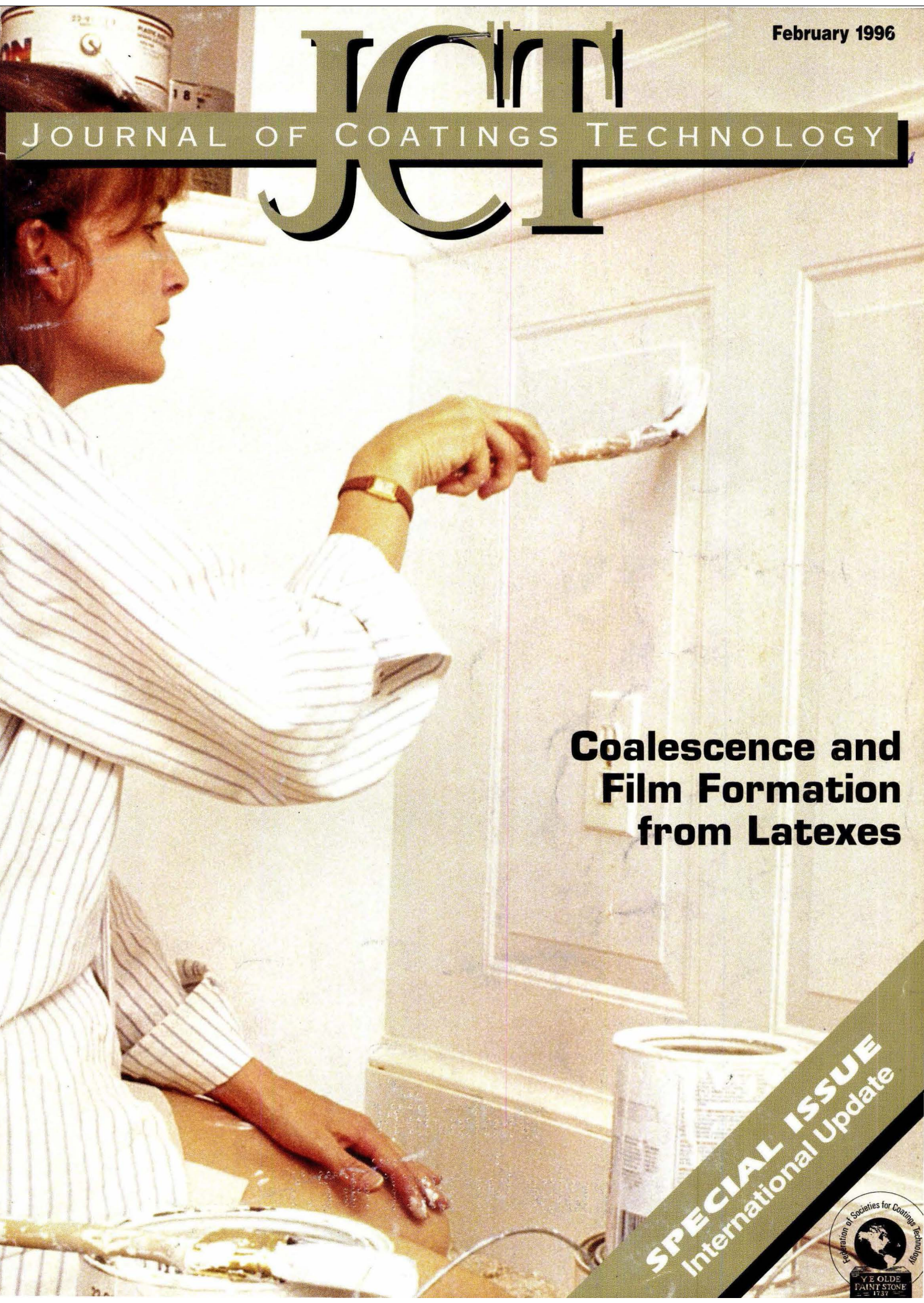


February 1996

# JCT

JOURNAL OF COATINGS TECHNOLOGY

# JCT



## Coalescence and Film Formation from Latexes

**SPECIAL ISSUE**  
International Update





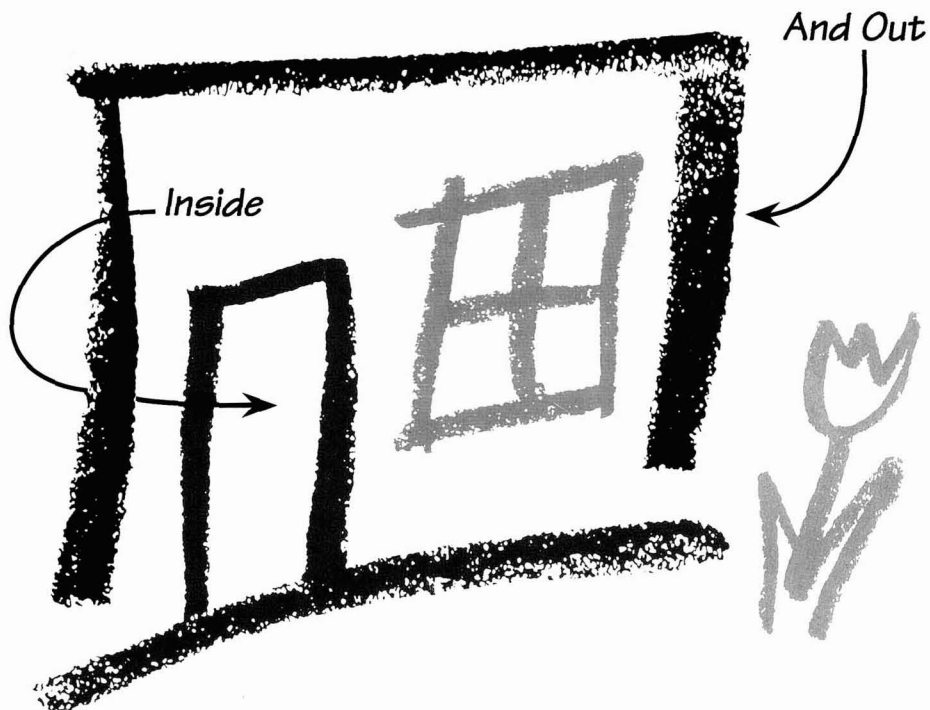
# NUOCIDE® FUNGICIDE KEEPS MILDEW OUT OF THE PICTURE.

pigments or additives to perform. Test fence and industry-wide use prove this non-fugitive, shelf stable biocide provides the most cost effective protection available!

And Hüls can enter the picture long before your paint touches the surface. Our technical service provides complete assistance to biocide customers. After all, instead of having to fix mildew problems, Hüls wants you to prevent them, period.

Hüls' NuoCide fungicide, based on the active ingredient chlorothalonil, protects paint from mildew years longer than any tested competitor. It's virtually insoluble in water and won't leach out of the paint film, even in areas of heavy rainfall and high humidity. Also, it won't degrade in U.V. light, as it doesn't depend on other

**hüls**



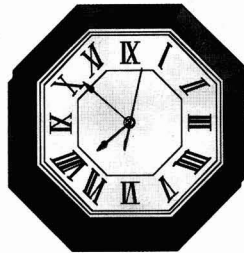
**HÜLS AMERICA INC. Colorants and Biocides Division**  
220 Davidson Avenue, Somerset, NJ 08873 (908) 560-6800

HULS-14-AB-R1

Circle No. 283 on the Reader Service Card



How Much



Do You Spend in  
Training?

## SciQuest—A Revolutionary Coatings Tool for State-of-the-Art Multimedia Training . . .

- Eliminates the Need for Expensive Off-Site Training
- Offers Employees at Every Level the Opportunity to Increase Knowledge and Experience
- Provides the Most Comprehensive Overview of Coatings Technology and Manufacturing

### Here's What the Experts Have to Say:

*"Volume I of SciQuest is a MUST for coatings technologists, forensic chemists, professors and teachers, sales and marketing personnel, managers and others. In addition, office personnel and other non-technologists will find it is fun to use and easy to understand. The 24 embedded videos and thousands of graphics provide a quick, visual understanding and feeling for many processes."*

—Dr. Joseph V. Koleske, Editor  
ASTM Paint and Coatings Test Manual,  
14th Edition of the Gardner-Sward Handbook

*"SciQuest is the most accessible, in-depth resource of information on coatings, in my experience."*

—Robert Springate  
R&D Supervisor  
TruTest Manufacturing

*"This user friendly, informative CD is a must for industrial and university information centers and serious coatings operations. It is easily accessed, very readable and like having a consultant at your disposal. Get one!"*

—Dr. Thomas J. Miranda  
Adjunct Professor, Chemistry  
Indiana University, South Bend

**With just a keystroke, the world of coatings can be yours to explore and master!**

System Requirements: IBM PC or compatible, 386 or greater, Microsoft Windows with 8 MB of RAM, VGA monitor, 256 Color recommended, CD-ROM drive.

For more information on SciQuest, contact:

**Federation of Societies for Coatings Technology**  
492 Norristown Rd., Blue Bell, PA 19422-2350.  
Phone: (610) 940-0777 or FAX: (610) 940-0292

Call for a Free  
CD DEMO DISC  
(610) 940-0777



What Do These Terms Have In Common?

# ACETYLATED CONGO S.B.P. SPIRITS SAGGING

## They can all be found in the NEW Coatings Encyclopedic Dictionary

Editor: Stanley LeSota

This is the world's most up-to-date, comprehensive, authoritative reference for the language of YOUR INDUSTRY.

- ▶ Over 6,000 industry terms defined
- ▶ Cross referenced for synonyms and related categories
- ▶ Current industry vocabulary, including state-of-the-art technologies and regulatory terms
- ▶ Quick, clear references for technical, as well as commonly used industry terms

This is a **MUST HAVE** resource for *anyone* working in the paint, coatings, ink, art, visual and related industries.

Perfect for marketing, sales, R&D, chemists, government and regulatory workers, artists, architects, manufacturers, technicians, teachers, students and more. Developed and approved by the Federation of Societies for Coatings Technology.



Call 610-940-0777  
Fax 610-940-0292

Or use the order form below.

**CALL  
NOW TO  
RESERVE  
YOUR  
NEW EDITION!  
610-940-0777**

**YES!** Send me the **NEW EDITION** of the **COATINGS ENCYCLOPEDIA DICTIONARY NOW!**  
Please refer to #JC0296 when ordering

Number of Copies _____	Federation Members	Soft Cover	Hardback
	Non-Members	\$80*	\$105*
		\$105*	\$135*

I am paying by:  Check or money order  Company Purchase Order (please attach)  
 MasterCard  Visa  American Express

Credit Card Number \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

Company name \_\_\_\_\_ Attn: \_\_\_\_\_

Address \_\_\_\_\_ City/State/Zip \_\_\_\_\_

Mail to: Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350

\*Volume pricing is also available on orders of 5 or more. Please call for more information. Shipping and handling charges and appropriate sales tax (PA 6%) are additional.





## Technical Articles

- 33** Coalescence and Film Formation from Latexes—K.L. Hoy  
*The author presents a model to explain the mechanism of coalescence and filming process. This paper represents a good contribution to the coating science and will aid the practitioners and the theoreticians alike to help gain insight in the film formation process.*
- 41** Flame-Retardant Brominated Styrene-Based Polymers. IX. Dibromostyrene-Based Latexes—  
 J.-L. Wang and N.A. Favstritsky  
*This manuscript illustrates the synthesis and application of bromine-based latexes in a number of materials, including organic coatings, textile backcoatings, paints, clearcoatings, adhesives, sealants, caulks, binders, carpet backing, and so on.*
- 49** Colloidal Aspects of Waterborne Epoxy Paints—V.V. Verkholtantsev  
*The colloidal aspects of formulating two-part ambient cured waterborne epoxy paints which utilize so-called self-emulsifying technology (liquid epoxy resin plus water-thinnable hardener) are discussed.*

## Feature Article

- 59** Phenolic Resins: Revisiting an Established Technology—K. Bourlier  
*The intention of this presentation is to revisit the basic chemistry of phenolic polymers and hopefully give new insights regarding their utility in today's coatings formulations.*

## Federation News

- 11** New Name, Format, Technology Conference to Highlight FSCT's 1996 Annual Convention
- 12** FSCT Invites Nominees for 1997 Mattiello Lecture and Nominations Sought for Armin J. Bruning Award
- 13** Coatings Industry Honor and Remembrance Fund

## Departments

Comment .....	7	New FSCT Members .....	70
Technical Abstracts .....	8	Future Society Meetings .....	72
Regulatory Update .....	9	People in the News .....	73
SPECIAL UPDATE—International Coatings .....	15	Obituary .....	74
Industry News .....	27	New Products .....	75
Meetings Update .....	29	Calendar of Events .....	77
Society Reports .....	65	Humbug from Hillman .....	80



© 1996 by FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350. Phone (610) 940-0777; Fax: (610) 940-0292.

Second class postage paid at Blue Bell, PA and at additional mailing offices. POSTMASTER: Send address changes to JOURNAL OF COATINGS TECHNOLOGY, 492 Norristown Rd., Blue Bell, PA 19422-2350.

Subscription: U.S. and Canada – 1 year, \$40; 2 years, \$75; 3 years, \$110. Europe (Air Mail) – 1 year, \$70; 2 years, \$135; 3 years, \$200. Other Countries – 1 year, \$55; 2 years, \$105; 3 years, \$155.

ห้องสมุดเคมีวิทยาศาสตร์มหาวิทยาลัย





# Guide for Authors



## GENERAL

The JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology for its membership of approximately 7,000 in 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico. The JOURNAL is devoted to the advancement of knowledge in the science and technology of surface coatings, the materials comprising such coatings, and their use and performance.

The Editors invite submission of original research papers, review papers, and papers under the special headings *Open Forum* and *Back to Basics*, and *Letters to the Editor*. All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere. When review papers contain tables or graphs from copyrighted articles, the authors will be required to obtain permission for use from the copyright holders. When the organization with which the authors are affiliated requires clearance of publications, authors are expected to obtain such clearance before submission of the manuscript. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY. Authors are obligated to reveal any exceptions to these conditions at the time a manuscript is submitted.

The JOURNAL OF COATINGS TECHNOLOGY has first right to the publication of papers presented at the International Coatings Technology Conference of the Federation and at local regional meetings or symposia of the Constituent Societies.

*Papers in which proprietary products or processes are promoted for commercial purposes are specifically nonacceptable for publication.*

## SUBMISSION OF MANUSCRIPTS...

### ...for the Journal

Four complete copies should be sent to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 492 Norristown Rd., Blue Bell, PA 19422. The cover letter should address copyright, clearance, and release issues discussed above and should specify paper category: *Original Research*, *Reviews*, *Open Forum*, or *Back to Basics*.

*Letters to the Editor:* The JOURNAL will consider for publication all correspondence relevant to the coatings industry and to the contents of the JOURNAL. When a letter concerns an article appearing in the JOURNAL, the original author is usually given an opportunity to reply.

### ...by Constituent Societies For International Coatings Technology Conference Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to Mike Bell, Director of Educational Services, FSCT, 492 Norristown Rd., Blue Bell, PA 19422.

### ...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to Mike Bell at the address previously listed. (For complete details, see "Roon Awards" section of the JOURNAL in the January 1995 issue.)

## MANUSCRIPT PREPARATION

In general, authors are advised to use the "Handbook for Authors" published by the American Chemical Society as a guide to the preparation of manuscripts (ACS, 1155 Sixteenth St., Washington, D.C. 20036). Another excellent reference work is "How to Write and Publish a Scientific Paper," by Robert A. Day (ISI Press, 3501 Market St., University City Science Center, Philadelphia, PA 19104).

Authors are encouraged to consider submissions in several categories and to prepare their manuscripts accordingly. The categories are:

*Original Research Papers:* The main technical content of the JOURNAL OF COATINGS TECHNOLOGY will continue to be original research papers. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid repetitious or awkward use of passive voice.

*Review Papers:* Papers that organize and compare data from numerous sources to provide new insights and unified concepts are solicited. Reviews that show how advances from other fields can beneficially be applied to coatings are also desired. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

*Open Forum:* Topics for this category may be nontechnical in nature, dealing with any aspect of the coatings industry. The subject may be approached informally. Editors encourage submission of manuscripts that constructively address industry problems and their solutions.

*Back to Basics:* Papers that provide useful guides to Federation members in carrying out their work are solicited. Topics in this category are technical but focus on the "how to" of coatings technology. Useful calculations for coatings formulation and procedures that make a paint test more reproducible are examples of suitable topics. Process and production topics, i.e., paint manufacture, will also be reviewed in the *Back to Basics* category.

If a submitted paper consists of the text of a presentation made previously to a monthly or special meeting of a Society for Coatings Technology, or to another technical group, the name of the organization and the date of the presentation should be given. If someone other than the author of the paper made the presentation, this information, too, should be noted. Papers originally composed for oral presentation will have to be revised or rewritten by the author to conform to the style described in this guide.

Manuscripts should be typed with double spacing on one side of 8 1/2 x 11 inch (22 x 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

## Title

The title should be as brief and informative as possible. Selection of titles that are key word-indexable is a helpful and recommended practice.

## Authors' Biographies and Photographs

Give complete names, company or institutional affiliations, and brief biographical sketches of all authors. If available, submit a 5 x 7 inch (13 x 18 cm) black-and-white photograph with glossy or smooth high sheen surface, for each author. See later section on photographs for further details.

### Abstracts

A 75-100 word abstract must be part of the manuscript, and should be a concise description of the key findings or teachings of the work described in the paper. The abstract should not repeat the title or include reference numbers, nor should it duplicate the Conclusion or Summary.

### Text

Main headings and sub-headings should be used to improve readability, and to break up typographical monotony. The text should not be presented as an alphanumeric outline.

The main headings usually should be INTRODUCTION, EXPERIMENTAL, RESULTS AND DISCUSSION, and SUMMARY or CONCLUSIONS. Sub-headings will be specific to the subject.

Only as much review as is necessary should be given to provide an introduction to the subject; the main burden for extensive background should be placed on the list of references.

Standard scientific and technical terminology should be used to convey clear and unambiguous meaning, but the use of technical jargon or slang should be avoided. Authors should bear in mind that the JOURNAL has an international audience, for many of whom English is a second, not native, language. Use of regional idioms or colloquialisms should be avoided. The use of obscure abbreviations is also discouraged. When appropriate, abbreviations should be made in parenthesis immediately following first mention of the term in the text, and then used alone whenever necessary.

Recent issues of the JOURNAL should be consulted for desired style and technical level.

### Metric System

Metric system units should be used wherever applicable with the equivalent English units shown afterwards in parentheses. The ASTM Metric Practice Guide, E 380-72 (American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103) is a convenient reference.

### Tables, Graphs, and Drawings

Tables, rather than descriptive text, should be used only when they are genuinely helpful. They should be proportioned in accordance with the height and width limitations of the JOURNAL's pages. Each table should be typed on a separate sheet, rather than included in the text, and appended to the manuscript. Each table should be numbered and have a descriptive caption. Tables should be referenced in the text (e.g., "See Table 1").

In numerical data in tables, numbers less than one should have a zero before the decimal point.

Graphs should be on good quality white or nonphotographic blue-lined 8 1/2 x 11 inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a copy of the original graph. Graph captions and legends should also be typed on a separate sheet from original for typesetting.

Drawings should conform to the guidelines given for Graphs and should be proportioned to fit the height-to-width ratio of the JOURNAL's pages and columns.

### Photographs

All photographs should be sharp, clear, black-and-white prints no larger than 8 x 10 inches in size. Photos should be clearly labeled on the reverse side, taking care not to mar the image.

Color prints and slides are unacceptable.

When illustrations are secured from an outside source, the source must be identified and the Editor assured that permission to reprint has been granted.

### Nomenclature

Whenever possible, generic names should be used in preference to trade names. When trade names must be used to avoid ambiguity, and the name is a registered trademark, the symbol R, in a circle or parentheses, should be given immediately following, and the manufacturer listed as a footnote. In general, trade names should be used only in footnotes or in an appendix, rather than in the text.

If special nomenclature is used, include a nomenclature table giving definitions and dimensions for all terms.

Nomenclature of chemical compounds should conform to the style of *Chemical Abstracts* and the IUPAC rules. For oligomeric or polymeric materials, characteristics such as molecular weight, polydispersity, functional group content, etc. should be provided.

### Equations

Equations must be typed, or written clearly, with equations numbered sequentially in parentheses to the right. If Greek letters are used, write out their names in the manuscript margin at the first point of use. Place superscripts<sup>2</sup> and subscripts, accurately. Avoid the use of superscripts in a manner that can lead to their interpretation as exponents.

### Summary

The paper should be concluded with a summary which is intelligible without reference to the main text. The summary may be more complete than the abstract, listing conclusions drawn from the text. A well written summary can serve to inspire the busy reader to turn back to the paper, to read it thoroughly.

### Acknowledgment

If used, it should follow the summary.

### References

These should be listed in the numerical order in which they are cited in the text, and should be placed at the end of the manuscript. Names of authors may or may not be shown in the text with reference numbers. If possible, include titles of articles referenced in the literature. The following are examples of acceptable reference citations for periodicals,<sup>1,2,3</sup> books,<sup>4</sup> and patents.<sup>5</sup>

- (1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official DIGEST*, 36, No. 475 (Part 1), 839 (1964).
- (2) Davidson, H.R., "Use and Misuse of Computers in Color Control," *JOURNAL OF COATINGS TECHNOLOGY*, 54, No. 691, 55 (1982).
- (3) Stephen, H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, 65, No. 5, 191 (1982).
- (4) Patton, T. (Ed.), *Pigment Handbook*, Vol. 1, John Wiley & Sons, Inc., New York, 1973.
- (5) Henderson, W.A. Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

### OTHER INFORMATION

Galley proofs will be sent to the author for checking about six weeks prior to publication.

Offprints may be purchased in quantities of 100 or more. Authors will receive price quotations. Each author will receive a complimentary copy of the JOURNAL issue in which his or her paper was published.

\* \* \* \*

The JOURNAL OF COATINGS TECHNOLOGY is copyrighted by the Federation of Societies for Coatings Technology. The editorial contents of the JOURNAL may not be reprinted in whole or in part without written permission of the publisher.



The JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology at 492 Norristown Rd., Blue Bell, PA 19422-2350. Phone: (610) 940-0777. FAX: (610) 940-0292.

Annual dues for Active and Associate Members of the Federation of Societies for Coatings Technology is \$25.00. Of this amount, \$16.75 is allocated to a membership 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 .....	\$40.00	\$70.00	\$55.00
2 Years .....	\$75.00	\$135.00	\$105.00
3 Years .....	\$110.00	\$200.00	\$155.00

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.

Publisher ..... Robert F. Ziegler  
 Editor ..... Patricia D. Viola  
 Technical Editor ..... Robert F. Brady, Jr.  
 Managing Editor ..... Kathleen M. Wikiera  
 Assistant Editor ..... Jonna D. Coachman  
 Director of Marketing ..... Lyn Pollock  
 Subscription Fulfillment Manager ..... Audrey E. Boozier

**Publications Committee**

F. Louis Floyd, Chairman  
 B. Brady J. Hinkle R. Woodhall  
 B. Carr G. Pilcher P.D. Viola  
 R.A. Dickie L. Price R.F. Ziegler  
 J. Stauffer

**Editorial Review Board**

Robert F. Brady Jr., Chairman  
 D.R. Bauer H.E. Hill P.E. Pierce  
 A.H. Braudau L.W. Hill G.R. Pilcher  
 J.H. Braun T. Hockswender T. Provider  
 D. Brezinski S.F. Kia R.A. Ryntz  
 R.A. Dickie J.V. Koleske C.K. Schoff  
 F.L. Floyd H. Lowrey R. Stanzola  
 P.R. Guevin, Jr. J.W. Martin J.O. Staffer  
 C.R. Hegedus J.L. Massingill

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

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

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

Copyright 1996 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. Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients is granted by the Federation of Societies for Coatings Technology for users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of \$1.00 per copy, plus .25 per page is paid directly to CCC, 27 Congress St., Salem, MA 01970. For those organizations that have been granted a photocopy license by CCC, a separate system of payment has been arranged. The fee code for users of the Transaction Reporting Service is: 0032-3352/86 \$1.00 + .25.

**FSCT Board of Directors—1995-96**

**PRESIDENT**

\*DARLENE R. BREZINSKI  
 Consolidated Research Inc.  
 200 E. Evergreen  
 Mount Prospect, IL 60056

**PRESIDENT-ELECT**

\*JAY AUSTIN  
 Halox Pigments  
 1326 Summer St.  
 Hammond, IN 46320

**SECRETARY-TREASURER**

\*THOMAS E. HILL  
 Pratt & Lambert  
 P.O. Box 22  
 Buffalo, NY 14240

MARK D. ALGAIER  
 Hillyard Industries, Inc.  
 St. Joseph, MO

EVANS ANGELOS  
 Omya, Inc.  
 Clarendon Hills, IL

FREIDUN ANWARI  
 BFGoodrich Co.  
 Brecksville, OH

LARRY BRANDENBURGER  
 The Valspar Corp.  
 Minneapolis, MN

PHILIP C. BREMENSTUHL  
 Zeneca Resins  
 Riverside, CA

JOSEPH CARAVELLO  
 Guardsman Products, Inc.  
 Sugar Land, TX

BRENDA L. CARR  
 Coatings Development Co.  
 Painesville, OH

MARTHA COLIN  
 Colin y Lozano S. de RL  
 Mexico DF, Mexico

DONALD F. DENNY  
 E.W. Kaufmann Co.  
 Southampton, PA

MICHAEL L. DEPIETRO  
 Pratt & Lambert, Inc.  
 Buffalo, NY

J. ANDREW DOYLE  
 National Paint & Coatings  
 Association  
 Washington, D.C.

VAN S. EVENER  
 BASF Corp.  
 Whitehouse, OH

\*FOREST FLEMING  
 Akzo Nobel Coatings, Inc.  
 High Point, NC

F. LOUIS FLOYD  
 Duron, Inc.  
 Beltsville, MD

MICHAEL C. FRANTZ  
 Daniel Products Co.  
 Jersey City, NJ

JAMES E. GEIGER  
 Consultant  
 Largo, FL

TERRY GELHOT  
 Carboline Co.  
 St. Louis, MO

JOSEPH D. GIUSTO  
 Lenmar, Inc.  
 Baltimore, MD

\*GERRY J. GOUGH  
 ICI Packaging Coatings  
 Holden Surface Coatings  
 Ltd.  
 Birmingham, England



WILLIAM M. HOLLIFIELD  
 Perry & Derrick Co., Inc.  
 Cincinnati, OH

WILLIAM F. HOLMES  
 Ameritex Chemical &  
 Coatings Inc.  
 Irving, TX

DAVID JACK  
 Technical Coatings Co., Ltd.  
 Burlington, Ont., Canada

CHARLES A. KAPLAN  
 Gillespie Coatings, Inc.  
 Longview, TX

MAUREEN M. LEIN  
 Davidson/Textron  
 Dover, NH

RONDA K. MILES  
 Union Carbide Corp.  
 Garland, TX

\*J. DICK MULLEN  
 G-3 Industries  
 Aurora, CO

JOHN J. OATES  
 Midland Park, NJ

DENNIS R. OWEN  
 Technical Coatings Co.  
 Santa Clara, CA

LARRY PITCHFORD  
 Reynolds Metals  
 Louisville, KY

YVON POITRAS  
 Mills Paint Sales, Ltd.  
 Delta, B.C. Canada

SUZANNE RICHARDSON  
 Tioxide Americas Inc.  
 St. Laurent, Que., Canada

PATRICIA SHAW  
 Radiant Color  
 Richmond, CA

WILLIAM C. SPANGENBERG  
 Hammond Lead Products, Inc.  
 Pittsburgh, PA

\*JOSEPH P. WALTON  
 Jamestown Paint Co.  
 Jamestown, PA

\*Executive Committee  
 Members

**EXECUTIVE VICE PRESIDENT**

ROBERT F. ZIEGLER  
 FSCT Headquarters  
 492 Norristown Rd.  
 Blue Bell, PA 19422

# COMMENT

## Broadening the Horizons



A major item in the Federation's on-going strategic planning deliberations (which will be discussed in detail at a special meeting of the Board of Directors at the end of the month) is an enhancement of the FSCT's international presence.

As our member-readers are acutely aware, the growth of the international coatings industry impacts our business lives daily. The opening of markets around the world and the expansion of multinational corporations create opportunities. In planning to take advantage of these opportunities, however, many of us are finding that environmental and regulatory topics are not just a concern in the U.S. but impact coatings operations globally.

As the FSCT looks to cooperate more with its international sister organizations, it seeks to make Federation members aware of the issues being faced by their counterparts in other countries.

Highlighting this issue of the JCT are reports on the state of overseas coatings industries. What issues are influencing the development of coatings in Sweden; how is the European technical association addressing its members needs; what factors are affecting growth in the Brazilian coatings market? These topics and other details influencing the industries of the foregoing countries, as well as New Zealand and Japan, are presented in the article starting on page 15. (Presented in a later issue will be reports from Mexico, Australia, and the U.K.)

The sharing of information has been the guiding principle of the FSCT from its earliest beginnings; the FSCT and its members can only benefit by extending this principle internationally.

Robert F. Ziegler  
Executive Vice President

## Technical Abstracts

Translations provided by: Spanish—Jesús Camacho, of Instituto Mexicano de Tecnicos en Pinturas y Tintas.

### **Coalescence and Film Formation from Latexes—K.L. Hoy**

JCT, Vol. 68, No. 853, 33 (Feb. 1996)

A paint is a complex liquid coating material composed of pigments, fillers, polymeric binders, and other additives dispersed and/or dissolved in a liquid. When applied to a surface, the liquid is changed by a film forming process to a solid, adherent composite film. The formation of a paint film is so spontaneous and familiar that most give little thought to the mechanism and dynamics of the process. Yet it is the dynamics of film formation that can provide perspective to the design and application of polymeric latexes.

Previously, a number of workers have studied the "mechanism" by which the latex particles coalesce with each other.<sup>1-5</sup> Their attention has been focused on the details of how particle-particle contacts and interactions take place. It is the author's intent to emphasize the thermodynamics of the filming process. A general theory of film formation from a paint is derived from thermodynamic considerations. Model calculations are made and the results are encouraging. They are able to predict the effect of pigmentation and identify new areas for polymer and formulation research. The theory is capable of being specialized for either solvent or latex systems.

### **Coalescencia y Formación de Película a Partir de Latex—K.L. Hoy**

Una pintura es un material de recubrimiento de líquido complejo, compuesto de pigmentos, extendedores, cadenas poliméricas y otros aditivos dispersados y/o disueltos en un líquido. Cuando se aplica a una superficie, el líquido es cambiado por un proceso de formación de película a un sólido, película de compuesto adherente. La formación de una película de pintura es tan espontánea y familiar que no se piensa mucho en la dinámica y el mecanismo del proceso. Sin embargo, conocer la dinámica de formación de película puede proporcionar una mejor perspectiva para el diseño y la aplicación de latex poliméricos.

Previamente, algunos investigadores han estudiado los "mecanismos" por los cuales las partículas de latex interactúan con cada una de las otras. Su atención se ha enfocado sobre los detalles de cómo toman lugar las interacciones y contacto partícula-partícula. Es un intento de los autores enfatizar los principios termodinámicos del proceso de formación de la película. Una teoría general de formación de película a partir de una pintura está derivado de consideraciones termodinámicas. Son obtenidos calculos a partir de modelos y los resultados son confrontados. Estos son útiles para predecir el efecto de la pigmentación e identificar nuevas áreas para la investigación de formulaciones y polímeros. La teoría es adecuado para aplicarse en otros solventes o sistemas de latex.

### **Flame-Retardant Brominated Styrene-Based Polymers. IX. Dibromostyrene-Based Latexes—J.-L. Wang and N.A. Favritsky**

JCT, Vol. 68, No. 853, 41 (Feb. 1996)

Dibromostyrene can copolymerize with butadiene, alkyl acrylates and methacrylates, vinyl acetate, styrene, and unsaturated carboxylic acids to form a wide variety of flame-retardant latexes via an emulsion polymerization technique. The latex is characterized in terms of glass transition temperature, residual monomer, solids content, pH, Brookfield viscosity, specific gravity, particle size, mechanical stability, UV stability, and flame retardancy. These novel dibromostyrene-based latexes are useful for a wide variety of applications in textile backcoatings, paints, clearcoatings, adhesives, sealants, caulks, binders, carpet backings, and so on.

### **Polímeros Base Estireno Bromados Retardantes de Flama—J.L. Wang y N.A. Favritsky**

El dibromoestireno puede copolimerizar con butadieno, acrilatos alquílicos y metacrilatos, acetatos de vinilo, estireno y ácidos carboxílicos insaturados para formar una gran variedad de latices retardantes a la flama vía una técnica de polimerización por emulsión. El latex es caracterizado en terminos de temperatura de transición vítrea, monomero residual, contenido de sólidos, pH, viscosidad de Brookfield, gravedad específica, tamaño de partícula, estabilidad mecánica, estabilidad UV y retardancia de flama. Estos nuevos latices base dibromoestireno son útiles para una gran variedad de aplicaciones en recubrimientos para textiles, pinturas, recubrimientos claros, adhesivos, selladores, etc.

### **Colloidal Aspects of Waterborne Epoxy Paints—V.V. Verkholtantsev**

JCT, Vol. 68, No. 853, 49 (Feb. 1996)

The colloidal aspects of formulating two-part ambient cured waterborne epoxy paints which utilize so-called self-emulsifying technology (liquid epoxy resin plus water-thinnable hardener) are discussed. Experimental data are presented for commercial amine-type water-thinnable hardeners on dilution behavior, co-emulsification with liquid epoxy resins, and performance of paint compositions. Approaches are offered for the selection of key components and some additives (in particular, of co-solvents and co-emulsifiers) for epoxy waterborne film forming compositions.

### **Aspectos Coloidales de Pinturas Epoxicas Base Agua—V.V. Verkholtantsev**

Son discutidos los aspectos coloidales de formular pinturas epoxicas base agua auto curadas en dos partes las cuales utilizan tecnología llamada de auto-emulsificación (resina epoxica líquida positivo endurecedor adelgazable con agua). Los datos experimentales son presentados para endurecedores comerciales tipo amina adelgazables con agua en condiciones de dilución, co-emulsificación con resinas epoxicas líquidas y comportamiento de composiciones de pinturas. Las aproximaciones son ofrecidas para la selección de componenetes clava y algunos aditivos (en particular, de co-solventes y co-emulsificadores) para composiciones epoxicas base agua de formación de película.



## Regulatory Update February 1996

**T**his digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by National Paint and Coatings Association, Washing-

ton, D.C. The Regulatory Update is made available as a service to FSCT members, to assist them in making independent inquiries about matters of particular interest to them. Although all reasonable steps have been taken to ensure the reliability of the Regulatory Update, the FSCT cannot guarantee its completeness or accuracy.

### **Department of Transportation Research and Special Programs Administration**

#### **December 19, 1995—60 FR 65492 Transportation of Hazardous Materials by Rail**

##### **Action: Notice of proposed rulemaking**

The Research and Special Programs Administration (RSPA) has proposed a number of changes to the Hazardous Materials Regulations dealing with rail requirements, based on petitions from industry and agency initiatives. This action is designed to update current requirements, while improving safety and reducing costs for transporters of hazardous wastes.

Among the amendments were provisions to eliminate or clarify certain marking or placard requirements for rail cars; to modify regulations for hazardous waste manifests; and to revise specifications for tank cars carrying hazardous waste.

For more information, contact Beth Romo, RSPA, (202) 366-4488, or James Rader, Federal Railroad Administration, (202) 866-0510.

### **Environmental Protection Agency December 15, 1995—60 FR 64330 National Emission Standards for Hazardous Air Pollutants (NESHAP) for Shipbuilding and Ship Repair (Surface Coating) Operations**

#### **Action: Final rule**

The U.S. Environmental Protection Agency (EPA) is promulgating national emission standards for hazardous air pollutants (NESHAP) for shipbuilding and ship repair (surface coating) operations under section 112 of the Clean Air Act Amendments. Under the NESHAP, new and existing major sources must limit emissions using maximum achievable control technology (MACT) to control hazardous air pollutants (HAPs). The NESHAP itself is based on the use of lower-

VOC coatings that meet the 1992 California VOC limits for marine coatings.

Surface coating operations at shipyards are the focus of the NESHAP, and a number of HAPs are used as solvents in marine coatings. The HAPs emitted by the facilities covered by this final rule include xylene, toluene, ethylbenzene, methyl ethyl ketone, methyl isobutyl ketone, ethylene glycol, and glycol ethers. The final rule is estimated to reduce baseline HAPs emissions by 24% or 350 tons per year (tpy).

Electronic copies of the background information document for the regulation and the final rule itself are available from the EPA's Technology Transfer Network bulletin board at (919) 541-5742. For more information, contact Dr. Mohamed Serageldin, EPA, (919) 541-2379

### **Environmental Protection Agency December 21, 1995—60 FR 66344 Hazardous Waste Management System: Identification and Listing of Hazardous Waste: Hazardous Waste Identification Rule (HWIR)**

#### **Action: Proposed rule**

EPA has proposed amendments to current regulations under the Resource Conservation and Recovery Act (RCRA) which would establish constituent-specific exit levels for low-risk solid wastes that are designated as hazardous because they are listed, or have been mixed with, derived from, or contain listed hazardous wastes. Under this proposal, generators of listed hazardous wastes that meet the self-implementing exit levels would no longer be subject to the hazardous waste management system under Subtitle C of RCRA. EPA would set up a risk-based "floor" to hazardous waste listings which the agency intends to use to encourage pollution prevention and waste minimization.

Many of the exit levels have been set using a risk assessment system which evaluates potential exposure paths from sources such as surface impoundments and waste piles. The remaining exit levels were based on an alternative risk analysis.

For additional information, call the RCRA/Superfund Hotline at (800) 424-9346. For technical information, contact William Collins, Greg Helms, or Pamela McMains, EPA, (202) 260-4770.

**President Signs Bill Tightening Lobbying Rules**—On December 19, President Clinton signed into law legislation that imposes new reporting restrictions on lobbyists, requiring people who spend more than one-fifth of their time lobbying either Congress or the executive branch to register with Congress. They must also disclose twice annually their clients and the issue on which they are lobbying. In addition, the term "lobbying" is broadened to include not only contact with lawmakers but also encounters with their aids, as well as preparation of research to shape policy.

**Superfund Taxes Expire**—Because the President and Congress failed to agree on a budget before the end of the year, the taxes on petroleum and chemical products that fund the Superfund program formally expired on December 31. Congress is expected to renew the taxes as part of the budget bill or Superfund reauthorization, but under House rules, this would require a two-thirds vote, rather than a simple majority.

**Federal Agencies Rulemaking Authority Limited Under House Bill**—A bill which would require federal agencies to submit all proposed rules for Congressional and Presidential approval was introduced in the House

on December 6. The Congressional Responsibility Act (H.R. 2727), sponsored by Rep. John Hayworth (R-AZ), has been referred for consideration to the House Committees on Rules and the Judiciary. The basis of the bill is the idea that the sole authority to make laws should be in the hands of elected officials, rather than unelected agency employees.

Under this legislation, all regulations promulgated by a government agency must first be approved by both the House and Senate and be signed by the President, before it can go into effect. It also defines expedited Congressional procedures for the approval of agency regulations, including limiting debate and banning any amendments to proposals.

#### How To Obtain Congressional Documents

The government does not charge a fee for copies of Congressional bills, reports, and public laws. However, there is a limit to the number of copies that may be ordered. The procedure is different in the House and Senate.

**House of Representatives**—The public may order House documents by telephone or by mail. Six documents can be ordered over the phone; twelve documents can be ordered by mail. However, multiple copies of a single item cannot be requested. Only one document request per day will be filled. Send mail orders to House Document Room, B-18, House Annex No. 2, Washington, D.C. 20515.

To order documents by phone, call (202) 255-3456. This number also provides information on the status or availability of House documents.

**Senate**—All Senate documents can be ordered by mail. The public can order up to six different items, per request. Like the House, multiple copies of a single item cannot be requested, and only one document request per day will be filled. Send mail orders to Senate Document Room, B-04, Hart Bldg., Washington, D.C. 20510. Please note that phone orders will not be accepted. For information on the status and availability for specific documents, call (202) 224-7860. This number is for information purposes only.

## States Proposed Legislation and Regulations

### California

**Recycling**—CA S. 1385 (Rosenthal) continues the requirement that all state agencies purchase re-refined automotive lubricants, recycled antifreeze, recycled solvents, and recycled paints indefinitely which would thereby delete the original repeal date of January 1, 1997. The bill was introduced on January 4 and referred to the Senate Committee on Governmental Organization.

### Colorado

**Hazardous Waste (Proposed Regulation)**—The Colorado Department of Public Health and Environment (DPHE) has proposed a regulation which considers the addition of aerosol cans to the university waste regulations. Contact Howard Roitman, DPHE, (303) 692-3300.

### Connecticut

**Air Quality (Proposed Regulation)**—The Connecticut Department of Environmental Protection (DEP) has proposed a rule which would amend the definition of organic volatile organic compounds (VOCs), adding "acetone," "cyclic, branched, or linear completely methylated siloxanes," and "parachlorobenzo-trifluoride" (PCBTf) to the list of exemptions from the definition of VOCs. Contact Ellen Walton, DEP, (203) 424-3027.

### Florida

**Solid Waste (Proposed Regulation)**—The Florida Department of Environmental Protection (DEP) issued a

notice announcing the withdrawal of a proposed rule which would have repealed obsolete regulations in regard to full cost accounting for solid waste management. Contact Betsy Hewitt, DEP, (904) 921-9638.

### Georgia

**Air Quality (Regulation)**—A final rule of the Georgia Department of Natural Resources (DNR) amends regulations by (1) updating the definition of VOCs; (2) adopting by reference federal maximum achievable control technology (MACT) standards; and (3) exempting facilities with a potential to emit less than 10 tons per year of VOCs from certain surface coatings standards. The rule became effective on September 17, 1995. Contact Marlin Gottschalk, DNR, (404) 363-7028.

### Indiana

**Air Quality (Proposed Regulation)**—The Indiana Department of Environmental Management (DEM) has proposed a rule which would add acetone to a list of compounds considered to be nonphotochemically reactive. Contact Phil Doyle, DEM, (317) 232-8420.

**Solid Waste (Proposed Regulation)**—The Indiana DEM has issued a notice announcing its intention to amend hazardous waste management and the hazardous waste management permit program by incorporating federal standards. Contact Steve Mojonier, DEM, (317) 233-1655.

### Kansas

**Air Quality (Regulation)**—A final rule of the Kansas Department of Health and Environment (DHE) updates the definition of VOCs by adding PCBFT; cyclic, branched, or linear completely methylated siloxanes; and acetone to the list of compounds that are not subject to regulation and clarifying regulations for class 1 operating permits including emission information that must be included in a permit application. The rule also specifies that, while waiting for a permit to be issued, a source must submit a timely application to operate without a permit. The rule was effective December 8, 1995. Contact Chuck Layman, DHE, (913) 296-1579.

**Hazardous Waste (Proposed Regulation)**—The Kansas DHE has proposed a regulation which would exclude certain hazardous waste generators from specific reporting and recordkeeping requirements, and an annual monitoring fee. The proposal does not affect large quantity hazardous waste generators regulated by the federal Environmental Protection Agency (EPA). Contact George McCaskill, DHE, (913) 296-1606.

### Maryland

**Lead**—MD H. 61 (Arnick) alters the definition of "abatement" related to lead-containing substances, the scope of properties subject to accreditation requirements, and the scope of exceptions to accreditation required to be adopted by regulation. The

legislation was introduced on January 10 and referred to the House Committee on Environmental Matters.

The Maryland Department of the Environment (DOE) has issued an emergency proposal concerning the reduction of lead risk in housing. The rule is effective February 24, 1996 and expires on August 24, 1996. Contact Mike Haire, DOE, (410) 631-3680.

### Massachusetts

*Highway Transportation (Regulation)*—An emergency rule of the Massachusetts Registry of Motor Vehicles (RMV) amends regulations for periodic annual staggered safety and emissions inspection procedures for all motor vehicles including trailers. The rule was effective November 8, 1995. Contact John Houghton, RMV, (617) 351-9909.

### Michigan

*Hazardous Waste (Proposed Regulation)*—A proposed rule of the Michigan Department of Environmental Quality (DEQ) would amend regulations for the state hazardous waste management program. The regulation would specify that large quantity hazardous waste generators must comply with federal air emissions standards for process vents, equipment leaks, tanks, surface impoundments, and containers. Contact Ronda Blayer, DEQ, (517) 373-9548.

### Minnesota

*Air Quality (Proposed Regulation)*—The Minnesota Pollution Control Agency (PCA) has proposed a rule which would increase air emission permit fees by 8 to 10%. The proposal would also amend emission inventory reporting procedures by revising methods for calculating emissions, determining which pollutants a facility must report for the inventory, and describing how the different fees are assessed. A hearing was scheduled for February 8, 1996. Contact Mike Mondloch, PCA, (612) 297-5847.

*Lead (Proposed Regulation)*—A proposed rule of the Minnesota Pollution Control Agency (PCA) would govern methods for the removal of lead paint from steel structures. Among other things, the proposal would (1) define relevant terms; (2) adopt compliance provisions and implement notification requirements; and (3) establish standards for identifying lead in paint

and procedures for removing lead paint from bridges and storage structures. A hearing was scheduled for February 6, 1996. Contact Norma Coleman, PCA, (612) 296-7712.

*Toxics-in-Products*—MN H. 2014 (Workman) repeals the Toxics-in-Products Law prohibiting the distribution of certain materials (including paints) containing lead, cadmium, mercury, or hexavalent chromium. The bill was prefiled on December 15.

*Water Quality (Regulation)*—The Minnesota Pollution Control Agency (PCA) has adopted a final rule which amends regulations pertaining to the clean water partnership program. Among other things, the program (1) provides low-interest loans from the water pollution control revolving funds clarifying all loan procedures; (2) updates grant eligibility criteria; and (3) establishes loan and grant conditions and project reporting standards. The rule was effective December 4, 1995. Contact Shannon Lotthammer, PCA, (612) 296-7727.

### Mississippi

*Air Quality*—The Mississippi Air Facilities Branch (AFB) Title V Operating Permit program has received the concurrence of the EPA to allow deferment of the Title V application due date for one year (until January 27, 1997) for certain facilities. In order to qualify for this deferment, a facility must be able to demonstrate that the annual emission rate of each pollutant in tons per year from the facility in 1994 was less than 50% of the applicable major source threshold. Contact Air Facilities Branch, (601) 961-5171.

### Missouri

*Air Quality (Regulation)*—The Missouri Department of Natural Resources (DNR) has adopted a final rule regarding general operating permits for basic and intermediate installations. The rule delays the application deadline for certain intermediate installations by 10 months, and grants a flexible deadline for basic installations. The rule is effective 30 days after publication in the Code of State Regulations. Contact Air Pollution Control Board, DNR, (314) 751-7840.

The Missouri DNR has proposed regulations which would amend air quality standards by incorporating by reference federal standards and regulations. The proposal would (1)

revise the definitions of "installation" and "federally enforceable"; (2) update the list of named installations under the state's Title V operating program; and (3) add language for compliance with federal Title V operating permit program guidelines. Contact Air Pollution Control Program, DNR, (314) 751-7840.

A final rule of the Missouri DNR adopts regulations pertaining to the submission of emission data, emission fees, and process information. The rule also updates definitions of "contaminant" and "pollutant." The rule is effective 30 days after publication in the Code of State Regulations. Contact Air Pollution Control Program, DNR, (314) 751-7840.

*Hazardous Waste (Regulation)*—Final rules adopted by the Missouri Department of Natural Resources set forth notification requirements for owners and operators of underground storage tanks, and eligibility requirements for participation in the state underground storage tank insurance fund. The rules are effective 30 days after publication in the Code of State Regulations. Contact Clean Water Commission, DNR, (314) 751-6721.

A final rule of the Missouri DNR sets forth hazardous waste fees and taxes applicable to hazardous waste generators. The rule is effective 30 days after publication in the Code of State Regulations. Contact Hazardous Waste Program, DNR, (314) 751-3176.

### New Hampshire

*Air Quality*—NH S. 600 (Rodeschin) clarifies the authority of the Division of Air Resources to issue a single permit to a facility that covers all regulated emissions emitted from, and individual devices located at, that facility; and issues facility-wide operating permits to nonmajor stationary sources covering all regulated emissions as provided in the current law for major sources subject to the Clean Air Act. Introduced on January 3, the bill was referred to the Senate Committee on Environment.

*Lead*—NH S. 516 (Stawasz) makes it clear that the law regulating discrimination in housing does not require a person to rent a dwelling or dwelling unit which has been found to have a lead exposure hazard present, if such dwelling or unit is to be occupied by a child of a certain age or younger. The bill was introduced on January 3 and referred to the Senate Committee on Public Institutions, Health, and Human Services.



NH S. 663 (Wheeler and Herman) establishes lead paint risk reduction procedures which may be carried out by a property insurance coverage. The bill was introduced on January 3 and referred to the Senate Committee on Public Institutions, Health, and Human Services.

*Water Quality*—NH H.C.R. 27 (Rosen) urges Congress to repeal certain Clean Water Act requirements. The bill was introduced on January 3 and referred to the House Committee on State and Federal Relations.

### New Jersey

*Environmental Penalties*—NJ A. 1521 (Solomon and Corodemus) provides a grace period of 30 to 90 days for industry to correct minor environmental violations. On December 22, the governor signed the legislation.

*Hazardous Waste*—NJ A. 1005 shifts liability for the cost of cleaning up a hazardous substance discharge on public property from state and local governments to the responsible parties or the state Spill Compensation Fund, unless the state caused or contributed to the discharge. The bill was signed by the governor on December 8.

*Lead*—NJ S. 1537 (Bassano and Matheussen) requires the screening of children for lead exposure and appropriates funds for that purpose. The legislation was signed by the governor on January 5.

### New York

*Air Quality (Proposed Regulation)*—A notice of the New York Department of Environmental Conservation (DEC) announces revisions to a proposed rule regarding the operating permit program for air contamination sources. The proposal would add definitions, integrate into the state program federal Clean Air Act air emissions permitting requirements under Title V, and incorporate by reference new source performance national emission standards for hazardous air pollutants (NESHAP) and MACT standards. Contact Patrick Lavin, DEC, (518) 457-7688.

### North Carolina

*Lead (Proposed Regulation)*—The North Carolina Department of Environment, Health and Natural

Resources (DEHNR) has proposed a rule which would require expanded laboratory reporting and clarify the different trigger mechanisms for reporting, identification, investigation, notification, and abatement of lead poisoning hazards. The regulation would also add lead poisoning hazard standards for lead-contaminated dust and allow for electronic submission of blood lead data. Contact Grady L. Balentine, Department of Justice, (919) 733-4618.

### Rhode Island

*Air Quality (Proposed Regulation)*—The Rhode Island Department of Environmental Management (DEM) has proposed a rule which would amend the operating permits program for major sources of air pollution by adding caps for 13 stationary sources, thereby relieving the sources from having to obtain operating permits. Contact Division of Air Resources, DEM, (401) 277-2808.

The Rhode Island DEM has proposed a regulation which would regulate the work practices and limit the VOC and volatile hazardous air pollutant (VHAP) content of coatings used in wood product manufacturing operations. Contact Barbara Morin, DEM, (401) 277-2808.

The Rhode Island DEM has proposed a rule which would amend regulations by exempting acetone, PCBTF, and volatile methyl siloxanes from the definition of VOCs. (These substances are currently exempt from the federal definition). Contact Barbara Morin, DEM, (401) 277-2808.

*Automotive Refinishing (Proposed Regulation)*—A proposed rule of the Rhode Island DEM would prohibit the sale of automobile refinishing products which do not comply with specific VOC limitations; require the listing of the VOC content of coatings and surface preparation products on Certified Product Data Sheets (CPDSs); and allow the use of spray gun cleaners which are not totally enclosed if approved by the department. Contact Barbara Morin, DEM, (401) 277-2808.

### Texas

*Air Quality (Regulation)*—A final rule of the Texas Natural Resource Conservation Commission (TNRCC)

amends regulations regarding new construction permits and permit modification. The rule insures that at the time of the permit renewal, the commission may not impose more stringent conditions unless it is deemed necessary to avoid a condition of air pollution, or to ensure compliance with otherwise applicable federal or statutory air quality control with requirements. The rule was effective December 11, 1995. Contact Sam Wells, TNRCC, (512) 239-1441.

*Hazardous Waste (Regulation)*—The Texas Natural Resource Conservation Commission (TNRCC) has adopted a final rule which governs reporting and recordkeeping requirements for source reduction and waste minimization plans. The rule became effective on December 25, 1995. Contact Hygie Reynolds, TNRCC, (512) 239-6825.

*Lead (Proposed Regulation)*—The Texas Department of Health (DOH) has proposed a rule which would allow Texas governmental entities to apply for and expend federal funds in the regulation of lead-based paint activities in target housing. The regulation would include new requirements for accreditation of training providers, and for certification of persons involved in lead-based paint activities. Contact David K. Lacker, DOH, (512) 834-6600.

### Virginia

*Water Quality (Proposed Regulation)*—The Virginia State Water Control Board (SWCB) announced its intention to repeal regulations in reference to facility and aboveground storage tank registration requirements, and aboveground storage tank pollution prevention requirements. Certain provisions would be incorporated into new regulations for facilities and aboveground storage tanks thereby making the proposed repeal necessary. Contact David Ormes, DEQ, (804) 698-4263.

### Washington

*Lead (Proposed Regulation)*—A notice has been issued by the Washington Department of Labor and Industries (DLI) to adopt lead regulations that are consistent with federal Occupational Safety and Health Administration (OSHA) standards. Contact Merle Larson, DLI, (360) 902-5519.

## New Name, Format, Technology Conference To Highlight FSCT's 1996 Annual Convention

The Federation of Societies for Coatings Technology will hold its 74th Annual Meeting, October 23-25, at McCormick Place, Chicago, IL. Last held in Chicago in 1992, the FSCT event will feature several changes in format and new concepts in educational opportunities.

FSCT, to highlight the expanded format of its Annual Meeting, has renamed its trade show and also has instituted a concurrent technology conference of focused instructional seminars.

### International Coatings Expo

The International Coatings Expo "ICE" (formerly Paint Industries' Show), is sponsored and managed by the FSCT and provides expanded coverage of the coatings industry's suppliers of raw materials, manufacturing processes and applications equipment, and the variety of services used in the decorative and protective coatings industry. Currently, over 60% of available exhibit space is contracted.

The Annual Meeting Technical Program will be held concurrently with the ICE and will feature the prestigious Mattiello Memorial Lecture and Technical Focus Presentation.

Also included in the program will be the Roan Awards Competition as well as Con-

stituent Society technical presentations and reports from the international technical community.

### International Coatings Technology Conference

A newly scheduled event, the International Coatings Technology Conference offers a series of focused technical seminars in a one- and two-day format beginning on Tuesday, October 22 and concluding on Thursday, October 24. Developed specifically for the novice, intermediate, or experienced coatings chemists, sessions will feature well-known instructors and cover such topics as surfactant chemistry, preparation of technical presentations, technical writing, design of experiments, spray application, substrates, coatings characterization, polymer chemistry, and back to basics (chemistry). An Executive Forum on Technology Assessment is designed to provide corporate decision-makers with the necessary information to plan for the future.

All Conference participants will be provided with course materials as part of their registration fee. Under separate registration from the FSCT Annual Meeting events, Conference registrants may attend the ICE and its technical program.

### Concurrent NPCA Annual Meeting

For the first time, the Annual Meeting will run concurrently with the NPCA annual meeting as a result of the joint cooperative program between the organizations. The scheduling of the concurrent events will provide both suppliers and manufacturers from both groups ample time and opportunity to discuss areas of mutual interest.

### Hotel and Registration Information

Eight hotels have been selected to provide accommodations for the FSCT Convention and Conference. The Chicago Hilton and Towers is the headquarters hotel. Other hotels are: Essex Inn, Executive Plaza, Fairmont Hotel, Hyatt on Printers Row, Hyatt Regency, Palmer House Hilton (NPCA headquarters hotel), and Renaissance Chicago.

Hotel and Convention and Conference registration forms and attendance information will be available in April and will be sent to all FSCT members.

For more information, contact FSCT, 492 Norristown Rd., Blue Bell, PA 19422; (610) 940-0777; Fax: (610) 940-0292.



## FSCT 1996 International Coatings Expo Current List of Exhibitors

Aceto Corp.  
ACT Laboratories, Inc.  
Advanced Software Designs  
Air Products & Chemicals, Inc.  
Akzo Nobel Chemicals  
Alnor Oil Co.  
American Chemical Society  
American Colors, Inc.  
Amoco Chemicals  
ANGUS Chemical Co.  
Anker Labelers USA Inc.  
Arco Chemical Co.  
Arizona Chemical Co.  
B.A.G. Corp.  
BatchMaster Software Corp.  
Brookfield Engineering Lab.  
Buckman Laboratories  
Buhler Inc.  
Burgess Pigment Co.  
BYK-Chemie USA

BYK-Gardner, Inc.  
Cabot Corp.  
Calgon Corp.  
Cardolite Corp.  
CB Mills  
CCP  
Center for Applied Engineering Inc.  
Chemical & Engineering News  
Chemir/Polytech Laboratories, Inc.  
Civacon  
Clariant Corp.  
Columbian Chemicals Co.  
CR Minerals Corp.  
Crosfield Co.  
D/L Laboratories  
Daniel Products Co., Inc.  
Datacolor International  
Degussa Corp.  
Dominion Colour Corp.  
Dow Corning Corp.

Draiswerke, Inc.  
Dry Branch Kaolin Co.  
DSM Resins U.S., Inc.  
Eagle Zinc Co.  
Eastern Michigan University  
Eastman Chemical Co.  
Ebonex Corp.  
Eiger Machinery, Inc.  
Engineered Polymer Solutions  
Epworth Mfg Co., Inc.  
Etna Products Inc.  
European Coatings Journal  
Exxon Chemical Co.  
F S C T  
The Feldspar Corp.  
Filter Specialists, Inc.  
Fluid Management  
FMJ International Publications Ltd.  
H.B. Fuller Co.  
Paul N. Gardner Co., Inc.

Georgia Pacific Resins, Inc.  
The BFGoodrich Co.  
Goodyear Tire & Rubber Co.  
Haake, Inc.  
Halox  
Harcros Pigments Inc.  
Henkel Corp.  
HERO Industries Ltd.  
Hickson Specialties, Inc.  
Hilton Davis Co.  
Hockmeyer Equipment Corp.  
Hoechst Celanese Corp.  
Horiba Instruments Inc.  
J.M. Huber Corp.  
Hunterlab  
Ideal Manufacturing & Sales Corp.  
Inmark, Inc.  
International Compliance Center Ltd.

(Continued on next page.)

## FSCT Invites Nominees for 1997 Mattiello Lecturer

The Federation of Societies for Coatings Technology is seeking nominations for the 1997 Joseph J. Mattiello Lecturer. The Mattiello Lecture will be presented at the 75th Annual Meeting of the Federation, to be held November 5-7, 1997, in Atlanta, GA.

The lecture commemorates the contributions of Dr. Joseph J. Mattiello, former President of the Federation, who was instrumental in expanding the application of the sciences in the decorative and protective coatings fields.

The Mattiello Lecture Committee will select a person recognized for outstanding contributions to science, technology, and engineering related to the coatings industry to present a paper on a phase of chemistry, engineering, human relationship, or other discipline fundamental to paint, varnish, lacquer, or related protective and decorative coatings. The Mattiello Lecturer shall embody the standards of technical accomplishment, service to the coatings industry, and leadership established by Joseph J. Mattiello.

All nominations for the Mattiello Lecturer shall include the following information:

- Name, age, and place of birth
- Current position and brief job history
- Education and degrees, with dates
- Brief reference to other significant awards
- Description and significance of accomplishments that are deemed to qualify the nominee for the award.

The items cited should be concerned with coatings, be pertinent or related to coatings, or be concerned with the constituents of coatings. Some activities and accomplishments which are considered to be appropriate

for citation in the nomination are the following:

- Publication and communications such as the following:
  - Journal articles
  - Patents
  - Books (authored, edited, or organized)
  - Chapter in books
  - Lectures and presentations
  - Symposia or meetings organized

(Reprints may be submitted with the nomination but should be restricted to those that reflect seminal contributions; teaching credentials or skills, per se, are not to be considered in this award.)

- Inventions and discoveries

- New scientific principles, understanding or insight
- New or improved products
- New or improved instrumentation or testing methods
- New or improved analytical methods
- Novel uses or applications of products
- New or improved processes for production of resins or coatings, etc.
- Engineering aspects
- New or improved application methods

Please forward all nominations by May 1, 1996, to Patricia D. Viola, Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350.

## Nominations Sought for Armin J. Bruning Award

Dr. Robert T. Marcus, Chairman of the Bruning Award Committee, has announced that nominations are being sought for the 1996 recipient of the Armin J. Bruning Award. Established to recognize an individual for outstanding contributions to the science of color in the field of coatings technology, the award commemorates Mr. Bruning, the inventor of the Davis-Bruning colorimeter. Mr. Bruning was noted for his devotion to the pursuit of the scientific study of color.

A nominee for the award must have contributed significantly to the field of color study. These contributions could include very basic work which increases our understanding of the interaction of colorants, light and observers (human and instruments). However, the contributions of the nominee could also include various aspects of techniques or theories developed by others, or the teaching of color science or the dissemination of information in a manner which has direct benefit to the coatings industry. The nominee does not have to be a member of a Constituent Society or a member of the Federation of Societies for Coatings Technology.

To nominate an individual for the Bruning Award, please contact Dr. Marcus, Chairman, at Pantone, Inc., 590 Commerce Boulevard, Carlstadt, NJ 07072-3098, (201) 935-5500, fax (201) 842-9016.

The nomination must include documentation concerning the nominee's qualifications and contributions in the area of color science for the coatings industry. Nominations must be received prior to May 17, 1996.

## International Coatings Expo Exhibitors (cont'd)

International Resources Inc.  
International Specialty Products  
ITT Marlow Pumps/ITT A-C  
Pumps  
S.C. Johnson Polymers  
Kemira Pigments, Inc.  
Kenrich Petrochemicals, Inc.  
King Industries, Inc.  
Kline & Co.  
KTA-Tator, Inc.  
LaQue Center  
Lawter International  
The Leneta Co.  
Liquid Controls Corp.  
Littleford Day Inc.  
Longview Fibre Co.  
The Lubrizol Corp.  
MacBeth  
The Mearl Corp.  
Micro Powders, Inc.  
Micromeritics  
Millipore Corp.  
Ming-Zu Chemical Industries

MiniFIBERS, Inc.  
Minolta Corp.  
Mississippi Lime Co.  
University of Missouri-Rolla  
Morton International - UCD  
Muetek Analytical, Inc.  
Nacan Products Limited  
Nametre Co.  
Netzsch Incorporated  
Neupak Inc.  
New Way Packaging Machinery  
Inc.  
North Dakota State University  
Ohio Polychemical Co.  
Olin Chemicals  
OSi Specialties, Inc.  
Oxy Chem  
Paint & Crgs Ind. Magazine  
Parasol Systems, Inc.  
Particle Sizing Systems, Inc.  
Peninsula Polymers  
Poly-Resyn, Inc.  
PPG Industries, Inc.

P Q Corp./Potters Industries  
Premier Mill Corp.  
Q-Panel Lab Products  
Raabe Corp.  
Radtech International North  
America  
Ranbar Technology, Inc.  
RHEOX, Inc.  
Rhône-Poulenc  
Rohm and Haas Co.  
Ronningen-Petter  
Charles Ross and Son Co.  
Russell Finex, Inc.  
Sartomer Co., Inc.  
SCM Chemicals  
Shamrock Technologies Inc.  
Shell Chemical Co.  
Sherwin-Williams Chemicals  
Silverline Mfg Co., Inc.  
Software 2000 Inc.  
Univ. of Southern Mississippi  
Spraymaton, Inc.  
Starex Chemical Co.

Sub-Tropical Testing Service  
Sud-Chemie Rheologicals  
Taotek North America, Inc.  
Tayca Corp.  
Tego Chemie Service USA  
Troy Corp.  
U.S. Aluminum, Inc.  
U.S. Borax, Inc.  
U.S. Silica Co.  
Union Carbide Corp.  
Union Process, Inc.  
United Mineral & Chemical Corp.  
Van Waters & Rogers Inc.  
Wacker Silicones Corp.  
X-Rite, Inc.  
Yamada America, Inc.  
Carl Zeiss, Inc.  
Zeneca Resins





## Coatings Industry Honor and Remembrance Fund

In mid-1992, the Coatings Industry Education Foundation (CIEF) was proud to announce the establishment of the Coatings Industry Honor and Remembrance Fund, which is administered by the Trustees of the CIEF. The concept of an "Honor and Remembrance" fund was new to our industry, and was first suggested by 1993 FSCT President Colin Penny, who felt that many of us would like to honor friends, spouses, respected colleagues and outstanding employees in a public and substantive way. Colin felt that—by establishing a fund dedicated specifically to the honor and/or remembrance of those special people—the CIEF would be creating a meaningful and lasting tribute to their work. Since the intent of the Trustees is to use the earnings from the principal of this fund for educational assistance in the form of scholarships, fellowships, and grants to colleges and universities with coatings programs, anyone making a donation will also have the additional satisfaction of knowing that their gift will be used to help educate those who will carry on the tradition of scientific and technological excellence in the coatings

industry—and who may very well be honorees of this same fund, someday.

By recognizing gifts to the Honor and Remembrance Fund in the JOURNAL OF COATINGS TECHNOLOGY, it is the Trustees' intent to give international recognition to both the donors and the honorees, as well as to focus on the educational benefits being derived from such gifts. This is a bold venture which will enable every individual, corporation, and society associated with the coatings industry to really "make a difference," by recognizing specific individuals' contributions to our industry, while furthering the educational efforts of the CIEF at the same time. Gifts in any amount (made payable to "CIEF—Honor and Remembrance Fund," and sent to the Federation Office) will be recognized annually in the JOURNAL OF COATINGS TECHNOLOGY, and will be divided into the following five categories:

- ◆ Gifts up to \$249
- ◆ Gifts from \$250-\$499
- ◆ Gifts from \$500-\$999
- ◆ Gifts from \$1,000-\$9,999
- ◆ Gifts of \$10,000 and greater

All gifts to the Honor and Remembrance Fund will be tax deductible to the extent that the law allows, and may be made as a direct gift to the Fund, as a gift in honor of a living person, or as a gift in remembrance of one who is deceased. Examples:

- ◆ The Acme Corporation
- ◆ The Ohio Coatings Society, in honor of Maynard Q. Browning
- ◆ Mr. and Mrs. Pierre M. Lundquist, in remembrance of John Z. Edwardson

It is currently the intention of the Trustees to reprint the list annually, with some indication of gifts which have been added since the last printing. The Trustees also placed a plaque, in 1994, in the Federation Office in Blue Bell, listing all donors of record, with sufficient room to add additional donors in the future. As of December 1995, the Honor and Remembrance Fund has received generous, and deeply appreciated, gifts from the following individuals:

### The Coatings Industry Honor and Remembrance Fund

(Donations through December 31, 1995)

#### \*Gifts of \$10,000 and Greater\*

*Len and Neta Schaeffer, in remembrance of Fred and Ruth Daniel*

*The Baltimore Society for Coatings Technology, in remembrance of Richard D. McCloskey*

*The Kansas City Society for Coatings Technology, in remembrance of Terryl F. Johnson\**

#### \*Gifts of \$1,000-\$9,999\*

*Mrs. Herbert L. Fenburr, in remembrance of Dr. Herbert L. Fenburr*

*The Houston Society for Coatings Technology, in remembrance of Loren B. Odell*

*The Dallas and Houston Societies for Coatings Technology*

*John J. Oates, in remembrance of Elias Singer*

*The Chicago Society for Coatings Technology\**

#### \*Gifts of \$250-\$499\*

*Colin D. Penny*

*Saul Spindel, in honor of Sidney B. Levinson*

#### \*Gifts up to \$249\*

*The Birmingham Paint, Varnish, and Lacquer Club, in remembrance of Ray Mowl and Ken Cooke*

*Sidney Lauren, in remembrance of Fred G. Schwab*

*Mr. & Mrs. George R. Pilcher, in remembrance of Helen Skowronska*

#### \*Gifts of \$500-\$999\*

*Akzo Coatings Inc. (Columbus), in remembrance of our employees who died in 1992*

*The Baltimore Society for Coatings Technology, in remembrance of our deceased members*

*Mr. and Mrs. Hiram P. Ball, in remembrance of Fred G. Schwab*

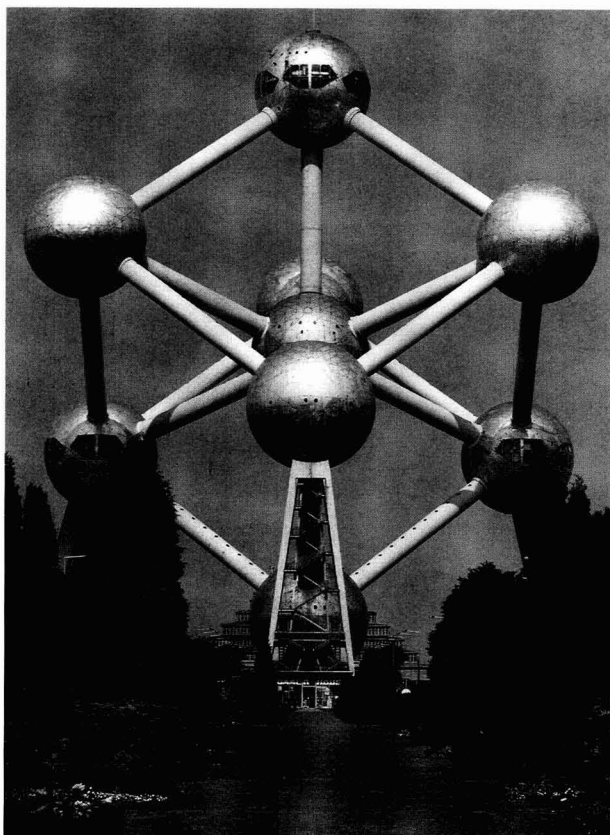
*Doris S. Schwab, in remembrance of Fred G. Schwab*

\*Gift received during 1995

# XXIII FATIPEC Congress

Brussels Exhibition Center, Auditorium 2000  
10 - 14 June 1996

European Coating/s Show  
11 - 13 June 1996



**ATIPEC**, the Belgian association of technicians of paint, ink and related manufacturing industries, member of **FATIPEC**, has the honour to invite you to the XXIIIrd FATIPEC Congress.

The theme of this congress is: "**Performance, environment and legislation: challenges and sources of innovation in the coating industry**".

Many challenges face the coating industry, such as the development of raw materials for new generations of coatings, new analytical and testing methods and putting "responsible care" into practice.

Ten plenary lectures will be presented by the affiliated countries of FATIPEC and the member associations of **COATINGS SOCIETIES INTERNATIONAL** (FSCT, JSCM, OCCA, SLF, SCAA, SCANZ).

In parallel, 72 original and unpublished communications will be presented by lecturers from the Czech Republic, Denmark, France, Germany, Great Britain, Israël, Italy, Japan, Korea, The Netherlands, Poland, Switzerland, U.S.A...

These presentations have been divided into four groups:

- 1- **Analysis and physical chemistry**
- 2- **Durability - ageing - corrosion**
- 3- **Raw materials - formulation**
- 4- **Environment**

The lectures will be simultaneously translated into the three official languages of the congress: English, French and German.

For the first time, the **European Coating/s show**, a worldwide exhibition, will be combined with the **FATIPEC** Congress on the same site and during the same week.

Participants and accompanying persons will benefit from an enriching touristic and cultural programme concentrated not only in Brussels but also in Brugge (the famous Venice of the North) and Namur (Capital of Wallonia).

#### **General information:**

programme and registration form are available from the congress secretariat:

Destrée Organisation

Rue des Drapiers, 46 - B. 1050 Brussels

Tel.: 32-2-512 44 42 - Fax: 32-2 502 44 43

Circle No. 285 on the Reader Service Card



*It has long been said that the world is getting smaller. While astrophysicists and cartographers may argue this point—now a rather trite saying—it is true that regional social and business events affect more than just the local inhabitants and industry. A global business environment is now a fact of life.*

*In an effort to bring our readers up-to-date on the international coatings scene, we are pleased to present here reports from Europe, Scandinavia, South America, Japan, and New Zealand, detailing the state of the coatings industry in these areas as well as the activities of their respective coatings technical organizations.*

*The FSCT is proud to be associated with these groups and the people which they serve.*

Featuring reports from:

Associação Brasileira dos Fabricantes de Tintas (ABRAFATI)  
Federation d'Associations de Techniciens des Industries des Peintures,  
Vernis Emaux et Encres d'Imprimerie de l'Europe Continentale (FATIPEC)  
Federation of Scandinavian Paint and Varnish Technologists (SLF)  
Japan Society for Colour Material (JSCM)  
Surface Coatings Association New Zealand (SCANZ)

# Associação Brasileira dos Fabricantes de Tintas (ABRAFATI)

## The Brazilian Paint Industry

ABRAFATI is the Brazilian paint manufacturers association. Its 24 members are responsible for more than 80% of the Brazilian paint production. All large and medium-sized paint producers are associated with ABRAFATI and provide the necessary funding to the Association.

The largest producers are Akzo-Nobel, BASF, Sherwin-Williams, Tintas Coral, and Tintas Renner. The production of these five companies is more than 60% of the total Brazilian production. The market is complemented by another 10 medium-sized companies and also by many small regional producers.

The five major companies have permanent representation on ABRAFATI's Board of Directors, composed also by representatives of medium and small associates. In this way, the whole industry is represented.

The industry is mature, with up-to-date technology, modern and efficient plants, and products with international quality basis. Strong competition is the rule on the market.

Present trends involve increase of productivity, total quality management, and the development of more environmentally friendly coatings, bringing the latest new technologies to the market.

Factories are concentrated mostly in or around São Paulo, with some larger production units in Porto Alegre, Rio de Janeiro, and Recife. This gives a large distribution web to about 12,000 medium and small sized paint and hardware outlets around the country. Mega-stores are beginning to appear only now as paint retailers in Brazil, and this could change the future distribution trend.

Most raw materials are produced in Brazil. Titanium dioxide is produced by Tibrás (50,000 tons/year) and also converted from imported clinker to final product by DuPont (15,000 tons/year), but the combined capacity is not enough to supply the present needs (90,000 tons/year). Vinyl acetate monomer is locally produced in large scale by Rhodia (Rhône-Poulenc). Acrylic monomers are not yet produced locally. No restrictions, besides import duties, apply on imports of paints or raw materials and it can be stated that the market is now open, with a competition between local producers and imports.

Some data on the Brazilian paint market (mill.gallons):

	'92	'93	'94	'95 (est.)
Decorative	140	142	150	158
Industrial	23	26	28	30
OEM	5	6	7	8
Refinishing	10	9	10	11
Total	178	183	195	207

Total sales value in 1994 was \$1.63 billion.

With the recent creation of the Mercosul regional common market (Brazil, Argentina, Uruguay, and Paraguay), the five largest Brazilian paint producers are now very much present

in the whole Mercosul area, after some corporate mergers and acquisitions. It is expected that Chile and Bolivia will join Mercosul in a short time.

## Who is ABRAFATI

ABRAFATI's organization comprises an executive board and working committees, composed of directors and line managers of associated companies. Presently, there are seven committees who meet monthly to discuss problems and propose solutions related to legal, economical, technical, environmental, safety and occupational health, human resources, and financial areas.

The President is Ernst J. Blumenthal, retired Director and shareholder of Globo S.A. Tintas e Pigmentos, a medium-sized paint and pigment producer. Vice-Presidents are Dilson Ferreira (Akzo-Nobel), Ekhard Rettich (BASF—Div. Glasurit), and José Júlio Cardoso de Lucena (Tintas Coral). On the Board of Directors are also Claudio Geiger (Sherwin-Williams), Roberto Ritter (Tintas Renner), Paulo Gonçalves (Courtaulds International), Maurice Max (Globo S.A. Tintas e Pigmentos), Heinz Mayer (BASF—Div. Glasurit), Edson Fernando Vieira de Mattos (Tintas Coral), José Manuel Sardo (Akzo-Nobel), Luiz C. Caovilla (Elgin), Silverio Macchia (Tintas Ancora), and Thomas Herrmann (Tintas Renner). The Executive Secretary is Mario R. Krausz.

Due to the ever-changing legislation in some of these areas, much is achieved by knowledge of new industry challenges and corresponding contacts at government level. The committees provide a very important contribution to the industry by rapidly identifying arising challenges. Since they are composed of top company managers in their respective fields, the committees serve as a permanent "braintrust," providing fast and correct guidelines and solutions.

ABRAFATI provides courses in paint technology for the training of technical staff. A two-volume book (in Portuguese) on paint technology was published in 1993 and is already in its second revised and enlarged edition, providing very valuable information on the science of coatings technology.

Every two years, ABRAFATI promotes an International Paint Congress and Raw Materials Exhibition. The fourth Congress was held last October (three days) with more than 3,000 visitors at the exhibition and 750 Congress participants. Seventy-eight papers on paint technology, environmental solutions, automation, and other relevant themes were presented by international lecturers, simultaneously in five lecture rooms at the Anhembi Convention Center in São Paulo. There were 102 exhibitors at the exhibition. The Congress is a great success, the largest in Latin America, and the converging point of Mercosul paint technicians and suppliers.

Additional information on ABRAFATI will be gladly supplied on request and interested parties should write to: Mr. Mario R. Krausz, Executive Secretary, ABRAFATI- Associação Brasileira dos Fabricantes de Tintas, Rua Hungria 574, conj. 22, 01455-000 São Paulo, SP, Brazil.

### Ernst J. Blumenthal

*Ernst J. Blumenthal, retired Director and shareholder of Globo S.A. Tintas e Pigmentos, a medium-sized paint and pigment producer, currently serves as President of ABRAFATI.*





# Fédération d'Associations de Techniciens des Industries de Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale (FATIPEC)

## FATIPEC

FATIPEC, which is celebrating its 46th anniversary this year, is one of the first supra-national professional organizations in Europe.

The success of its work is reflected in the growing part it plays in the development of basic and applied research, as well as in the field of technology. The international conventions held every two years—enhanced by an exhibition for products, equipment and service suppliers, and attended by specialists from over 30 countries—prove the high esteem it enjoys among professional circles.

## History

At the initiative of the professional associations of France and Belgium, the first international congress of the paint and varnish chemists was held in Paris in 1947. The participation of 900 colleagues from 18 countries by far exceeded the organizers' expectations.

Following this congress chaired by J. Borel, a first Liaison Committee between the United States, Great Britain, and France was set up under the impulse of L. Ravel. The idea of a West-European federation took shape during the meeting in Milan in 1948 and Basle in 1949, leading to the "Fédération d'Associations de Techniciens des Industries des Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe Continentale." FATIPEC was founded by the Belgian, Dutch, French, Italian, and Swiss associations of paint and varnish technicians in Geneva, on January 8, 1950, at the "Athénée" in the very hall where the International Red Cross was formed in 1863. The following names are of the founders, who signed the bylaws of FATIPEC, now acknowledged as the international organization for the paint field: C. Dechaux, France; C. Denzler, Switzerland; C.A. Lobry De Bruyn, Netherlands; D. Pagani, Italy; and A. Van Der Borgh, Belgium.

By their sides, three promoters for that European foundation: R. Bertaut, France; A. Blom, Switzerland; and L. Ravel, France.

Other meeting attendees included the delegate from the Federation of Societies for Coatings Technology, R.W. Matlack, and observers from: Germany, Dr. E.A. Becker; Norway, A.R. Bjercke; and Spain, S. Medina-Castellanos.

## Aims

According to its statutes, the Federation has the following aims serving the promotion of international relations:

- (a) To develop friendship between its members;
- (b) To promote and disseminate scientific and technical knowledge concerning the manufacture and use of paints, varnishes, enamels, and printing inks;
- (c) To promote research and interchange of ideas and to publish the scientific and technical contributions made to the industries concerned;
- (d) To encourage all efforts towards a better understanding among the paint and varnish technicians of all nations; and
- (e) To convene an international meeting—to be organized in turn by the association of the country holding the presi-

dency—where the results of works as yet unpublished are to be presented and discussed.

## Organization

FATIPEC is open to all associations complying with the conditions set forth in its bylaws. One point to be mentioned is that the member organizations should consist of professionals with university degrees only. Decision on the acceptance of a new member lies with the Board.

The section "Körperfarben und Anstrichstoffe" (today "Anstrichstoffe und Pigmente") of the Gesellschaft Deutscher Chemiker applied for membership in FATIPEC in 1951. In 1965, the section "Paints and Varnishes" of the Hungarian Chemists' Association applied, and in 1994, the Surface Coatings Division of the Polish Chemists Association and the working group of Czech Chemical Society applied for membership in FATIPEC, which now numbers nine members, viz. Belgium, Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Poland, and Switzerland.

In 1994, the Spanish Association joined FATIPEC as a "Candidate member" until 1996. In 1995, the Greek Association and the Romanian Association have joined FATIPEC as "Candidate members" until 1997. This means that in 1997, FATIPEC will represent 12 member countries.

The highest authority of the FATIPEC is the General Meeting of its members, which convenes every other year. Each member association is represented by one delegate.

The General Meeting elects the president of the Federation. Every two years this office is passed on in a fixed order among the member associations, who propose their respective candidates to the General Meeting.

The President directs the work of the Board, which meets at least once a year. Besides the President, it consists of permanent members and nine members elected by the General Meeting for a two-year term according to their proficiency rather than their nationality.

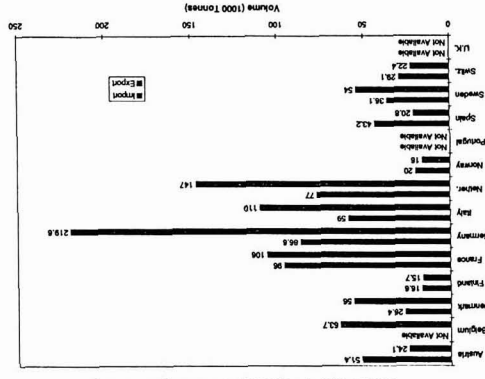
Moreover, the President directs the work of the Scientific and Technical Committee, to which each association delegates representatives. This committee is responsible for preparing the scientific and technical activities of FATIPEC and selecting subjects suitable for congress presentation.

The General Secretariat, having its offices in Paris in the "Maison de la Chimie" at 28 rue Saint Dominique, is held by a General Secretary. This individual implements the decisions made by the Board and maintains constant and close contact between the member associations as well as with the member-associations.

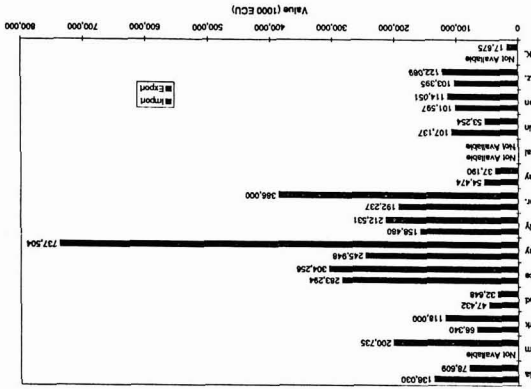
In addition, there is an Honorary Board, existing since 1962, which is formed of the former Presidents and the founders of FATIPEC.

Initiated by FATIPEC, the International Committee to Coordinate Activities of Technical Groups in the Coatings Industry—ICCATCI/CICATIRS was founded in 1979 in Paris, including now—besides FATIPEC—the following organizations; FSCT (USA); JSCM (Japan); OCCA (UK); SCANZ (New Zealand); SCAA (Australia); and SLF (Scandinavia). In 1994 ICCATCI/CICATIRS changed its name into CSI—Coatings Societies International.

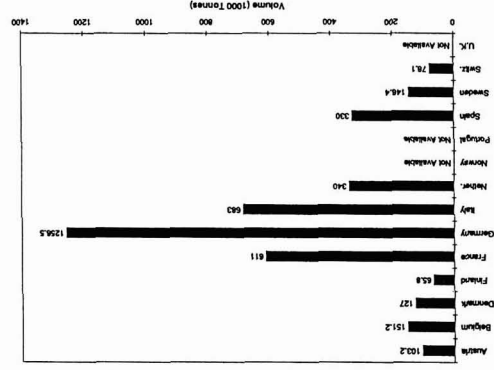




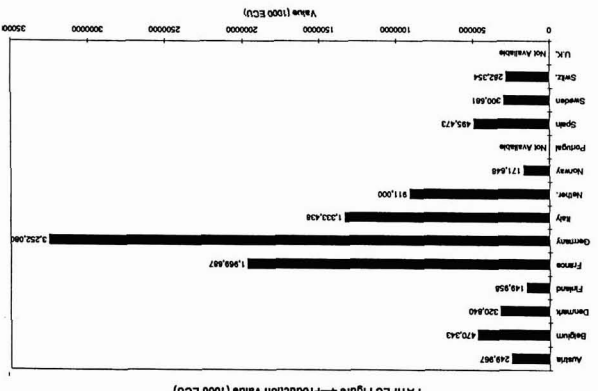
FATPEC Figure 5—Export/Import in Volume (1000 Tonnes)



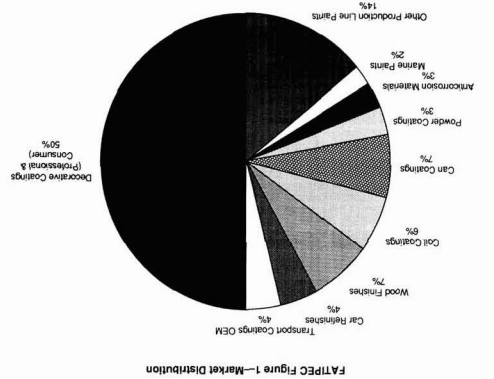
FATPEC Figure 6—Export/Import Value (1000 ECU)



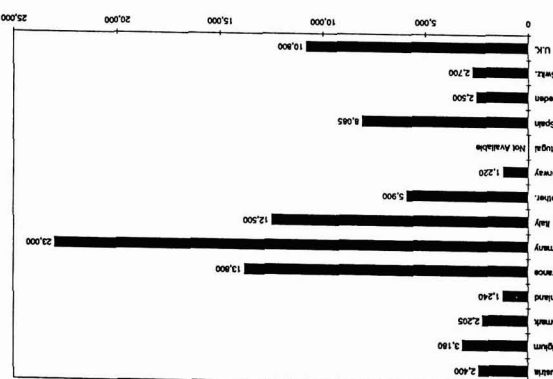
FATPEC Figure 3—Production Volume (1000 Tonnes)



FATPEC Figure 4—Production Value (1000 ECU)



FATPEC Figure 1—Market Distribution



FATPEC Figure 2—Number of Employees

## **Finance**

The member associations pay contributions related to membership. Special grants may be received. It is very important to state that all members of FATIPEC are individuals and not societies which gives FATIPEC independence and authority.

## **Achievements of FATIPEC**

Every two years, FATIPEC organizes an international Scientific Congress, attracting about 600 participants, including delegates of affiliated associations from North America, Japan, Scandinavia, Great Britain, Australia, and New Zealand.

Translated simultaneously into three languages (French, German, and English) and divided up into 100 presentations, this congress offers an overview of the current level of knowledge, and thus possesses a unique prestige in the field of paint and ink industry.

The current President of FATIPEC is Mr. A. Clause.

During the last FATIPEC Congress held in Budapest (May 1994), he was

## **Francis Borel**

*The General Secretary of FATIPEC is Mr. Francis Borel. Mr. Borel has been employed for many years in a paint factory. At the present, he is General Manager of BYK-Chemie in France.*



*During the past 18 years, Mr. Borel has served as General Secretary and also President of the French Association AFTPVA. From 1989 to 1993, he was General Secretary of CSI and he currently serves as the technical delegate of FATIPEC to CSI.*

*The address of the Secretariat is: Mr. F. Borel, 34 Chemin du Halage, La Bonneville, 95540 Mery Sur Oise (France); Tel 33-1-48-67-52-24; Fax 33-1-48-67-47-92.*

elected President of FATIPEC for 1995-96, and will be responsible for the organization of the XXIIIrd FATIPEC Congress, which will take place in Brussels, on June 10-14, 1996.

The theme of the Congress is: "Performance, Environment and Legislation: Challenges and Sources of Innovation in the Coatings Industry."

In conjunction with the FATIPEC Congress, the exhibition European Coatings' Show 96 will also be held.

Each individual association assists its local industry by the means of:

- publication of scientific magazines;
- congresses (e.g., EUROCOAT) and technical meetings;
- education of technicians and engineers;
- support to young graduates to obtain their doctorate; and
- to give the opportunity to universities to present lectures at national and international meetings.

The official address of FATIPEC is: Maison de la Chimie, 28 rue Saint Dominique, 75007 Paris (France).

# **Federation of Scandinavian Paint and Varnish Technologists (SLF)**

## **The Scandinavian Paint Industry Its Structure and Trends**

The per capita use of paint in Scandinavian is among the highest in the world. However, unlike many other markets, it is mostly concentrated in a few big companies. Over the last few years many consolidations and buy-outs have taken place that make it difficult to analyze the market and present it in a simple way. One example of such a buy-out is that of the large Danish company Sadolin. They were first purchased by the Swedish Nobel Group, with Nobel group consequently being purchased by the Dutch company Akzo. Should such companies be considered as Scandinavian or foreign? In the following discussion they have mainly been excluded, as details of these would appear in an analysis of continental European companies.

The paint industry in Scandinavia is well developed and functions at a high technical level. This is not only true for industrial customers but also for the quality-conscious do-it-yourself (DIY) customer. This may be exemplified by the very extensive use of color dispensing machines in retail sales. Such systems have been found to be very advantageous, not only for the customer who can obtain practically any desired color, but also for the retailer and paint manufacturer who can thereby reduce both storage and production costs.

Perhaps a good impression of the philosophy of the Scandinavian paint industry can be obtained from the

following anecdote. Last autumn the German paint journal *Fabre + Lack* organized a 10-day study tour to the Scandinavian paint industry. The 15 participants were reportedly surprised by the extreme cleanliness and tidiness coupled with high productivity and rationalization. In this respect there is no doubt that the Scandinavian paint manufacturers are among the best in the world. As one of the delegates said after the visit to a Danish factory, "Actually they should pay to be allowed to work here."

## **Structure of the Market**

As Scandinavia consists of four distinct national cultures and markets, it can be quite difficult to generalize about the Scandinavian paint industry as a whole. As there are both similarities and differences, the four paint industries, those of Denmark, Finland, Norway, and Sweden, will be discussed individually. However, the general tendencies that characterize the Scandinavian market as a whole are also presented.

Table 1 gives an overview of the market structure as it was in 1993, the last date for which we have full figures available.

What in the context of Scandinavia may be considered a large company may not, perhaps, be considered as such on a world-scale. However, among the 26 biggest manufacturers in the world, we find six from the Scandinavian countries. The figures for these for the year 1994 are given in Table 2.

**SLF Table 1**

Company Size in U.S.\$	Denmark	Norway	Sweden	Finland
Large, > 60 million	4	1	10	2
Large to medium, 30-60 million	1	—	1	1
Medium, 10-30 million	5	6	3	1
Small to medium, 5-10 million	3	4	5	3
Small, < 5 million	16	12	12	2
Total number of companies	29	23	31	9
Total employees	2205	1220	2500	1240
Production (Tons)	127,382	65,500	146,400	65,800
Production per employee, approx.	58	54	58	53
Paint consumption per capita (Kg)	19.1	16.2	14.6	13.1

As shown in Table 2, the market structures of the four Scandinavian countries are somewhat different; this will be seen from the following descriptions of the individual countries.

**Denmark**

The four most important Danish companies are those three given in the table above, together with Sadolin. The latter, as already stated, now belongs to the Akzo Group.

Dyrup, one of the larger producers of quality wood-protective stains in Europe, purchased Gori, a smaller Danish firm specializing in high-quality stains; they now cover about 65% of the Danish market for this type of product. They also have operations in several European countries, being especially strong in Europe.

The production and use in Scandinavia of such high-quality wood-protective stains for housing is characteristic of the Scandinavian market. As in Norway, there has long been a tradition for this type of product.

Flügger, a very successful company in the professional decorative trade, also has a large subsidiary plant in Sweden. In terms of profit, Flügger is probably one of the most successful paint firms in Scandinavia today.

Hempel specializes in marine paints, these being a well established product in a traditional shipbuilding and seafaring nation. Tikkurila has a market share of about 50%. Together with the Norwegian Jotun, they rank as No. 2 and 3 in the world.

**Finland**

The paint industry in Finland is mainly covered by three companies, those of Tikkurila owned by Kemira (given in the Table 2), Teknos-Winter, and Sadolin (now Akzo Nobel).

The entire Finnish market amounts to about 80 million liters.

Tikkurila, with operations in eight countries, produces all types of paint and varnish, ranging from decorative paints to heavy duty and industrial coatings. Their car refinishing paints are mainly exported to Russia. Tikkurila has a three percent share of the European market and is among the top 12. It

is the leader in Europe in tinting systems and No. 2 worldwide.

Teknos-Winter, the largest private paint manufacturer in Finland, produces all types of paint, including powder coatings. These are also produced at Teknos-Schou, a company located in Denmark, who specializes in this type of product.

It can be seen that where the Finnish paint companies have invested outside Finland it has often been in Denmark. Tikkurila has invested strongly in the UK, in the Netherlands, and in the Baltic states. This was originally due to the wish to get a foot-hold in the EEC. However, even though Finland is now within the ECC, large investments are still taking place within Europe. This is exemplified by the investment of the Finnish chemical combine of Neste in a plant at Gent, Holland, for producing materials for resin production.

**Norway**

The Norwegian market is dominated by Jotun A/S, with a turnover in 1995 of about U.S.\$ 700 million, 70% of which comes from abroad. It has 42 production units in more than 20 countries. Jotun has a three percent share of the European market. The company produces all types of paint.

The very extensive use of color-dispensing machines in retail sales in Scandinavia is exemplified by the case of Jotun who, together with Tikkurila in Finland, specializes in such tinting systems. In Norway there are about 1,000 paint retail shops to whom Jotun has sold some 900 systems. Jotun has sold about 1,500 systems worldwide.

Within some segments, Jotun is very well known; for example, Jotun is placed third in Europe in the production of

**SLF Table 2**

Company	No. of Employees	Net Sales, U.S.\$ Million
S. Dyrup & Co., Denmark	1048	214
Flügger A/S, Denmark	673	135
Hempel Marine Paints, Denmark	2250	417
Tikkurila OY, Finland	1559	270
AB Wilh. Becker, Sweden	2253	468
Jotun A/S, Norway	2820	597

unsaturated polyesters, fifth in the world in the production of powder coatings, and, together with Hempel, second or third in the world in marine coatings.

### **Sweden**

The most important companies in Sweden are AB Wilh. Becker, Klintens Sweden AB, and Nobel Paints and Adhesives (now owned by Akzo).

AB Wilh. Becker is the largest Scandinavian paint and coatings manufacturer, ranked No. 7 in Europe and having a market share of about four percent. Becker is a market leader within the coil-coating sector in Europe. It is also the largest manufacturer of artists' paints in Europe.

Sweden, compared to Denmark or Finland, boasts heavy industrial production. Volvo and Saab, Asea, and Electrolux are among the well-known firms established in Sweden. This has, of course, influenced the existence of subcontractors, among whom are paint manufacturers. For this reason, Becker has been able to become, for example, suppliers of high-quality automobile finishes.

### **Trends, Developments and Challenges**

Not all factories perhaps are quite up to the level of sophistication referred to by the German visit, yet financial yields of 10% and more are normal. The extensive use of dispensing machines in the DIY trade is still on the increase. While there are the advantages to both retailer and customer referred to previously, there is the disadvantage of dependence on a single supplier. Such systems can only be used with products from a specific producer who has a rather large share of the market. Market shares in Scandinavia of 50-70% occur quite frequently.

The Scandinavian paint industry has long paid particular attention to the occupational health and environmental aspects of the industry, which reflected in the current strict legislation pertaining both to the manufacture and use of paint products. The main targets of R&D have therefore been safety, health, and the environment.

Earlier the emphasis was on cost per liter. The cost per square meter of applied coating and its durability were thereafter considered as the most important factors. Today, however, the total Life Cycle Assessment (LCA) is thought to be the most relevant factor when considering the environmental impact of paint products. This assessment is no easy task, where all economic and ecological factors have to be estimated from the production of the raw materials themselves, through production and use, to the final recycling or destruction of the paint materials. In spite of the problems in such assessments, their introduction will give a common language and will also supply information for public

and in-house debate regarding the environmental impact of paints.

The demand to reduce the solvent content of paint, and thereby the environmental impact, is very strong. However, it is not always absolutely true that waterborne paints are to be preferred; only a full LCA can give a rational answer. Therefore, most companies in Scandinavia have started to use LCA in their development work, and consequently ask the paint industry to give an LCA for their products.

### **Internationalization**

Each Scandinavian country is a relatively small market area, but the product range is large. The exceptionally large market shares of the bigger paint manufacturers have resulted in a situation in which each producer makes all types of paint products. Therefore, the cost of product development has become very high. The larger companies in Scandinavia need to acquire market shares in larger markets in order to overcome the high expenses entailed in modern R&D work. Expansion outside Scandinavia is therefore necessary, and several companies are now multinational concerns situated in 20 or 30 countries, not only within Europe but over the world.

### **Federation of Scandinavian Paint and Varnish Technologists**

SLF, founded January 26, 1953, is the federation of the four Scandinavian Paint and Varnish Technologists' Associations. These associations are the Danish (461 members), the Finnish (182 members), the Norwegian (375 members), and the Swedish (648 members).

Each of these four associations has its own finances and its own set of laws which, although similar in content, do differ somewhat according to the differing local conditions and educational requirements.

Due to the large geographical extent, the Swedish Association is divided into three societies—Stockholm, Gothenburg, and Malmoe. Norway is also divided into two societies—Oslo and Bergen. Thus, for most practical purposes, such as lecture meetings and social events, SLF consists of seven separate societies.

The purpose of the supra-national Federation therefore is to promote cooperation between the four Scandinavian Associations, to arrange joint inter-Scandinavian meetings, to raise the level of technical expertise and knowledge of its members, and, last but not least, to promote contact between the Scandinavian Associations and the international paint and varnish chemists' associations comprising CSI.

One of the main ongoing concerns is that of Professional Gradings. SLF is strongly promoting this service, leading, as it will, not only to higher levels of expertise among its members

#### **Kaare Kleive**

*Kaare Kleive, born in 1928, received the M.Sc. in Chemistry in 1958 at the Technical University of Graz, Austria, and began employment with Jotun A/S in Norway.*



*From 1964 to 1967 he was Raw Material Manager at Wilh. Becker AB, Sweden. In 1968, he started-up the Jotun Thailand Ltd. factory as its Technical Manager, and was later appointed its Managing Director. From 1974 he returned to Jotun A/S in Norway as Laboratory Manager. As appointed Senior Chemist at Jotun A/S, he also served as Technical Coordinator for Jotun's international activities, Technical Manager for export within Europe, Manager for the R&D service laboratory, and finally, Jotun Corporate Raw Material Manager.*

*Together with his collaborators, he has published several articles on the subject of wood protection.*

*Kaare Kleive has been active in the Norwegian Paint and Varnish Technologists' Association. He was elected to serve as President of the Federation of Scandinavian Paint and Varnish Technologists for the years 1995 to 1997.*



but also to a higher internationally accepted status for its members in the industry as a whole.

The Federation's affairs are managed by a Board and are directed by a President. The presidency is held in turn by each of the four Associations for a three-year period, rotating in the order of Sweden, Denmark, Norway, and Finland. The presidency is currently in Norway, for the period 1995 to 1997.

To ensure continuity with presidential changes, certain activities of SLF are centralized through an honorary general secretary, currently placed in Copenhagen.

The Federation regularly issues a journal, *färg och lack scandinavia*, which is sent to all members of the Scandina-

vian Associations. The present circulation is 2,000 of which about 1,700 go to members of SLF. The journal is managed by an editor who is responsible to the board.

An inter-Scandinavian Congress is held every three years, taking place in the country of the president who is responsible for organizing it. This is considered as an international event to which all members of CSI are invited, the language spoken is either English, or Scandinavian with simultaneous translation to English.

The main mission of SLF is in the field of education, both formal and informal, where emphasis is placed on raising the standards of technical competence at all levels within the industry.

## Japan Society for Colour Material (JSCM)

### Update of Paint Industry in Japan

According to the Japan Paint Manufacturers Association, the paint industry in Japan experienced steady growth reaching a peak in fiscal 1990 (April to March) when production volume reached 2.198 million tons and shipment volume was 2.177 million tons. The industry, however, started to decline and the shipment volume of paint recorded year by year fell for three years until fiscal 1993. In 1994, as a result of the first Paint Show in Japan at Makuhari Messe in April, the shipment volume of paint reached 2.005 million tons, a 2.5% increase from the previous year as shown in Figure 1. Based on 1994 paint industry results and the government forecast for the real growth of GDP of 2.8% for 1995, the shipment volume for fiscal 1995 was expected to amount to 2.044 million tons at the end of last year.

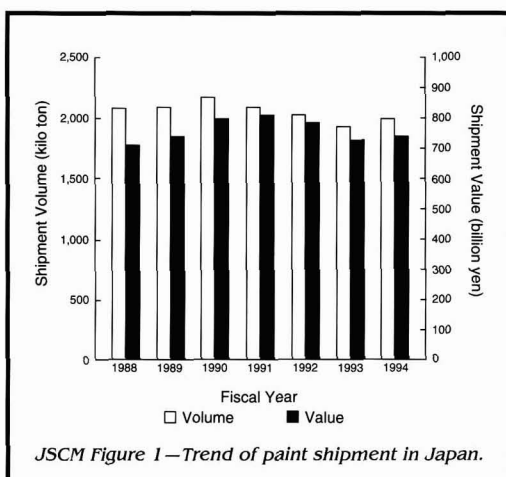
The Japan Paint Manufacturers Association recently reported on the summary of paint industry for the first half of fiscal 1995 (April to September). The production volume was 0.938 million tons, which was 96.2% of that for the same term of last year. The shipment volume did not exceed one million tons and remained at 0.991 million tons (97.5%), leading to predictions that the shipment volume would not exceed two million tons throughout the year. The shipment value was 362.9 billion yen, which was 95.8% of that for the same term

of last year. The average price of paint was 366 yen/kg in all, which went down by 7 yen/kg compared with last year.

Reviewing general trends in paint production by product category, nine products reported an increase in volume compared with the same term of last year. They include inorganic coatings (108.8%); although its absolute volume is small, emulsion paints (with aggregates) (107.5%); insulating enamels and varnishes (104.3%); powder coatings (fluidized bed) (103.8%); and unsaturated polyester enamels and varnishes (101.2%). Among the five products, unsaturated polyester enamels and varnishes have resulted in positive growth in this term from a negative in 1994, and the others are maintaining positive growth. An increase in shipment in both volume and value were experienced by: emulsion paints (with aggregates) 106.9% in volume and 105.7% in value; inorganic coatings, 106.5% and 100.4%; and insulating enamels and varnishes, 104.2% and 102.7%, respectively. The shipment of ship bottom paints increased to 107.5% in volume but decreased to 95.1% in value, and there were five more products that showed similar results. The reason for the increase of emulsion paints was attributed to the construction of new buildings and houses. The increase of shipbottom paints in volume is because of the current schedule to scrap and build large tankers.

On the other hand, several products have decreased in shipment volume. Shipment of road-marking paints was 88.8% in volume compared with that for the same term of last year, vinyl resin enamels and varnishes 89.2%, alkyd resin based paints for household and maintenance use 92.5%, nitrocellulose lacquers 93.0%, waterborne coatings including electrodeposition 93.3%, thermosetting amino-alkyd enamels and varnishes 95.2%. Other products are shown in Table 1.

Shipment volume of alkyd resin based anticorrosive paints, baking type of acrylic resin enamels and varnishes, chlorinated rubber based paints, and powder coatings (fluidized bed) remained almost the same as last year. As a result of the decrease in shipment volume, there are several products whose shipment value decreased more than 10% from last year. Shipment of tar-epoxy resin enamels was 87.8% in value, oil-based paint including oil-based anticorrosive paints 88.2%, vinyl resin enamels and varnishes 89.4%, and waterborne coatings 89.5%. Accordingly, production of alkyd resin based paints was 85.3% in volume, oil-based paints 87.2%, and vinyl resin enamels and varnishes 88.1%. The big decrease of the shipment volume and value of such products as thermosetting amino-alkyd enamels and varnishes and waterborne coatings, which are used in automobile industry, was a result of the failure to increase domestic



**JSCM Table 1—Shipment Volume and Growth Rate of Various Product Categories**

Product	Volume: kilo ton				
	1994 Annual		1995 1st Half		
	Volume	% to 1993	Volume	% to 1994 1st Half	
Oil-based paints (including oil-based anticorrosive paints)	11.7	90.3	5.8	90.2	
Nitrocellulose lacquers	36.2	98.5	17.5	93.0	
Insulating enamels & varnishes	43.3	109.6	22.3	104.2	
Synthetic resin based	Sub-total	1,379.4	103.1	682.9	97.4
Organic solvent type	Sub-total	869.6	102.9	434.1	97.2
Alkyd resin enamels & varnishes	54.3	102.3	27.3	96.4	
Alkyd resin-based paints (household and maintenance use)	65.7	96.1	32.8	92.5	
Alkyd resin-based anticorrosive paints	76.8	97.0	39.6	99.9	
Thermosetting amino-alkyd enamels & varnishes	130.6	103.5	63.1	95.2	
Vinyl resin enamels & varnishes	26.9	88.9	12.8	89.2	
Acrylic resin enamels & varnishes, air drying	83.3	103.8	42.0	96.3	
Acrylic resin enamels & varnishes, baking	50.0	105.2	24.9	100.0	
Tar-epoxy resin enamels	25.9	97.8	12.5	96.1	
Epoxy resin-based coatings	90.1	106.4	46.0	98.5	
Polyurethane enamels & varnishes, single pack	8.7	112.1	4.4	104.8	
Polyurethane enamels & varnishes, multi pack	112.1	113.9	57.2	102.2	
Unsaturated polyester enamels & varnishes	25.8	99.2	13.4	101.8	
Chlorinated rubber-based paints	15.1	90.6	7.8	99.8	
Ship-bottom paints	14.9	85.6	8.6	107.5	
Others	89.1	107.6	41.4	92.2	
Water thinnable type	Sub-total	374.7	103.8	188.1	100.3
Emulsion paints	136.2	109.0	71.1	102.4	
Emulsion paints (with aggregates)	96.5	98.2	52.7	106.9	
Waterborne coatings (including ED.)	142.1	103.1	64.2	93.3	
Non-solvent type	Sub-total	135.2	102.5	60.8	91.0
Powder coatings (electrostatic spray)	21.2	110.9	10.0	98.8	
Powder coatings (fluidized bed)	8.0	103.2	4.0	100.6	
Road marking paints	106.0	101.0	46.8	88.8	
Inorganic coatings	9.4	110.9	4.9	106.5	
Miscellaneous	49.8	98.3	23.2	94.8	
Thinners	440.6	106.3	216.9	97.8	
Related products (putty, remover, etc.)	34.2	106.3	17.1	100.2	
Grand Total	2,004.6	103.7	990.7	97.5	

Source: Japan Paint Manufacturers Association

car sales as much as expected, but also to the reduction in the number of car models and production lines. The steady growth of powder coatings was halted by the restraint of investment for equipment in this term.

There are approximately 250 paint manufacturing companies in Japan. According to a recent report of the Japan Paint Manufacturers Association for the top 35 companies in October, the business outlook is brighter. Twenty of the 35 companies reported an increase in shipment volume compared with last October and a growth rate exceeding 10% was achieved for three companies. Shipment volume remained at the same level for four companies and decreased for 11. An increase was reported from 20 companies for shipment value and shipment volume. The following is a comparison of shipment values of this October with last October by demand fields: an increase for 19 companies and a decrease for six companies in architecture and building materials; an increase for four, two remained the same, and a decrease for 13 in motor vehicles; an increase for six, two remained the same, and a decrease for three in steel structures and marine usage; an increase for 10, two remained the same, and a decrease for 12 in electric

appliances, industrial machineries, and metal products; and an increase for eight and a decrease for six in wooden products.

Based on manufacturers' prospects for the paint industry in November, the shipment in volume is projected to increase for 18 companies, remain the same for 10, and decrease for seven, and the shipment in value is projected to increase for 17, remain the same for nine, and decrease for nine.

The Japanese government has decided to set the target for the real growth of GDP for fiscal 1996 at 2.5%. Nominal growth that includes inflation is 2.7%. The forecast is optimistic compared with the average projection by private economists at around 2.0%. In the December report of the Economic Planning Agency, they refrained from using the word "weak" to describe the recovery for the first time in four months. According to the report, individual consumption is showing a gradual increase and housing construction is also rebounding. "The Japanese economy has begun to search for the steps toward recovery," said an agency official. In these circumstances, the Japanese paint industry is expected to have a brighter business in 1996.

## **Japan Society for Colour Material**

Japan Society for Colour Material (JSCM) is an academic and professional organization consisting of scientists and technologists in the field of pigments, paint, printing inks, colorants for plastics, cosmetics, and so on. The Society was established in 1927 to promote and extend scientific and technological knowledge concerning color materials for academic and industrial progress in these fields and improvement of our life and environment through many activities.

The Society registers 2,100 individuals and 200 corporate bodies as members who are engaged in research, production, application, management, and related work at universities, colleges, institutes, and industrial companies. The main office of the Society is located in Tokyo. The Society also has three branches of Kanto (East Block of Japan) in Tokyo, Kansai (West Block) in Osaka, and Chubu (Middle Block) in Nagoya, and they assist and organize local activities.

### **Isao Kumano**

*Isao Kumano is President of the Japan Society of Colour Material (1994-95). He served as Vice-President from 1986-87, was Vice-President and Director of Kanto Branch from 1988-1993, and was Chairman of Pigment Technology Research Group of JSCM from 1971-1993. He received the Society Prize of JSCM, Prize for Industrial Technology (Shikiza Kyokai-Gijutsu Sho) with his colleagues at Toyo Ink Manufacturing Co., Ltd. in 1976.*



*Mr. Kumano studied organic chemistry at Kyoto University where he received the B.S. in Chemistry in 1956.*

*Mr. Kumano joined Toyo Ink Manufacturing Co., Ltd. in 1956 where he worked on R&D of organic pigments, especially phthalocyanine pigments.*

*Currently Director of the company, he is responsible for environment, safety and product liability.*

*Mr. Kumano has lectured on pigments, dyestuffs, painting and other coloring materials at Tama Art University in Tokyo since 1994.*

The activities of the Society are comprised of publication of a periodical journal and books, annual conference, award, seminar, discussion, and lecture meeting, symposia and technical exchange and cooperation with related organizations.

The *Journal of the Japan Society of Colour Material (Shikizai Kyokai-shi)* is issued monthly and publishes research papers, reviews, lecture notes, etc. The annual conference is held in the fall every year alternating between Tokyo, Osaka, and Nagoya, and there are presentations of original papers, plenary lectures and award winner's lectures, together with a presentation of the Society Award and technical forum.

The first International Conference in Japan was held in Tokyo in 1987 celebrating the 60th Anniversary of the Society and the second conference took place in Osaka in 1992 commemorating the 65-Year Memorial with many overseas and domestic participants. The Society will celebrate its 70th Anniversary in 1997 and is planning the Third International Conference on October 22-24, in Tokyo. The Society hopes to welcome many papers, plenary lectures, and participants from overseas.

## **Surface Coatings Association New Zealand (SCANZ)**

### **International Update—New Zealand**

Those of you who have had the pleasure of visiting New Zealand either on business or on holiday would have immediately notice the predominance of weatherboard clad and colored roofing that exists on New Zealand houses. Over a period of time, this has lead to a widespread coatings industry which supports a surprising number of coating manufacturers. Even today there are nearly 50 companies producing some form of coating in this small country of three and a half million people. Add to this a need for industrial and protective coatings, a thriving marine market, and miles of marked tarmack you have a reasonable coatings market, of arguably, 50 to 60 million liters.

Over the last three years, the industry has recovered from the crash of the late '80s and the subsequent recession of the early '90s. The introduction of an open economy with all of its threats has been survived and, in many cases, opened the door for opportunities for many companies. Growth has returned to the New Zealand economy over recent years but during the latter half of 1995 this seems to have somewhat deserted the coatings industry. The reasons for this are difficult to understand as we are told that the economy is still

in a growth phase, although at a reduced rate with retail sales ahead of last year.

The material cost increases over the past 12 months have been quite severe and intense competition in the paint market has kept prices (and margins) down. Perhaps the faltering economies of our trading partners has had some effect. This could be particularly true in the case of Australia where decreased activity could be depressing export opportunities and causing the Australian's to export more competitively into New Zealand and our markets.

In recent times, the word "acquisition" has reappeared, with Wattyl being the most active taking over a local Auckland operation of Norfolk Paints and more recently acquiring the Taubmans decorative business in New Zealand. In a similar move, Croda Lusteroid Paints has also acquired the powder coatings business of the independently operated Western Chemicals. The emergence of Benjamin Moore in this part of the world is clear evidence that the coatings business has gone global. In other ways, overseas acquisitions are having an effect in that technology sources can easily dry up as the source is taken over and the technology is taken in-house.

The legislative burdens are the main challenges facing the

coatings industry as we move into the latter stages of the 20th Century. The epidemic ISO 9002 has been survived by most, but Occupational Health and Safety requirements are now impacting, and the Toxic Substances and Hazardous and New Organisms Legislation loom ahead. In addition, VOC requirements are yet to be fully implemented. Looking further ahead, environmental requirements will become more stringent, and as the Resource Management Act becomes predominant, the industry will find it increasingly difficult to maintain profitability in such a competitive environment.

### **Surface Coatings Association New Zealand**

The New Zealand Association was first formed as a Division of OCCA UK in 1952 and became the fully independent OCCA New Zealand in 1986. On January 1, 1994, the name was changed to Surface Coatings Association New Zealand (SCANZ). As such the organization is closely modeled on the old "OCCA" principles with the prime role being "education."

There are two sections, one in Auckland and the other in Wellington which operates a division of Christchurch for the benefit of the South Island members. The divisions hold

regular technical meetings quite often in conjunction with other Associations and Societies and when overseas speakers are available.

The main event is the annual conference held over two days normally in the July-August period.

In 1996, the conference is scheduled for August 8-11, at the Plaza International Hotel, in Wellington. The theme of the conference is "Cradle to Grave, The Life Cycle of Paint Products."

Interested attendees, or those wishing to present a paper, please contact: SCANZCON.96 Secretariat, P.O. Box 38 546, Wellington, New Zealand; Tel/Fax: 64 4 568 8993; Email: frank\_s@wn.planet.gen.nz.

In conjunction with the Auckland Institute of Technology a two-year Diploma in Surface Coatings Technology is offered, which can form part of a degree course in Applied Science. Since SCANZ is affiliated with OCCA UK, a full range of internationally recognized professional gradings are sponsored.

As a member of Coatings Societies International, we participate fully in the international activities of our co-members which helps remove the remoteness of our geographical location.

#### **Lee Hall**

*Lee Hall was born in the UK, but left at the age of two for Australia, taking a further 10 years to move on to "Godzown" in 1961.*

*He attended Auckland University and graduated with a B.Sc. Degree in Chemistry and Geology in 1971.*

*Mr. Hall initially worked in various technical roles at Chemby Chemicals and moved into marketing and sales at Chemby Marketing. In late 1988, SCM Chemicals Ltd. commenced its own operations in New Zealand where Mr. Hall currently serves as New Zealand Manager.*

*He has held various positions in SCANZ and OCCA NZ such as section and national secretary, Auckland Section Chairman, and is currently President.*

*Mr. Hall is married with two children and spends his recreation time fishing or playing golf when family, work, and SCANZ allow.*



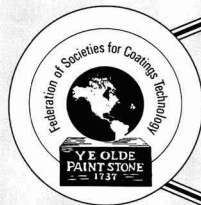
*Announcing . . .*

**1996**

***Pan-American Coatings Expo***

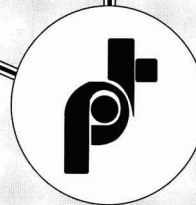
*co-sponsored by*

**ANAFAPYT**



***Federation of  
Societies for Coatings  
Technology***

***Instituto Mexicano  
de Técnicos en  
Pinturas y Tintas***



***August 15-17, 1996***

\*\*\*\*

***Sheraton Maria Isabel Hotel  
Mexico City***

*For more information, contact*  
***Federation of Societies for Coatings Technology***  
492 Norristown Road • Blue Bell, Pennsylvania 19422-2350  
(610) 940-0777 • Fax: (610) 940-0292



## NPCA to Hold 109th Annual Meeting in Chicago

The 109th Annual Meeting of the National Paint and Coatings Association (NPCA), Washington, D.C., will be held on October 23-25 at the Palmer House (Hilton) in Chicago, IL. This meeting will be held concurrently with the Federation of Societies for Coatings Technology's International Coatings Technology Conference and the International Coatings Expo (formerly the Paint Industries's Show).



Despite switching to the Wednesday through Friday schedule, NPCA will continue its new two-day format. The agenda for Wednesday includes the opening session, the honors luncheon, and forum sessions. Thursday's schedule will consist of the legislative/regulatory update breakfast forum, the general session, the final business session and luncheon and additional forums. NPCA's Annual Meeting will officially conclude with the Thursday night

Chairman's reception. NPCA has extended its meeting dates to include Friday, October 25, which will allow its members additional time to attend the FSCT's International Coatings Technology Expo.

NPCA registrants will be admitted to the FSCT International Coatings Expo during each of the three days at no charge as part of the NPCA registration fee.

For additional information on NPCA's Annual Meeting, contact Cheryl Matthews at NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597.

### Battelle Forecasts 1.7% Increase in R&D Spending; Federal Government to Decrease Contributions

Expenditures for research and development (R&D) in 1996 are expected to reach \$174 billion. According to the annual Battelle-R&D Magazine Forecast, this is a 1.7% increase over the \$171 billion that the National Science Foundation estimates was spent in 1995.

Although R&D investment stalled in the early 1990s and the predicted 1996 increase is nominal, this period of stagnation is concluding and R&D spending will increase in the near future.

Major predictions for 1996 include:

- Federal R&D spending will decrease. Battelle estimates the federal government

will spend \$60.4 billion in 1996, about a one-half percent less than was spent in 1995.

- Industry will increase R&D spending. Industry will spend \$104.6 billion in 1996, an increase of three percent over last year.

- The remainder of R&D expenditures—\$8.8 billion—will be supported by universities and nonprofit organizations.

- A key to industrial investment is that long-anticipated real growth—spending that will outdistance inflation—will occur.

- Private industry will increasingly look for opportunities to outsource internal R&D functions.

- An increasing share of U.S. industry's R&D will be performed off-shore, primarily in facilities owned by the same industry.

(Continued on next page.)

### October Resin Production Up 4.8% from September

According to statistics released by The Society of the Plastics Industry's (SPI) Committee on Resin Statistics, Washington, D.C., production of plastics resins totaled 5.8 billion pounds in October 1995, an increase of 4.5% over the same month in 1994.

Production figures were up 4.8% from September numbers. Production in 1995 year-to-date totaled 57.1 billion pounds, a 4.8% increase over the same 10-month period in 1994.

The October 1995 figures are based on primary data on selected major plastics materials as compiled by Ernst & Young, Washington, D.C., for SPI's Committee on Resin Statistics.

### North American Coatings Council Defines Objectives

At a recent organizational meeting of the North American Coatings Council held in Chicago, IL, by representatives of several trade associations related to the coatings industry, the objects of the Council were defined. The founding organizations are ANAFAPYT—the Mexican Paint Association; Canadian Paint & Coatings Association; Federation of Societies for Coatings Technology; National Paint & Coatings Association; Powder Coating Institute; and the Roof Coatings Manufacturers Association.

It was agreed that the objective of the Council is "to provide a forum for industry communication and the promotion of programs of mutual interest and that membership should "be open to national trade associations in the North American coatings industry, with meetings open to any industry companies who want to participate."

Any trade associations who share these interests and would like to be included in future meetings may contact Joseph P. Walton, Jamestown Paint Co., P.O. Box 157, Jamestown, PA 16134; (412) 932-3101.

### DuPont Automotive Survey Reveals "Nature" Colors Challenging White as the Most Popular Vehicle Color

Cost, options, safety equipment, and warranty are all important factors to consider when purchasing a new automobile; however, often the most crucial decision is based on vehicle color. According to the 1995 color popularity survey conducted by DuPont Automotive, Troy, MI, North American consumer preference in vehicle color increased for the nature colors—green, light brown, and beige—as well as for perennial favorites white and black.

While the popularity of dark green declined slightly this year, light green emerged as a top-12 color choice in all vehicle categories, extending the overall popularity of green for the third year in a row.

The survey revealed that white was selected most frequently by consumers in three

categories—luxury, full/intermediate, and truck/van—but green took the top spot in sport/compact vehicles with 15.2% of the market, compared with white's 14.4%.



Based on research, the following trends were predicted.

Teal/aqua's popularity fell in all categories signaling the trend is moving on. Black, always a popular color, has been climbing in popularity for the past two years. Silver, one of the "precious metal" colors predicted to rise in popularity, jumped in all categories. By gaining popularity in the full/intermediate and the sport/compact categories, purple's popularity continued to increase, but not as rapidly as predicted. Light brown gained popularity in all but the sport/compact category.

## ISO Certification

ISO 9002 registration was recently issued to U.S. Silicas's Mapleton Depot, PA plant.

**Universal Chemicals & Coatings, Inc.**, Elgin, IL has achieved ISO 9001 certification.

**PQ Corp.**, Valley Forge, PA, has announced that seven of its U.S. plants have qualified for ISO 9002 certification. The plants that were most recently certified are located in Chattanooga, TN; Utica, IL; Tacoma, WA; Baltimore, MD; Chester, PA; Berkeley, CA; and Anderson, IN.

The North American Silicas/Absorbents product line of **Grace Davison**, Baltimore, MD, has achieved ISO 9001 certification.

**Lomas International**, Macon, GA, has been awarded ISO 9002 certification.

**Corning Costar**, Cambridge, MA, received ISO 9002 registration for its Scarborough, ME, plant that produces Nuclepore™ brand cartridge filters.

The Instrument Systems Division of **Minolta Corp.**, Ramsey, NJ, has earned ISO 9001 certification for its radiometric instruments operations facility.

**Crosfield Co.**, Joliet, IL, has obtained ISO 9002 registration for the manufacture of sodium metasilicate, sodium silicate, detergent zeolites, silica hydrogels, and specialized silicas.

**Lepel Corp.**, Edgewood, NY, has received certification under ANSI/ASQC ISO 9001: 1994 Quality Standards.

The Quality Management System of **Challenge Inc.**, Indianapolis, IN, received ISO 9002 certification.

The Muskegon, MI, pigment manufacturing facility of **Sun Chemical Corporation's** Colors Group, Cincinnati, OH, has earned ISO 9002 registration.

**National Starch and Chemical Co.**, Bridgewater, NJ, has announced that its Alco Chemical, Chattanooga, TN, division received ISO 9001 certification.

## Small Increase in R&D Expenditures Predicted by Battelle for 1996

(continued from previous page.)

• The federal government's efforts at budget-cutting, coupled with significant philosophical changes toward the national science policy, will broadly affect federal R&D support and the federal laboratories.

Besides the boom time for R&D spending in the 1980s, Jules J. Duga, Battelle research scientist, said that there has been significant restructuring and redirection of industrial R&D budgets. "These restructurings are influencing the extent to which industry will subcontract its research and development, and the roles assumed by collaborative research programs."

### Federal Government Support for R&D

Until 1980, the federal government was ahead of private industry as the country's largest supporter of R&D. Since then, industry has become the dominant supporter of research, accounting for up to 60% of R&D funding. Measured in current dollars, Battelle and *R&D Magazine* find a six-year decline in real federal support for R&D.

Most of this decrease has been absorbed by defense spending and other big ticket items, such as the superconducting supercollider. As the debate over the federal budget deficit continues, Battelle and *R&D Magazine* expect to see continued changes.

In addition, the support of industrially performed R&D is expected to decrease slightly while the total government support of colleges and universities, which includes support of the Federally Funded Research & Development Centers (FFRDC), shows only a modest growth. However, if the FFRDC contributions were separated from the equation, federal support of the academic sector would experience a substantially greater growth rate for 1996.

The outlook for future federal support of R&D could be considerably bleaker. At the present, there is significant Congressional opposition to programs that foster closer federal/industrial ties in areas that stress commercialization of new technology.

Budget proposal estimates, projected to the year 2002, call for constant dollar reductions—as high as 33%—in nondefense R&D. Few agencies have escaped significant proposed reductions in the 1996 budget, and several are slated for complete elimination over the next few years.

### Industrial Support for R&D

Following a few years of stagnant growth in R&D funding, 1996 is the year industry is expected to begin increasing its commitment to R&D. The nearly \$105 billion predicted by Battelle is slightly less than surveys conducted by *R&D Magazine* and the

Industrial Research Institute (IRI). In addition to the long anticipated real growth that will occur in 1996, industry's support of contracted R&D—in academia, other industry, and nonprofit organizations—will increase.

Several aspects of industrial R&D support deserve special attention.

• The expected change in R&D spending varies considerably among industrial divisions. Industries that expect to significantly increase funding include electronics and communications, pharmaceuticals, and personal care products.

• Much greater attention will be paid to the development side of the R&D investment, indicating less dedication to long-term programs or initiatives.

• Industry will increase its interaction with federal laboratories and look to create strategic alliances and cross-licensing opportunities.

### Performance of Industrial R&D

R&D performed within industrial laboratories obtains its support from three sources: a company's own funds, contracts from other companies, and federal government contracts. The industrial restructuring referred to previously has had an impact on the extent to which industry is contracting with other industrial entities.

This trend is expected to continue over the next several years. The extent to which industrial contract research is performed is of such long-term importance that efforts should be undertaken to measure and assess this activity in greater detail.

### Major Trends and Conclusions

According to the report, the principal factors that will influence R&D support and performance in the U.S. are the following:

• The federal government, under pressure from the budget, will consider and very likely undertake major restructuring of the R&D budget.

• Efforts will be made to reduce the size and scope of the federal laboratory system, with emphasis placed on potential privatization.

• Industrial support of R&D will increase.

• Private industry will continue to pare its technology-development resources, except for those areas where the payoff is of relatively short term. Also, long-range research support will be reduced.

• The globalization of markets, the reduced cost of technology development, and the need to respond to a broader range of local conditions, will force a greater degree of off-shore, industrially contracted research, much of which will be conducted at independent laboratories.

### Pacific Northwest Society's Spring Symposium To Coincide with FSCT Spring Week in May

The Pacific Northwest Society for Coatings Technology's 49th Annual Spring Symposium will be held on May 2-4, 1996 at the DoubleTree Suites Hotel, Seattle, WA. The Symposium will be held in conjunction with FSCT Spring Week, which will take place on May 3-5.

The technical portion of the symposium will feature the following presentations:

"Waterborne Acrylic Stains for Wood"—Robert Krasnansky, Rohm & Haas;

"Surfactant Free Acrylic Latexes for Waterproofing Wood"—Ray Southwell, Specialty Polymers;

"Organic Pigments for Heavy Metal Free Coatings-Solvent & Waterborne Systems"—Romesh Kumar, Hoechst Celanese Corp.;

"New Acrylic Emulsion Technologies for Industrial Wood Finishes"—Charles C. Shearer, of Zeneca Resins;

"OSB Board"—Louisiana Pacific;

"Masonite"—Weyerhaeuser Co.;

"Masonry"—Hardy Board;

"Wood Siding"—Cedar Products;

"New Waterborne Water Repellents"—Victoria Scarborough, Thompson & Formby;

"Novel, VOC Compliant Wood Preservative Coatings with Outstanding Penetrating Properties"—Eeva-Liisa Kuusisto, of Troy Chemical Co.;

"Fast Drying, Ultra-Low VOC, Two-Component Waterborne Polyurethane Coatings for the Wood Industry"—Christine A. Renk, of Bayer Corp.

In addition to the technical program, a slate of social activities have been planned. Some of the events include golfing, a Murder Mystery cruise, and a tour of Seattle.

FSCT Spring Week will begin with the Incoming Society Officers Meeting on May 4. The Board of Directors Meeting will be held on May 5.

For additional information on the PNWSCT Spring Symposium, contact Beverly Spears, Tarr Inc., 4510 B St., N.W., Ste. B, Auburn, WA 98001; (206) 859-2979. To obtain information on FSCT Spring Week, contact Tori Graves, FSCT, 492 Norristown Rd., Blue Bell, PA 19422; (610) 940-0777.

### Paint Volatile Organic Compounds to Be Explored at ASTM Training Course in Cleveland on May 1-2

The American Society for Testing and Materials (ASTM), West Conshohocken, PA, will conduct a two-day technical and professional training course on paint volatile organic compounds. The course, which focuses on how to obtain precise, meaningful VOC data from laboratory tests on paints and related coatings, will be held May 1-2, 1996 at the ICI Strongsville Research Center, in Cleveland, OH.

Highlights of the course include laboratory demonstrations on the use of gas chromatography, the Karl Fischer titration method, paint density, and other test methods needed to determine the VOC of coatings. In addition to a discussion on the latest VOC technologies and changes in VOC measurements (e.g., multicomponent paints and VOC aerosols, and more), the basic principles of the ASTM test methods used to measure VOC in the U.S. Environmental Protection Agency's New Source Performance Standard will be covered.

The course is designed for chemists and others who use EPA tests to determine if paints or coatings meet VOC requirements. Individuals from the paint industry, shipbuilders, textile manufacturers, government regulatory bodies, commercial laboratories, and paint users can also benefit from the course.

As part of the course, laboratory demonstrations will also be featured.

The fee for the course is \$670 and includes ASTM's *Manual on Determination of VOC in Paints, Inks, and Related Coatings*, copies of all referenced ASTM standards covered in the course, lecture notes, visual aids, coffee and soda breaks, lunches, and

transportation to and from the demonstration sites.

Contact Kristina Falkenstein, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959 for additional information.

## W A N T E D

The Eastern Training Conference and Show gains momentum as show exhibitors register early for select booth locations. The event, sponsored by the Philadelphia Society for Coatings Technology, will be held May 8-10, 1996 at the Valley Forge Convention Plaza, King of Prussia, PA.

The Show will be an exhibition where suppliers to the paint and coatings industry are able to exhibit their product lines. It is being assembled to closely resemble the same format as the FSCT-sponsored International Coatings Exhibition (formerly the Paint Industries' Show). The exhibitions, however, will be in tabletop fashion. Rental for a 10 x 10 booth for the duration of the show is \$350. The booth includes: pipe and drape, eight-foot skirted table, two chairs, and ID sign.

Companies which have reserved booths at the Show include: Air Products, BFGoodrich, BYK-Chemie, BYK-Gardner, Calgon, Cook Composites and Polymers, Daniel Products Co., Disti-Kleen, Fawcett, Hüls America Inc., King Industries, Monsanto, Netzsch, Neville, Penn Colors, Potters, Premier Mill, Quaker City Chemicals, Russell Finex, Silberline, Southern Clay Products, Specialty Minerals, Tego Chemie, Troy Chemical Co., and Unimin.

Attendees to the Show are expected from a 500-mile radius of the Convention Plaza, which includes the following Societies: Montreal, Toronto, New England, Cleveland, Western New York, New York, Philadelphia, Pittsburgh, Baltimore, and Piedmont. There will be no charge for admission to the Show.

Companies interested in exhibiting at the Eastern Conference and Show may request an Exhibitors Kit from Sam Firestone, S.E. Firestone Associates, 101 Surrey Rd., Melrose Park, PA 19027-2931; (215) 635-1366.

## UMR Coatings Institute Releases Schedule for 1996 Coatings Short Course Classes

The Coatings Institute at the University of Missouri-Rolla (UMR), Rolla, MO, has released its schedule for the upcoming Coating Short Courses in 1996.

The first short course "Basic Composition of Coatings" will be held on both March 18-22 and September 9-13, in Rolla. This course is designed to introduce newcomers to the technical aspects of paint manufacture, testing, and use. Topics to be discussed will include the history of paint, materials used in manufacture, simple formulating techniques that can be put to immediate use, introduction to the equipment used to make and test modern protective coatings, modern chemical instrumentation as applied to coatings, and simple cost accounting that allows beginners to start on a stable economic basis.

"Introduction to Paint Formulation" is an intensive five-day course that begins with the basic steps of paint formulation, from understanding the process to an actual laboratory formulation. Through study and working in the laboratory, the attendee can learn to formulate paints to meet specific requirements. In addition, participants will be able to study and experiment with basic raw materials and their influences on the performance of the finished coating, formulation and testing of coatings in the laboratory to meet the special demands of the job, limitations of plant production equipment, and formulation variables for moving a coating from the lab to the plant and modern chemical instrumentation as applied to coatings. This course will be held at the UMR campus on April 22-26 and September 23-27.

The next course "Physical Testing of Paints and Coatings" will be offered on May 13-17 in Rolla. This course is designed to improve quality control protocol for paints

and coatings. Attendees will learn about monitoring the manufacturing process, finished product testing, setting up specifications, color computer technology, raw materials, government regulations, record keeping, complaint handling, and modern chemical instrumentation as applied to coatings. All of the tests in this course are based on ASTM methods and other currently acceptable practices.

"Basic Coatings for Sales, Marketing, and General Personnel," scheduled for July 15-17 in St. Louis, MO, is designed to aid sales, marketing, and general personnel in the coatings industry to have a better understanding of the composition of coatings. This course includes composition of coatings, re-

lationships between composition and performance characteristics, customers' specifications and testing techniques as related to formulation criteria, and business aspects of coatings.

The fee for the Basic Composition of Coatings is \$845. The cost for Introduction to Paint Formulation and Physical Testing of Paints and Coatings is \$945, and the fee for "Basic Coatings for Sales, Marketing, and General Personnel" is \$745. The fee includes classroom sessions and course notes.

For more information, contact Cynthia N. Campbell or Michael Van De Mark, UMR Coatings Institute, UMR, 1870 Miner Circle, Rolla, MO 65409-0010.



## American Vacuum Society to Host ICMCTF '96

The Thin Film and Vacuum Metallurgy Divisions of the American Vacuum Society (AVS), New York, NY, have released the program for the upcoming 23rd International Conference on Metallurgical Coatings and Thin Films (ICMCTF '96). Slated for April 22-26 at the Town & Country Hotel, San Diego, CA, this conference will include 600 technical papers on various subjects relating to metallurgical coatings and thin films.

The conference will include:

- Eight symposia covering various aspects on coatings and equipment;
- An evening forum featuring a roundtable discussion on the status and trends in industrial applications of diamond coatings;
- Workshops on Chemical Mechanical Polishing, including a tutorial on the basics

of this technique, and Ion Assisted Technologies;

- A short course on "Surface Preparation for Thin Film Deposition";
- A poster session providing researchers an opportunity to discuss their work interactively with meeting attendees using detailed poster summary displays; and
- An extended exhibition featuring the industry's latest equipment.

For more information on ICMCTF '96 contact Mary Gray, Conference Secretary, 1090 G Smallwood Dr., Ste. 502, Waldorf, MD 20603.

## ITW Ransburg to Conduct Training Courses in 1996

ITW Ransburg, Toledo, OH, will conduct training classes for all aspects of liquid electrostatic finishing, from basic sessions on fundamentals of liquid electrostatics to specific training on electrostatic hand guns.

"Fundamentals of Liquid Electrostatic Coating Course" will cover the theory and application of electrostatics. Topics to be discussed include disk, bells, spray guns, and fluid handling equipment. This course will be held on May 7-8, August 13-14, and November 5-6.

"No. 2 Process Hand Gun Training Class" will cover the use, care, operation, and proper spray techniques. This course will be offered March 4-5, June 3-4, September 16-17, and December 9-10.

For additional information, contact ITW Ransburg, 320 Phillips Ave., Toledo, OH 43612-1493.

### Louisville Society for Coatings Technology Presents

#### "Spectrum of Coatings Science"

**April 17, 1996**  
**Executive West Hotel**  
**Louisville, KY**

**Contact: Ilona Duvall, Red Spot Paint & Varnish,**  
**1107 E. Louisiana, Evansville, IN 47711**  
**(812) 467-2337**

## Institute of Materials Science Organizes Spring Program in Polymers

The Institute of Materials Science, New Paltz, NY, will conduct the 27th Annual Spring Program in Polymers on March 11-15, 1996, in Orlando, FL. The Program will be divided into three courses and the topics to be discussed for each course are as follows.

### Pigment Dispersion

"Introduction: The Colloidal Background of Dispersions," "Principles of Adsorption," "Adsorption of Surfactants and Wetting Phenomena," "Electrical Double Layers in Colloidal Systems: DLVO Theory," and "How Polymers Adsorb and Affect Colloids Stability"—Johannes Lyklema, of Wageningen Agricultural University;

"Morphology of Organic Pigments," "Surface Treatment of Pigments for Enhancement of Dispersions," "Energetics of Pigment Dispersion," "Pigment Dispersants of Nonaqueous Systems," "Introduction to Dispersion Rheology," and "Measurements of Dispersion in Dilute and Concentrate Forms"—Joerg Schroeder, of BASF;

"Pigment Dispersants of Aqueous Systems," "Pigment Dispersants in Paints: Practical Considerations-Stability Formulation and Equipment," and "Pigmentation of Various Polymer Systems: Powder, Plastics, Ink"—Henry L. Jakubauskas, of E.I. du Pont de Nemours & Co.;

"Media Mill Dispersion: Process and Equipment," "Principles of Ball and Pebble Milling," and "Other Dispersion Processes"—Webster H. Edwards, of E.I. du Pont de Nemours & Co.

### Introduction to Polymer Colloids/Emulsion Polymers

"Emulsion Polymerization: Mechanism and Kinetics"—Alvin E. Hamielec, of McMaster University;

"Control of Morphology"—Donald C. Sundberg, of University of New Hampshire;

"Latex Particle Size Analysis" and "Characterization of Molecular Weight Distribution by Size Exclusion Chromatography"—Theodore Provder, of ICI Paints;

"Structured Latexes: Synthesis Characterization of Particle Morphology; Properties and End-Use Applications," and "Latexes for Paper Making and Paper Coating"—Do Ik Lee, of Dow Chemical Co.;

"Modern Methods for Particle Morphology"—William G. Haseltine, of CYTEC Industries;

"Latex Rheology" and "Thickeners for Latex Formulation"—Edward J. Schaller, of Rohm & Haas Co.;

"Polymerization of Acrylamide in Inverse Emulsion and Microemulsion"—Joseph Kozakiewicz, of American Cyanamid Co.;

"Electrostatic Stabilization of Colloids"—Johannes Lyklema;

"Film Formation in Waterborne Coatings"—Alec Scranton, of Michigan State University;

"Hydrogels"—John Klier, of Dow Chemical Co.; and

"Some Properties of Novel Polytelomeric Compositions"—Jan J. Spitzer, of BASF-Charlotte.

### Fundamentals of Adhesion

"Theories of Adhesion Mechanisms," "Acid-Base Interaction, Surface Energetics, and Adhesion," and "Discussion—Unsolved Problems Related to Adhesive Technology"—Lieng-Huang Lee, of Xerox Corp.;

"Thin Film Adhesion—Principles and Applications"—John Baglin, of IBM-Almaden;

"Surface Analysis Applied to Adhesion" and "Surface-Chemical Aspects of Polymer/Metal, Fiber/Matrix, and Composite/Com-

posite Adhesion"—J.P. Wightman, Virginia Polytechnic Institute and State University;

"Mechanics Applied to Adhesives, Adhesive Joints, and Adhesive Science (Parts I & II)"—H.F. Brinson, of University of Houston;

"Test Methods for Stress Analysis of Bonded Structure"—Raymond B. Krieger, Jr., of American Cyanamid Co.;

"Adhesion of Polyimides to Ceramic and Metal Substrates"—Paivikki Buchwalter, of IBM-T.J. Watson Research Center;

"Silane Coupling Agents as Adhesion Promoters"—Peter G. Pape, Sr., of Dow Corning Corp.; and

"Recent Advances in Structural Adhesives"—Kevin J. Schroeder, of Ciba.

For more information, contact Dr. Angelos V. Patsis, Institute of Materials Science, State University of New York-New Paltz, New Paltz, NY 12561.

## Cleveland Society for Coatings Technology Presents

### The 39th Annual Technical Symposium "Formulating, Manufacturing & Painting the Future"

April 24-25, 1996  
John S. Knight Center  
Akron, OH

#### Topics to be included:

- UV
- Powder
- Water
- E-Coat
- High-Solids
- Manufacturing of Coatings

Entertainment: Rock 'n Roll Hall of Fame

Contact: Jim Miller, J. Miller & Associates  
3057 Kent Rd., Silver Lake, OH 44224  
(216) 688-5761

or

Skip Glover, The Mahoning Paint Corp.  
653 Jones St., P.O. Box 1282  
Youngstown, OH 44501-1282  
(216) 744-2139



# FSCT Publications Order Form

## Buyer Information

YOUR COMPANY: Check the one block which applies most specifically to the company or organization with which you are affiliated:

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

YOUR POSITION: Check the one block which best describes your position in your company or organization:

- 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
- J  Other \_\_\_\_\_  
please specify

## Billing Address

**FSCT Member**       **Non-Member**

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City & State \_\_\_\_\_

Country \_\_\_\_\_ Postal Code \_\_\_\_\_

Phone \_\_\_\_\_ FAX \_\_\_\_\_

## Shipping Address (if different)

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City & State \_\_\_\_\_

Country \_\_\_\_\_ Postal Code \_\_\_\_\_

Phone \_\_\_\_\_ FAX \_\_\_\_\_

## Method of Payment

Please check one:

Charge to the following card:

- MC     VISA
- AMEX     DISCOVER

Enclosed is check # \_\_\_\_\_  
(checks must be payable in U.S. Funds on U.S. Bank)

Enclosed is P.O. # \_\_\_\_\_

Exp. Date: \_\_\_\_\_

Credit Card Number: \_\_\_\_\_

Name \_\_\_\_\_  
(print cardholder's name)

Signature \_\_\_\_\_

**Total Amount Due:** \_\_\_\_\_

(No shipping or handling charges on prepaid orders. PA residents, please add 6% sales tax.)

## Orders

	Member \$15	Non- Mem. \$25	Quantity Ordered
<i>( Less 10% for Full Series Purchase )</i>			
Film Formation	<input type="checkbox"/>	<input type="checkbox"/>	___
Radiation Cured Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Introduction to Polymers and Resins	<input type="checkbox"/>	<input type="checkbox"/>	___
Coil Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Corrosion Protection by Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Mechanical Properties of Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Automotive Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Coating Film Defects	<input type="checkbox"/>	<input type="checkbox"/>	___
Application of Paints and Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Organic Pigments, Second Edition	<input type="checkbox"/>	<input type="checkbox"/>	___
Inorganic Primer Pigments	<input type="checkbox"/>	<input type="checkbox"/>	___
Marine Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Sealants and Caulks	<input type="checkbox"/>	<input type="checkbox"/>	___
Aerospace and Aircraft Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Introduction to Coatings Technology	<input type="checkbox"/>	<input type="checkbox"/>	___
Cationic Radiation Curing	<input type="checkbox"/>	<input type="checkbox"/>	___
Rheology	<input type="checkbox"/>	<input type="checkbox"/>	___
Powder Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Introduction to Pigments	<input type="checkbox"/>	<input type="checkbox"/>	___
Painting of Plastics	<input type="checkbox"/>	<input type="checkbox"/>	___
Metal Surface Characteristics			
Affecting Organic Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___
Color and Appearance	<input type="checkbox"/>	<input type="checkbox"/>	___
White Pigments	<input type="checkbox"/>	<input type="checkbox"/>	___
Methodologies for Predicting			
the Service Lives of Coatings Systems	<input type="checkbox"/>	<input type="checkbox"/>	___
Silicones	<input type="checkbox"/>	<input type="checkbox"/>	___
Adhesion Aspects of Polymeric Coatings	<input type="checkbox"/>	<input type="checkbox"/>	___

JCT: \_\_\_\_\_ (specify no. of yrs.) (annual subscrip. included w/FSCT membership)

	U.S. & Canada	Europe (Air Mail)	Other Countries
1 Year	<input type="checkbox"/> \$40	<input type="checkbox"/> \$70	<input type="checkbox"/> \$55
2 Years	<input type="checkbox"/> \$75	<input type="checkbox"/> \$135	<input type="checkbox"/> \$105
3 Years	<input type="checkbox"/> \$110	<input type="checkbox"/> \$200	<input type="checkbox"/> \$155
Coatings Encyclopedic Dictionary	<input type="checkbox"/> Soft Cover	<input type="checkbox"/> \$80	<input type="checkbox"/> \$105
	<input type="checkbox"/> Hard Cover	<input type="checkbox"/> \$105	<input type="checkbox"/> \$135
Glossary of Color Terms		<input type="checkbox"/> \$6 (one price)	___
Infrared Spectroscopy Atlas		<input type="checkbox"/> \$150	<input type="checkbox"/> \$200
Pictorial Standards		<input type="checkbox"/> \$100 (one price)	___
Panorama	<input type="checkbox"/> 1 Yr.	<input type="checkbox"/> \$900	<input type="checkbox"/> \$1200
	<input type="checkbox"/> 2 Yrs.	<input type="checkbox"/> \$1600	<input type="checkbox"/> \$2100
SciQuest		<input type="checkbox"/> \$750	<input type="checkbox"/> \$800

### Federation of Societies for Coatings Technology

492 Norristown Rd., Blue Bell, PA 19422 Phone: (610) 940-0777 Fax: (610) 940-0292

*FSCT Publications are also available at:*

The U.K. Birmingham Paint, Varnish & Lacquer Club, c/o Robert McD. Barrett,  
B.I.P. Chemical Ltd., P.O. Box 6, Warley, West Midlands, England

Jesus Camacho, ANAFAPYT, Gabriel Mancera 309, Col. Del Valle, 03100 Mexico, D.F., Mexico

\* *Third Place Winner in 1995 Roon Awards Competition* \*

# Coalescence and Film Formation from Latexes

Kenneth L. Hoy—Applied Science Consulting Services\*

## FILM FORMATION SOLVENT-BORNE PAINT

A properly formulated solvent-borne paint is one in which the pigments and fillers are prewet by the solvated vehicle. In effect the pigment and filler particles have adsorbed a highly solvated layer of polymer (entropic stabilization) on their surface. The adsorbed layer is composed of the higher molecular weight fraction of the solvated polymer vehicle.

Upon application, the solvents begin to evaporate and the film begins to shrink. Since length and width of the film are nearly constant, the volume loss is primarily in thickness of the film. The rate of solvent loss on drying mirrors the change in thickness that takes place. At first, the solvent loss is rapid and mainly a function of evaporation potential (vapor pressure) of the solvent. The next stage of film formation is the loss of solvent transitions from a solvent vapor pressure driven process to a slower diffusional process of solvent through the ever increasingly viscous polymer matrix.

If the pigmentation, i.e. pigment volume concentration (PVC) of the paint is well below a critical level, termed critical pigment volume concentration (CPVC), then continued solvent loss concentrates the binder until the increase in viscosity/modulus of the binder immobilizes the film. Further loss of volume creates stress throughout the film.<sup>6-9</sup> At PVCs near or at the CPVC, the shrinkage continues until there is an overlap of the entropic layers adsorbed on the pigment particles, at this point the anisotropic shrinkage causes the development of local strains. These strains continue to increase with loss of solvent and reach a maximum when the pigment particles come in contact with each other or the modulus of a localized region of the vehicle has increased to the point which prevents further relaxation of these localized strains. Thus, in any dry paint film, two types of residual strain can be identified: (1) transverse strains,<sup>†</sup> i.e., strains distributed over the length and width of the film; and (2) localized strains, strains that are between neighboring domains or particles of pigments and fillers.

Even though much of the stress is relieved with time, there are always residual strains which are frozen into the paint film.

Presented at 73rd Annual Meeting of Federation of Societies for Coatings Technology, on October 9, 1995, in St. Louis, MO.  
\*839 McQueen Blvd., St. Albans, WV 25177.

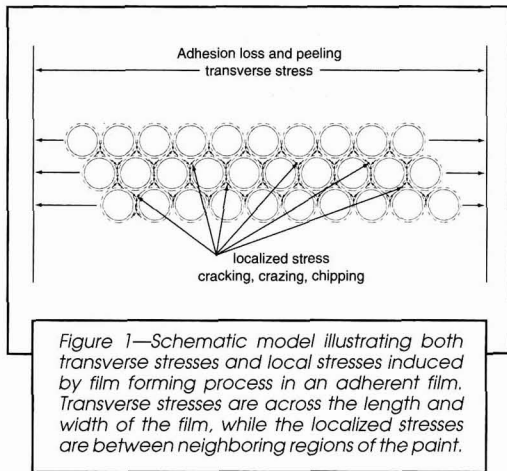
<sup>†</sup>In the work cited in references 6-9, these strains are referred to as internal strains. In this work, the designation of transverse strain is preferred to indicate that they operate across the length and width of the paint film.



A paint is a complex liquid coating material composed of pigments, fillers, polymeric binders, and other additives dispersed and/or dissolved in a liquid. When applied to a surface, the liquid is changed by a film forming process to a solid, adherent composite film. The formation of a paint film is so spontaneous and familiar that most give little thought to the mechanism and dynamics of the process. Yet it is the dynamics of film formation that can provide perspective to the design and application of polymeric latexes.

Previously, a number of workers have studied the "mechanism" by which the latex particles coalesce with each other.<sup>1-5</sup> Their attention has been focused on the details of how particle-particle contacts and interactions take place. It is the author's intent to emphasize the thermodynamics of the film-forming process. A general theory of film formation from a paint is derived from thermodynamic considerations. Model calculations are made and the results are encouraging. They are able to predict the effect of pigmentation and identify new areas for polymer and formulation research. The theory is capable of being specialized for either solvent or latex systems.

These residual strains can lead to the destruction of the paint film; the transverse strains are responsible for adhesive losses, i.e., peeling failure and blistering of the paint film while the



localized strains cause cracking, cold checking, alligatoring, etc. Figure 1 is a schematic model of filming stresses in a paint.

**FILM FORMATION FROM LATEX PAINTS**

A latex paint consists of highly dispersed pigments and a well-stabilized polymer particle in an aqueous fluid phase. In contrast to a solvent-based paint, the pigment and fillers are not prewet by the polymer vehicle. Each element, pigment, filler, and polymer particle are independently stabilized. In a properly formulated paint, both latex and pigment particles show little tendency to flocculate or agglomerate.

Upon application and formation of a film, the pigments and latex polymer particles must encase the pigment particles and bind them within the glassy polymer matrix. The latex film forming process can be considered to take place in three distinct stages: (1) the concentration stage; (2) the compaction stage; and (3) the gradual coalescence stage.

**THE CONCENTRATION STAGE:** During the concentration stage, the initial water loss mimics the rate of evaporation of water alone.<sup>10</sup> The loss of water causes crowding or gathering of both the polymer particles and the pigment particles. As the crowding becomes more stressed, the particle stabilization layers on both pigment and polymer particles (both entropic and electrostatic double layer) resist further concentration and initiate a "redistribution" of the particles in the film to maintain the lowest energy state possible. Depending upon the particle sizes of pigment and latex, there is a predisposition for the smaller to concentrate in the free interparticle space of the larger<sup>11,12</sup> until the critical packing of the system is attained.\*

**THE COMPACTION STAGE:** The onset of critical packing,  $K_c$ , marks the beginning of the compaction stage. With further loss of water, failure of the stabilization layers occurs; the more robust persisting the longer, but it too will ultimately

\*In this description of film formation, it is assumed the system is below CPVC.

collapse and further compaction of the film by evaporative losses causes polymer particles to deform or begin coalescence; neighboring pigment particles form clusters.

**THE GRADUAL COALESCENCE STAGE:** In the last stages of drying, the continued loss of water requires: (1) that the polymer particles flow together, wet, and surround the pigments; or (2) alternatively if flow is not possible, the polymer and pigment particles dewet at stress concentration points, and a cohesive fracture of the tender semi-solid film (mud cracking) takes place.

Although the film has the appearance of being dry, coalescence continues for some time, and the paint film properties continue to develop for several days. The gradual coalescence process is driven by the creep compliance or relaxation of induced stresses caused by the loss of volume and adherence of the film to the substrate.

Because of constrained packing at the substrate and the air boundaries, the first zones of the film to reach critical packing are the film edges and thin areas, e.g., brush and stipple marks. These film zones have a much higher viscosity and at the same time are the first areas to initiate coalescence. Therefore, film formation moves in a lateral manner emanating from the point or first zones of coalescence.<sup>13</sup>

**VOLUME RELATIONSHIPS**

**Basic Volume Definitions**

A coating is expected to have a number of properties, many of which are directly related to the arrangement of the particulate materials (pigments and fillers) in the element of volume (vehicle). Because we are dealing with how particles of matter occupy space, it is more convenient to work with volume relationships rather than mass.

Consider an element of volume,  $v_e$ , in which there is dispersed or suspended particulate matter of such size that the volume,  $v_p$ , of any individual particle is very small with respect to the volume of the element. The total volume,  $\sum v_p$ , of the particles is the summation of the volume of the individual particles. The ratio of the volume of particles to the element of volume is defined as the volume concentration,  $\phi$ , in equation (1).

$$\phi = \frac{\sum v_p}{v_e} = \frac{V_{\text{particles}}}{V_e} \tag{1}$$

Let us envision a suspension of a particulate material dispersed in a volume of fluid, and let us increase the number of particles until each particle is in contact with each of its nearest neighbors. Although there is enough fluid to wet and fill the voids space between all the particles, movement of particles is impossible.

**Table 1—Coatings Properties as a Function of CPVC**

Property	Below CPVC	Above CPVC
Gloss .....	High	Low
Porosity .....	Low	High
Dirt pickup .....	Low	High
Modulus at break .....	Low	High
Elongation at break .....	Flexible	Brittle
Water permeability .....	Low	High

The system is said to have reached critical packing, and the free volume of the system is now zero, i.e., the particles are so crowded into the element of volume that they are not free to move. The ratio of the volume of particles to the total volume, i.e., sum of the volume of particles plus the volume of the fluid when each particle is in contact with its nearest neighbors, is the critical packing constant for the dispersion. The free volume ( $V_{free}$ ) of the original suspension is given by equation (3). From equation (3) it is apparent that when  $\phi$  is equal to  $K_c$  the free volume is zero.

$$K_c = \frac{\sum V_i}{\sum V_i + \text{Void Volume}} = \frac{V_{particles}}{V_{particles} + \text{Void Volume}} \quad (2)$$

$$V_{free} = 1 - \frac{\phi}{K_c} \quad (3)$$

The properties of a coating are directly related to the volume occupied by the particulate material (pigments and fillers) per element of volume of the system (vehicle volume plus particulate volume). This basic concept of pigment volume concentration was introduced to the coatings industry by Asbeck and Van Loo.<sup>14</sup> They were able to identify a unique PVC at which nearly all of the coating properties underwent a dramatic transition, usually from good to poor (see Table 1). This unique property was termed the critical pigment volume concentration. Coatings technologists have successfully explained many performance properties of coatings using this simple concept. CPVC is a specific application of a more general relationship.

Both PVC and CPVC are volume relationships in the solid dry film of the paint, while  $\phi$  and  $K_c$  refer to the volume relationships in the liquid paint film. These volume relationship definitions are key to the development of a general filming theory for latex paints.

### Volume Relationships in Solvent Paints

In a properly formulated solvent-based coating, it is assumed that particles of pigments are uniformly encompassed by an adsorbed layer of the polymer vehicle. In the dry paint film, CPVC can be defined as that unique PVC in which the volume of binder is sufficient to encapsulate and fill the voids between the pigment particles. Most solvent-based paints are formulated well below the CPVC. In solvent paints the polymer vehicle is an integral part of the fluid phase.

$$PVC_{\text{solvent paint}} = \frac{\text{Volume}_{\text{pigments}}}{\text{Volume}_{\text{pigments}} + \text{Volume}_{\text{binder}}} \quad (4)$$

### Volume Relationships in Latex Paints

In latex paints, the concept of CPVC, while remaining generally valid, the relationship must be modified<sup>15</sup> to describe correctly the pigment volume relationships, i.e., the amount of pigment required to attain CPVC is highly dependent not only on the packing characteristics of the pigment, but on the properties of the polymer and the particular latex vehicle as well. The exact manner in which particles of latex polymer and pigment particles interact influences the distribution of pigments and fillers in a paint film and plays an important role in determining the CPVC of the paint, appearance, film coalescence, residual film stress, and performance

of the paint composition in general. It is suggested that a more general equation for CPVC would include a constant ( $b$ ), an adjustable term which is a function of latex particle size, pigment particle size, and the shear modulus of the polymer, which in turn is a function of  $T_g$  and molecular weight. In a solvent-borne paint,  $b$  is equal to 1. Figure 1 is an approximation\* of the CPVC of a latex as a function of particle size of both the pigment and latex. A more accurate relationship would necessarily include modulus term. In the calculation, average pigment size is 0.2 microns and the CPVC in a solvent system is 46.0%.

$$CPVC_{\text{latex paint}} = \frac{V_{\text{pigment}}}{V_{\text{pigment}} + b \cdot V_{\text{vehicle}}} \quad (5)$$

where  $b = 1$ , solvent paints  
 $b > 1$ , latex paints

In contrast to solvent paints, the latex is not a part of the fluid phase, but rather discrete particles suspended along with the pigment and filler particles. As a result we can write a new volume relationship which describes the latex composition:

$$\phi_{\text{Latex Composition}} = \frac{V_{\text{Polymer}} + V_{\text{Pigment}} + V_{\text{Filler}}}{V_{\text{Polymer}} + V_{\text{Pigment}} + V_{\text{Filler}} + V_{\text{Aq. Phase}}} \quad (6)$$

In the film forming process, as the water evaporates, the latex composition approaches and eventually exceeds the critical packing, i.e.,  $\phi_{\text{composition}} \geq K_c$  and as a consequence, drying composition must take one of the following paths:

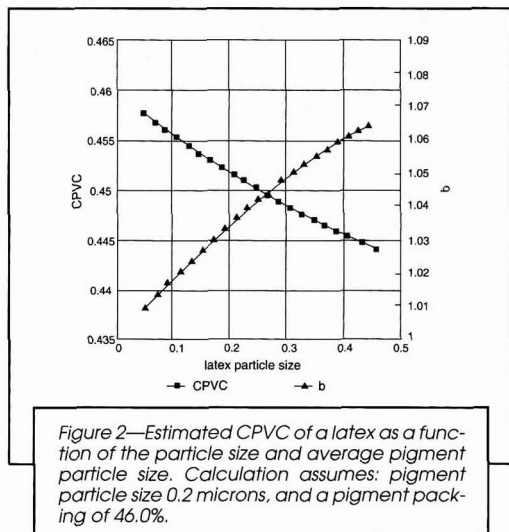
- (1) If the latex polymer particles can deform, i.e., they coalesce and flow around the pigment particles, a film is formed; or
- (2) If the latex particles cannot deform, the aqueous phase will dewet from the pigments, polymer, and substrate, therefore, cracks form in the composition.

The exact path the drying composition will take depends on polymer modulus as a function of  $T$  of the polymer and the packing of the pigment/filler composition.

## THERMODYNAMIC CONSIDERATIONS

Although it is possible to develop polymeric materials by emulsion polymerization that can be dried and redispersed, film formation from latex compositions generally is an irreversible process. It occurs only when the forces driving film formation exceed the forces which would maintain the dispersed state. It will be remembered that much work was done on the system to insure stability, i.e., the adsorption of ionic species and surfactants ( $Q_{\text{electrostatic}}$ ) to form double layers, the solvation of hydrocolloids by water ( $Q_{\text{entropic}}$ ), and their adsorption or grafting to the polymer surface to form entropic layers. These layers create energy barriers to London-Hamker's attractive forces, which much be surmounted if film formation is to occur. But even after the particles are in contact with each other, there is work required to cause the polymer particles to coalesce ( $Q_{\text{coalescence}}$ ) into a coherent film. The work of film formation,  $Q_{\text{ff}}$  must counteract and exceed the sum of these forces before film formation can take place.

$$* \quad b = \left[ \frac{\text{size}_{\text{pigment}} + \frac{\text{size}_{\text{max}}}{2}}{\text{size}_{\text{pigment}}} \right]^3$$



$$Q_{ff} > Q_{electrostatic} + Q_{entropic} + Q_{coalescence} \quad (7)$$

Clearly, the one and only force which offsets the stability barriers and facilitates film formation is driven by the evaporation of water.<sup>16,17</sup> The extreme loss of water causes the collapse of double and entropic layers. Further, the loss of water results in a volume shrinkage of the liquid film. It is the liquid film shrinkage, which in combination with the surface forces causes flow and consolidation of the polymer particles to a coherent coalesced film.

The free energy of evaporation is given by:

$$\Delta G_{vap} = \Delta E_{vap} + P\Delta V_{vap} - T\Delta S_{vap} \quad (8)$$

Where  $\Delta E_{vap}$  is the energy of vaporization of water,  $P\Delta V_{vap}$  is the work done by the system to expand the water vapor against the atmosphere. Both of these energy terms represent energy consumed by the evaporation of the water itself, which must be supplied from the surrounding environment. Thus we can write the inequality:

$$T\Delta S_{vap} > \Delta E_{vap} + P\Delta V_{vap} \quad (9)$$

From this reasoning it can be concluded that the filming process is entropy driven and the available energy to do useful work from the surroundings must be greater than the energy required for film formation ( $Q_{ff}$ ), equations (10) and (10a).

$$Q_{useful\ work} = T\Delta S_{vap} - \Delta E_{vap} - P\Delta V_{vap} \quad (10)$$

$$Q_{useful\ work} > Q_{ff} \quad (10a)$$

The energy required for film formation ( $Q_{ff}$ ) can be divided into two discrete components. The work required for the concentration stage I, ( $Q_{concentration}$ ), and the work of compaction and coalescence, stage II, ( $Q_{coalescence}$ ), is shown in Figure 3 and equation (10b).

$$Q_{ff} = Q_{concentration} + Q_{coalescence} \quad (10b)$$

The work of concentration is the energy required to force particulate matter into close proximity to one another, and is

directly related to the change in viscosity, a function of  $\phi$ , times the shear rate as the rapid evaporative stage I process proceeds, see equation (10c). It has been found<sup>18</sup> that the rate of evaporation under "normal conditions" is about 85% of that of pure water.

$$Q_{concentration} = Q_{electrostatic} + Q_{entropic} \quad (10c)$$

$$Q_{concentration} = \bar{\gamma} \int_{\phi}^{K_c} \partial \eta_{paint}$$

It is, however, the work of coalescence, stage II, that is the main focus of the present paper, for it is at this point the process becomes irreversible. It is stage II that the paint technologist and polymer chemist must address in the design of new latex systems.

Since work can be defined as  $P\Delta V$ , the work of coalescence must be equal to the complex shear modulus ( $M_{film}^*$ ) of the coating (pressure), at the temperature the film is being formed, times the volume change in the film as  $\phi$  changes from  $K_c$  to 1 (dry film), equation (11).

$$Q_{film\ coalescence} = M_{film}^* \Delta V_{filmK_c \rightarrow 1} \quad (11)$$

The volume change can be obtained by rearranging equations (1) to (11a), and differentiating with respect to the volume concentration at constant polymer volume, equation (11b). Integrating of equation (11b) between the limits  $K_c$  to 1 gives the film volume change during coalescence, equation (11d).

$$V_{film} = \frac{V_{polymer}}{\phi} \quad (11a)$$

$$dV_{film} = -V_{polymer} \frac{d\phi}{\phi^2} \quad (11b)$$

$$\Delta V_{film} = V_{polymer} \int_{\phi=K_c}^{\phi=1} \frac{d\phi}{\phi^2} \quad (11c)$$

$$\Delta V_{film} = V_{polymer} \left[ 1 - \frac{1}{K_c} \right] \quad (11d)$$

The volume of the polymer/unit area of the film is estimated from equation (12). If it is assumed that the area of the film is nearly constant and only the thickness of the film changes,  $V_{coating}$  can be defined in terms of  $t_{dry\ film}$ , the dry film thickness, equation (13).

$$V_{polymer} = V_{coating} \left( 1 - \frac{PVC}{100} \right) \quad (12)$$

$$V_{coating} = Area_{coating} \cdot t_{dry\ film} \quad (13)$$

In a pigmented system, it is the complex shear modulus of the pigmented system ( $M_1^*$ ) rather than the shear modulus of the pure polymer ( $M_{polymer}^*$ ) that is important; the shear modulus of the pigmented film can be related to the shear modulus of the pure polymer times a function ( $\beta$ ) that describes the packing and reinforcing character of the pigments, equation (14).

$$Q_{coalescence} = \beta M_{polymer}^* V_{polymer} \left[ 1 - \frac{1}{K_c} \right] \quad (14)$$

Some have suggested that theoretical expressions for viscosity and shear modulus should be of the same form.<sup>19</sup> From



this reasoning one might imply that a Mooney model [equation (15)] could be used to estimate the reinforcing character of a pigment or filler; however, it is known that a direct transposition of the Mooney expression overstates the reinforcing character of a pigment or filler even when corrections have been made for the binder polymer not being elastomeric (Poisson's ratio < 0.5) and the shape of the particles are not spherical.

$$J = J_0 \exp \left[ \frac{2.5 \text{ PVC}}{1 - \frac{\text{PVC}}{\text{CPVC}}} \right] \quad (15)$$

The Kerner equation is reported to be much more accurate at reasonable filler ratios and could be used as an alternative to the Mooney model; however, the Kerner equation is a continuous function and does not display the discontinuity at CPVC that exists. For these reasons it is reasonable to modify another free volume expression which will display a discontinuity at CPVC. The Doolittle equation may represent such a model, equation (16a). The function  $\beta$ , then must include four factors: (1) a free volume function of the PVC and CPVC; (2) a function of Poisson's ratio of the binder polymer; (3) a term describing the shape/orientation of the pigments/fillers in the paint film; and (4) the shear modulus of the pure polymer. Recasting the function  $\beta$  in term of the Doolittle equation yields equation (16b).

$$J = J_0 \exp \left[ \frac{b}{V_{free}} \right] \quad (16a)$$

$$\beta = \exp \left[ \frac{f_{(v_1, \Xi)} \text{ CPVC}}{\text{CPVC} - \text{PVC}} \right] \quad (16b)$$

$$M_1 = M_{polymer} \exp \left[ \frac{f_{(v_1, \Xi)} \text{ CPVC}}{\text{CPVC} - \text{PVC}} \right] \quad (16c)$$

The general relationship for the function  $(f_{(v_1, \Xi)})$  in the case of shear deformation for any Poisson's ratio is given by equation (17). When spherical particles are dispersed in a liquid,  $f_{(v_1, \Xi)}$  reduces to 2.5 (Einstein's coefficient or 2.5). The value of Poisson's ratio for ideal elastomer approaches that of a liquid (0.5); Poisson's ratio for a polymer below its  $T_g$  (glassy solid) is approximately 0.35.

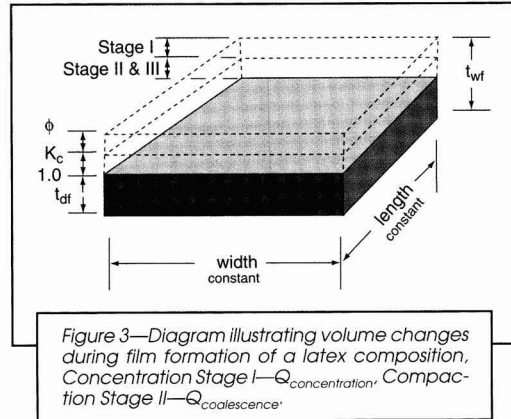
Like modulus, Poisson's ratio passes through an inflection as the temperature increases from below the glass temperature,  $T_g$ , to above the glass temperature. Thus, a temperature dependent filming model must necessarily relate both polymer modulus and Poisson's ratio as a function of temperature.

$$f_{(v_1, \Xi)} = \Xi \left[ \frac{15(1 - v_1)}{8 - 10v_1} \right] \quad (17)$$

where:

- $v_1$  = Poisson's ratio of polymer at filming temperature
- $\Xi$  = pigment particle shape factor (spheres = 1)

Substitution of equations (12), (13), and (16b) into equation (14) gives a working model [equation (18)] for the energy required to completely coalesce a latex paint film. Much of the needed data is expressed in terms familiar to the paint technologist.



$$\frac{Q_{coalescence}}{\text{Area}_{coating}} = M_{polymer} \exp \left[ \frac{f_{(v_1, \Xi)} \text{ CPVC}}{\text{CPVC} - \text{PVC}} \right] \left[ 1 - \frac{1}{K_c} \right] \left[ t_{df} \left( 1 - \frac{\text{PVC}}{100} \right) \right] \quad (18)$$

The degree or percent coalescence can be defined as:

$$\% \text{ Coalescence} = \frac{\phi_{df} - K_c}{1 - K_c} \times 100 \quad (19)$$

The cohesive forces holding the liquid film together are the surface tension of the water and interfacial tension between water and the wetted particles. These forces are the work of adhesion and the work of cohesion. They are approximately numerically equal to the work of dewetting and liquid film rupture. They are given by:

$$W_{wp} = \gamma_w + \gamma_p - \gamma_{wp} \quad (20)$$

$$W_{w,poly} = \gamma_w + \gamma_{poly} - \gamma_{w,poly} \quad (21)$$

$$W_{ww} = 2 \gamma_w \quad (22)$$

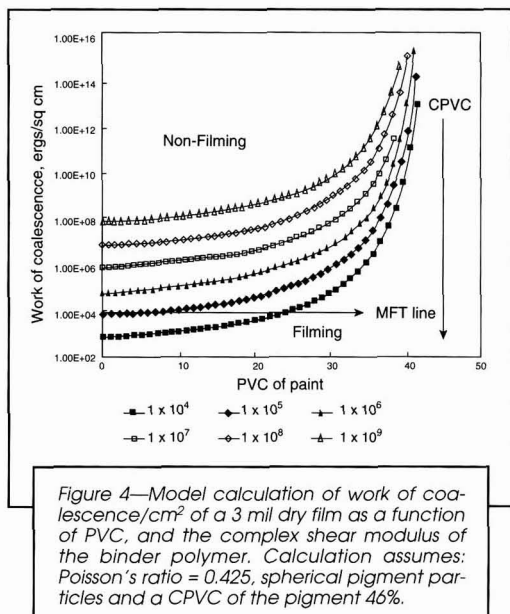
$W_{wp}$ ,  $W_{w,poly}$ , and  $W_{ww}$  are the work of adhesion to the pigment, polymer, and the work of cohesion of water.  $\gamma_w$  is the surface energy of water and  $\gamma_p$  and  $\gamma_{poly}$  the surface energy of the pigment and the polymer.  $\gamma_{wp}$  and  $\gamma_{w,poly}$  are the interaction energies at the water-pigment and water-polymer interfaces.

If the complex modulus is excessively high, then the polymer cannot deform within the time frame of the experiment (coalescing time) and, the second pathway, i.e., film rupture is followed. The determinate factor dictating which pathway the drying process will take can be likened to a chain with a weak link. The liquid film will crack if the  $Q_{coalescence}$  is > than any or all of the dewetting terms (weak links), and conversely film formation will take place if all the dewetting terms are greater than the energy required for coalescence.

$$\text{Cracking if, } Q_{coalescence} > W_{ww}, W_{wp}, W_{w,poly} \quad (23)$$

$$\text{Filming if, } W_{ww}, W_{wp}, W_{w,poly} > Q_{coalescence} \quad (24)$$

$Q_{coalescence}$  is the ideal work required to consolidate the film to strain free, zero void film. Adhesion to the substrate and the complex shear modulus of the drying paint film are forces restraining complete coalescence. Consequently, if the rate of



evaporation of water is faster than the ability of the polymer to deform (compliance), strains and air inclusions develop. The air inclusions are micro voids that are filled with air that diffuses into the film as the water evaporates. Hence the volume change is always less than  $1 - K_c$ , but rather  $\phi_{df} - K_c \cdot \phi_{df}$  is the theoretical ratio of the specific volume of the film components to the actual specific volume of the dried film.\*

$$sp \cdot vol_{strain\ free} = \sum_{n=1}^{n=m} \frac{\%_n}{\rho_n} \cdot 100 \quad (25)$$

$$\phi_{df} = \frac{sp \cdot vol_{strain\ free}}{sp \cdot vol_{dried\ film}} \quad (26)$$

Poorly coalesced films are always cloudy or hazy because air inclusions or micro voids in the film cause a diffraction of transmitted light.† Conversely, well coalesced films are often crystal clear.

The complex shear modulus can be modified by polymer design and by the use of coalescing aids/filming aids, which act as a fugitive plasticizer to temporarily lower the complex shear modulus.

### TEST OF THE MODEL

A good approximation of the Poisson's ratio for a filming polymer is  $\approx 0.425$  (the average of 0.5 and 0.35). If it is assumed that the critical packing constant,  $K_c$ , is  $\approx 0.525$  and the shape of the pigment particles are nearly spherical, Figure 2 shows a model calculation of the energy or work required for film formation at several moduli of the latex polymer. The

\*Applies only to paints formulated below CPVC.

†Another cause of hazy or cloudy films is incompatibility with the surfactant system with the base polymer.

MFT line represents a latex which will just form a film at 40°F. The model clearly shows the exacerbation of pigments and fillers on film formation. In the model calculation, the sign of the work is negative (indicating work done on the film), but for convenience of the log plot the absolute value of work is shown.

### Methods of Measuring Film Formation

Both industrial and academic latex chemists and paint technologists have sought means of testing the film forming character of their experimental efforts. The most often determined property is the minimum filming temperature (MFT).

MFT is defined as the lowest temperature at which a coherent film will form. It is readily determined on a gradient temperature bar by visually observing the lowest temperature at which "clear" film can form. It is a measure of the temperature at which  $Q_{coalescence}$ , i.e., the product of volume change and the complex shear modulus/viscosity of the film equals or just exceeds the surface forces of the liquid phase. It is particularly useful on unpigmented systems. In simple copolymers and homopolymers, the ratio of MFT and  $T_g$  constant<sup>20</sup> is shown by equation (27).

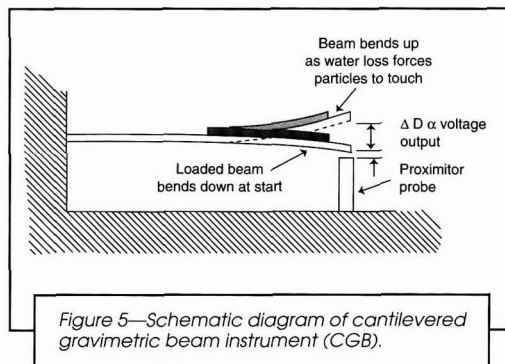
$$\frac{MFT (K^\circ)}{T_g (K^\circ)} = 0.935 \quad (27)$$

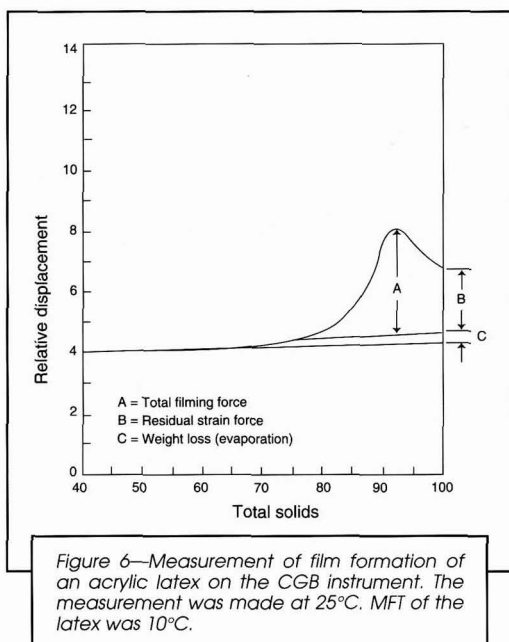
Because the opacity of pigmented films confuses the observation of the coherency of the film, it does not accurately predict film coalescence of pigmented systems.

### Film Stress Measurements

A more useful instrument for measuring film formation is the CGB instrument\* described by Hoy and Peterson.<sup>21</sup> When a film forming composition is placed in the sample boat of the instrument (Figure 4), the initial response is a negative deflection due to the load placed on the beam. When  $\phi$  is below critical packing, an excess of fluid maintains the fluidity of the dispersion and a positive deflection records only the weight loss. When critical packing is reached, the solid particles cannot move more closely together, i.e., free volume = 0. Thereafter, continued evaporative volume losses cause the

\*Cantilever Beam instruments have been previously reported for measuring stress in coatings, see reference 3.





surface forces to exert a tensile stress upon the bed of particles causing a rapid, pronounced deflection of the supporting beam (transverse strains). If the latex is a nonfilming composition, "mud cracking" takes place and the beam returns to the base line (localized strains); however, if the latex is a filming composition, the polymer deforms, flows, and encapsulates the pigment, i.e., the film coalesces. As the film forms, the stress on the beam is partially relieved and the deflection of the beam returns towards, but does not reach, the base line. The residual deflection of the beam is a measure of the residual transverse strain remaining in the film; the information that can be gained is: (1) the force required for polymer flow and deformation,  $Q_{\text{coalescence}}$ ; (2) remaining excess strain in the film; and (3) volume solids at  $K_c$  (see Figure 5).

The information gained from this type of measurement together with the MFT provides the applications technologist with new perspective on polymer and formulation development. A polymer or formulation designed to relieve most of the stress of filming would have better adhesion, and be less prone to checking, cracking, and other performance defects.\*

## SUMMARY

A general model has been developed from thermodynamics for the work of film formation/unit area from latexes. The model is based on the product of volume changes that occur in the film subsequent to reaching critical packing and the

modulus of the polymer as modified by pigment and fillers. The equation for the model is:

$$\frac{Q_{\text{coalescence}}}{\text{Area}_{\text{coating}}} = M_{\text{polymer}}^n \exp \left[ \frac{f_{(v1,2)} \text{CPVC}}{\text{CPVC} - \text{PVC}} \right] \left[ 1 - \frac{1}{K_c} \right] \left[ 1 - \frac{\text{PVC}}{100} \right]$$

The model predicts the effect of pigments and fillers on the filming properties of latex paint compositions and points to research areas in which technical improvements need to be made. It is hoped that the model will promote a better understanding of the filming process and will assist both latex polymer synthesis and coating application technologists in their quest to develop better products.

## ACKNOWLEDGMENTS

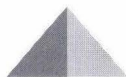
The author would like to thank Union Carbide for allowing the use of their extensive library resources.

## References

- (1) Dillon, D.A., Matheson, D.A., and Bradford, E.B., *J. Colloid Sci.*, 6, 108 (1951).
- (2) Brown, G.L., *J. Polymer Sci.*, 22, 423 (1956).
- (3) Stewart, C.W. and Johnson, P.R., *Macromolecules*, 3, No. 6, 755 (1970).
- (4) Imoto, Tatsuya, *Prog. Org. Coat.*, 2, 193 (1973-74).
- (5) Eckersley, S.T. and Rudin, A., "Mechanism of Film Formation from Polymer Latexes," *JOURNAL OF COATINGS TECHNOLOGY*, 62, No. 780, 89 (1990).
- (6) Croll, S.G., "Adhesion Loss Due to Internal Strain," *JOURNAL OF COATINGS TECHNOLOGY*, 52, No. 665, 35 (1980).
- (7) Croll, S.G., "Residual Strain Due to Solvent Loss from a Crosslinked Coating," *JOURNAL OF COATINGS TECHNOLOGY*, 53, No. 672, 85 (1981).
- (8) Perera, D.Y. and Eynde, D.V., "Considerations on a Cantilever (Beam) Method for Measuring the Internal Stress in Organic Coatings," *JOURNAL OF COATINGS TECHNOLOGY*, 53, No. 677, 39 (1981).
- (9) Perera, D.Y. and Eynde, D.V., "Internal Stress in Pigmented Thermoplastic Coatings," *JOURNAL OF COATINGS TECHNOLOGY*, 53, No. 678, 40 (1981).
- (10) Croll, S.G., "Heat and Mass Transfer in Latex Paints During Drying," *JOURNAL OF COATINGS TECHNOLOGY*, 59, No. 751, 81 (1987).
- (11) Bierwagen, G.P., "Physical Model for Mudcracking in Latex Paint Films," *JOURNAL OF COATINGS TECHNOLOGY*, 51, No. 658, 117 (1979).
- (12) Stieg, F.B., "Are Conventional Trade Sales Formulating Practices Wasteful?," *JOURNAL OF COATINGS TECHNOLOGY*, 48, No. 612, 51 (1976).
- (13) Hoy, K.L., *Proc. International Conference in Organic Coatings Science & Technology*, Pastis, A.V. (Ed.), Athens, Greece 7, 211 (1981).
- (14) Asbeck, W.K. and Van Loo, M., *Ind. Eng. Chem.*, 41:1470 (1949).
- (15) Steig, F.B. Jr., "Latex Paints and the CPVC," *JOURNAL OF PAINT TECHNOLOGY*, 41, No. 531, 243 (1969); "Particle Size Parameter and Latex Paints," *JOURNAL OF PAINT TECHNOLOGY*, 42, No. 545, 331 (1970).
- (16) Sheetz, D.P., *J. Appl. Polymer Sci.*, 9, 3759 (1965).
- (17) Hoy, K.L., "Estimating Effectiveness of Latex Coalescing Aids," *JOURNAL OF PAINT TECHNOLOGY*, 45, No. 579, 51 (1973).
- (18) Croll, S.G., "Heat and Mass Transfer in Latex Paints During Drying," *JOURNAL OF COATINGS TECHNOLOGY*, 59, No. 751, 81 (1987).
- (19) Nielsen, L.E., *Mechanical Properties of Polymers and Composites*, Vol. II, p. 386, Marcel Decker, New York, 1974.
- (20) Hoy, K.L., "Estimating Effectiveness of Latex Coalescing Aids," *JOURNAL OF PAINT TECHNOLOGY*, 45, No. 579, 51 (1971).
- (21) Hoy, K.L. and Peterson, R.H., "Measurement of Particle Packaging in Dispersed Systems," *JOURNAL OF COATINGS TECHNOLOGY*, 64, No. 806, 59 (1992).

\*As a general rule, baked films usually outperform films formed at room temperature. It is the author's belief that transverse and local stress reduction is largely responsible for the better performance. Baked films should contain only the stress induced by the cooling process. Ideally a baked film having the same thermal expansion coefficient as the substrate would provide the best adhesive performance.





# PANORAMA™

## Coatings MSDS CD Retrieval System

*A new vista in Material Safety Data Sheet access and storage for the Coatings Industry*

*Only from the Federation of Societies for Coatings Technology*

**A Comprehensive MSDS Access, Storage, Retrieval System on CD**  
Panorama™ is a new vista in Material Safety Data Sheet (MSDS) access and storage for the coatings industry. Each entry on Panorama is fully indexed, and integrated information searching software is included, permitting users to locate an individual MSDS by:

- ▲ Product name
- ▲ Manufacturer
- ▲ CAS number
- ▲ Chemical name
- ▲ Key words
- ▲ Specific in-house codes

### Satisfies Government Regulations

Panorama meets the requirements of government legislation mandating that manufacturers maintain a 30-year file of MSDS information, without supporting a mountain of paperwork. The single Panorama CD replaces over 1,000 computer disks or 250,000 pages of typewritten text.

### Continuous Improvement, Continuous Updates

In an effort to provide users the most current and comprehensive MSDS information, Panorama is available only by annual subscription. Each quarter, a new Panorama CD will be supplied to subscribers. The updated version will contain all original MSDS, plus all new and revised sheets. Superseded MSDS, while remaining on file as required by law, will be labeled to alert the user that they have been replaced by more current data.

### Panorama: Only from the Federation of Societies for Coatings Technology

It was inevitable the Federation of Societies for Coatings Technology (FSCT) would develop the Panorama system. In concert with the FSCT's Chicago Society, Panorama development began in 1991. Today, over 8,700 individual raw material products are contained on the system's single CD, and the number is growing weekly.

Never before has such information been available in a single, affordable, easy-to-use package, providing users with comprehensive information on over 8,000 raw material products in the coatings industry.

### Subscribe Today

One and two-year subscriptions are available. Special discounts are provided to FSCT and NPCA member companies.

### For Additional Information

To subscribe, or if you have additional questions, call the Panorama InfoLine at 1-610-940-0777. Write inquiries to: Panorama, Federation of Societies for Coatings Technology, 492 Norristown Road, Blue Bell, PA 19422-2350. Fax (610) 940-0292.



# PANORAMA™

**Instant MSDS access ▲ Information management ▲ User customization**  
**Satisfies government regulations ▲ Developed and backed by the FSCT**



Federation of Societies for Coatings Technology  
492 Norristown Road  
Blue Bell, PA 19422-2350  
(610) 940-0777  
Fax (610) 940-0292



Circle No. 7 on the Reader Service Card



Panorama is endorsed by the National Paint & Coatings Association



# Flame-Retardant Brominated Styrene-Based Polymers. IX. Dibromostyrene-Based Latexes

J.-L. Wang and N.A. Favstritsky—Great Lakes Chemical Corp.\*

## INTRODUCTION

Acrylic, styrene-butadiene, styrene-acrylic, vinyl-acrylic, and vinyl acetate-vinyl versatate 10 latexes are commercially used in a variety of surface coatings. In many coatings applications, the latexes used are desired to have flame-retarding properties. This applies in particular where latexes are used in textiles, carpeting, paints, clearcoatings, adhesives, sealants, caulks, nonwoven binders, and so on.

The usual method by which flame-retardant properties are imparted to latexes is the blending in of flame-retardant additives. Many of these flame-retardant additives contain bromine, such as brominated diphenyl or diphenyl oxide compounds together with antimony trioxide. However, such flame-retardant additives have a major disadvantage in that their use gives rise to problems, such as the generation of strong white pigmentation and settling out effect, and toxicity resulting from the presence of antimony trioxide.

A common approach has been the addition of solid organic and inorganic compounds to latexes to confer flame retardancy. Mischutin<sup>1</sup> describes the admixture of an aqueous dispersion of a halogenated organic compound and metallic oxide with a polymeric adhesive binder. Although this approach has been shown to provide the desired flame retardancy, many undesirable features are again introduced. Solids ultimately separate from the latex emulsion despite any dispersion techniques employed. The dispersions tend to be high in viscosity and impede application of the latex. Latex films become stiffer due to the presence of solids, interfering with the flexibility or "hand" of the latex. In addition, solids tend to have a pigmenting effect which masks or changes the color of the substrate.

Liquid compounds have been added to latexes as well. Blackford<sup>2</sup> teaches the use of liquid chlorinated paraffin in a latex to achieve fire retardancy. Drawbacks to the use of liquids include migration from the polymer with time; separation from the liquid latex emulsion; adverse effect upon adhesion; plasticizing; swelling of the latex; and poor chemical, solvent, and water resistance. Salts and other water-soluble solids eliminate the problems of settling of solids; however, they contribute to other problems as well as generally having an adverse effect upon the stability of the latex emulsion.

*Dibromostyrene can copolymerize with butadiene, alkyl acrylates and methacrylates, vinyl acetate, styrene, and unsaturated carboxylic acids to form a wide variety of flame-retardant latexes via an emulsion polymerization technique. The latex is characterized in terms of glass transition temperature, residual monomer, solids content, pH, Brookfield viscosity, specific gravity, particle size, mechanical stability, UV stability, and flame retardancy. These novel dibromostyrene-based latexes are useful for a wide variety of applications in textile backcoatings, paints, clearcoatings, adhesives, sealants, caulks, binders, carpet backings, and so on.*

Chemical integration of monomers into latex polymer to impact flame retardancy has had limited success. Copolymers of vinyl chloride and vinylidene chloride tend to be less flammable than nonchlorinated polymers, but because chlorine is less effective than bromine or phosphorus, additive flame retardants are still needed. Another disadvantage of the chlorinated polymers is their reduced thermal and hydrolytic stability. Oven aging studies of chlorinated polymers show that even less than five minutes at 300°F causes discoloration. Therefore, there is a need for polymeric latexes which possess desired physical properties combined with flame retardancy.

The preparation of the latexes is well known and has been described in the literature. Nač<sup>3-5</sup> described the synthesis of a limited class of epoxy resins based on the preparation of cotelomers which were subsequently epoxidized. Hydrogen peroxide was used as both the initiator and the telogen for the reaction of bromostyrene (mono, di, and tri) with 1,3-butadiene to yield cotelomers having terminal-OH groups. The cotelomers were semi-liquids or solids, with molecular weights ranging from 600 to 14,000. These random oligomers were then epoxidized to produce epoxy resins useful as a matrix for composite materials. These cotelomers were described as being useful components of flame-retardant polymers, especially polyurethanes. Mackay<sup>6</sup> described a latex of carboxylic acid

Presented at the 22nd Annual Waterborne, High-Solids, and Powder Coatings Symposium, on February 22-24, 1995, in New Orleans, LA.

\*P.O. Box 2200, West Lafayette, IN 47906.



Table 1—Synthesis of DBS/B Latexes

Example	Monomer Charge DBS:B	Reaction time, hr	Solids %	Conversion %	T <sub>g</sub> , °C <sup>a</sup> calc.	MVSS-302 <sup>b</sup>
1	88:12	2	35.5	96	88.8	SE
2	75:25	2.5	35.9	97	45.3	SE
3	67:33	3	31.8	86	23.4	SE
4	60:40	5.25	34.4	93	6.6	SE
5	50:50	14.42	35.9	97	-14.4	SE
6	40:60	14.42	36.3	98	-32.5	RB
7	25:75	20.75	34.8	94	-55.3	RB
8	20:80	20.25	34.0	92	-62.0	RB

(a) Calculated T<sub>g</sub> values (DBS, 414°K, and B, 188°K) according to the following equation:

$$1/T_g = W_1/T_{g1} + W_2/T_{g2} + \dots + W_n/T_{gn}$$

where T<sub>g</sub> = multipolymer T<sub>g</sub> in °K, W<sub>n</sub> = weight fraction of the monomer present, and T<sub>gn</sub> = the homopolymer T<sub>g</sub> in °K.

(b) MVSS-302 test on latex coated polyester fabrics (100% polyester weighing 6 oz/yd<sup>2</sup>): SE = self-extinguishing; RB = rapid burn; SE/NBR = SE/no burn rate.

based polymer. In addition to an  $\alpha$ ,  $\beta$ -ethylenically unsaturated carboxylic acid monomer or a compound hydrolyzable to such a carboxylic acid monomer, the polymers comprised a ring-halogenated ethylenically unsaturated aromatic monomer (e.g., monochlorostyrene) and an aliphatic conjugated diene (e.g., butadiene). Mackay indicated that a fire-resistant latex foam required a carboxylic latex, a melamine-formaldehyde resin, antimony trioxide, and a filler comprising an amphoteric metal oxide hydrate. The Mitsui Toatsu patent<sup>7</sup> described a curable composition containing 5/30/60/5-acrylic acid/methyl methacrylate/butyl methacrylate/bromostyrene copolymer and a basic catalyst, coated on a slate tile and dried (cured) at room temperature with excellent resistance to soiling, water, and cracking. Formulations without halogen-containing vinyl polymers did not give good resistance to soiling, water, and cracking. There is no mention of flame retardancy of the composition and its application as flame retardant. De Man<sup>8,9</sup> described a fire-resistant copolymer of bromostyrene and another monomer, preferably acrylonitrile, and a process for preparing same by emulsion polymerization to produce copolymers having 95 to 25 wt% bromostyrene, the balance being the second monomer. However, no mention of flame-retardant coatings application was made.

This paper reports the synthesis, characterization, and applications of novel flame-retardant dibromostyrene-based latexes, which summarizes four U.S. patents<sup>10-13</sup> and five papers published in the *Polymer Preprints*.<sup>14-18</sup> They are copolymers of dibromostyrene (DBS) with the following monomers:

- (1) Butadiene (B);
- (2) Styrene (S) and butadiene;
- (3) Methacrylic acid (MAA) and either ethyl acrylate (EA) or butyl acrylate (BA);
- (4) Methyl methacrylate (MMA) and either 2-ethylhexyl acrylate (2-EHA) or EA;
- (5) EA, MMA, and MAA;
- (6) BA, S, and MAA;
- (7) 2-EHA, EA, and itaconic acid (IA);
- (8) BA, MMA, and IA;
- (9) BA, S, and IA; and
- (10) BA with and without IA.

Choice of a monomer or monomer mixture is based upon the final glass transition temperature (T<sub>g</sub>) of the copolymer desired. Other criteria include desired physical properties and chemical resistance.

## EXPERIMENTAL

### Materials

Dibromostyrene, a product of the Great Lakes Chemical Corp., contains about 82% dibromostyrene, 12-13% monobromostyrene, and 5-6% tribromostyrene by weight. S, MAA, EA, BA, MMA, 2-EHA, and IA were used directly as received from Aldrich Chemical. Sodium dodecyl sulfate (SDS), ammonium persulfate, sodium bisulfite, ammonium carbonate, n-dodecyl mercaptan (n-DDM), and t-dodecyl mercaptan (t-DDM) were also used directly as received from Aldrich. Butadiene (B) was purchased from Matheson Gas Products and used without further purification.

### Synthesis of DBS/B Latexes

A soap solution (a mixture of 180 parts deionized water, 5 parts SDS, 0.3 parts potassium persulfate, and 0.3 parts sodium bisulfite) was prepared and charged into a 32-oz bottle. To the bottle, a mixture of 20-88 parts DBS and 0.175 parts n-DDM was charged. The bottle (with cap) was weighed on a balance, and 12-80 parts butadiene added slowly until an excess (1 to 2 parts) was present. The cap was then placed loosely on the neck of the bottle, and the butadiene was allowed to evaporate until the correct weight was established. The cap was sealed with rubber and Teflon gaskets and was then tightened quickly by hand using rubber gloves. The bottle was placed in a clamp in a 50°C water bath and rotated. The reaction was allowed to reach 86-98% conversion at 31.8-36.3% solids in 2-20.75 hr (Table 1). The 50/50- and 60/40-DBS/B latex coated polyester fabrics (100% polyester weighing 6 oz/yd<sup>2</sup>) passed the MVSS-302 test, SE/NBR (pass), and SE (best), respectively.

### Synthesis of DBS/S/B Latexes

The general procedure for preparing DBS/B latexes was repeated here to prepare terpolymer latexes which contained 40-20% by weight of DBS, 15-68% by weight of S, and 45-12% by weight of B. The reaction reached 94% conversion at

Table 2—Synthesis of DBS/S/B Latexes

Example	Monomer Charge DBS:S:B	Reaction time, hr	Solids %	Conversion %	T <sub>g</sub> , °C calc.	MVSS-302
9	20:68:12	4.25	35	94	66.6	—
10	30:40:30	14.33	35	94	21.7	SE
11	30:30:40	14.33	35	94	0.5	SE/NBR
12	35:25:40	14.33	35	93	1.5	SE
13	40:20:40	14.33	35	94	2.5	SE
14	40:15:45	14.33	35	94	-7.2	SE

**Table 3—Synthesis of DBS, MAA, and Either EA or BA Terpolymer Latexes**

Example	Monomer Charge DBS/EA/BA/MAA	Reaction Time, hr	Solids %	Conversion %	T <sub>g</sub> <sup>a</sup> °C
15	20:78:0:2	7(50°C)	50	100	2.4
16	20:79:0:1	7(50°C)	50	100	0.9
17	30:0:67:3	7(50°C)	50	100	-14.7
18	20:0:77:3	7(50°C)	50	100	-28.6
19	20:0:76:4	7(50°C)	50	100	-27.0
20	20:0:74:6	7(50°C)	50	100	-23.8
21	20:0:72:8	7(50°C)	50	100	-20.5

(a) Calculated T<sub>g</sub> values (DBS, 414°K; EA, 251°K; BA, 217°K; and MAA, 501°K).

35% solids at 50°C in 4.25 to 14.33 hr, as shown in Table 2. The 30-40/15-40/30-45-DBS/S/B latex coated polyester fabrics or velvets obtained an SE rating with a total burn distance of 0.5-1.0 in.

#### Synthesis of DBS/MAA/EA or BA Latexes

Emulsion polymerization of DBS, MAA, and either EA or BA were carried out in 8-oz bottles. The ingredients comprising 103.67 parts by weight deionized water, 3 parts SDS, 0.3 parts potassium persulfate, 0.3 parts sodium bisulfite, with 0.2 parts or without t-DDM, and 20-30 parts DBS, 0-79 parts EA or BA and 1-8 parts MAA were charged into 8 oz bottles and flushed well with nitrogen, and then reacted at 50°C to about 50% solids in seven hours. The whole bottle was cooled to room temperature and neutralized with one percent NaOH to a pH of 7. The results of these preparations are set forth in Table 3. The latexes in examples 15 through 21 perform well in a variety of coating applications, and display improved flame retardancy.

#### Synthesis of DBS/MMA/2-EHA or EA Latexes

The general procedure for preparing DBS/MAA/EA or BA latexes was repeated to prepare terpolymer latexes which contained 20-25% by weight of DBS, 0-65% by weight of 2-EHA or EA, and 15-23% by weight of MMA. The reactions reached 100% conversion at 50% solids at 50°C in nine hours, as shown in Table 4. The latexes in examples 22 through 25 perform well in a variety of coating applications and display improved flame retardancy.

#### Synthesis of DBS/EA/MMA/MAA Latexes

Preparation of 0-20% DBS, 65% EA, 13-33% MMA, and 2% MAA tetrapolymer latexes was carried out in 8-oz bottles by the same technique as described in preparing DBS/MAA/EA or BA latexes, except that 7.56 parts alkyl aryl polyether alcohol (Triton X-207 from Union Carbide) was dissolved in 100 parts total monomers and charged into the bottle containing 0.12 parts (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>, 0.16 parts NaHSO<sub>3</sub>, and 113.51 parts deionized water. The reactions reached 93-95% conversion at 45.3-46.3% solids at 65°C in 2.5-4.5 hr, as shown in Table 5. The product was cooled to 30°C, strained, and the pH adjusted to

9.5 with 2-amino-2-methyl-1-propanol. The latex in example 26 performs well in a variety of coating applications, displays improved flame retardancy, indicated by an oxygen index of 25, while the latex in example 27 gives no flame retardancy.

#### Synthesis of DBS/BA/S/MAA Latexes

The general procedure for preparing DBS/MAA/EA or BA latexes was repeated to prepare tetrapolymer latexes which contained 0-30% by weight of DBS, 55-78% by weight of BA, 0-43% by weight of S, and 2-3% by weight of MAA. The reaction reached 94-97% conversion at 43.9-46.2% solids at 65°C in 3.67-19.75 hr, as shown in Table 6. The product was cooled to 30°C, strained, and the pH adjusted to 9.5 with 2-amino-2-methyl-1-propanol. The latexes in examples 28 through 30 perform well in a variety of coating applications and display improved flame retardancy, indicated by an oxygen index of 24, while the latex in example 31 gives no flame retardancy.

#### Synthesis of DBS/2-EHA/EA/IA, DBS/BA/MMA/IA, DBS/BA/S/IA, and DBS/BA Latexes With and Without IA

A 1,000 mL four-neck, round bottom flask with an overhead stirrer is used. A reflux condenser with N<sub>2</sub> blanket is attached to one neck. A thermometer is attached via another neck. Two feed lines, each with a Masterflex pump, are entered via the third neck. A thermometer with therm-o-watch control of a stirring hot plate is used to control a hot water bath in which the flask is submerged. The hot plate is supported on a jack to allow easy removal of the flask from the hot water bath. The monomers are contained in a 500 mL graduated cylinder connected to one feed line, while the initiator is contained in a 100 mL graduated cylinder connected to the other feed line.

First, the N<sub>2</sub> purge is turned on, as is stirring, the condenser, and the hot water bath. It is set to 77°C. The surfactant (2-3 parts SDS) is rinsed into the flask with all but 100 mL of deionized water. The reactor is plugged. The initiator (0.35-0.47 parts ammonium persulfate) is measured out and dissolved in the remaining 100 mL of deionized water. The monomers, except IA, are measured out and mixed together in the 500 mL graduated cylinder. Just before turning on the pumps, the IA (2-4 parts) is added to the reactor and allowed to dissolve.

**Table 4—Synthesis of DBS, MMA, and Either 2-EHA or EA Terpolymer Latexes**

Example	Monomer Charge DBS/2-EHA/EA/MMA	Reaction Time, hr	Solids %	Conversion %	T <sub>g</sub> <sup>a</sup> °C
22	20:65:0:15	9(50°C)	50	100	-28.0
23	20:57:0:23	9(50°C)	50	100	-16.6
24	25:0:57:18	9(50°C)	50	100	25.4
25	20:0:57:23	9(50°C)	50	100	24.4

(a) Calculated T<sub>g</sub> values (DBS, 414°K; 2-EHA, 203°K; EA, 251°K; and MMA, 378°K).

The monomer pump is set at 4 mL/min, and the initiator pump is set at 1 mL/min with a goal of adding all reactants in approximately 90 min. Reaction temperature is maintained at about 75°C. After all reactants are added, the mixture is held at 85°C for two hours. The reaction is cooled to 40°C and filtered through cheese cloth. Coagulum is collected, and the latex is analyzed for percent solids, viscosity, UV stability, residual monomer, and flame retardancy (Tables 7 and 8). The latex is also analyzed for physical properties such as residual monomer, solids, pH, viscosity, specific gravity, particle size, mechanical stability, and flame retardancy after the pH of the latex is adjusted to about 6.5 with 5% NH<sub>4</sub>OH (Table 9).

## CHARACTERIZATION

DBS-based butadiene and acrylic latexes were characterized in terms of  $T_g$ , residual monomer, solids, pH, Brookfield viscosity, specific gravity, particle size, mechanical stability, UV stability, and flame retardancy.  $T_g$  was measured at 10°C/min by DSC. Residual monomer was measured by GC. Particle size was measured by capillary hydrodynamic fractionation (CHDF). Mechanical stability was measured by a Waring blender test. UV stability was measured by xenon arc weatherometer, 0.55 W/m<sup>2</sup> at 340 nm for 300 hr. Flammability of the latex was tested by the following: (1) Motor Vehicle Safety Standard 302 (MVSS-302) flammability test when used in textile backcoatings; (2) the limiting oxygen index test (ASTM D 2863) when used in paints; (3) exposure to a three-inch blue methane Bunsen burner flame when used in contact adhesives; (4) the Butler chimney test (ASTM D 3014) when used in caulks; (5) exposure to a four-inch high, 1950°F propane flame from a Fisher burner when used in nonwoven polyester fiber filter medium; and (6) DOC.FF-1-70 (pill test) flammability test when used in carpet backings.

Table 5—Synthesis of DBS/EA/MMA/MAA Tetrapolymer Latexes

Example	Monomer Charge DBS/EA/MMA/MAA	Reaction Time, hr	Solids %	Conversion %	Oxygen Index	$T_g^a$ °C
26	20:65:13:2 <sup>b</sup>	4.5(65°C)	45.3	93	25	16.3
27	0:65:33:2 <sup>b</sup>	2.5(65°C)	46.3	95	23	12.5

(a) Calculated  $T_g$  values (DBS, 414°K; EA, 251°K; MMA, 378°K; and MAA, 501°K).  
(b) Using 7.56 parts alkyl aryl polyether alcohol (Triton X-207, Union Carbide, Danbury, CT).

Table 6—Synthesis of DBS/BA/S/MAA Tetrapolymer Latexes

Example	Monomer Charge DBS/BA/S/MAA	Reaction Time, hr	Solids %	Conversion %	Oxygen Index	$T_g^a$ °C
28	30:67:0:3 <sup>b</sup>	17(50°C)	44.0	97	24	-14.7
29	20:78:0:2 <sup>c</sup>	3.67(65°C)	43.9	97	—	-30.1
30	20:55:23:2 <sup>d</sup>	19.75(65°C)	46.2	95	24	-0.8
31	0:55:43:2 <sup>d</sup>	14(65°C)	45.8	94	22	-4.7

(a) Calculated  $T_g$  values (DBS, 414°K; BA, 217°K; S, 373°K; and MAA, 501°K).  
(b) Using 5 parts block copolymer of propylene oxide and ethylene oxide (F108, BASF Wyandotte Corp., Parsippany, NJ).  
(c) Using 7.59 parts octylphenoxy polyethoxy ethanol (Triton X-165, Union Carbide).  
(d) Using 7.56 parts alkyl aryl polyether alcohol (Triton X-207, Union Carbide).

## RESULTS

### Textile Backcoating

The latex (example 54, Table 9) was applied to 100% polyester fabric weighing 6 oz/yd<sup>2</sup>. The treated fabric was dried for one hour at 100°C. The dry add-on was 2.8 oz/yd<sup>2</sup>.

The coating appears to have good flexibility, high temperature strength, and acceptable tackiness. The coated fabric was tested for flammability by Motor Vehicle Safety Standard 302 (MVSS-302). The flame failed to burn the 1-1/2 in. gauge line, resulting in an SE (best) flammability rating.

A second latex was prepared in an identical manner except that dibromostyrene was omitted. Resultant coated fabric prepared similarly burned the full 10 in. beyond the 1-1/2 in. gauge mark when tested by MVSS-302, resulting in an RB (worst) flammability rating.

### Latex Based Paint

An open vessel with continuous high shear mixing was charged with 40 parts by weight water, 0.15 parts antifoaming agents, dispersants and surfactants Tamol 731 (0.4 parts), Triton X-207 (0.28 parts), and Silwet L-7602 (0.28 parts) [Tamol is a product of Rohm and Haas, Triton and Silwet are products of Union Carbide], 0.62 parts sodium polyacrylate thickener, 18 parts titanium dioxide, 28.3 parts calcium carbonate, and 7.34 parts 1-butanol. The mixing speed was reduced to lower shear conditions. Fifty parts of latex (example 62, Table 9) was added. This was followed by 1.15 parts methyl Cellosolve (Union Carbide), 4.58 parts water, and 2.98 parts sodium polyacrylate thickener.

The paint produced appears to have good adhesion and film forming characteristics. It was used to coat 1 mil Mylar to a 10 mil wet thickness using a laboratory coating machine. The dry film thickness was 3 mil. An analogous paint was produced by the same procedures except that 30 parts styrene was used in place of dibromostyrene in preparing the latex.

Both paints were tested using the limiting oxygen index test (ASTM D 2863) to determine if the small quantity of dibromostyrene had an effect upon flammability. The paint film without dibromostyrene has a limiting oxygen index of 22. The paint containing dibromostyrene has a limiting oxygen index of 24, a significant improvement in flame retardancy.

### Contact Adhesive

The latex (example 59, Table 9) was coated onto 0.5 mil Mylar polyester film. The film was dried for two minutes at 150°F. Two pieces of coated polyester film, which were still warm, were pressed together and rolled with a roller, taking care to avoid wrinkling.

Peel strength was judged to be adequate when the two layers of Mylar

Table 7—Composition and Physical Properties of DBS and BA Latexes With and Without IA<sup>a</sup>

Example	Composition Parts			T <sub>g</sub> <sup>b</sup> °C	Residual Monomer %			Solids %	Brookfield Viscosity cps	UV Stability <sup>c</sup> ΔE
	DBS	BA	IA		DBS	BA	IA			
32	5	95		-40	0.00	0.01		48.5	1780	1.26
33	10	90		-36	0.00	0.00		48.4	1240	0.31
34	15	85		-33	0.00	0.00		48.4	2360	1.18
35	20	80		-25	0.00	0.02		45.4	70	0.31
36	25	75		-22	0.01	0.00		48.6	1032	1.17
37	30	70		-19	0.00	0.00		49.0	411	—
38	45	55		-05	0.00	0.00		48.3	424	0.99
39	9.8	88.2	2	-32	0.00	0.13	0.01	46.7	4580	—
40	20	78	2	-20	0.00	0.10	0.01	46.7	2650	—
41	30	68	2	-9	0.40	0.22	0.02	46.9	640	—
42	40	58	2	1	0.46	0.37	0.06	46.9	27	—
43	50	48	2	30	0.02	0.18	0.02	46.0	247	—
44	60	38	2	33	0.03	0.46	0.11	47.6	41	—
45	70	28	2	56	0.56	0.54	0.16	48.4	84	—
46	85	13	2	102	0.14	0.32	0.14	48.9	15	—

(a) Latexes prepared with 100 parts DI water, 2 parts SDS, 0.35 parts (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>, 0.04 parts ammonium carbonate, and 100 parts total monomers without neutralization. Reaction conditions: Semi-continuous addition of monomer and initiator for 1.5 hr at 75°C; heating for one more hour at 75°C; and then heating for another hour after addition of 0.04 parts NaHSO<sub>3</sub> and 0.04 parts (NH<sub>4</sub>)<sub>2</sub>S<sub>2</sub>O<sub>8</sub>.

(b) Measured at 10°C/min by DSC.

(c) Measured by xenon arc weatherometer, 0.55 W/m<sup>2</sup> at 340 nm for 300 hr.

had approximately one gram per square foot of latex adhesive between them. The Mylar latex composite was wrapped loosely around a four-inch diameter cylinder of fiberglass batt insulation and secured with staples. A three-inch blue methane Bunsen burner flame was placed against the lower and side surfaces of the batt/Mylar construction, which was positioned at a 45° angle from vertical. There was no observable after-flame when the burner flame was removed after 10-15 sec of contact.

A similar construction using latex containing styrene substituted for dibromostyrene was prepared. When the burner flame was removed, flame propagated upward from the point of contact until it was extinguished with a water jet 30-60 sec later.

### Latex Sealant

The latex composition described in the Contact Adhesive section was used in a caulk formulation. Two parts Triton X-405 (Union Carbide), 23 parts butyl benzyl phthalate, 4 parts Varsol #1 (Exxon), 2.5 parts ethylene glycol, 2 parts Compo-

sition T dispersant (Calgon), 120 parts calcium carbonate (2 micron average particle size), and 2.5 parts titanium dioxide were added to 100 parts by weight latex. The resultant caulk adheres well to a number of substrates, including wood, glass, and concrete.

A bead of caulk about 1/4 in. diameter was placed on a 1/2 in. wide strip of asbestos cement board. The caulk was tested for flammability by the Butler chimney test (ASTM D 3014). The caulk, which was prepared with latex, in which styrene was substituted for dibromostyrene, had a burn extent greater than 250 mm, which is the top of the scale in the chimney. The caulk prepared from latex containing dibromostyrene was significantly superior, and burned between 90 and 100 mm.

### Nonwoven Binder

The blended latex emulsion composed of 40/60 (examples 47/49, Table 9) was placed into a tray. A nonwoven polyester fiber filter medium weighing about 1.25 oz/yd<sup>2</sup> was pulled through the latex, assuring complete immersion. Upon drying at 300°F for one minute, the filter media was weighed and found to have a dry pick up of 96%.

A second sample of latex was prepared substituting 30 parts styrene for dibromostyrene. The dry pick up was 71%. Both filter media samples were tested for flammability by exposure to a four-inch high, 1950°F propane flame from a Fisher burner. The filter medium was held 2-1/2 in. over the top of the burner at a 15° angle from horizontal.

The filter medium, which was not bound with latex containing brominated styrene, ignited and burned until it was extinguished with a water jet. The extent of burn was greater than 12 in. The filter medium bound with latex containing brominated styrene burned approximately 7-1/4 in. from the burner flame and self extinguished, demonstrating superior flammability resistance.

Table 8—Flame-Retardant Property of DBS/BA/IA Terpolymer Latexes

Example	Composition Parts			Burn Distance in	Pickup oz/yd <sup>2</sup>	MVSS-302 <sup>a</sup>
	DBS	BA	IA			
39	9.8	88.2	2	1.07	3.6	SE
40	20	78	2	1.08	4.0	SE
41	30	68	2	.77	3.7	SE
42	40	58	2	.70	2.7	SE
43	50	48	2	1.00	2.2	SE
44	60	38	2	.70	3.3	SE
45	70	28	2	.60	2.1	SE
46	85	13	2	.70	2.6	SE

(a) MVSS-302 test on latex coated polyester fabrics (100% polyester weighing 6 oz/yd<sup>2</sup>).

SE = self-extinguishing.

**Table 9—Composition and Physical Properties of Acrylic Latexes**

Example	Composition Parts				T <sub>g</sub> , °C calc.	Residual Monomer %	Solids %	pH	Brookfield Viscosity cps	Specific Gravity	Particle Size nm	Mechanical Stability <sup>a</sup> mg/100 g	MVSS-302 <sup>b</sup>
<b>DBS/BA/MMA/IA</b>													
47	30	67	1	2	-15	N.D. <sup>c</sup>	47.7	5.20	40	1.105	136.4	149	SE
48	30	58	10	2	0	0.03	47.4	6.20	33	—	147.8	—	SE
49	30	32	36	2	41	0.02	49.2	5.80	33	1.120	100.9	—	SE
50	30	18	50	2	70	0.05	49.2	7.85	51	1.118	—	—	SE
51	42	55	1	2	3	—	49.2	7.30	50	1.087	—	—	SE
52	50	40	8	2	30	—	49.8	6.84	20	1.188	—	—	SE
53	60	35	3	2	40	—	45.4	7.30	19	1.219	—	—	SE
<b>DBS/2-EHA/EA/IA</b>													
54	30	60	8	2	-25	N.D.	48.4	3.10	69	—	—	10	SE
55	30	67	1	2	-30	—	48.9	7.29	—	—	—	—	SE
56	30	65	1	4	-26	—	45.9	2.05	—	—	—	—	SE
57	30	20	48	2	0	—	47.0	6.30	—	—	—	—	SE
58	30	18	48	4	5	—	27.5	6.10	—	—	—	—	SE
59	43	52	3	2	-7	—	50.1	7.20	30	1.104	—	—	SE
<b>DBS/BA/S/IA</b>													
60	30	58	10	2	0	0.15	47.5	1.80	38	1.105	—	—	SE
61	38	55	5	2	3	0.037	46.8	7.26	—	1.102	—	—	SE
62	30	67	0	3 <sup>d</sup>	-15	—	45.0	9.50	—	—	—	—	SE

(a) Dilute 80 g latex with DI water to 100 g, then stir at high speed in Waring blender for 10 min, and filter and weigh coagulum.  
 (b) MVSS-302 test on latex coated polypropylene and polyester fabrics; SE = self-extinguishing.  
 (c) N.D. = non-detectable.  
 (d) Prepared using 5 parts Pluronic F108 (BASF Wyandotte Corp., Parsippany, NJ).

**Carpet Backing**

Precoat compounds were applied to carpet direct from a tufting machine. The carpet consisted of 100% nylon face fibers having a weight of 29 oz/yd<sup>2</sup>.

The following procedure was used to prepare the latex emulsion: 105.7 parts (by weight) deionized water, 5 parts SDS, 0.3 parts potassium persulfate, and 0.3 parts sodium bisulfite were added to a quart bottle. After stirring, 57 parts S and 4 parts MAA were added. Finally, 39 parts B was charged quickly. The bottle was capped and rotated about a horizontal axis in a 50°C water bath for 15 hr. Conversion was greater than 99%. The latex emulsion was neutralized to pH 7 with ethylenediamine. A second latex was made similarly, substituting 18 parts DBS for 18 parts S. For each 100 parts by weight of solids in the latex emulsions, 0.5 parts sodium hexametaphosphate, 0.5 parts Dow Corning Antifoam B, 600 parts CaCO<sub>3</sub>, and 2.5 parts Rohm and Haas ASE-60 acrylate thickeners were added.

A labcoater was used to obtain an applied weight of 18 oz/yd<sup>2</sup> once the carpet was oven dried. Table 10 summarizes the

**Table 10—Latex Carpet<sup>a</sup> Backing**

Component	1	2	3
Styrene	57	39	57
Butadiene	39	39	39
Methacrylic acid	4	4	4
Dibromostyrene	0	18	0
CaCO <sub>3</sub>	600	600	400
ATH	0	0	200
DOC. FF-1-70 results	Fail	Pass	Pass
Avg. extent of burn, in.	4.0	1.2	1.35

(a) The carpet consisted of 100% nylon face fibers having a weight of 29 oz/yd<sup>2</sup>.

results of DOC. FF-1-70 (pill test) flammability tests on three formulations. It can readily be seen that 18 parts of dibromostyrene in the latex confers as much flame retardancy as 200 parts of alumina trihydrate (ATH) flame retardant.

**DISCUSSION**

Dibromostyrene-based butadiene and acrylic latexes having desirable physical properties in combination with flame retardancy can be made readily by an emulsion polymerization technique. Dibromostyrene can copolymerize with monomers such as B, EA, BA, 2-EHA, MMA, VAc, S, AA, MAA, and IA to form a wide variety of flame retardant latexes (Tables 1-10). Monomer selection is based upon the final application of the latex. Criteria include the glass transition temperature (T<sub>g</sub>), physical properties, and chemical resistance desired. The first factor to be taken into account in the choice of a monomer or monomer mixture is the glass transition temperature at which the system undergoes a change from a hard, brittle material to a softer, more flexible one. Since polymers are generally unable to form films from latexes at temperatures below the T<sub>g</sub>, a requirement is that the polymer be above the T<sub>g</sub> at the application and use temperature (unless co-solvents or coalescing aids are used). A further restriction is placed on the T<sub>g</sub> of the polymer by the fact that polymers become very soft at temperatures too far above the T<sub>g</sub>, resulting in poor hardness, blocking, abrasion resistance, dirt collection, and so on. A balance must be obtained, therefore, between the good flexibility, adhesion, coalescence, and so forth, obtained at temperatures farther above the T<sub>g</sub> and the good mechanical resistance properties found closer to the T<sub>g</sub>. This is generally accomplished in coatings intended for ambient use by using polymers having



$T_g$ s in the  $-30^\circ$  to  $30^\circ\text{C}$  range, with preferred  $T_g$ s in the range of  $0^\circ$  to  $30^\circ\text{C}$ .

To meet application (environmental) requirement, it is necessary to run all polymerization reactions near completion with very little ( $<0.5\%$ ) or no residual monomers. Solids % and residual monomers were measured after each polymerization was done. Residual monomers were measured by GC.

As shown in Tables 3 and 4, all polymerization reactions reached 100% conversion at  $50^\circ\text{C}$  in seven and nine hours, respectively, with a total monomer residue in the range of 0.03 to 0.30%. These latexes are acceptable for a variety of coating applications.

As shown in Tables 5 and 6, polymerization reactions reached 93-95% at  $65^\circ\text{C}$  in 2.5-4.5 hr and 94-97% at  $65^\circ\text{C}$  in 3.67-19.75 hr, respectively. All of these latexes containing high monomer residue level ( $>3\%$ ) are not acceptable for coating applications.

Composition and physical properties of DBS and BA latexes with and without IA are listed in Table 7. A definite linear correlation exists between  $T_g$  and DBS content in both latexes. No residual DBS monomer was present in excess of 0.56%. The latexes made without IA showed a lower residual DBS monomer ( $<0.01\%$ ) than those made with IA ( $<0.56\%$ ). This is due to the much lower reactivity of IA when compared to DBS and BA. The solids percent for all latexes was kept in the 45.4 to 49% range. The Brookfield viscosity decreases with increasing DBS concentration in both latexes. A good correlation exists between DBS concentration in both latexes and the log of the viscosity. Results show good UV stability for all compositions in the DBS/BA latexes, but no actual correlation between UV stability and DBS concentration. Although UV studies were not done, the presence of IA in the latexes is not expected to decrease UV stability.

Flame retardant property of DBS/BA/IA terpolymer latexes is listed in Table 8. The data indicate that increasing DBS content results in shorter burn distance. All samples

(down to  $\sim 10$  parts DBS) passed the MVSS-302 test criteria to obtain an SE rating.

Composition and physical properties of DBS-based acrylic latexes are listed in Table 9. Latexes were characterized in terms of nine physical properties. Among them,  $T_g$  is the most important consideration in selecting latex for any applications. The low  $T_g$  composition in the range of  $-30$  to  $+5^\circ\text{C}$  is soft and tacky. It is suitable for use as automotive, drapery, aircraft carpet, adhesive, flexible ducting, aircraft seating fabric, and so on. The high  $T_g$  composition in the range of  $+30^\circ$  to  $+70^\circ\text{C}$  is stiff and tack free. All of these coatings are easily applied with conventional techniques, such as dipping, flow coating, knife coating, and machine roller coating. As with most water-based acrylic coatings, a thickener is generally used to keep the coating in place prior to oven drying. Other end uses for DBS-based latexes include sealants, caulks, non-woven binders, paints, and the like.

By varying the glass transition temperature of the latex composition, coatings with a range of physical properties are obtained. It has been our observation that one can mix different proportions of example 49 with high  $T_g$  ( $+41^\circ\text{C}$ ) and example 47 with low  $T_g$  ( $-15^\circ\text{C}$ ) to obtain various coatings with the desired intermediate  $T_g$  and physical properties without sacrificing flammability characteristics. These blended latex coatings offer advantages over traditional highly filled flame-retardant coatings. These include freedom from settling or separation, reduced environmental concerns, improved physical properties, and clarity.

## CONCLUSIONS

The DBS-based butadiene and acrylic latexes possess desired physical properties for use in coatings, adhesives, and sealants. The bromine content of the latexes has enabled the material to pass six different flammability requirements for the following end uses: textile backcoating, latex-based paint, contact adhesive, latex sealant, nonwoven binder, and carpet backing.

JINJIANG WANG is R&D Project Leader at Great Lakes Chemical Corporation. He received the M.S. Degree from Kent State University in 1966 and the Ph.D. Degree in Polymer Chemistry from the University of Akron in 1971. He joined the Goodyear Tire & Rubber Company in 1966. During his 21-year career with Goodyear, he had worked on synthesis, characterization, and application of latexes, rubber, plastics and resins, chemical modification of natural and synthetic rubber and latex, synthesis of isoprene oligomers, and metathesis of olefins. He joined Great Lakes in 1988 and his current research involves new flame-retardant latexes and polymers, compatibilizers, impact modifiers, and polymer additives. He has published 18 papers and granted 13 U.S. patents with a number of foreign patents. In 1992, Dr. Wang received an Achievement Award for his contribution in the development of flame retardant dibromostyrene-based latex products.



NICK A. FAVSTRITSKY is Manager of Polymers Research at Great Lakes Chemical Corporation. He received the B.S. Degree from the UC Berkeley, M.S. Degree from Yale and Ph.D. Degree from Oregon State. Prior to joining Great Lakes in 1984, he had extensive industrial R & D experience in product and process development as a research scientist and technical manager. He carried out research in catalysis, oxidation, hydrogenation, polyester synthesis, polyester waste recovery, continuous emulsion polymerization, and textile and tire cord fiber development. While at Great Lakes, Dr. Favstritsky and his team have been active in developing new flame retardants, polymer additives, novel coatings, water treatment chemicals, specialty monomers, and polymers. He has published more than 11 papers in the dibromostyrene-based products. He is (co)author of more than 30 U.S. patents and a number of foreign patents.



J.-L. Wang and N.A. Favstritsky

## ACKNOWLEDGMENTS

The authors are obliged to Tamara Annand, Xiaomin Zheng, David M. Hemmerly, and Bill Schomer for the synthesis of the dibromostyrene-based latexes and Rich S. Rose, David E. May, and David J. Honkomp for the coating formulation experiments and flammability testing.

## References

- (1) Mischutin, V. (to White Chemical Corp.), U.S. Patent 3,877,974 (1975).
- (2) Blackford, E.A. (to Sinclair-Koppers Co.), U.S. Patent 3,766,189 (1973).
- (3) Naé, H.N., *Polymer Prep.*, 27 (2), 399 (1986).
- (4) Naé, H.N., Goldman, M., and Vofsi, D., *J. Polymer Sci., Polymer Chem. Ed.*, 24, 1239 (1986).
- (5) Vofsi, D., Naé, H.N., and Daren, S. (to Yeda Research and Development Co.), GB 2,164,051A (1986).
- (6) Mackay, J.E. (to Dow Chemical Co.), CA 907,229 (1972).
- (7) JP 56/120754-A2 [81/120754] (to Mitsui Toatsu Chemicals) (1981).
- (8) De Man, H.C.J. (to Stamicarbon B.V.), EP 0013052-A1 (1980).
- (9) De Man, H.C.J. and Smids, P.T.J.L. (to Stamicarbon B.V.), U.S. Patent 4,412,051 (1983).
- (10) Favstritsky, N.A. and Wang, J.-L. (to Great Lakes Chemical Corp.), U.S. Patent 5,066,752 (1991).
- (11) Favstritsky, N.A., Wang, J.-L., and Rose, R.S. (to Great Lakes Chemical Corp.), U.S. Patent 5,100,986 (1992).
- (12) Wang, J.-L., Favstritsky, N.A., and Rose, R.S. (to Great Lakes Chemical Corp.), U.S. Patent 5,438,096 (1995).
- (13) Rose, R.S., Wang, J.-L., Favstritsky, N.A., May, D.E., and Honkomp, D.J. (to Great Lakes Chemical Corp.), U.S. Patent 5,290,636 (1994).
- (14) Wang, J.-L. and Favstritsky, N.A., *Polymer Prep.*, 34(1), 558 (1993).
- (15) Wang, J.-L. and Favstritsky, N.A., *Polymer Prep.*, 34(1), 560 (1993).
- (16) Wang, J.-L. and Favstritsky, N.A., *Polymer Prep.*, 35(2), 701 (1994).
- (17) Wang, J.-L. and Favstritsky, N.A., *Polymer Prep.*, 35(2), 824 (1994).
- (18) Wang, J.-L., Favstritsky, N.A., and Hemmerly, D.M., *Polymer Prep.*, 36(1), 395 (1995).

"Tell me, and I forget.  
Teach me, and I may remember.  
Involve me, and I learn."

— Benjamin Franklin

JCT – Monthly Technical Journal

Coatings Encyclopedic Dictionary

Infrared Spectroscopy Atlas  
2 Volume Desk Set

Series – A Collection  
of Informative Monographs

Pictorial Standards of  
Coatings Defects Manual

Audio/Visual Presentations

Sci-Quest CD-ROM Tutorial  
for Coatings Industry

Panorama CD-ROM  
of MSDS

Annual International  
Coatings Exposition

International Coatings  
Technology Conference



Federation of Societies  
for Coatings Technology

492 Norristown Road  
Blue Bell, Pennsylvania 19422-2350  
(610) 940-0777 Fax (610) 940-0292

FSCT Membership includes special product discounts and invaluable international networking. "Become involved and learn..."

Circle No. 12 on the Reader Service Card

# Colloidal Aspects of Waterborne Epoxy Paints

V.V. Verkholtantsev—Tambour Ltd.\*

## INTRODUCTION

Liquid epoxy resins or an aqueous dispersion thereof in combination with a water-reducible curing agent (aminoamides, polyamidoamines, or epoxy adducts) represent the state-of-the-art in waterborne epoxy technology.<sup>1,3</sup> This technology emerged a few decades ago in the course of a trend towards environmentally friendly coating compositions. Current commercial waterborne epoxy paints are generally competitive with their conventional solvent-based counterparts in a number of important application fields including the construction industry, building engineering, and corrosion protection.

Whether the performance of waterborne formulations approaches that of their solvent-based counterparts in each sphere of utility is still debatable. In particular, waterborne epoxy paints are considered to suffer a few drawbacks:<sup>4,5</sup> shorter pot life, lower chemical resistance (especially to organic acids), and poorer protective properties (anticorrosive coatings).

Nevertheless, waterborne epoxy paints are still one of the most convenient classes of ambient cured coatings. They provide outstanding decorative, mechanical, and protective properties, combined with inflammability and lower toxicity.<sup>4,7</sup> Relatively poor weather, light, and thermal stability are drawbacks of both water and solvent-based epoxy coatings, which in turn limit their outdoors application. These drawbacks can be at least partly overcome by modification with a suitable film forming resin—acrylic, vinyl, etc.<sup>8</sup>

Two principal technologies are used for producing waterborne epoxy paints: (1) so-called “self-emulsifying technology,” in which one component is liquid epoxy resin, and the other is an aqueous composition based on a water-thinnable epoxy hardener; and (2) “emulsion technology,” in which a pre-made epoxy emulsion of liquid or (more frequently) solid polyfunctional epoxy resin is mixed with an aqueous hardener solution prior to application.<sup>4</sup>

This paper summarizes some results and observations obtained in the course of development of a series of waterborne epoxy paints (Tambour Ltd.). An attempt has been made to give a deeper look into selected colloid aspects of the “liquid epoxy resin plus water-thinnable hardener” approach. This could give a better understanding of the means to control and improve coating properties through proper selection of epoxy resin, hardener, and colloid-affiliated additives (co-solvents, co-emulsifier) and circumstances of film formation. Water-

*The colloidal aspects of formulating two-part ambient cured waterborne epoxy paints which utilize so-called self-emulsifying technology (liquid epoxy resin plus water-thinnable hardener) are discussed. Experimental data are presented for commercial amine-type water-thinnable hardeners on dilution behavior, co-emulsification with liquid epoxy resins, and performance of paint compositions. Approaches are offered for the selection of key components and some additives (in particular, of co-solvents and co-emulsifiers) for epoxy waterborne film forming compositions.*

borne epoxy paints based on epoxy emulsions will not be discussed in this paper.

## EXPERIMENTAL

Commercial water-thinnable hardeners (Table 1) and liquid epoxy resins (Table 2) were used in this work for model experiments and formulation of epoxy emulsions and paint compositions.

Rheological measurements were performed using a rotor-type viscometer (Sheen Rotothinner). Surface tension measurements used a ring tensiometer (Torsion Balance, White Elec. Inst. Co. Ltd.). Particle size distribution was determined using a laser analyzer Galai CIS-1 (diluent: aq. solution of Triton X 100, 0.05%). Molecular weight characteristics were measured with GPC assembled instrument [RI Waters 410, IP SP 8810, column by Polymer Laboratory 2 MIXE (3 μm)].

### Components and Compositions

**PAINT COMPOSITION:** Guide formulations for two-part, ambient cured epoxy waterborne paints, which contain all necessary functional components, are available from suppliers of water-thinnable hardeners (curing agents) or liquid epoxy

\*POB 2238, Akko 24121, Israel.

**Table 1—Liquid Epoxy Resins (Commercial)**

Sample	Viscosity at 25°C m Pa s	EEW <sup>a</sup> g/Eq
R1 .....	870	195
R2 .....	11000	188
R3 .....	570	187
R4 .....	7200	178

(a) Epoxy equivalent weight.

resins.<sup>9-13</sup> Basically, these formulations can be presented in two versions, comprising the following components (% wt):

**Version 1****Part W (Water-Based):**

Water-thinnable epoxy hardeners, 50-80% solids .....	17-18
Co-solvent-1 .....	2-4
Rheology additives .....	0.5-1
Co-emulsifier (lower molecular weight) .....	0.2-0.5
Wetting agent .....	0.6-1.2
Pigments and extenders .....	22-30
Other functional additives .....	0-1
Water .....	34-35

**Part R (Epoxy Resin-Based):**

Liquid epoxy resin .....	14-15
Plasticizer, modifier .....	0-3
Co-solvent-2 .....	0-2

W/R weight ratio ca. 4:1

**Version 2****Part W:**

Water-thinnable epoxy hardener, 50-80% solids .....	18-19
Water .....	25-30
Co-solvent-1 .....	0.5-1
Wetting agent .....	0.5-1
Pigments and extenders .....	22-30
Other functional additives .....	0-1.5

**Part R:**

Liquid epoxy resin .....	14-16
Emulsifier (higher molecular weight) .....	2-3
Active diluent or co-solvent-2 .....	1.5-2
Water .....	5-7

W/R weight ratio ca. 4:1

These versions differ in their approach to the use of additives affecting colloid properties and the emulsification process. In the first version, the emulsifying capacity of the hardener is enhanced, while in the second version, the resin phase is transformed into a more easily emulsifiable state.

**HARDENER:** Water-thinnable hardener is the first component to be selected for epoxy waterborne paints.

The macromolecular composition and molecular structure of amino-type hardeners designed for waterborne epoxy paints is quite specific and resembles amphiphilic emulsifiers. For example, amido-amines, synthesized by condensation of polyamines with fatty acids or their dimers, consist of a hydrophobic (fatty) part and a hydrophilic part. The latter carries amine groups or their salts with a volatile organic acid, which makes the hardener molecule partially ionic, thereby increasing its affinity to water. So, their properties are characteristically amphiphilic.<sup>17</sup>

Therefore, a water-thinnable epoxy hardener, in addition to being a polyfunctional curing agent, performs an emulsifying function. It provides a film forming emulsion during the mixing of the hardener and resin components in the case of "liquid epoxy resin plus aqueous hardener solution" technol-

ogy, or maintains colloid stability of a previously prepared epoxy emulsion in the case of "epoxy emulsion plus aqueous hardener solution" technology.

For example, let us estimate an emulsion particle size that can be obtained with a standard liquid epoxy/water-thinnable hardener combination (Araldite PY 340-2 plus Hardener HZ 340, Ciba Geigy).<sup>9</sup>

From the standpoint of the emulsifier/resin ratio (3-10%) that has been used to obtain direct emulsions of resins,<sup>4,14,15</sup> the recommended resin/hardener ratio 1.67/1 of solids by weight (or 1.52/1 of solids by volume) for the PY 340-2/HZ 340 combination is excessive. Let us assume that the emulsification proceeds until the full quantity of the hardener is adsorbed on the water/resin interface.

The maximum interfacial area  $S$  developed with 1 cm<sup>3</sup> of the hardener can be calculated from the following formula:

$$S = \frac{\rho}{M} \cdot S_0 \cdot A \quad (1)$$

where  $S_0$  is the surface area per one adsorbed hardener molecule,  $\rho$  and  $M$  are the density, and the molecular weight of the hardener,  $A$  is the Avogadro number.

The number average molecular weight of HZ 340 is 212 (GPC evaluation). For the magnitude of  $S_0$ , one may assume 40 Å<sup>2</sup>/molecule (in the range of the surface-active molecules of higher molecular volume),<sup>16</sup> and  $\rho = 1.08$  g/cm<sup>3</sup>. Calculation according to equation (1) gives  $S = 1.22 \times 10^7$  cm<sup>2</sup> per 1 cm<sup>3</sup> of the hardener or, for the resin/hardener ratio,  $1.85 \times 10^7$  cm<sup>2</sup> per 1 cm<sup>3</sup> of epoxy resin.

The specific interfacial area of emulsions ( $S_{sp}$ ) correlates<sup>17</sup> with their particle radius ( $r$ ):

$$S_{sp} = \frac{3}{r} \quad (2)$$

Using the resin-bound value of  $S$ , the calculation according to equation (2) gives  $r = 1.62 \cdot 10^{-7}$  cm (or 1.62 nm, and particle volume 17.8 nm<sup>3</sup>). Correspondingly, each particle contains ca. 42 of epoxy molecules and 49 hardener molecules. The calculated  $r$  value is a few order less than the radius of regular liophobic emulsions, and corresponds to the particle size of microemulsions and solubilizates.<sup>18</sup> This means that the stoichiometric hardener/resin ratio is sufficient for formation of an epoxy emulsion even of high dispersity.

Viscosity and surface tension of the hardeners listed in Table 2 are compared in Figure 1. A somewhat sharper drop in viscosity on dilution with water and somewhat higher values of surface tension are characteristic for epoxy adduct-type hardeners (H3, H4, and H5) in comparison to amido-amine H1. Polyamino-amide H2 exhibits a flatter dilution profile, with substantial viscosity dropping below 10% solids.

**Table 2—Commercial Water-Thinnable Hardeners (Curing Agents)**

Sample	Hardener Type	Viscosity at 25°C m Pa s	Solids, %	AHW <sup>a</sup> g/Eq
H1 .....	Amido-amine	9000	55	175
H2 .....	Polyamidoamine	22000	50	150
H3 .....	Modified amino-adduct	25000	70	200
H4 .....	Polyamine adduct	2300	80	200
H5 .....	Polyamine adduct	20000	80	115

(a) Active equivalent weight hydrogen.

All tested hardeners only reach a state of cloudy solution when diluted with water in the concentration range of 6-25% solids (so-called cloud-point). As for any solutions of partially soluble polymers and oligomers, the cloud-point reflects their transformation from the state of a true solution into a state of microemulsion.<sup>19</sup> Addition of 2-5% water-miscible co-solvents (ethyl alcohol, methoxy propyl acetate, propylene glycol ethers, etc.) causes substantial improvement in dilution profile of these hardeners, decreasing viscosity and shifting the cloud-point concentrations to more dilute solutions.

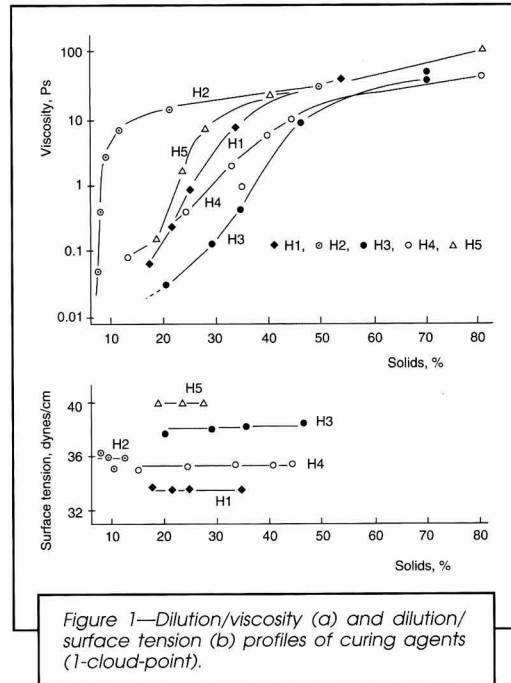
Continuing dilution of hardener solutions below their cloud-points did not result in an inflection in the surface tension versus concentration dependence; such an inflection would be attributed to the critical concentration of micelle formation (CCMF). For example, a solution of hardener H2, upon dilution below the cloud-point concentration range of 7-10% solids, yields a dispersion with particle size of 210-230 nm.

Therefore, these hardeners should be referred to as "noncolloid" (i.e. nonmicellar) surfactants, as is characteristic for water-soluble polymers and oligomers having a nonregular molecular structure. Correspondingly, they can be effective in emulsification processes at elevated concentrations compared to typical micellar emulsifiers (soaps).<sup>20</sup>

**LIQUID EPOXY RESIN:** The major criterion for selection of epoxy resins for waterborne paints is their performance in coatings. Their emulsifiability is another important factor. Special grades of liquid epoxy resins, hydrophilized and having reduced viscosity, have been offered for commercial use [for example, see references (9) and (10)]. General purpose liquid epoxy resins can also be used if their viscosity and hydrophobicity are reduced by addition of a co-solvent, active diluent, or emulsifier.

**VOLATILE ADDITIVES (CO-SOLVENTS):** Waterborne epoxy paint formulations may contain one or more volatile organic liquids to perform the following functions:

- Improve compatibility between the hardener and water,



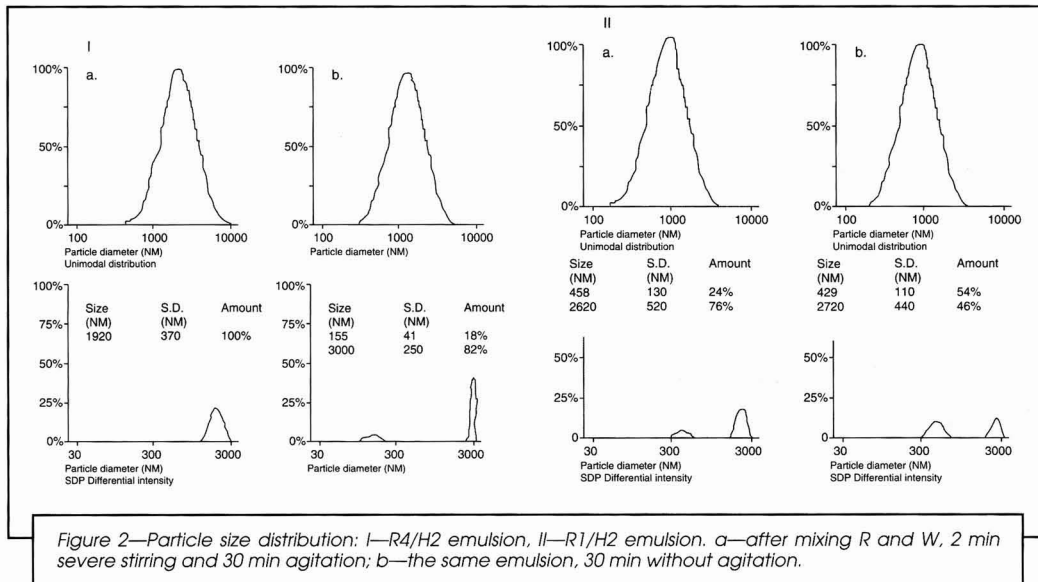
- providing a better dilution profile and a later cloud-point;
- Promote the emulsifying process (as a component of the water phase);
- Promote the emulsifying process (as a diluent of the resin phase);
- Extend the colloid stability of the paint (influencing its pot life);

Table 3—Functions of Volatile Additives (Co-Solvents)

Function	Compatibility with Water	Volatility	Example <sup>a</sup>		
			δ	SW	ER
Improvement in dilutability for a hardener .....	Medium	Medium		Propylene glycol	
			9.2	Methyl Ether Acetate	34
Emulsification promoter (in water phase) .....	High	Medium	10.4	Propylene glycol methyl ether	68
				Unlimited	
Emulsification promoter (in resin phase) .....	Medium	Medium	9.4	Methoxy Propyl Acetate	—
				20	
Colloid stabilizer .....	High	Medium	9.9	Butyl glycol	6
				Unlimited	
Promoter for drying .....	High	Low	14.9	Propylene glycol	<1
				Unlimited	
Water-releaser .....	High	High	14.5	Methyl alcohol	610
				Unlimited	
Coalescing agent .....	Low	Low	9.1	Butyl carbitol acetate	<1
				6.5	

(a) δ = solubility parameter, (cal/cm<sup>3</sup>)<sup>0.5</sup>; SW = solubility in water, %; and ER = evaporation rate, Bu-Ac = 100.





- Keep the structure of the drying film “open,” allowing complete release of water and promoting a coherent film;
- Ease the removal of water from a drying film; and
- Act as a coalescing agent.

When selected to perform each of these functions, the co-solvent needs to be considered according to its volatility and polarity, which indicates its affinity to key components (water, hardener, epoxy resin) and its distribution between the phases on emulsification and film forming processes. Since no commercially available solvents are capable of performing all functions simultaneously, the use of more than one co-solvent (2-5% volume total) may be recommended. Table 3 provides examples of co-solvents and their volatility and miscibility with water.

When a stable emulsion is produced, any surface active component in the composition will be distributed between the interface and solution, and any nonsurface active component, for example, a co-solvent, will be distributed between the water and resin phases.

**Table 4—Particle Size of Emulsions, Obtained in Different Regimes**

Regime	2 min of Intense Stirring	Mean Particle Size, nm		
		After 0.5 hr	After 1 hr	After 2 hr
		<b>R1/H1</b>	<b>Emulsion</b>	
Stirring	1010	849	1000	984
Resting		742	1210	1170
		<b>R1/H2</b>	<b>Emulsion</b>	
Stirring	828	296	831	2440
Resting		431	639	2670

As the hardener, which stabilizes the emulsion, becomes more involved in the reactions with epoxy resin, a shift in the distribution of a co-solvent toward the water phase will be stimulated. This improves the solubility of the hardener in the aqueous phase and maintains its effectiveness as a surfactant, while resisting early aggregation and loss of application characteristics.

**CO-EMULSIFIERS:** Two types of emulsifiers are offered to promote emulsification of liquid epoxy resins: lower molecular weight emulsifiers (having a higher diffusion mobility and surface activity from aqueous phase) and higher molecular weight surfactants. Both are nonionic and, having HLB > 12, enable direct emulsions formation.

Correspondingly, emulsifiers of the first group are to be introduced into the aqueous phase, serving simultaneously as wetting agents and temporary emulsifiers during the emulsification process (Surfynol 104 [Air Products] as an example). The higher molecular weight emulsifiers (Atlas G 1350 [ICI], etc.) are more suitable for the resin phase.

**OTHER COLLOID ADDITIVES:** Functions of a few other additives are conventional, particularly:

—*Defoamer and antifoam agents.* Water-thinnable hardeners are different in their foam-build properties (which tend to be more expressed in a diluted state), and defoamers tend to show substantial selectivity.

—*Pigment wetting agent.* As a regular process, pigments and extenders are dispersed in a moderately diluted hardener solution. Except in some special cases, no additional dispersant is needed.

—*Substrate wetting agent.* A few substrate wetting agents (Borchigol VL 73 S is an example) are recommended to reduce surface tension of aqueous hardener solutions. Sometimes, especially for amino-adducts without an additional surfactant, the surface tension of the hardener solution falls in

the range of 36-40 dynes/cm, i.e., 2-6 units higher than is needed for architectural and industrial substrates.

—*Rheology additives* should also be viewed as colloid modifiers, since they act to modify inter-particle interaction. Just as for regular water-based paints, molecular thickeners and inter-particle bridgers (associative thickeners, particularly) and disperse structure-formers (e.g. selected brands of bentones) can be utilized.

## EMULSIFICATION PROCESS

The standard procedure to prepare two-part waterborne paints for application is hand mixing or mechanical stirring (severe stirring is not obligatory) and dilution with water if necessary. A rest period of 20-30 min (induction period) is allowed between mixing and use.

The mixing of the two parts of a waterborne epoxy paint prior to application initiates two spontaneous processes: (1) a mass transfer across the water/resin interface (thus providing conditions for self-emulsification); and (2) a chemical reaction between epoxy resin and a hardener. These processes proceed simultaneously and, to a certain extent, are mutually dependent. Both affect all the technological properties of the paint: flow behavior, drying time, stability of the coating properties during the pot life, the pot life limit, etc.

**EMULSION TYPE:** Waterborne epoxy paint technology is based on direct emulsions (epoxy-in-water); otherwise the binder is not water-dilutable.

The hydrophilic-lipophilic balance number (HLB), the critical packing parameter, and some other criteria<sup>21</sup> stand for the emulsion type. An illustrative criterion to predict the type of emulsion, which utilizes a classical colloid approach,<sup>22</sup> was suggested in terms of viscosity ( $\eta$ ), surface activity of corresponding components in both phases ( $\Delta$ ), and their concentrations ( $c$ ) on condition of equality of volumes of the co-emulsifying phases ( $V_w = V_r$ ):

$$D = \frac{\eta_r}{\eta_w} \cdot \frac{\Delta_w}{\Delta_r} \cdot \frac{c_w}{c_r} \quad (3)$$

where  $r$  indicates the resin and  $w$  the aqueous phases. Condition  $D > 1$  refers to oil-in-water (resin-in-water,  $r/w$ ) emulsions, and  $D < 1$  to inverse emulsions ( $w/r$ ).

Taking into account the well-known influence of phase volume ratio on direction of emulsification process,<sup>23</sup> equation (3) can be rewritten as:

$$D = \frac{\eta_r}{\eta_w} \cdot \frac{\Delta_w}{\Delta_r} \cdot \frac{c_w}{c_r} \left( \frac{V_w}{V_r} \right)^n \quad (4)$$

where  $n > 1$ .

So, adding a water phase gradually to a resin phase, we are in a condition of  $V_w < V_r$ . Having a co-emulsifier in the resin phase, we provide  $\Delta_w$ ,  $\Delta_r$ , and  $D_{r/w} < 1$  and, correspondingly, observe formation of an inverse emulsion in the first step of the emulsification process. In the next step, when  $V_w$  becomes larger than  $V_r$ , the emulsion transforms into a direct emulsion in excess of hardener solution through the phase inversion point (PIP-technology). This technology demands that the viscosity of epoxy resin be as low as possible.

According to a more widely distributed technology, a resin phase is added to a water phase, providing  $V_w > V_r$  and higher

surface activity from the water phase. Therefore, this technology from the beginning stands for the emulsion "resin-in-water" (direct emulsion technology).

It is to be noted that any waterborne epoxy emulsion or paint is in a nonequilibrium state from the moment of its formation up to the cured state. So, any predictive calculations based on equilibrium characteristics (solubility parameter, surface tension, surface activity, etc.) should be viewed as approximate.

Nevertheless, the design of commercial water-thinnable hardeners finally provides the formation of resin-in-water emulsion at any order of mixing, when the stoichiometric of somewhat higher resin/hardener ratio is used along with a moderate dilution of a hardener with water.

Wegmann<sup>4</sup> considers inverse emulsification more effective. In our experience, a well-formulated composition has to allow both consequences for mixing parts  $W$  and  $R$ , giving finally in both cases a resin-in-water emulsion with close particle size, application characteristics, and coating performances.

**FORCED AND SELF EMULSIFICATION:** Description of the technology as "self-emulsifying" is quite conventional. This term is based on the experience that the mode and intensity of co-emulsification  $W$  and  $R$  parts have little influence on the flow behavior, other technological characteristics, and coating performance, if the composition is well-balanced. Practically, it is enough if these parts are properly mixed during a few minutes and allowed a stand-by period of 20-30 min before application.

Figure 2 and Table 4 provide a comparison of particle sizes for emulsions obtained with or without agitation. Conditions for this experiment, which illustrates the contribution of self-emulsification, are described in the following:

Parts  $W$  and  $R$  were mixed (room conditions, stoichiometric resin/hardener ratio) and stirred rapidly for two minutes. Then the emulsion was separated into two portions. One was stirred continuously (half as intensively, 500 rpm), and the other was kept resting in a separate container.

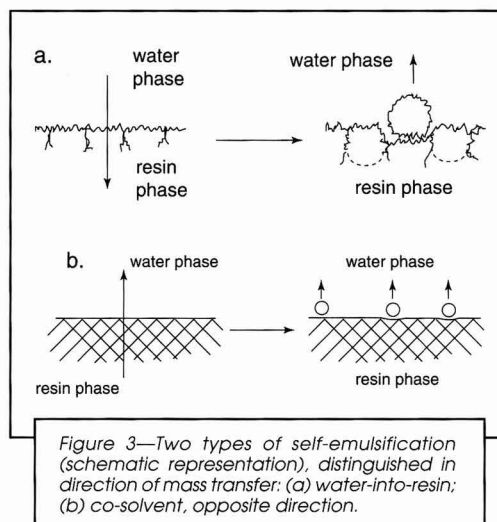


Figure 3—Two types of self-emulsification (schematic representation), distinguished in direction of mass transfer: (a) water-into-resin; (b) co-solvent, opposite direction.

**Table 5—The Formation of Cured Films on Epoxy Resin/Hardener Interfaces (Hardener H2, 10% Solids, 48 hr for Interfacial Contact)**

Resin	Weight of Cured Films g/m <sup>2</sup>	Film Thickness μm
R1 .....	104	347
R2 .....	17	57
R3 .....	62	207
R4 .....	44	147

Immediately after intensive agitation, the emulsion obtained from R4/H2 system shows unimodal particle size distribution. In 30 min of rest it becomes bimodal due to appearance of a finer fraction of 155 nm (Figure 2a). Emulsion R1/H2 shows bimodal particle size distribution from the very beginning (Figure 2b). In 30 min without agitation this emulsion forms a fraction of highly dispersed particles (460 nm), whereas its rough fraction decreases.

As seen from the data in Table 4, both agitated and non-agitated emulsions are characterized by rather similar particle size distributions 30 min after mixing. In time, both emulsions of R1/H2 exhibit the same character of change in particle size, since self-emulsifying process soon becomes overlapped with coagulation. Both emulsions of R1/H2 remained practically unchanged over the two hour observation period, thus exhibiting greater stability in comparison to emulsions R1/H2.

These data show that emulsification of liquid epoxy resins in water-thinnable hardeners proceeds as a conjunction and overlapping in time of two processes: forced emulsification (controlled by supply with an external energy) and self-emulsification (controlled by spontaneous internal processes).

Self-emulsification phenomena are caused by mass transfer across the resin/water interface. Two possible mechanisms are shown schematically in Figure 3: depending on circumstances, mass transfer across an interface can produce a new disperse phase when proceeding in either direction.

Mechanism A is more characteristic for epoxy emulsions, since it demands conditions that can be satisfied easily in technical compositions: high enough concentration of an emulsifier (the function of which is performed by the hardener) and low viscosity of the resin. According to this mechanism,<sup>24</sup> self-emulsification of liquid epoxy resin proceeds through the following steps: (1) penetration of aqueous hardener solution into the resin phase (with the help of fluctuations of its density and viscosity, which co-solvents and co-emulsifiers introduced into the resin phase intensify); (2) formation of pre-shaped particles (especially with the help of microphase separation); and (3) detachment of the pre-shaped particles under the action of osmotic-type forces.

In particular, higher molecular weight emulsifiers incorporated into the resin phase may cause microseparation and formation of a hydrophilic network of nuclei for self-emulsification<sup>25</sup> due to their incomplete (nonmolecular) compatibility with liquid epoxy resins. Such micro separation is stimulated when even a small amount of water is added to the resin phase.

Mechanism B demands that a substantial amount of water-miscible co-solvent be introduced into the oil phase (which has to be nonviscous), and that a stabilizer be present in the water phase. The latter function can be performed by the hardener molecules. Compared to the previous mechanism,

this mechanism has been claimed to generate finer ultramicroemulsions.<sup>24</sup> In our experiments, however, no direct evidence was obtained that this mechanism generates a new and more disperse phase in the presence of a reasonable (5-10%) amount of water-miscible co-solvents in the liquid epoxy resin.

The agitation applied during the first step of emulsification probably (1) advances the resin/hardener interface, forming a rough emulsion, and (2) promotes detachment of self-emulsified fine particles from the resin surface, which is restricted due to relatively high viscosity of the aqueous phase. Such agitation is needed immediately after mixing, but then the self-emulsification processes mainly contribute to disperseness of the emulsion.

According to Reh binder,<sup>26</sup> self-emulsification may only occur when the interfacial tension is less than 0.1 dynes/cm (25°C), which is well below the accuracy of a regular instrumental interfacial tension measurement. But this consideration was developed for homophase liquids. Any subphase or phase nonuniformity of the resin phase should be viewed as a factor promoting emulsification processes and self-emulsification particularly.<sup>25</sup>

Simple experiments with undisturbed resin/hardener interface can illustrate the intensity of self-emulsifying and the other affiliated processes on the interface.

When a layer of hardener solution is spread over a liquid epoxy resin surface (in a regular Petri-dish, with layers of aqueous and resin phases of 3-7 mm thick), within 6-20 hr a crosslinked polymer film will be formed that is durable enough to be collected, washed out with appropriate solvent, dried, and weighed. Then one can calculate the amount of cured resin per unit area. Table 4 exhibits some typical results.

When this experiment is carried out with a nonviscous liquid epoxy resin, which is suitable for self-emulsifying technology, or with a more viscous species, modified with a solvent, active diluent, or an emulsifier, a milky-white interfacial layer appears in one to two hours. This layer remains redispersible in a hardener solution for a few hours as an emulsion of partially cured epoxy resin. Then, in another four to six hours, an interfacial reaction terminates with coagulation of the previously formed emulsion and with formation of a coherent cured film, insoluble in epoxy solvents.

A few liquid epoxy resins are compared in Table 5 in respect to their ability to form a cured film on the resin/hardener interface, showing a qualitative correlation between the resin viscosity and quantity of the cured polymer film.

Assuming for these polymer films that density is 1.0, solids content and conversion is 50%, their weight per unit area was recalculated into film thickness. The data, which is represented in Table 5, ranges between 60 and 350 microns. In order to produce, for instance, a film of 200 μm thickness by the Fickian diffusion<sup>27</sup> of one oligomer (hardener) into the other (epoxy resin) with a diffusion coefficient<sup>28</sup>  $D = 10^{-12}$  cm<sup>2</sup>/s in place of self-emulsification mechanism, the system needs, according to approximate calculation, ca. 230 days.

**STABILIZATION:** In order to produce a stable emulsion, the process of emulsification has to consist of two steps, partially overlapped with time: emulsification and stabilization. When the self-emulsifying step is over, the system needs either the hardener, possessing sufficient stabilizing functions, or an additional higher molecular weight surface active component as

a stabilizer in order to maintain its dispersity and associated properties.

Commercial water-thinnable hardeners normally manifest a sufficient stabilizing function during the emulsification process and later on. But this function becomes gradually depleted during the pot life in the course of hardener consumption in the curing process. Higher molecular weight surfactant or polymer dispersant can promote colloid stabilization for a longer period, thereby extending the pot life.

**MACROCONDITIONS FOR EMULSIFICATION:** According to the previous analyses and practical experience,<sup>9-14</sup> the conditions for effective emulsification by mixing and stirring parts W (aqueous pigmented phase, hardener-based) and R (liquid resin-based) include:

- volume W/R ratio well > 1;
- viscosity  $\eta_r/\eta_w$  ratio > 1;
- surface tension (W part) < 38 dynes/cm (substrate-tolerant application demands < 34 dynes/cm); and
- solids content—above cloud-point: amido-amines > 6-8%, amine adducts > 10-12%.

## FILM FORMING PROCESS AND POTLIFE

Film formation from waterborne epoxy paints was studied extensively.<sup>29</sup> It was pointed out that when the chemical reaction starts between the epoxy resin and the hardener, the *minimum film forming temperature* (MFFT) of the emulsion rises gradually, therefore putting a time limit on the ability of full coalescence of resin particles. So, in the case of waterborne epoxy paints, it is more appropriate to determine its pot life according to the coating performance, rather than rheology (the latter approach is accepted for epoxy solvent-based paints). Here it is worthwhile to discuss a few features of film forming processes associated with colloid behavior of the binder.

From experiments with synthetic latices and film forming emulsions it was shown<sup>30</sup> that the MFFT depends on  $T_g$  of the latex polymer as well as on the colloid stability of the polymer dispersion. So, each measure that helps to elevate or maintain colloid stability of epoxy/hardener emulsion can extend its pot life.

The phase inversion point (PIP) is desired to be as late as possible. In case of early phase inversion, microdrops of water will be locked in the curing film, causing porosity. From the colloid standpoint, this may be avoided by the use of co-solvents and a co-emulsifier that lower the chemical reaction rate.

Four types of co-solvents (see Table 3) can improve the drying process: a water-releaser (highly volatile water-miscible liquid), and those which are retained in a drying layer: coalescents, capable to maintain the ability for coalescence in spite of the development of curing reactions, promoter of drying and colloid stabilizer, which maintains solubility of the hardener in water.

Figures 4 and 5 exhibit a typical situation for the time dependence of paint viscosity, surface tension, dry time, and coating gloss (experimental paints I and II).

Paint I, whose behavior is shown in Figure 5, becomes a gel in five hours after mixing W and R parts. Surface tension remains unchanged and as low as 32.5 dynes/cm during the

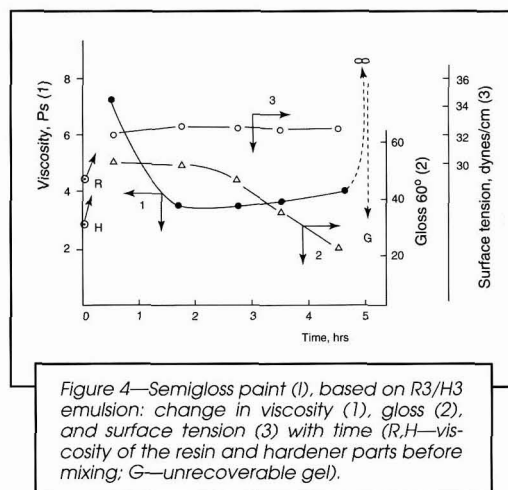


Figure 4—Semigloss paint (I), based on R3/H3 emulsion: change in viscosity (1), gloss (2), and surface tension (3) with time (R,H—viscosity of the resin and hardener parts before mixing; G—unrecoverable gel).

whole period of experiments (4.5 hr). The later the composition is applied to a substrate, the shorter its drying time. Coating gloss remains almost unchanged during two hours (paint I, Figure 5) or three hours (paint II, Figure 6) and then drops rather fast.

For high gloss epoxy waterborne paints, the pot life limit is relatively short and sharp. According to the data presented in Figure 5, the following approximate formula is applicable to these paints:

$$t_a + t_{td} = \text{Const} \quad (5)$$

where  $t_a$  is the period between the W + R mix and application and  $t_{td}$  is the touch-dry time.

So, the total time, including the stand-by period and the drying time, is a characteristic for each glossy paint. Hence, the faster curing the paint one wants to prepare, the shorter the pot life will be. For instance, when the demand for touch-

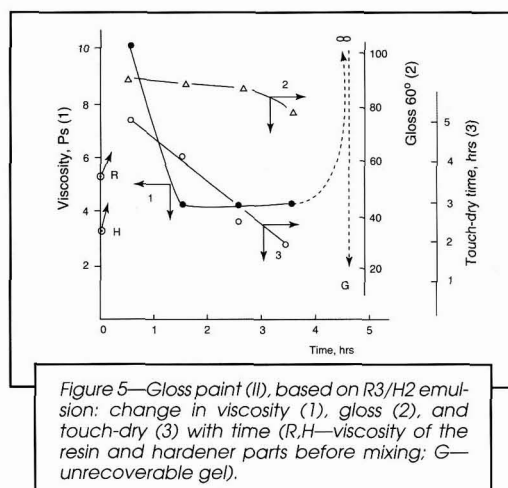


Figure 5—Gloss paint (II), based on R3/H2 emulsion: change in viscosity (1), gloss (2), and touch-dry (3) with time (R,H—viscosity of the resin and hardener parts before mixing; G—unrecoverable gel).

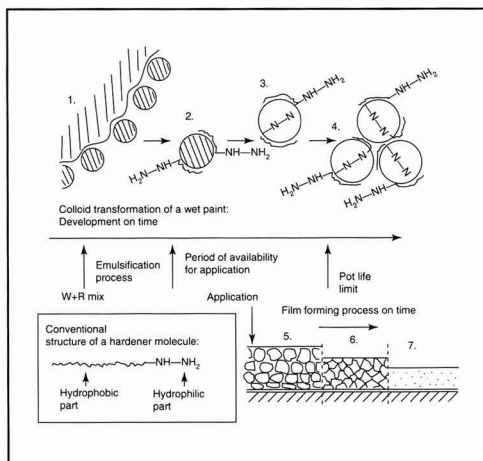


Figure 6—Colloid processes during pot life and film formation (schematic representation):

(1) Epoxy emulsion, fine particle (secondary particle, formed due to the self-emulsification process) and big particles (primary particle, formed by the forced emulsification); (2) fine particle, stabilized with adsorbed molecules of a hardener; (3) fine particle, stabilized with hardener molecules, partially consumed in curing reaction; (4) aggregate of the secondary particles; (5) applied to a substrate emulsion or emulsion paint; (6) phase inversion point; and (7) coherent coating.

dry time is no longer than five hours, paint II can be practically used for 1.5-2 hr after mixing W and R parts. Well balanced formulation of a gloss decorative paint allows pot life >2 hr (without losing gloss with time) and touch-dry time two to four hours.

As a continuation of Figure 3, a scheme of colloid transformations during the pot life and film forming processes is represented in Figure 6. This scheme outlines considerations regarding various components of waterborne epoxy paints.

## PAINTS

Based on liquid epoxy resin/water-thinnable curing agent combinations, epoxy waterborne paints expand their application in building engineering, for maintenance, in anticorrosive coatings and more. Aminoamide and polyamidoamine hardeners are more suitable for architectural coatings, whereas adduct-type hardeners should be preferred for anticorrosive and chemical resistant coatings.<sup>31</sup> An incomplete list of their technological applications is as follows:

**BUILDING PAINTS:** Waterborne epoxy paints, due to their excellent adhesion to building substrates, including damp concrete, easy washability, chemical, solvent, and wear resistance of coatings, are exploited successfully and increasingly:

—for sealing, healing, and priming concrete and similar building substrates;

—as intercoats between old paints and new topcoats, especially in case the latter contains some active solvents (thereby preventing lifting); and

—as topcoats for indoor and limited for outdoor application, mainly for laundries, kitchens, hospitals, and other special compartments, that demand easy decontamination and chemical resistance of the coatings.

**FLOORING PAINTS:** Compositions with elevated solid content (>70% in W + R mixture), and thereby having relatively low volume shrinkage, are useful for industrial flooring, but mainly for toppings.

**PLASTIC PAINTS:** Having very low VOC, waterborne epoxy paints do not damage polymer substrates, even thermoplastics. At the same time, they have a high potential for adhesion. Thereby, the paints with surface tension <32 dynes/cm are convenient for application directly to plastics.

**ANTICORROSIVE PRIMERS:** With suitable anticorrosive pigments, which here are key components and as important as resin and hardener, properly formulated waterborne epoxy metal primers provide corrosion resistance comparable to solvent-based counterparts.

**MAINTENANCE PAINTS:** This type resembles the building topcoat, but contains more volatile co-solvents, adhesion promoter, polymer modifier, and sometimes an anticorrosive pigment.

## CONCLUSION

Selected colloid properties of five commercial water-thinnable epoxy hardeners (as representing various types of amine-type curing agents, particularly amido-amine, polyamidoamine, and polyamine adduct) were studied to provide a better foundation for their use in epoxy waterborne paints.

Their viscosity/dilution (with water) profiles are substantially different, as are their cloud-point concentrations (in a range of 6-25% solids). Surface tension ranged between 33 and 40 dynes/cm for different hardeners, remaining practically unchanged on moderate dilution below the cloud-point. Above the cloud-point their aqueous solutions can provide effective emulsification of liquid epoxy resins when the stoichiometrical epoxy/hardener ratio has been used (which is near the technically recommended ratio).

By measurement of particle size in emulsions obtained in different regimes (with and without continuous stirring), two characteristic sizes of disperse particles were found in liquid epoxy/waterborne hardener emulsions: "secondary" particles (200-400 nm), produced due to a self-emulsification process from the rough primary particles, produced by the forced emulsification, and aggregates of the secondary particles (ca. 3000 nm).

A simple method was used to evaluate the result of interfacial processes: formation of a cured epoxy film on an undisturbed interface. A thicker interfacial layer of emulsion is a reflectance of effective self emulsification, and the thickness of an insoluble film is a proof of well-balanced emulsifiability.

Functions of co-solvents and co-emulsifiers are discussed to promote their well-grounded selection for paint compositions.



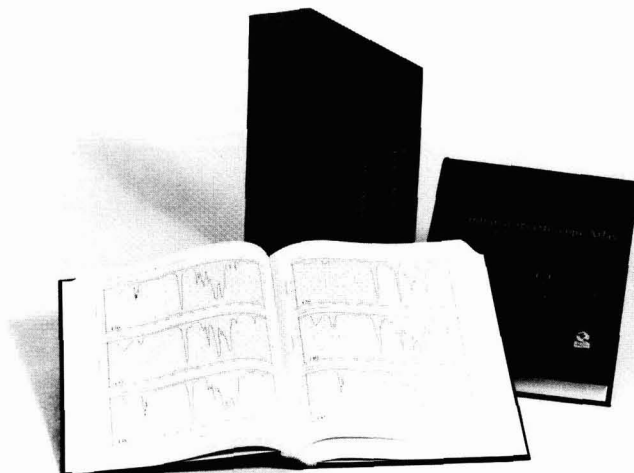
A well-known effect of performance deterioration for the gloss waterborne epoxy paints after a few hours of standby before application (particularly, reduction of their gloss) that normally occurs well before the paint gels, should be explained as a result of reduction in colloid stability, early aggregation, and restricted particle coalescence.

A properly selected liquid epoxy resin, water-thinnable hardener, amount of additives (particularly co-solvents and co-emulsifiers), and a properly timed application are needed to provide a reliable emulsification of liquid epoxy resins, an acceptable pot life, and a stable performance for epoxy waterborne coatings.

### References

- (1) Richardson, F.B., "Water-Borne Epoxy Coatings: Past, Present and Future," *Mod. Paint Coat.*, 78, No. 4, 84 (1988).
- (2) Kemp, N., "Water-Reducible Epoxy System for Problematic Environments," *Amer. Paint Coat. J.*, 77, No. 6, 76 (1992).
- (3) Spychaj, T. and Pyltowska, E., "Water-Thinnable Epoxy Coating Compositions," *Inter. Polymer Sci. Tech.*, Vol. 20, No. 9, 95 (1993).
- (4) Wegmann, A., "Novel Epoxy Resin Emulsion," *JOURNAL OF COATINGS TECHNOLOGY*, 65, No. 827, 27 (1993).
- (5) Gniecko, J. and Helfand, D., "Epoxy Advances Upgrade Performance, Handling Properties," *Mod. Paint Coat.*, 84, No. 3, 26 (1994).
- (6) Chou, J.L., "Novel Corrosion Resistance Waterborne Epoxy Coatings," 4th Asia-Pacific Conference (Hong Kong), Paper 17.7, 1994.
- (7) Darwen, S., "Development in High Performance Waterborne Epoxy Coatings," 184, No. 4344, 65 (1994).
- (8) Verkholtantsev, V., "Epoxy Composite (PPC) Epoxy Coatings: Water-Borne Versus Solvent-Based," 4th Asia-Pacific Conference (Hong Kong), paper 16, 1994.
- (9) Ciba Geigy AG, "Water-Emulsifiable Cold-Curing Epoxy Coatings," Publ. No. 24852/c.
- (10) Hoechst, Technical Information: "Waterbased 2-Pack-Systems," GES 2907.c, ed. 8/1993.
- (11) AKZO, "Epilink" DP 660. Technical Bulletin," 01.08.1992.
- (12) Dow Plastics, "Water-Borne Epoxy System for High Performance Coatings," (technical leaflet), No. CH 223-127-E-893.
- (13) Reichhold Chemicals, "Formulating Waterborne Epoxy Coatings Using 'Epotuf' Epoxy Resins and Hardeners," September 1993.
- (14) Mangusheva, T.A., "Emulsions of Liquid Epoxy Resins," Ph.D. Thesis, Coating Research Institute, Moscow, 1984.
- (15) Kojima, S. and Watanabe, Y., "Development of High Performance, Waterborne Coatings. Part I. Emulsification of Epoxy Resin," *Polymer Eng. Sci.*, 33, No. 5, 253 (1993).
- (16) Erkova, L.N. and Checkik, O.S., *Latices* (in Russian), Khimiya, Leningrad, p. 130, 1983.
- (17) Sherman, P. (Ed.), *Emulsion Science*, Academic, New York, 1968.
- (18) Robb, I.D. (Ed.), *Microemulsions*, Plenum, New York, 1982.
- (19) Shinoda, K. and Friberg, S., *Emulsions and Solubilization*, Wiley Interscience, p. 4, 1986.
- (20) Lipatov, Y., *Colloid Chemistry of Polymers*, (in Russian), Naukova Dumka, Kiev, p. 73, 1984.
- (21) Davis, H.T., "Factors Determining Emulsion Type: Hydrophile-Lipophile Balance and Beyond," *Colloids Surfaces AS: Physicochem. Eng. Aspects*, v. 91, 9 (1994).
- (22) Verkholtantsev, V. and Shvaikovskaia, I., *Emulsions of Alkyd Oligomers*, (in Russian), Kolloidni Zhurnal, 49, 1178, 1987.
- (23) Abramson, A.A. (Ed.), *Surfactants: Their Properties and Applications*, (in Russian), Khimiya, Leningrad, p. 178, 1981.
- (24) *Ibid.*, p. 193.
- (25) Pirogov, G.A. et al., "Emulsions of Modified Polyesters, Having Controlled HLB and Polydispersity," (in Russian), Coll. Book *Chemistry and Technology of Film Formers and Coatings*, Moscow, p. 20., 1985.
- (26) Rehbinder, P.A., "Present Problems of Colloid Chemistry," *Colloid Journal of the USSR*, 20, No. 5, 527 (1958).
- (27) Moore, W.J., *Physical Chemistry*, Longman Sci. Techn., p. 163, 1990.
- (28) Tchalikh, A.E., *Diffusion in Polymers* (in Russian), Khimiya, Moscow.
- (29) Godau, C. and Stengel-Rutkowski, B., "Film Formation in Waterborne 2-Pack Epoxy Systems," (in German), *Farbe und Lack*, #4, 340 (1993).
- (30) Verkholtantsev, V., "Processes Accompanying Film Formation in Latices," (in Russian), Dr. Sci. Dissertation, Institute for Chemistry and Technology, Leningrad, 1969.
- (31) Hare, C.H., "Amine Curing Agents for Epoxies," *J. Prot. Coat. Linings*, No. 7, 77 (1994).

# An Infrared Spectroscopy Atlas for the Coatings Industry



## Two Volumes—1024 Pages, Over 2500 Spectra

This revised and expanded two-volume, fourth edition contains a compilation of more than 2,500 spectra, fully indexed, of materials commonly used in the coatings industry. All spectra have been generated on high resolution Fourier Transform spectrophotometers with recorded spectral ranges covering the region between 4,000 and 400  $\text{cm}^{-1}$ .

Authored by experts in the field of coatings infrared analysis, the 1024-page text consists of eight fundamental and comprehensive chapters, including theory, instrumentation, IR instrumentation accessories, sample preparation, and qualitative and quantitative analysis.

A fully indexed literature survey represents the most complete bibliography published in

this type of text. It is organized into sections such as theory, general information, reviews, instrumentation, experimental techniques, compilation of spectra, quantitative analysis, coatings, polymers applications and pigment applications. Each section is in chronological order.

This handsome set is packaged in a sturdy slip case for easy shelf storage.

Also, a computerized database of all the spectra featured in the Atlas has been developed by the Nicolet Instrument Corp., in cooperation with the Federation. The Nicolet Coatings Technology Database is available at additional cost from Nicolet to assist in computer searching during quantitative infrared analysis.

**\$150—Federation Members/\$200—Non-Members**

Please make all checks payable in U.S. Funds on a U.S. Bank

---

## Federation of Societies for Coatings Technology

492 Norristown Rd., Blue Bell, PA 19422-2350  
(610) 940-0777 • Fax: (610) 940-0292

# Phenolic Resins: Revisiting an Established Technology

Ken Bourlier—Georgia-Pacific Resins, Inc.\*

Phenolic resins have enjoyed a valuable niche in the coatings industry for many decades. Their excellent performance characteristics coupled with outstanding versatility have made phenolics a popular choice for formulators looking to provide value in various coatings applications. Although the coatings industry is undergoing significant changes due to environmental and regulatory pressures, phenolics are playing an important role in this evolutionary process. The true value of phenolic polymers is in their ability to enhance the performance properties of various base polymers with relatively low addition levels. As the base polymer systems have evolved over the years, phenolics too have been able to make the transition to these new systems.

Despite the long history of phenolic resins, there appears to be a need for a technical review of this venerable technology. Understanding phenolic resins has long been considered an art rather than a science. Much of the early pioneering work was done without the benefit of today's sophisticated analytical techniques. The variety of starting materials along with the permutations of possible reaction products makes it difficult to predict how specific products will perform. Understanding the idiosyncrasies of phenolic resins, particularly the benefits and interactions with other polymers, is an essential element of engineering the proper coatings formulation. The intention of this presentation is to revisit the basic chemistry of phenolic polymers and hopefully give new insights regarding their utility in today's coatings formulations.

## Basic Chemistry

There are two basic types of coatings resins produced from the reaction of phenol and formaldehyde. Resoles are produced under high pH conditions and are characterized by their ability to polymerize at elevated temperatures. These thermosetting polymers may either crosslink with themselves or with

other polymers that have secondary hydroxyls. Crosslinking takes place via a condensation reaction with terminal methylol groups on the phenolic polymer. The reaction of a phenolic resole with a bisphenol-A epoxy resin is shown in Figure 1.

Resoles are used mainly for baking coatings that are applied to metal substrates subject to severe operating environments. Novolaks are produced under low pH conditions and form solid thermoplastic type materials. They are commonly used as modifiers for oil or alkyd based varnishes. Coatings applications generally use novolaks based on substituted phenols which impart better performance characteristics. Figure 2 shows typical representations of a phenol-based resole and a butylphenol based novolak resin.

The type of phenol chosen significantly affects the performance characteristics of the resulting polymer. Phenolic manufacturers vary the type and amount of phenols to produce final products that perform in a wide variety of end-use applications. When choosing a phenolic resin for a particular purpose, it is important to understand the contrasting performance parameters inherent in the different types of phenols. Figure 3 is a representation of some of the common phenol types.

Phenol is a tri-functional monomer; it reacts with formaldehyde in the one para and two ortho positions. Resoles produced from phenol are known for their high crosslink density when properly cured. The high degree of crosslinking imparts the excellent chemical resistance, hardness, and

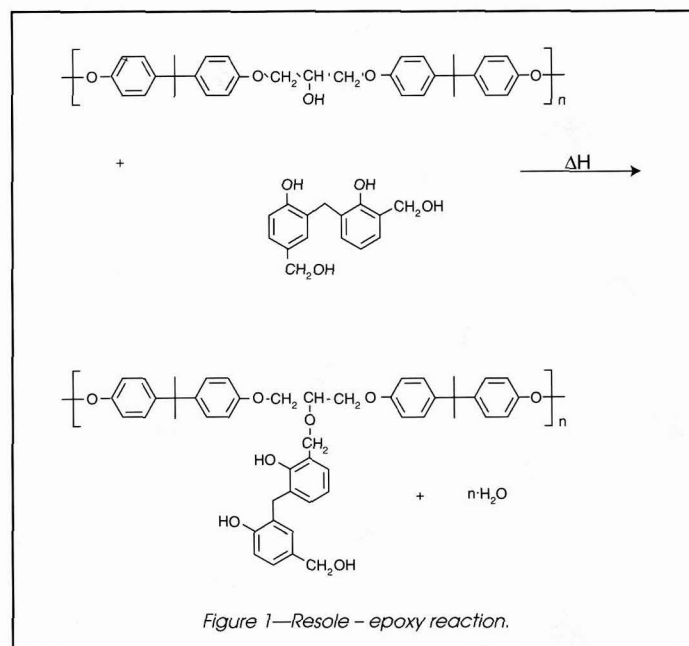
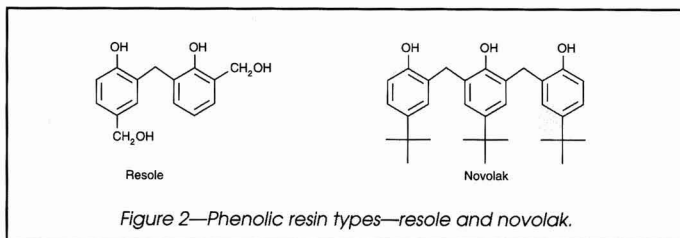


Figure 1—Resole-epoxy reaction.

\*153 W. Hanover Ave., Randolph, NJ 07869.



corrosion inhibiting properties. It is also the reason these polymers are extremely brittle. Ortho cresol is a di-functional monomer because it has only one ortho and one para position available for the reaction with formaldehyde. Resoles produced from ortho cresol produce cured films with much greater flexibility but commensurately poorer chemical resistance. The cure rate is much slower than phenol based resins so adjustments should be made in the curing process. Higher bake temperatures or longer cycles are needed to achieve the proper cure. Para cresol is also a di-functional monomer but it may react only linearly. Resoles derived from para cresol are even more flexible than ortho cresol and cannot thermoset because of the reduced crosslink density. As expected, the chemical resistance and other performance properties are poorer as well. Meta cresol is a tri-functional monomer and produces cured films with excellent performance properties and high crosslink density similar to that of phenol. However, resoles made from meta cresol cure much faster than phenol resins and bake cycles must be adjusted accordingly.

One of the interesting aspects of all the cresol based products, when compared with phenol resins, is they have very different compatibility parameters with other polymers and some solvents. The methyl group on the aromatic ring gives cresol resins better compatibility with epoxy, vinyl, and polyester resins. The solvency in aromatic solvents also improves. This phenomenon continues as more aliphatic constituents are added to the ring. Para tertiary butylphenol resins have even better compatibility with aliphatic polymers and solvents. Novolak resins used to modify oils and alkyds are based on butyl phenol to take advantage of the resin's compatibility with drying oils and mineral spirit type solvents. Although they do not react into the film, their presence in the polymer network improves moisture resistance, intercoat adhesion, and durability.

Phenolic resins undergo an oxidative reaction to form quinone methides. The formation of quinones (Figures 4a & 4b) cause the yellow

discoloration that is typical in phenolic resins. Using para substituted phenols, such as butyl phenol or bisphenol-A, significantly reduces the formation of color bodies but does not eliminate them altogether. Because of this, the role of phenolic resins is limited to primers when coatings with light colors are required. Phenolics are outstanding materials to consider when formulating coatings to be used as primers. They impart excellent performance properties and provide superb intercoat adhesion to most common polymers used as topcoats.

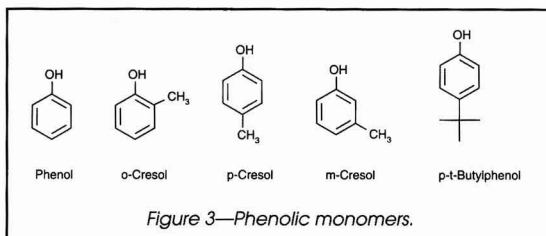
Phenolic novolak resins are supplied as solids and must be melted or dissolved in the proper solvents when added to a coatings formulation. Since they are relatively low in molecular weight, these resins have found utility in high-solids applications where low solvent levels are necessary. Novolak resins, unlike resoles, may be designed with compatibility towards the odorless aliphatic solvents that are commonly used in air dry coatings.

## Applications

Phenolic resins are currently used in a wide variety of applications. The choice of phenol monomer, along with diverse processing parameters, gives phenolic resin suppliers a plethora of possible products to offer coating formulators. Popular coatings applications that utilize phenolic resins include:

### Baking Coatings

- Linings for drums and pails
- Interior coatings for food containers
- Tank-car linings
- Coatings for heat exchanges
- Coatings for industrial equipment



### Air-Dry Coatings

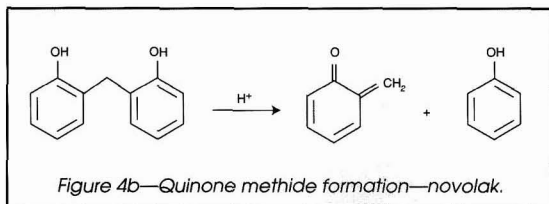
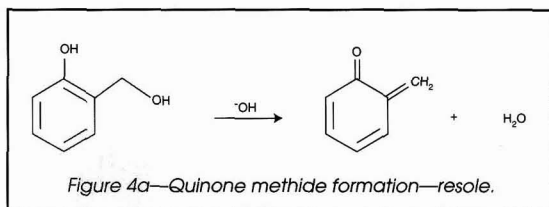
- Tung oil varnishes
- Alkyd-based primers
- Wash primers

## Formulation Parameters

### BAKING COATINGS

Phenolic resoles are sometimes used as the sole polymer in a formulation; but in the vast majority of applications phenolics are used as a modifier for other polymers. Coatings formulators balance the performance enhancements against the inherent shortcomings of phenolics to obtain an optimal balance of performance properties. Because of the variety of phenolic resin offerings, formulators should be aware of the different bake times necessary to promote proper cure. Heat reactive phenolic resins require significant heat to produce thermosetting films. Proper baking temperatures have a pronounced effect on the performance properties of the cured film. Undercuring produces films that are soft and exhibit poor chemical resistance. Overcured films will become very brittle with reduced adhesion properties. Cure rates may be controlled by varying the temperature, cycle time, or with the addition of an acid catalyst. The optimal cure rate of phenolic resins can be accurately measured with a dynamic mechanical analyzer (Figure 5). During the initial baking period, there is a rapid increase in the elastic modulus as the phenolic begins crosslinking. When the coating is fully cured, the elastic modulus plateaus as crosslinking is completed. This initial area where the elastic modulus reaches its maximum suggests the proper conditions necessary for optimal cure.

Phenolic resoles used in baking coatings cure via a condensation reaction. Water is released as the film becomes fully cured. Since water must be able to exit the film, coatings are limited to a film thickness of approximately 0.8 mils. Applications requiring thicker films must have a series of thinner films that are applied and cured independently to prevent blistering. Phenolic resoles do not have good flow properties by themselves as a consequence of their high polarity and require surface tension modifiers. Modified silicones or polyacrylate surfactants are useful additives that may be blended into phenolic coatings to improve the film forming properties. However, it is recommended that surfactants be used judiciously because adhesion properties and recoatability can be adversely affected if levels become too high. Phenolic resoles are excellent crosslinkers for high molecular weight polymers



used in applications requiring flexibility. Lubricants are often added to these formulations where the substrate must be bent or formed after the film has been applied. Micronized waxes or petrolatum can be added in small quantities to prevent cracking or crazing.

As mentioned earlier, the cure rate of the formulation depends on the type of phenolic chosen for the desired end-use. The cure rates of phenolic formulations may be accelerated with acid catalysts. Blocked PTSA or phosphoric acid added in levels of 0.1 to 0.5% of total resin solids works well. Excessive use of catalyst will cause homopolymerization of the phenolic resin and often results in film blistering.

Phenolic resole resins are usually supplied as a solvent-based liquid. They may be thinned with a variety of solvents to obtain the correct viscosity parameters. Alcohols, ketones, and glycol ethers make excellent solvents while aromatics may be used as diluents for many of these heat-reactive resins. Aliphatic solvents should not be used with phenolic resoles. The solvency of resoles depends on the type of monomer used and the molecular weight of the final product.

Although it requires a considerable amount of heat to cure phenolic resins in a commercially viable time period, they do polymerize slowly at room temperature. Phenolic resoles should be used within a reasonable period of time to prevent the viscosity advancement that occurs during ambient storage. Refrigeration greatly extends the useful life of these products. Solvent blends with alcohols present provide the best storage stability for heat-reactive phenolic resins.

#### AIR-DRY VARNISHES

Oil-soluble phenolic novolaks are based on substituted phenols. There are products

available for use in "cooked" varnishes as well as those intended for cold-blend tung oil formulations. Resins designed for cooked varnishes are heated to 450°F with drying oils to produce coatings that have excellent corrosion resistance. However, the high viscosity of these formulations precludes their use in high-solids coatings. These phenolic resins typically are 100% soluble in aliphatic solvents. The products specifically designed for use in cold-blends are found in high-solids formulations but have slightly less tolerance towards aliphatic solvents. A small percentage of alcohol must be present in the solvent mix to produce a compatible mixture. Oil varnishes may be used as clear coatings for wood applications or pigmented for use in metal primers. Phenolic novolaks are also used as additives in alkyd-based formulations. Addition levels of 5-15% upgrade the moisture resistance and intercoat adhesion properties of the alkyd polymer. The phenolic resins may be dissolved and cold-blended into the alkyd mixture or added as a solid during the manufacture of the alkyd. High-solids butyphenol based novolak resins are the products of choice for this application.

#### Recent Trends

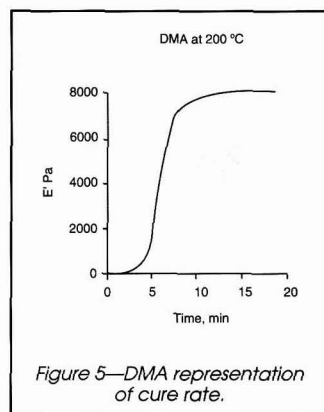
We have witnessed in the past decade the emergence of environmental regulations that limit the release of volatile organic compounds in coatings. This trend has shifted the development of phenolic resins towards products that are useful in low VOC applications. In both air-dry and baking coatings, high-solids phenolic resins have become popular for coatings formulators. Low molecular weight novolak resins with improved performance properties have found utility in air-dry formulations. They are used in combination with drying oils or alkyds in high-solids formulations for exterior coatings applications. For baking coatings the trend has

also been towards low molecular weight resins used in high-solids formulations. Storage stability and compatibility problems associated with low molecular weight heat-reactive products have been solved by etherification of the methylol groups with *n*-butanol. Etherified phenolic resoles are becoming increasingly popular as crosslinking agents for coatings that must be formulated with reduced solvent levels.

Water-based phenolic dispersions are also available for low VOC applications. A non-ionic protective colloid is used to make the phenolic resin water dispersible. This process greatly reduces the amount of solvent present but does sacrifice some of the performance properties. These products offer an excellent compromise between high-end corrosion resistance and stringent environmental regulations.

#### Future Possibilities

Over the years, phenolic resins have been solid performers in a variety of coatings formulations. Phenolic resin suppliers have accrued product lines that consist of a vast assortment of resins made from different raw materials with diverse chemical properties. Coatings formulators have managed to find specific phenolic polymers that enhance the performance parameters of their particular application. Much of the applications research associated with the use of phenolics

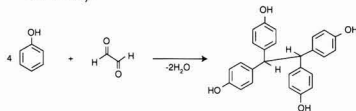


has centered on a trial and error basis. Phenolic resins with known physical properties are evaluated in new formulations to satisfy traditional performance needs such as improved chemical resistance or better intercoat adhesion. Phenolics will continue to play an important role in coatings formulations, however, I envision that phenolic resin development will change. Instead of fitting products into a predefined role, I believe phenolics will be engineered, along

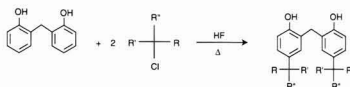


K. Bourlier

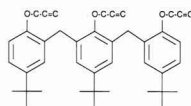
with other polymers, to meet the future demands of coatings formulations. Phenolic resins will be redesigned to improve the existing benefits and reduce some of the disadvantageous properties. The breadth and scope of possible chemical reactions that involve phenol are impressive. A partial list of some interesting synthesis techniques and potential ideas for further exploration is presented to stimulate your curiosity.



Novel approaches may be taken to produce hydroxyl functional phenolic resins that may be used as polyols in urethane systems. The phenolic hydroxyl will react with isocyanates to produce highly crosslinked coatings. There are many ways to produce these polyol products using a variety of synthesis methods. Shown here is the reaction of phenol with glyoxal.



Phenols may also be modified with halogenated materials via a Friedel-Crafts reaction. Phenolic resins can be matched with various materials to change the solubility parameters of the phenolic. If the phenolic is then reacted into a coatings system, the solubility parameters can be modified to suit the formulator's needs.



The phenolic hydroxyl group, along with the methylene bridge created from the reaction with formaldehyde, causes the formation of quinone methides. Quinones cause the yellow discoloration associated with phenolic resins. It is possible to block the phenolic hydroxyl and thereby increase the oxidative stability of phenolic resins. Capping the hydroxyl group often results in lowering the melt viscosity of the resin as well. This may find value in reducing the solvent requirements of the coatings formulation. Shown here is the reaction product of a novolak using allyl chloride, but there are

many other documented methods of blocking the phenolic hydroxyl group.

Phenolic resins will continue to provide value in today's traditional coatings applications. Their versatility, coupled with a reasonable cost, ensures phenolics will remain an important formulator's tool in coatings development. The vast array of synthesis possibilities relating to phenolic resin development also guarantees they will evolve to meet the future needs of the changing coatings market.

#### REFERENCES

- (1) Fry, J.S., Merriam, C.N., and Boyd, W.H., *Chemistry and Technology of Phenolic Resins and Coatings*, in ACS Symposium Series, Applied Polymer Science, American Chemical Society, Washington, D.C., 1985.
- (2) Martin, R.W., *The Chemistry of Phenolic Resins*, Wiley, New York, 1956.
- (3) Knop, A. and Pilato, L., *Phenolic Resins*, Springer-Verlag, Berlin, 1985.
- (4) Satas, D., *Coatings Technology Handbook*, Marcel Dekker, New York, 1991.
- (5) Kormmann, M. and Groeschel, F., *Polymeric Coating Behaviour in H<sub>2</sub>S Corrosive Media*, Matériaux et Techniques, No. 9-10, 1992.



## Join the **FSCT** at the International Coatings Technology Conference and Expo

(formerly Annual Meeting and Paint Industries' Show)

October 23-25, 1996

McCormick Place North

Chicago, IL





**Reader Service Card  
February 1996 Issue**

**Your Company**

(Check One Block)

- AA  Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants, Adhesives
- BB  Manufacturers of Raw Materials
- CC  Manufacturers of Equipment and Containers
- DD  Sales Agents for Raw Materials and Equipment
- EE  Government Agency
- FF  Research/Testing/Consulting
- GG  Educational Institution/Library
- HH  Paint Consumer
- JJ  Other

**Your Position**

(Check One Block)

- KK  Management/Adm.
- LL  Mfg. & Engineering
- MM  Quality Control
- NN  Research & Development
- PP  Technical Sales Service
- QQ  Sales & Marketing
- RR  Consultant
- SS  Educator/Student/Librarian
- TT  Other

Circle the numbers of the items you would like more information on, and mail it—postage paid!

001	021	041	061	081	101	121	141	161	181	201	221	241	261	281
002	022	042	062	082	102	122	142	162	182	202	222	242	262	282
003	023	043	063	083	103	123	143	163	183	203	223	243	263	283
004	024	044	064	084	104	124	144	164	184	204	224	244	264	284
005	025	045	065	085	105	125	145	165	185	205	225	245	265	285
006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300

Name \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Phone \_\_\_\_\_ FAX \_\_\_\_\_



**Reader Service Card  
February 1996 Issue**

**Your Company**

(Check One Block)

- AA  Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants, Adhesives
- BB  Manufacturers of Raw Materials
- CC  Manufacturers of Equipment and Containers
- DD  Sales Agents for Raw Materials and Equipment
- EE  Government Agency
- FF  Research/Testing/Consulting
- GG  Educational Institution/Library
- HH  Paint Consumer
- JJ  Other

**Your Position**

(Check One Block)

- KK  Management/Adm.
- LL  Mfg. & Engineering
- MM  Quality Control
- NN  Research & Development
- PP  Technical Sales Service
- QQ  Sales & Marketing
- RR  Consultant
- SS  Educator/Student/Librarian
- TT  Other

Circle the numbers of the items you would like more information on, and mail it—postage paid!

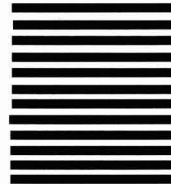
001	021	041	061	081	101	121	141	161	181	201	221	241	261	281
002	022	042	062	082	102	122	142	162	182	202	222	242	262	282
003	023	043	063	083	103	123	143	163	183	203	223	243	263	283
004	024	044	064	084	104	124	144	164	184	204	224	244	264	284
005	025	045	065	085	105	125	145	165	185	205	225	245	265	285
006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300

Name \_\_\_\_\_  
 Company \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
 Phone \_\_\_\_\_ FAX \_\_\_\_\_



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**BUSINESS REPLY MAIL**  
FIRST CLASS PERMIT NO. 12522 CHICAGO, ILLINOIS  
POSTAGE WILL BE PAID BY ADDRESSEE

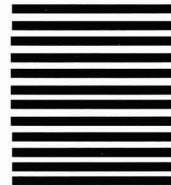


**Journal of Coatings Technology**  
Reader Service Center  
650 S. Clark St.  
Chicago, IL 60605-9960



NO POSTAGE  
NECESSARY  
IF MAILED  
IN THE  
UNITED STATES

**BUSINESS REPLY MAIL**  
FIRST CLASS PERMIT NO. 12522 CHICAGO, ILLINOIS  
POSTAGE WILL BE PAID BY ADDRESSEE



**Journal of Coatings Technology**  
Reader Service Center  
650 S. Clark St.  
Chicago, IL 60605-9960



## Society Reports

### CHICAGO—NOVEMBER

#### "Oxsol® 100"

Educational Chair Frank Leo, Henkel Corp., presented a \$2,000 grant to Dr. Gregory B. Kharas, of DePaul University. The grant will be used in conjunction with research in the Coatings Technology Graduate Program.

Daniel Skelly, of Occidental Chemical Corp., delivered the evening's technical presentation on "Oxsol 100—AN ALTERNATIVE ORGANIC SOLVENT THAT IS VOC EXEMPT."

Mr. Skelly introduced a new family of solvents based on parachlorobenzotrifluoride. He also analyzed the regulatory status of these solvents and their chemistry. In addition, the speaker compared other solvents and examples of their use in several types of coatings formulations.

According to Mr. Skelly, some advantages of these solvents include reduced VOCs and HAPs, and virtually no adverse effects on such properties as viscosity, drying time, or film hardness.

GERRY NOREN, *Secretary*

### CLEVELAND—NOVEMBER

#### Scroll of Honor Presented

Robert F. Ziegler, FSCT Executive Vice President, presented Doris Schwab, widow of Fred Schwab, with a plaque commemorating Mr. Schwab's induction into the FSCT Roll of Honor. Mr. Schwab was the recipient of the 1993 George Baugh Heckel Award.

Mr. Ziegler then went over the FSCT strategic plan. He stated that FSCT must change in order to keep up with the ever-changing coatings industry. For example, the Paint Industries' Show has been renamed the International Coatings Expo. In addition,



jectve and scientific or variable and controversial. For example, when the paint is yellowing and chalking in the field, active hydrogens from radical formations, peroxy units, or unsaturation can be blamed for the problem. All latex types will weather since they all contain active hydrocarbons. According to the speaker, accelerated weather-

*At the November Cleveland Society meeting, Doris Schwab, widow of Fred Schwab, was presented with a plaque commemorating Mr. Schwab's induction into the FSCT Roll of Honor, by FSCT Executive Vice President Bob Ziegler.*

tion, a separate conference has been developed which will feature two-day seminars. This conference has been named the International Coatings Technology Conference.

New England Society member Sherman E. Caswell, of Brookfield Engineering, spoke on "FUNDAMENTALS AND APPARATUS."

Mr. Caswell explained the use and pros and cons of the paddle, T Bar, disc, cylinder, cone, and plate geometry.

JAMES J. CURRIE, *Secretary*

### GOLDEN GATE—NOVEMBER

#### Latex Chemistry

The meeting's speaker was Violete L. Stevens, a paint and coatings consultant. Ms. Stevens discussed "FIELD OBSERVATIONS AND LATEX CHEMISTRY."

Ms. Stevens stressed the importance of quantifying the "performance assessment" of a coating. Observations may exist as sub-

in the following: QUV A-340 bulbs show results similar to sunlight except at the longer wavelengths and QUV B-313 show a peak at 320 nm and are much more stringent than sunlight. Characteristics like these of each of the accelerated weathering devices point to the importance of knowing the spectra of the polymer. For example, styrene acrylic has a strong adsorption at 200 nm and will yield false results for weathering.

The speaker acknowledged that the design of the latex and the amount of impurities contained within it will have an effect on its durability. Therefore reaction conditions during manufacture will dictate the morphology and behavior of the polymer. In addition, the molecular weight distribution and sequences of crosslinking are also critical. For example, sunlight at 295 nm will excite impurities in the film to form peroxide units and cause yellowing, chalking, and color changes.

Ms. Stevens cited a study in which four buildings were painted with separate vehicle systems: acrylic, styrene acrylic, vinyl acrylic, and styrene butadiene. The houses were lo-

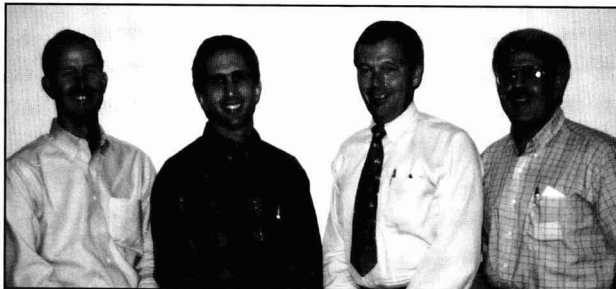


*Members of the 1995-96 Chicago Society Executive Committee are pictured above. Seated (left to right): Membership Chair—Susan Simpson; Treasurer—William Bellman; Vice President—Marcella Nichols; Immediate Past-President—Natu Patel; and Past-President—Gregory McWright. Standing: Associate Member—Richard Cranstoun; 75th Anniversary Yearbook Chair—Alison Azar; Associate Member—Steven Brauer; Educational Chair—Frank Leo; President—David Stromberg; Secretary—Gerry Noren; and Society Representative—Evans Angelos.*

ing will help determine the weathering characteristics of each of the different types of latexes.

To choose the appropriate vehicle system, Ms. Stevens recommended the following: (1) initial screening through the use of accelerated devices; (2) exposure at one of three specific exterior sites; and (3) follow up with actual outside results. The three specific exterior sites are panel racks located in Florida (sunlight with high humidity), Arizona (sunlight with low humidity), or Michigan (freeze and thaw cycles).

Ms. Stevens compared some accelerated weathering ultraviolet devices which resulted



Officers of the Houston Society for the term 1995-96 are as pictured: Vice President—Guy Sullaway; President—Edward Boss; Secretary—Ken Mundy; and Treasurer—Vic Santamaria.



Los Angeles Society Officers for 1995-96 are pictured above: Vice President—V.C. "Bud" Jenkins; Secretary—Joseph B. Evans; Society Representative—Philip C. Bremenstuhl; Ray Dimairo; Treasurer—Arthur W. Lorenz; Bylaws Chair—Sandra Dickinson; and President—Robert J. Skarvan.



Elected to serve as Officers of the Montreal Society include, seated: Secretary—Robert Benoit; Vice President—Ralph Weberbauer; President—Alain Charbonneau; and Treasurer—Luc P  pin. Standing: Horace Philipp; Sylvain B  lisle; Nicole Papineau; Jean Brunet; Society Representative—Suzanne Richardson; and Technical Committee Chair—R  n   D  cary.

cated around the country from Florida to Wisconsin and the results were monitored and photographed.

The speaker stated that it is important to consider the chemical reactivity of the binder and of the substrate. The substrates are not inert. For example, drywall contains a caustic sizing and fresh concrete or masonry usually have amounts of hydroxyl on the surface. Even aged masonry still can have the metal oxides deep in the film converted to metal hydroxides by the presence of water during an unusually wet summer.

According to Ms. Stevens, thermodynamics of hydrolysis should be focused on now. Alkyds, vinyl acrylics, acrylics, styrene acrylics, and styrene butadienes were evaluated. If you have hydrolysis, you will have equilibrium between the acid and alkali groups. Acrylics will yield alcohol and acids, while vinyls will generate polyvinyl alcohol and acid salts. Alkyds are even worse as they break into separate units from the backbone. The zinc soap on galvanized steel will hydrolyze the alkyd. Acrylics are much better. The least reactive are epoxies and the styrene butadiene groups followed by the styrene acrylics, acrylics, vinyl butyl acetates, alkyds, and polyesters.

To perform this process in the laboratory, Ms. Stevens suggests that the release paper should be painted, then the paint should be removed, and finally it should be immersed in one molar sodium hydroxide solution, then put vial into 140°F oven for three days. After that, the vial is shaken up and the clarity is observed. Styrene butadiene usually gave intact films. This is a simulation of what happens on a surface that contains a caustic residue like stucco. The results are compared to buildings coated with similar systems and a rough scale was evident.

The next example provided by the speaker was for a moisture barrier coat. A Michigan house example shows that for different seasons, the migration of moisture through the wall of the house is not desirable. In the winter, the moisture will go through the wall and condense on the outside of the house reducing the R value for insulation effectiveness. In the summer, the humid air will go through the wall into the house and cause the air conditioner to work harder. A coating on the inside of the house that acts as a barrier to water migration through the walls is desirable.

Based on the results from the alkali resistance, Ms. Stevens noted that it should be no surprise that a solvent epoxy works best followed by a styrene butadiene latex. Moisture barrier coatings are currently being sold featuring these vehicles.

Q . I want to paint my stucco Florida house with pink acrylic latex. How long must I wait to make sure the stucco surface is nonreactive?

A. Unfortunately, stucco is never fully cured. Caustic is constantly being released



during wet periods due to the metals being converted to hydroxyl ions. It may not show up until you have an especially wet summer season.

JEFFERY I. BUCHMAN, Secretary

## PHILADELPHIA—NOVEMBER

### "Automotive Coatings"

A moment of silence was observed for the passing of Emerson W. Kaufmann.

Wayne Kraus, of Hercules Incorporated, updated the members on the status of the Eastern Training Conference slated for May.

Robert Traicoff, of Ford Motor Co., delivered the evening's presentation on "AUTOMOTIVE COATINGS INTO THE NEXT CENTURY."

Mr. Traicoff began by stating that the main challenge faced by automakers today is customer satisfaction. Customers demand improved appearance and durability and zero defects. Automakers are also faced with challenges from the government as well. Current legislation requires clean air with near zero emissions and no hazards in the workplace.

According to the speaker, one of the most important properties of an automotive coating is smoothness (uniformity of gloss and color). In order to achieve smoothness, Mr. Traicoff recommends a more uniform electrocoat, anti-chip electrocoat, four bake-four coat systems, reduced thickness basecoats, colored primers, tinted clearcoats, or tricoat systems.

In addition, the speaker also attributed clear topcoats for expanding the colors that are now available. Clear topcoats protect against UV degradation.

In order to prevent chips, mar scratches, gloss loss, blisters, and corrosion, the automotive paint formulator must perform a balancing act with formulations as well as bake times and temperatures. Formulators must also consider the shape of the vehicle. The speaker stated that engineering and the coatings group collaborate on design considerations.

Mr. Traicoff stated that the majority of new cars today are coated with water-based primers and basecoats and topcoated with two-pack urethane or melamine clears. He said that work is ongoing to optimize these systems, especially the topcoat.

Mr. Traicoff outlined some of the experimental design systems that are currently being used at Ford to evaluate current and new technologies.

The speaker concluded by stating that Ford, GM, and Chrysler have formed a Low Emission Paint Consortium to develop technology for low emission paint.

PATRICIA M. PETERSON, Secretary

## Constituent Society Meetings and Secretaries

**BALTIMORE** (Third Thursday—Martin's West, Woodlawn, MD). JOSEPH SCHILARE, The Valspar Corp., 1401 Severn St., Baltimore, MD 21230.

**BIRMINGHAM** (First Thursday—Strathallan Hotel, Birmingham, England). DAVID C. MORRIS, PPG Industries (UK) Ltd., P.O. Box 359, Rotton Park St., Birmingham, B16 0AD, England.

**CDIC** (Second Monday—Location alternates between Cincinnati, Columbus, Dayton, and Indianapolis). THERESA CASE, Fibreglass Evercoat Co., Inc., 6600 Cornell Rd., Cincinnati, OH 45242.

**CHICAGO** (First Monday—Sharko's Restaurant, Villa Park, IL). GERRY K. NOREN, DSM-Desotech, Inc., 1122 St. Charles St., Elgin, IL 60120.

**CLEVELAND** (Third Tuesday—Monthly meeting site TBA). JAMES CURRIE, Jamestown Paint Co., 108 Main St., Jamestown, PA 16134.

**DALLAS** (Second Thursday following first Wednesday—Dallas Medallion Hotel, Dallas, TX). MIKE TEMPLIN, Hilton-Davis Co., 1696 Dickerson Dr., Arlington, TX.

**DETROIT** (Second Tuesday—meeting sites vary). RAY STEWART, Akzo Nobel Coatings, Inc., 1845 Maxwell St., P.O. Box 7062, Troy, MI 48007-7062.

**GOLDEN GATE** (Monday before third Wednesday—alternates between Francisco's in Oakland, CA, and Holiday Inn in S. San Francisco). DON MAZZONE, Dowd & Guild, Inc., 14 Crow Canyon Ct., #200, San Ramon, CA 94583.

**HOUSTON** (Second Wednesday—Medallion Hotel, Houston, TX). KEN MUNDY, Ribelin Sales, Inc., 7786 Blankenship Dr., Houston, TX 77055.

**KANSAS CITY** (Second Thursday—Cascone's Restaurant, Kansas City, MO). CURRY SANDERS, Tnemec Co., Inc., 123 N. 23rd Ave., N. Kansas City, MO 64116.

**LOS ANGELES** (Second Wednesday—Steven's Steakhouse, Commerce, CA). ARTHUR W. LORENZ, Sinclair-Ameritone Paint Corp., 6100 S. Garfield Ave., Los Angeles, CA 90040.

**LOUISVILLE** (Third Wednesday—Executive West Motor Hotel, Louisville, KY). PAUL BAUKEMA, Akzo Nobel Coatings, Inc., R&D Div., 4730 Crittenden Dr., P.O. Box 37230, Louisville, KY 40233.

**MEXICO** (Every fifteen days—Gabriel Mancera, Mexico City, Mexico). SERGIO ROJAS, Pinturas International, S.A. De C.V., Ganaderias 234, Col. Granjas Esmeralda, 09810 Mexico, D.F., Mexico.

**MONTREAL** (First Wednesday—Restaurant Le Bifhèque, St. Laurent, Quebec). ROBERT BENOIT, KRONOS Canada Inc., 3390 Marie Victorin, Varennes, Que., J3X 1T4 Canada.

**NEW ENGLAND** (Third Thursday—Best Western TLC, Waltham, MA). RICHARD TWOMEY, Kronos, Inc., 68 Fisher St., Medway, MA 02053-2004.

**NEW YORK** (Second Tuesday—Landmark II, East Rutherford, NJ). ROBERT W. SCHROEDER, Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

**NORTHWESTERN** (Tuesday following first Monday—Jax Cafe, Minneapolis, MN). MICHAEL D. COAD, McWhorter Technologies, 1028 S. Third St., Minneapolis, MN 55415.

**PACIFIC NORTHWEST** (PORTLAND SECTION—Tuesday before third Wednesday—Tony Roma's, Mall 205, Portland, OR; SEATTLE SECTION—Third Wednesday—Wynndham Gardes Hotel, Sea-Tac, WA; VANCOUVER SECTION—Thursday after third Wednesday—Abercorn Inn, Richmond, B.C.). KENNETH WENZEL, Chemical Distributors, Inc., P.O. Box 10763, Portland, OR 97210.

**PHILADELPHIA** (Second Thursday—DoubleTree Guest Suites, Plymouth Meeting, PA). PATRICIA M. PETERSON, ARCO Chemical Co., 3801 West Chester Pike, Newtown Square, PA 19073-3230.

**PIEDMONT** (Third Wednesday—Ramada Inn Airport, Greensboro, NC). ALEX BIAHNIK, Chemcraft Sadolin, Inc., P.O. Box 669, Walkertown, NC 27051.

**PITTSBURGH** (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). JAMES GIAMMARCO, Lockhart Chemical Co., 2873 W. Hardies Rd., Gibsonia, PA 15044.

**ROCKY MOUNTAIN** (Monday following first Wednesday—Monthly meeting site TBA). JOHN ELVERUM, Hauser Chemical Research, 5555 Airport Blvd., Boulder, CO 80301.

**ST. LOUIS** (Third Tuesday—The Salad Bowl Restaurant, St. Louis, MO). ROBERT PHELPS, P.D. George Co., P.O. Box 66756, St. Louis, MO 63166.

**SOUTHERN** (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). EVE DE LA VEGA-IRVINE, J.M. Huber Corp., One Huber Rd., Macon, GA 31298.

**TORONTO** (Second Monday—Speranza Restaurant & Banquet Hall Convention Centre, Brampton, Ont., Canada). MIKE MOLNAR, CIBA Pigments, P.O. Box 2000, Mississauga, Ont., L5M 5N3 Canada.

**WESTERN NEW YORK**—MARKO MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.



Mexico Society Officers for the term 1995-96 are, seated: Alicia Olascoaga; Gabriela Gordillo; Society Representative—Martha Colin; Treasurer—Marina Estevez; Elizabeth Vargas; and Julieta Lucio. Standing: Gustavo Vera; Secretary—Jorge Hijuelos; President—Marcello Herrera; Vice President—Mauricio Misdrahi; Francisco Rodriguez; and Jesús Camacho.

## MEXICO SOCIETY

El Instituto Mexicano de Tecnicos en Pinturas y Tintas agradece a las siguientes compañías su valiosa participacion durante el año de 1995 con las siguientes conferencias:

- Compañía: Bayer de Mexico, S.A. de C.V.  
 Exponente: Horst Rottscheidt  
 Conferencia: Recubrimientos de Poliuretano Para Pisos en Edificios Nuevos y Reparacion
- Compañía: Shell Development Co.  
 Exponente: Don A. Sullivan  
 Conferencia: Soluciones a Problemas Regulatorios de Solventes: Reemplazamientos de Hidrocarburos Aromaticos
- Compañía: ICSA, S.A. de C.V.  
 Exponente: Roberto Castañeda y Jose Osawa  
 Conferencia: Microesferas Huecas y Solidas
- Compañía: Connor Comercial, S.A. de C.V.  
 Exponente: Kent A. Peterson  
 Conferencia: Dispersion en un Solo Paso Usando Los Molinos de Alta Velocidad Tipo Rotor Estator
- Compañía: Degussa Corp. U.S.A.  
 Exponente: Maria Nargiello  
 Conferencia: La Influencia de la Dispersion Sobre el Desarrollo del Color de el Negro de Carbon en Recubrimientos
- Compañía: Hüls America Inc.  
 Exponente: Jeffery Hinkle  
 Conferencia: Proteccion de Recubrimientos de un Ataque Mercurial: Sobreviviendo Sin Mercurio
- Compañía: Residuos Industriales Multiquim, S.A. de C.V.  
 Exponente: Leopoldo Carvantes L.  
 Conferencia: Alternativas Para el Tratamiento y Disposicion de Desechos Peligrosos



Elected to serve as Officers of the New York Society are: Secretary—Robert W. Schroeder; Vice President—John W. Du; President—Cary Grobstein; Society Representative—Michael C. Frantz; and Treasurer—Larry R. Waelde.

## PHILADELPHIA—DECEMBER

### Ultra High Gloss Latex

FSCT Executive Vice President Robert F. Ziegler presented Dick Kiefer with a Federation Honorary Membership certificate.

Neil Shearer, of The 3E Group, reported that January's plant tour will be conducted at Chemcentral in Morrisville, PA.

Chuck Albert, of the Design Data Corp., reported that the Formulator's Data Disk has been formally transferred to his company for commercial development. To date 150 copies of the disk have been sold.

Piedmont Society member Gerald Vandezande, of Union Carbide Emulsion Systems, spoke on "ULTRA HIGH GLOSS LATEX AND CROSSLINKING TECHNOLOGY."

Mr. Vandezande stated that the properties of the ultra high gloss latexes include high gloss, alkyd-like properties, low temperature film formation, and hard film surfaces. He noted that conventional latex particle size is 0.3 microns while high gloss latex particles are 0.08 microns. The pigments disperse better in the small particle size latex. Another result from these latexes is better barrier properties. The greater surface area allows these products to be easily modified with epoxies. Depending on the level of modification, chemical resistance and block resistance can be increased significantly.

Another strategy reacts the epoxy with diethylene triamine. When 10% epoxy modification was used, two to one epoxy to amine level was determined to be optimum. Higher amine levels caused increased water sensitivity. At a moderate cost and no VOC, block and solvent resistance are increased.

Q. Does epoxy affect yellowing and gloss retention?

A. No change in light stability. We are still evaluating exterior exposure.

PATRICIA M. PETERSON, Secretary

## ROCKY MOUNTAIN—JANUARY

### "Universal Primers"

An award was given to John S. Baker for his presentation of the Society paper, "The Effects of Reverse-Side Substrate Insulation

on the Exterior Exposure Performance of an Acrylic Emulsion Coating," at the FSCT Annual Meeting in St. Louis, MO. Awards were also bestowed upon the members of the committee who collaborated on the paper. The following accepted awards for their efforts: Ginny Carnes, of Walsh & Associates; J. Dick Mullen, of G-3 Industries; Kenneth Wolma, of Sashco; Tom Snider, of Ponderosa Paint Manufacturing; and Gerry Umbreit.

Eight scholarship applications were received for the Cal Poly Coatings seminar scheduled for June 17-22. Paul Delmonico, of Old Western Paint Co., was the recipient of the scholarship.

Chicago Society member, Michael C. Wildman, of Engineered Polymer Solutions, Inc., discussed "THE NEXT GENERATION OF HIGH PERFORMANCE UNIVERSAL PRIMERS."

Mr. Wildman began by comparing the properties and qualities desired in a universal primer, such as stain blocking, corrosion resistance (protection), good adhesion to a variety of substrates, and suitability for interior and exterior use. He covered the properties for a VT alkyd, stain latex primer, and several stain blocking emulsions (SBE) which represented new technology.

According to the speaker, the SBE primers showed stain blocking performance for tannin stain and markers, which was comparable to the alkyd VT primer. The SBE primer mechanism for stain blocking appeared to work in the following manner: as the stain leached from the substrate into the primer layer, it became insoluble, and could not diffuse through the topcoat layer(s). Mr. Wildman used charts to show the change in color (DE) as a measurement of blocking for solvent-soluble, and water-soluble markers. Note: stain blocking performance was affected by marker with the most effective against green markers.

The SBE primers have performed quite well to date in outdoor exposure testing and accelerated environmental testing. Stain blocking performance was affected by the type and concentration of extender pigments(s). Small particle size calcium carbonate and magnesium silicate performed best, whereas a magnesium aluminum silicate performed poorly. The lower the PVC, the better the stain blocking performance.

Mr. Wildman indicated that coatings using the SBEs could be formulated:

(1) without the need for stain inhibiting pigments; (2) with no or very low VOCs required (typically 0-3%); (3) with no HAPs solvents required; and (4) with reduced need for titanium dioxide, thereby lowering raw material costs.

Q. Have the SBE primers been tested on Masonite®?

A. Studies are in progress and the SBE primers are expected to perform well.

JOHN A. ELVERUM, Secretary

## NEW PUBLICATION

# Coming Soon— A NEW Monograph in the Federation Series on Coatings Technology

## Methodologies for Predicting the Service Lives of Coatings Systems

by Jonathan W. Martin et al.



For more information, contact Meryl Simon,  
Federation of Societies for Coatings Technology,  
492 Norristown Rd., Blue Bell, PA 19422  
(610) 940-0777 • Fax: (610) 940-0292

# New FSCT Members

## CHICAGO

### Active

- Berry, Richard D.—Morton International, Crystal Lake, IL.  
 Bierman, Harold M.—Olin Corp., Libertyville, IL.  
 Birr, Daniel P.—Universal Chemicals & Coatings, Inc., Elgin, IL.  
 Cross, Horace B. Jr.—Pearl Paints North America, Harvey, IL.  
 Grauer, Kris J.—S.C. Johnson Polymer, Racine, WI.  
 Hallaert, Patricia E.—Tru-Test Manufacturing Co., Inc., Cary, IL.  
 Hart, Stephen W.—EPS Inc., Marengo, IL.  
 Holzrichter, Norman A.—Rust-Oleum Inc., Pleasant Prairie, WI.  
 James, Debra A.—McWhorter Technologies, Carpentersville, IL.  
 Kandell, Gary A.—Pearl Paints North America, Harvey, IL.  
 Kohlmeyer, John M.—Tru-Test Manufacturing Co., Inc., Chicago, IL.  
 Mall, D. Douglas—Tru-Test Manufacturing Co., Inc., Cary, IL.  
 Moody, Keith M.—Eastman Chemical Co., Batavia, IL.  
 Popli, Rakesh K.—S.C. Johnson Polymer, Racine, WI.  
 Powers, Edmund J.—Tru-Test Manufacturing Co., Inc., Cary, IL.

### Associate

- Cowley, Alan C.D.—Brandt Technologies, Elmhurst, IL.  
 Landes, Donald M.—Rheox Inc., Schaumburg, IL.  
 Stayart, Scott H.—The Chidley & Peto Co., Grand Haven, MI.  
 Tourgee, Richard I.—Hoechst Celanese Corp., Cincinnati, OH.  
 Vincent, Nancy J.—Henkel Corp., Aurora, IL.

## DETROIT

### Active

- Fisher, Timothy G.—The Sherwin-Williams Co., Troy, MI.

### Associate

- Delegato, Domenic C.—A.T. Callas Co., Troy, MI.  
 Zuidema, James F.—A.T. Callas Co., Troy, MI.

## HOUSTON

### Active

- Berger, Paul D.—Witco Corp., Houston, TX.  
 Flory, Arthur C.—NACE International, Houston, TX.  
 Garza, Ruben—The Rectorseal Corp., Houston, TX.  
 Shah, Sunil C.—Courtaulds Coatings, Houston, TX.

### Associate

- Compton, Charles W.—Raw Materials Corp., Houston, TX.  
 Dalton, David R.—Kemira Pigments Inc., Houston, TX.  
 Derington, Jack—Hüls America Inc., Houston, TX.  
 Goldberg, Gerald J.—Raw Materials Corp., Houston, TX.  
 Lee, Frank A.—Bossco Industries, Inc., Houston, TX.  
 Leggett, David—U.S. Zinc, Houston, TX.

- Mayfield, Ross R.—Koch Chemical Co., Houston, TX.  
 Reeves, Ronald B.—Solvent and Chemicals Inc., Pearland, TX.

## KANSAS CITY

### Active

- Huntley, Gary R.—Davis Paint Co., N. Kansas City, MO.  
 Klein, William J.—Tnemec Co., Inc., N. Kansas City, MO.  
 Pettis, Dan W.—Kansas Correctional, Lansing, KS.  
 Waddell, Barbara W.—Kansas Paint & Color, Wichita, KS.

### Associate

- Harkness, Guy—Cook Composites & Polymers Co., Kansas City, MO.  
 Landes, Donald M.—Rheox, Inc., Schaumburg, IL.  
 Riemann, Mark R.—Cook Composites & Polymers Co., Kansas City, MO.  
 Swift, W. Dean—Reichhold Chemicals, Kansas City, MO.

## LOS ANGELES

### Active

- Pascual, Lourdes G.—Vista Paint Corp., Fullerton, CA.  
 Quinteros, Phillip—HCl Holchem, Pacoima, CA.  
 Stowers, Larric J.—Brogdex Co., Pomona, CA.

### Associate

- Ali, Hassan—P.T. Hutchins Co., Ltd., Los Angeles, CA.  
 Alley, Frank L.—E.T. Horn Co., La Mirada, CA.  
 Baldwin, Fred J.—Datacolor International, Inc., Anaheim Hills, CA.  
 Gomez, Margarita M.—P.T. Hutchins Co., Ltd., Los Angeles, CA.  
 Hutchins, Ward F.—P.T. Hutchins Co., Ltd., Los Angeles, CA.  
 Hutzler, Chuck—Ashland Chemical Co., Orange, CA.  
 Svoboda, Joseph F.—Amoco Corp., Foothill Ranch, CA.  
 Vondette, Brian C.—X-Rite Corp., Costa Mesa, CA.  
 Wilson, Lowell D.—Sun Chemical, Newport Beach, CA.

### Eductor/Student

- Vilchiz, Victor H.—Cal Poly San Luis Obispo, San Luis Obispo, CA.

## NORTHWESTERN

### Active

- Coad, Eric C.—3M Company, Woodbury, MN.  
 Evert, Todd E.—The Valspar Corp., Minneapolis, MN.  
 Garlough, Greg D.—Electrochemical Inc., Maple Plain, MN.  
 Poblacki, Kevin P.—H.B. Fuller Co., Oakdale, MN.

### Associate

- Moody, Keith M.—Eastman Chemical Co., Batavia, IL.

- Whiting, Thomas E.—G.R. O'Shea Co., Itasca, IL.

## PHILADELPHIA

### Active

- Bass, Samuel Woody—M.A. Bruder & Sons, Philadelphia, PA.  
 Bolinsky, Michael A.—Silverline Mfg. Co., Inc., Tamaqua, PA.  
 Curcio, Michael A.—Silverline Mfg. Co., Inc., Tamaqua, PA.  
 Floyd, William A. Jr.—Silverline Mfg. Co., Inc., Tamaqua, PA.  
 Guy, James—Marquette Products, Philadelphia, PA.  
 Pepe, Frank R.—Navmar Applied Sciences Corp., Warminster, PA.  
 Rauls, Thomas E.—Chemcoat, Montoursville, PA.  
 Rehn, Arthur J. Jr.—Navmar Applied Sciences Corp., King of Prussia, PA.  
 Rodriguez, Carmen L.—Arco Chemical Co., Newtown Square, PA.  
 Smith, Thomas G.—Rohm & Haas Co., Lindenwold, NJ.  
 Stanish, Margaret M.—MAC Specialty Coatings, Penns Grove, NJ.  
 Will, James T.—Harcros Pigments Inc., Easton, PA.

### Associate

- Davis, William O.—Thoro System Products, Bristol, PA.  
 Jenikovsky, Richard—Charles Ross & Son, Cape May, NJ.  
 LaSota, Denis E.—Denbar Associates, Landenberg, PA.  
 Sportello, Larry P.—Mardem Manufacturing, Red Bank, NJ.

## PIEDMONT

### Associate

- Hetzell, Robert L.—Reichhold Chemicals, Durham, NC.  
 Oberhill, Karl M.—Sun Chemical-Pigments, Richmond, VA.

## ST. LOUIS

### Active

- Brundick, William J.—Marsh Co., Belleville, IL.  
 Dunham, Carolyn K.—The P.D. George Co., St. Louis, MO.  
 Goodman, Kimberly N.—Marsh Co., Belleville, IL.  
 Hornsey, Charles D.—Marsh Co., Belleville, IL.  
 Hunt, Brandon L.—U.S. Paint Corp., St. Louis, MO.  
 Lewis, William S.—Carboline Co., Xenia, OH.  
 Menon, Nalini—Walter Wurdack Inc., St. Louis, MO.  
 Meyerjord, William A.—Watson Coatings, St. Louis, MO.  
 Pitstick, A. John—Carboline Co., Xenia, OH.  
 Schremp, Chrissa L.—Marsh Co., Belleville, IL.  
 Wurdack, William D. Jr.—Walter Wurdack Inc., St. Louis, MO.  
 Yadamec, Thomas J.—Carboline Co., Lake Charles, LA.

### Associate

- Elliott, Linda F.—Hitox Corp., Irving, TX.  
 Landes, Donald M.—Rheox Inc., Schaumburg, IL.

# Tearing Out This Ad Can Improve Your Career

## The Federation's Series on Coatings Technology Has the Facts to Make You Succeed

The Federation of Societies for Coatings Technology gives you the tools you need to enhance your career with its Series on Coatings Technology, an innovative series of booklets on various phases of coatings technology and manufacturing. Each booklet is authored by a coatings expert, and thousands of copies have been sold to coatings manufacturers, chemists, suppliers and students worldwide.

From the Introduction to Coatings Technology and Film Formation to Corrosion Protection and Coatings Film Defects, each booklet in the ever-expanding series provides an authoritative and comprehensive insight into an important industry subject – information vital to you in today's changing environment.

For coatings professionals, the Series on Coatings Technology is just a phone call away.

### A Must for Every Reference Library, Perfect for Educating Sales Representatives

Complete sets of the Series can be used as reference tools for any laboratory or library.

Many are also useful for sales representatives – teaching them more about various aspects of the industry and its products.

### Make Your Move – Start Building Your Career One Volume at a Time

To order single booklets or the complete Series, call today to place your order.

**(610) 940-0777**

All Federation members receive special member discount pricing!

**Automotive Coatings**  
by  
Bruce N. McBane

**Pigments**

**Coil Coatings**  
by  
Joseph E. Gas

**Mechanical Properties  
Of Coatings**  
by  
Loren W. Hill



**Federation of Societies for  
Coatings Technology**

492 Norristown Road, Blue Bell, PA, 19422-2350  
(610) 940-0777, Fax (610) 940-0292



Circle No. 10 on the Reader Service Card



## Future Society Meetings

### Baltimore

- (Mar. 21)—General Meeting—Mattye Reymont, Shell Chemical Co.  
(Apr. 18)—“GOOD TESTS—BAD TESTING”—Saul Spindel, D/L Laboratories, Inc.  
(May 16)—General Meeting and Elections.

### Birmingham

- (Feb. 29)—Symposium: Paint at the Crossroads—Strathallan Hotel.  
(Mar. 28)—POWDER COATINGS: “WE MIGHT STILL BE GREEN BUT WE ARE NOT WET”—David Bate, H.B. Fuller Coatings.  
(Mar. 30)—60th Anniversary Dinner Dance.  
(May 2)—67th Annual General Meeting.

### Chicago

- (Feb. 5)—“PROBLEMS ASSOCIATED WITH WATERBORNE COATINGS FOR WOOD”—David Setzke, SC Johnson Polymer.  
(Mar. 4)—“PIGMENTS FOR TRAFFIC MARKING SYSTEMS”—Mike Issel, Sino-American Pigments.  
(Apr. 1)—“FIELD OBSERVATIONS AND LATEX CHEMISTRY”—Violete Stevens.  
(May 10)—Annual Awards Banquet.

### Los Angeles

- (Mar. 10)—“AN ADDITIVES APPROACH TO DEFECT ELIMINATION IN THERMOPLASTIC WATERBORNE INDUSTRIAL MAINTENANCE COATINGS”—Joel Schwartz, Air Products & Chemicals Co.  
(Apr. 10)—“RHEOLOGICAL MEASUREMENTS AND HOW THEY APPLY TO THE PAINT AND COATINGS INDUSTRY”—Scott Krane, Haake Instruments.  
(May 8)—“THE LATEST TRENDS IN ACCELERATED CORROSION TESTING: PROHESION, QUV AND AUTOMOTIVE CYCLIC CORROSION TESTING”—Steve Grossman, Q-Panel Corp.

### New York

- (Mar. 12)—“NOVEL HARDENERS FOR POLYURETHANE POWDER COATINGS”—Ron Guida, Hüls America, Inc.  
(Apr. 9)—“THE LOBBYING PROCESS: FROM BEGINNING TO END”—William Pascrell, Princeton Public Affairs Group.  
(May 14)—PaVac Awards Night. “COLORED ORGANIC PIGMENTS FOR THE COATINGS INDUSTRY”—Peter Lewis, Sun Chemicals.

### Pacific Northwest

- (Mar.)—“AN ADDITIVES APPROACH TO DEFECT ELIMINATION IN THERMOPLASTIC WATERBORNE INDUSTRIAL MAINTENANCE COATINGS”—Joel Schwartz, Air Products & Chemicals Co.  
(Apr.)—“RHEOLOGICAL MEASUREMENTS AND HOW THEY APPLY TO THE PAINT AND COATINGS INDUSTRY”—Scott Krane, Haake Instruments.  
(May)—“THE LATEST TRENDS IN ACCELERATED CORROSION TESTING: PROHESION, QUV AND AUTOMOTIVE CYCLIC CORROSION TESTING”—Steve Grossman, Q-Panel Corp.

### Philadelphia

- (Mar. 14)—“WHO BUYS TRADE SALES PAINTS, WHERE, AND WHEN”—Allen Irish, NPCA; Bill Cook, Wm. Cook & Co., and John Stauffer, Rohm & Haas Co.  
(Apr. 26)—Awards Night  
(May 8-10)—Eastern Training Conference and Technical Seminar.

### Pittsburgh

- (Mar. 11)—Past-President's Night.  
(Apr. 8)—“COATINGS FOR AUTOMOTIVE PLASTICS”—Jack Burgman, PPG Industries, Inc.

- (May 13)—Society Officer Elections and Spouses' Night.

### Rocky Mountain

- (Mar. 11)—“AN ADDITIVES APPROACH TO DEFECT ELIMINATION IN THERMOPLASTIC WATERBORNE INDUSTRIAL MAINTENANCE COATINGS”—Joel Schwartz, Air Products & Chemicals Co.  
(Apr. 8)—“RHEOLOGICAL MEASUREMENTS AND HOW THEY APPLY TO THE PAINT AND COATINGS INDUSTRY”—Scott Krane, Haake Instruments.  
(May 6)—“THE LATEST TRENDS IN ACCELERATED CORROSION TESTING: PROHESION, QUV AND AUTOMOTIVE CYCLIC CORROSION TESTING”—Steve Grossman, Q-Panel Corp.

### Toronto

- (Mar. 18)—“HEAVY DUTY MAINTENANCE COATINGS—THE CANADIAN EXPERIENCE”—Speakers from the Ministry of Transportation and the Corrosion Service Co., Ltd.  
(Apr. 15)—Annual Technical Symposium.  
(May 13)—“THE APPLICATION OF SCIENCE TO THE EXAMINATION AND CONSERVATION OF MUSEUM OBJECTS”—Sandra Lawrence, Ontario Gallery of Art.

## Society Sponsored Event

Northwestern Society for Coatings Technology

presents

### 25th Annual Technical Symposium

*“Waterborne Coatings: Formulating for the Future”*

March 5, 1996

Minneapolis Airport Marriott  
Minneapolis, MN

For more details, contact  
Kristin Halverson at (612) 469-1500 or  
David Anson and (612) 522-6621

## People in the News



**W.B. Irvine**

**W. Bryn Irvine**, of the CDIC Society, has been named Vice President and Sales Manager for Palmer Supplies Co., Cleveland, OH. Now based in Cleveland, Mr. Irvine previously worked out of Cincinnati as a Sales Representative.

Resulting from the sale of the *American Paint and Coatings Journal* to Douglas Publications, Inc., Richmond, VA, several staffing changes have been made at The American Paint Journal Co., St. Louis, MO. St. Louis Society member **Chuck Reitter**, former Editor and corporate President, will rejoin the publication's staff and serve as Editor and Group Publisher.

Other appointments include: **Mark Padow**—Associate Editor; **Fred Speckmann**—Associate Publisher; and **Ross Snodgrass**—District Manager.

Zeneca Resins, Wilmington, MA, has named **Robert J. Seidewand** Director of Marketing and Technology. In his new role, Dr. Seidewand is responsible for all technical, marketing, and sales functions for the company.

Other appointments include: **Susan M. Anderson**—Industry Business Manager for Architectural Coatings and Graphic Arts; **William L. Otterbein**—Industry Business Manager for Industrial Coatings and Adhesives and Sealants; **Gregory P. Reardon**—Manager, Marketing, Planning and Communications; **John H. Kibbee**—Demand Manager; **Michael O'Shaughnessy**—Manager Business Development, Latin America; **James Gistis**—Sales Manager, Architectural Coatings and Graphic Arts; **Gail Pollano**—Sales Manager, Industrial Coatings and Adhesives and Sealants; **Clifford Tishler**—Distributor Manager; **James J. Bilancieri**—Applications Manager, Architectural Coatings; **Ronald A. Lombardi**—Applications Manager, Graphic Arts; **Nicholas Nash**—Applications Manager, Industrial Coatings and Adhesives and Sealants; **Brian Hagaman**—Product Manager; and **Mary L. Hamilton**—Product Manager.

Ms. Pollano and Mr. Hagaman are members of the New England Society.

**Raj Saxena** has been appointed Western Regional Sales Representative for Coatings Raw Materials for Huls America Inc., Somerset, NJ. He will oversee the sales of the company's coatings raw materials product lines.

J.F. Shelton Co., Vancouver, B.C., has appointed Pacific Northwest Society member **Allan Green** Regional Manager of its subsidiary, J.F. Shelton Canada, Inc. His primary focus will involve representing a variety of raw material and specialty containers lines to the paint and coatings industry.

Cleveland Pigment & Color Co., Akron, OH, has hired **Douglas A. Leiberman** as Sales Representative. Mr. Leiberman will serve customers in Ohio, western Pennsylvania, and eastern Indiana.

In a related move, **Michael McKenna**, of the Cleveland Society, will head the company's new sales office in Chicago, IL. This office will handle customers in Illinois, Wisconsin, and Minnesota, as well as portions of Michigan and northwestern Indiana.



**S.B. Buckman**

Buckman Laboratories International, Inc., has selected new officers. Elected are: **Steven B. Buckman**—Chairman of the Board, Chief Executive Officer, and Chief Operating Officer; **Robert H. Buckman**—Vice Chairman; and **Edson P. Peredo**—President.

**Brian R. Swallow** has been appointed to the newly created executive position of Director, Pigment Manufacturing Worldwide for The Mearl Corp., Briarcliff Manor, NY. Reporting to Mr. Swallow will be the company's facilities in Peekskill, NY; Charleston, SC; and Eastport, ME.

The company has also elected **Dominick A. Pincairo** to the position of Chairman of the Board. He succeeds **Leon M. Greenstein**, who had served as Chairman since 1988.

**Philip Morey** has been appointed to head AQS Services, Inc., Atlanta, GA, a new subsidiary of Air Quality Sciences, Inc. Dr. Morey is a nationally and internationally recognized indoor air quality specialist and microbiological expert.

The American Physical Society, Akron, OH, has announced the winner of its 1996 High Polymer Physics Prize. Awarded is **Alan N. Gent**, the Harold A. Morton Professor Emeritus of Polymer Engineering and Polymer Physics at The University of Akron.

### Emulsion Polymer Development Chemists Needed

Positions available in the U.S. and Europe. Advanced degree preferred. Send resumes in confidence to:

Mike Fahey  
NORTECH RESOURCES  
321 Delaware Ave.  
Delmar, NY 12054  
Phone: (518) 475-9700  
Fax (518) 475-0981

### Quality

### Used

### Equipment

### For Sale

High speed dispersers, pebble mills, horizontal and vertical media mills, pumps, chillers, filling and packaging machinery, laboratory instruments, safety, material handling equipment. Call for complete listing. We also buy your surplus equipment.

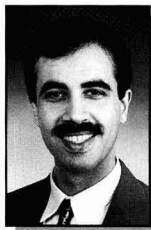
**Western Equipment Co.**  
(510) 820-8883  
FAX: (510) 820-9188

### Wanted—Experienced Paint Chemist/ Technical Director

Great opportunity to join an established Trade Sales manufacturer located in sunny El Paso, Texas. We're looking for an experienced TS chemist with at least five years of experience formulating trade sales, light industrial, and VOC compliant coatings. Stimulating and challenging work environment. Excellent compensation package in a part of the country with ideal year-round climate. MOST importantly, we offer a growth opportunity for the future. Our employees know of this ad. Send confidential resume with employment/salary history to W.M. Tunno, Hanley Paint Co., P.O. Box 12130, El Paso, TX 79913.



**A. Pandit**



**A. Niroomand**

**Ardhyang Pandit** has been appointed Staff Scientist within the Coatings and Construction Materials business group of Rhône-Poulenc, Cranbury, NJ. Mr. Pandit, who will provide technical and applications support, has 18 years of experience in coatings.

**Amir Niroomand** has also joined the company as Research Chemist. His focus will be on the formulation and testing of polyisocyanates for industrial and maintenance coatings.

The Board of Directors of Witco Corp., Greenwich, CT, has chosen its corporate officers. Elected are: **David Barton**—Group Vice President; **John Bondur**—Vice President, Human Resources; **Bruce Davis**—Vice President of Purchasing and Logistics; **Dick Liu**—Group Vice President, Asia/Pacific; and **Peter Loewrigkeit**—Group Vice President, Resins. Mr. Davis is a member of the Chicago Society.

In other news, the company has promoted **Ronald Edelstein** to Chief Information Officer. He was previously General Manager of Information Systems.

PPG Industries, Inc., Pittsburgh, PA, has elected **Raymond W. LeBoeuf** to the position of President, Chief Operating Officer, and a Director of the Corporation. Mr. LeBoeuf will operate all units of the company plus the purchasing and distribution, science and technology and information technology departments.

In addition, **Frank A. Archinaco** was appointed Senior Vice President, Glass, and **E. Kears Pollock** was named Senior Vice President, Coatings and Resins.

Elsewhere, **Daniel E. Adams** accepted the position of Marketing Manager, Carrier and Coatings, in the company's Silicas unit. Mr. Adams will be responsible for recommending, formulating, and implementing global strategies for these business segments.

The Society of Manufacturing Engineers, Dearborn, MI, has selected **Scott W. Beckwith**, President of Beckwith Technology Group, Murray, UT, as the 1996 recipient of its J.H. "Jud" Hall Composites Manufacturing Award. Dr. Scott has over 30 years of experience conducting and supervising work related to solid rocket propulsion and composite structures.

**John Kennedy** has been appointed Sales Manager, Latin America, for the Colorants and Biocides Division at Hüls America Inc., Somerset, NJ. Mr. Kennedy will be responsible for the sales of specialty minerals, colorants, and colorant systems into the Latin American market.

In other news, **Wolfgang Minnerup** was named Business Controller. Dr. Minnerup will development business strategies.

**Barrie H. Athol** has accepted the position of Marketing Manager of the Americas Marketing Organization of Datacolor International, Inc., Charlotte, NC. In his new position, Mr. Athol will direct marketing activities of the company's North and Latin America operations.

## Why Renew?

### Check Out Five Great Reasons Why You Should Renew Your Membership In The FSCT

- A 1-year subscription to the **JOURNAL OF COATINGS TECHNOLOGY**, the technical publication of the coatings industry, is included with your membership.
- Monthly Society technical talks offered locally keep **YOU** informed of the ever-changing technology in the coatings industry.
- Incredible **networking** opportunities with industry colleagues.
- Federation publications and seminars are available to you at substantial \$\$ savings.

Special **Member rates** for registration to the FSCT's International Coatings Technology Conference and International Coatings Expo (*formerly the Paint Industries' Show*).

### Your Membership In The Local Society Includes Membership In The Federation



For more information, contact your local Society, or write to Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (610) 940-0777 • Fax: (610) 940-0292

## OBITUARIES

**Malcolm S. Burgess, Sr.**, founder of Burgess Pigment Co., passed away on December 29, 1995.

Mr. Burgess was recognized as both a pioneer and leader in the kaolin industry. He was responsible for the formation of Burgess-Washington Clay, Ltd. which involved the development and continuing association with Thiele Kaolin Co.

In 1985, Mr. Burgess published *Kaolin, a Glacier's Gift to Georgia*, a book summarizing his life and the history of the kaolin industry.

Mr. Burgess is survived by his wife, Carol; a son, Malcolm S. Burgess, Jr.; a daughter, Ms. Stewart Burgess; and two grandchildren.

**Paul N. Gardner, Sr.**, President and CEO of the Paul N. Gardner Co., Inc., Pompano Beach, FL, died on October 10, 1995. He was a member of the Southern Society and the 50-Year Club of the Federation of Societies for Coatings Technology.

Mr. Gardner was also involved with ASTM D-1, which he joined in 1946. Prior to starting his company, with which he remained active until his death, Mr. Gardner was President and Chairman of the Board of the H.A. Gardner Co., Bethesda, MD.

Mr. Gardner is survived by his wife, Ardis C. Gardner; a son, Paul N. Gardner, Jr.; and a daughter, Sandra G. Landon.

**John R. Bourne**, Past-President of the Oil & Colour Chemists' Association (1987-88), passed away on August 25, 1995. The Birmingham Society member was 77.

## New Products



### Paints/ Coatings

#### Anti-Graffiti

DuPont High Performance Coatings has developed a high-gloss coating system designed to withstand repeated graffiti attacks. Imron® polyurethane enamel systems are engineered to provide a high-gloss, easily cleaned, hard coating that maintains gloss even after repeated removal of graffiti using lacquer thinner, MEK, or other caustic agents. It is available in clear or a variety of colors and may be applied over old finishes that are in decent condition.

Circle No. 30 on Reader Service Card

#### Waterborne Coatings

Two additions to Soluol Chemical Co. Inc.'s line of waterborne polyurethane coatings are introduced. Solucote 17-36C, which provides UV resistance, is a hard aliphatic waterborne polyurethane polymer for high performance uses where hardness, abrasion/chemical/solvent resistance, and flexibility are required. Solucote 76-199 is a hard aromatic waterborne polyurethane polymer designed for high performance interior uses or exterior uses where UV stability is not a critical factor.

Circle No. 31 on Reader Service Card



### Laboratory Apparatus

#### Filtration

A high performance membrane filtration system for paint/pigment waste is highlighted. V\*SEP® (vibratory shear enhanced process) performs separations ranging from molecular dimensions up to 40 microns. New Logic's technology, which may be used to wash and concentrate organic and inorganic pigments, allows manufacturers to take wash water and produce clear filtrate and concentrated sludge.

Circle No. 32 on Reader Service Card

#### Film Measurement

The PosiTector 100-B nondestructive handheld coating thickness gauge measures thin polymer coatings on nonmetal substrates such as plastic and wood. DeFelsko Corp. reports a measuring range of 0.3-20 mils. Included is an automatic temperature and pressure compensated probe to improve resolution at the lower range and repeatability.

Circle No. 33 on Reader Service Card

#### Spectrophotometer

A benchtop spectrophotometer employs a variety of functions that allow it to perform color measurement on solids, liquids, powders, and pastes. The CM-3500d uses an optional petri dish accessory, and is capable of measuring spectral transmittance of liquids or specimens in sheet or plate form. This apparatus is available from Minolta Corp.'s Instrument Systems Division.

Circle No. 34 on Reader Service Card

#### Diaphragm Pump

The Double Diaphragm Pump from Bran & Luebbe is engineered for pumping aggressive or environmentally hazardous chemicals, suitable for the chemical, petrochemical, pharmaceutical, and personal care industries. A visual gauge and/or limit switch signals system pressure/diaphragm failure and assures that no intermediate fluid will contaminate the process liquid. A visual and electrical alarm and a rupture detection system are provided for safety.

Circle No. 35 on Reader Service Card

#### Coating Thickness

The Fischerscope® X-ray XUV system, from Fischer Technology, is available for contact-free coating thickness measurement and coating alloy analysis. The system features PC-based operating software that automates a variety of measurement and data evaluation functions. The unit also includes multiple-focal planes, a dual-magnification optical system, and a new housing design to accommodate a range of shapes and sizes.

Circle No. 36 on Reader Service Card

#### Coating Gauges

ASOMA Instruments, Inc. offers coating gauges and monitors, including coating thickness/weight analyzers. These gauges use energy dispersive X-ray fluorescence (EDXRF) technology to test coatings on a range of substrates. A brochure describes the models and price ranges available, focusing on silicone on paper/plastic/film coating, conversion coating, and vacuum coating in situ.

Circle No. 37 on Reader Service Card

#### Moisture Analyzer

A gas moisture analyzer with a digital display is available from the Sahara Air Dryer Division of the Henderson Engineering Co. The readout indicates dewpoints from -120 to 80°F, and the probe operates from -166 to 158°F at pressures up to 5,000 psig in air, nitrogen, methane, carbon dioxide, and natural and other gases. Measurement is at operating pressure, not at atmosphere, eliminating correction charts.

Circle No. 38 on Reader Service Card



### Sealants/ Caulks

#### Color Formulations

Pelmor Laboratories, Inc. has added blue and white formulations to its line of high performance fluoroelastomer sealants, adhesives, and coatings. The white (PLV 2038) and blue (PLV 2002) two-component fluoroelastomers have been compounded from a fluorine-containing synthetic rubber. These products are reported to be temperature, chemical, UV, and abrasion resistant.

Circle No. 39 on Reader Service Card

#### Poly Flex Caulk

Polyseamseal® Poly Flex Caulk, a high-performance water-based sealant, is now available in squeeze tubes. Designed for easy application, this Darworth Co. product is available in 2.25 ounce tubes for small jobs and 6 ounce tubes for medium-sized projects. The caulk is paintable, cleans up with soap and water, and can be used indoors or out.

Circle No. 40 on Reader Service Card



### Books/ Publications

#### DOT Compliance

A new DOT compliance manual integrates EPA and DOT requirements for transporting hazardous wastes and other hazardous materials. This Elsevier Science Inc. publication includes more than 40 real-world examples. *Transporting Hazardous Wastes and Other Hazardous Materials: A Guide to DOT Regulations* provides guidance in transporting RCRA hazardous wastes, CERCLA hazardous substances, and PCB wastes in the United States.

Circle No. 41 on Reader Service Card

#### Safety Management

A guide to chemical process safety management that lists the highly hazardous and toxic chemicals regulated under the Clean Air Act Amendments of 1990 is available from the Environmental Resources Management Group. "Accidental Releases: A Guide for Industry" contains the combined list of 128 highly hazardous chemicals subject to the OSHA Process Safety Management Standard and the 140 toxic and flammable chemicals subject to the EPA's Accidental Release Prevention requirements.

Circle No. 42 on Reader Service Card

## Plastic Finishing

The Sherwin-Williams Co. offers a "Plastic Finishing Selector Guide" for specifying its line of Polane® polyurethane and Kem Aqua® waterborne coatings for common substrates and molding processes. The guide references substrates with primers and topcoats, along with VOC content. Recommendations are based on performance properties.

Circle No. 43 on Reader Service Card

## Functional Training

"Critical Issues in Industrial Training" has been printed. This Manufacturing Technology Strategies publication investigates the systematic application of functional training to make manufacturing workers problem solvers, technical writers, and trainers. Based on the principle that all learning is self-learning, functional training is a methodology that places learning responsibility with the worker.

Circle No. 44 on Reader Service Card

## Epoxy Resins

*Epoxy Resins, III*, a multiclient, techno-economic marketing study, has been completed by Skeist Inc. The report provides an investigation of product forms, markets, applications, types of resins, curing agents, technological trends, marketing shifts, prices, major suppliers, leading end users, and supply/demand. The industry analysis presents an evaluation of the structure of the epoxy business, and company profiles have been developed.

Circle No. 45 on Reader Service Card

## Protection and Safety

Corporate objectives for environmental protection and safety are described in "Guidelines for Responsible Care" in Environmental Protection and Safety. The booklet provides corporate guidelines for product stewardship, dialogue with employees and the public, environmental protection, occupational safety, plant safety, and hazard protection and safety in technological transfer. This publication is available from Bayer Corp.

Circle No. 46 on Reader Service Card



## Accelerated Weathering

Atlas Electric Devices Co. offers the XR35 xenon Weather-Ometer® for laboratory simulation of extreme climatic conditions. It is capable of testing materials under freeze/thaw conditions while exposing them to elevated UV levels. Humidity and chamber temperature are individually controlled to facilitate precise and repeatable test results.

Circle No. 47 on Reader Service Card



## Viscosity Cups

Available in four different orifice diameters, Gardco/Parlin viscosity cups are designed for measuring viscous materials such as adhesives. Machined from solid brass, the flat bottom has a press-fitted stainless-steel orifice. The cup was designed for the viscosity determination of Newtonian and near-Newtonian materials.

Circle No. 48 on Reader Service Card

## Steel Drums

Type 316 polished stainless steel drums, from Skolnik Industries, Inc., are engineered for corrosion and pitting resistance, tensile strength, and reusability. The drums are available in capacities of 20 through 55 gallons, with top, body, and bottom gauges of 1.5 or 1.2 mm. In both open and closed head styles, many containers are rated for UN solids and/or liquids.

Circle No. 49 on Reader Service Card

## Oil Analysis

Two new tribology products from CSI are designed to make oil analysis more accurate and affordable. The OilView® Particle Counter 51PC measures not only particles, but the quality of oil. The OilView Route Manager 51RM automates the administrative aspects of labeling samples, preventing mix-up of samples, and keying in the sample details.

Circle No. 50 on Reader Service Card

## Infrared Samples

Spectra-Tech Inc. introduces KBr powder packets to aid in infrared sample preparation. The packets are small, moisture and heat resistant, pre-measured packets containing 0.5 g of dry KBr powder, the amount used for preparing pellets for transmission analyses and dispersing a sample for diffuse reflectance analyses. The packets are available in quantities of 25, 100, 250, or 500.

Circle No. 51 on Reader Service Card

## Adhesive Primer

A new water-based, solvent-free, corrosion-inhibiting adhesive primer reportedly provides zero VOCs. The product, which can be used as a dip coating or sprayed using standard industrial equipment, including airless or HVLP systems, is engineered to simplify air pollution compliance for its users. BR®6747 from Cytec Engineered Materials Inc. contains no organic solvents.

Circle No. 52 on Reader Service Card

## Respirator Filters

Two new 3M respirator filters meet NIOSH 42 CFR 84 standards for respirator performance. The 8210 N95 particulate respirator is designed for worker protection against certain solid and non oil-based aerosol particles. The 2091 fiberglass-free filter provides protection against solid particulates such as dusts, welding fumes, lead, and asbestos, as well as oil-based and non oil-based liquid aerosols.

Circle No. 53 on Reader Service Card

## Epoxy System

Vianova Resins has developed a waterborne epoxy system that is designed to allow concrete surfaces to be primed and topcoated within eight hours of surface finishing. Beckopox® EP 384W epoxy resin and Beckopox AH 623 W special hardener is a specially formulated epoxy/hardener combination that can be applied to "green" concrete.

Circle No. 54 on Reader Service Card

## Drum Liner

A 15-mil thick, smooth-sided 55-gallon drum liner folds flat and nests for easy storage, but shakes open to install inside drums. Designed to fit into steel, fiber, or plastic drums, these seamless liners feature a molded lip to fit over the container top. Vacuum formed from LDPE, the ValuLiner™ VLN drum liner is available from the New England Plastics Corp.

Circle No. 55 on Reader Service Card

## Aerosol Emissions

Air Quality Sciences, Inc., announces an environmental chamber test protocol for measuring chemical emissions from consumer aerosol products. The protocol uses an environmental chamber set for actual indoor conditions and a control system remotely activates the aerosol container to release the product. Air samples are collected from the breathing zone of the user as well as the perimeter area and analyzed for volatile organic compounds, semi-volatile organic compounds, and particles.

Circle No. 56 on Reader Service Card

## ISO Documentation

Along with Polaroid Corp., The Media Group, Inc., presents The Documentation Kit, which includes a Polaroid Camera and a video entitled "Simplifying the ISO 9000 Documentation Process." The presentation educates the user on documenting for ISO 9000 certification and on using the camera. The video provides an overview of the quality manual, an understanding of the levels and format of documents, and details on controlling related documents in an ISO 9000 quality system.

Circle No. 57 on Reader Service Card



# Calendar of Events

## FEDERATION MEETINGS



For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (610) 940-0777, FAX: (610) 940-0292.

### 1996

(May 3-5)—FSCT Spring Week. Held in conjunction with the Pacific Northwest Society's Annual Spring Symposium. Seminar on the 3rd and 4th. Incoming Society Officers Meeting on the 4th. Board of Directors Meeting on the 5th. Doubletree Suites Hotel, Seattle, WA.

(Aug. 15-17)—Pan-American Coatings Expo. Co-sponsored by Federation of Societies for Coatings Technology, ANAFAPYT, and Instituto Mexicano de T cnicos en Pinturas y Tintas. Sheraton Maria Isabel Hotel, Mexico City, Mexico.

(Oct. 23-25)—International Coatings Technology Conference and Expo (Formerly Annual Meeting and Paint Industries' Show). McCormick Place North, Chicago, IL.

### 1997

(Nov. 5-7)—International Coatings Technology Conference and Expo (Formerly Annual Meeting and Paint Industries' Show). Georgia World Congress Center, Atlanta, GA.

## SPECIAL SOCIETY MEETINGS

### 1996

(Mar. 5)—"Waterborne Coatings: Formulating for the Future." 25th Annual Technical Symposium sponsored by the Northwestern Society, Minneapolis Airport Marriott, Minneapolis, MN. (Kristin Halverson, Chemcentral/Minnesota, 21675 Hamburg Ave., Lakeville, MN 55044; (612) 469-1500 or David Anson, Hirschfield's Paint Mfg., Inc., 4450 Lyndale Ave., N., Minneapolis, MN 55412; (612) 522-6621).

(Mar. 20-22)—Southwestern Paint Convention. Sponsored by Houston and Dallas Societies. Del Lago Resort, Conroe, TX. (Thomas Fitzgerald, Monarch Paint Co., P.O. Box 55604, Houston, TX 77255; (713) 462-5313).

(Apr. 16)—FOCUS '96—"Driving Technology to Meet New Challenges." Sponsored by the Detroit Society. Michigan State University Management Center, Troy, MI. (Rosemary Brady, Akzo Nobel Coatings, Inc., 1845 Maxwell St., P.O. Box 7062, Troy, MI 48007-7062; (810) 637-8565).

(Apr. 17)—"Spectrum of Coatings Science." Sponsored by the Louisville Society. Executive West Hotel, Louisville, KY. (Ilona Duvall, Red Spot Paint & Varnish, 1107 E. Louisiana, Evansville, IN 47711; (812) 467-2337).

(Apr. 24-25)—"Formulating, Manufacturing, and Painting for the Future." Cleveland Society Joint Manufacturing/Educational Conference. Sponsored by the Cleveland Society. John S. Knight Center, Akron, OH. (Jim Miller, J. Miller & Associates, 3057 Kent Rd., Silver Lake, OH 44224; (216) 688-5761).

(May 2-4)—49th Annual Spring Symposium. Sponsored by the Pacific Northwest Society. DoubleTree Suites Hotel, Seattle, WA. (Beverly Spears, Tarr, Inc., 4510 B St., N.W., Auburn, WA 98001; (206) 859-2979).

(May 8-9)—Eastern Training Conference and Show. Sponsored by the Philadelphia Society for Coatings Technology. Valley Forge Convention Center, Valley Forge, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435. Booth reservations: Sam Firestone, S.E. Firestone Associates, Inc., 101 Surrey Rd., Melrose Park, PA 19207-2931).

(May 8-10)—Southern Society Annual Meeting. Hyatt Regency-West Shore, Tampa, FL. (Walter R. Naughton Jr., Scott Paint Corp., P.O. Box 10218, Sarasota, FL 34278-0218; (813) 371-0015).

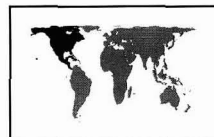
(June 14-15)—Joint Meeting of the St. Louis and Kansas City Societies. Holiday Inn, Lake of the Ozarks, MO. (Randall Ehmer, Walsh & Associates, Inc., 500 Railroad Ave., N. Kansas City, MO 64116; (816) 842-3014).

### 1997

(Feb. 18-20)—Western Coatings Societies' 23rd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA. (Bruce Cotton, Pluess-Staufner (California), Inc., P.O. Box 825, Lucerne Valley, CA 92356; (619) 248-7306; or Ron Elliott, J.R. Elliott Enterprises, Inc., 300 Thor Pl., Brea, CA 92621; (714) 529-0711).

## OTHER ORGANIZATIONS

### 1996—North America



(Mar. 4-6)—"Toughening of Polymers." Sponsored by The American Chemical Society: Division of Polymeric Materials: Science and Engineering. Hilton Head, SC. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

(Mar. 5)—Steel Water Tank seminar. Sponsored by Steel Plate Fabricators Association. Anaheim, CA. (Steel Plate Fabricators Association, 3158 Des Plaines Ave., Des Plaines, IL 60018).

(Mar. 11-13)—Ninth Annual Industrial Lead Paint Abatement and Removal Conference. Sponsored by Steel Structures Painting Council (SSPC). Pittsburgh Hilton and Towers, Pittsburgh, PA. (Dee Boyle, SSPC, 40 24th St., Pittsburgh, PA 15222).

(Mar. 11-14)—24th Annual Symposium and Equipment Exhibition. Sponsored by American Vacuum Society (AVS). Orlando, FL. (Margaret Stringer, AVS, 120 Wall St., 32nd Floor, New York, NY 10005).

(Mar. 11-15)—27th Annual Spring Program in Polymers. Sponsored by the Institute of Materials Science. The Grosvenor Resort Hotel-Disney World Village, Lake Buena Vista, FL. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Mar. 12-14)—Advanced Productivity Exposition. Sponsored by the Society of Manufacturing Engineers (SME). New Charlotte Convention Center, Charlotte, NC. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Mar. 13-14)—17th Annual Equipment Exhibition. Sponsored by American Vacuum Society (AVS). San Jose, CA. (Margaret Stringer, AVS, 120 Wall St., 32nd Floor, New York, NY 10005).

(Mar. 18-22)—"The Basic Composition of Coatings." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409-0010).

(Mar. 19-22)—BatchMaster Training Course. Sponsored by BatchMaster Software Corp. (Elizabeth Phillips, BatchMaster Software Corp., 1500 Pacific Coast Hwy., Ste. E, Seal Beach, CA 90740).

(Mar. 20-22)—"Electrocoat '96." Conference sponsored by Products Finishing. Clarion Plaza Hotel, Orlando, FL. (Cindy Goodridge, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

(Mar. 24-29)—NACEExpo/96. Colorado Convention Center, Denver, CO. (NACE International, P.O. Box 218340, Houston, TX 77218-8340).

(Mar. 25-28)—ARMA Spring Committee Meetings. Sponsored by Asphalt Roofing Manufacturers Association (ARMA). Atlanta, GA. (ARMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Mar. 25-28)—Westec Advanced Productivity Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Los Angeles Convention Center, Los Angeles, CA. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Mar. 26-29)—"Experiment Design Made Easy." Sponsored by Stat-Ease Corp. Raleigh, NC. (Rich Burnham, Stat-Ease Inc., Hennepin Square, Ste. 191, 2021 E. Hennepin Ave., Minneapolis, MN 55413-2723).

(Mar. 31-Apr. 3)—1996 Spring Convention. Sponsored by The Adhesive and Sealant Council, Inc. Hyatt Regency O'Hare, Rosemont, IL. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Apr. 9)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Philadelphia, PA. (Brookfield Engineering Laboratories, Inc., Dept. NR-118, 240 Cushing St., Stoughton, MA 02072).

(Apr. 11)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Chicago, IL. (Brookfield Engineering Laboratories, Inc., Dept. NR-118, 240 Cushing St., Stoughton, MA 02072).

(Apr. 13-14)—"Eastern Education & Trade Fair." Sponsored by the National Decorating Products Association (NDPA). Sturbridge Host Hotel, Sturbridge, MA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Apr. 14-17)—The American Ceramic Society's 98th Annual Meeting and Exposition. Indiana Convention Center and RCA Dome, Indianapolis, IN. (The American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081-8720).

(Apr. 16-18)—1996 Annual Forum. Sponsored by The Conference on Safe Transportation of Hazardous Articles (COSTHA). Atlanta Airport Hilton and Towers, Atlanta, GA. (COSTHA, 9053 Shady Grove Ct., Gaithersburg, MD 20877).

(Apr. 16-19)—"Introduction to Coatings Science." Short course sponsored by The University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406).

(Apr. 22-23)—"Practical Chemistry of Polyurethanes and Diisocyanates." Seminar sponsored by Technomic Publishing Co., Program Division. Sheraton Colony Square Hotel, Atlanta, GA. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Apr. 22-26)—"Basic Coatings for Sales, Marketing, and General Personnel." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409-0010).

(Apr. 22-26)—23rd International Conference on Metallurgical Coatings and Thin Films (ICMCTF '96). Sponsored by the American Vacuum Society. Town & Country Hotel, San Diego, CA. (Mary Gray, Conference Secretary, 1090 G Smallwood Dr., Ste. 502, Waldorf, MD 20603).

(Apr. 23-25)—Fabtech East. Sponsored by the Society of Manufacturing Engineers (SME). Pennsylvania Convention Center, Philadelphia, PA. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Apr. 23-25)—Rapid Prototyping and Manufacturing Conference & Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Hyatt Regency Hotel, Dearborn, MI. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(Apr. 23-26)—"Response Surface Methods for Process Optimization." Sponsored by Stat-Ease Inc. Minneapolis, MN. (Carol Summer, Stat-Ease Inc., Hennepin Square, Ste. 191, 2021 E. Hennepin Ave., Minneapolis, MN 55413-2723).

(Apr. 24-25)—"Advances in Polyurethane Foam Formulation." Seminar sponsored by Technomic Publishing Co., Program Division. Sheraton Colony Square Hotel, Atlanta, GA. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Apr. 28-May 1)—American Oil Chemists' Society (AOCS) Meeting. Indiana Convention Center and RCA Dome, Indianapolis, IN. (AOCS Education/Meetings Dept., P.O. Box 3489, Champaign, IL 61826-3489).

(Apr. 28-May 2)—Radtech North America. Exhibition and Conference sponsored by RadTech International North America. Nashville, TN. (Christine Dionne, RadTech International North America, 60 Revere Dr., Ste. 500, Northbrook, IL 60062).

(Apr. 30-May 1)—"Thermoplastic Foams." Seminar sponsored by Technomic Publishing Co., Program Division. Sheraton Colony Square Hotel, Atlanta, GA. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(May 1-2)—"Paint Volatile Organic Compounds (VOC)." Training course sponsored by the American Society for Testing and Materials (ASTM). Cleveland, OH. (Tina Falkenstein, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(May 1-2)—Automotive Finishing Conference & Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Cobo Center, Detroit, MI. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121).

(May 5-7)—1996 ISCC Annual Meeting and Joint Symposium. Sponsored by the Inter-Society Color Council. Doubletree Guest Suites Resort at Walt Disney World Village, Lake Buena Vista, FL. (Robert T. Marcus, ISCC Publicity Chairman, c/o Pantone, Inc., 590 Commerce Blvd., Carlstadt, NJ 07072-3098).

(May 6-10)—"Dispersion of Pigments and Resins in Fluid Media." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(May 7)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Atlanta, GA. (Brookfield Engineering Laboratories, Inc., Dept. NR-118, 240 Cushing St., Stoughton, MA 02072).

(May 8-9)—ARMA Executive Committee Meeting and Board of Directors Meeting. Sponsored by Asphalt Roofing Manufacturers Association

(ARMA). Baltimore, MD. (ARMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(May 8-9)—"Surgical Tissue Adhesives." Seminar sponsored by Technomic Publishing Co., Program Division. Westin Hotel, San Francisco, CA. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(May 9)—Rheology Seminar. Sponsored by Brookfield Engineering Laboratories, Inc. Kansas City, MO. (Brookfield Engineering Laboratories, Inc., Dept. NR-118, 240 Cushing St., Stoughton, MA 02072).

(May 12-17)—42nd Annual Technical Meeting and Exposition of the Institute of Environmental Sciences. Radisson Twin Towers Hotel, Orlando, FL. (Institute of Environmental Sciences, 940 E. Northwest Hwy., Mt. Prospect, IL 60056).

(May 13-17)—"Physical Testing of Paints and Coatings." Short Course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409-0010).

(May 13-18)—"Interpretation of IR and Raman Spectroscopy." Short course sponsored by the Fisk Infrared Institute. Vanderbilt University, Nashville, TN. (Clara Craver, Fisk Infrared Institute, 1000 17th Ave., N., Nashville, TN 37208).

(May 14-17)—"Practical Emulsion Polymerization." Conference sponsored by Business Communications Co., Inc. Ramada Plaza, Stamford, CT. (Business Communications Co., Inc., 25 Van Zant St., Norwalk, CT 06855).

(May 20-22)—"Advances on Flame Retardancy of Polymeric Materials: Applications, Materials, Industry Developments, Markets." Conference sponsored by Business Communications Co., Inc. Ramada Plaza, Stamford, CT. (Business Communications Co., Inc., 25 Van Zant St., Norwalk, CT 06855).

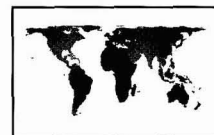
(May 20-24)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Professional Development Institute, P.O. Box 1792, Kent, OH 44240).

(May 21-23)—Eastec Advanced Productivity Exposition. Sponsored by the Society of Manufacturing Engineers (SME). Eastern States Exposition Center, West Springfield, MA. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

(May 21-24)—"Coatings Science for Coatings Technicians." Short course sponsored by The University of Southern Mississippi (USM), Hattiesburg, MS. (Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406).

## 1996—Africa

(Mar. 25-29)—"Coatings for Africa '96." Sponsored by Oil & Colour Chemists' Association (OCCA). Cape Town Civic Centre, Cape Town, South Africa. (Chris Pacey-Day, SURFEX Ltd., Priory House, 967 Harrow Rd., Wembley HA0 2SF, England).



## 1996—Asia

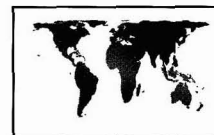
(Mar. 12-13)—Middle East Coatings Show. Exhibition and conference sponsored by FMJ International. Hyatt Regency Hotel, Dubai, United Arab Emirates. (Mike Tarrant, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS).

(May 28-31)—China Coat. Exhibition sponsored by Sinostar International Ltd. Guangzhou, China. (Sinostar International Ltd., 1001 Shiu Lam Bldg., 23 Luard Rd., Wanchai, Hong Kong).

(June 5-6)—Asia-Pacific Coatings Show. Exhibition and Conference sponsored by FMJ International. Hong Kong Convention and Exhibition Centre, Hong Kong. (Mike Tarrant, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

(June 5-8)—The International Exposition for Coatings & Paints. Sponsored by Chinese Chemical Society (CCS) and Chemical Industry and Engineering Society of China (CIESC). Shanghai Exhibition Center, Shanghai, P.R. China. (Worldwide Exhibitions Service Co., Ltd. (WES), 4/F, Bldg. 2, 1486 Nanjing Rd. (W), Shanghai 200040, P.R. China).

(June 12-13)—Korean Coatings Show '96. Exhibition and Conference sponsored by FMJ International. Hong Kong Convention and Exhibition Centre, Hong Kong. (Nicky Molloy, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

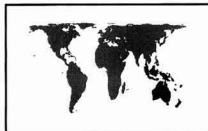


(July 9-12)—Autofact Asia Conference. Sponsored by the Society of Manufacturing Engineers (SME). Singapore International Convention and Exhibition Center (Suntec City), Singapore. (SME, One SME Drive, P.O. Box 930, Dearborn, MI 48121-0930).

## 1996—Australia

(Jan. 18-25)—International Schools and Conference on X-ray Analytical Methods—AXAA '96. Sponsored by the Australian X-ray Analytical Association (AXAA), Inc. Sydney, Australia. (The Secretariat, AXAA '96, GPO Box 128, Sydney, NSW 2001, Australia).

(Aug. 11-16)—Third International Hydrocolloids Conference. Cosponsored by the CSIRO and the Cooperative Research Centre for Industrial Plant Biopolymers. Landmark Park Royal Hotel, Potts Point, Sydney, Australia. (Gail Hawke, Third International Hydrocolloids Conference, P.O. Box N399, Grosvenor Place, Sydney, NSW 2000, Australia).



## 1996—Europe

(Mar. 4-6)—Carbon Black '96. Conference sponsored by Intertech. Le Meridien Hotel, Nice, France. (Melanie Briggs, Intertech Conferences, 411 U.S. Route One, Portland, ME 04105).

(Mar. 11-13)—"Design of Experiments." Training course sponsored by Paint Research Association (PRA). Teddington, Middlesex, England. (Sue Benjamin, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD England).

(Mar. 18-22)—"Globe '96." Sponsored by Maack Business Services. Davos, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Mar. 26-28)—"Pressure Sensitive Adhesives: Materials, Testing, and Applications." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Mar. 27-28)—"Practical Chemistry of Polyurethanes and Diisocyanates." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Apr. 11-12)—"Polymer Structure and Practical Properties." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Apr. 15-17)—"Color Measurement and Color Control." Training course sponsored by Paint Research Association (PRA). Teddington, Middlesex, England. (Sue Benjamin, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD England).

(May 7-8)—"Hydrogels: Specialty Plastics for Biomedical and Pharmaceutical Applications." Seminar sponsored by Technomic Publishing AG. Basel Hilton Hotel, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

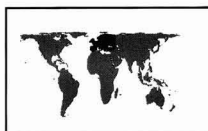
(May 8-10)—"Medical Packaging Technology and Validation of the Packaging Process." Seminar sponsored by Technomic Publishing AG. Zurich Hilton Hotel, Zurich, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(May 21-22)—"Thermoforming: Process and Design." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(May 23-24)—"Thermoplastic Foams." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(May 30-31)—"Nanomaterials: Design, Preparation, Characterization, and Applications." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(June 3-5)—"Styrenics '96." Sponsored by Maack Business Services. Zurich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).



(June 4-5)—"Sealing Technology: Materials, Design, and Applications." Seminar sponsored by Technomic Publishing AG. Hotel International, Basel, Switzerland. (Program Division, Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(June 10-14)—FATIEPEC. Conference sponsored by the Belgian Association of Coatings Technicians. Brussels, Belgium. (Michael Kuhn, Vincentz Verlag, Postfach 6247, 30062 Hannover, Germany).

(June 11-13)—European Coatings Show '96. Exhibition and conference sponsored by Vincentz Verlag. Brussels, Belgium. (Michael Kuhn, Vincentz Verlag, Postfach 6247, 30062 Hannover, Germany).

(June 10-13)—"Science and Technology of Pigment Dispersion." Vitznau (Luzern), Switzerland. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

(June 17-19)—18th International Conference in Stabilization and Controlled Degradation of Polymers. Luzern, Switzerland. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

(June 25-26)—SURFEX '96. Sponsored by Oil & Colour Chemists' Association (OCCA). Harrogate, North Yorks, England. (Chris Pacey-Day, SURFEX Ltd., Priory House, 967 Harrow Rd., Wembley HA0 2SF, England).

(July 1-3)—Ninth International Symposium on Polymer Analysis and Characterization. Keele College, Oxford University, United Kingdom. (John Dawkins, Dept. of chemistry, Loughborough University of Technology, Loughborough, Leicestershire, LE11 3TU, United Kingdom).

(July 1-5)—22nd International Conference in Organic Coatings—Waterborne, High-Solids, Powder Coatings. Vouliagmeni (Athens), Greece. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

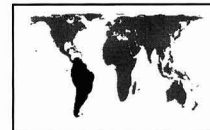
(Sept. 18-20)—EUROCOAT '96. Congress-Exhibition sponsored by Association Française de Techniciens des Peintures, Vernis, Encre D'Imprimerie, Colles et Adhésifs (FATIEPEC). Congress Centre, Genova, Italy. (AITIVA/EUROCOAT '96. Dr. R. Ferretto c/o Boero Colori, Via Molassana, 60, I-16138 Genova, Italy).

(Sept. 18-20)—"Polypropylene '96." Sponsored by Maack Business Services. Zurich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Oct. 21-22)—"World Congress PET '96." Sponsored by Maack Business Services. Zurich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

## 1996—South America

(July 10-11)—Latin American Coatings Show '96. Sponsored by FMJ International. Sheraton Hotel, Buenos Aires, Argentina. (Mike Tarrant, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).



## Advertisers' Index

<i>Air Products and Chemicals</i> .....	Cover 4
<i>FATIEPEC</i> .....	14
<i>Federation of Societies for Coatings Technology</i> .....	2
<i>Hüls America Inc.</i> .....	Cover 2
<i>Tricom</i> .....	Cover 3
<i>Western Equipment Co.</i> .....	73

NOTE: The Advertisers' Index is published for the convenience of our readers and as an additional service to our advertisers. The publisher assumes no liability for errors or omissions.

## Humbug from Hillman

Last August, Frank Borrelle and Sid Lauren met with me at the "Nest" to plot new methods for inhibiting scientific development in the coatings industry. For inspiration, Frank and I studied our pen pal Larry Hill's column, "Overspray" in *Surface Coatings Australia*. It soon became obvious that Sid was present to sabotage our efforts. He not only succeeded in aborting the program but he took a sneak picture of Frank and myself in a stupor while reading one of Larry's masterworks.

Somehow the photo made the pages of SCA. It is reported that at least three Aussies cancelled planned trips to the States after seeing Borrelle's picture . . . in fear that it could happen to them.

All this to introduce a sample of Larry Hill's splendid observations on the human condition. Viz:

A few thoughts on married life:

- The best way to keep a husband is in doubt.
- Pity women! Before marriage they have to wait up half the night for him to go; after marriage they have to wait up half the night for him to come home.
- Marriage ties do not exist; the wife always wins.
- When a man sees eye to eye with his wife, it means his vision has been corrected.
- Give a man enough rope—and he'll want to skip.
- The best way to remember your wife's birthday is to forget it once.
- After a man says "I do," he discovers a long list of things he better not do.
- Never marry for money; however, it is a good idea to associate with wealthy men/women and fall in love.
- When a person makes a mistake in his or her first marriage, the victim is the second spouse.
- And don't forget, maturity is the time of your life when, if you still had your youth, you would have the time of your life.



Chicago Society's Ted Fuhs wrote: "I found these on our bulletin board - - - They are outrageous!" . . . What do you think?:

"640 k ought to be enough for anybody."—Bill Gates, 1981.

- "Energize" said Picard and a pink bunny appeared.
- 640k- 4480k in dog bytes.
- A PROGRAM is used to turn data into error messages.
- A feature is a bug with seniority.
- A hangover: the wrath of grapes.
- All those who believe in telekinesis, raise my hand.
- Behavioral psychology: pulling habits out of rats.
- CONgress (n) - opposite of PROgress.
- Deja Moo—the feeling you've heard all this bull before.
- Desperate times call for cheap shots.
- Dime: a dollar with all the taxes taken out.
- Eagles soar, but weasels don't get sucked into jet engines.
- Gypsy dwarf escapes jail: Small medium at large.

- How come wrong numbers are never busy?
- How much deeper would the ocean be without sponges?
- I'm bored. I'm armed. And I'm off my medication.
- Lawyers: the larval form of politicians.
- Light year: a regular year with less calories.
- NEEDED: a voting machine with space for COMMENTS.
- Politics: Poli (Many) + Tics (Blood sucking parasites).
- Radioactive cats have 18 half lives.
- Radioactive halibut will make fission chips.
- Reality is the leading cause of stress.
- Refuse novocaine . . . Transcendental Medication.
- Vultures only fly with carrion luggage.
- What color is a chameleon in a mirror?
- What was the best thing BEFORE sliced bread?
- Why is "abbreviated" such a long word?



Bob Athey found the following philosophical fruitful thoughts in a newsletter from his local horticultural nursery:

"Why is it that our memory is good enough to retain the least triviality that happens to us, and yet not good enough to recollect how often we have told it to the same person?"—La Rochefoucauld

"When the missionaries came to Africa, they had the Bible and we had the land. They said, "Let us pray." We closed our eyes. When we opened them, we had the Bible and they had the land."—Bishop Desmond Tutu



Dave Platt brings us back to our occasional study of medical terminology with this contribution:

- Hangnail—Coat hook.
- Organic—Church music.
- Varicose veins—Veins very close together.
- Outpatient—Patient who has fainted.
- Morbid—Higher offer.
- Tumor—Extra pair.



And, some timely observations from Robert Link:

—A budget is a mathematical computation that proves you can't live on what you're earning.

—We're living in unusual times. There are pocket calculators, pocket cameras, and pocket recorders. In fact there is everything for the pocket . . . except money.

—Remember this: A positive attitude may not solve all your problems . . . but it will annoy enough people to make it worth the effort.

—Herb Hillman, *Humbug's Nest*,  
P.O. Box 135, Whitingham, VT 05361.



# INDUSTRY STANDARDS

## THE TELEVISION SERIES

Investigate the differences in VOC levels between waterborne acrylic maintenance coatings and solventborne paints as we speak with experts from Rohm & Haas Company. For pre-show information, call: 1-800-874-6917.



With expertise from the top industry professionals in the nation, this special edition of "Industry Standards" will bring you to the cutting edge of technology in today's dynamic Paint and Coatings Industry.



Examine the current demand for solvent-free and environmentally effective floor systems as we discuss advances in epoxy and polyurethane coatings technology with Master Builders. For information before the show, call: 1-800-227-3350.

Coming in February to the Discovery Channel Transponder and other cable networks.



Shell Chemical Company

Never underestimate what we can do together.™

Waterbase coatings are seeing new advances in the areas of resins and curing agents. Find out how these advances have helped to improve product performance with information from experts at Shell Chemical Company. For pre-show information, call: 1-800-TEC-EPON.

Bayer



Learn how the Bayer Corporation is developing raw materials for new polyurethane coatings technologies that satisfy both government environmental regulations and customer performance requirements. For information before the show, call: 1-412-777-2830.

 **LUBRIZOL**

Learn how research & development advances in the area of dispersants, rheology control additives, and surface modifiers have improved the performance of high solids solventborne coatings with experts from The Lubrizol Corporation. For preview information, call: 1-216-943-4200.

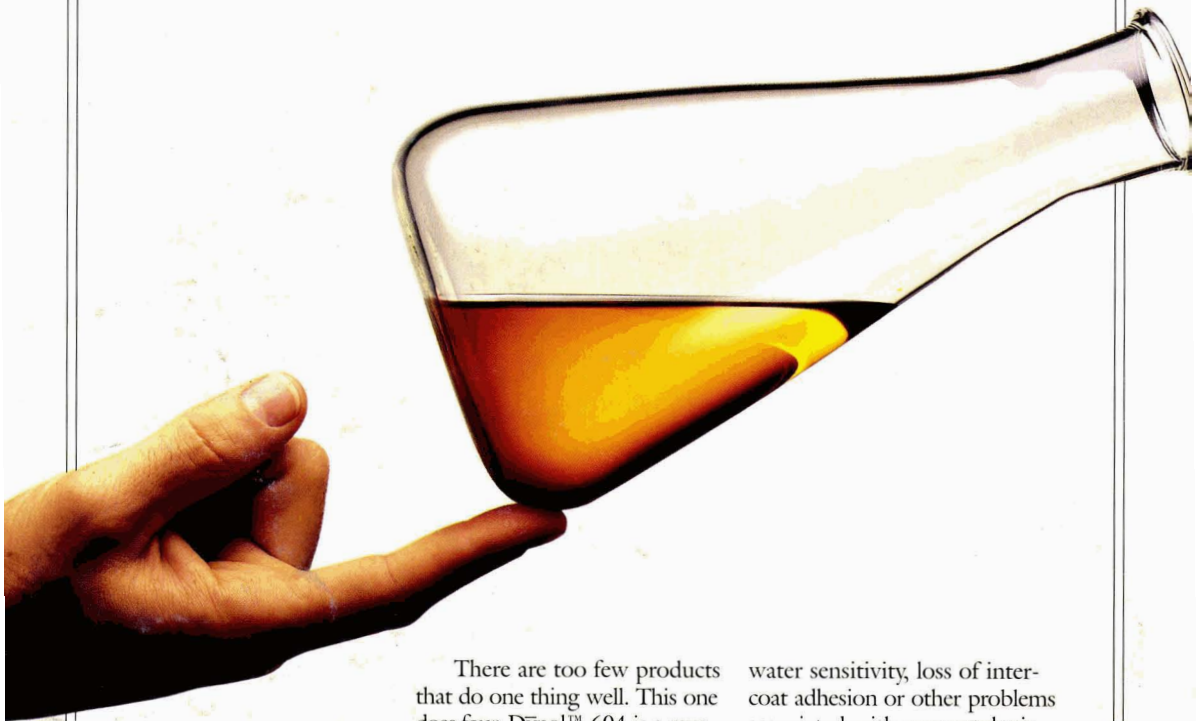


Find out how cooperative efforts between the paint manufacturer and the various raw material manufacturers are enhancing product performance. See how experts from the Sherwin Williams Company are meeting the challenges of VOC compliance. For additional information, call: 1-800-336-1110 ext. 1098.

**Tricom Pictures, Educating and Entertaining the World**  
**1-800-333-2008**



D̄ynol™ 604 surfactant. The perfect combination of reduced surface tension, low VOC and low foam with no drawbacks. That's quite a balancing act.



There are too few products that do one thing well. This one does four. D̄ynol™ 604 is a revolutionary new surfactant for water-based coatings, inks and adhesives from Air Products and Chemicals, Inc. And an excellent choice for difficult-to-wet substrates that require good flow and leveling under diverse conditions. It combines all the properties you want – the unique ability to significantly reduce *both* dynamic and equilibrium surface tension, the lowest dynamic surface tension of any organic surfactant available, and less than 1.5% VOC. All without increased foaminess,

water sensitivity, loss of intercoat adhesion or other problems associated with nonacetylenic technologies. D̄ynol 604 surfactant is the product of years of research and the natural evolution of Air Products' world-class water-based technology. D̄ynol 604 surfactant. When it comes to surfactants for waterborne coatings, inks and adhesives, this is the edge of the wave. For more information or a sample call (800) 345-3148 or (610) 481-6799.

**AIR**  
**PRODUCTS** 

*More than chemicals. Chemistry.*

© 1995 Air Products and Chemicals, Inc.

Circle No. 238 on the Reader Service Card