible $SO_4^{\overline{\bullet}}$ competitive reactions taking place during emulsion polymer preparations will be the main concern.

Differences in overall initiation rates and polymerization efficiency might become apparent for cases involving competition between $SO_4^{\overline{\bullet}}$ with mixed monomer systems or $SO_4^{\overline{\bullet}}$ competitive interaction between monomer, surfactants, and colloid stabilizer materials. Wasteful competition reactions are governed by monomer, surfactant, and colloid availability or solubility in the water phase, as well as the individual ionization potential value (chemical structure) for each component in the emulsion polymerization system.

In a mixed monomer emulsion polymerization system, assuming equivalent monomer reactivity and water solubility, lower ionization potential valued monomers should interact with $SO_4^{\overline{\bullet}}$ much faster than or relative to a higher ionization potential valued monomer component (*Figures* 5 and 6 and *Table* 1). A difference in rate of interaction between $SO_4^{\overline{\bullet}}$ and mixed monomer systems could lead to changes in latex polymer morphology or water sensitivity, depending on the chemical structure of the monomers initially charged in the reaction flask during the emulsion polymerization reaction.[16]

In a similar manner, colloid stabilizers or surfactants which are easily oxidized (polyethers, alcohols, mercaptan or thioether-terminated oligomeric surfactants) will show a preferential consumption of $SO_4^{\overline{\bullet}}$, instead of allowing for $SO_4^{\overline{\bullet}}$ interaction with a dissolved vinyl monomer. This competition among $SO_4^{\overline{\bullet}}$ and monomer-surfactant components leads to a lowering of the overall polymerization rate efficiency, a decrease in polymer solution viscosity, and it improves the freeze-thaw resistance of the latex.[17]

References

(1) Bovey, F. A., Kolthoff, I. M., Medalia, A. I., and Meehan, E. J., "Emulsion Polymerization," Interscience Publishers, Inc., N.Y., 1955.
(2) Blackley, D. C., "Emulsion Polymerization," J. Wiley and Sons, N.Y., 1975.
(3) McGinniss, V. D. and Kah, A. F., JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 634, 61 (1977).
(4) Kennedy, R. J. and Stock, A. M., *J. Org. Chem.*, *25*, 1901 (1960).
(5) Dogliotti, L. and Hayon, E., *J. Phys. Chem.*, *71*, 2511 (1967).
(6) Weeks, J. L. and Rabani, J., *ibid.*, *70*, 2100 (1966).
(7) Weissberger, A., "Technique of Organic Chemistry," Volume VIII - parts I and II, Interscience Publishers, N.Y., 1961 and 1963.
(8) Vanderhoff, J. W., Symposium "Advances in the Characterization of Metal and Polymer Surfaces," Centennial ACS Meeting, N.Y., April 4-9 (1976).
(9) Watanabe, K., Nakayama, T., and Mottl, J., *J. Quant. Spectrosc. Radiat. Transfer*, *2*, 369 (1962).
(10) Houk, K. N. and Manchausen, L. L., *J. Am. Chem. Soc.*, *98*, 937 (1976).
(11) McGinniss, V. D., Unpublished results.
(12) Neta, P., et al., *J. Am. Chem. Soc.*, *99*, 163 (1977).
(13) Ledwith, A. and Russell, P. J., *Polymer Letters*, *13*, 109 (1975).
(14) Kuhlmann, R. and Schnabel, W., *Polymer*, *18*, 1163 (1977).
(15) Ito, O. and Matsuda, M., *Polymer Preprints*, *20*, 562 (1979).
(16) Hoy, K., "Effect of Reaction Pathway on Emulsion Polymer Structure," JOURNAL OF COATINGS TECHNOLOGY, *51*, No. 651, 27 (1979).
(17) Levine, E. et al., JOURNAL OF PAINT TECHNOLOGY, *41*, No. 537, 531 (1969).

Society Meetings

Birmingham May 3

E.E. Millington, of I.P.I.C., spoke on "CATHODIC ELECTROPAINTS—CURRENT STATUS OF THE AUTOMOTIVE MARKET."

Developments of the commercial operation of anodic electropaints, said Mr. Millington, can be divided into three generations. Generation I (1963-67) anodic electropaints were based on simple resin systems such as maleinized vegetable oils, showed poor corrosion resistance and throwing power, and had a limited color range. Generation II (1967-71) electropaints were based on resins modified with phenolics and melamines, showed improved throwing power and bath stability, but still had a limited color range. Generation III (1971-76) saw the use of synthetic resins from petroleum derivatives, which resulted in great improvement in corrosion and cosmetic corrosion performance, and a wider color range, continued Mr. Millington. This system is currently in use in the U.K. at Ford.

The development of cathodic electropaints from 1976 onward could be considered Generation IV. These are based on 100% synthetic resin such as epoxies, and show dramatic improvements in resistance to corrosion, cosmetic corrosion, and throwing power. Excellent bath stability and a wide color range are other features of this system.

Mr. Millington went on to say that one of the problems of the anodic system is dissolution of the substrate, which reduces corrosion resistance. It was first thought that cathodic deposition did not dissolve the substrate and, hence, gave a very pure film. However, recent work has shown that a very small amount of iron dissolution occurs with the cathodic system.

Q. Is the cathodic dissolution enough to cause staining in white electropaints?

A. Yes.

Q. Does the cathodic electropaint have an effect on the intercoat adhesion of subsequent coats?

A. We haven't seen any adhesion problems using acrylics.

BRIAN F. GILLIAM, *Publicity Officer*

C-D-I-C May 14

The following officers were elected for the year 1979-80: President—Robert A. Broerman, of Tenneco Chemicals, Inc.; Vice-President—W.J. Frost, of Ashland Chemical Co.; Secretary—Robert D. Thomas, of Perry & Derrick Co., Inc.; and Treasurer—Nelson W. Barnhill, of Inland Div., General Motors Corp.

Officers of the Los Angeles Society for 1978-1979. (left to right): Vice-President—Albert Seneker, of Ameron Corp.; Secretary—Jan. P. Van Zelm, of McCloskey Varnish Co.; President—Fred Croad, of Engard Coatings Corp.; and Secretary—Donald I. Jordan, of Cargill, Inc.

The educational speaker, Bob Donnellon, of Cincinnati Gas & Electric Co., spoke on "NUCLEAR POWER."

W.J. FROST, *Secretary*

Golden Gate May 14

David Busker, of Kenrich Petrochemicals, Inc., spoke on "TITANATE COUPLING AGENTS IN COATINGS."

Mr. Busker mentioned that titanates can: reduce polymer innercoatings without reducing desirable properties; aid corrosion resistance; improve hegman grind; improve tintorial strength; allow for higher filler loading in thermo plastics; help extend resin with calcium carbonate; help eliminate solvent; aid conductivity; and increase production and lower mixing energy.

Mr. Busker also said that titanates are hydrophobic and insoluble, and must be compatible with the vehicle. He also stressed the order of addition: base polymer, solvent or water, and titanate-percentage based on pigment or extender.

Q. How is the titanate introduced to the phosphate system on bare steel?

A. One percent is ample.

Q. How does it relate to low viscosity for settling?

A. It depends on the system. Some will give a natural thixatropic reaction and prevent settling.

SHARON VADNAIS, *Secretary*

Los Angeles May 9

A moment of silence was observed in memory of J.V. Dostalik, of Dostachem, who died recently.

Twenty-five year pins were awarded to W.F. Benson, M.P. Eisner, C.W. Finegan, H.W. George, A.D. Giordano, E.A. Gross, F.T. Hawlish, F.D. Holmes, T.C. Jensen, G.M. Kashmer, B. Krantz, E.H. Marberg, W.D. Meadows, W.C. Metcalf, H.J. Miles, J. Misity, C.W. Nelson, R.E. Nemzek, R.L. Price, L.F. Smith, J.R. Snell, C.F. Springer, L.E. Starks, F.E. Stewart, and G.J. Western.

David Busker, of Kenrich Petrochemicals, Inc., who spoke on "TITANATE COUPLING AGENTS IN COATINGS."

Mr. Busker explained that coupling agents are molecular bridges between the interface of an organic filler and an organic polymer matrix. He said that titanium derived coupling agents are unique in that their reaction with the free protons at the inorganic interface results in the formation of organic monomolecular layers on the inorganic surface. He further stated that the absence of polymolecular layers at the interface, together with the chemical structure of the titanates, create a novel surface modification resulting in viscosity reduction in excess of coupling agents heretofore known.

Q. Can titanates be added to a slurry (already mixed) of polymer resin and calcium carbonate?

A. This would not be very effective since titanates preform by removing the hydrogen proton.

JAN P. VAN ZELM, *Secretary*

Officers of the New England Society of Coatings Technology for 1978-1979. (left to right): Secretary—Robert G. Modrak, of Benjamin Moore & Co.; President—Martin L. Davis, of Sterling-Clark-Lurton Corp.; and Treasurer—Gil Sullivan, of Independent Packaging.

New York May 8

Among the honored guests in attendance were Frank J. Borrelle, Federation Executive Vice-President and Tom Kocis, Federation Field Director.

The following officers were elected for the year 1979-80: President—Sidney J. Rubin, of Greenpoint Paint & Varnish Co.; Vice-President—Marvin J. Schnall, of Troy Chemical Corp.; Secretary—Donald E. Brody, of Skeist Laboratories, Inc.; and Treasurer—Theodore Young, of Jesse S. Young Co., Inc.

Richard Max announced the formation of an Ad Hoc Committee on waste disposal, and asked those interested in joining the committee to contact him or Bob Rossomando, of the New York Paint and Coatings Association.

Don Brody, Chairman of the Education Committee, reported that the Fundamentals of Coatings Technology Course will be repeated for the ninth year, starting this fall.

Morris Coffino, of D.H. Litter Co., Inc., was presented with the 1979 PaVaC Award for his outstanding contributions to the coatings industry and to the New York Society.

Detroit Society Officers for 1978-1979. (left to right): President—Mackenzie Endo, of Ford Motor Co.; Vice-President—Walter C. Stuecken, of Grow Chemical Co.; Treasurer—G.M. Sastry, of Chrysler Corp.; Secretary—Gary Van De Streek, of Wyandotte Paint Products; and Society Representative—Harry B. Majcher, of Standard Detroit Paint Co.

Milton Goll, of Cosan Chemical Corp., spoke on "BIODETERIORATION OF ORGANIC COATINGS—STATE OF THE ART."

Mr. Goll began by reviewing the history of microbiological involvement with coatings. He then indicated the need for better laboratory testing so that results will correlate better with field exposure. With regard to can spoilage, he indicated that this occurs in a reduced oxygen or, at times, in an anaerobic environment.

The problem of viscosity loss in paints due to the breakdown of cellulosic thickeners was discussed at length. For some time, cellulase enzymes were believed to be the major cause of this viscosity loss, but more recent work indicates that residual redox catalysts present in the latex or other raw materials may be an important factor. Mr. Goll pointed out the need for a greater understanding of the effects of formulation ingredients on biodeterioration. He also stressed the importance of good plant housekeeping, and felt these factors may be more significant than the use of anti-microbial agents.

Mr. Goll briefly reviewed the available biocides, and indicated that phenylmercurials, which still constitute 40% of total biocide sales, are generally more effective than nonmercurials, especially in latex paints. Organic fungicides are satisfactory in solvent-based paints but are generally poor in latex paints. He pointed out that the EPA hearings vindicated mercury as a source of toxicity in paints, and also confirmed the reduced efficiency of nonmercurials.

Q. Is it possible to test thinned latex paint to determine the cause of the viscosity loss?

A. Some hydrolase enzymes and some redox catalysts can be identified, but this work is incomplete.

MARVIN J. SCHNALL, *Secretary*

Pacific Northwest, Vancouver Section April 19

Robert Lattie, of Atlas Electric Devices Co., spoke on "ACCELERATED WEATHERING—YESTERDAY, TODAY, AND TOMORROW."

Mr. Lattie discussed the history of accelerated weathering, from the fade meters of the early 1900's to the sophisticated units of today.

R.P. STEWART, *Secretary*

Philadelphia May 10

Among the honored guests in attendance was Thomas Kocis, Federation Field Director.

The following officers were elected for the year 1979-80: President—Carl W. Fuller, of Reichard-Coulston, Inc.; President-Elect—Barry Oppenheim, of McCloskey Varnish Co.; Secretary—Matthew J. Hanrahan, of Lilly Industrial Coatings, Inc.; and Treasurer—Ellis Moore, of Tenneco Chemicals, Inc.

Twenty-five year pins were awarded to Murray Abriss, Ben Chatzinoff, Matthew J. Hanrahan, Edward Barrett, Sr., Dave Engler, and Walter Strobel.

The Union Carbide film "TUESDAY, MAY 19, 1981," was shown.

The film describes the tragic results which could occur through the careless or forgetful behavior of people in the chemical industry.

BARRY OPPENHEIM, *Secretary*

Pittsburgh May 7

The following officers were elected for the year 1979-80: President—Robert Marcus, of PPG Industries, Inc.; President-Elect—Raymond Uhlig, of Technical Coatings Co.; Secretary—Richard Trudel, of Mobil Chemical Co.; and Treasurer—William Cibulas, of Mobay Chemical Co.

Carl Thorstad, of Johns-Manville Products Corp., spoke on "PHYSICAL CHARACTERISTICS OF EXTENDERS."

Mr. Thorstad showed data and graphs of pore size and pore volume for several extender pigments. The data was obtained from instruments such as the Coulter Counter, Mercury Porsimeter, Scanning Electron Microscope, and Spectrophotometers. Data derived from these instruments showed relationships between pore volume, particle size of the extender, and oil absorption.

RAY UHLIG, *Secretary*

Western New York May 8

The following officers were elected for the year 1979-80: President—Thomas E. Popovec, of National Gypsum Co.; Vice-President—George C. Reid, of Spencer Kellogg Div.; Secretary—Jay A. Robey, of Spencer Kellogg Div.; and Treasurer—Charles Glinski, of Pierce & Stevens Chemical Corp.

Robert Price, of Spencer Kellogg, spoke on "CONSERVATION ORIENTED COATING SYSTEMS."

Mr. Price pointed out that energy shortages and government regulations has caused a shift from traditional solvent thinned coatings to high solids coatings, use of permitted solvents, and water systems.

GEORGE C. REID, *Secretary*

Northwestern Society Officers for 1978-1979. (left to right): Society Representative Lowell Wood, of Frost Paint & Oil Corp.; Secretary—Roger Anderson, of Minnesota Mining & Manufacturing; G. Dale Ernst, of Tennant Co.; Don Emch, of Valspar Corp.; Tom Drucker, of Stewart Paint Co.; President—Robert Heskin, of Sinclair & Valentine; and Vice-President—Al Heitkamp, of Cargill Inc.

Elections

BIRMINGHAM

Active

Baldwin, Richard Allan — W. Cannings Materials, Ltd., Birmingham.
French, Raymond Henry — B.I.P. Ltd., Chemical Div., Warwickshire.
Heath, Elaine Mary — Blundell-Permoglaze Ltd., Birmingham.

DALLAS

Active

Culp, Michael B. — Ameron, Inc., Enmar Finishes Div., Little Rock Ark.
Patel, Mahendra J. — Western Specialty Coatings Co., Dallas, Tex.
Quaglia, Louis — DeSoto, Inc., Garland, Tex.
Salitros, James J. — Technical Coatings, Inc., Lubbock, Tex.

Associate

Broome, Joe L. — Pioneer Chemical, Inc., Dallas, Tex.
Johnson, Louis B. — Drew Chemical Corp., Ruston, La.
Rice, Clayton D. — Harmon Colors Corp., Lilburn, Ga.

LOS ANGELES

Active

Bahe, Edward J. — Whittaker Coatings & Chemicals, Colton, Calif.
Bangle, Donald R. — Aztec Chemical, Inc., San Gabriel, Calif.
Banks, Van D. — Whittaker Coatings & Chemicals, Colton.
Carbone, Victor, T. — Chemical Technology Labs, Inc., Gardena, Calif.
Cota, Eduardo — Pinturas Y Barnices Calette, San Ysidro, Calif.
Doyle, Robert L. — Ameron Protective Coatings Div., Brea, Calif.
Elder, J.L. — Sequoia Paint Co., Bakersfield, Calif.
Flint, Donald R. — Ram Chemicals, Gardena, Calif.
Floriani, Robert J. — Whittaker Coatings & Chemicals, Colton.
Milford, Ellen — Whittaker Coatings & Chemicals, Colton.
Nano, Victor N. — Chemical Technology Labs, Inc., Gardena.
Nording, Richard F. — Conchemco, Inc., Los Angeles, Calif.
Peters, Frank — Dunn Edwards, Los Angeles.
Rolker, John H. — Exxon Enterprises, Pasadena, Calif.
Rupsa, Gerald G. — DeSoto, Inc., Orange, Calif.
Schoenfeld, Jon M. — Santa Barbara Paint, Santa Barbara, Calif.
Swendseid, Russell T. — Rainproof & Colortec, North Hollywood, Calif.
Talley, Jay D. — Five Star Mfg. Co., Hawaiian Gardens, Calif.
Thompson, Carl V. — Whittaker Coatings & Chemicals, Colton.

Associate

Brede, Wallace — Spencer Kellogg Div., Long Beach, Calif.
Copenhaver, Daniel A. — Calsol, Inc., Pomona, Calif.
DiGiacomo, Tony — Dorsett & Jackson, Inc., Los Angeles, Calif.
Donohoe, Thomas D. — TCR Industries, Carson, Calif.
Fuzzard, Paul S. — Charter Chemicals, Long Beach, Calif.
Grant, Fred G. — Spencer Kellogg Div., Long Beach.
Hamilton, Edward Lee — Hilton Davis Chemical Co., Irvine, Calif.
Hassis, Carl, A. — Dorsett & Jackson, Los Angeles, Calif.
Hayford, Steven G. — Witco Chemical, Los Angeles.
Laird, Ken — Modern Coatings, Cerritos, Calif.
Parrish, L.D. — Sierra Color Chemical, Northridge, Calif.
Rozen, Raymond H. — Chase Chemical Co., Pacoima, Calif.
Samler, Larry W. — John B. Moore Corp., So. Elmonte, Calif.
Schifano, Frank E. — Drew Chemical Corp., Anaheim, Calif.
Scott, Jr., James P. — N L Industries, Inc., Newport Beach, Calif.
Winder, Steve D. — Dorsett & Jackson, Inc., Los Angeles.

LOUISVILLE

Active

Browning Jr., Lloyd W. — Porter Paint Co., Louisville, Ky.
Liegel, James F. — Velsicol Chemical, Cincinnati, Ohio.
Nichols, Mike S. — Portor Paint Co., Louisville, Ky.
Roberts, Curtis C. — John L. Armitage Co., Gallatin, Tenn.
Taft, Jr., William K. — M & T Chemical, Carrollton, Ky.

Associate

Collins, Jerry — Whittaker, Clark & Daniels, Inc., Cincinnati, Ohio.
Ellis, James H. — McKesson Chemical Co., Louisville Ky.
Leverone, Mark — C L Zimmerman Co., Cincinnati, Ohio.
Snead, William E. — PB&S Chemical Co., Lexington, Ky.

NORTHWESTERN

Active

Gill, Norman W. — Tennant Co., Minneapolis, Minn.

ROCKY MOUNTAIN

Active

Ciocchetti, Dennis — Komac Paint Co., Denver, Colo.

Associate

Whitworth, Don Q. — E. I. duPont de Nemours & Co., Inc., Littleton, Colo.

SOUTHERN

Active

Benham, Jack E. — J B Intl. Marketing Corp., Miami, Fla.
Carrillo, Viriato M. — Ambrosia Industrial, Inc., South Miami, Fla.
Dhawan, Rajendra K. — Coronada Paint Co., Edgewater, Fla.
Le, Thang P. — Bruning Paint Co., Inc., Pompano Beach, Fla.
Lee, Billy M. — Coronado Paint Co., Edgewater, Fla.
Ricker, David J. — Artex Hobby Product Inc., Lexington, S.C.

Associate

Allen, Daryl, A. — Gulf Coast Chemical Corp., Largo Fla.
Clark, Frank J. — Glidden Pigments Div., SCM Corp., Jackson, Miss.
Fisher, Bernard T. — Glidden Pigments Div., SCM Corp., Dunedin, Fla.
Kaulakis, Franklyn — Freeport Kaolin Co., Dunwoody, Ga.
LeBeau, Jerry P. — Florida Drum Co., Jacksonville, Fla.
Lemmick, Richard A. — Union Carbide Corp., Atlanta, Ga.
Mixon, Daniel L. — Atlanta Solvents & Chem. Co., Doraville, Ga.
Rego, Andrew J. — Interstab Chemicals, Inc., Marietta, Ga.
VanOtten, Gary W. — du Pont de Nemours & Co., Cumming, Ga.

WESTERN NEW YORK

Active

Brown, R. Alan — Spencer Kellogg Div., Textron, Inc., Buffalo, N.Y.
Edwards, Terry — General Railway Signal, Churchville, N.Y.

Technical Articles in Other Publications

Compiled by the Technical Information Systems Committee—H. Skowronska, Chairman

Double Liaison—Chimie des Peintures
(in French)

Published by Les Presses Continentales, 75 Rue du Cherche-Midi,
F75006, Paris, France.

Vol. 25 No. 280 December 1978

Kresse, P.—"Ferrites, a New Class of Anticorrosion Pigments Chemically Active;" 23-28.
Loutz, J.M., Demarteau, W., and Colpaert, M.—"Use of Acrylic Emulsion for the Protection of Asbestos Cement Articles;" 29-34.

Vol. 26 No. 281-282 January-February 1979

Dequenne, J.—"Experimental Plans Method Applied to a Zinc Rich Primer. Formulation;" 21-28.
"Water Soluble Paints" (Report of a meeting prepared by the Rhone-Alpes section of the A.F.T.P.V.); 29-43.
Hinton, A.J.—"Effects of the National Rules Related to Security on the Paint Preservatives Situation and on the Development of New Preservatives;" 44-48.

Organic Coatings and Plastics Preprints

Preprints of Papers presented by the Division of Organic Coatings and Plastics Chemistry at the American Chemical Society/Chemical Society of Japan Chemical Congress, Honolulu, Hawaii

Vol. 40 No. 1 April 1979

International Conference on Adhesion and Adsorption of Polymers

- Polymer surface interactions (5 papers)
- Characterization of adhesive interfaces (5 papers)
- Polymeric structural adhesives (7 papers)
- Fracture strengths of polymeric systems (7 papers)
- Modification of polymer interfaces (7 papers)
- Kinetics of polymer adsorption (6 papers)
- Characterization of adsorbed interfaces (6 papers)
- Adsorption of biopolymers (5 papers)

Modification of Polymers

- Reactions on polymers (12 papers)
- Radiation interactions and miscellaneous papers (15 papers)
- Natural polymers (6 papers)

Borden Award Symposium honoring Professor Roger S. Porter - Highly Ordered Solid Polymers (5 papers)

Polymers for Optical Fibers (21 papers)

New Concepts in Coatings and Plastics

- Applications (8 papers)
- Surface and performance characteristics (6 papers)
- Synthesis (8 papers)

Plastic Morters, Sealants and Caulking Compounds (10 papers)

Resins for Aerospace

- Adhesives, Coatings and Sealants (12 papers)
- Reinforced plastics (14 papers)
- Instrumental characterization techniques (14 papers)

Current Trends in Surface Coatings (9 papers)

Polymer Alloys, Blends, Grafts and Interpenetrating Networks (26 papers)

For information regarding price and availability of this publication, please contact R.H. Mumma at Hercules, Inc., Lower Warren Street, Glen Falls, N.Y. 12801.

Journal of the Oil and Colour Chemists' Association

Published by Oil and Colour Chemists' Association, Priory House,
967 Harrow Road, Wembley, Middlesex, HA0 2SF England

Vol. 61, No. 12 December 1978

Seavell, A.J. - "Anti-Corrosion Properties of Mimosa (Wattle) Tannin;" 439-462.
Craker, W.E. and Smart, S.P. - "Subjective Comparison (of Gloss). What does Influence You?;" 463-468.
Naser, A.M., Gomma, A.Z., and Moustafa, M. - "New Water-Soluble Compositions" (Resins and Coatings); 469-473.

Vol. 62 No. 1 January 1979

Groenewoud, W.M. - "Measurement of the Electrical Properties of Typical Tank Coatings. Some Preliminary Investigation of the Effects of Seawater and Cargoes on Such Properties;" 10-17.
Harrison, J.B. - "The Realistic Prediction of Primer Performance - A Case History;" 18-22.
Rajagopalan, K.S., Guruviah, S., and Roy, D.N. - "Protection by Organic Coatings;" 23-33.
Barry, S., Bravery, A.F., and Coleman, L.J. - "A Method for Testing the Mould Resistance of Paint Films;" 34-35.

Vol. 62 No. 3 March 1979

Sengupta, S.C., Agarwal, S.C., and Prasad, N.—"Quantitative Estimation of Aldehydic Acids in Lac Resin and Its Fractions;" 85-88.
Scantlebury, J.D. and Ho, K.N.—"Polarization Resistance—Its Meaning When Applied to a Coated Substrate;" 89-92.
Prini, R.F. and Kapusta, S.—"Electrochemical Testing of the Protective Power of Zinc Rich Paints;" 93-98.
Hinton, A.J.—"Regulatory Legislation—Effect on Preservative Choice;" 99-104.

Pigment & Resin Technology

Published by Sawell Publications Ltd., 127 Stanstead Road,
London SE23 1 JE, England

Vol. 7 No. 12 December 1978

Anon. - "Titanium Dioxide Pigments in Thermosetting Acrylic Finishes;" 4-12.
Anon. - "Coatings Update: Review Articles on Maintenance Coatings;" 13-15.

Vol. 8 No. 1 January 1979

Bennett, R.R. - "Nitropropane as an Aid to Solvent Balance Control;" 5-9.
Uerdingen, W. - "Low-Solvent Two-Pack Polyurethane Coatings;" 10-13.
Anon. - "Coatings Update: Coating Film Studies;" 16-18.

Skandinavisk Tidskrift för Färg och Lack

Published by Dansk Bladforlag K/S, Holbergsgade 20, 1057
Copenhagen, Denmark

Vol. 25 No. 1-2 January/February 1979

Nielsen, K.B. - "Free Amine Content and Evaporation of Amines from Water-Borne Systems;" 11-17. (in Danish)

Federation Signs Agreement with USM To Develop Coatings Correspondence Course

The Federation of Societies for Coatings Technology is pleased to announce the signing of an agreement with the University of Southern Mississippi for the sponsorship and development of a Correspondence Course on Surface Coatings Science and Technology.

The agreement was signed at the Federation Board of Directors meeting in New Orleans on May 18. President James A. McCormick signed for the Federation, with Drs. B. George Bufkin and Gary C. Wildman, of the Polymer Science Department, signing for the University of Southern Mississippi.

The course will be designed for persons who have the equivalent of junior undergraduate level study, and will require a background in general, organic, analytical, and physical chemistry, along with the mathematics and physics normally taken in preparation for these courses.

Many employees in the coatings manufacturing industry and its supplier companies have no opportunity to receive specialized academic training in the science of coatings and polymers. Hence, they must learn on-the-job at the expense of the time and effort of co-workers. This problem is becoming increasingly acute as scientific principles are becoming daily more crucial for competing successfully in research, production, and sales of surface coatings.

The correspondence course responds to this need.

It will be a cooperative effort between faculty and industrialists to insure that the science of coatings will be presented successfully. The USM faculty will be assisted in the course development by experienced industry people who will serve as an Editorial Board for the Federation, providing technical and practical expertise in given specialty areas.

The course, to be offered through the Polymer Science Department and the Division of Extension and Public Service at the University of Southern Mississippi, will be divided into two sections, tuition to be $300 each.

A grade will be given on completion of each section, and a certificate on completion of the entire course; completion of the entire course will also entitle the student to eight semester hours of undergraduate credit at the University of Southern Mississippi.

President McCormick holds contractual agreement for coatings correspondence course, to be jointly sponsored and developed by the Federation and the University of Southern Mississippi. Looking on are Drs. B. George Bufkin and Gary Wildman, of USM's Polymer Science Department, and (standing) John A. Gordon, Jr., Chairman of the Federation's Educational Committee

Two textbooks consisting of about 27 chapters each will be prepared for the course, and produced by the Federation.

The appropriate book will be furnished to students for each section of the course. Students will answer the questions at the end of each chapter and mail the answers to the University of Southern Mississippi for grading and criticism. Students failing a chapter exam may rework their answers until they pass. A comprehensive exam will be given upon completion of the first section, and a comprehensive exam over the whole course will be given upon completion of the second section. Twenty-one months will be allowed to complete each section.

The two comprehensive exams will be administered by proctors who will be appointed by the Constituent Society of the Federation in whose area the student resides. On passing the final exam, the student will be awarded the certificate.

The course is scheduled to be available on or about September 1, 1981.

NEXT MONTH . . .
Annual Meeting Preliminary Program

Golden Impeller Award to be Presented at FSCT Annual Meeting

Morehouse Industries, Inc., Fullerton, Calif., has announced the establishment of the Golden Impeller Award for outstanding achievement in dispersion technology.

Roland E. Swett, Vice-President/General Manager of Morehouse, said "the Golden Impeller Award will be given annually to an individual in recognition and appreciation for outstanding service to the chemical processing industry for innovative designs and applications in the field of dispersion technology."

The first award was presented to Hugh F. Purcell, Vice-President of Applications and Technical Service for Morehouse, back in October 1978. Mr. Purcell, the author of numerous technical papers on dispersion, has devoted more than 30 years to the continuing development of high-speed dispersion technology and applications.

The Morehouse Golden Impeller Award (shown at right) is presented to Hugh Purcell (left) by Roland Swett

Mr. Swett has appointed an independent board of judges to review nominees for the 1979 award which will be presented during the Annual Meeting of the Federation of Societies for Coatings Technology, October 3-5, at the Convention Center in St. Louis.

On the board are Mr. Purcell; Dr. Zeno W. Wicks, of North Dakota State University; Michael W. Malaga, of Glidden Coatings & Resins Div.; John A. Gordon, Jr., of the University of Missouri-Rolla; and Albert Seneker, of Ameron Corp.

Anyone wishing to nominate a candidate for the award may do so by submitting the person's qualifications to Mr. Purcell (Morehouse Industries, Inc., 1600 West Commonwealth Ave., Fullerton, Calif. 92633).

The award consists of a plaque upon which is mounted an impeller which contains about three ounces of gold.

Tnemec Company Establishes $1,000 Scholarship at NDSU

An annual scholarship grant of $1,000 to an outstanding junior student in the Department of Polymers and Coatings at North Dakota State University has been established by the Albert C. Bean Scholarship and Loan Foundation.

The foundation was established in 1963 by the sales representatives of Tnemec Co., Inc., a manufacturer of specialized coatings for industrial and architectural use. The scholarship is a tribute to the leadership and management philosophies of the founder. The late Albert C. Bean founded Tnemec Co. in 1921 and served as its chief executive officer until his death in 1964.

Tnemec's headquarters and main manufacturing facilities are located in North Kansas City, Mo., with manufacturing plants also in Baltimore, Md., and Compton, Calif. Annual contributions by the Tnemec sales representatives with matching gifts by the company provide the funding for this special scholarship award and the other educational grants being made by the foundation.

Marcia Sayler, of Bismarck, is the first recipient of the scholarship, according to Dr. Zeno Wicks Jr., NDSU department chairman.

'Personal Growth' Theme Is Chosen For 1980 Southern Society Annual Meeting

The 44th Annual Meeting of the Southern Society for Coatings Technology will be held Wednesday, March 12, through Friday, March 14, 1980, at the Terrace Garden Inn in Atlanta. The theme for the three-day meeting will be "Personal Growth In Coatings Technology." The focus of the major portion of the program will be on personal growth and job fulfillment in the coatings industry.

A symposium, sponsored by the University of Southern Mississippi, on selected fundamentals of coatings technology and the annual golf outing will precede the formal Southern Society Meeting.

The symposium is expected to include sessions on the formulation of water-borne vehicles, experimental designs for the evaluation of paint variables and a review of paint calculations. The formal society program will cover such aspects of personal growth as self-improvement aids in coatings technology, additional formal education, success with the job and family, the value of fringe benefits, personal health, stress, alcohol and drug abuse, and physical fitness, areas of interest to both the society membership and spouses.

The Planning Committee is chaired by Don Morgan, of Spencer Kellogg, and includes Thad Broome, of Precision Paint Corporation, President-Elect of the Southern Society; Peter Decker, of Union Carbide Corp.; James Donnelly, of NL Titanium Pigments; and Ronald Nelson, of the Kelco Div.

Hotel reservation cards will be forwarded by the society with the registration package in January 1980, and may be made directly with Peggy McCrary at the Terrace Garden Inn, 3405 Lenox Road, Atlanta, Ga. 30326, Telephone (404) 261-9250.

People

Benjamin T. Scibek, a member of the New York Society for Coatings Technology, has been named Group Leader in Analytical Measurements for the Minerals and Chemicals Div. of Engelhard Corp. Mr. Scibek has been with the division for over 20 years and most recently was Supervisor for Protective Coatings Technical Service.

Dr. George E.F. Brewer, Coating Consultant, has been elected a Member of the College of Fellows of the Engineering Society of Detroit. This honor was conferred as a result of his "creative contributions . . . leadership in service . . . and recognition by his profession." Dr. Brewer presented the Joseph J. Mattiello Memorial Lecture at the 1973 Annual Meeting of the Federation of Societies for Coatings Technology.

Robert E. Meeks has been appointed Vice-President, Sales and Marketing, for ECP, Inc., a newly-formed subsidiary of Daubert Chemical Co.

John E. Walker has been named Vice-President and General Manager of newly-formed Wyandotte Paint of Canada, Ltd.

Peggy McDaniel, of Conchemco Coatings, has been transferred from the research center in Kansas City to the company's Houston plant laboratory. She will be involved with trade sales products, as well as with the formulation and quality control of chemical coatings.

Hempel's Marine Paints, Inc., Wallington, N.J., has named **Roger Woodhull** Plant Manager and **Herb Glendenning** Manager of Purchasing.

In a series of managerial appointments, ICI Americas, Inc. has named **John W. Mossel** Product Manager for fire fighting chemicals: **Michael Quinn,** Product Manager for additives and biocides; and **Bernard J. Stone,** Product Manager for polyesters.

Promoted in other areas of the company are: **Winslow K. Abbott,** Product Manager for surfactants and emulsifiers; **Donald A. Lemire,** Product Manager for enzymes; and **Paul E. Stubbe,** Product Manager for activated carbons.

B.T. Scibek

G.E.F. Brewer

H.S. Wheeler

D. Ulrich

Howard S. Wheeler has been elected a Corporate Vice-President and member of CIBA-GEIGY Corp.'s Corporate Managing Committee. Mr. Wheeler will also continue to serve as President of the company's Plastics and Additives Div., headquartered in Ardsley, N.Y.

As part of its management reorganization, the Sherwin-Williams Co. has announced the following changes: **Robert A. Tschannen** has been appointed Vice-President, Facilities and Administrative Services and **Christopher Lawlor** has been named to the position of Vice-President, International Div. Succeeding Mr. Lawlor as President and General Manager of the Specialty Products Div. is **Thomas N. Bird.** The company's International Coatings Div. will continue to be headed by **Torrey N. Foster,** Vice-President.

Meanwhile, **Ron F. Curley,** former Chairman and Chief Executive Officer of Sherwin-Williams Canadian Div., has retired after 31 years of service.

NL Industries recently announced the combination of its Industrial Chemicals division with the Worldwide Titanium Pigment Group to form one operational unit to be known as NL Chemicals. **Fred W. Montanari** will serve as President of this organization. In addition, the company has appointed **Harry Heilbron** Sales Manager of its European operations.

Duane N. Sunderman, of Battelle's Columbus Laboratories, has assumed the newly created position of Associate Director for International Assistance Programs.

In addition, **Albert H. Adelman** has replaced Dr. Sunderman as one of the company's Associate Directors of Research.

Darryl Ulrich has been named Technical Service Manager for the Industrial Coatings Dept. of H.B. Fuller Co., St. Paul, Minn. Mr. Ulrich will serve as liaison between customers and the sales and laboratory personnel for the company's line of powder coatings and water-based industrial finishes.

James M. McKelvey, Professor of Chemical Engineering and Dean of the School of Engineering and Applied Science at Washington Univ. in St. Louis, was the recent recipient of the Distinguished Educator Award of the International Society of Plastics Engineers. Dean McKelvey was honored for his outstanding contributions to the advancement of education in plastics science, engineering, and technology.

Heinz P. Geiss has been named Vice-President of Marketing for the Industrial Chemicals Division of American Hoeschst Corp. in Somerville, N.J.

The company also announced the following managerial appointments: **Dr. Gunther Hencken**—Manager of the recently reorganized Pigments Department; **Albert Medas**—Technical Manager for Pigments; and **Peter Morris**—Marketing Manager.

The first annual Outstanding Researcher Awards were recently presented by DeSoto, Inc. Recipients of the award were **Luigi Amariti, Frank Leo, Dennis Anderson,** and **Edward Murphy.** Messrs. Leo, Anderson, and Murphy are members of the Chicago Society.

DeSoto, Inc. has also announced the following appointments. **Frank Ragas** and **Joe F. Jones** have been named Senior Research Chemists and **James E. Reese** has been appointed Product Manager of Construction Coatings at the company.

In a series of field sales appointments, Tenneco Chemicals has named **Connie Sisk**—Regional Manager for the Cleveland area; **Henry Kirsch**—Regional Manager for the Houston area; **Wayne Cochran**—Regional Manager in Pleasanton, Calif.; **Robert Gutnecht**—Senior Sales Representative for the Buena Park, Calif. region; **A.L. DeGisi**—Resident Salesman in Louisville, Ky.; and **Thomas Mitchell**—Resident Salesman for Baltimore, Md.

Irvin Ebaugh, Jr. has been elected President of the Bruning Paint Co. In addition to his duties as chief operating officer, Mr. Ebaugh will serve on the Board of Directors.

Serving as Vice-Chairman of the Board will be **Irvin Ebaugh, Sr.**, a former President of the company.

In a series of managerial appointments, the Pigments Divison of Sun Chemical has named **Peter A. Smith** to the position of Automotive Market Manager; **Alan Rowder** to Sales Manager, Cleveland; **Anne M. Ernst** to Technical Sales Representative in the Memphis area; **Jay Edward Friedman** to Technical Sales Representative, Cleveland area; **E. Wayne LeMaster** to Technical Sales Representative for the Dallas area, and **Keith Locke** to the position of Technical Sales Representative for the Los Angeles area.

In a series of appointments, Cosan Chemical Corp., Carlstadt, N.J., has named **Robert A. Oppermann**—Senior Microbiologist; **Arthur R. Leckart**—Manager, Plastic Laboratory; and **Marvin Landau**—Manager, Coatings Lab. Mr. Landau is a member of the Philadelphia Society for Coatings Technology.

American Cyanamid Co. has appointed **Stephen M. Lustig** to the position of Marketing Manager, Resins & Adhesives. He will be located at the headquarters of the Industrial Chemicals Div. in Wayne, N.J.

Girish C. Dubey has been appointed Vice-President of Production and Research by Cambridge Coatings, Inc., Cleveland, Ohio. Mr. Dubey is a member of the Cleveland Society for Coatings Technology.

Richard C. Chodnicki has been appointed to the position of Technical Director and Director of Operations for Hanline Brothers Paint Manufacturers. A Past-President of the Baltimore Society, Mr. Chodnicki will be responsible for all technical and plant operations of the firm.

John J. Sweeney has been elected President of Drew Chemical Corp., a subsidiary of United States Filter Corp. Prior to his election, Mr. Sweeney was President of Celanese Plastics Co. and a Vice-President of Celanese Corp.

The Valspar Corp., Minneapolis, has, with the acquisition of Conchemco Coatings Group, created two new key positions within Valspar. Elected as Vice-President is **Richard D. Radford,** who will be responsible for Chemical Coatings Div. operations and coil. **Duane Syvrud** has been elected President of Colony Paint and will also be responsible as Marketing Manager, Masury. Mr. Radford is a member of the Kansas City Society.

Hunterlab has appointed **Philip N. Rolbin** as Area Manager of the Northeastern states and he will be headquartered in Chestnut Hill, Mass.

Helene R. Johnson has been promoted to the position of Vice-President of Lenmar. She will also continue her duties as the company's Technical Director. Ms. Johnson is a member of the Baltimore Society.

Marvin J. Soderberg has been promoted to Manufacturing Manager of the Spencer-Kellogg Div. of Textron, Inc. He will relocate to the company's Buffalo, N.Y. headquarters.

Meanwhile, the company has named **Robert J. Storm** to the position of Acting Plant Manager of its Bellevue, Ohio Plant.

Obituary

Burch Athey, Chairman of the Board of C.M. Athey Paint Co., died on April 26, 1979, following a long illness. A Founder and Past-President of the Baltimore Society for Coatings Technology, Mr. Athey was 80 years old.

Norman S. Harrington, former President of the Harrington Paint Co. died on April 14, 1979. He was 79 years old.

Edward J. Madigan, a Past-President of the Rocky Mountain Society, died on April 6, 1979. Associated with the coatings industry since 1942, Mr. Madigan was manager of Englewood Paint Manufacturing Company at the time of his death.

Literature

Polyester Accelerator

A polyester accelerator, a cobalt complex, has been introduced in recent literature as an economical substitute for cobalt in the promotion of peroxide cured polyesters. The polyester accelerator's unique metal complex is ideal for use in the plastics, fiberglass, and polyester industries. For further information, write Tenneco Chemicals, Inc., Coatings & Colorants, P.O. Box 354, Turner Place, Piscataway, N.J. 08854.

Metal Free Pigments

A new data sheet has been published which describes the physical properties, lightfastness, heat stability and bleed characteristics of three recently introduced pigments, including shade illustrations in an alkyd melamine enamel. These moderately priced computer formulated proprietary pigments are created to simulate existing shades currently made with heavy-metal containing pigments which now require replacement. To obtain sample cards and data sheets on these pigments, write CIBA-GEIGY Corp., Pigments Dept., Ardsley, N.Y. 10502.

Fire Test Data

Three reports describing tests to determine combustibility characteristics of rigid polyurethane foam and related coating materials have been introduced in recent literature. For copies of these bulletins, write Witco Chemical Corp., Isocyanate Products Div., Dept. 1574-C, 900 Wilmington Rd., New Castle, Del. 19720.

Hand-held Glossmeter

Information has been prepared which describes a new hand-held, one-piece glossmeter, designed for measurement of specular reflectance of non-metallic surfaces of paints, plastics, and other materials. For literature, write Hunterlab, Hunter Associates Laboratory, Inc., 9529 Lee Highway, Fairfax, Va. 22031.

Low Speed Mixer

Literature describing a portable, low speed, gear drive mixer is now available. For more information, contact, Nettco Corp., 80 Tileston St., Everett, Mass. 02149.

Computer Package

A new four-page technical bulletin describing a computer program package for coatings manufacturers has been released. This software package offers information on computerized formula design capabilities as well as inventory control, batch ticketing, and general business and accounting functions. For additional details, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, N.J. 08540.

Carbon-13 NMR Data

Publication of the second volume of the "Atlas of Carbon-13 NMR Data," edited by E. Breitmaier, G. Haas, and W. Voelter, has been announced. The two volume "Atlas" series serves as a convenient handbook and reference tool, providing essential information for chemists, biochemists, and spectroscopists. Volumes 1 and 2 are available in a casebound edition for $165; purchased separately, Volume 2 is $110; from Heyden & Son, Inc., 247 S. 41st Street, Phila., Pa. 19104.

"Scattering of Light"

This recently published 700-page collection of the scientific papers of Professor Sir C.V. Raman, which includes 94 original papers and monographs, is available from Heyden & Son, Inc., 247 S. 41st St., Phila., Pa. 19104.

Ultrafiltration

A full-color, 12-page brochure, describing ultrafiltration and its application in concentrating and dewatering dilute oily waste and latex waste emulsion is now available. This brochure can be obtained by writing Abcor, Inc., 850 Main St., Wilmington, Mass. 01887.

Defoamers

A new line of proprietary defoamers is described in literature recently released. The line includes both non-silicone defoamers and silicone-containing defoamers. Information, as well as product dosage levels, and samples of the foam control products can be obtained by writing to PATCO Coating Products, C.J. Patterson Co., 3947 Broadway, Kansas City, Mo. 64111.

APCA Proceedings

A hardbound, 213-page publication, based on an Air Pollution Control Association specialty conference on emmision factors and inventories, features 15 papers and 8 reviews of discussion workshops. To obtain additional information, contact Air Pollution Control Assoc., Publications Dept., P.O. Box 2861, Pittsburgh, Pa. 15230.

Dispersion Equipment

A five-in-one innovation in dispersion equipment which functions as dissolver, sand mill, ball mill, attritor and mixer is the subject of recently published literature. Bulletin SWM is available from the Epworth Manufacturing Co., Inc., 1400 Kalamazoo St., South Haven, Mich. 49090.

Spectroscopy Conference

A two volume publication, "Proceedings of the Sixth International Conference on Raman Spectroscopy," is now available. Included in these volumes are lectures and papers on such topics as the history of the Raman Effect, chemical applications, molecular crystals, and new techniques. Cost of the book is $84 from Heyden & Son, Inc., 247 S. 41st Street, Phila., Pa. 19104.

Flocculating Agent

Information is now available which describes a new flocculating agent for latex paint waste water treatment. Further details may be obtained by writing George S. McTavey, Cosan Chemical Corp., 400 Fourteenth St., Carlstadt, N.J. 07072.

NACE Standards

To aid in the controlling and prevention of corrosion, the National Association of Corrosion Engineers has compiled more than 35 Standards into a single collection, the "NACE Book of Standards." Representing scientific and engineering technology on such topics as pipeline corrosion, protective coatings, and materials for hydrogen sulfide service, these standards include recommended practices, test methods, and material requirements. This book can be obtained for $75 from NACE, P.O. Box 986, Katy, Texas 77450.

Letters to the Editor

TO THE EDITOR:

The Federation of Societies for Coatings Technology and the 26 Constituent Societies exist to provide information for their members. This comes from the Federation in the form of the *Journal of Coatings Technology* and the Annual Meeting and Paint Show. On the local level, it is gathered from talking to people at the meetings and from the speaker(s) who present technical talks. (In addition some Societies or sections have annual seminars.)

For the past seven years, I have been a member of the Program Committee of the New York Society, and this past year I was privileged to serve as its Chairman. During this period, I read of talks that were given at other Societies which I thought might be of interest to our members. I wrote to an officer at each of those Societies and asked if the talk was interesting and worthwhile, and if the speaker presented it in an interesting manner. In most cases, the answer was—silence.

Recently, the Federation Public Relations Committee was asked to compile information on papers given at Society meetings and the speakers who presented them. I was delighted when Chairman Harry Poth asked me to serve and, of course, I accepted.

This effort will succeed only if Society Program Committee Chairmen cooperate and return (to the Federation office) the "Report of Monthly Meeting Presentation" forms which were sent to them.

The matter of "secrets" in the paint industry went out 40 years ago. Today we must cooperate with each other to keep abreast of new developments — both technical and governmental. Silence is *not* the answer. Cooperation is!

It takes only a few minutes to fill out the form and return it.

We will all benefit if everyone cooperates.

SIDNEY J. RUBIN
President-Elect
New York Society

Book Review

POLYMERIZATION REACTIONS AND NEW POLYMERS

Edited by
Norbert A.J. Platzer
American Chemical Society
N.W., Washington, D.C.
1973 (287 pages)
$21.25

Reviewed by
Dr. Thomas J. Miranda
Whirlpool Corp.
Benton Harbor, Mich.

This book was published in 1973 as a compendium of papers from the American Chemical Society Meeting held in Boston in 1972.

Incorporated within this volume are papers on a number of new polymers including elastomers such as polycyanoprene, heat resistant polymers, novel polymerization reactions via ring openings, alternating and block copolymers, as well as photopolymerization. Also discussed in the text are a number of commercial processes, including magnet wire coatings.

A total of 18 papers are presented which include the following: "New Synthetic Rubbers," "New Heat-Resistant Transparent Polymers," "Segmented Polyester Copolymers," "Isocyanurate Polymers and Polyamides," "Polyphenylene Sulfides," "Cyclic Bis (Arylene Tetrasulfides)," "Polythioesthers," and "Polysulfones."

Although the book is not new, the information contained therein can be of good value to those who are concerned with evaluating new polymer methods and polymers which may have practical value in solving some of the newer opportunities facing those in the coating industry.

Coming Events

FEDERATION MEETINGS

(Oct. 2)—Federation Board of Directors Meeting. Sheraton St. Louis Hotel, St. Louis, Mo. (FSCT, Suite 832, 1315 Walnut St., Philadelphia, Pa. 19107).

(Oct. 3-5)—57th Annual Meeting and 44th Paint Industries Show. St. Louis Convention Center, St. Louis, Mo. (FSCT, Suite 832, 1315 Walnut St., Philadelphia, Pa. 19107).

SPECIAL SOCIETY MEETINGS

(Sept. 19-20)—Montreal and Toronto Societies Joint Symposium. Toronto—19th; Montreal—20th.

1980

(Mar. 12-14)—Southern Society 44th Annual Meeting. Terrace Garden Inn, Atlanta, Ga.

(April 17-19)—Dallas and Houston Societies. Southwestern Paint Convention, Hilton Inn, Dallas, Tex.

(May 1-3)—Pacific Northwest Society Annual Symposium. Marriott Hotel, Portland, Ore.

OTHER ORGANIZATIONS

(Aug. 11-15)—"Corrosion Control by Organic Coatings," sponsored by National Association of Corrosion Engineers. Lehigh University, Bethlehem, Pa. (Prof. Henry Leidheiser, Jr., Sinclair Lab. #7, Lehigh University, Bethlehem, Pa. 18015).

(Aug.12-17)—"NACE Basic Corrosion Course" and "Corrosion Prevention by Cathodic Protection," sponsored by National Association of Corrosion Engineers. Airport Holiday Inn, Portland,Ore. (Education Dept., National Association of Corrosion Engineers, P.O. Box 986, Katy, Tex. 77450).

(Aug. 19-24)—"Corrosion Prevention by Coatings," sponsored by National Association of Corrosion Engineers. University of Alabama, Tuscaloosa, Ala. (Education Dept., National Association of Corrosion Engineers, P.O. Box 986, Katy, Tex. 77450).

(Aug. 26-31)—Short Course on "Advances in Emulsion Polymerization and Latex Technology." Davos, Switzerland. (Dr. Gary W. Poehlein, Director, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, Ga. 30332).

(Sept. 11)—National Paint and Coatings Association. Hazardous Waste Management Seminar. New York, N.Y. (Georgene Savickas, NPCA, 1500 Rhode Island Ave., N.W. Washington, D.C. 20005.

(Sept. 11-12)—Institute of Applied Technology, Mini Course, "Coating Inspection: Instruments and Practices." St. Louis, Mo. (Institute of Applied Technology, Suite 600, 1776 K St., N.W., Washington, D.C. 20006).

(Sept. 23-26)—67th Canadian Paint Manufacturers Association Convention, sponsored by the Ontario Paint Association. Harbour Castle, Toronto, Ont. Canada. (R.E. Green, 1666 Aimco Blvd., Mississauga, Ont. L4W 1V4 Canada).

(Sept. 24-27)—South Central Regional Meeting, National Association of Corrosion Engineers. University of Southwestern Louisiana Conference Center, Lafayette, La. (Membership Services Dept., NACE Headquarters, P.O. Box 986, Katy, Tex. 77450).

(Sept. 24-28)—Institute of Applied Technology, Training Course, "Painting and Coating for Industry." Honolulu, Hawaii. (Institute of Applied Technology, Suite 600, 1776 K St., N.W., Washington, D.C. 20006).

(Sept. 24-28)—"Colloids and Surfaces." Carnegie-Mellon University. (Mrs. Gerry Cohen, Course Coordinator, Post College Professional Education, Carnegie Institute of Technology, Carnegie-Mellon University, Schenley Park, Pittsburgh, Pa. 15213).

(Sept. 25-27)—National Association of Corrosion Engineers Coatings Symposium. Ramada Inn, Niagara Falls, N.Y. (Robert Walpole, Walpole Associates, P.O. Box 622, Wellsville, N.Y. 14895.

(Sept. 27)—National Paint and Coatings Association. Hazardous Waste Management Seminar, Chicago, Ill. (Georgene Savickas, NPCA, 1500 Rhode Island Ave. N.W., Washington, D.C. 20005).

(Sept. 30-Oct. 2)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency O'Hare Hotel, Chicago, Ill. (Don White, National Coil Coaters Association, 1900 Arch St., Philadelphia, Pa. 19103).

(Oct. 1-4)—"Progress in Corrosion Control," Canadian Regional Meeting, National Association of Corrosion Engineers. Skyline Hotel, Ottawa, Ontario, Canada. (Membership Services Dept., NACE Headquarters, P.O. Box 986, Katy, Tex. 77450).

(Oct. 9-11)—Western Regional Meeting, National Association of Corrosion Engineers. Jack Tar Hotel, San Francisco, Calif. (Membership Services Dept., NACE Headquarters, P.O. Box 986, Katy, Tex. 77450).

Advertisers Index

Foam, and the side effects of controlling it, have for years been problems in trade sales coatings. They are becoming major problems in industrial coatings as well.

Now you have a new source of help in industrial and trade sales coatings—a company with a new approach to foam control formulations and service.

When you call Patco Coating Products, we do a lot more than just send samples. We're not another "me-too" defoamer supplier. We go out of our way to provide the best possible answer to your foam control problem, even to tailor-making a Patcote defoamer to meet your specific needs.

We have developed an extensive line of Patcote proprietary products for both trade sales and industrial applications. One of them may be the one you need. If not, our technical service staff stands ready to work with your bench chemists to develop a defoamer that suits your needs. We've done it for others. We'll do it for you.

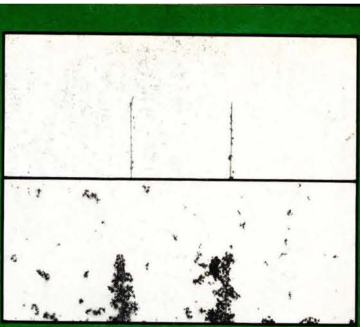
If you have a difficult foam control problem, let us hear from you. We can help. All it takes is a toll free telephone call to put Patco Coating Products' service to work for you. Or write for Patcote product information.

PATCO
COATING PRODUCTS
CJP

Patco Coating Products, C. J. Patterson Company

3947 Broadway, Kansas City, Missouri 64111 Toll Free Telephone (800) 821-2250 In Missouri dial (816) 561-9050

Comparison of Busan® 11-M1 (middle) with zinc phospho oxide (left) and calcium borosilicate (right) in latex emulsion primer. Each primer topcoated with two coats of latex emulsion paint without inhibitor. Panels exposed 200 hours in salt fog cabinet. Panels shown before and after paint was removed.



Comparison of Busan® 11-M1 with zinc chromate in an oil-alkyd primer. Primer on top panel contains 0.7 lb. Busan® 11-M1 per gal. Primer on bottom panel contains 0.7 lb. zinc chromate per gal. Both primers topcoated wth alkyd finish coat without inhibitor. Panels exposed for 10 years.

Busan® 11-M1. A proven corrosion inhibitor for water-thinned…

. . . or solvent-thinned paints.

And save about 30¢ a gallon.

Buckman Laboratories, Inc.

President's E Star Award for Exports

BUCKMAN LABORATORIES INTERNATIONAL, INC.
BUCKMAN LABORATORIES WHTC, INC.

1256 NORTH McLEAN BOULEVARD / MEMPHIS, TENNESSEE 38108, U.S.A. / TELEPHONE (901) 278-0330 / TELEX 5-3868 / CABLE ADDRESS BULAB

BUCKMAN LABORATORIES PTY. LTD.
SYDNEY, N.S.W., AUSTRALIA

BUCKMAN LABORATORIES, S.A.
GHENT, BELGIUM

BUCKMAN LABORATORIOS, LTDA.
CAMPINAS, S.P., BRAZIL

BUCKMAN LABORATORIES OF CANADA, LTD.
MONTREAL, P.Q., CANADA

BUCKMAN LABORATORIES, LTD.
TOKYO, JAPAN

BUCKMAN LABORATORIES, S.A. DE C.V.
MEXICO, D.F., MEXICO

BUCKMAN LABORATORIES (PTY) LTD.
DURBAN, NATAL, SOUTH AFRICA