jct JOURNAL OF COATINGS TECHNOLOGY

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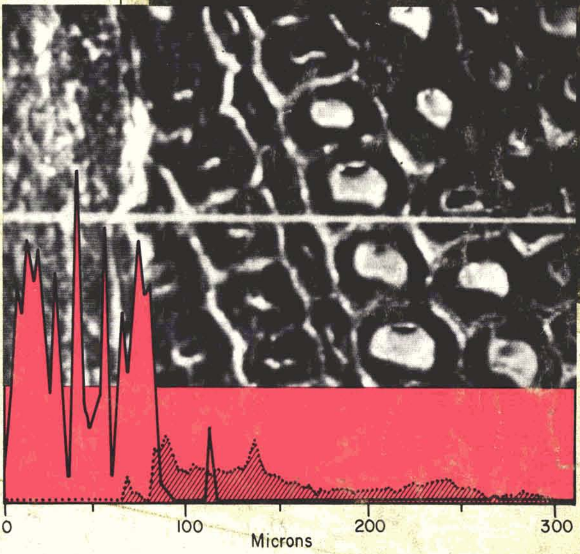
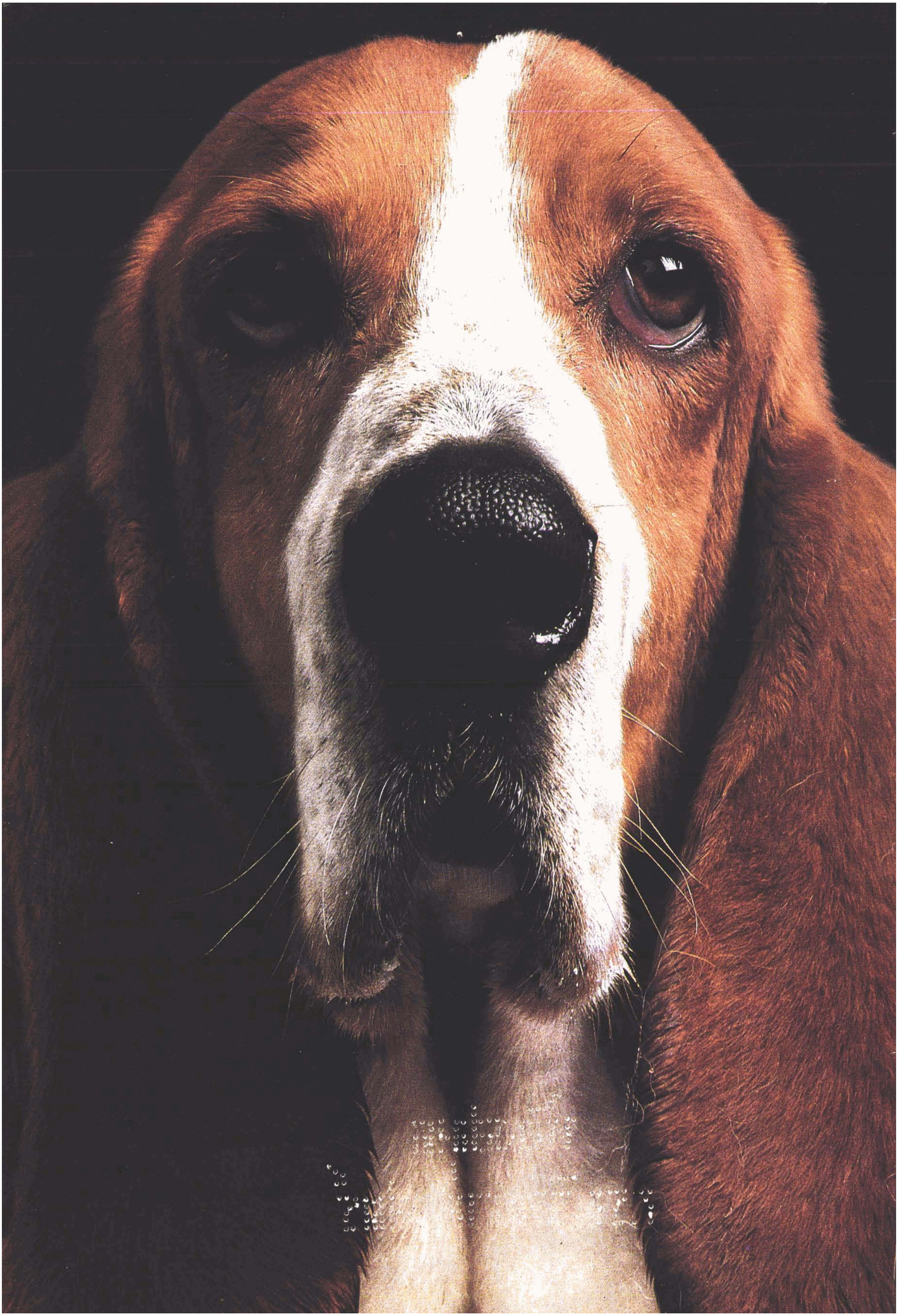
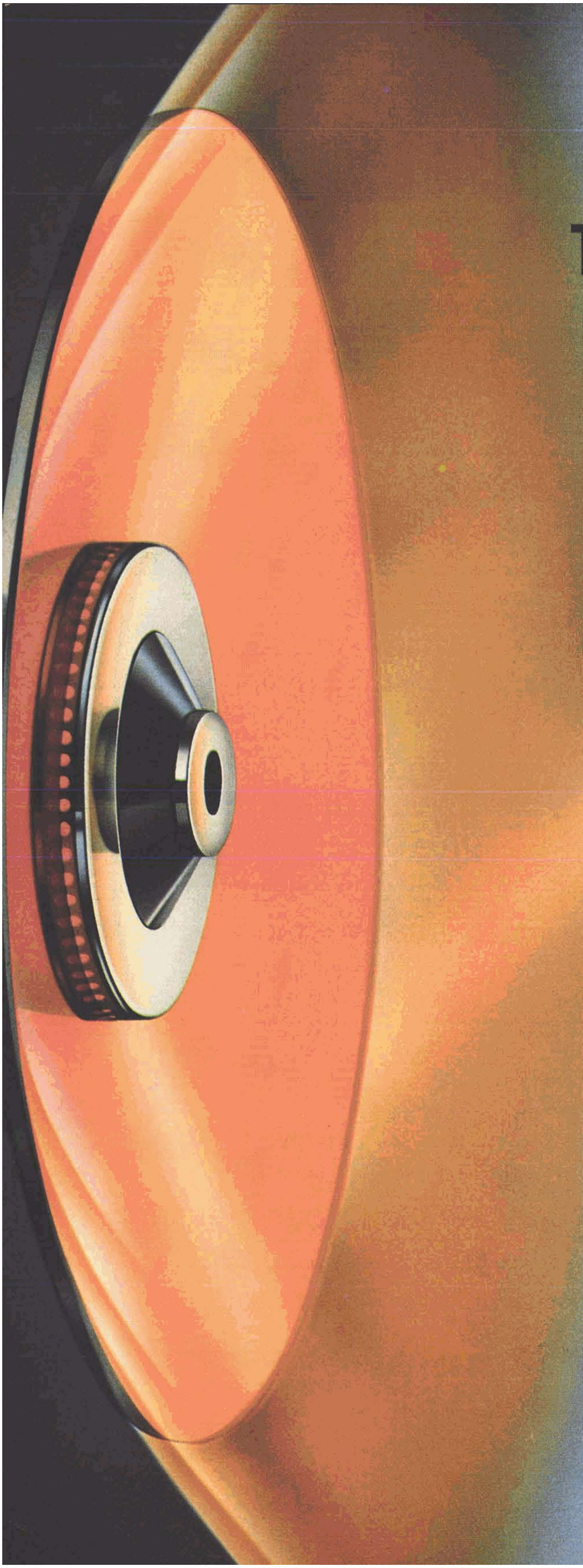
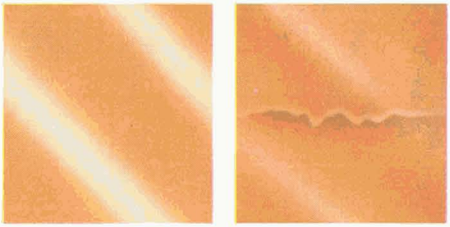
February 1989



Accumulation of Sulfur Compounds at the Interface of Paint and Wood Following Exposure to Sulfurous Acid.







FEBRUARY 1989

jct JOURNAL OF COATINGS TECHNOLOGY

VOLUME 61 NUMBER 769

Technical Articles

Federation News

Departments

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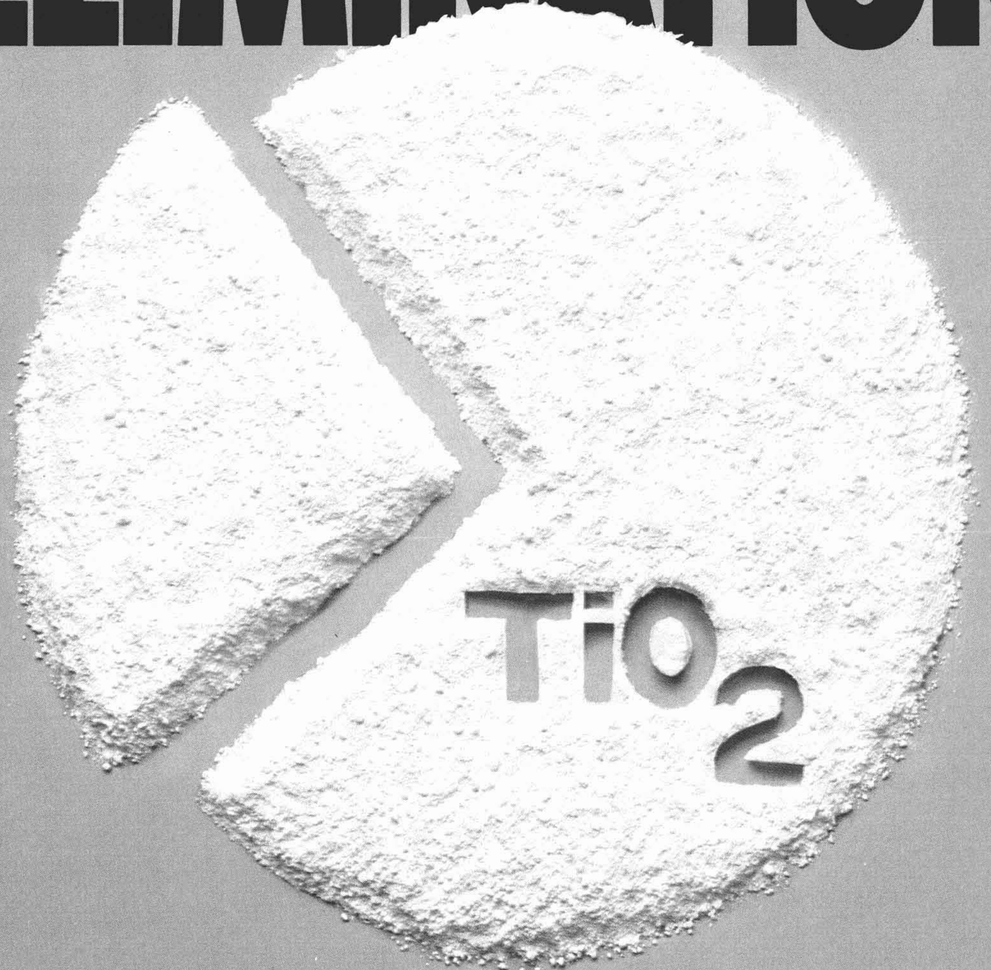
SOCIETY OF NATIONAL ASSOCIATION PUBLICATIONS

BPA

PROCESS OF ELIMINATION



New Ropaque® OP-62 cuts raw material costs.

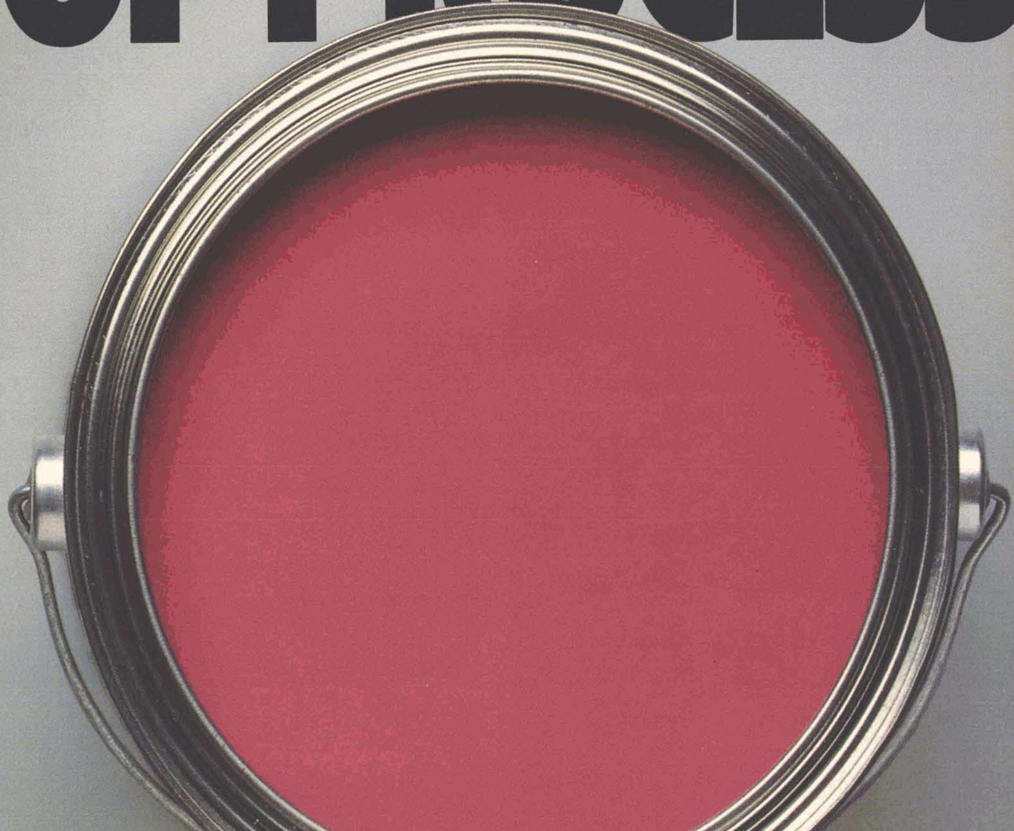
Now there's a better way to beat the high cost of TiO_2 without sacrificing the performance or quality of your paints.

Introducing the revolutionary new opaque polymer, Ropaque OP-62.

Like its predecessor Ropaque OP-42, new Ropaque OP-62 provides all the benefits of your existing paint formulation, but at a lower raw material cost. And it does so without losing scrub and stain resistance or adhesion.

In addition, new Ropaque OP-62 provides up to 50% greater hiding efficiency than its earlier counterpart. That means you use even less TiO_2 in the formulation of your paints. And that reduction can save you an average 10-20¢ per gallon.

So if you're looking for ways to reduce the cost of raw materials in your paints, why not try the process of elimination. New Ropaque OP-62.



JOURNAL OF
COATINGS
TECHNOLOGY

1315 Walnut St., Phila., PA 19107

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology at 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507. FAX: (215) 545-7703.

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Comment

Responsive Programming: We Hear You!

“We're back. You're tuned to FSCT, 769 AM, on “Coatings Today” in open forum and I see we have some listeners on the lines already, so let's go right to our first caller. Hello, what would you like to talk about?”

“Hi, I hope you can help me. I've heard that you're planning something really special as part of Spring Week this year. What's up?”

“Well, that seems to be a popular topic. You're right and we have all the details about it. You remember that Membership Survey sent out by the Professional Development Committee in 1986?”

“Yeah, so?”

“Well, in response to popular demand detailed on the survey, the Committee has developed a seminar on “Modern Analytical Resources: The Coatings Chemists' Ally,” to be held during Spring Week in Los Angeles on May 16-19.”

“That sounds too highbrow for me. What I need is something to help me solve everyday problems that come up in my lab and on-site. Besides, I'm no analytical chemistry genius.”

“No problem. This program is made for you! The seminar is designed for coatings chemists and others not specializing in analytical techniques. The Keynote Speaker, Clifford Schoff, and five leading industry experts will focus on practically applying these techniques to assist in solving paint-related problems. Besides, there will be plenty of opportunity for questions and answers during the seminar. Any other questions?”

“Just one more thing—is it too late to sign up?”

“No, I'll tell you what you should do. Did you receive your February issue of the JCT?”

“Got it right here.”

“Good, Now turn to page 10 and fill out the registration form. Send it to us today and we'll take it from there.”

“That's all I have to do? Well, thanks for your help. I'm looking forward to attending.”

“Glad I could help, I'll see you there. Okay, let's go to our next caller. . . . Hi, you're on “Coatings Today.” What's on your mind?”

“Yeah, about that last call. What page did you say that form was on?. . .”

Patricia D. Viola

Patricia D. Viola
Editor

Abstracts of Papers in This Issue

ACCUMULATION OF SULFUR COMPOUNDS AT THE INTERFACE OF PAINT AND WOOD FOLLOWING EXPOSURE TO SULFUROUS ACID—R.S. Williams, T.A. Kuster, and J. Spence

Journal of Coatings Technology, 61, No. 769, 19 (Feb. 1989)

Western redcedar *(Thuja plicata)* and southern pine *(Pinus* sp.) strips coated on all surfaces with acrylic latex paint were soaked for 10 days at room temperature in pH 2 sulfurous acid. Matched controls were soaked in distilled water. Analysis of cross sections using energy dispersive X-ray analysis showed an accumulation of sulfur compounds at the paint/wood interface on the specimens treated with acid. The sulfur concentration was highest in the wood just below the primer and decreased at a depth of several wood cells. The effect of the sulfur buildup on paint adhesion was not determined in this preliminary study, but it is the focus of continuing work.

USE OF A DISK CENTRIFUGE TO CHARACTERIZE VOID-CONTAINING LATEX PARTICLES—A.A. Cooper, M.J. Devon, and A. Rudin

Journal of Coatings Technology, 61, No. 769, 25 (Feb. 1989)

Void-containing polymer particles can be made by processes that include core-and-shell emulsion polymerizations. A disk centrifuge method is described for analyzing the particle size distribution and void volumes of products of this type. An equation has been developed to relate the diameter of a swollen particle with its sedimentation time on the disk centrifuge. The conditions have been established for which solutions to this equation are single valued. Examples are given of the synthesis and characterization of void-containing particles.

FOURIER TRANSFORM INFRARED SPECTROSCOPIC STUDIES OF COATINGS DEFECTS—D.J. Skrovanek

Journal of Coatings Technology, 61, No. 769, 31 (Feb. 1989)

Fourier transform infrared (FTIR) spectroscopy is applied to the study of several coatings defects in order to demonstrate its utility as a problem-solving tool. Specifically, weathering, cratering, quality control, and adhesion problems are addressed. The results indicate that infrared spectroscopy can be useful for studying coatings defects, especially when used in conjunction with an infrared microscope.

CHEMISTRY OF CURING REACTIONS: ROOM-TEMPERATURE CURE COATINGS BASED ON EPOXIES AND URETHANES—C. THANKACHAN

Journal of Coatings Technology, 61, No. 769, 39 (Feb. 1989)

To alleviate environmental pollution due to coatings emissions in baking ovens, novel coating compositions have been introduced, with emphasis on room-temperature cure. Epoxies and urethanes are of paramount importance in providing room-temperature cure coating compositions for a wide variety of applications. This review attempts to explain the chemistry of their curing mechanisms. Various curing reactions of epoxies and urethane formation are discussed.

Papers to Be Featured In the March Issue

"A Comparison of Catalysts for Crosslinking Acetoacetylated Resins via the Michael Reaction"—R.J. Clemens and F.D. Rector, of Eastman Chemical Products, Inc.

"Coatings with Interpenetrating Polymer Networks"—H.X. Xiao and K.C. Frisch, of Polymer Technologies, Inc., a subsidiary of University of Detroit.

"Effect of Substrate and Paint Layers on the Roughness and Appearance of a Silver Basecoat/Clearcoat System"—G.D. Cheever and P-A. P. Ngo, of General Motors Research Laboratories.

"Quantifying Pigment Dispersion—II. Iron Oxide Pigments"—Montreal Society for Coatings Technology, Technical Committee.

FSCT Seminar, May 16 and 17 in Los Angeles, Will Focus On Modern Analytical Techniques for the Coatings Chemist

The use of modern analytical techniques to assist in the solution of everyday coatings-related problems will be discussed at a 1-½ day seminar sponsored by the Federation of Societies for Coatings Technology.

Titled, "Modern Analytical Resources: The Coatings Chemist's Ally," the seminar will be held May 16-17 at the Los Angeles Airport Marriott, Los Angeles, CA, under the auspices of the Federation's Professional Development Committee.

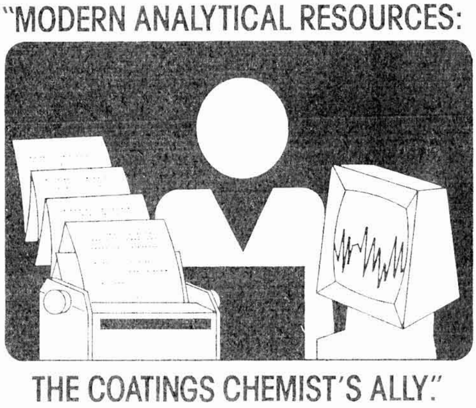
The program is aimed at the *coatings* chemist and others not specializing in analytical chemistry. The presentations and discussions will emphasize the practical application of analytical techniques to solving problems both in the laboratory and the field. There will be a minimum of discussion on the instrument and its operation; rather the accent will be on answering the question: "What Can the Technique Do for Me and My Company?"

Program

The Keynote Address will be delivered by Dr. Clifford K. Schoff, Scientist, PPG Industries, Inc., Coatings and Resins Research Center, Allison Park, PA, who will discuss "The Philosophy of Problem-Solving in Coatings Science and Technology." Dr. Schoff will also serve as Program Moderator.

Analytical resources available for solving problems in R&D and field performance of coatings will be explored in depth by three industry speakers, who will cover various techniques:

"Microscopy: Optical and Electronic"—Dr. Robert Z. Muggli, Senior Research Associate, McCrone Associates, Inc., Westmont, IL.



"Wet Chemistry, IR and Atomic Absorption Spectroscopy, and Chromatography"—James M. Julian, Senior Research Associate, DeSoto, Inc., Des Plaines, IL.

"X-Ray and Photoelectron Methods"—Dr. Norman E. Weston, Vice-President, Micron, Inc., Wilmington, DE.

Examples of how analytical techniques have helped solve some practical coatings problems will be described by Dr. Monroe Snider, Senior Research Associate, PPG Industries, Inc., Coatings and Resins Research Center, Allison Park, PA, and Richard M. Holsworth, Senior Scientist, The Glidden Co., Strongsville, OH.

An open forum will be featured, at which registrants can question speakers on specific problems and applications.

Registration

To register, fill out the accompanying form and return with payment to Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Included in the registration fee are copies of papers presented as well as a directory of independent testing laboratories.

Housing

Headquarters hotel is the Los Angeles Airport Marriott. If housing is required, please fill out the appropriate section of the registration form.

Complete program information can be obtained by contacting the Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, PA 19107 (Telephone: 215/545-1506).

FSCT 1989 Paint Show Adds Exhibit Space in New Orleans

The Federation has announced that the Paint Industries' Show will be held at both the Exhibition Center of the New Orleans Hilton and at The Rivergate, as previously announced. Due to the overwhelming success of the Paint Show, additional exhibit space is needed to accommodate all of the companies that wish to participate in New Orleans, November 8-10.

With the addition of the New Orleans Hilton, the 1989 Paint Show will have available a record-breaking 70,750 net square feet of exhibit space, making this the largest Paint Show in Federation history.

The New Orleans Hilton is conveniently located next to The Rivergate, and will also be the site of all technical programming during the 67th Annual Meeting of the Federation, which will be held concurrent with the Paint Show.

The theme of the Annual Meeting, "Coatings Worldwide: Meeting the Needs of the Nineties," underscores the coatings industry's heightened awareness that it is part of a global marketplace, and that all areas of interest and endeavor are being viewed from an increasingly international perspective.

Nine hotels have reserved blocks of rooms for the Federation: Marriott and Sheraton Hotels will serve as co-headquarters, other hotels include the Hilton, Doubletree, Holiday Inn Crowne Plaza, Meridien, Monteleone, Omni Royal Orleans, and Westin Canal Place.

For further information, please contact the FSCT at 1315 Walnut St., Philadelphia, PA 19107.

ANALYTICAL RESOURCES SEMINAR
REGISTRATION FORM

Registration fees: $150 (FSCT members); $180 (non-members)

Check must accompany registration form. Make checks payable to Federation of Societies for Coatings Technology. (Payment must be made in U.S. funds payable in U.S. banks.)

NICKNAME (For Registration Badge) ______________________________

FULL NAME ______________________________

JOB TITLE ______________________________

COMPANY ____________________ PHONE ____________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ______________

Name of Federation Society
Of Which You Are a Member ______________________________

No refund for cancelled registrations received after May 12.

Return form and check to: Federation of Societies for Coatings Technology
1315 Walnut Street, Suite 832
Philadelphia, PA 19107

IF YOU REQUIRE HOUSING AT THE MARRIOTT COMPLETE FORM BELOW

HOUSING FORM
Los Angeles Airport Marriott

NAME ______________________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ______________

Arrival Date ________ ☐ Before 6pm ☐ Late* Departure Date ______________

Please reserve: Single ______________ Double/Twin ________

Room rate is $93, single/$103, double occupancy (per night).

*Reservations will be held until 6:00 pm. If arrival is after 6:00 pm, hotel requires deposit for one night's lodging to guarantee availability. Make check payable to Los Angeles Airport Marriott.

Note: Reservations must be made no later than April 15 to guarantee availability and rates.

Return this form to: Federation of Societies for Coatings Technology
1315 Walnut Street, Suite 832, Philadelphia, PA 19107

Proposed Amendment to Federation By-Laws (For First Reading, May 19, 1989)

The question has been raised as to whether or not an individual elected to Society or Federation Honorary membership would be eligible to be elected or to continue to serve as a Society Representative, a position open to Society Active members only. It is the opinion of the By-Laws Committee that upon election to Society or Federation Honorary membership, an individual then assumes that class of membership.

Since election to Honorary membership is an honor, an individual should not be penalized in any manner for attaining that status, including the eligibility to serve on the Federation Board of Directors. It is not the intent of this Resolution to confer Active member status to any individual not holding that class of membership at the time of election to Honorary membership.

Therefore, be it RESOLVED that:

By-Laws Article I, Section A, Paragraph (2) Society Honorary Membership be amended as follows:

Add the following sentence:

"A Society Honorary Member shall continue to exercise all rights and privileges of the class of membership to which he or she would otherwise currently be entitled."

And, be it further RESOLVED that:

By-Laws Article I, Section A, Paragraph (3) Federation Honorary Membership be amended as follows:

Delete from the last sentence:

"and shall be entitled to receive all Federation publications regularly circulated to Active Members."

Add the following sentence:

"A Federation Honorary member shall continue to exercise all rights and privileges of the class of membership to which he or she would otherwise currently be entitled."

Comment: The By-Laws Committee recommends adoption.

Pacific Northwest Society Publishes Newsletter on Safety and Manufacturing

The Manufacturing Committee of the Pacific Northwest Society is soliciting participation in the publication of a newsletter for the exchange of ideas on safety and manufacturing, "Pacific Northwest Paintmaking." The newsletter, to be released quarterly, will contain two feature articles, one dealing with a safety issue, and the other with a manufacturing item. The Committee invites comments, ideas, safety, or manufacturing tips, and articles. Send submissions, which should be of general interest to all paintmakers, to the local editor. (Note: individual company supervisors must sign submissions.) In the Portland area, contact Kenneth A. Wenzel, McCloskey Corp., 4155 N.W. Yeon, Portland, OR 97210; in Seattle: Ross S. West, Preservative Paint Co., 54 Airport Way So., Seattle, WA 98108; and in Vancouver, B.C.: Valerie Braund, General Paint, 950 Raymur Ave., Vancouver, B.C. V8A 315.

67th Annual Meeting & 54th Paint Industries Show
FSCT
1989

1989 Edition of FSCT Guide to Coatings Courses Now Available

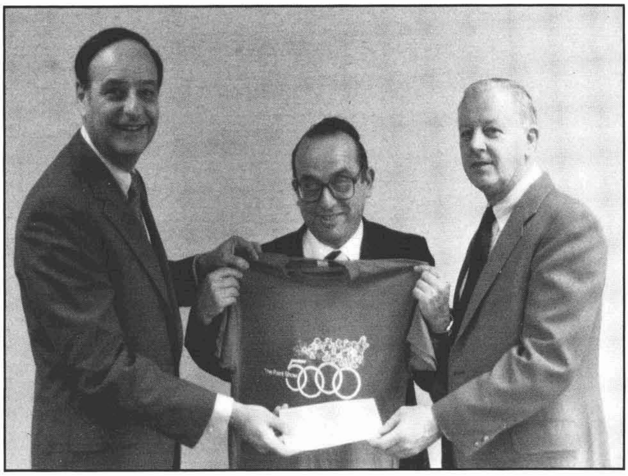
Publication of the 1989 edition of "Guide to Coatings Courses, Symposia, and Seminars" has been announced by the Federation of Societies for Coatings Technology.

Based on information supplied by FSCT Constituent Societies, educators, and various industry sources, the "Guide" lists a comprehensive variety of coatings educational offerings in the U.S. and Canada.

The listings are updated annually to reflect current information.

Copies of the "Guide" (8-1/2 x 11 in.) are available at a price of $5.00 each (postage paid).

To order, contact Federation of Societies for Coatings Technology, 1315 Walnut Street, Suite 830, Philadelphia, PA 19107 (Telephone: 215/545-1506).



"PAINT SHOW 5000" proceeds totalling $750 are presented by Mort Spiegel, Director of Sales and Marketing for Troy Chemical Corp. (left) to Thomas A. Kocis, FSCT Director of Communications and Field Services (right). The gift, which is donated to the Federation Scholarship Fund, represents proceeds from participants' registration fees for the five kilometer run, sponsored by Troy. The second annual Paint Show 5000 was held on October 20, in conjunction with the FSCT Annual Meeting and Paint Industries' Show in Chicago. Benjamin Dent (center) displays the souvinir t-shirt presented to runners

NPCA Presents 1988 Allen W. Clark Awards To Four Affiliates for Exemplary Community Service

The National Paint and Coatings Association (NPCA), Washington, D.C., has named four affiliates as recipients of the 1988 Allen W. Clark Award for exemplary community service. The awards were presented in October during the NPCA's 101st convention, held in Chicago, IL.

The following Clark recipients were named:

FIRST PLACE—Southern California Paint and Coatings Association (SCPCA). The SCPCA accomplished the objectives of the Clark Award in three separate projects. First, they assembled a team of over 300 union contractor volunteers and hundreds of area teens to remove graffiti from a six-block area of stores and business on Hollywood Boulevard. Color-coordinated shades with a special anti-graffiti coating were used to prevent future defacement. Second, they cosponsored, along with Coors Brewing Co., a paint-a-thon which brought a new coat of paint to the exteriors of 30 homes belonging to financially disabled senior citizens. Third, SCPCA joined forces with parents, teachers, and students to renew the Holmes Street Elementary School on Los Angeles' East Side.

SECOND PLACE—Louisville Paint and Coatings Association (LPCA). The LPCA refurbished the school facilities of the Home of the Innocents, a children's home and a historic landmark.

HONORABLE MENTION—Chicago Paint and Coatings Association (CPCA). A senior citizens' home, a mental health clinic, and a low-income neighborhood were among the beneficiaries of CPCA's program. Also, the Painted Ladies competition recognized homeowners for their creative use of paint.

HONORABLE MENTION—Wisconsin Paint and Coatings Association (WPCA). WPCA volunteers joined forces with area residents to bring an interior face lift to two women's shelters, Parent's Place and Regional Domestic Abuse Services Shelter, in Oshkosh. They also supported the city of Milwaukee in an innovative graffiti cleanup program that provided paychecks for unemployed minority teens.

The winners were selected from approximately 40 entries by an independent panel of industry representatives, who rated the works on the basis of three criteria: ability to showcase paint, contribution to the community, and industry exposure.

The Allen W. Clark Award is named in honor of Allen W. Clark, the founder of the *American Paint and Coatings Journal*, who launched the Clean-Up, Paint-Up, Fix-Up campaign in 1912.

Alcolac Signs Letter of Intent To Purchase Surfactants Plant

Alcolac, Baltimore, MD, and Berol Chemicals, Westport, CT, have executed a letter of intent for the transfer of the Berol Reserve, LA, plant to Alcolac. Completion of the transaction is scheduled for this month.

Alcolac will continue to manufacture many Berol products in a long-term cooperation and will assume manufacturing rights for several products now produced at the five-year-old plant.

All existing Berol employees at the Reserve production site will be kept by Alcolac and existing supply contracts will be honored. The facility produces ethoxylated surfactants for use in pulp, paper, agricultural, and industrial products. Alcolac plans substantial additional production of surfactants for personal care, institutional, and polymerization areas in the future.

Battelle Initiates Multiclient Program/Study On Free Volume Microprobe Applications

Battelle, Columbus, OH, has begun a multiclient program on "Free Volume Microprobe Applications for Polymers and Paints."

Battelle is pioneering the application of the new Free Volume Microprobe (FVM) analytical technique, a novel tool that nondestructively probes a polymeric material to reveal existence of submicroscopic voids, distance between crosslinks, and its molecular free volume (the space between molecular chains). The technique is being applied to a broad range of different polymeric systems and has the potential of providing insight into problems that for decades have plagued polymer scientists, quality control engineers, and formulators.

Battelle has discovered and demonstrated that FVM can be used to: characterize polymer blends; monitor pigment dispersion; evaluate crosslink density, particularly in highly crosslinked systems; detect subtle molecular transitions; detect weathering changes after very short exposure times; directly examine the interfacial region in a composite; and detect microscopic changes caused by mechanical damage in coatings, polymers, or composites.

During the program, Battelle specialists will be available to conduct single-client studies focused specifically on issues of importance to individual companies. Also, the study will provide participating companies with working knowledge of this new analytical tool background data in specific applications to guide adoption of the technique to meet client needs.

Participation in the nine-month program is available for an investment of $25,000. For more details, contact Bret Mayo, Battelle, 505 King Ave., Columbus, OH 43201-2693.

EMS-Chemie and Goodyear Sign Cooperative Agreement

A joint agreement between EMS-Chemie AG, Switzerland, and the Polyester Division, of Goodyear Tire & Rubber Co., has been announced. Under the agreement, the two companies will team up to provide both carboxyl and hydroxyl powder coating resins in North America.

The accord took effect the beginning of the year. Under the mutual agreement, Goodyear will supply the manufacturing capability, while EMS-American Grilon Inc., Sumter, SC, the U.S. subsidiary of EMS-Chemie, will provide sales and marketing support.

Goodyear will produce both the carboxyl and hydroxyl powder coating resins product lines in its Point Pleasant, WV, plant. EMS will market them in the North American market.

Product research and development will continue at both EMS headquarters in Switzerland and the U.S. The EMS technical service laboratory in Sumter will be expanded to support the entire product line.

Chemark Study Reviews World Coatings Market; Market Demand and Important Trends Featured

A study offering worldwide coverage of the total coatings market has been published by The Chemark Consulting Group, Inc., Cincinnati, OH. "The World Coatings Market Executive Overview" covers architectural, industrial, and protective coatings and separates out automotive products for special treatment.

The world market is divided into eight geographic regions: Western Europe, Eastern Europe, North America, Latin America, the Far East, the Middle East, Africa, and Oceania. Market demand and important trends are given for each of these regions. Major countries within regions are highlighted.

According to the study, the Far East is the fastest growing market for use of coatings. The annual growth rate of architectural, industrial, and protective coatings in the Far East is nearly 5%, which is more than two times the projected worldwide coatings growth rate.

The North American market, on the other hand, leads in size, consuming slightly less than one-third of the 17.5 million metric tons of coatings consumed worldwide in 1987. North America has a significant lead in the liters per capita consumed, using over 15 liters per capita, on average, versus 10 for Western Europe and just over one liter for the Far East.

Conventional low solids, solvent-borne coatings continue to dominate the world market, in spite of concerns about environmental and worker hazards. Water-borne coating systems have grown to second place among technologies, indicating an increasing worldwide awareness of environmental and safety issues.

Thirty-one world class coatings companies are profiled in the Appendix to the study. Three other Appendices deal with important planning concepts for the coatings industry: Strategic Planning, Technological Market Segmentation, and Tier Marketing.

For more details on obtaining a copy of the study, contact David P. Nick, The Chemark Consulting Group, Inc., 9916 Carver Rd., Suite 103, Cincinnati, OH 45242.

Glidden Revamps Industrial Coatings Organization; Product Development and Tech Service Group Created

Alan W. Allen, Vice President of The Glidden Co., Cleveland, OH, has announced the restructuring of the company's Industrial Coatings organization.

The reorganization centralizes marketing, sales, commercialization laboratories, technical service, and administration at the Westlake, OH site, which is in close proximity to Glidden's major research center, headquarters, and largest manufacturing location.

Heading the Marketing, Sales, and Customer Service Group is Thomas R. Korn, Director-Marketing, a newly created position reporting to Mr. Allen. Mr. Korn formerly was Regional Director of one of the company's six regions. Market managers report to Mr. Korn.

Another major organizational change is the creation of a Product Development and Technical Service Group devoted solely to liquid technologies—water-borne, prepaint, electrocoat, high-solids, conventional, and Gel-Kote®.

The group is under the leadership of Glenn H. Thompson, Director-Liquid Technologies. Mr. Thompson reports to Mr. Allen and is responsible for several core/commercialization laboratories, product development, and introduction, as well as technical service. Reporting directly to Mr. Thompson is Paul U. Gualano, Associate Director in charge of core laboratories; Joseph Schibig, Product Manager with responsibility for new product introductions to these markets; and Alan F. Lang, Manager—Technical Service with a staff whose knowledge is based on a broad sense of liquid coatings applications.

According to Mr. Allen, the powder coatings experts are still headquartered in Charlotte, NC, and managed by Ronald F. Farrell, General Manager. The group is responsible for diverse applications of powder coatings throughout North America.

Dexter Corp. Creates Packaging Product Div.

As part of a comprehensive reorganization of its operations, the Dexter Corporation, Windsor Locks, CT, has created a new Packaging Products Division. Based in Waukegan, IL, the new division was formerly the Packaging Products business unit of Dexter's Midland Division, which has been divided into two self-standing operating divisions. The other division has been named the Dexter Specialty Coatings Division.

Harold T. Crutcher, Senior Vice President and General Manager of the Packaging Products business, will serve as President of Dexter Packaging Products Division.

Manufacturing will be consolidated in plants at Birmingham, AL, and Hayward, CA, in the U.S. and abroad in Mexico, Venezuela, Canada, Wales, France, Italy, Singapore, and Japan. Division research and development will continue at the Waukegan laboratories. Supporting product development is carried out at most foreign locations.

The new Dexter Packaging Products Division is one of four businesses which now comprise the firm's new Specialty Coatings and Encapsulants Group. Albert Paolini, President of the Midland Division for seven years, was promoted to Corporate Vice President and Group President.

Computer Systems Supplier Acquired by Akzo Coatings

Akzo Coatings Inc., Troy, MI, has acquired Auto-Tec, Culver City, CA, a supplier of comprehensive integrated computer systems for management of automotive collision and mechanical repair shops.

Auto-Tec, which offers systems solutions and related consulting to enhance the productivity and profitability of its customers, will operate as an independent, wholly-owned Akzo subsidiary. Gary Fradkin, formerly Director of Sales and Marketing for Akzo's Sikkens® refinishes unit, has been appointed President. Ted Hill, Auto-Tec's founder, has joined Akzo as a business consultant to assist in the development of a broad range of information technology on both domestic and international projects.

Magnesium Elektron Limited Upgrading Production Plants

Magnesium Elektron Limited is investing $30 million to modernize and expand production facilities at its Manchester, England plant and at Magnesium Elektron, Inc., Flemington, NJ. Magnesium Elektron is a division of Alcan Chemicals.

The combined capacity of the two plants, which is several thousand tons per annum, will be increased by one-third. The Flemington plant has implemented a process improvement plant which is designed to increase production capacity. Site work at the Manchester facility is in the initial stage.

Magnesium Elektron Limited's chemical process route is being retained in addition to new modern operating and control technology.

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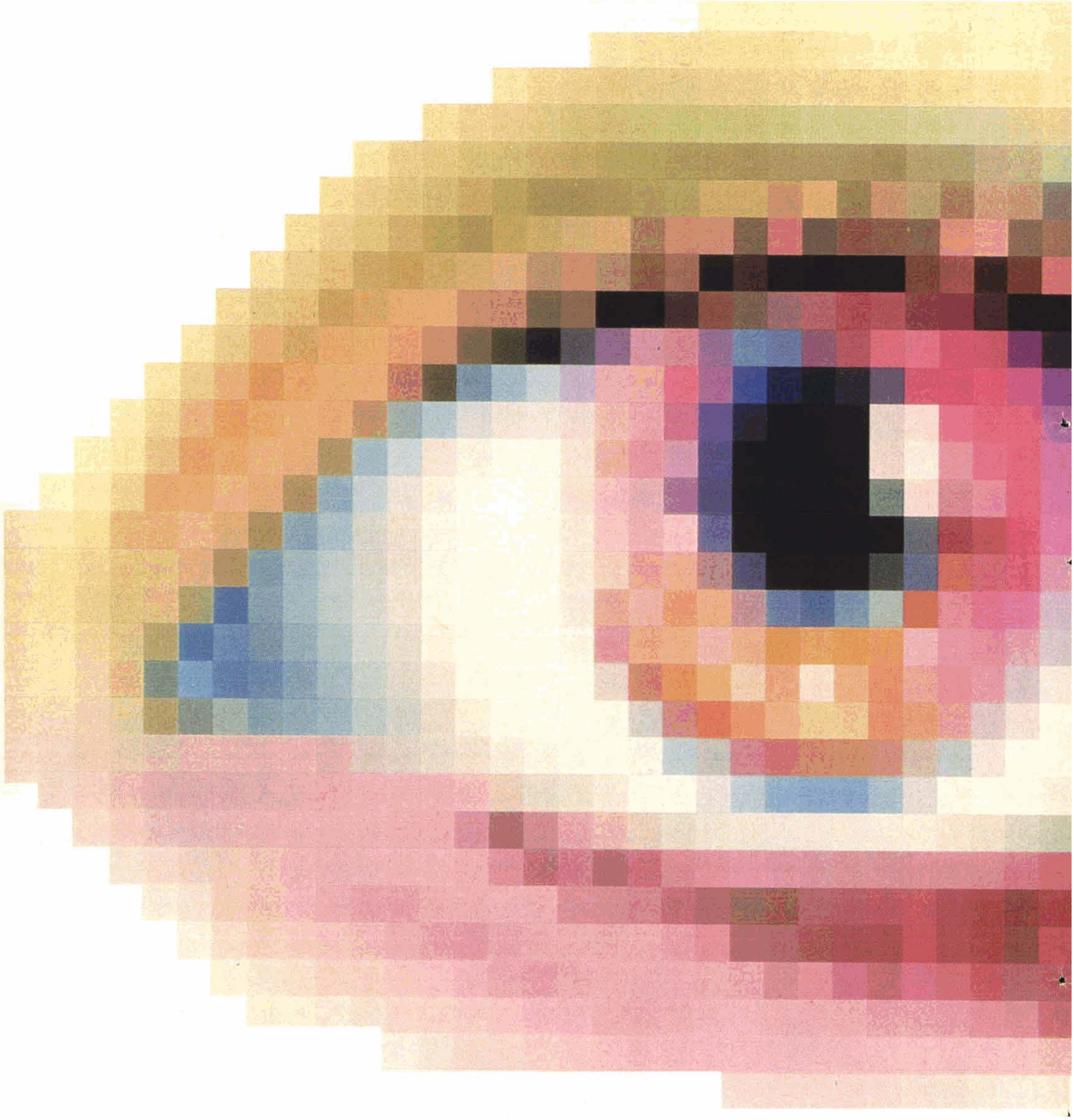

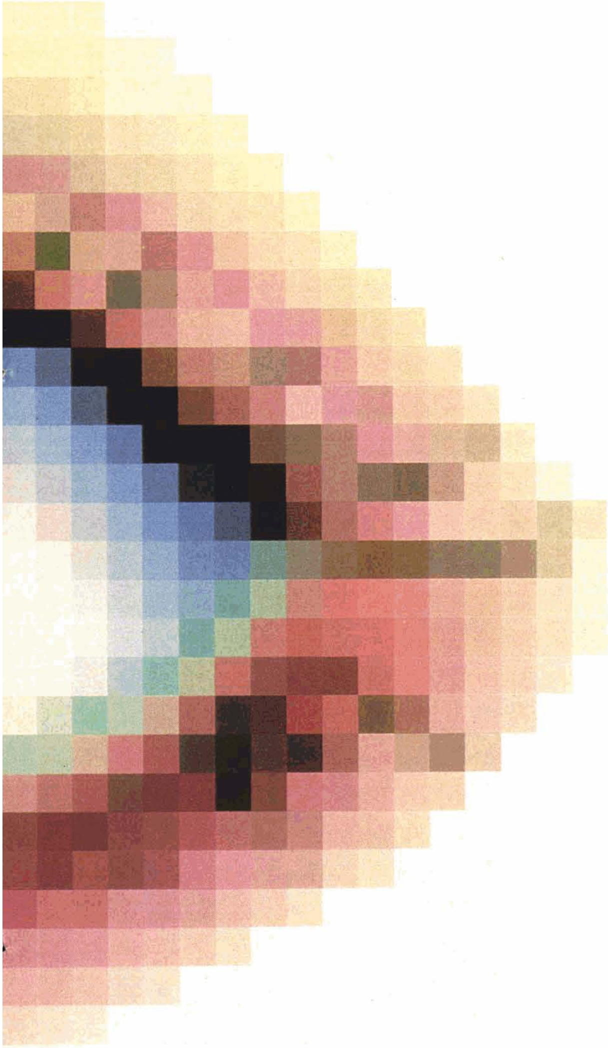

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Regulatory UPDATE

FEBRUARY 1989

This 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 Roy F. Weston, Inc., Washington, D.C.

EPA Reopens Public Comment Period on Benzene National Emission Standards for Hazardous Air Pollutants—The EPA is reopening the comment period on proposed standards and general policy issues related to benzene emissions from maleic anhydride plants, ethylbenzene/styrene plants, benzene storage vessels, benzene equipment leaks, and coke by-product recovery plants. See 53 Federal Register 50428 (December 15, 1988).

On July 28, 1988, EPA proposed rulemaking under section 112 of the Clean Air Act for the above five source categories of benzene emissions. That proposal included four policy approaches for setting national emission standards for hazardous air pollutants (NESHAPS). Comments were due by January 30, 1989, at Central Docket Section (LE-131), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460.

For general information or information specific to coke by-product recovery plants or benzene storage vessels, contact Gail Lacy at (919) 541-5261, Standards Development Branch, Emission Standards Division, Research Triangle Park, NC 27711. For information specific to benzene equipment leaks, EB/S process vents, or maleic anhydride process vents, contact Janet Meyer at the above address, (919) 541-5254.

Objections and Requests for Hearings Filed with EPA Over Cancellation of Tributyltin-Containing Pesticides—In October 1988 [See 53 Federal Register 39022 (October 4, 1988)], EPA announced its decision to cancel all registrations and deny applications of all pesticide products containing tributyltin (TBT) compounds as active ingredients. This would be done unless registrants modified certain terms and conditions of their registrations. See the January 1988 and February 1988 issues of FSCT *Regulatory Update* for more information.

Opportunity for objections and requests for hearings was given, and registrants did file objections and requested hearings.

For information on the issues and proceedings, contact the docket on file with the Hearing Clerk, U.S. EPA, (Mail Code A-110), Room 3708, Waterside Mall, 401 M Street, S.W., Washington, D.C. 20460, (202) 382-4865.

OSHA Promulgates Nine Month Administrative Stay on Formaldehyde Provisions—OSHA has announced a nine month administrative stay on key hazard communication provisions of its regulations for occupational exposure to formaldehyde. The stay is effective until September 13, 1989. In the meantime, employers must continue to comply with the provisions of OSHA's Hazard Communication Standard. See 53 Federal Register 50198 (December 13, 1988).

On November 8, 1988, OSHA announced that it was providing a 60-day start-up period (until December 6, 1988) from the date of Office of Management and Budget's approval of its formaldehyde hazard communication provisions. At that time, OSHA would begin enforcing the newly approved provisions. See 53 Federal Register 45080. OSHA announced that during this period, it would evaluate the petition submitted by the Formaldehyde Institute and others asking for an administrative stay. OSHA also gave the public an opportunity to comment on whether to grant the petition and whether OSHA should initiate rulemaking to reconsider the hazard communication provisions contained in paragraph (m) of the formaldehyde standard.

The paragraphs in question contained criteria for determining when the presence of formaldehyde constitutes a health hazard. The provisions also required information that must be included on warning labels on containers of formaldehyde-treated products as well as information to be included in the accompanying Material Safety Data Sheets (MSDS).

During the nine month administrative stay, OSHA will propose to revoke these provisions of the formaldehyde standard and to invite public comments on the substitution of the full Hazard Communication Standard (29 CFR 1910.1200) or other equally protective alternatives commenters may submit.

For further information, contact James Foster, Occupational Safety and Health Administration, Office of Information and Consumer Affairs, U.S. Department of Labor, Room N-3647, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8151.

Information is available at the docket for the formaldehyde standard, Docket H-225C at the OSHA Docket office, Room N-2634, at the above address and telephone number.

Toxicology and Carcinogenesis Studies on Dye Intermediate Available; Some Evidence of Carcinogenic Activity—The Department of Health and Human Services National Toxicology Program (NTP) has announced that the Technical Report describing the toxicology and carcinogenesis studies on 2-amino-4-nitrophenol is available. The chemical is an intermediate in the manufacture of *C.I. Mordant Brown 33* and *C.I. Mordant Brown 1*, used for dyeing leather, nylon, silk, wool, and fur. It is also used in semipermanent hair dyes to produce gold-blond shades. The two-year studies were conducted by administering the chemical in corn oil by gavage to groups of 50 F344/N rats, both male and female; and to 50 $B6C3F_1$ mice, both male and female, at three dosage rates for five days a week. See 53 Federal Register 51322 (December 21, 1988).

For further information, contact Richard D. Irwin, P.O. Box 12233, Research Triangle Park, NC 27709, (919) 541-3340. Copies of the study, "Toxicology and Carcinogenesis Studies of 2-Amino-4-Nitrophenol in F344/N Rats and $B6C3F_1$ Mice (Gavage Studies) (TR339)," are available without charge from the NTP Public Information Office, MD B2-04, P.O. Box 12233, Research Triangle Park, NC 27709, (919) 541-3991.

EPA Promulgates Final NPDES Rules—On January 4, 1989, EPA promulgated final regulations regarding the National Pollutant Discharge Elimination System (NPDES). These changes are a result of the enactment of the Water Quality Act of 1987, specifically Section 402, and changes the NPDES permit and pretreatment programs. See 53 Federal Register 245 (January 4, 1989).

The 1987 Water Quality Act made a number of changes to the NPDES programs, which necessitate changes in the regulations.

Since the rule is considered an interpretive rule because it codifies new statutory requirements of the Water Quality Act, the rule is excluded from notice and comment procedures.

The rule covers many changes, including:

- tightens point source definition to explicitly include landfill leachate collection systems;
- neither Federal or approved State NPDES programs may require a permit for discharges composed of all storm water prior to October 1, 1992, unless the discharge falls within five specified exceptions;
- extends some compliance deadlines for technology-based [Best Conventional Pollution Control Technology (BCT), Best Practicable Control Technology Currently Available (BPT), Best Available Technology Economically Achievable (BAT)] requirements;
- allows EPA or State discretion in extending deadlines for facilities proposing to use innovative technology to meet effluent limitations;
- puts forth new application requirements for Fundamentally Different Factors (FDF) Variance Requests; and
- sets forth new guidelines for availability of Section 301(g) variances (nonconventional pollutants).

Comments should be addressed to David Greenburg, Permits Division, (EN-336), U.S. EPA, 401 M Street, S.W., Washington D.C. 20460. Supporting information and all comments on the rulemaking are available for inspection and copying at the EPA Public Information Reference Unit, Room 2402.

For further information, contact David Greenburg, at above address, (202) 475-9524.

EPA Proposes Changes to Superfund Scoring Model—EPA is proposing revisions to the Hazard Ranking System. The Hazard Ranking System (HRS) evaluates the potential threats to public health and the environment from hazardous waste sites. If the evaluation results in a score above a certain threshold, the site may be placed on the National Priority List (NPL). See 53 Federal Register 51962 (December 23, 1988).

The revisions are intended to make the HRS more accurate in assessing relative potential risk as well as meet statutory requirements imposed by the Superfund Amendments and Reauthorization Act of 1986 (SARA).

An HRS score is determined for a site by evaluating several migration routes, called "pathways," such as water and air. The current HRS determines the score using five pathways: air, groundwater, surface water, direct contact, and fire/explosion. The site is given a score from 0 to 100; a score above 28.5 makes a site eligible for placement on the NPL.

SARA required EPA to revise the HRS and required EPA to assess and evaluate several areas for possible HRS changes, specifically:

- contaminated surface waters,
- damage of natural resources which may affect the human food chain, and
- contamination of ambient air associated with a release or threatened release.

EPA has proposed to retain the groundwater, surface water, and air pathways, and to add a new pathway, on-site exposure. The proposed revisions also remove the direct contact and fire/explosion pathways.

EPA has proposed the rule with a 60-day comment period (comments due by February 21, 1989) and expects to finalize the rule by early 1990. The revised HRS will be applied to any site newly listed on the NPL after the effective date of the revised HRS. Until the effective date, sites will be scored with the current HRS. SARA also specified that EPA not be required to rescore any site evaluated with the current HRS before the effective date.

Comments may be mailed or delivered to the CERCLA Docket Clerk. Mark the comments Docket No. 105NCP-HRS, Mail Code OS-240, Superfund Docket Room, LG-100, U.S. EPA, 401 M Street, S.W., Washington D.C. 20460. Send four copies of comments.

Requests for documents supporting these revisions should be made to the CERCLA Docket Office, Waterside Mall Subbasement, U.S. EPA, 401 M Street, S.W., Washington D.C. 20460, (202) 382-3046.

For further information, contact Steve Caldwell or Jane Metcalfe, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response, OS-230, U.S. EPA, 401 M Street, S.W., Washington D.C. 20460, (202) 382-3000 or (800) 424-9346.

Toxic Pollutant Criteria Under Clean Water Act—Guidance Available—EPA announced the availability of guidance for state compliance with the section of Clean Water Act that deals with toxic pollutant criteria in State water quality standards. The final guidance document includes an appendix which contains a listing of toxic pollutants as defined by Section 307(a) of the Water Quality Act. A limited number of copies of the guidance document are available. For further information, contact Kent Ballentine, Standards Branch, Office of Water Regulations and Standards, (WH-585), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460, (202) 475-7315. See 54 Federal Register 326 (January 5, 1989).

EPA Proposes to Delete Sodium Hydroxide from Toxic Chemical Release Reporting Under SARA Community Right-to-Know—EPA is proposing to delete sodium hydroxide (solution) from the list of toxic chemicals under Section 313 of Title III of SARA. See 53 Federal Register 49688 (December 9, 1988). Proposed deletion is in response to a petition from The Chlorine Institute, Inc.

EPA stated that sodium hydroxide does not meet Section 313 criteria and is only dangerous under conditions of direct ingestion (not Section 313 criteria) or chemical spills (covered under other reporting authorities).

Comments are due by February 7, 1989. Send comments (in triplicate) to: OTS Docket Clerk, TSCA Public Docket Office, (TS-793), U.S. EPA, Room NE G-004, 401 M Street, S.W., Washington, D.C. 20460. Mark comments: Attention: Docket Control No. OPTS-400020.

For further information, contact Renee Rico, Petition Coordinator, Emergency Planning and Community Right-to-Know Information Hotline, U.S. EPA, Mail Stop OS-120, 401 M Street, S.W., Washington, D.C. 20460. Telephone toll free (800) 535-0202; in Washington area and Alaska: (202) 479-2449.

Agency for Toxic Substances and Disease Registry (ATSDR) Announces Availability of Toxicological Profiles—ATSDR announced the availability of the second group of 25 draft toxicological profiles for review and comment.

These profiles were prepared in compliance with the Superfund Amendments and Reauthorization Act of 1986 (SARA) which requires the ATSDR to prepare toxicological profiles for each substance included on the first priority list of 100 chemicals most commonly found in facilities on the CERCLA National Priorities List. The toxicological profiles may be used later to develop new regulations or amend existing regulations. See 53 Federal Register 51192 (December 20, 1988).

The following draft toxicological profiles were available on or about December 20, 1988.

Profile	CAS Number
1,1-Dichloroethene	75-35-4
Alpha-, beta-, gamma-, and delta Hexachlorocyclohexane	319-84-6, 58-89-9, 319-85-7, 319-86-8
Chloroethane	75-00-3
Isophorone	78-59-1
Toluene	108-88-3
2,4- and 2,6-Dinitrotoluene	121-14-2, 606-20-2
1,2-Dichloroethane	107-06-2
p,p′-DDT, DDE, DDT	72-55-9, 50-29-3, 72-54-8
N-nitrosodi-n-propylamine	621-64-7
1,1,2,2-Tetrachloroethane	79-34-5
1,2-Dichloropropane	78-87-5
Carbon tetrachloride	56-23-5
Zinc	7440-66-6
Selenium	7782-49-2
Chlordane	57-74-9
Phenol	108-95-2
Benzidine	92-87-5
3,3′-Dichlorobenzidine	91-94-1
Pentachlorophenol	87-86-5
Mercury	7439-97-6
1,1,2-Trichloroethane	79-00-5
N-nitrosodimethylamine	62-75-9
Bromodichloromethane	75-27-4
Bis(2-chloroethyl)ether	111-44-4
Bis(chloromethyl)ether	542-88-1

A 90-day comment period is being provided for each profile, starting from the actual release date. Each profile includes a format for graphically displaying the levels of significant human exposure. Public comment on this specific issue is particularly solicited. Requests for the profiles should be sent to Edward J. Skowronski, Assistant Branch Chief, Research Analysis Branch, ATSDR, Chamblee 28 South, 1600 Clifton Road, Atlanta, GA 30333. One copy of each profile will be provided free of charge.

One copy of all comments and five copies of all supporting documents should be sent to Mr. Skowronski at the above address. Mark documents with the docket control number ATDSR-7.

All comments and draft profiles are available for inspection at the ATSDR, Trailer 11, 4770 Buford Highway N.E., Chamblee, GA from 8:00 a.m. to 4:30 p.m., Monday through Friday.

EPA Promulgates Standard Chemical Information Request—EPA has promulgated a standard approach for gathering information on the manufacture, importation, and processing of chemical substances and mixtures under Section 8(a) of the Toxic Substances Control Act (TSCA). The rule is called the Comprehensive Assessment Information Rule (CAIR), and is effective February 6, 1989. See 53 Federal Register 51697 (December 22, 1988).

The rule is to be used to obtain information needed by all programs at EPA and other Federal agencies to support assessment and regulation of chemical substances and mixtures.

The rule also establishes uniform reporting and recordkeeping requirements and a list of questions from which specific information requirements will be assembled on a substance by substance basis. EPA also established specific reporting requirements for 19 substances. For the 19 substances and for additional substances EPA may add to this rule, EPA states who is required to report on each substance (manufacturers, importers, and/or processors) and which previous years are covered by the rule.

Among other substances, the list includes acetamide, hydroxylamine and three of its salts, semicarbazide and semicarbazide hydrochloride, and several toluene diisocyanates (TDI isomers).

Requirements for reporting are illustrated in a matrix, listing the substance, who is required to report, the time period covered, and the specific questions listed for reporting. Persons who are required to report only answer questions for the activity designated in the rule. For example, if EPA were to require manufacturers of a substance to report, then a person who both manufactures and processes the substance would answer the CAIR questions only for manufacturing.

For further information, contact Michael M. Stahl, Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, U.S. EPA, Room EB-44, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-1404.

Notice of Availability of "Recommendations for Chemistry Data for Indirect Food Additive Petitions"—The FDA announced the availability of single copies of "Recommendations for Chemistry Data for Indirect Food Additive Petitions." These recommendations supercede the "FDA Guidelines for Chemistry and Technology Requirements of Indirect Food Additive Petitions." See 53 Federal Register 49927 (December 12, 1988).

For further information, contact Vir Anand, Center for Food Safety and Applied Nutrition, (HFF-330), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

FDA Issues Final Rule for Indirect Food Additives; Adhesives and Components of Coatings—The Food and Drug Administration is amending its food additive regulations in response to a petition filed by the Dow Chemical Co. The amendments provide for the safe use of "ethylene-octene-1 copolymers containing not less than >70 weight percent ethylene," as adhesives in the manufacture of multilayer structures intended to contact food. The regulations are effective December 27, 1989. Comments were due by January 26, 1989, at Dockets Management Branch, (HFA-305), Food and Drug Administration, Room 4-62, 5600 Fishers Lane, Rockville, MD 20857. See 53 Federal Register 52131 (December 27, 1988).

For further information, contact Richard H. White, Center for Food Safety and Applied Nutrition, (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

SUMMARY CALENDAR OF REGULATORY ACTIONS

December 13, 1988	OSHA announced administrative stay of occupational exposure to formaldehyde hazard communication provisions until September 13, 1989. (See this issue.)
January 4, 1989	New National Pollutant Discharge Elimination System Permit Regulations effective. (See this issue.)
January 26, 1989	Written objections and requests for hearings were due on various indirect food additive regulation amendments. (See this issue.)
January 30, 1989	Comments were due on benzene NESHAPS proposed rule-reopening of public comment period. (See this issue.)
February 6, 1989	Comprehensive Assessment Information Rule effective. (See this issue.)
February 7, 1989	Comments on proposed deletion of sodium hydroxide from toxic release reporting. (See this issue.)
February 21, 1989	Comments due on EPA proposed rule proposing changes to the Hazard Ranking System (to score Superfund sites). (See this issue.)

Accumulation of Sulfur Compounds At the Interface of Paint and Wood Following Exposure to Sulfurous Acid

R. Sam Williams and Thomas A. Kuster
U.S. Department of Agriculture*

John Spence
U.S. Environmental Protection Agency†

Western redcedar *(Thuja plicata)* and southern pine *(Pinus* sp.) strips coated on all surfaces with acrylic latex paint were soaked for 10 days at room temperature in pH 2 sulfurous acid. Matched controls were soaked in distilled water. Analysis of cross sections using energy dispersive X-ray analysis showed an accumulation of sulfur compounds at the paint/wood interface on the specimens treated with acid. The sulfur concentration was highest in the wood just below the primer and decreased at a depth of several wood cells. The effect of the sulfur buildup on paint adhesion was not determined in this preliminary study, but it is the focus of continuing work.

INTRODUCTION

All construction materials eventually degrade when used outdoors. The degradation of many of these materials can be inhibited and/or retarded by maintaining a good coat of paint on them; but, paint also degrades. Degradation of a paint system can occur through one of many mechanisms or a combination of mechanisms. These different mechanisms are manifested as different modes of paint degradation.

Gradual erosion of the paint is the least serious mode of paint degradation and involves only the surface. Erosion is caused mainly by a combination of sunlight, moisture, and oxygen; degradation factors such as wind, particulates, and other chemicals generally are less important. Since erosion affects only the surface of the paint, the paint system can be easily renewed by applying more paint.

Blistering and peeling of paint are more serious degradation modes. The degradation mechanism for these failures is primarily moisture—induced loss of adhesion at the coating/substrate interface. Failure can also occur between paint layers; but in this case, the cause is usually attributed to improper surface preparation prior to painting.[1] Loss of adhesion at the interface is affected by the chemical and physical properties of both the paint and the substrate. This loss of adhesion shortens the service life of the paint system and requires substantially more time and money for refinishing than does erosion.

Blistering and peeling of paint on wood has been the subject of many publications and a few are cited.[2-11] Research on blistering of paint on wood has included effects of paint type and formulation, wood structure, application techniques, weathering, and moisture. The common factor in these studies has been the effect of moisture. Changes in the moisture content of either the paint or wood substrate cause dimensional changes that develop stresses at the interface. These stresses, combined with other physical changes at the interface, such as accumulation of water-soluble extractives, can lead to loss of paint adhesion.

Chemical changes at the interface can also cause loss of adhesion. This is particularly true of wood that has been photochemically degraded prior to finishing. Researchers at the Forest Products Laboratory (FPL) found that when unpainted wood siding was exposed to summer weather conditions, paint adhesion decreased 50% in boards exposed for 16 weeks.[12] In other work at the FPL, it was shown that intermittent soaking of specimens in sulfu-

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*Forest Service, Forest Products Laboratory, Madison, WI 53705-2398.

†Atmospheric Research and Exposure Laboratory, Research Triangle Park, NC 27711.

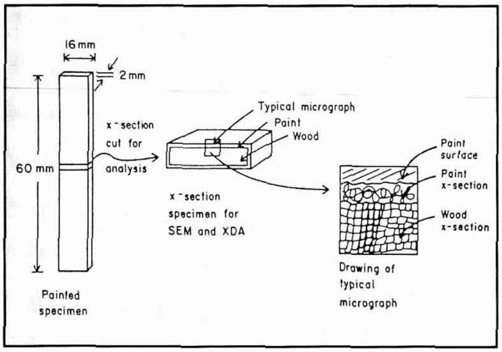

Figure 1—Painted wood strip showing cross section and typical location of SEM and EDXA. (ML875530)

rous,* sulfuric, and nitric acids can accelerate this photochemical degradation.[14] Treatment with sulfurous acid of pH 2 doubled the rate of erosion of western redcedar *(Thuja plicata)* compared with specimens soaked in distilled water.

Although photochemical degradation of wood is not likely if wood is coated with a highly opaque paint, other chemical reactions may occur that weaken wood and thus cause loss of paint adhesion. If acid deposition or its precursors, such as sulfur dioxides, are factors that degrade painted wood, it is necessary that some chemical diffuse through the paint. By limiting the exposure to sulfurous acid, the accumulation of sulfur compounds is a necessary condition for damage to paint systems. In this study, the extent that sulfur dioxide or bisulfite ions accumulated at the paint/wood interface was investigated.

In research using painted wood, the effect of acid conditions on the substrate has not been clearly demonstrated. Ulfvarson and Pattyranie[15] reported that 1% aqueous solutions of HCl and NaOH caused a slight decrease in paint blistering as compared with water. Using buffered solutions at pH 6, 7, and 8, Browne[16] found that free films of oil and alkyd paints swelled differently depending upon the pH and type of paint pigment. Greater swelling occurred at pH 6 and 8, particularly for paint containing zinc oxide. No explanation was given for these results. In other work using free alkyd paint films soaked in sulfurous acid, Svoboda, et al.,[17–19] reported that sulfur dioxide diffused into the paint.

Researchers at the FPL, in cooperation with the U.S. Environmental Protection Agency, are studying the effects of acid deposition on exterior paints. This study is being supported by the National Acid Precipitation Assessment Program (NAPAP) and addresses the effects of both wet (acid rain) and dry deposition on painted wood.

In this preliminary work, painted wood was immersed in sulfurous acid at pH 2 to determine the extent to which sulfur compounds would migrate into the paint/wood system. Further studies are underway to define the chemical reactions that may occur at the paint/wood interface. By linking the chemical changes at the interface with physical changes such as paint adhesion, we hope to determine whether acid deposition affects paint failure such as blistering and peeling.

EXPERIMENTAL

Thin strips of western redcedar *(Thuja plicata)* and southern pine *(Pinus* sp.), 16 × 2 × 60 mm (radial, tangential, longitudinal), were coated with specially formulated low-sulfur paints. The acrylic latex paints had the following compositions:

Primer Composition	**Top Coat Composition**
Pigment 20%	Pigment 29%
Titanium dioxide	Titanium dioxide
(type IV)[20] 16%	(type IV) 14%
Silica 4%	Titanium dioxide
	(type II)[20] 3%
	Silicates 7%
	Mica 5%
	Tinting colors .... trace
Vehicle 80%	Vehicle 71%
Acrylic resin	Acrylic resin
(nonvolatile) 27%	(nonvolatile) 19%
Additives 3%	Additives 2%
Water 46%	Water 48%
Ethylene glycol 4%	Ethylene glycol 2%

Wood specimens were painted with primer, primer and one top coat, or primer and two top coats. Paint was brush-applied, dried for one day between coats, and cured for one week at laboratory conditions. The specimens were then immersed in pH 2 sulfurous acid at room temperature (22°C) for 10 days in sealed containers. The concentration of the acid was monitored and changed as necessary to maintain constant pH. Following immersion in the acid, the specimens were air dried and cut perpendicular to the grain *(Figure* 1). Cross sections were carbon-coated for scanning electron microscopy (SEM) and energy dispersive X-ray analysis (EDXA).

Micrographs and elemental analysis of cross sections were obtained at several locations for each of the specimens (duplicate specimens of two species with three different paint systems). Analyses were obtained using a JEOL* JSM-840 scanning microscope and a Tracor Northern* TN-5500 energy dispersive spectrometer. Elemental maps of the cross section were collected for Ti, Si, Al, and S for 0.1-sec dwell time at each point of a 128 × 128 grid. Line scans were collected for Ti and S by counting for 30 sec at 100 points in a line across the surface.

RESULTS

Drawings showing the original painted specimen, the cross section, and a typical SEM view are show in *Figure* 1. The micrographs show the cross section of wood and paint with a small portion of the paint surface at the top.

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*Although sulfurous acid is either not present or present in minute amounts in aqueous solutions of sulfur dioxide, for simplicity, sulfurous acid is used to designate these solutions.[13]

*The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

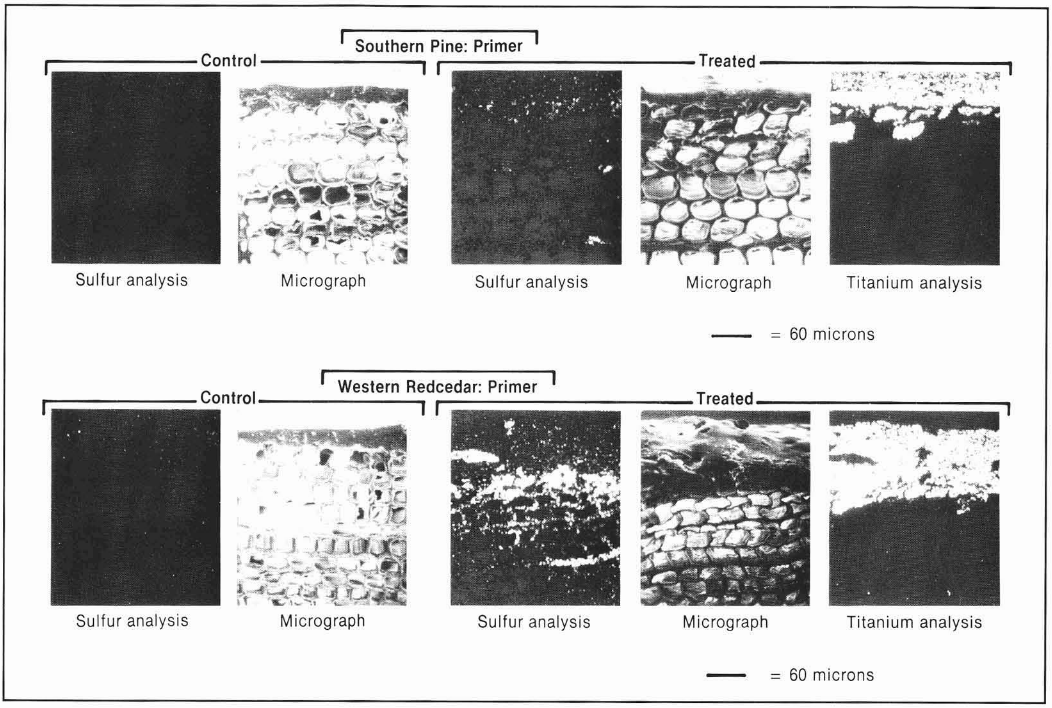

Figure 2—SEM and EDXA of wood painted with one coat of primer: The two pairs of (top) southern pine and (bottom) western redcedar. Photographs on the left are the EDXA sulfur analysis and micrograph for the control soaked in distilled water. The sets of three on the right side are the sulfur analysis, micrograph, and titanium analysis for the specimen soaked in sulfurous acid. (MC879011)

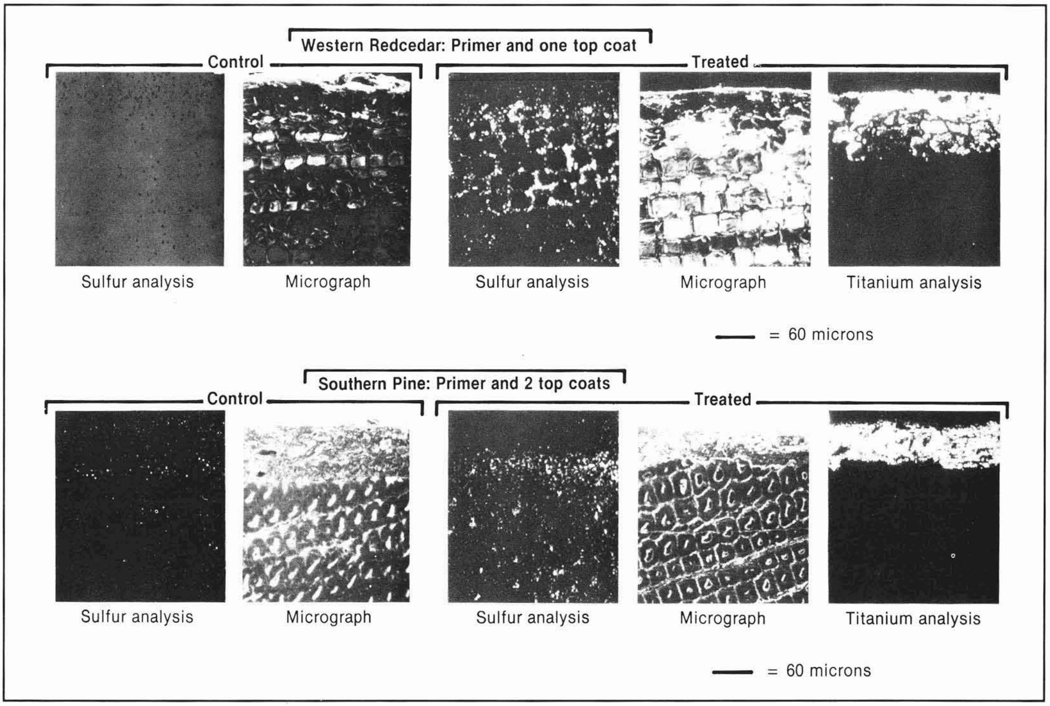

Figure 3—SEM and EDXA of (top) western redcedar painted with one coat of primer and one top coat; and (bottom) southern pine painted with one coat of primer and two top coats. (MC879012)

In *Figure* 2, matched sets of southern pine and western redcedar specimens with one coat of paint are shown. On the left side, the micrograph and the EDXA for the cross section of the controls show no sulfur above background. The right side contains elemental maps of sulfur and titanium of specimen soaked in sulfurous acid.

The map of the titanium helps to define the interface. Titanium dioxide pigment is too large to penetrate the wood cell wall; however, the paint can fill the lumen (cavity of the wood cell), if there is access through cracks or if the cell intersects the surface. The cell wall of the surface cells is easily defined by the areas lacking titanium. The cross sections of wood just below the paint/wood interface clearly show an accumulation of sulfur in the cell wall of the sulfurous acid-treated specimen. The controls show mainly background noise.

Similar results were obtained with all combinations, as shown by western redcedar painted with primer and one top coat and southern pine painted with primer and two top coats (*Figure* 3). A small amount of residual sulfur in the paints was detected above the background noise in a few specimens as shown by the control in *Figure* 3.

Elemental constituents in the cross section of the acid-treated and control specimens were determined. A series of analyses for southern pine painted with primer and two top coats is shown in *Figure* 4 (treated) and *Figure* 5 (control). The sulfur peak is highlighted for the region of interest (2.18 - 2.44 keV). The vertical full scale is the same for all figures.

In *Figure* 6, a line scan of the cross section shows the location of Ti and S with respect to the paint/wood interface. The Ti defines the limits of paint penetration into the wood. The S trace shows an increase in sulfur at the interface and substantial penetration (approximately 200 μm) of sulfur compounds into the wood. With about the same vertical full scale as in *Figure* 6, the control (*Figure* 7) shows no sulfur in the primer or the wood.

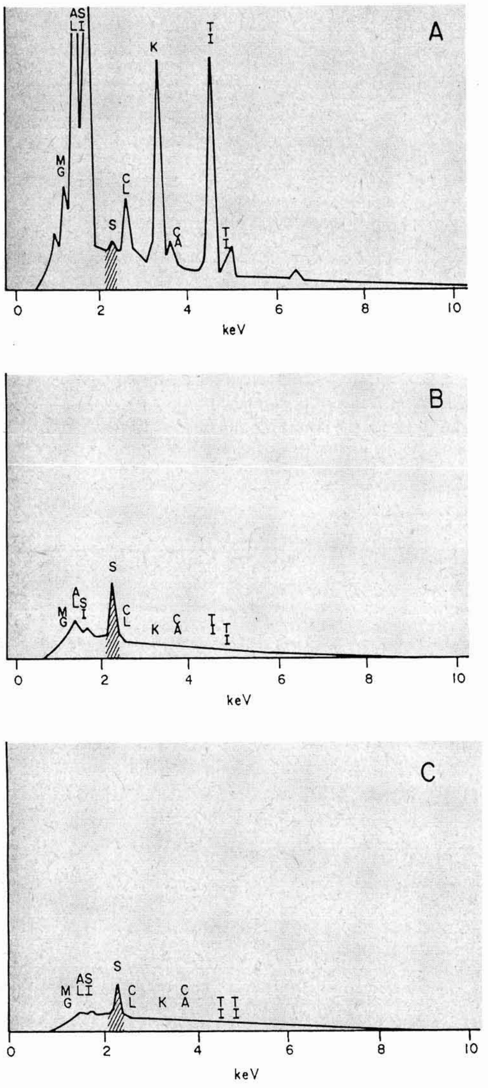

Figure 4—EDXA elemental spectra at several points in the cross section of western redcedar with one coat of primer and two top coats and soaked in sulfurous acid. The sulfur peak is highlighted. Vertical full scale = 4,096 counts. Analysis at (A) middle of the paint cross section; (B) wood cell wall at the wood surface; and (C) eighth wood cell below the paint/wood interface. (ML875527, ML875528)

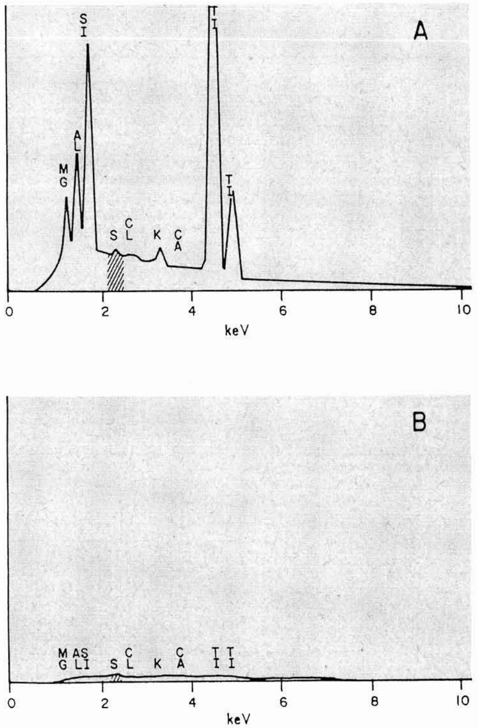

Figure 5—Same paint system (*Figure* 4) soaked in distilled water. Analysis at (A) middle of the paint cross section; and (B) wood cell at the wood surface. (ML875529)

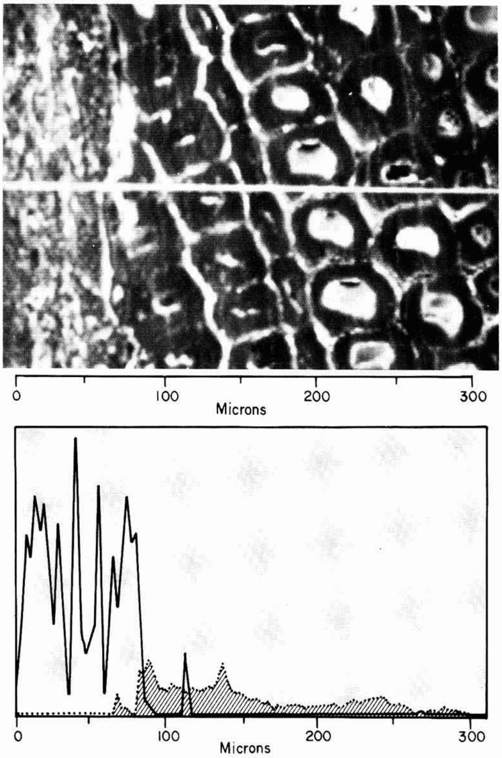

Figure 6—SEM and line scan of sulfurous acid treated southern pine painted with one coat of primer and two top coats. Vertical full scale = 10,643 counts. ——— Ti, – – – S. (ML875532)

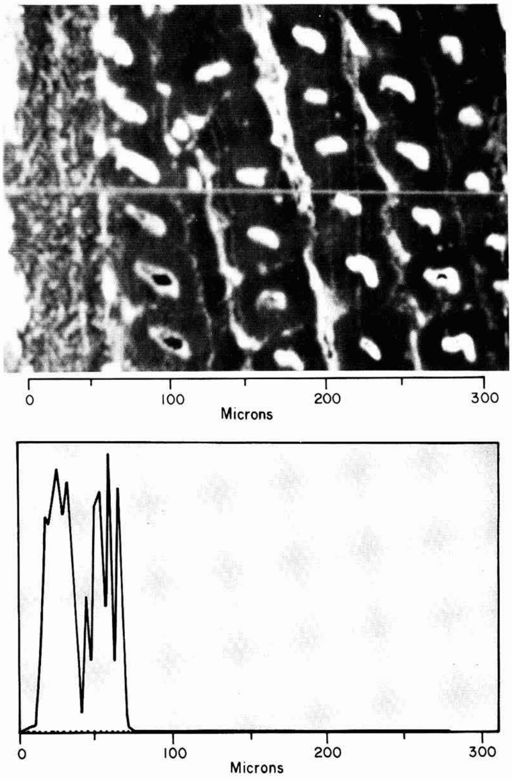

Figure 7—SEM and line scan of untreated southern pine painted with one coat of primer and two top coats. (ML875531)

DISCUSSION

The small amount of sulfur in the paint film compared to that in the wood was somewhat surprising in light of the previous work by Svoboda, et al.,[17] that showed sulfur compounds present in alkyd paint films. The difference in the amount of sulfur compounds in the two materials may be caused by differences in reactivity with sulfurous acid (i.e., latex paint films examined in this study may have been more resistant to sulfurous acid). Unreacted sulfurous acid in the paint film probably evaporated prior to analysis. Since the sulfur is found almost exclusively in the wood, the sulfur dioxide or bisulfite ions appear to have diffused through the paint film and may have reacted with lignin in the wood to form lignosulfonic acid. In acid sulfite pulping of wood, bisulfite ions react with the benzylic carbon atoms in phenolic and nonphenolic moieties in the lignin to form lignosulfonic acid.[21] In addition, lignosulfonic acids are stronger than sulfurous acid and would probably hydrolyze some of the hemicelluloses and cellulose. The result of these reactions could change the surface characteristics of the wood and possibly degrade the wood at the interface. It is not possible to prove actual wood degradation by EDXA; however, further work is planned to measure the change in adhesive strength and to establish if chemical changes occur at the paint/wood interface.

CONCLUSIONS

Sulfur compounds, either as bisulfite ions or sulfur dioxide dissolved in water, migrated through an acrylic latex paint system and accumulated at the wood/paint interface. High sulfur concentrations were found from the interface to 200 μm into the wood. This was observed for western redcedar and southern pine painted with primer, primer and one top coat, or primer and two top coats. In this work, it was not possible to identify the sulfur compounds in the wood.

ACKNOWLEDGMENTS

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Use of a Disk Centrifuge to Characterize Void-Containing Latex Particles

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Void-containing polymer particles can be made by processes that include core-and-shell emulsion polymerizations. A disk centrifuge method is described for analyzing the particle size distribution and void volumes of products of this type. An equation has been developed to relate the diameter of a swollen particle with its sedimentation time on the disk centrifuge. The conditions have been established for which solutions to this equation are single valued. Examples are given of the synthesis and characterization of void-containing particles.

INTRODUCTION

Core and shell polymer latices can be synthesized by sequential emulsion polymerizations[1-3] to produce particles with unusual and valuable morphologies. Polymer particles that contain voids are of particular interest in the coatings industry.[4-6] Such materials can contribute to the opacity of organic films and thereby reduce the requirements for titanium dioxide and extender pigments in a paint formulation.

A particularly successful variety of such opacifiers is a product in which a thermoplastic polystyrene or acrylic sheath surrounds an acid-containing core. Such core-and-shell particles are heated to temperatures above the softening point of the shell polymer in aqueous mixtures containing volatile bases like ammonia.[4] This swelling process results in the neutralization of the core polymer and swelling of the core-and-shell particles—the interiors of which now contain significant proportions of water. When such particles dry in a paint film, the evaporation of water and the volatile base leave a void within each particle that contributes to scattering of light and hiding of the matrix.

Optical and electron microscopy have been used to monitor the production of swellable core-and-shell polymer particles. Here we present a new method for analyzing the particle size distributions and void volumes of particles of this type. This method, based on the disk centrifuge, may be applied regardless of the monomers used to form the core-shell particles and of the extent to which these particles swell. This method eliminates problems encountered with microscopy of deformable particles, the need for stains or gold coating on the particles, and the requirement for image analysis of a large number of particles for accurate distribution averages.

THEORY

Latex particle size data can be readily obtained from a disk centrifuge with a photodetector attachment.[7,8] The disk centrifuge operates by driving particles radially outward through a spin fluid under high centrifugal force. The particles settle at rates determined by their sizes and densities. At a specific radial distance, the sedimenting particles interrupt a light beam and particle sizes and relative concentrations are calculated from instrumental parameters. Particle settling is described by Stokes' equation.

$$D^2 = \frac{6.299 \times 10^9 \eta \log (R_1/R_2)}{t\, \omega^2 \Delta\rho} \qquad (1)$$

where t = spinning time in minutes
D = particle diameter in micrometers
ω = centrifugal speed in rotations per minute
$\Delta\rho$ = density difference between particles and spin fluid in grams/mL
η = spin fluid viscosity in poise
R_1 = distance to which a particle of size D settles

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under the given conditions from an initial distance of R_2

R_2 = starting distance of particles, determined by the volume of spin fluid used in the rotor

A typical raw centrifuge trace for core particles of the core/shell emulsion is reproduced in *Figure* 1. Once the raw curve is obtained, it can be converted to a particle size distribution by applying Stokes' Law to the time axis of the experimental trace. The conversion of the y axis, which is in arbitrary turbidity units, to a concentration of particles requires techniques that are described elsewhere.[9]

An efficient disk centrifuge method for characterizing core-and-shell particles which do not contain voids has been presented by Seidewand and Erickson.[10] A uniformly sized latex of diameter, D_i, which is initially present when the shell polymerization stage is started, will grow to a final diameter, D_f, by the end of the second stage of polymerization. The value of D_f depends on the weight fraction, Y, of the shell stage polymer that associates with the initial particles. (Some second stage polymer may conceivably form new particles instead of enveloping the core particles.) The relationship between Y and diameter is given by:

$$y = \frac{\left(\frac{\pi}{6} D^3_f - \frac{\pi}{6} D^3_i\right)}{\frac{\pi}{6} D^3_p - \frac{\pi}{6} D^3_i} = \frac{D^3_f - D^3_i}{D^3_p - D^3_i} \qquad (2)$$

Here D_i is the initial particle diameter, D_f is the final particle diameter, and D_p is the projected particle diameter. D_p is calculated from the latex recipe and equation (3).

$$D_p = D_1 \left(\frac{w_1/\rho_1 + w_2/\rho_2}{w_1/\rho_1}\right)^{1/3} \qquad (3)$$

where ρ_1 is the density of the initial (core) latex particle, w_1 is the weight fraction of polymer present from the first stage polymerization, ρ_2 is the density of the second stage polymer, and w_2 is the weight fraction of polymer present from the second stage. The values of Y and D_f are affected by monomer characteristics, the emulsion polymerization recipe, and the method of monomer polymerization.

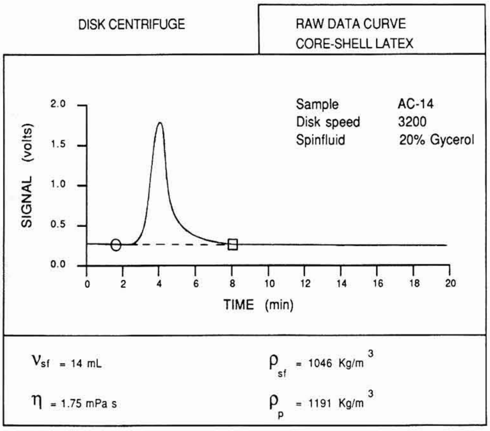

Figure 1 — Strip chart display of the sedimentation behavior of a core-shell emulsion

The Stokes' equation [equation (1)] relates the size and density of a particular particle to its retention time on the disk. With swollen particles, however, the spin time is known but density and particle size are both changed from the unswollen state. Fortunately, density and particle size are not independent of each other. If one assumes that the increase in particle volume resulting from swelling results in the creation of a separate domain of known density, then the diameter and the density are linked. Equations for handling disk centrifuge data can be derived as follows.

Equation (1), the original Stokes' equation, can be rearranged to give D directly in terms of t for a solid latex particle, which has subsequently been swollen by formation of an internal void of known density. *Figure* 2 shows the particle structures and parameters involved in the following equations. The density of the swollen particle may be expressed in terms of:

V_p = volume of solid polymer in unswollen particle
ρ_p = density of solid polymer
V_v = volume of the internal void formed by swelling
ρ_v = density of the internal void formed by swelling (this density is approximated by the density of the aqueous medium that contains the particles)
V_{LP} = total volume of the swollen particle
$V_{LP} = V_P + V_v$
ρ_{LP} = density of the swollen particle

$$\rho_{LP} = \frac{M_{LP}}{V_{LP}} = \frac{M_p + M_v}{V_p + V_v} = \frac{\rho_p V_p + \rho_v V_v}{V_p + V_v} \qquad (4)$$

where M_{LP}, M_p, and M_v are the masses of the swollen particle, polymer, and void, respectively. Substitution of these terms and rearrangement of equation (1) leads to:

$$D^2(\rho_{LP} - \rho_{SF}) = \frac{6.299 \times 10^9 \eta_{SF} \log R_1/R_2}{\omega^2 t} \qquad (5)$$

where D is now the diameter of the void-containing particle and ρ_{SF} is the density of the spin fluid. Substitution for density with the ratio of mass over volume and then rearrangement gives:

$$D^2\left(\frac{M_p + M_v}{V_p + V_v} - \rho_{SF}\right) = \frac{6.299 \times 10^9 \eta_{SF} \log (R_1/R_2)}{\omega^2 t} \qquad (6)$$

The volume of the void, V_v, is the difference between the volume of the particle and the actual volume of polymer ($V_{LP} - V_P$). Insertion of this term results in:

$$D^2\left(\frac{V_P\rho_P + (V_{LP} - V_p)\rho_v}{V_{LP}} - \rho_{SF}\right) = \frac{6.299 \times 10^9 \eta_{SF} \log R_1/R_2}{\omega^2 t} \qquad (7)$$

Equation (7) may be expressed as follows since V is generally equal to $\frac{\pi D^3}{6}$.

$$D^2\left[\frac{\frac{\pi}{6} D^3{}_o\rho_p + \left(\frac{\pi}{6} D^3 - \frac{\pi}{6} D^3{}_o\right)\rho_v}{\frac{\pi}{6} D^3} - \rho_{SF}\right] = \frac{6.299 \times 10^9 \eta_{SF} \log R_1/R_2}{\omega^2 t} \qquad (8)$$

Here D and D_o are the respective diameters of the swollen and unswollen particles. Simplification in two steps leads to equation (9), and then to equation (10).

$$D^2\left[\frac{D^3_o}{D^3}(\rho_p - \rho_v) + \rho_v - \rho_{SF}\right] = \frac{6.299 \times 10^9\, \eta_{SF} \log R_1/R_2}{\omega^2 t} \qquad (9)$$

$$(\rho v - \rho_{SF})D^2 + D^3_o(\rho_p - \rho_v)D^{-1} = \frac{6.299 \times 10^9\, \eta_{SF} \log R_1/R_2}{\omega^2 t} \qquad (10)$$

Finally, the observed sedimentation time can be expressed as

$$t = \frac{6.299 \times 10^9\, \eta_{SF} \log (R_1/R_2)}{\omega^2} \frac{1}{(\rho_v - \rho_{SF})D^2 + D^3_o(\rho_p - \rho_v)D^{-1}} \qquad (11)$$

This is the most general expression that relates the diameter of the swollen particle to spin time. It is valid for the case where $\rho_v \neq \rho_p$, $\rho_p \neq \rho_{SF}$, and $\rho_{SF} \neq \rho_v$. Three particular cases of swelling are:

(1) $\rho_v = \rho_p$. In this case, the physical condition of the particles is such that no swelling has occurred and there is no void. Therefore, equation (11) simplifies to the original Stokes' equation.

(2) $\rho_v = \rho_{SF}$. In this case, equation (10) simplifies to a linear relationship

$$t = \frac{6.299 \times 10^9\, \eta_{SF} \log (R_1/R_2)}{\omega^2 D^3_o (\rho_p - \rho_v)} D \qquad (12)$$

or, more simply

$$t = kD \qquad (12a)$$

(3) $\rho_{SF} = \rho_p$. In this case, the unswollen particle will not sediment and D_o must be determined under another centrifuge configuration. The swollen particle will sediment if $\rho_v > \rho_{SF}$ and equation (11) becomes

$$t = \frac{6.299 \times 10^9\, \eta_{SF} \log (R_1/R_2)}{\omega^2 (\rho_v - \rho_{SF})} \left[\frac{1}{D^2 - D^3_o D^{-1}}\right] \qquad (13)$$

It is necessary to prove that equation (11) gives a single value of D for a given t. If this were not true, the technique could not be used. It can be proven that D is a single valued function of t by setting the derivative of t with respect to D equal to zero. If D were not a single valued function of t, this derivative must equal zero at some point (i.e., the function has a minimum or maximum).

For simplicity:

$$K \equiv \frac{6.299 \times 10^9\, \eta_{SF} \log R_1/R_2}{\omega^2} \qquad (14)$$

$$K' \equiv (\rho_v - \rho_{SF}) \qquad (15)$$

and

$$K'' \equiv D^3_o (\rho_p - \rho_v) \qquad (16)$$

and equation (11) becomes:

$$t = K \left[\frac{1}{K'D^2 + K''D^{-1}}\right] \qquad (17)$$

Therefore:

$$\frac{dt}{dD} = -K \left[\frac{1}{K'D^2 + K''D^{-1}}\right]^2 (2K'D - K''D^{-2}) \qquad (18)$$

Now, for $\frac{dt}{dD} = 0$

$$2\,K'D = K''D^{-2} \qquad (19)$$

Substitution for K' and K'' and rearrangement leads to equation (20) and then to equation (21).

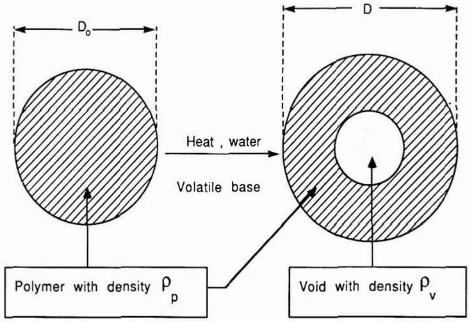

Figure 2 — Particle structures and parameters involved in the equations that are used here

$$2(\rho_v - \rho_{SF})D = D^3_0 (\rho_p - \rho_v)D^{-2} \qquad (20)$$

$$2(\rho_v - \rho_{SF})D^3 = D^3_0 (\rho_p - \rho_v) \qquad (21)$$

Since the swollen diameter, D, is always greater than the unswollen diameter, D_0, dt/dD will never equal zero if the inequality of equation (22) holds:

$$\frac{\rho_p - \rho_v}{2(\rho_v - \rho_{SF})} < 1 \qquad (22)$$

In practical cases, it is easy to arrange the experimental configuration of the centrifuge so that the inequality of equation (22) is true. This may be easily accomplished by adjusting the spin fluid density, ρ_{SF}. We have plotted equation (11) for a set of experimental conditions in *Figure* 3. This shows that equation (11) can be linearized to equation (12a) with the appropriate set of spin conditions. It also shows that equation (11) is a single valued relation between t and D, at least for D up to about 2 μm.

OPERATING PROCEDURE

Disk centrifuge measurements can give particle size distributions for unswollen particles. It is not possible to assess the size distribution of void-containing particles, however, since the spin time will depend on void volume as well as the overall dimensions of the particles. The technique described here compares the sizes of particles that appear at the peak in the disk centrifuge trace (of *Figure* 1). The calculation procedure is as follows:

(a) The diameter, D_o, of the unswollen beads is calculated from equation (1) for the time, t, which corresponds to the peak in the disk centrifuge trace. A value for the particle density is needed, to estimate the $\Delta\rho$ term in this equation. This density may be calculated from the measured bulk density and total solids of the latex. Alternatively and less exactly, the particle density can be estimated as the weighted average of the densities of the homopolymers of the various monomers that were used in the polymerization.

(b) The diameter, D, of the void-containing particles is obtained from equation (13). The value of t in this equation is again that corresponding to the centrifuge trace of turbidity vs spinning time. The value of the void density, ρ_v, can be taken as equal to 1.04 gm per cm^3. (Calcula-

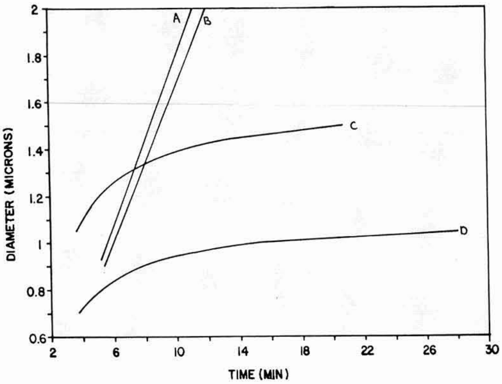

Figure 3 — A plot of equation (11) for latex samples: A—AC-17; B—AC-18; C—AC-16; and D—AC-14. Spin conditions: A—D_o = .925, ρ_v = 0.9978, ρ_p = 1.058, and ρ_{SF} = 0.9978; B—D_o = .891, ρ_v = 0.9978, ρ = 1.061, and ρ_{SF} = 0.9978; C—D_o = 1.048, ρ_v = 0.9978, ρ_p = 1.170, and ρ_{SF} = 1.0461; and D—D_o = 0.699, ρ_v = 0.9978, ρ_p = 1.191, and ρ_{SF} = 1.0461

tions from bulk density and total solids data indicate an apparent void density of about 1.04g/cm^3. Errors are introduced if a value close to unity is assigned.)

Equation (13) cannot be solved analytically. A simple iterative algorithm has been written in BASIC, and is available without charge from the authors.

EXPERIMENTAL

Polymerization

The emulsions were prepared in a thermostated glass reactor, fitted with a stirrer, condenser, and a glass tube for purging with nitrogen. The recipes and procedures used were those found in, or adapted from those found in, reference (4). Typical sequential emulsion polymerization recipes are reproduced as follows:

Emulsion Polymerization of Seed Polymer

Water	433 g
Anionic surfactant (Siponate DS-10, Alcolac, Inc.)	0.3 g
Ammonium persulfate initiator	0.45 g
t-Butyl hydroperoxide (70%)	0.15 mL
Sodium formaldehyde sulfoxylate	0.15 g
Ammonia (aqueous, 28%)	1.5 g

Monomer Emulsion

Water	39.7 g
Anionic surfactant (Siponate DS-10)	0.06 g
Butyl acrylate	62 g
Methyl methacrylate	56 g
Methacrylic acid	1.55 g

In a one litre reactor, water, surfactant, initiator, and 7.5 g of the monomer emulsion were combined with stirring under a nitrogen atmosphere at 78°C. After 15 minutes, the remaining monomer emulsion was added at a rate of 1 g/min and the reaction temperature was raised to 85°C. Fifteen minutes after monomer addition was complete, the mixture was cooled. At 55°C, the t-butyl hydroperoxide and then the sodium formaldehyde sulfoxylate dissolved in 5 mL of water were added. The emulsion was filtered through a 100 mesh screen to remove coagulum. Number average particle size was determined to be 94 nm.

Emulsion Polymerization of Core Polymer

Water	1060 g
Ammonium persulfate initiator	2.1 g
Seed polymer emulsion (19.6% solids)	31 g

Monomer Emulsion

Water	118 g
Anionic surfactant (Siponate DS-10)	0.4 g
Methyl methacrylate	245 g
Methacrylic acid	105 g
Ethylene glycol dimethacrylate	1.75 g

In a two litre reactor, water, initiator, and seed polymer were combined with stirring under a nitrogen atmosphere at 85°C and filtered through a 100 mesh screen. Number average particle size was determined to be 332 nm.

Emulsion Polymerization of Core-Shell Polymer

Water	486 g
Ammonium persulfate initiator	0.262 g
Core polymer emulsion (23% solids)	32.9 g

Monomer Emulsion

Water	100 g
Styrene	123.8 g
Butyl acrylate	8.2 g
Anionic surfactant (Siponate DS-10)	0.5 g
Nonionic surfactant (Igepal Co 970, GAF Corp.)	2.0 g

In a one litre reactor, water, initiator, and core polymer were combined with stirring at 85°C. Monomer emulsion was added at 1.7 g/min. One hour after monomer addition was complete, the emulsion was cooled to 25°C and filtered through a 100 mesh screen. Number average particle size was determined to be 890 nm.

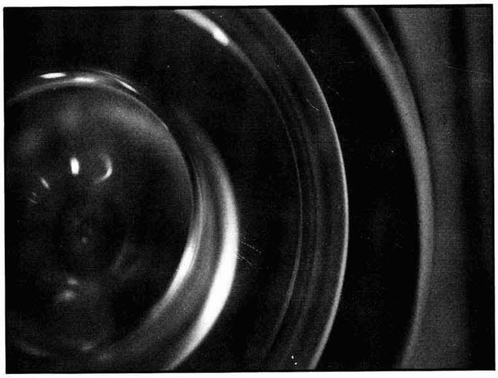

Figure 4 — Latex particle separation in the disk centrifuge for unswollen, swollen, and second generation particles

Table 1—Results of the Polymerizations

Latex No.	Sheath	D_c (core)	D_0 (unswollen)	D (swollen)	Diameter Swelling (%)	Core Volume (%)
AC-14	pMMA[a]	332	700	710	1.5	41
AC-16	p(MMA-co-18.5% BuA[b])	332	1050	1330	26.7	3270
AC-17	polystyrene	332	925	1070	15.7	1185
AC-18	p(sty[c]-co-6.6% BuA)	332	890	1010	13.5	890

(a) pMMA = poly(methyl methacrylate).
(b) BuA = butyl acrylate.
(c) Sty = styrene.

CENTRIFUGE METHOD

Particle size measurements were performed on an ICI-Joyce Loebl Disk Centrifuge. Centrifuge speeds were chosen so that particles passed the detector between 1-25 min after injection. The output of the optical detector was recorded on a strip chart recorder operated at 2.5 V full scale. Samples were diluted to between 0.25-0.5% weight concentrations with a 80% water/20% methanol mixture. The spin fluid was water or a glycerol-water mixture. The density gradient within the spin fluid was formed with methanol for a spin fluid of water and with water for a spin fluid of glycerol-water. In all cases, stable sedimentation conditions were achieved. The external gradient method of Holsworth and Provder[11] was used to form a density gradient within the spin fluid.

RESULTS AND DISCUSSION

Table 1 summarizes the results of the polymerizations. The swellant in all cases was aqueous ammonia. Diameter swelling is calculated from the ratio of D to D_0. The core volume swelling is calculated with the reasonable assumption that all volume changes are in the core. During swelling, the shell polymer is stretched in size but does not change in volume; thus the shell becomes thinner. In sample AC-16, for example, the total diameter increase is from 1050 nm to 1330 nm, a volume increase of $\pi/6(1330^3 - 1050^3) = 626 \times 10^6 \text{ nm}^3$. That volume increase is due solely to increase in the core volume. The original core diameter is 332 nm, thus the core volume increase is

$$\frac{626 \times 10^6 \text{ nm}^3}{\frac{\pi}{6}(332 \text{ nm})^3}(100\%) = 3270\%$$

For illustrative purposes, we mixed swollen and unswollen aliquots of a latex that contained a second generation of particles (i.e., second stage polymer that formed new particles). *Figure* 4 shows three bands in the disk window. The first band is the unswollen core-shell particles. The swollen particles, band two, always appear after the unswollen particles even though they are larger in size. The third band is the second generation of particles from the core-shell polymerization (these assignments can be determined in separate experiments with the swollen and unswollen core-shell latices).

CONCLUSIONS

Size analysis of latex particles that contain a void is possible with the disk centrifuge. An equation has been developed that relates the diameter of a swollen particle to its original diameter and its time of appearance on the disk centrifuge. The form that this equation takes depends on the spin conditions used. The most simple case is a linear equation. We have found the condition for which the solution to our equation is a single valued function and constructed a calibration curve for degree of swelling. This equation can be used for routine analysis of swollen core-shell particles.

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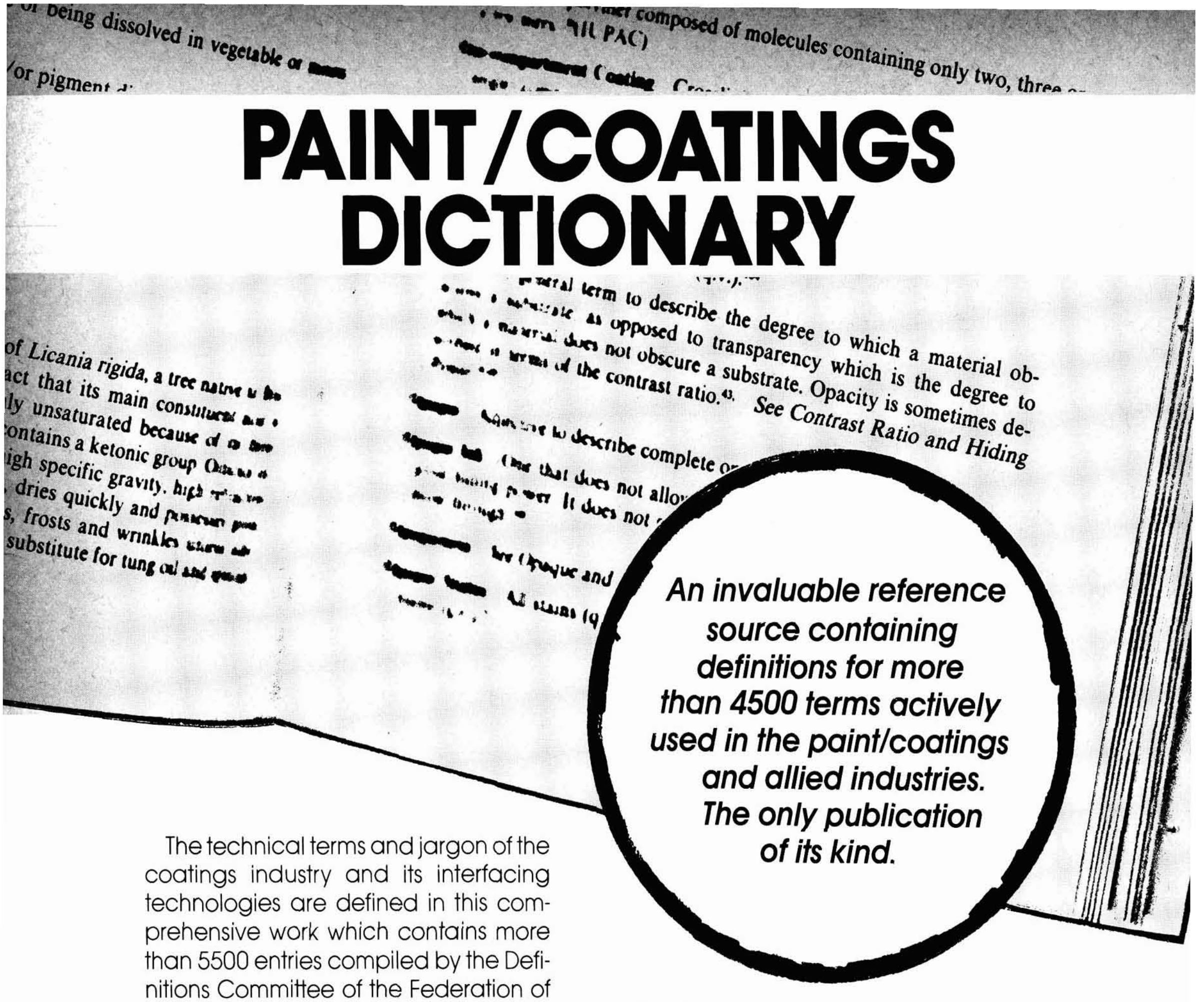

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Fourier Transform Infrared Spectroscopic Studies of Coatings Defects

Daniel J. Skrovanek
PPG Industries, Inc.*

Fourier transform infrared (FTIR) spectroscopy is applied to the study of several coatings defects in order to demonstrate its utility as a problem-solving tool. Specifically, weathering, cratering, quality control, and adhesion problems are addressed. The results indicate that infrared spectroscopy can be useful for studying coatings defects, especially when used in conjunction with an infrared microscope.

INTRODUCTION

Organic coatings are widely used to provide protection and decoration to materials. However, a major difficulty with organic coatings is their tendency to form surface defects.[1] For example, a coating can become contaminated or trap solvent and result in surface irregularities, such as craters or pops. Contamination of the surface of the article to be coated can cause adhesion failure, resulting in delamination of the coating. Prolonged exposure to the elements can result in a coating with poor durability and loss of gloss. As these examples illustrate, coatings defects are clearly undesirable. Although coatings defects can take many forms, they are all similar in that they cause appearance problems and provide sites for premature failure. Hence, it is necessary to prevent the occurrence of coatings defects, or if they do occur, to find a way to correct them. A key step to achieving this is an accurate analysis of the specific problem encountered.

There are many techniques available for characterizing coatings defects. The main factor dictating the choice of a particular technique is understanding what information is desired. The naked eye is usually the first technique used to analyze a defect, and much information can be gained from visual observation. For example, visual observation allows one to differentiate between cratering and orange peel. However, the use of a microscope greatly enhances the ability to characterize a defect. For example, cross-sectioning of the paint film and substrate and examination with a microscope can sometimes reveal the presence of a contaminant as the cause of a crater. Establishing that a contaminant is responsible for a defect may be sufficient. However, if the determination of the chemical composition of the contaminant is desired, microscopy alone is usually insufficient for this and other techniques are required. A technique which has proven useful in the laboratory for the characterization of coatings defects is infrared spectroscopy, particularly when coupled with an infrared microscope.

Infrared spectroscopy has traditionally been a useful tool for the identification and characterization of materials. The infrared spectrum of a material results from the interaction of electromagnetic radiation with the sample, resulting in the absorption of radiation in the infrared frequency range. These vibrations give rise to a characteristic spectrum which is useful for the identification of the sample.

When compared to other analytical techniques, infrared spectroscopy enjoys several advantages which make it particularly amenable to the study of coatings defects. Infrared spectroscopy is sensitive to the functional groups (i.e., bonds) present rather than merely the elements composing the compound, so that additional information concerning the identity of a compound is obtained. Additionally, minimal sample preparation is usually required and quality spectra can be obtained in just minutes so that overall sampling time is usually short. The infrared radiation employed by the technique is a gentle probe compared to other techniques which employ ions or electrons; hence, infrared spectroscopy is nondestructive and allows subsequent analyses to be per-

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formed on the same sample. Quantitative analysis is also possible through the use of the Beer-Lambert Law.[2] Finally, the use of an infrared microscope allows site-specific analyses.[3-5]

The infrared microscope is an external accessory to an infrared spectrometer and allows micro analyses to be performed. The term "micro" refers to samples as small as the diffraction limit of infrared radiation, which is roughly 10 microns. The microscopy technique is also well-suited to the study of small areas within macro samples such as those commonly encountered with coatings defects.

The infrared microscope basically consists of an optical microscope, which allows the sample to be viewed in a conventional manner, and optics for recording the infrared spectrum. The infrared microscope is designed to allow visible light (which permits viewing of the sample) and infrared light to be coincident so that the infrared spectrum of the exact area which is viewed is recorded. This site specificity makes infrared microscopy a potentially powerful tool for the study of coatings defects since the defects tend to be small and localized.

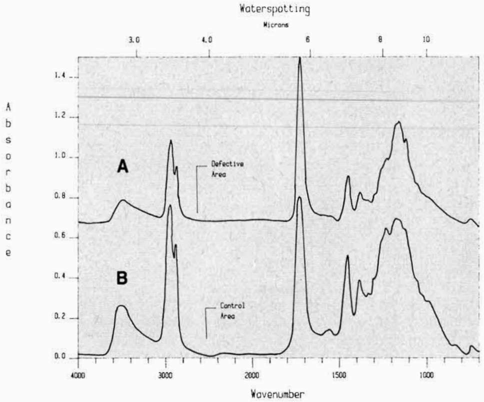

Figure 2—Infrared spectra of an experimental coating formulation which exhibits waterspotting. (A) Defective area resulting from six months of Florida exposure; (B) control area of the same sample

EXPERIMENTAL

The samples which were analyzed were a variety of different commercial coatings which had exhibited defects during service. The infrared spectroscopic experiments were conducted on a Mattson Instruments Cygnus 100 Fourier transform infrared spectrophotometer equipped with a high-intensity source and liquid nitrogen-cooled mercury-cadmium-telluride (MCT) detector. A Bach-Shearer FTIR microscope which is capable of recording both transmittance and reflectance infrared spectra was employed for the microscopy experiments. A series of knife edges which forms a rectangular aperture was used to selectively mask off the appropriate regions of the sample to be analyzed. A Mattson Instruments Accu-Load variable angle ATR attachment was used to record the attenuated reflectance spectra. Spectra were acquired at a resolution of 4 cm^{-1} by signal averaging between 16-2000 scans. Specific details concerning the sampling procedure used to examine each sample are given in the following sections.

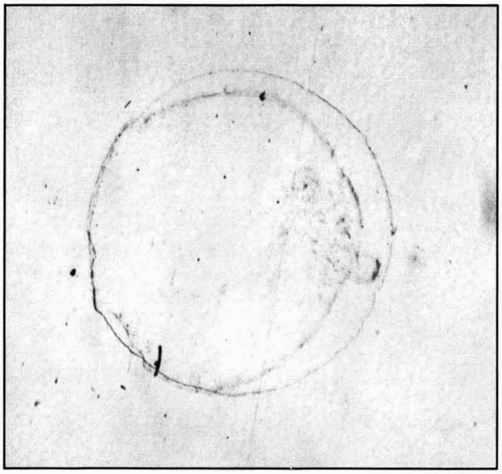

Figure 1—Photomicrograph of a typical waterspotting defect (15X magnification)

RESULTS AND DISCUSSION

To illustrate the problem-solving utility of infrared spectroscopy as applied to coatings defects, examples of coatings which exhibited defects while in service are given. Although these examples are only a partial representation of the coatings defects one may encounter, they nevertheless serve to illustrate the abilities and limitations of FTIR spectroscopy as applied to coatings defects.

Effect of Weathering

When a coating is exposed to the elements for extended time periods, it usually exhibits some degradation of appearance and physical properties due to ultraviolet rays, humidity, temperature cycling, air-borne contaminants, and rain (which may contain dissolved material as in the case of so-called "acid rain"). Degradation may be manifested by discoloration, loss of gloss, blushing, and surface irregularities which all detract from the coating's appearance. In addition, the physical properties of the coating can also deteriorate as exhibited by softening, poor solvent resistance, and even loss of the coating itself. Clearly, it is advantageous to characterize the defect in order to gain information as to the cause and to suggest a possible solution.

FTIR microscopy has been applied successfully to the characterization of waterspotting-type defects which result from exposure to the elements. Waterspotting is the change in the surface appearance of the coating which results from the action of water standing on the paint film. These defects usually are manifested by discolored spots, rings, or blotches with lower gloss than the surrounding coating. A typical example is shown in *Figure* 1. Spotting is usually caused by the water sensitivity of the coating which may allow unreacted or low molecular weight material to be extracted or the defect may also result from dissolved material being deposited on the surface as the water evaporates.[6] Because these defects tend to be small and localized, they are difficult to characterize by most analytical techniques. However, an FTIR microscope is particularly amenable to study this problem.

One example of the successful application of FTIR microscopy to characterize a waterspotting problem concerned a new coating formulation which was subjected to Florida exposure for six months of durability testing. After exposure, the coating exhibited many small, discolored spots at various locations on the surface of the coating and was considerably softer at these locations.

A small amount of the defective area was scraped with a spatula onto a potassium bromide (KBr) window and the sample was analyzed in the transmission mode. The infrared spectrum of the nondefective area of the coating was acquired in an analogous manner. The spectra of the defective and nondefective areas are shown in *Figure* 2A and 2B, respectively. At first glance, the spectra appear quite similar except for some obvious intensity differences due to sample thickness variations. However, upon closer inspection, there are some subtle differences which suggest chemical variations. For example, the breadth of the C=O stretching band at approximately 1730 cm^{-1} appears broader in the control sample than in the defective sample. Also, some differences can be seen in the band envelope between 1000-1300 cm^{-1}. However, it is very difficult to assess these differences solely by a comparison of these spectra.

The spectral differences can be accentuated by the use of digital subtraction.[7] Digital subtraction involves subtracting those bands which are common to both spectra to a zero baseline to reveal the chemical differences that exist between them. For the case of the spectra shown in *Figure* 2, the differences which result from the subtraction would be attributable to the effect of waterspotting. The result of the subtraction is shown in *Figure* 3. As can be seen, chemical differences do exist and it is now possible to confidently assess these differences as due to ester groups. Based on the information gained from this subtracted spectrum, it is possible to suggest formulation changes which may alleviate the problem.

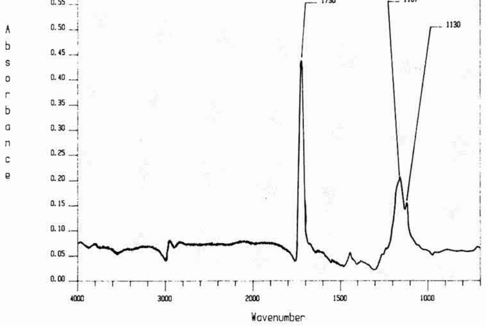

Figure 3—Difference spectrum showing the effect of waterspotting

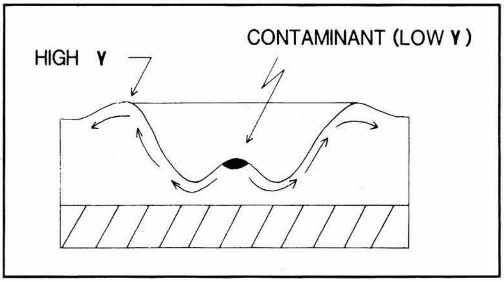

Figure 4—Schematic cross section of a crater. [Reproduced from reference (3)]

Cratering

Another frequently observed coatings defect is cratering—the formation of small, bowl-shaped depressions in a coating film which frequently have drops or bands of material at their centers and often have raised, circular edges. Cratering can be caused by many factors, but some of the more common causes are gel particles, dirt, fibers, overspray, substrate contamination, and oil droplets from air lines or machinery. A schematic cross section of a typical crater is shown in *Figure* 4.[6]

The driving force for crater formation is the foreign matter or contaminant usually found at the center of the crater which causes a surface tension gradient. For example, in the case of an oil droplet, the low surface tension oil spreads radially, creating a circular area of low surface tension material which induces flow in the coating away from the low surface tension region towards the higher surface tension bulk of the coating, resulting in a crater. Hence, identification of the contaminant is highly desirable in order to prevent the future occurrence of cratering. Infrared microscopy is particularly suited for the study of craters because of the ability of the technique to selectively analyze the small areas characteristic of craters.

When analyzing a crater, the first step is observation of the crater with a stereo microscope to determine if a contaminant is present. If a contaminant particle is visible, it is best to extract the particle and analyze it by transmission infrared microscopy. This is because the amount of energy throughput is significantly greater for transmission experiments than for reflectance experiments. In the reflectance mode, an additional beamsplitter is employed in the instrument to direct the infrared radiation onto the sample from above. When infrared radiation strikes the beamsplitter, one-half of the radi-

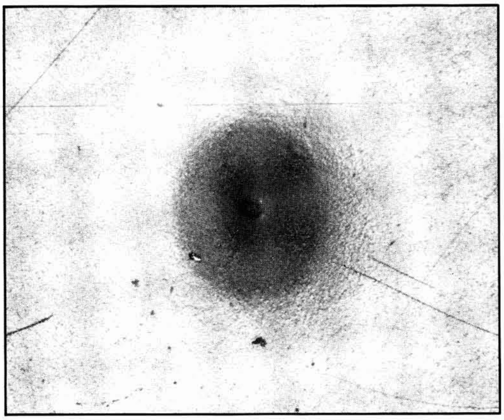

Figure 5—Photomicrograph of a typical crater (20X magnification)

ation is lost. The infrared beam strikes the sample from above, reflects off the surface of the sample, and then retraces its path through the microscope optics where it impinges on the beamsplitter once again. This time, the half of radiation that passes through the beamsplitter is directed onto the MCT detector. Since one-half of the energy is lost each time the infrared beam strikes the beamsplitter, the reflectance mode has, at best, only 25% of the energy throughput of the transmission mode. Consequently, spectral quality generally is poorer for reflectance experiments. Therefore, whenever possible, transmission infrared microscopy is preferable.

Although transmission experiments are favored, unfortunately the majority of craters are analyzed via the reflectance mode. This is because a contaminant may not be visible when the crater is analyzed with a microscope, or if a contaminant is visible, it is not always possible to isolate it from the rest of the sample in order to analyze it via transmission microscopy. This is especially true when an oil or some other thin film is responsible for the cratering.

Figure 5 shows a typical crater from a coated metal part which exhibited severe cratering over the majority of its surface. When the crater was analyzed with a stereo microscope, foreign material was not visible at the center of the crater. Therefore, in order to analyze this problem, it was necessary to employ reflectance infrared microscopy.

The procedure followed in this case was to first obtain the infrared spectrum of the noncratered area, as shown in *Figure* 6. Next, the infrared spectrum of a cratered area of the same metal part was obtained and is displayed in *Figure* 7. As can be seen, in addition to the absorptions due to the coating, there are bands not due to the coating. Hence, even though an obvious contaminant was not visible, these additional bands must be due to a contaminant which in this case is china clay, a common filler used in coatings.

A comparison of this reflectance spectrum to the spectra shown in *Figure* 2 which were acquired in the transmission mode clearly shows the poorer spectral quality of reflectance spectra. In the reflectance spectrum of *Figure* 7, distorted band shapes are obvious in the bands centered at 3300 cm^{-1} and ca. 2900-3000 cm^{-1}. In addition, the interference fringes between 1800-2700 cm^{-1} which are caused by scattering give the appearance of additional absorptions. Fortunately, the contaminant bands were well-separated from the bands due to the coating so that, in spite of the diminished spectral quality, the contaminant was able to be identified.

Although in the previous example it was possible to identify the contaminant responsible for the cratering, in general, if a visible contaminant cannot be found and then isolated from the coating, the chances of identifying the cause of the cratering are not very good. This is due to several reasons. First, if the contaminant is organic, it is possible for both the coating and the contaminant to be composed of the same functional groups (as, for example, a gel particle). Thus, when comparing the spectra of defective and nondefective areas, it is difficult to discern chemical differences. When the spectra are acquired in the reflectance mode, the spurious bands due to scattering

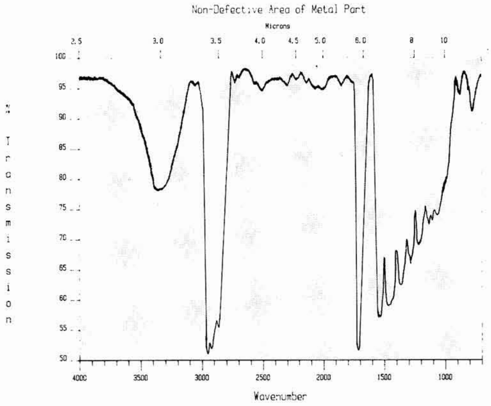

Figure 6—Infrared spectrum of a noncratered area of a metal part

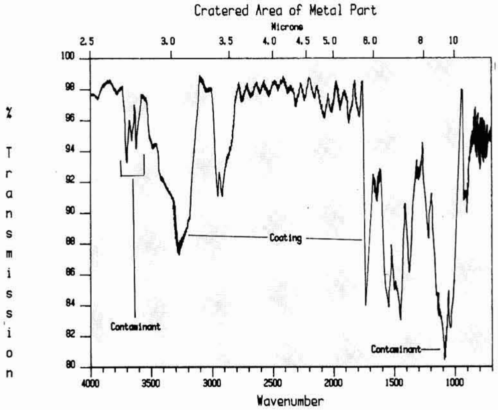

Figure 7—Infrared spectrum of a cratered area of a metal part

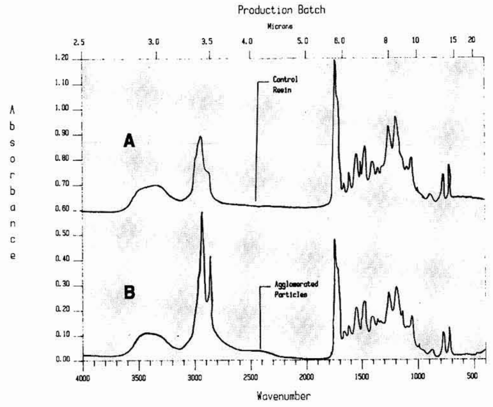

Figure 8—Infrared spectra of a production batch of an acrylic resin. (A) Control sample; (B) defective sample

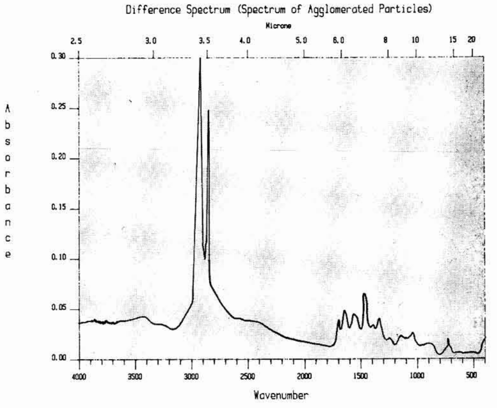

Figure 9—Infrared spectrum of the phase separated material of an acrylic resin. Spectrum was obtained by subtraction

would become accentuated after digital subtraction so that it would be difficult to differentiate between real bands and bands which are artifacts due to spectral acquisition. Secondly, the concentration of the impurity is usually very small relative to the amount of the coating so that one sees only weak absorptions which may not be detected or are completely masked by the strong absorptions of the coating. Finally, in many cases, the impurity which is responsible for the crater may disappear once the coating is baked so that there is nothing to analyze. For example, if a volatile contaminant caused dewetting and formation of the crater, in all likelihood it will be driven off when the coating is subsequently baked and hence cannot be detected. For these reasons, it is sometimes difficult to analyze craters by infrared spectroscopy and draw definitive conclusions regarding the cause of the problem.

Quality Control

Raw materials which are out of specification or are contaminated by an external source are frequently responsible for coatings defects. Consequently, it is necessary to ensure that the coating raw materials meet a consistently high standard of quality by maintaining strict quality control. Optical microscopy has been an important technique for maintaining quality because it can reveal the presence of contaminants. Establishing that contamination has occurred is valuable because the contaminated material can be rejected from the coating formulation. However, it is more critical to establish the chemical composition of the contaminant so that its source can be identified and eliminated and the problem prevented from future occurrence.

A recently encountered quality control problem concerned a production batch of an acrylic resin which developed a film on its surface and the walls of its container. A component of the coating was suspected of separating out to cause the problem. One way to attack this problem is to attempt to isolate the phase separated material by filtration, extraction, or some other means and hopefully obtain a sufficient quantity of sample for analysis. However, this method is slow and tedious and the use of solvent to do the extraction may chemically alter the sample. A better way to solve this problem is by the use of infrared microscopy.

A small amount of the material deposited on the vessel walls was scraped onto a KBr window and dried thoroughly. The infrared spectrum was recorded and is shown in *Figure* 8B. The infrared spectrum of the control resin was obtained by casting a sample onto a KBr window, thoroughly drying, and then recording its infrared spectrum, which is shown in *Figure* 8A. A cursory glance of these two spectra indicates that they are very similar except for intensity differences in the C—H stretching region between 2800-3000 cm^{-1}. Thus, it appears that the suspicious material also contains a significant amount of the resin.

To obtain the infrared spectrum of the phase separated material exclusive of the resin, the spectrum of the non-

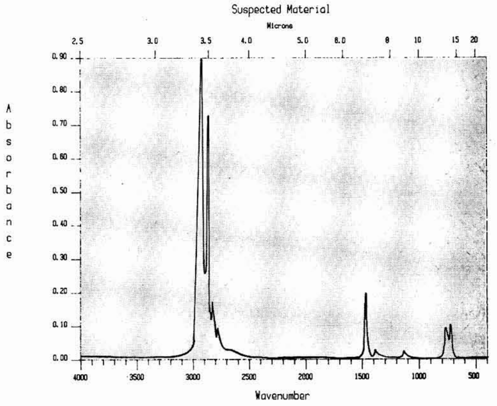

Figure 10—Infrared spectrum of the component of the acrylic resin formulation thought to be separating out of the formulation

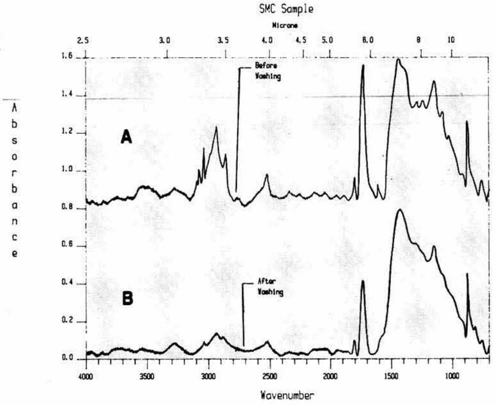

Figure 11—Infrared spectra of an SMC part which exhibits adhesion failure. (A) Before washing; (B) after washing

defective sample was subtracted from the spectrum of the control sample and the result is displayed in *Figure* 9. This spectrum indicates a material which is predominately hydrocarbon-based. An analysis of the formulation indicated that such a material is a component. Therefore, to definitively identify this component as the phase separated material, its infrared spectrum was obtained and is displayed in *Figure* 10. A comparison of *Figures* 9 and 10 indicates that, within experimental error, the spectra are nearly identical and hence, it is possible to positively identify this material as the cause of the problem.

Adhesion Problems

Another problem frequently encountered in the coatings industry is poor paintability or lack of adhesion of the coating to the substrate. Sometimes this is due to the surface tension of the paint being too high because of an error in the manufacture of a batch or in the formulation. More frequently, it is due to the presence of a contaminant on the substrate surface. Therefore, identification of surface contamination is highly desirable.

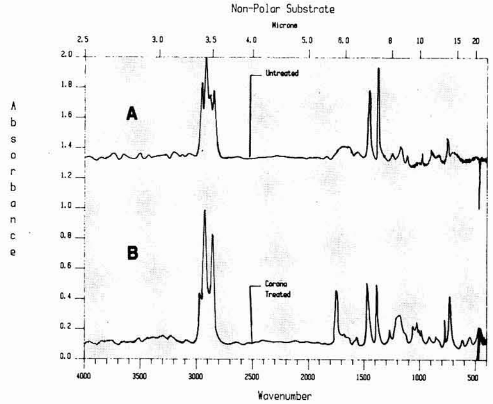

Figure 12—Infrared spectra of a nonpolar substrate used in exterior automotive applications. (A) Untreated sample; (B) Corona electrical discharge treated sample

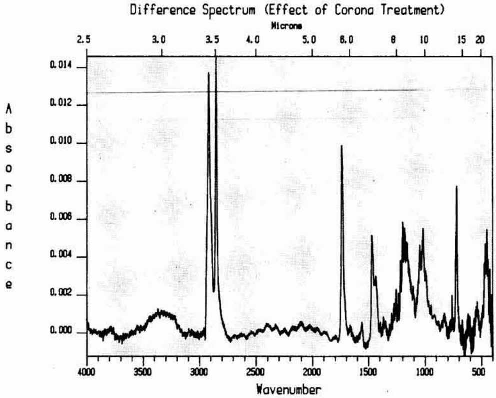

Figure 13—Difference spectrum showing the effect of a Corona electrical discharge on the surface of a nonpolar substrate used for exterior automotive applications

The presence of a contaminant on the substrate surface can sometimes be inferred from surface tension measurements. For example, a substrate from one production batch may have a significantly lower surface tension than a substrate from another production batch. This would suggest the presence of surface contamination on the substrate from the first batch. However, it is more practical to identify the chemical composition of the contaminant so that its source may be found and the problem prevented from future occurrence. Infrared spectroscopy is useful for identifying the chemical composition of materials.

A recent problem involving poor coating adhesion occurred with a molded part made of sheet molding compound (SMC). The as-received part showed poor adhesion, but, if washed with a soap and water solution prior to painting, the adhesion was significantly better. A hydrocarbon-based mold release agent was suspected as causing the problem.

The infrared spectrum of an SMC part before and after washing was recorded using the attenuated total reflectance (ATR) technique and the results are displayed in *Figure* 11. As can be seen from these spectra, the sample after washing has markedly weaker hydrocarbon C—H stretching vibrations between 2800-3000 cm^{-1}, suggesting that washing removes a material containing a significant amount of hydrocarbon C—H groups. The fact that the mold release agent is known to be a hydrocarbon-based material makes this the likely cause of the adhesion problem. This was definitively proven by extracting the mold release agent from the SMC part and running the extract by transmission spectroscopy and comparing this spectrum to that of a sample of the mold release agent.

In general, nonpolar substrates are difficult to paint because of their inherently low surface tension. Consequently, the surface of these materials must be altered in some manner to facilitate adhesion of the coating. One technique for treating nonpolar surfaces to improve paintability is the use of a Corona discharge treatment.[8] This technique uses an electrical discharge to cause oxidation of the surface to be painted, thereby increasing its polarity and making the surface more wettable. Characterizing the chemical changes that occur to the surface upon treatment is useful for understanding the reasons for the increased adhesion and also to gain an insight into designing adhesion promoters which may be used in lieu of the Corona treatment.

An illustrative example concerned a nonpolar substrate used in an exterior automotive application. The as-received sample had a surface tension of less than 30 dyn/cm, consistent with its nonpolar nature. The infrared spectrum corresponding to this material is shown in *Figure* 12A and exhibits vibrations characteristic of an essentially olefinic material. After treatment with the Corona discharge, the surface tension increased to above 50 dyn/cm and yielded the infrared spectrum shown in *Figure* 12B. It is apparent that modification of the surface had occurred. These changes may be accentuated by digital subtraction as shown in *Figure* 13, making it possible to identify the chemical changes that occur to the surface of the material as a result of the Corona discharge treatment. The strong C=O band at around 1700 cm^{-1} and the C—O band at roughly 1200 cm^{-1} suggest that polarity is imparted to this material in the form of ester-type groups. Also, the intense bands between 2800-3000 cm^{-1}, 1400-1500 cm^{-1}, and at about 730 cm^{-1} indicate the introduction of considerably more C—H groups into the material. Based on this information, adhesion promoters can be designed which incorporate this functionality into their structure.

SUMMARY AND CONCLUSIONS

The application of FTIR spectroscopy to the study of some typical coatings defects was presented. Specifically, weathering, cratering, quality control, and adhesion problems were investigated. The results indicated that infrared spectroscopy can be a particularly useful technique for the study of coatings defects, especially when coupled with an infrared microscope. The abilities and limitations of the technique were illustrated and its utility as a problem-solving tool was demonstrated.

Although infrared spectroscopy has considerable potential for the study of coatings defects, it is not a panacea and hence is best utilized in conjunction with other techniques. By obtaining supporting information, the problem of characterizing a defect is more complete and less likely to be erroneous. This is especially important because many problems are not as they seem and incorrect diagnosis of a problem can lead to much wasted effort and can be responsible for the commercial failure of a basically good coating.

ACKNOWLEDGMENT

The author wishes to thank the management of PPG Industries, Inc. for permission to publish this work. In addition, the assistance of Ms. Zorita Wilkins in obtaining the photomicrographs is appreciated.

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Chemistry of Curing Reactions: Room-Temperature Cure Coatings Based on Epoxies and Urethanes

Chacko Thankachan
BASF Coatings & Inks Canada Ltd.*

To alleviate environmental pollution due to coatings emissions in baking ovens, novel coating compositions have been introduced, with emphasis on room-temperature cure. Epoxies and urethanes are of paramount importance in providing room-temperature cure coating compositions for a wide variety of applications. This review attempts to explain the chemistry of their curing mechanisms. Various curing reactions of epoxies and urethane formation are discussed.

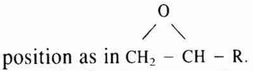
INTRODUCTION

The field of coatings and inks is expanding every day, and innovations are being introduced into the market at a faster rate than usual. Although the market is embracing the new technological developments, a thorough understanding of their curing reactions will help the formulator to develop coating compositions to meet individual requirements.

The energy conservation efforts of the late 1970's and the advent of high technology made it possible to bring innovative coating and ink compositions into the marketplace. The increasing demand by the environmental protection agencies, as evidenced by the Los Angeles Pollution Act of 1966—a result of concern about volatile hydrocarbon solvents being released into the atmosphere—pressured coating and ink manufacturers to high-solids, no-bake coating compositions that are faster curing and less polluting, but remain durable and attractive.

The intent of this article is to review the chemistry of curing of two such room-temperature curable coatings: epoxies and urethanes.

EPOXIES

The term "epoxy" is applied to any resin containing a bridge consisting of an oxygen atom attached to two carbon atoms in an adjacent position as in  $\overset{O}{CH_2 - CH} - R$. This type of bonding creates strain in the epoxy ring structure and is susceptible to a wide range of attack from nucleophilic and electrophilic reagents. The vulnerability of the epoxy group to external attack leads to a wide range of thermosetting and thermoplastic materials. This has been capitalized on by the coating industry to provide an enormous range of coatings for a variety of applications.

The commercial exploitation of epoxy resins began in 1947. The first product was made by Devoe-Raynolds Company in the U.S.; it was intended as a polyol for the preparation of synthetic drying oils, and roughly corresponded to the structure in *Figure* 1.[1]

The major types of epoxy resins available to the market are: glycidated resins; cycloaliphatic resins; and epoxidized oils, all of which contain an epoxy ring or oxirane group.[2] From these, the glycidated resins made from bisphenol A and epichlorohydrin were the first commercial resins (*Figure* 1) and still represent the bulk of the epoxy resins consumed.

Epoxy resins cure either through the reaction of secondary hydroxyl groups with other resins such as urea-formaldehyde, phenol-formaldehyde,[3] etc., or through the opening of terminal epoxy groups by curing agents

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*303 Campbell Ave., Toronto, Ontario M6P 3V8, Canada.

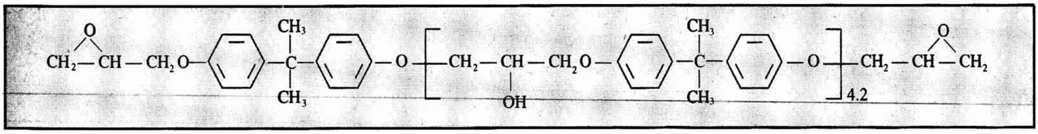


Figure 1—Structure of first commercial epoxy resins

and catalysts. The former class of curing requires baking so that sufficient energy is provided for the hydroxyls to crosslink with other materials to form ether linkages. Since the intent of this review is to study the mechanism of room-temperature cure, only the latter class of curing is discussed.

Chemistry of Curing

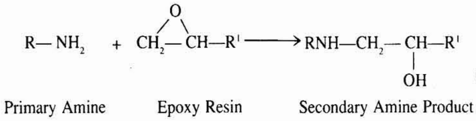
The curing of an epoxy resin can occur either through homopolymerization between the epoxide molecules in the presence of catalysts, or through addition polymerization of the epoxy group with other reactive molecules known as curing agents. The most widely used curing mode is the latter, and the most commonly used catalysts are the polyamines, polyacids, etc., which contain active hydrogen atoms. These curing agents crosslink with the epoxy resins, via the transfer of the hydrogen to the oxygen of the oxirane ring and the subsequent ring opening of the terminal epoxy group.

Epoxy coatings are versatile and are applied for a variety of required properties, such as chemical resistance, dielectric or insulation properties, low shrinkage on cure, dimensional stability or fatigue resistance, thermal stability, bacteria and fungus resistance, water resistance, etc.[4] Conversion of epoxy resins to the thermoset stages requires a curing agent or catalyst.[5] In room-temperature cure coatings, where internal crosslinking between the secondary hydroxyls of epoxy resin molecules are negligible, the attainment of the desired properties in the final coating greatly depends on the nature of the curing agent employed. One of the major approaches in the formulation of high-solid epoxy coatings is the use of modified curing agents which yield reduced formulation viscosities allowing higher resin loading.[6] To facilitate the selection of a curing agent, a knowledge of the chemical makeup and an understanding of the curing mechanism is essential.

Epoxy-Amine Reactions

By far the most commonly used curing agents in room-temperature cure epoxy coatings are aliphatic amines. Since the curing agents will react with the epoxy group upon contact, they are commonly sold as two-package systems. To achieve the EPA mandated requirements of lower coatings emissions, high-solid coating compositions comprised of low molecular weight liquid epoxy resins, along with low viscosity amines, are preferable.[7] Since the aliphatic amines are moderately toxic, a wide variety of proprietary amine adducts, ketimines, polyamides, amidoamines, etc., which are considerably less toxic, have been introduced into the market. The list of such agents is expanding daily to suit customized uses in a variety of applications.

From their studies, O'Neil and Cole[8] concluded that the only significant reaction between an amine-type curing agent and an epoxy resin was with the amino hydrogens of these curing agents. Reaction between a primary amine and a secondary amine with an epoxy resin results in a secondary and a tertiary amine product, as illustrated in equations (1) and (2).



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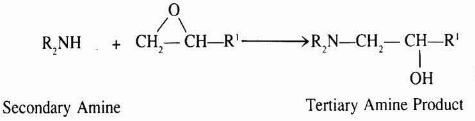
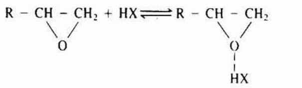


(2)

The epoxy-amine reactions are found to be accelerated via the hydroxyls formed by the *in situ* reaction and also by the addition of compounds containing hydroxyl groups such as phenols, hydroxy alkylated amines, etc.[9]

Gough and Smith[10] attributed these amine epoxide reactions to the ability of the accelerators to donate hydrogen bonds. The authors' list of hydrogen donors or accelerators included $-OH$, $-COOH$, $-SO_3H$, $-CONH_2$, $-CONHR$, $-SO_2NH_2$, and $-SO_2NHR$. Smith[11] suggested a mechanism as illustrated in equations (3) through (5).



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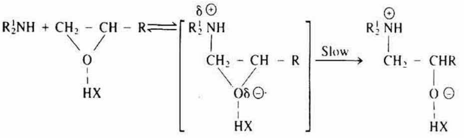

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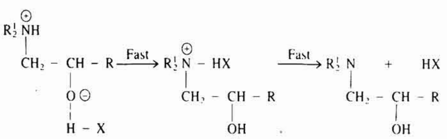
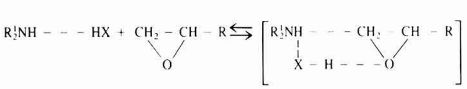


(5)

In equation (3), a hydrogen bond is formed between the oxygen of the epoxy ring and the hydrogen of the donor, followed by the linkage of the nitrogen to the epoxy carbon and the rate-determining step of the epoxy ring opening [equation (4)]. The end product in equation (5) is arrived at by the fast displacement of protons. However, Tanaka and Mika[12] argue that the basicity difference between an amine and an oxirane ring favors the hydrogen-bond formation between the amine and the hydrogen donor. Based on this and other evidence, they suggest the mechanism given in equations (6) through (8).

$$R^1_2NH + HX \rightleftarrows R^1_2NH - - - HX \qquad (6)$$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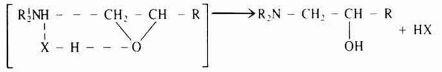
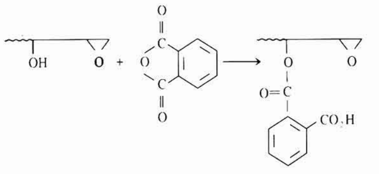

(8)

Epoxy-Acid Anhydride Reactions

Epoxy resins react with acid anhydrides to yield esters. The reaction can be catalyzed by acidic or basic catalysts. In the absence of a catalyst, acid anhydrides react with a hydroxyl group of the epoxy resin to form the half acid ester, followed by the reaction of the carboxyl group with an epoxy ring to give the diester as illustrated in equations (9) and (10).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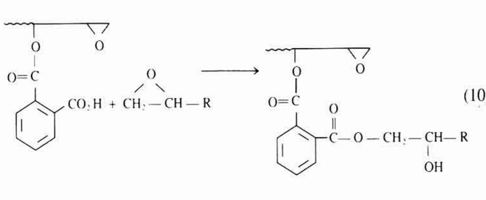

(10)

Epoxy-Mercaptan Reactions

Although epoxy-amine coating compositions continue to serve the market unchanged and unchallenged, other areas are being explored for new types of low-temperature cure catalysts. Mercaptans are found to be a suitable candidate of the new generation low-temperature cure catalysts for epoxy coatings.

On their own, epoxy-mercaptan reactions are slow at room temperature and often require baking conditions to attain optimum cure properties. However, recent studies[13] have shown that mercaptan-epoxy reactions proceed at low temperatures at a faster rate in the presence of tertiary amines.

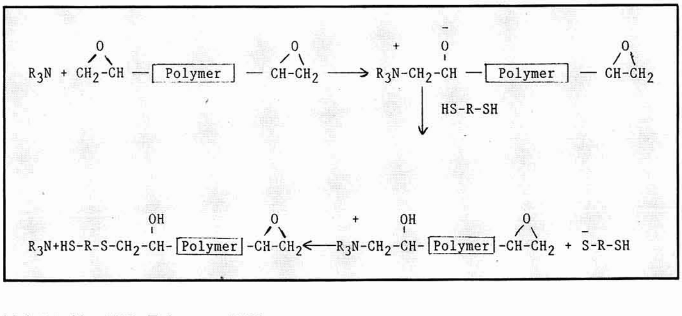
The proposed mechanism of cure involves homopolymerization step of the epoxy resin initiated by the tertiary amine followed by the hydrogen transfer from the mercaptan to the oxygen and the subsequent displacement of the tertiary amine by the mercaptide ion as illustrated in *Scheme* 1.[13]

With the present day technology, it is now possible to disperse epoxy resins into water without destroying the epoxy functionality, making water-borne epoxy resins a reality.[5] Most of the traditional epoxy curing agents, with the exception of those which are hydrolyzable, such as anhydrides, can be employed as curing agents in water-borne epoxy systems.

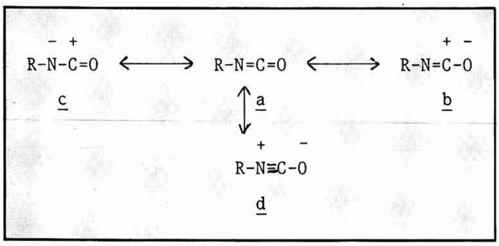
Besides the previously mentioned reactions, epoxy-curing reactions proceed with a wide variety of curing agents such as polyureas, polyurethanes, polyhydric alcohols, etc. However, most of these reactions occur at elevated temperatures, and since this review is concerned with room-temperature cure, further discussion of these reactions is irrelevant.

URETHANES

Urethane chemistry, like that of epoxy resins, revolves around the reactivity of hydrogen donor molecules toward the isocyanate group. Although the reaction of isocyanates with various hydrogen donors was first documented by Wurtz in 1849, it was not until the end of the 1930's, when O. Bayer and his coworkers discovered the diisocyanate addition polymerization, that polyurethanes assumed major commercial importance.[14a] World War II saw rapid growth in polyurethane chemistry for commercial applications, particularly in the aircraft industry, where polymers with highly specific properties were coming into increasing demand.



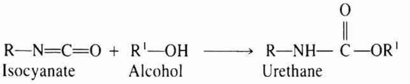
Scheme 1



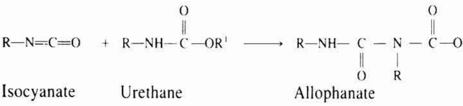
Scheme 2

"The polyurethanes we know today form a wide variety of rather closely associated polymers containing a diisocyanate backbone. The structure of these polymers shows the repeating urethane groups, regardless of whatever other groups appear in the structure .... Other groups which may appear in the structure are urea, ester, ether, aromatic, amine, biuret, allophanate," etc.[14b] The number, repeatability, and the manner in which these groups are arranged in the final polymer depend on the nature of the hydrogen donor molecule to which the diisocyanate is reacted.

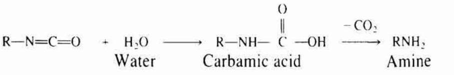
Any resin containing an $>\mathrm{N}-\overset{\overset{\mathrm{O}}{\|}}{\mathrm{C}}-\mathrm{O}-$ group is apt to be called a urethane resin.[15a] The various reactions possible between an isocyanate group and a hydrogen donor molecule are illustrated in equations (11) through (16).[15]



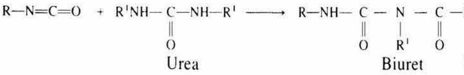
$$\underset{\text{Isocyanate}}{\mathrm{R{-}N{=}C{=}O}} + \underset{\text{Alcohol}}{\mathrm{R^1{-}OH}} \longrightarrow \underset{\text{Urethane}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}OR^1}} \qquad (11)$$



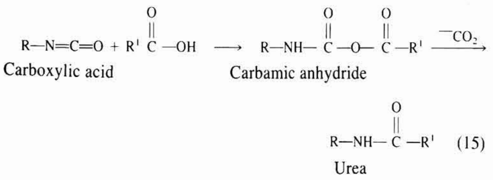
$$\underset{\text{Isocyanate}}{\mathrm{R{-}N{=}C{=}O}} + \underset{\text{Urethane}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}OR^1}} \longrightarrow \underset{\text{Allophanate}}{\mathrm{R{-}NH{-}\underset{\underset{O}{\|}}{C}{-}\underset{\underset{R}{|}}{N}{-}\overset{\overset{O}{\|}}{C}{-}OR^1}} \qquad (12)$$



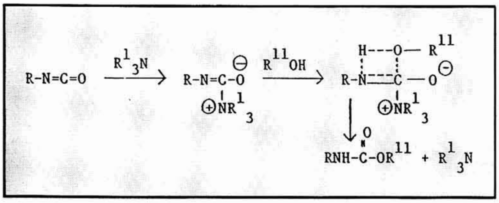
$$\mathrm{R{-}N{=}C{=}O} + \underset{\text{Water}}{\mathrm{H_2O}} \longrightarrow \underset{\text{Carbamic acid}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}OH}} \xrightarrow{-\mathrm{CO_2}} \underset{\text{Amine}}{\mathrm{RNH_2}} \qquad (13)$$



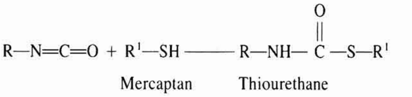
$$\mathrm{R{-}N{=}C{=}O} + \underset{\text{Urea}}{\mathrm{R^1NH{-}\underset{\underset{O}{\|}}{C}{-}NH{-}R^1}} \longrightarrow \underset{\text{Biuret}}{\mathrm{R{-}NH{-}\underset{\underset{O}{\|}}{C}{-}\underset{\underset{R^1}{|}}{N}{-}\underset{\underset{O}{\|}}{C}{-}NHR^1}} \qquad (14)$$



$$\mathrm{R{-}N{=}C{=}O} + \underset{\text{Carboxylic acid}}{\mathrm{R^1\overset{\overset{O}{\|}}{C}{-}OH}} \longrightarrow \underset{\text{Carbamic anhydride}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}O{-}\overset{\overset{O}{\|}}{C}{-}R^1}} \xrightarrow{-\mathrm{CO_2}} \underset{\text{Urea}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}R^1}} \qquad (15)$$



Scheme 3



$$\mathrm{R{-}N{=}C{=}O} + \underset{\text{Mercaptan}}{\mathrm{R^1{-}SH}} \text{———} \underset{\text{Thiourethane}}{\mathrm{R{-}NH{-}\overset{\overset{O}{\|}}{C}{-}S{-}R^1}} \qquad (16)$$

The order of reactivity of some hydrogen donors toward an isocyanate group is primary amines > primary alcohols > water > ureas > secondary and tertiary alcohols > urethanes > carboxylic acids > carboxylic acid amides.[16]

By far the most commercially exploited hydrogen donors are hydroxyl terminated polymers. A wide variety of polyether polyols and polyester polyols has been developed for polyurethane applications. The ease of developing the polyols, coupled with the freedom of pigment selection* brought the hydroxyl terminated polymers to the forefront of curing agents used in the urethane chemistry. Only the hydroxyl isocyanate reaction is discussed here.

Chemistry of Curing

Polyisocyanates react with active hydrogen compounds (e.g., polyols) to form urethanes. Since this reaction proceeds at room temperature without the aid of a catalyst, they are sold as two-component systems. The reaction between the isocyanate and the polyol produces the cured product (urethanes) at ambient conditions. The curing process can be enhanced by the presence of a catalyst. A variety of catalysts can be employed to accelerate the speed of the reaction. Gel tests were used to quickly screen numerous catalysts for the isocyanate-hydroxyl reaction, and the time for diisocyanate/polyether polyol to gel at 70°C was noted as an indication of catalytic strength.[17] Squiller and Rosthauser[18] studied the rate of cure by various catalysts on different isocyanates with a polyester triol; results are compiled in *Table* 1.

The relative order of reactivity with the majority of catalysts is found to follow MDI > TDI > HDI > IPDI. Isocyanates are found to give products by adding across the N=C group to form carbamates rather than across the C=O group to form carbimidates. The reactions and reactivity of isocyanates can best be understood by considering resonance stabilization of the isocyanate group. The internal conjugation leads to charge separation between the nitrogen, carbon, and oxygen atoms as indicated in *Scheme* 2, where *b* and *c* are the major contributors.[19]

The tertiary amine catalyzed reaction is proposed to proceed by the mechanism shown in *Scheme* 3.

Britain and Gemeinhardt[17] proposed a similar mechanism for the base catalyzed reaction of an isocyanate and a hydroxyl-bearing polymer; this is given in *Scheme* 4.

The metal compounds, on the other hand, catalyze the isocyanate-hydroxyl reaction through the formation of a coordination complex between the metal and the isocyanate group[17b,19] as shown in *Scheme* 5.

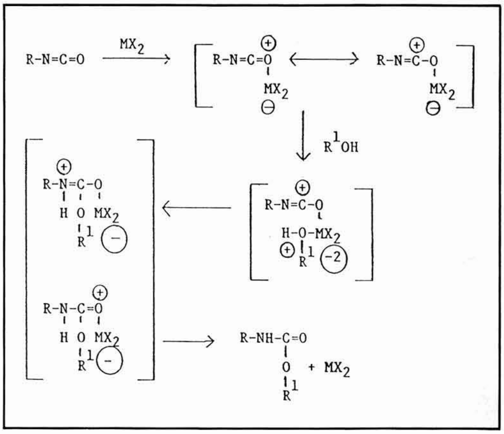
---

*Adsorbed moisture on pigments will react with isocyanate prepolymers, making the selection and storage of pigments very difficult.

Table 1—Gel Test—Diisocyanate/Polyester Triol[18]

Catalyst (1% PbW)	Gel Time (Min) at 70°C HDI[a]	IPDI[b]	MDI[c]	TDI[d]
None	220	>240	100	180
DABCO (diaza (2.2.2) bicyclooctane)	25	30	<1	1
Stannous octoate	8	90	4	10
Zinc octoate	30	120	30	90
Dibutyltin dilaurate	2	15	<1	5
6% Manganese	10	90	30	60
Zirconium octoate	120	>240	45	120
Bismuth stearate	30	60	5	15
24% Lead	15	25	3	10
Dibutyltin diacetate	1	5	<1	1
Lead stearate	25	45	1	4

(a) Hexamethylene diisocyanate.
(b) Isophorone diisocyanate.
(c) Diphenylmethane diisocyanate.
(d) Toluene diisocyanate.



Scheme 5

VAPOR-CURE COATING COMPOSITIONS

Increased awareness of the environmental pollution due to the release of volatile organic contents into the atmosphere during the baking cycle, coupled with the oil crisis of the 1970's, saw the successful development of water-based coatings, high-solids coatings, and radiation-curable coatings. Through radiation cure, instant-cured compositions can be produced; these are often 100% in solids and thus are less polluting than conventional solvent-based coatings. During the initial stages of their introduction to the market, radiation-curable coatings were heralded to be the future of the industry.

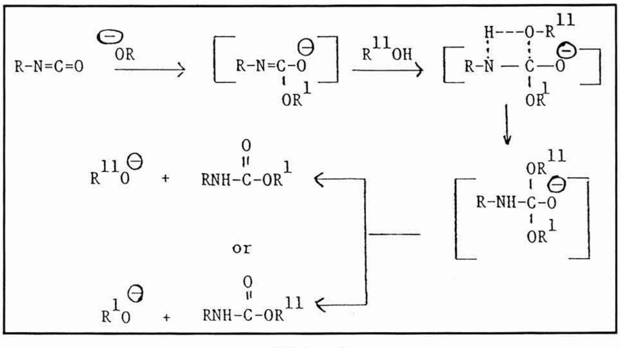
While radiation-curable coatings were making inroads into the marketplace, a number of drawbacks—such as very slow cure with black and white-pigmented UV-curable coatings, and the difficulty in obtaining very high flexibility, etc.—were being observed. These problems and the machinery needed for the application of radiation-cure coatings remained as the stumbling block of their exponential growth. Though radiation-cure coatings are very fast curing and solvent-free, they cannot be truly called energy-free systems to classify them as room-temperature curable coatings. During the introduction of radiation-cure coatings, other areas were being explored to come up with fast-curing systems that can actually compete with radiation-curable coatings in drying speed, and at the same time cure at ambient conditions and are virtually energy-free.

The introduction of vapor-cure coatings has to be perceived as an alternate to radiation-curable coatings. In vapor-cure, the coating composition attains a tack-free state on contact with a catalytic amount of a vapor—often a catalyst at room temperature; hence, the name. The vapor-cure coating composition described here is comprised of an isocyanate-hydroxyl reaction in the presence of tertiary amine vapor as the catalyst.

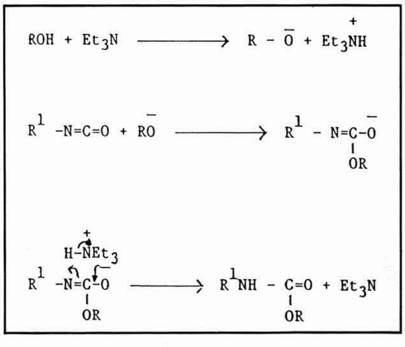
Chemistry of Curing

The mechanisms illustrated in *Schemes* 3 and 4 suggest that the more active the hydrogen of the hydrogen donor in an isocyanate hydroxyl reaction, the faster will be the urethane formation. In the presence of a tertiary amine vapor such as triethyl amine vapor, the hydroxyl-bearing polymer easily can be transformed into a base if the hydrogen is labile or acidic and the newly generated base can take part in the curing mechanism as shown in *Scheme* 6.

Among the organic hydroxyl-bearing compounds, aromatic hydroxyl compounds (e.g, phenolics) are more

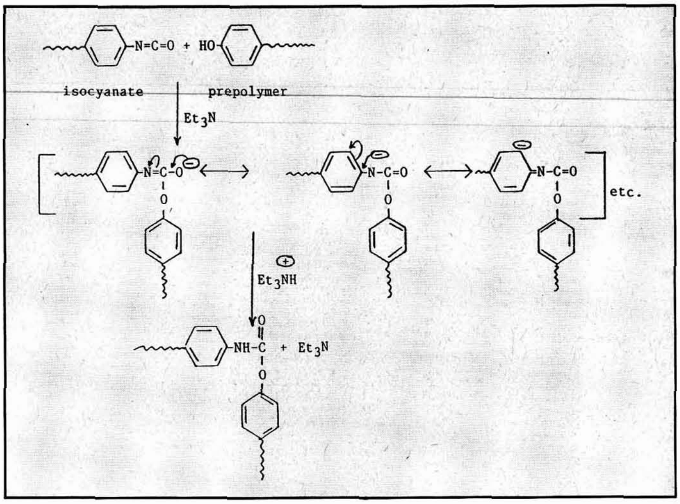


Scheme 4

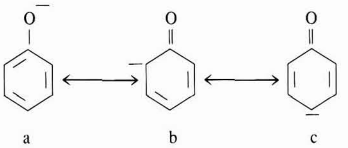


Scheme 6

Scheme 7

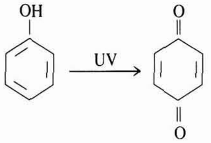


acidic in nature (more active hydrogen), because the resultant phenoxide ion is resonance-stabilized as shown in structures a, b, and c.



By virtue of this resonance stabilization, phenolic resins such as novalacs or resoles containing free phenolic hydroxyl groups can be cured instantly at room temperature with isocyanates in the presence of a tertiary amine vapor. This type of reaction (*Scheme* 6) using aromatic hydroxyl containing resins and isocyanates has been taken advantage of in the preparation of room-temperature curable foundry resin compositions in the presence of triethyl amine vapor.[20]

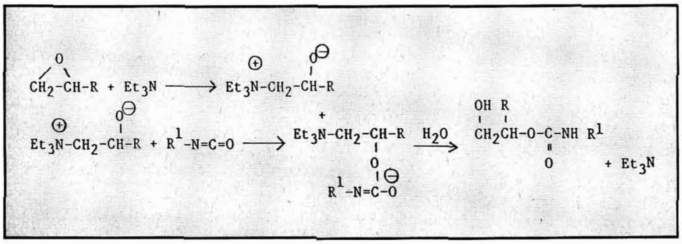
Unfortunately, phenolic coating compositions tend to yellow and as such are objectionable in coating compositions where color plays a dominant role. This yellowing of phenolic resins is believed to occur because of the rearrangement of phenolic structure into quinanoid type structure in the presence of UV light, as shown in equation (17).



(17)

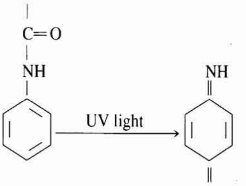
This tendency to yellowing, and the poor flexibility of the phenolic-isocyanate cured compositions, have been overcome to some extent by Taft, et al.[21] Their attempts were concerned with capping diphenolic acid in polyesters and hydroxy benzoic acid with hydroxyl containing prepolymers.

A new dimension to vapor curing was achieved through the incorporation of *p*-hydroxy benzoic acid and 2,6-dimethylol *p*-cresol into alkyd compositions by Thankachan, et al.[22] Alkyds are a versatile class of polymers in which a wide range of properties can be custom-built into the polymer by varying the fatty acid used in the manufacture of alkyds. However, one prerequisite for the fast curing of an isocyanate-phenolic hydroxyl-bearing polymer in the presence of a tertiary amine vapor is that the isocyanate must be directly attached to an aromatic ring. This criterion supports the mechanism of vapor-cure reaction as given in *Scheme* 6. Presumably, the aromatic ring attached to the isocyanate group stabilizes the intermediate through resonance, as shown in *Scheme* 7.



Scheme 8

Like the phenolics, urethane coatings based on aromatic isocyanates tend to yellow when exposed. This yellowing probably occurs by the gradual rearrangement of the urethane group to quinanoid type of structure as in the case of phenolics [equation (18)].



(18)

This type of rearrangement can be prevented by proper substitution of the aromatic ring para to the isocyanate group in the case of isocyanates, and para to the hydroxyl group in the case of phenolics. A variety of polyisocyanates with para substitution is available in the market. However, aromatic isocyanates are not as durable for exterior applications as aliphatic isocyanates.

During the course of investigations, the author[23] has observed that liquid epoxy resin based on bisphenol A cures with aromatic isocyanates in minutes in the presence of triethyl amine vapor. Neither the film properties attained in this reaction nor the nature of polymerization was studied. A variety of possibilities exists. One possibility is that triethyl amine initiated the homopolymerization of the epoxy resin. The base generated during the course of this homopolymerization reaction must have reacted with the isocyanate which is finally converted to the urethane in the presence of moisture, as shown in *Scheme* 8.

CONCLUSION

With the increased concerns about the environment, coating compositions tend to move away from the conventional solvent-based coatings to high-solids, water-based, radiation-cure, and room-temperature cure types. Innovations through research have made it possible to have room-temperature cure coatings like epoxies and urethanes. These coatings are being used in a variety of applications and are found to withstand severe test requirements. An understanding of the chemistry of their curing mechanisms will help us to formulate novel compositions for specific end uses. Through this review, the author has tried to bring the main room-temperature cure reactions of epoxies and urethanes into the limelight.

ACKNOWLEDGMENT

The author is grateful to the Communications Department of BASF Corporation, Coatings & Inks Division for proofreading the manuscript and the positive suggestions given. The author also wishes to thank William Stevenson for his persistent encouragement, and Fred Forth, Shiro Sasaki, and Devinder Dhotar for their enlightened discussions on this topic. Finally, the author expresses his sincere thanks to Mary White for the meticulous typing of this manuscript.

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Society Meetings

CDIC .... OCT.

"Water-Borne Coatings Plant"

The technical speaker was Bill Machemer, of Troy Chemical Corp. Mr. Machemer's topic was "SANITIZING YOUR WATER-BORNE COATINGS PLANT."

Tim Mara, of the Cincinnati Bar Association, was the meeting's educational speaker. Mr. Mara gave an informative presentation on personal liability.

W.E. WHITLOCK, *Secretary*

CDIC .... NOV.

"Micronized Products"

Warren Pushaw, of Micro Powers, Inc., was the technical speaker for the evening. His talk was entitled "MICRONIZED PRODUCTS FOR THE PRINTING/PAINT AND COATINGS INDUSTRY."

The educational speaker was Thomas Hissong, of the Dayton Museum of Natural History. Mr. Hissong gave a talk and slide presentation on the Amazon River in Peru.

JON E. ANDERSON,
Acting Secretary

CHICAGO .... NOV.

"Polyether Amines"

President Evans Angelos, of Omya, Inc., presented Gerald Cuca, of Fitz Chem Corp., Chairman of the Management Development Seminar Committee, and John Wamelink, of Reichhold Chemical Co., Chairman of the Educational Committee, with the First Place plaque in the Class A Competition of the Materials Marketing Associates (MMA) awards. The prize, originally presented at the 1988 Annual Meeting and Paint Show in Chicago, was in recognition of the Society's "Creative Management with a Personal Touch" seminar.

The meeting's first speaker was Wheeler C. Crawford, of Texaco Chemical Co. Mr. Crawford spoke on "FORMULATING WITH POLYETHER AMINES."

The speaker discussed polyether amines and their unique characteristics including: low color, viscosity, and vapor pressure; longer pot life; and capability of imparting improved toughness and adhesion. Mr. Crawford stated that polyether amines are most often used as curing agents with epoxy resins and isocyanates or isocyanate prepolymers. The talk also featured a review on applications and comparisons with other commonly used curing agents.

Wayne B. Wright, of PATCO, gave the evening's second presentation. His topic was "USE OF DEFOAMERS IN INDUSTRIAL COATINGS."

Mr. Wright talked about some of the problems encountered in using defoamers, such as persistency, wetting, best times to add, etc. He also reviewed differences in silicone and nonsilicone defoamers, including advantages and disadvantages. The speaker explained why defoamers are used and what happens with multicoat applications.

CLIFFORD O. SCHWAHN

DALLAS .... NOV.

"Performance Solvents"

President Bruce Alvin, of DeSoto, Inc., presented a plaque to Immediate Past-President Noel L. Harrison, of Western Specialty Coatings Co., for his year of service to the Society.

The technical speaker for the evening was Ron Readshaw, of Union Carbide Corp. His talk was entitled "PERFORMANCE SOLVENTS FOR HIGHER SOLIDS AND WATER-BORNE COATINGS."

According to the speaker, the best method to reduce VOC emissions, in order to comply with governmental regulations, is to reduce solvent by using higher solids, water-borne, or powder coatings.

Mr. Readshaw stated that a good solvent for high solids coatings should have low density for VOC calculations, strong solvency for low coating viscosity, low surface tension for good wetting, proper boiling point for polymerization use, and low odor and toxicity. He discussed methyl n-amyl ketone, and ethyl, n-butyl, and n-pentyl propionates.

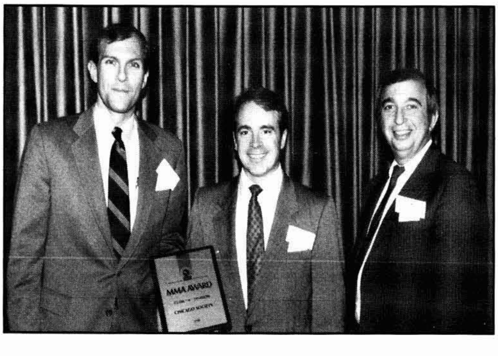
Dipropylene glycol propyl ether and dipropylene glycol butyl ether are two of the newest solvents used in trade sales and industrial water-borne coatings, said Mr. Readshaw. He stated that they compare favorably to other solvents in viscosity effects, distribution coefficient, reduction of minimum filming temperature (MFT), and surface tension. According to the speaker, the butyl ether version is especially effective in reducing MFT.

In conclusion, Mr. Readshaw said that since both solvents are relatively slow evaporators, but faster than some other common filming aids, they may provide faster block resistance.

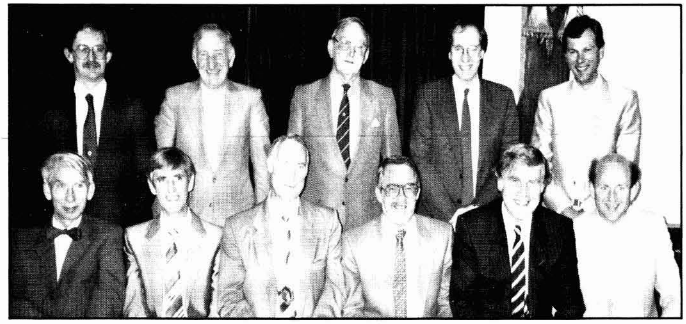
Q. Could you elaborate on toxicity?

A. These products have low acute toxicity compared to ethylene oxide based products and have shown not to be teratogens.

RONDA MILES, *Secretary*



FIRST PLACE PRIZE—John Wamelink and Gerald Cuca hold the Class A Competition MMA Award won by the Chicago Society for their seminar "Creative Management with a Personal Touch." The presentation took place at the Society's November meeting. At right is Society President Evans Angelos



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LOS ANGELES............NOV.

Library Night

A moment of silence was observed in memory of Art Edwards, founder of Dunn-Edwards Paint Co., who died recently.

President Melinda K. Rutledge, of Allo Colouring Co., presented the Past-President's Award to Ray DiMaio, of Koppers Co., Inc., for his excellent service to the Society.

Ms. Rutledge announced that James F. Calkin, of E.T. Horn Co., was awarded the First Prize in the Ernest T. Trigg Awards competition, presented at the 1988 Annual Meeting and Paint Show in Chicago, IL.

Environmental Committee Chairman Dave Muggee, of E.T. Horn Co., commented on the availability of 1,1,1-trichloroethane (methyl chloroform). The response was made in reference to a statement made by Mr. Muggee at the October meeting that 1,1,1-trichloroethane might be a significant contributor to ozone depletion. The manufacturer said that:

(1) 1,1,1-trichloroethane is not part of the Montreal Protocol and this protocol has not been signed by enough countries to make it binding.

(2) The EPA does not know what is causing ozone depletion and is going to look at chlorinated hydrocarbons. 1,1,1-trichloroethane only has about one-tenth the potential of ozone depletion that the chlorofluorocarbons have.

(3) The EPA is worried about increase in the consumption of 1,1,1-trichloroethane as the chlorofluorocarbons are phased out. There has been some talk of restricting production. It was pointed out to the manufacturer that this was about the only exempt solvent available so that limits would be counterproductive of VOC reduction.

Dodwell DeSilva, of Major Paint Co., gave an update on Rule 1136 which calls for a drastic reduction of VOC on all industrial wood coatings. He noted four deadlines, the first of which was January 1. By the next deadline, July 1, the transfer efficiency in airless and air-assisted airless equipment must be rated at 65%. The only equipment the AQMD presently rates this high is a high volume, low pressure system, or turbine guns. All other equipment used must be proven to have a 65% transfer efficiency.

Carrie Pachon, Assistant Director of the Commerce Library, discussed the recently acquired computer-enhanced magazine index.

The meeting's technical speaker was John Guarino, of Radcure Specialties. Dr. Guarino's topic was "RADIATION CURING."

The speaker explained that the concept of radiation curing is the polymerization of the total liquid mixture to produce a dry, solid coating. The radiation curing process, especially rapid polymerization, requires free radical production, either by UV or EB, stated Dr. Guarino.

He said that UV curing is basically applicable only to clears and is slowed tremendously by the presence of pigment. EB cure, on the other hand, does not "see" pigment and can be used with pigmented systems such as TiO_2, yellows, and others.

Dr. Guarino stated advantages of radiation curing as being: no solvent needed, energy efficiency, high speed, and space saving. Disadvantages include: higher cost materials, skin irritation, flat sheet or web only, and not for food packaging.

According to the speaker, radiation curable coatings now comprise about $200 million worth of a $10 billion market, or about 2% of the total coatings and ink market in the U.S. Dr. Guarino expects the radiation curable coatings market to grow as VOC restrictions increase. Markets for radiation cure include: inks and coatings, vinyl flooring, wood coatings, release coatings, electronics, plastic containers, and antistatic packaging.

Q. What is the future of radiation cure coatings in the coil coating industry, regarding the economics, flexibility, and durability?

A. This is an excellent question. . . . Everyone said that if there was a technology that needed radiation curing it was coil coatings. In the beginning, there were limitations to the materials that were available. I believe that with those epoxy acrylates and the multifunctional acrylates you ended up with a very hard crosslinked coating that did not have the flexibility needed in the coil industry. I have seen people calculate out the economics of "if the coating did perform would it be economical?" It has to do with the speeds. You shut off your oven and now you are curing that

MONTREAL SOCIETY—Officers elected for 1988-89 are as follows: Seated: Society Representative—Horace S. Philipp, Y. Abraham, Vice President—Gilles Belisles, President—Robert Ferrie, Immediate Past-President—Eric J. Templeton, and Secretary—Robert Benoit. Standing: Manufacturing Committee Chairman—Larry Krivanek, Educational Committee Chairman—Charles C. Craib, Robert D. McComb, Membership Committee Chairman—Yvon Maillette, Patricia L. Hayden, Treasurer—Luc Pepin, and V. Pedersen

metal, let us say by EB for a pigmented coating, at 1000 ft/min, so you match what is done in coil coating now. I think the economics are there. The flexibility never was. The durability, assuming available technology now rather than then, as far as performance, we have made clear urethane acrylates on Florida exposure for five years that have no problem. This is for clears. I think our industry has given up on coil coating because it is not a single entity. It is all these different plants. I do not know if that is a good answer but it was a good question. Someday it is going to happen. It is already happening in Japan. The Japanese have made up their minds that the coil coating industry is going to be electron beam and it is going to be two coats, a primer coat and a top coat. In the U.S., people are asking one coat to do the whole job. That is another part of why it did not happen. The Japanese are doing it so maybe we will have to follow them again.

James D. Hall, *Secretary*

PAST PRESIDENTS' AWARD—President Melinda K. Rutledge applauds as Ray DiMaio accepts his award as outgoing President at the Los Angeles Society November meeting

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Snyder's Willow Grove, Linthicum, MD). Gary Morgereth, McCormick Paint Works, 2355 Lewis Ave., Rockville, MD 20851.

BIRMINGHAM (First Thursday—Strathallen Hotel, Birmingham, England). D.A.A. Wallington, Ferro Drynamels Ltd., Westgate, Aldridge, West Midlands, England WS9 8YH.

CDIC (Second Monday—Sept., Dec., Mar. in Columbus; Oct., Jan., Apr. in Cincinnati; and Nov., Feb., May in Dayton). W.E. "Buddy" Whitlock, Ashland Chemical Co., P.O. Box 2219, Columbus, OH 43216.

CHICAGO (First Monday). Karl E. Schmidt, Premier Paint Co., 2250 Arthur Ave., Elk Grove Village, IL 60007.

CLEVELAND (Third Tuesday—meeting sites vary). Richard J. Ruch, Kent State University, Dept. of Chemistry, Kent, OH 44242.

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). Rhonda Miles, Union Carbide Corp., 2326 Lonnecker Dr., Garland, TX 75041.

DETROIT (Second Tuesday—Ukrainian Cultural Center, Warren, MI). Liana Callas Roberts, A.T. Callas Co., 1985 W. Big Beaver, Suite 308, Troy, MI 48043.

GOLDEN GATE (Monday before third Wednesday—Alternate between Francesco's in Oakland, CA and Holiday Inn in S. San Francisco). Jack Duis, Pacific Coast Chemical, 2424 Fourth St., Berkeley, CA 94710.

HOUSTON (Second Wednesday—Look's Sir-Loin Inn, Houston, TX). Michael G. Falcone, International Paint (USA) Inc., 17419 Little Shoe Ln., Humble, TX 77396.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). Mark Algaier, Hillyard Chemical, P.O. Box 909, St. Joseph, MO 64501.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). James D. Hall, Sinclair Paint Co., 6100 S. Garfield Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). James Simpson, Reliance Universal, Inc., Resins Div., 4730 Crittenden Dr., P.O. Box 37510, Louisville, KY 40233.

MEXICO (Fourth Thursday—meeting sites vary). Gerardo del Rio SEC, G.B.W. De Mexico, S.A., Poniente 116 No. 576, Nueva Industrial Vallejo, 02610 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wongs Restaurant, Montreal). Robert Benoit, NL Chemicals Canada Inc., 4 Place Ville-Marie, Ste. 500, Montreal, Que., H3B 4M5 Canada.

NEW ENGLAND (Third Thursday—Sheraton, Lexington, MA). Arthur Leman, Samuel Cabot Co., 100 Hale St., Nebt, MA 01950.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). Roger P. Blacker, Whittaker, Clark & Daniels, Inc., 1000 Coolidge St., So. Plainfield, NJ 07080.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). Terry Strom, Ti-Kromatic Paints, Inc., 2492 Doswell Ave., St. Paul, MN 55108. Winnipeg Section (Third Tuesday—Marigold Restaurant, Winnipeg). Edwin R. Gaskell, Guertin Bros. Coatings & Sealants Ltd., 50 Panet Rd., Winnipeg, MB, R2J OR9 Canada.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). John Berghuis, NL Chemicals Canada Inc., 3450 Wellington Ave., Vancouver, B.C., V5R 4Y4 Canada.

PHILADELPHIA (Second Thursday—Williamson's GSB Bldg., Bala Cynwyd, PA). Christopher H. Huhn, Loos & Dilworth, Inc., 61 E. Green Ln., Bristol, PA 19007.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). Gary L. Waters, Sadolin Paint Products, Inc., P.O. Box 669, Walkertown, NC 27051.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). Carol Storme, Valspar Corp., 2000 Westhall St., Pittsburgh, PA 15233.

ROCKY MOUNTAIN (Monday following first Wednesday—Holiday Inn North, Denver, CO). Bruce Rehmann, Komac Paint, 1201 Osage St., Denver, CO 80204.

ST. LOUIS (Third Tuesday—Salad Bowl, St. Louis, MO). Terry Gelhot, Rockford Coatings Co., 1825 Avenue H, St. Louis, MO 63125.

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). James R. Salisbury, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). Gerry Parsons, DeSoto Coatings Ltd., 895 Rangeview Rd., Mississauga, Ont., L5E 3E7 Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary), Marko K. Markoff, 182 Farmingdale Rd., Cheektowaga, NY 14225.

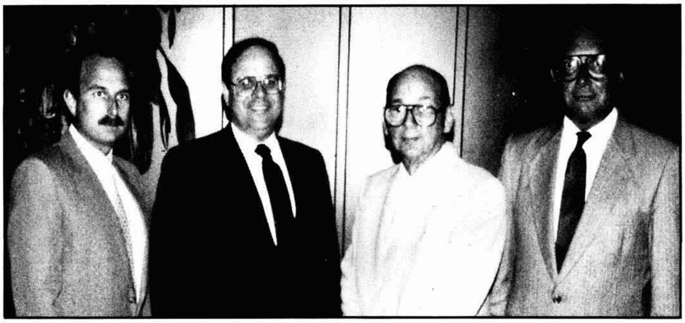
LOUISVILLE .... NOV.

"Isoparaffins"

A moment of silence was observed in memory of Charles M. Jackson who died recently. Mr. Jackson twice served as President of the Society and was an Honorary Member of the New England Society.

Peter G. Miasek, of Exxon Co., gave the evening's technical presentation, entitled "Isoparaffins Impart Beneficial Properties to Coatings Through Low Surface Tension."

The speaker used a slide presentation to highlight three important points relating to isoparaffins. First, a coating's abililty to wet substrates could be improved by lowering surface tension with isoparaffins. Second, foaming problems could be overcome by using isoparaffins to replace a portion of the glycol and silicone additives, without



NEW YORK SOCIETY—1988-89 Officers are: Treasurer—Jeffrey C. Kaye, President—Irwin H. Young, Vice President—Arthur A. Tracton, and Secretary—Roger P. Blacker

sacrificing any coating performance and possibly at a lower raw material cost. Third, wet edge time in water-borne coatings could be extended while inhibiting foaming through the use of isoparaffins.

James U. Simpson, *Secretary*

NEW ENGLAND . . . . OCT.

"VOC Regulatory Arena"

The meeting's speaker was Fredrick Zimmerman, staff member and general counsel for the National Paint and Coatings Association. His topic was "The VOC Regulatory Arena."

The speaker began his presentation by explaining the Federal Clean Air Act, which requires states to meet certain Air Quality Standards and has led some states to implement VOC requirements for coatings. Mr. Zimmerman used handouts which displayed a government listing of states and areas that do not comply with Federal Air Quality Standards. He stated that these areas, if they have not already done so, will probably be contemplating VOC regulations for coatings along with the states that already have them.

A chart in the handout compared the difference between the VOC regulations in New Jersey, New England, and California. According to Mr. Zimmerman, the differences present an enormous problem to coatings manufacturers doing business with these states because the different regulations can require separate formulations and labeling for each state. He stated that the NPCA is lobbying to get uniform VOC regulations between the different states so that coatings manufacturers can formulate the VOC compliant products that will be compliant in all states having such regulations.

In conclusion, Mr. Zimmerman noted how many areas of the country are not compliant with air quality regulations, which could lead to strict regulations in the future in these areas to improve their air quality. This probably will lead more states to adapt VOC regulations for coatings, he said. The NPCA wants either a federal VOC standard or more uniformity of VOC regulations between states so that coatings manufacturers only will have to comply with one standard rather than a variety of VOC regulations from state-to-state. Mr. Zimmerman also urged paint companies to participate in the regulatory process whenever possible in order for the coatings industry to be treated fairly by these regulations.

Q. Is the New Jersey VOC rule bad legislation?

A. Yes. Their regulations mainly differ from other states in areas of labeling, not actual VOC content. Different labeling regulations are extraneous to actual VOC limits. They place a burden on industry that has nothing to do with air quality.

Q. Are "existing stock" dates still in force?

A. They are being challenged to allow companies to sell their non-VOC compliant existing stocks after the VOC deadline.

Q. Will Massachusetts implement VOC regulations?

A. Massachusetts did not commit to VOC regulations in their plans to improve air quality. However, they are not in compliance with air quality in some areas and they are allowed to regulate VOC's if they want.

Arthur A. Leman, *Secretary*

NEW YORK . . . . NOV.

"Horizontal Media Mills"

A moment of silence was observed for Society Honorary Member Gabe Malkin who died recently.

The Society honored Temple C. Patton, scientist and author, for his contributions to the coatings industry. A scholarship in his name was awarded to a senior at Fairleigh Dickinson University, Ann Marie Bossong.

The speaker for the evening was Christ Zoga, of Premier Mill Corp. His topic was "Horizontal Media Mills."

Mr. Zoga explained current dispersion and milling methods. Important features discussed were the increasing pressures for the coatings manufacturer to be more in existing facilities, how to increase productivity and the equipment necessary to do so, the advantages of modern equipment, dispersers, and mills. In conclusion, Mr. Zoga noted how to tailor the equipment to your operation's methods and standards.

Q. Comparing a ball mill to a media mill, which piece of equipment is more efficient in dispersing carbon black?

A. The media mill is more efficient.

Q. What is the composition of the media?

A. For best results, having a closely graded grinding media for milling efficiency.

Roger P. Blacker, *Secretary*

NORTHWESTERN SOCIETY—Officers for 1988-89 are as follows: President—Richard W. Karlstad, Vice President—Mark W. Uglem, Secretary—Terry Strom, and Treasurer—Daniel W. Dechaine

Elections

BIRMINGHAM

Active

Churchill, Tony Colin—H.S. Richards Ltd., Warley, West Midlands.
Field, Peter—Ardrox-Pyrene Ltd., Bletchley, Milton Keynes.
Ingram, Terence R.—H.S. Richards Ltd., Warley.
Marriott, Michael B.—Egd Baston, Birmingham.

Society Honorary

Matlack, R.W.—Medford, NJ.

CDIC

Active

Gray, Linda L.—PPG Industries, Inc., Delaware, OH.
Sharrock, Robert F.—Hilton-Davis Chemical Co., Cincinnati, OH.
Van Kuren, Thomas A.—PPG Industries, Inc., Delaware.
Zuckerman, Paul H.—PPG Industries, Inc., Delaware.

Associate

Fortney, Timothy L.—American Dispersions, Louisville, KY.
Specht, John J.—Michelman Inc., Cincinnati, OH.
Sullivan, John J.—Sullivan Chemical, Cleveland, OH.

CHICAGO

Active

Yapp, William J.—Carbit Paint Co., Chicago, IL.

GOLDEN GATE

Active

Adkins, Adrian S.—Schoofs Inc., Moraga, CA.
Brennan, Timothy A.-Performance Coatings, Ukiah, CA.
Chiesa, Peter Jordan—Polytecnica, Wallace, CA.
Cummings, Lowell—Adco Co., San Francisco, CA.
Ficher, Linda—O'Brien Corp., S. San Francisco, CA.
Garrett, Ted—Harrisons & Crosfield Pacific, Emeryville, CA.
Honeck, Fred M.—A.C.C. Inc., Fairfax CA.
Jourdain,Charles J.—California Redwood Assoc., Novato, CA.
Khambatta, Jal J.—Kam Synthetics Inc., Foster City, CA.
Morton, John A.—J.O. Morton, Aptos, CA.
Rudlowski, Georg A.—Hüls America, Inc., Pleasanton, CA.

Associate

Anand, Jo N.—Dow Chemical Corp., Walnut Creek, CA.
Byas, Ronald L.—ICI Resins US, Oakland, CA.
Ehmke, Ronald S.—Pacific Coast Chemical Co., Berkeley, CA.
Osen, Bert—Trans Western Chemicals, Inc., Commerce, CA.
Rumble, C. Rodney—Sun Chemical Corp., San Ramon, CA.
Sheldon, Karen S.—S.C. Johnson & Son, Inc., Burlingame, CA.
Villar, John A.—WGM/Eastman, S. San Francisco, CA.

NEW ENGLAND

Active

Fossa, Carl E.—Sagamore Ind. Finish, Amesbury, MA.
Peterson, Philip E.—Dryvit Systems Inc., West Warwick, RI.

Associate

Esslinger, Hanspeter—Aqualon Co., New Boston, NH.
Rice, Ann—Unocal Chemicals Div., East Providence, RI.

NEW YORK

Active

Coopersmith, Allen B.—R&A Specialty Chemical Corp., Inc., Brooklyn, NY.
Lewis, Joseph P.—Hempel Coatings (USA) Inc., Rutherford, NJ.
Magier, Lawrence—Troy Chemical Corp., Newark, NJ.

Associate

Fuller, Barry D.—Paul O. Abbe, Inc., Little Falls, NJ.
Kaplan, Paul D.—Heubach Inc., Newark, NJ.
McBride, Donald J.—HeucoTech Ltd., Newark.

PHILADELPHIA

Active

Chang, Louis C.—Hüls America, Inc., Piscataway, NJ.
White, Rudolph Henry—Reichhold Chemicals, Inc., Dover, DE.
Wisnewski, David L.—CIBA-GEIGY Corp., Newport, DE.
Yin, Anthony T.—Dupont Taiwan Ltd., Taipei, Taiwan, ROC.

Associate

Boorman, Brian W.—Van Horn, Metz & Co., Inc., Conshohocken, PA.
Hong, Richard K.—NL Chemicals, Highstown, NJ.
Lozanoski, Paul—Hercules Incorporated, Wilmington, DE.
Mullen, Robert L.—Miller Paint Equip., Warrington, PA.
Rober, Kristin E.—Hercules Incorporated, Wilmington.

ST. LOUIS

Active

Crouse, Stephen L.—Brod-Dugan Co., St. Louis, MO.
Gibson, Donald J.—Akzo-Lanchem, E. St. Louis, MO.
Hart, Edwin L.—U.S. Paint Div., St. Louis.
Klepser, Robert J.—Carboline Co., St. Louis.
Krill, Charles L.—Caldwell Paint Mfg. Co., St. Louis.
Krishnan, Seshan G.—Diamond Vogel Paints, Burlington, IA.
Nelson, Dru A.—Rockford Coatings Corp., St. Louis.
Rowland, Ronald H.—Consultant, Monett, MO.
Schweig, Jeff A.—Bi-Angle Chemical Co., Inc., St. Louis.
Smith, Betty L.—U.S. Paint Div., St. Louis.
Tran, Tai T.—Carboline Co., St. Louis.
Wurdack, William D. Jr.,—Walter Wurdack Inc., St. Louis.

Associate

Bowman, John V.—Archway Chemical & Supply, Inc., St. Louis, MO.
Hindan, Edwin R.—Sinmast of St. Louis Inc., St. Louis.
McKittrick, James J.—Archway Chemical & Supply, Inc., St. Louis.
Onergil, Oner M.—Mozel Equipment Co., St. Louis.
Peckham, Gregg M.—Archway Chemical & Supply, Inc., St. Louis.

TORONTO

Active

Gittons, Winston A.—Sico Industries Inc., Rexdale, Ont.
Goodman, Howard M.—Selectone Paints Ltd., Weston, Ont.
Melking, Thomas—Klintens Inc., Rexdale.
Phillon, Mac—Sico Industries Inc., Rexdale.
Shah, Arvind C.—Sico Industries Inc., Rexdale.
Teo, K.E.—Deltec Manufacturing Ltd., Scarborough, Ont.
Umbenhower, Michael—Klintens Inc., Rexdale.
Vehra, Mohammad Azim—Sico Industries Inc., Rexdale.

Future Society Meetings

Birmingham

(Mar. 2)—"Coil Coating"—G.C. Simmons, Becker Paints U.K. Ltd.

(Apr. 6)—"Zinc Phosphate (An Anticorrosive Pigment)"—Keith Chater, I.S.C. Alloys Ltd.

(May 4)—60th Annual General Meeting.

Dallas

(Mar. 8-10)—Southwestern Paint Convention, Dallas, TX.

(Apr. 13)—"New Developments in Vinyl Resins"—Tom Ginsburg, Union Carbide Corp.

Golden Gate

(Feb.17)—Joint Meeting with Golden Gate PCA. Holiday Inn.

(Mar. 6)—"High Solids and Solventless Silicone Resin Based Paints for Various Coating Applications"—Bill Saad, General Electric Silicones, Francesco's Restaurant.

(Apr. 17)—"Rheological Measurements as a Guide to Additive Performance"—Marvin Schnall and James Jodrey, Troy Chemical, Holiday Inn.

(May 15)—"Carbon Blacks—Pigments for Coatings, Production, Properties, Application, Dispersion"—Maria Nargiello, Degussa Corp., Francesco's Restaurant.

(June 19)—Manufacturing Committee Program. Holiday Inn.

Houston

(Mar. 8-10)—Southwestern Paint Convention. Dallas, TX.

(Apr. 12)—"New Developments in Vinyl Resins"—Tom Ginsberg, Union Carbide Corp.

(May 10)—Speaker to be announced.

Kansas City

(Mar. 9)—Hallmark Card Tour, Leavenworth, KS.

(May 11)—Education Night.

Los Angeles

(Mar. 1)—"High Solids and Solventless Silicone Resin Based Paints for Various Coating Applications"—Bill Saad, General Electric Silicones.

(Apr. 12)—"Rheological Measurements as a Guide to Additive Performance"—Marvin Schnall and James Jodrey, Troy Chemical Corp.

(May 10)—"Carbon Blacks—Pigments for Coatings, Production, Properties, Application, Dispersion"—Maria Nargiello, Degussa Corp.

New England

(Feb. 16)—"Crowding and Spacing Titanium Dioxide Theory and Example"—Rebecca W. Craft, Du Pont Co.

(Mar. 16)—"Computer Controlled Production Plant for Industrial Paints"—Pius Eigenmann, Buhler-Miag, Inc.

New York

(Mar. 14)—"Statistical Quality Control"—Heinz Newmann, Rohm and Haas Co.

(Apr. 11)—"Novel New Uses for Isoparaffins"—Mark Danti, Exxon Chemical Co.

(May 9)—Past Presidents' and PaVaC Awards Night.

Pacific Northwest—Portland, Seattle, & Vancouver Sections

(Mar. 7-9)—"High Solids and Solventless Silicone Resin Based Paints for Various Coating Applications"—Bill Saad, General Electric Silicones.

(Apr. 18-20)—"Rheological Measurements as a Guide to Additive Performance"—Marvin Schnall and James Jodrey, Troy Chemical Corp.

(May 16-18)—"Carbon Blacks—Pigments for Coatings, Production, Properties, Application, Dispersion"—Maria Nargiello, Degussa Corp., Portland Motor Inn.

Piedmont

(Mar. 15)—"Crowding and Spacing Titanium Dioxide Theory and Example"—Rebecca W. Craft, Du Pont Co.

(Apr. 19)—"Federation Night"

(May 17)—"Color Nonuniformity—Causes and Cures"—Marvin Schnall, Troy Chemical Corp.

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May 16—FSCT Spring Seminar
May 17—Seminar Continues
May 18—FSCT Society Officers Meeting
May 19—FSCT Board of Directors Meeting

(Seminar presented under the auspices of the Professional Development Committee)

Federation of Societies for Coatings Technology

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THE SETAFLASH TESTER

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The program covers theoretical and practical techniques used for dispersion in paint plants, showing laboratory test equipment and plant scale manufacturing procedures. 20 minutes (60 slides) **$65**

INTRODUCTION TO RESIN OPERATIONS

Produced by the Manufacturing Committee, Toronto Society for Coatings Technology

This presentation has been developed to assist in the selection and training of resin plant operators, and focuses on basic concepts of manufacture and the role of a resin operator. 12 minutes (58 slides) **$65**

A BATCH OPERATED MINI-MEDIA MILL

Produced by the Manufacturing Committee, New York Society for Coatings Technology

This presentation describes the design and operation of a batch operated mini-media mill, and was developed to assist in the training of plant personnel to operate such equipment. 8½ minutes (51 slides) **$60**

NOW AVAILABLE!

OPERATION OF A VERTICAL SANDMILL—(Produced by the Manufacturing Committee, Kansas City Society for Coatings Technology). This program describes the design and operation of a vertical sandmill, to assist in the training of plant personnel to operate such equipment. 14 minutes (73 slides)............................. **$75**

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People

Ann Tiefenthaler has joined the Additives Division, CIBA-GEIGY Corp., Ardsley, NY, as an Associate Chemist—Coatings, Radiation Curing, and Photography Department. Ms. Tiefenthaler, who recently completed a Masters Degree in Polymers and Coatings at North Dakota State University, will work in the Additives Technical Service and Development Laboratories. She is a member of the Northwestern Society.

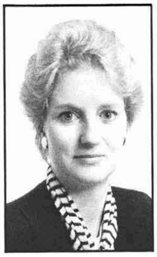
Also, the Additives Division has appointed **James Hyun** as Associate Chemist—Coatings, Radiation Curing, and Photography Department. Mr. Hyun joins the department after three years with the Antioxidant Research Group. He will be working towards formalized efforts to identify new applications and new directions for the division.

Donald E. Brody is the new Technical Director—New Products, for Pyrolac Corp., Hawthorne, NJ. He brings over 40 years of experience in many sectors of the coatings industry to his new position. Mr. Brody was last employed by Maas & Waldstein Co. He is a member of the New York Society.

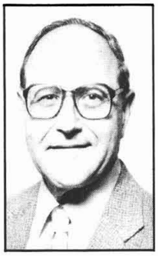
ECC America Inc., Atlanta, GA, has announced the following appointments: **J. Thomas Kilgore, Jr.,** General Marketing Manager—Specialty Products; **Neil T. Doidge,** Marketing Manager—Coatings Industry; **William T. Powell,** Sales Manager—Specialty Products; **Christopher B. Hutcheson,** Marketing Manager—Ceramics and Industrial Minerals; **Betsy C. James,** Product Specialist—Household and Personal Care; **Kenneth A. Haagenson,** Product Specialist—Extenders; and **Carl V. Nablo,** Sales Representative—Specialty Products.

Mr. Haagenson is a member of the Southern Society.

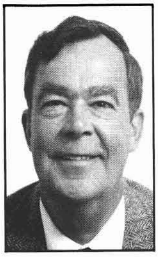
Alexander Ramig, Jr., Vice President—Research and Development, The Glidden Co., Cleveland, OH, has been appointed International Research Director of ICI Paints, and a member of the ICI Paints International Advisory Council. Dr. Ramig will direct the activities of ICI researchers worldwide and is responsible for achieving the objectives aimed at ICI customers throughout the world. Dr. Ramig is a member of the Cleveland Society.



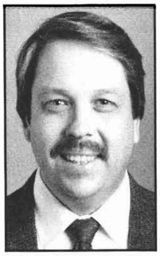
A.M. Tiefenthaler



D.E. Brody



E. Holzrichter



R.C. Johnson

Whittaker Coatings, Batavia, IL, has appointed **Edward Holzrichter** Vice President—Polymer Research. In his new capacity, he will continue to operate out of Whittaker's primary research facility in Colton, CA, and carry full responsibility for the direction of the company's resin research and analytical support programs. Mr. Holzrichter is a member of the Los Angeles Society.

The National Paint and Coatings Association, Washington, D.C., announced that Technical Director **Raymond J. Connor** is the recipient of the John D. Keane Award of Merit. The award, sponsored by the Steel Structures Painting Council, recognizes Mr. Connor's significant contributions to the protective coatings industry and the SSPC. The Keane Award is equivalent to the NPCA's George Baugh Heckel Award which is presented at its Annual Meeting. Mr. Connor is a member of the Baltimore Society for Coatings Technology.

Magnesium Elektron, Inc., Flemington, NJ, announces the appointment of **Carl E. Concia** as Vice President—Sales and Marketing. He will direct the growth of the firm's zirconium chemicals business in North America and focus on penetrating emerging markets for the existing product line and for new zirconium compounds.

Ann-Marie Bossong, a senior at Fairleigh Dickinson University, was awarded a scholarship in honor of Temple Patton at the November 15 monthly meeting of the New York Society for Coatings Technology. Mr. Patton is a noted scientist and author who has contributed much throughout the years to the coatings industry.

The Angus Chemical Co., Northbrook, IL, has announced the appointment of **Ross C. Johnson** as Senior Research Chemist in the Technical Center. Mr. Johnson is responsible for applications and development laboratory functions in support of sales, marketing, and coatings programs.

In other news, **Robert W. Tait** has joined Angus as a Sales Representative—Specialty Chemicals. He is accountable for sales of all nitroparaffin and derivative products in Arizona, southern California, Hawaii, western Louisiana, New Mexico, and Texaco.

Mr. Johnson and Mr. Tait are members of the Chicago Society.

Marvin J. Rheault has been promoted to Director of Sales/North America, for NL Chemicals, Inc., Hightstown, NJ. Mr. Rheault joined NL Chemicals Canada in 1965 and has held numerous sales positions with the company, including Director of Sales and Marketing and General Sales Manager.

Richard Charles Rippel has been appointed Senior Marketing Representative/Chemicals for Eastman Chemical Products, Inc., Kingsport, TN. Located in St. Louis, MO, Mr. Rippel will handle Eastman's chemicals for coatings, inks, chemical specialties, food, pharmaceuticals, cosmetics, adhesives, and plastics additives.

Dan Kennedy has joined the staff of CheMarCo, Greenville, SC, as a Sales Representative. Mr. Kennedy will be responsible for sales in Alabama, Mississippi, and central Tennessee. He will be based in Tuscaloosa, AL.

Harald P. Wulff, President of Henkel Corp., Gulph Mills, PA, has been named to the additional post of Chief Executive Officer. As CEO, all units of Henkel Corp. will now report to him. Dr. Wulff joined Henkel in 1980 and has held several management positions. Prior to working for Henkel, he was associated with BASF where he served in various research and business management posts.

Ashland Chemical Co., Columbus, OH, has announced the appointment of **Michael Froman** to Manager—Raw Materials and Energy Purchasing. In this position, he purchases all raw materials and energy for the company's manufacturing operations. Mr. Froman joined Ashland in 1985 and previously served as Sales Development Manager for the Composite Polymers Division.

The Chemical Coatings Division, Sherwin-Williams Co., Chicago, IL, has hired **George A. Higgins** as Director—Sales and Marketing for the Automotive Group. He is responsible for the implementation and commercialization of coatings for thermoset and thermoplastic automotive substrates, with an emphasis on high-solids spray primers and in-mold coatings. Mr. Higgins previously served as Vice President of Sales for Seibert Oxidermo, Inc.

Rohm and Haas Co., Philadelphia, PA, has appointed **Gregory A. King** Group Marketing Manager—Industrial Coatings. Mr. King's new assignment includes marketing and development programs in new growth areas for industrial coatings. He has been with Rohm and Haas since 1978 and has served in a variety of technical, marketing, and development positions for the company's polymers and resins business.

CLASSIFIED ADVERTISING

Mark Cook has been promoted to Sales Representative for C.P. Hall Co., Chicago, IL. He will handle sales in Florida, southern Georgia, and southern Alabama. Mr. Cook formerly was Sales Coordinator in the Memphis, TN office.

Union Camp Corp., Wayne, NJ, announces the promotion of **Walter L. Jones** to Vice President—Chemical Group. He is responsible for the company's Bush Boake Allen Division. Mr. Jones joined Union Camp in 1966.

Also, **Julian W. Boyden** is the new President and General Manager—Bush Boake Allen. He previously was Vice President of Bush Boake Allen for the Far East. He will be based at the division's headquarters in London, England.

The Polymers Group, Exxon Chemical Co., Houston, TX, has named **Conrad J. Jankowski** Vice President—Polymers Technology, and **Gregory L. McPike** Vice President—Industry Sector Marketing for Polymers Americas.

Mr. Jankowski works out of the Polymers Technology Center in Baytown, TX, and has worldwide responsibility for managing core science, advanced analytical research, and new product and process research and development.

Mr. McPike handles sales to key markets, including adhesives and sealants, electricals and appliances, food packaging, health care, performance packaging, textiles, and transport.

Anthony E. Porter has accepted the newly-created position of Director—Manufacturing Engineering at Akzo Coatings Inc., Troy, MI. Mr. Porter has more than 15 years of experience in sales management, planning, and manufacturing. He most recently was Marketing Manager for M&T Chemicals.

In another managerial move, **Eduardus A. van Rossum** has been appointed General Manager—Woodfinishes. He has direct responsibility for the overall management of the woodfinish business unit, including nationwide distribution for a specific product line. Mr. van Rossum will assume full responsibility for his new position in July.

Bob Battaglia has been named Area Sales Manager at Crown Metro Aerospace Coatings, Inc., Greenville, SC. His territory includes the northeastern U.S., and Quebec and eastern Ontario. Mr. Battaglia was formerly employed in technical sales at U.S. Paint Co.

Executive assignments in the Americas unit of Arco Chemical Co., Newtown Square, PA, include: **John G. Johnson, Jr.,** President—ARCO Chemical Americas; **Wayne D. Kuhn,** Vice President—Oxygenates; **Denis C. Boyle,** Vice President—Styrenics; **Jack E. Oppasser,** Vice President—Sales and Marketing; **G.W. Haines,** Vice President—Polyols; **W. Roland Beasley,** Vice President—Operations in the Americas unit; and **John F. Lennon,** Vice President—Planning and Control.

Fusion UV Curing Systems, Rockville, MD, has named **Lonnie Murphy** Western Regional Manager. His responsibilities include managing the sales representatives for his region, increasing the number of sales representatives on the West Coast, conducting seminars regarding UV curing, targeting markets on the West Coast, and coordinating sales programs with chemical suppliers.

In other news, **Sabrina Jacob** is the new Marketing Coordinator for the UV Curing Department. She has been tasked with coordinating all national and international trade shows and sales meetings, and preparing and executing promotional material, product literature, editorials, press releases, and advertising.

The Specialty Chemicals Group, Morton Thiokol, Inc., Chicago, IL, has promoted **George D. Lutz** to Vice President—Industrial Coatings. Mr. Lutz assumes the duties for the Powder Coatings Group in addition to his present position of President of Bee Chemical Co.

Edward Williams is the newly appointed Product Manager—Porcelain Enamel for the O. Hommel Co., Pittsburgh, PA. In his new position, Mr. Williams directs national sales and services functions for porcelain enamel to the appliance industry. He has been with O. Hommel since 1969 and previously was Southeastern Region Manager—Porcelain Enamel.

Philip T. Newton, Vice President, Secretary, and Treasurer, of the O'Brien Corp., S. San Francisco, CA, recently retired after 31 years with the company. Mr. Newton will continue as President of Surety Pacific Insurance Co., Inc.

Also, **Barry Johnson** has been named National Sales Manager of the Trade Sales Division dealer group of the O'Brien Corp. Mr. Johnson most recently served as National Sales Manager of Specialty Brands, Inc., and brings 18 years of experience in sales and sales management to his new position.

19th Biennial Western Coatings Societies' Symposium Tentative Program Sessions Announced

The Western Coatings Societies' 19th Biennial Symposium and Show will be held at the Disneyland Hotel and Convention Center, in Anaheim, CA, on March 14-16. The event is jointly sponsored by the Los Angeles, Golden Gate, Pacific Northwest, and Rocky Mountain Societies for Coatings Technology. This year's theme is "Leadership Through Technology," with an emphasis on the importance of the western U.S. as a member of the vital Pacific Rim economy.

Presentations tentatively scheduled for the three-day symposium include:

"Federal and State Regulatory Affairs Update"—Andrew Doyle, of NPCA; H. Young, Jr.; S. Sides; T. Graves; and Donald R. Curl and Dave Muggee, of E.T. Horn Co.

"Entering the Paint Markets of Pacific Rim Countries"—Jack Bleckman, of Major Paint Co.

"Light Scattering by Titanium Dioxide Pigment"—William Ross, of DuPont Co.

"High Solids Resins"—Austin C. Abbott, of Velsicol Chemical Corp.

"Stress Management"—Andrea Van Steenhouse

"The Regulatory Aspects of Coatings"—P. Venturini, of CARB

"Use of Opaque Polymer and Fine Particle Extenders in Interior Flat Paints"—D. Fasano and B. Listerquit, of Rohm and Haas Co.

"Industrial Cleavage of Melamine Bonds Under High Temperatures"—Richard Johnson, of Cargill, Inc.

"Overview/Comparison of Today's Rheology Modifiers for Low VOC Coatings"—Robert E. Van Doren, of NL Chemicals

"Water-based Lacquers (Rule 1136)"—Ted Del Danno, of Rohm and Haas Co.

"New Solvents—High Solids Coatings/Coalescing Solvents for Architectural Industrial W/B Coatings"—Andrew Defusco, of Union Carbide Corp.

"Industrial Toxicology Hygiene"—Bernard Quinn, of Mobay Corp.

"Evolution of Water-Borne Epoxy Technology"—George Roy, of Hi-Tek Polymers Inc.

"Special Equipment Requirements for Spray Finishing with Compliance Coatings"—Glen Muir, of Grayco

"Titanium Dioxide and the Effect of Surface Treatments"—Calvin C. Tatman, of SCM Chemicals, Inc.

"Statistical Process Control Review of Past Performance"—Galen Reese, of Union Carbide Corp.

"Liquid Crystalline Polymers in High Solids Coatings"—S. Peter Pappas, of North Dakota State University

"Water-based High Solids Alternatives for Bridge and Traffic Coatings"—Ray Warness, of the California Department of Transportation Laboratory

"New Metal Catalysts for High Solids Coatings"—Robert G. Middlemiss, of Mooney Chemicals, Inc.

"Advanced Phosphate Anticorrosive Pigments for Compliant Primers"—Ann Bittner, of Heubach, Inc.

"Biological Treatment of Waste Water and Contaminated Ground Water and Soil in the Paint Industry"—John Kornuc, of Environmental Pro

"Architectural 250 Gm/L Alkyds"—Joseph L. Mulvey, of Reichhold Chemicals, Inc.

"Very High Solids and Water-Borne Anticorrosive Coatings"—Gerald Sugerman, of Kenrich Petrochemicals, Inc.

For more information, contact Program General Chairman Andrew R. Ellis, NL Chemicals, 231 E. Imperial Highway, #221, Fullerton, CA 92635.

Philadelphia Society to Hold Titanium Dioxide Seminar

The Philadelphia Society for Coatings Technology Technical Committee is sponsoring the seminar, "Understanding and Dealing with the TiO_2 Shortage," on May 1, at the Philadelphia Airport Hilton Inn.

Highlighting the seminar will be presentations in the area of market trends and current TiO_2 extender technology.

For further seminar information, contact Program Chairman Thomas L. Peta, C.J. Osborn, Division of Suvar Corp., P.O. Box 1310, Merchantville, NJ 08109.

DuPont Schedules Management Seminars On Crisis and Risk Communications

The DuPont Co., Wilmington, DE, has announced the 1989 schedule for its management seminars on "Managing Risk Communications," "Crisis Communications Management," and "Process Safety Management."

"Managing Risk Communications" is designed for those people who implement right-to-know mandates. The course instructs on how to foster public support and create communication activity plans for operations. Dates and locations are as follows: February 15-16—Denver, CO; March 30-31—Houston, TX; and April 26-27—Philadelphia, PA.

The seminar on "Crisis Communications Management" is structured to build the communications skills needed to deal with the media and the community before, during, and after an incident. It is directed at corporate and plant management, and safety, health, environmental, and public relations staffs. The class is scheduled for: March 21-22—Washington, D.C.; May 23-24—Denver; July 18-19—Portland, ME; September 19-20—San Francisco, CA; and November 14-15—Atlanta, GA.

For more information, write Risk Communications Seminars, DuPont Safety Services, P.O. Box 4500, Greenville, DE 19807.

The "Process Safety Management" course is designed to teach the essential skills needed to conduct process reviews and to identify potential process problems. The seminar is geared toward process, production, and maintenance engineers, as well as engineers and managers responsible for process reviews. The course schedule is: May 9-11—New Orleans, LA; July 11-13—Calgary, Alberta, Canada; August 8-10—Wilmington, DE; October 17-19, Philadelphia; and October 31-November 2—San Antonio, TX.

Direct all inquiries to Process Safety Management, DuPont Safety Services, P.O. Box 4500, Greenville, DE 19807.

Role of Surface Coatings in Fire Protection Is Focus of OCCA/PRA Symposium, March 14-15

The Oil & Colour Chemists' Association and the Paint Research Association, in conjunction with the Paintmakers Association and the Fire Protection Association have scheduled a two-day seminar on "The Role of Surface Coatings in Fire Protection," to be held in Heathrow, London, March 14-15.

Coatings can play a critical role in protecting steel, wood, plastic, and other substrates. The symposium is designed to explore such topics as: the capabilities and limitations of surface coatings in a total protective system, what progress has been made in prolonging fire retardation, and how can modern raw materials contribute to this goal. Papers by leading experts will discuss various facets of fire protection from both theoretical and practical angles. Some of the presentations scheduled include:

"Why Protect Structures and Buildings," by I. Smith, Consultant

"Protection of Steel: External," by C. Ellicott, of Mandoval Coatings

"Protection of Steel: Internal," by F. Alman, of W & J Leigh

"Development of Fire Retardancy for Treated Boards," speaker to be announced

"Protection of Timber by Surface Coatings," by L.C. Newman, Nullifire

"Decoration and Protection of Low Smoke Emission Boards," by D. Lewis, of Trimite

"Contribution of Surface Coatings to Fire Growth," by R. Shaw, Warrington Fire Research Station

"A Review of the Proposed New British Standard—Coatings for the Fire Protection of Building Elements," by C. Lloyd-Lucas, of Speciality Chemicals, ICI

"Surface Coatings—Their Role During and After a Fire," by A. Lewis, FPA

"Fire Engulfment Trials on LPG Vessels with Insulating Coatings," by A.F. Roberts, of Fire and Explosion Laboratory, HSE

"Toxic Hazards from Burning Polymers," by P. Fardell, of Fire Research Station

"Fire Protection of Offsea Structures," by I.V. Dunk, of Textron Specialty Material.

The symposium is limited to 200 delegates. For further information, contact Mr. C. Pacey-Day (OCCA), Priory House, 967 Harrow Rd., Wembley, Middlesex HA0 2SF, England.

Letters to the Editor

Dear Editor:

I have just learned of the death, in September, of John B. (Jack) Coulston, who had been President of Reichard-Coulston, Inc.

Little known to the industry was Jack's long-term dedication to developing understanding between Christians and Jews. He was an officer in World War II who led his troops to liberate a small but vicious Nazi death camp. The horrible situation they came upon affected his life until the time of his death. He vowed to do all he could to memorialize the Holocaust and thus help to prevent such a horror ever again.

Jack lectured, wrote, and arranged innumerable meetings and religious services to bring Christians and Jews together. With the help of his devoted wife Annie and their daughter, he worked tirelessly to bring harmony and understanding to a fractured world. He was a very rare and great gentleman.

Herb Hillman
"Humbug's Nest"
Whitingham, VT

Literature

Insolubilizer Resin

An environmentally safe, nonformaldehyde based insolubilizer resin for paper coatings has been introduced in literature. The insolubilizer is designed to act as a crosslinking agent for polymers containing hydroxyl groups and for compounds with anhydroglucose units. For further information on Curesan® 199 coating insolubilizer, write to Austin R. Proctor, Market Development Manager, Paper Industry Specialty Chemicals, PPG Industries, One PPG Place, Pittsburgh, PA 15272.

Elemental Analyzer

A product bulletin describing an easy-to-use, automated elemental analyzer which is designed to test samples that vary in size from .1 to 100 mg, depending on sample type, has been published. Contact Bruno Lavettre, Product Manager, HBI/Carlo Erba Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001, for more information on the Model 1108 Elemental Analyzer.

Curing Agents

Comparison data, use information, product data and an ECA Performance Guide are highlighted in an "Epoxy Curing Agents and Hydroxyl Functional Acylics Binder." Copies are available upon request, from Henkel Polymers Div., 5325 S. 9th Ave., La Grange, IL 60525-3602.

Strain Gauge Scale

Literature has been published on a strain gauge scale which offers a stainless steel platform, cast aluminum housing, one button external calibration as well as optional counting, batching, and quality control programs. Contact Sartorius Corp., 140 Wilbur Place, Bohemia, Long Island, NY 11716, for more information on its Model I33-G scale.

Tube Cleaning Machine

A fact sheet describing the specifications of a tube cleaning machine has been issued. The machine is designed to clean fouled vertical or horizontal tubes .439-2 in. in diameter from 2 to 40 ft in length. Information on the Eagle II HD Tube Cleaning machine can be obtained by writing Eagle Industries, P.O. Box 6185, Long Beach, CA 90806.

Filter Cartridge

A new filter cartridge for magnetic media applications is the subject of literature. The product is designed for final filtration in critical applications. Key features are: an absolute removal rating, a depth component, and integral seals. To obtain a brochure on the Magnefine™ cartridge, write to: Filterite, 2033 Greenspring Dr., Timonium, MD 21093.

Computer Programs

Four specialized computer programs to help color formulators select and evaluate the most efficient and cost-effective pigment for a particular application are the subject of a product bulletin. For more details, write to: Pigments Div., CIBA-GEIGY Corp., Three Skyline Dr., Hawthorne, NY 10532.

Attritors

A brochure which describes the features and specifications of laboratory size attritors is available. The literature provides details on batch, circulation, and continuous attritors, and lists a broad line of optional accessories. For a copy of the brochure "Laboratory Attritors," write to: Union Process, Inc., 1925 Akron-Peninsula Rd., Akron, OH 44313.

Test Methods

A series of analytical test methods has been published. The series includes a method for determining epoxide content, three different methods for measuring percent solids of resin products, and a method for determining amine nitrogen content of curing agents. To receive this series of test methods, write to: Manager, Resins Advertising, Shell Chemical Co., One Shell Plaza, P.O. Box 2463, Houston, TX 77252-2463.

Portable Spectrophotometer

A compact, portable spectrophotometer for color measurement of a wide variety of surfaces has been introduced in literature. The main body of the unit measures 340 × 440 × 117 mm (13$\frac{3}{8}$ × 17$\frac{7}{16}$ × 4$\frac{5}{8}$ in.) and the entire system weighs 11.5 kg (25.3 lb). For more information on the Spectrophotometer CM-1000 and other industrial meter products, contact Minolta Corp., Industrial Meter Div., 101 Williams Dr., Ramsey, NJ 07446.

Powder Spray Gun

A product data sheet highlights an automatic powder spray gun. The spray gun features include: higher deposition efficiency, straight-through design, forward air system, retrofitted to all systems, and external hookups. For additional details on the HP1000 automatic powder spray gun, write to: Volstatic, Inc., 7960 Kentucky Dr., Florence, KY 41042.

Spectrophotometer

A new 12-page brochure on a UV/visible spectrophotometer is now available. The publication highlights three flexible and expandable double-beam scanning spectrophotometers designed to meet the changing requirements of the laboratory. To obtain a copy of brochure L-1113 on the Lambda 3 Series UV/Visible Spectrophotometer, write to: The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012.

Air Release Agent

A non-silicone containing air release agent is the topic of a technical bulletin. The product was developed to facilitate the release of entrapped air in solvent containing as well as 100% solids systems for applications including coatings, potting, and encapsulating. Technical data sheets and samples of XP1330 are available from Furane Products Co., Isochem Operations, 99 Cook St., Lincoln, RI 02865.

Painting Ink Solvent

A new printing ink solvent which is designed to help formulators meet a range of ink performance demands is the subject of a data sheet. The solvent's viscosity allows formulators to give ink more body without having to increase solids content. For additional technical information on Exx-Print™ 588 D, write to: Exxon Co. U.S.A., P.O. Box 2180, Houston, TX 77252-2180.

Lining Application

A brochure which describes coating and lining application services is available. The publication features information on capabilities, facilities, general equipment, and materials. For a copy of "Applicators of Protective Coatings and Linings," write to: Arbonite Corp., 3826 Old Easton Rd., P.O. Box 888, Doylestown, PA 18901.

Production Dispensing

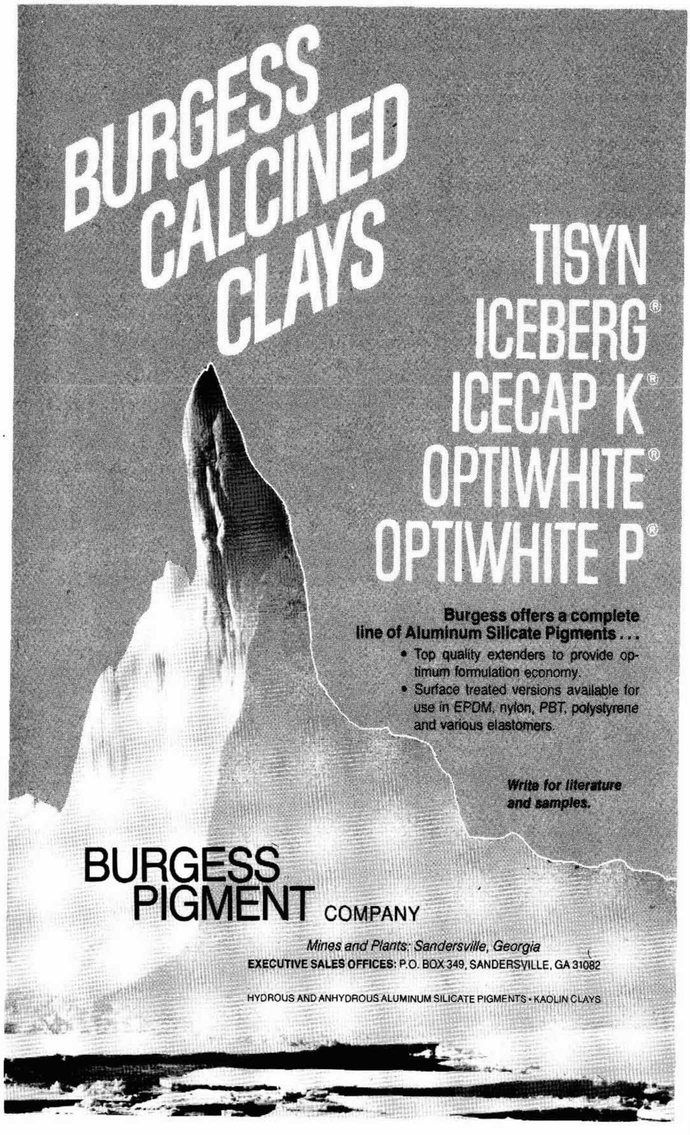
A new, six-page color brochure on a production dispensing system has been published. The publication gives an overview of the system and details user benefits. A two-page system flow diagram and in-use color photos, along with engineering features and highlights explain the system configuration. For more information and/or a copy of "Fluid Handling Technology to Meet Today's Manufacturing Challenges," write to: Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543.

Color Formulation System

A color formulation system featuring software designed for paint and coating applications is highlighted in a technical bulletin. Functions of the system include computerized match prediction, batch correction, shade/formula data base management, accurate cost and metamerism calculations, and consistent quality control. For a copy of the bulletin on the Optimatch™ Color Formulation System, write to: Macbeth, P.O. Box 230, Newburgh, NY 12550.

Coating Lubricant

A low density polyethylene lubricant which is adaptable for pigmented coatings and size press applications in both paper and paperboard is highlighted in a product bulletin. The product has an expected shelf life of up to two years and its 60% total solids content is designed to reduce storage requirements. For further information on Polysan 60, contact: Austin R. Proctor, Market Development Manager, Paper Industry Specialty Chemicals, PPG Industries, Inc., One PPG Place, Pittsburgh, PA 15272.



Polymeric Modifiers

Two latex modifiers for use in asphalt or coal tar emulsions are the subject of literature. The polyvinyl acetate copolymer is recommended as a latex modifier for asphalt emulsion driveway sealers. The vinyl acrylic terpolymer is suggested as a latex modifier for asphalt and coal tar emulsions in roof coatings and other elastomeric products. For further data on Resyn® 5904 and X-Link™ 2813, write to: National Starch and Chemical Corp., Resins and Specialty Chemicals Div., Finderne Ave., Bridgewater, NJ 08807.

Water-Borne Polymers

Two new water-borne polymers have been introduced in literature. The high solids water-borne urethane dispersion is designed for a variety of high-performance applications including ink additives, concrete coatings, and wood floor coatings. The acrylic copolymer emulsion is for use in formulating clear and pigmented industrial coatings for metal and wood substrates. For data on NeoRez® R-9637 and NeoCryl® A-6037, write to: ICI Resins US, 730 Main St., Wilmington, MA 01887.

Epoxy Resin

A product bulletin introduces a new light stable epoxy resin product which has passed required pre-manufacturing review by the EPA in the U.S. and by corresponding environmental agencies in Europe. The epoxy resin is designed for use in a variety of air dry and force dry, high performance coatings, often as a replacement for aliphatic isocyanate coating systems. Technical literature and samples of Santolink® LSE 107 are available from: Monsanto Chemical Co., New Business Development Dept., 730 Worcester St., Springfield, MA 01151.

Sphere Spectrophotometer

A diode array, d/8 integrating sphere spectrophotometer for color measurement in reflectance and transmission modes is the subject of literature. The spectrophotometer is designed to scan and display color values in one second and also utilizes double beam technology. For additional information on The Color Sphere®, write to: Pacific Scientific Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910.

High Temperature Materials

A review of the wide range of techniques that are available for characterizing high temperature materials is available. The literature provides a broad, practical overview of the techniques, emphasizing their range of applicability, relative precisions, and limitations. "Microstructural Characterization and Chemical Characterization" is obtainable by writing to: The Institute of Metals, Marketing and Sales Dept., 1 Carlton House Terrace, London SW1Y 5DB, England.

UV-Cure Release Coatings

UV-cure release coatings for the pressure-sensitive adhesive industry have been highlighted in literature. The release coatings are designed to provide low-temperature cure in the manufacture of labels, tapes, and other products. More data on the UV9300 polymer series is available from: Janice Mansfield, General Electric Co., Waterford, NY 12188.

Mask Dispenser

A product bulletin details a mask dispenser designed to enable painters to dispense a continuous sheet of masking paper or film with tape in one stroke. The dispenser has only two moving parts and comes with a carrying holster. For more information on the Hand-Masker, write 3M DIY Business, Bldg. 223-4S-01, 3M Center, St. Paul, MN 55144.

Resins Systems

Two resin systems are the subject of literature. The low temperature bake system is designed to eliminate the mixing and baking of two-component urethanes. The second resin system exhibits 4H pencil hardness and 160 in. lbs reverse impact. For details on the T4000 and T5000 Resin Systems, write to: Denomi Corp., P.O. Box 41535, Minneapolis, MN 55441.

Corrosion Test Chamber

A line of environmental corrosion test chambers is highlighted in a technical bulletin. The chambers feature a completely seamless molded construction and are corrosion-proof, rust-proof, shock-proof, and virtually maintenance free. For further details on the KTS 400 Environmental Corrosion Test Chamber, write to: Lab-Line Environeers, Ltd., One Lab-Line Plaza, Melrose Park, IL 60160.

Bench-Scale Reactor

A technical bulletin features an automated laboratory bench-scale reactor/calorimeter with heat balance calorimetry capability. The reactor has a completely insulated reflex condenser (and jacketed vessel) measuring temperatures in and out of the reactor and condenser. For information on the Contalab reactor/calorimeter, write to: Contraves Industrial Products Div., 11258 Cornell Park Dr., Cincinnati, OH 45242.

Organic Thixotrope

A new liquid organic thixotrope which provides rheology and thermal sag control when used in a wide range of high solids baking and air dry coatings is the subject of a product sheet. The thixotrope is designed to be incorporated at any point in the manufacturing process or as an additive for post correction. For a free brochure on Thixatrol® 289, write to: NL Chemicals, Inc., P.O. Box 700, Hightstown, NJ 08520.

Aqueous Laminating Ink

A product bulletin introduces a new aqueous laminating ink designed for a variety of film packaging applications. The water-based ink is for use in flexographic and rotogravure and offers press stability and low foam characteristics. For data on Aquaprop, write to: Croda Inks Corp., 7777 N. Merrimac Ave., Niles, IL 60648.

Powder Coating Systems

A new, 12-page catalog which describes how powder coating systems work has been published. The literature also provides a complete list of the company's branch offices with warehouse and service facilities. For a copy of Catalog SPE, "Electrostatic Powder Coating Equipment and Systems," write to: Binks Manufacturing Co., Advertising Dept., 9201 W. Belmont Ave., Franklin Park, IL 60131.

Water-Borne Specialty Coatings

A line of high solids enamels and water-borne specialty coatings for the automotive and industrial markets has been introduced in literature. The coatings feature low VOC ratings and can be formulated in virtually any color. The finishes use synthetic resins and high strength pigments for single-coat, semi-gloss coatings in a variety of gloss ranges. For information, write to: Akzo Coatings, Inc., P.O. Box 7062, Troy, MI 48007-7062.

Exterior Latex

A technical data sheet introduces a new exterior latex paint which, when tested, has lasted up to 50% longer than conventional latex flat house paints. The paint is available in over 1000 colors and can be used to repaint aluminum or vinyl siding. For additional details on Manor Hall Exterior, write Pittsburgh Paints, 1 PPG Place, Pittsburgh, PA 15272.

Process Viscometers

A series of process viscometers has been introduced in a technical data sheet. The viscometers utilize concentric cylinder measuring systems to determine the dynamic viscosity of a variety of process fluids. For details on the 101/105 Series, write to: Contraves Industrial Products Div., 11258 Cornell Park Dr., No. 612, Cincinnati, OH 45242-9006.

Northwestern Society 18th Annual Symposium

March 7 Marriott Inn, Bloomington, MN

"Coatings and Your Health"

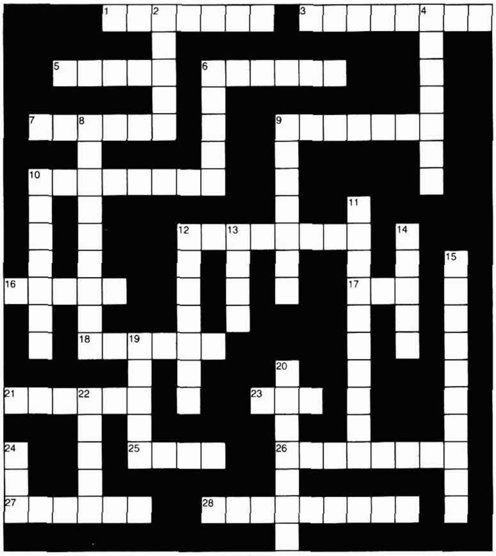
Topics to Be Discussed:

- Industrial Hygiene and Toxicology of Pigments and Isocyanates
- Ergonomics
- Poison Control Criteria

For information, contact Herman Bacchus, Valspar Corp., P.O. Box 1461, Minneapolis, MN 55440.

CrossLinks

by Earl Hill



Solution
to be
Published in
March issue

No. 28

DOWN

2. Single pigment having maximum absorption strength
4. Wall decoration prepared via translucent paints
6. Poisonous
8. Light metal; soaps used in waterproofing compounds
9. Low molecular weight polymer, T____
10. Solid cylindrical steel rod, used in flexibility testing
11. Polymer with three distinct units
12. *Having to do with building* construction
13. Calcium oxide
14. Yellowish natural earth pigment
15. Having to do with false *body (Rheol.)*
19. To unite; to join together (Chem.)
20. Having to do with the structural quality of a surface
22. Resistance test using a brush
24. Water vapor transmission (Abr.)

ACROSS

1. Titanium dioxide
3. Polyhydric alcohol $C_6H_8(OH)_6$, S____
5. Coloring material, usually for wood (N.)
6. What a salesperson does a lot of, T____
7. Wood (Syn.)
9. *Formulated paint with egg* as a vehicle
10. Pigment type used in VCR tapes
12. Triazine used in heat reactive resins
16. *Attribute of fibers in wood*
17. Polychlorinated diphenyls (Abr.)
18. Ocean-going type of coating
21. Unique, high temperature *spray process*
23. A roll of a substrate used in a printing process
25. Plasticizer, Tributoxy ____ ____ (Abr.)
26. Marble-*like flooring* material
27. Opaque; cloudy
28. Heat setting

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact FSCT, 1315 Walnut St., Philadelphia, PA 19107 (215-545-1506).

1989

(Mar.)—Federation Seminars on Statistical Process Control. Level I: Mar. 6-7, Philadelphia Airport Hilton, Philadelphia, PA; Mar. 13-14, Chicago O'Hare Marriott, Chicago, IL; and Mar. 20-21, Bristol Place Hotel (Airport), Toronto, Ont., Canada. Level II: Mar. 8-10, Philadelphia Airport Hilton; and Mar. 15-17, Chicago O'Hare Marriott.

(May 16-19)—Federation "Spring Week." Seminar on the 16th and 17th; FSCT Incoming Society Officers Meeting on the 18th; FSCT Board of Directors Meeting on the 19th. Los Angeles Airport Marriott, Los Angeles, CA.

(Nov. 8-10)—67th Annual Meeting and 54th Paint Industries' Show. New Orleans Hilton and The Rivergate, New Orleans, LA.

1990

(Oct. 29-31)—68th Annual Meeting and 55th Paint Industries' Show. Convention Center, Washington, D.C.

1991

(Nov. 4-6)—69th Annual Meeting and 56th Paint Industries' Show. Convention Center, Toronto, Ontario, Canada.

SPECIAL SOCIETY MEETINGS

1989

(Mar. 7)—Northwest Society. 18th Annual Symposium, "Coatings and Your Health." Marriott Inn, Bloomington, MN. (Herman Bacchus, Valspar Corp., P.O. Box 1461, Minneapolis, MN 55440).

(Mar. 14-16)—Western Coatings Societies' 19th Biennial Symposium and Show. Disneyland Hotel and Convention Center, Anaheim, CA. (Andrew R. Ellis, NL Chemicals, 231 E. Imperial Highway, Suite 221, Fullerton, CA 92635).

(Apr. 5-7)—Southern Society. Annual Meeting. Hyatt Regency Westshore, Tampa, FL.

(Apr. 19)—14th Annual FOCUS Conference of Detroit Society. Management Education Center, Troy, MI. (Detroit Society, 26727 Newport, Warren, MI 48089).

(May 1)—"Understanding and Dealing with the TiO_2 Shortage" Seminar sponsored by the Philadelphia Society. Philadelphia Airport Hilton Inn, Philadelphia, PA. (Thomas L. Peta, C.J. Osborn Chemical Co., Division of Suvar Corp., P.O. Box 1310, Merchantville, NJ 08109).

(May 4-6)—Pacific Northwest Society. Annual Symposium. Portland Marriott, Portland, OR. (John Daller, McCloskey Corp., 4155 N.W. Yeon, Portland, OR 97210).

(June 6-7)—32nd Annual Conference on "Advances in Coatings Technology." Sponsored by the Cleveland Society for Coatings Technology. B.P. America Inc. Research and Development Center, Warrensville Heights, OH. (De Villa Moncrief, Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113).

OTHER ORGANIZATIONS

1989

(Feb. 15-16)—"Managing Risk Communications" Seminar sponsored by DuPont Co. Denver, CO. Other dates and locations: Mar. 30-31—Houston, TX; and Apr. 26-27—Philadelphia, PA. (Risk Communications Seminars, DuPont Safety Services, P.O. Box 4500, Greenville, DE 19807).

(Feb. 19-22)—"Principles of Adhesion" Short Course and 12th Annual Meeting of The Adhesion Society. Marriott Hotel, Hilton Head Island, SC. (Don Hunston, National Bureau of Standards, Polymers Div., Gaithersburg, MD 20899).

(Feb. 20-22)—"Hazardous Waste Treatment: Biosystems for Pollution Control" Symposium. Sponsored by the U.S. Environmental Protection Agency and the Air and Waste Management Association. Westin Hotel, Cincinnati, OH. (Meetings Dept., Air and Waste Management Association, P.O. Box 2861, Pittsburgh, PA 15230).

(Feb. 20-22)—"Maintenance Coatings for Contractors and Paint Inspectors." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, UMR, Rolla, MO 65401-0249).

(Feb. 27-Mar. 3)—"58th Introductory Short Course—The Basic Composition of Coatings." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, UMR, Rolla, MO 65401-0249).

(Feb. 28-Mar. 2)—"Level II—Industrial Maintenance Course" sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 6-8)—"Estimating for Painting Contractors and Maintenance Engineers." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, UMR, Rolla, MO 65401-0249).

(Mar. 13-17)—"18th Introductory Short Course—Paint Formulation." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, Rolla, MO 65401-0249).

(Mar. 13-17)—Color '89. Sixth Congress of the International Color Association (AIC). Centro Cultural San Martín, Buenos Aires, Argentina. (Color '89, Grupo Argentino del Color, c/o División Optica, Inti, C.C. 157, 1650 San Martín (BA), Argentina).

(Mar. 14-15)—"The Role of Surface Coatings in Fire Protection" Symposium. Cosponsored by the Oil & Colour Chemists' Association and Paint Research Association. Skyways Hotel, London Heathrow, England. (Chris Pacey-Day, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF).

(Mar. 14-16)—"Inspection of High Performance Coatings" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 20-24)—"Surface Science and Technological Applications." Second Annual Short Course sponsored by the University of Florida, Gainesville, FL. (Dinesh O. Shah, Center for Surface Science & Engineering, University of Florida, 425 Chemical Engineering, Gainesville, FL 32611).

(Mar. 21-22)—"Crisis Communications Management" Seminar sponsored by DuPont Co. Washington, D.C. Other dates and locations: May 23-24—Denver, CO; July 18-19—Portland, ME; Sept. 19-20—San Francisco, CA; and Nov. 14-15—Atlanta, GA. (Risk Communications Seminars, DuPont Safety Services, P.O. Box 4500, Greenville, DE 19807).

(Apr. 3-4)—Washington Paint Technical Group's 29th Annual Symposium. Holiday Inn-Ballston, Arlington, VA. (Mildred A. Post, Washington Paint Technical Group, P.O. Box 12025, Washington, D.C. 20005).

(Apr. 3-7)—Surface Engineering and Coating Technology courses: "Wear Protective Coatings," "Optical Coatings," "Electroplating Technology: Principles and Current Practices," "Polymer Coatings: Non-Polluting Systems," and "Corrosion Protective Coatings," sponsored by CEI-Europe/Elsevier. Davos, Switzerland. (CEI-Europe/Elsevier, P.O. Box 2400, 1000 CK Amsterdam, The Netherlands).

(Apr. 5-7)—"Basic Coatings for Sales and Marketing Personnel." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, Rolla, MO 65401-0249).

(Apr. 7-9)—Second International Symposium on Polymer Analysis and Characterization sponsored by DuPont Co. Austin, TX. (Howard G. Barth, DuPont Co., Experimental Station, P.O. Box 80228, Wilmington, DE 19880-0228).

(Apr. 8-9)—Eastern Decorating Products Show sponsored by the National Decorating Products Association. World Trade Center, Boston, MA. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Apr. 9-11)—Annual Meeting of the Inter-Society Color Council. Ambassador West Hotel, Chicago, IL.

(Apr. 11-14)—"Advances in Corrosion Protection by Organic Coatings" Symposium. Christ's College Cambridge, England. (David Scantlebury, Corrosion and Protection Centre, UMIST, P.O. Box 88, Manchester, U.K. or Martin W. Kendig, Rockwell International Science Center, Thousand Oaks, CA 91360).

(Apr. 11-14)—International Surface Finishing '89. Sponsored by International Institute of Surface Finishing. Metropole Hotel, Brighton, England. (Secretary, The Institute of Metal Finishing, Exeter House, 48 Holloway Head, Birmingham B1 1NQ).

(Apr. 17-21)—Corrosion/'89 sponsored by the National Association of Corrosion Engineers. New Orleans, LA. (NACE, Conference Manager, P.O. Box 218340, Houston, TX 77218).

(Apr. 23-26)—National Coil Coaters Association (NCCA) Annual Meeting. Marriott's Marco Island Resort, Marco Island, FL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Apr. 23-28)—"7th International Meeting on Radiation Processing." Noordwijkerhout, The Netherlands. (E. Franken, 7th International Meeting on Radiation Processing, P.O. Box 4240, 6710 EE Ede, The Netherlands).

(Apr. 24-26)—"Crosslinked Polymers: Chemistry, Properties, and Applications" Short Course sponsored by State University of New York at New Paltz. Hotel Thayer, West Point, NY. (Angelos V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(Apr. 24-26)—"Chromatographic Separation of Enantiomers." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, Rolla, MO 65401-0249).

(Apr. 24-26)—"Thermoplastic Elastomers." Short course sponsored by State University of New York (SUNY). Hotel Thayer, West Point, NY. (A.V. Patsis, Chemistry Dept., SUNY, New Paltz, NY 12561).

(Apr. 24-27)—40th National Plant Engineering & Maintenance Show. McCormick Place East, Chicago, IL. (Show Manager, National Plant Engineering & Maintenance Show, 999 Summer St., Stamford, CT 06905).

(Apr. 24-28)—"Applied Rheology for Industrial Chemists." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(Apr. 24-29)—Materials Research Society Spring Meeting, Symposia, and Exhibition. San Diego, CA. (MRS, 9800 McKnight Rd., Ste. 327, Pittsburgh, PA 15237).

(May 1-4)—Society of Manufacturing Engineers' International Conference. Cobo Hall, Detroit, MI. (Violet Greco, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121-0930).

(May 2-4)—PaintCon '89. Sponsored by *Industrial Finishing* magazine. O'Hare Expo Center, Rosemont, IL. (PaintCon '89, 2400 E. Devon Ave., Suite 205, Des Plaines, IL 60018).

(May 2-5)—1st International Paint Congress. Sponsored by the Brazilian Association of Paint Manufacturers-ABRAFATI and the Union of the Paints and Varnishes Industry of the State of São Paulo. São Paulo, Brazil. (Guazzelli Congressos, Rua Manoel da Nóbrega, 864, 04001—São Paulo, Brasil).

(May 3-7)—80th Annual Meeting & Exposition of the American Oil Chemists' Society. Cincinnati Convention Center, Cincinnati, OH. (Myra Barenberg, AOCS Book Exhibit, 1608 Broadmoor Dr., P.O. Box 3489, Champaign, IL 61821-0489).

(May 8-12)—"Dispersion of Pigments and Resins in Fluid Media." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 9-11)—"Process Safety Management" Seminar sponsored by DuPont Co. New Orleans, LA. Other dates and locations: July 11-13—Calgary, Alberta, Canada; Aug. 8-10—Wilmington, DE; Oct. 17-19—Philadelphia, PA; and Oct. 31-Nov. 2—San Antonio, TX. (Process Safety Management, DuPont Safety Services, P.O. Box 4500, Greenville, DE 19807).

(May 15-19)—"Physical Testing of Paints and Coatings." Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Coatings and Polymer Science Program, Dept. of Chemistry, Rolla, MO 65401-0249).

(May 16-18)—14th Annual Powder & Bulk Solids Conference/Exhibition. O'Hare Exposition Center, Rosemont, IL. (Show Manager, Powder & Bulk Solids Conference/Exhibition, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060).

(May 22-26)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 24-26)—11th International Conference on "Advances in the Stabilization and Controlled Degradation of Polymers." Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, CSB 209, State University of New York, New Paltz 12561).

(May 29-31)—3rd International Conference on "Crosslinked Polymers." Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, State University of New York, New Paltz, NY 12561).

(June 5-9)—"High Solids Coatings." Short Course sponsored by North Dakota State University, Fargo, ND. (Frank N. Jones, NDSU, Fargo, ND 58105).

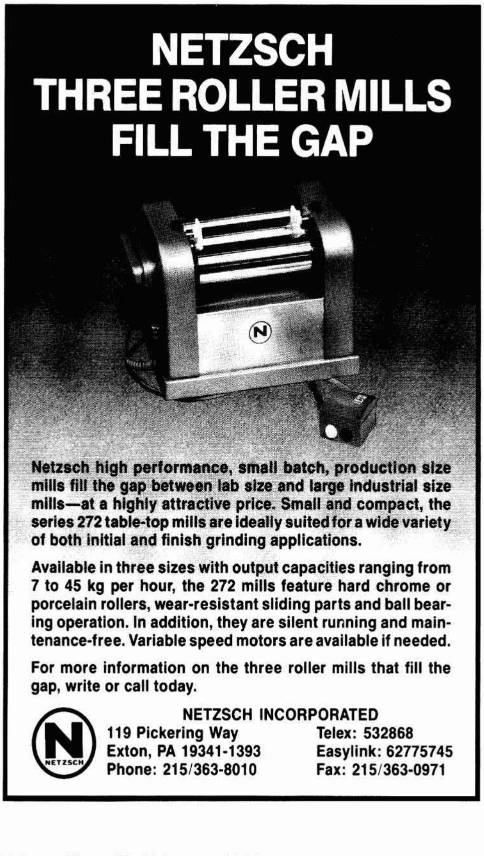
(June 5-9)—"Advances in Emulsion Polymerization and Latex Technology." 20th Annual Short Course sponsored by Lehigh University, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Mountaintop Campus, Bldg. A, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 11-14)—Dry Color Manufacturers' Assoc. Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (Tracy Kruisselbrink, DCMA, Ste. 202, 206 N. Washington St., P.O. Box 20839, Alexandria, VA 22314).

(June 12-23)—"Coatings Science." Short Course sponsored by North Dakota State University, Fargo, ND. (Frank N. Jones, NDSU, Fargo, ND 58105).

(June 18-21)—63rd Colloid and Surface Science Symposium. Sponsored by American Chemical Society Division of Colloid and Surface Science. University of Washington, Seattle, WA. (John C. Berg, Symposium Chairman, University of Washington, Dept. of Chemical Engineering, BF-10, Seattle, WA 98195).

(June 21-23)—Oil and Colour Chemists' Association Biennial Conference. Grosvenor Hotel, Chester, England. (Mr. Christopher Lacey-Day, Director, OCCA, Priory House, 967 Harrow Rd., Wembly, Middlesex HA0 2SF, England).



Advertisers Index

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'Humbug' from Hillman

For years, now, I have wondered about the Federation Honorary members. A peek at the list in the Year Book will show only 15 people so honored over the more than 65 years of Federation history. I have frequently thought that there must have been many more worthy of such selection. Present company excepted (you and me), I have long felt that many more should have been chosen for this signal honor.

Recently, while occupied in such thoughts, coincidentally enough, a letter arrived in a plain white envelope with no return address. I was pleased to learn that there is at least one other who feels as I do on the subject. I am happy to share the contents of the letter with my readers and hope that you will join us in a campaign to have those worthy candidates elected.

November 10, 1988

Mr. Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361

Dear Mr. Hillman:

Although I'll never admit to it, I propose the following people for Federation Honorary membership:

Al Abaster
Earl Absorption
Quince Acridone
Dan Acryloid
Mel Amine
"Tex" Aphor
Tammy Awl
M.I. Beekay
Ethel Benzene
Corry Butanol
Bernard Cell
Lou Cite
M.R.E Cloth
Molly B. Date
Stan Doil
Heidi Droxyl
Bev L. Edge
R.C. Elnine
Penny Erythritol
Polly Ester
Mat Finish
Phil Former
N.T. Fouling
Esther Gum
Moe Hardness
Ann Hydride
S.A. Ibee
Frank Incense
Theo Indigoid
Harold Ite
X. Kintoo
Shelly Lac
Di Latent
Flo N. Leveling
Z.O. Lex
K.O. Lynn
Pearl Lite
Cy Lloyd
C. Mentitious
Mona Mer
Vern Miculite
Sam Mill
Al U. Minium
Graham Molecular
Moe Nastral
C.D. Ness
Phil Nolic
Vi Nylite
Kay O'Paque
Hal Ogen
Rusty Oleum
Rex Orange
Mel Oriblu
Alan Pfund
"Ma" Pico
R.O. Plaz
Rhoda Plex
Ty Pure
Chip Resistance
Zeke Rich
Vern Samid
Wayne Scott
Sandy Sealer
Lynn Seed
Cal Signed
Becky Sol
Gil Sonite
Hal Spaint
Crystal Structure
Kurt Tancoater
Phil Terbag
Ann T. Terra
I.T. Threax
Sam Ticizer
A.C. Tickacid
Ann Timony
Nick L. Titanate
Reuben Toner
"Doc" Torblade
Cas Toroyl
Gladys Transition
Penny Tration
Nat Trosol
Tex O. Tropic
Sal Ubility
Gil Van Ized
Neil Whitemetal
Ben Zoguanamine

Thank you for your consideration.

Sincerely,
S. WARD ROCKER

The woman caring for her neighbor's daughter made bacon and eggs for breakfast.

"Mom always has hot biscuits for breakfast," said the youngster.

So the woman quickly prepared a plate of hot biscuits.

"No, thank you" said the little girl.

"I thought you said your mother has hot biscuits for you?"

"She does," said the child, "but I never eat them."

"The pain in your leg is caused by old age," the doctor told his elderly patient.

"That can't be," said the old man. "The other one is the same age and it doesn't hurt a bit."

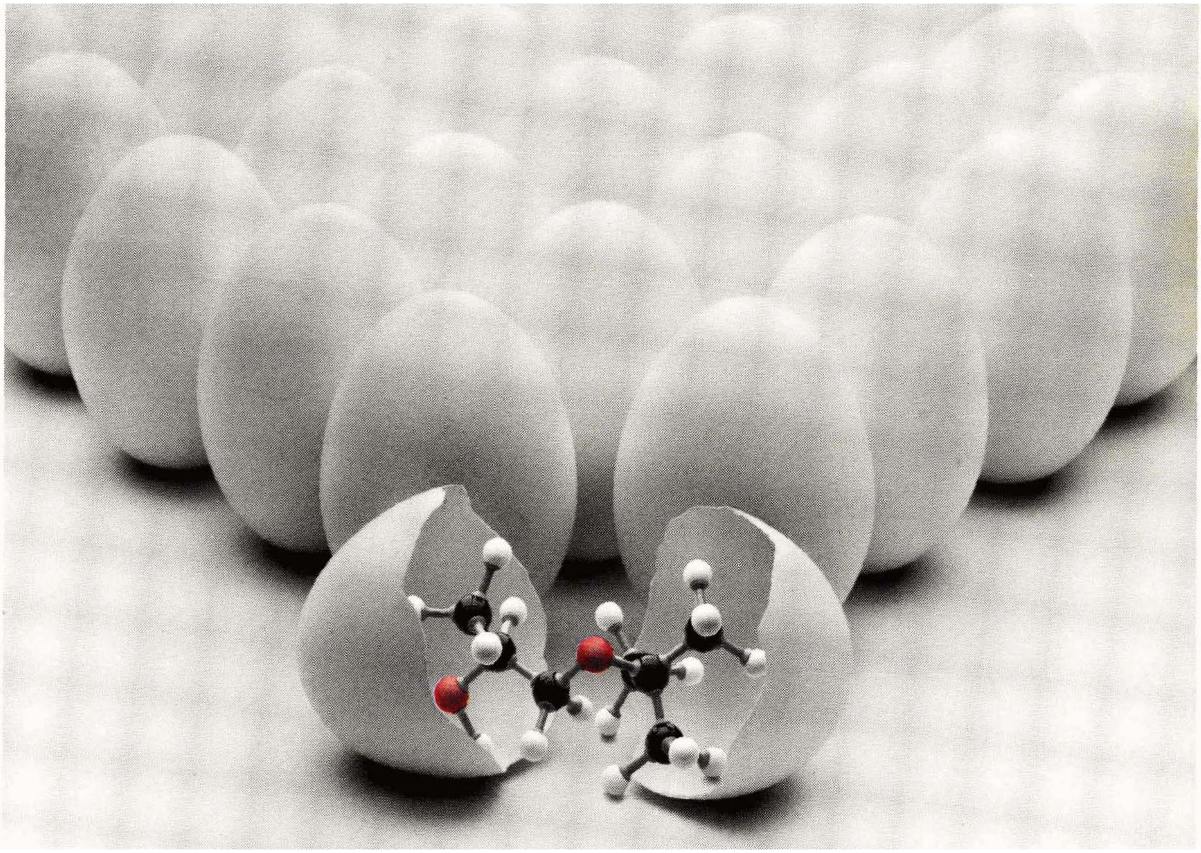
My friend Julius Nemeth observes that, "If you ain't the lead dog, the scenery never changes!"

Husband—"Your mother has been with us for twenty years. Isn't it about time she got a place of her own?"

Wife—"My mother? I thought she was your mother!"

— The Lion

—Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361



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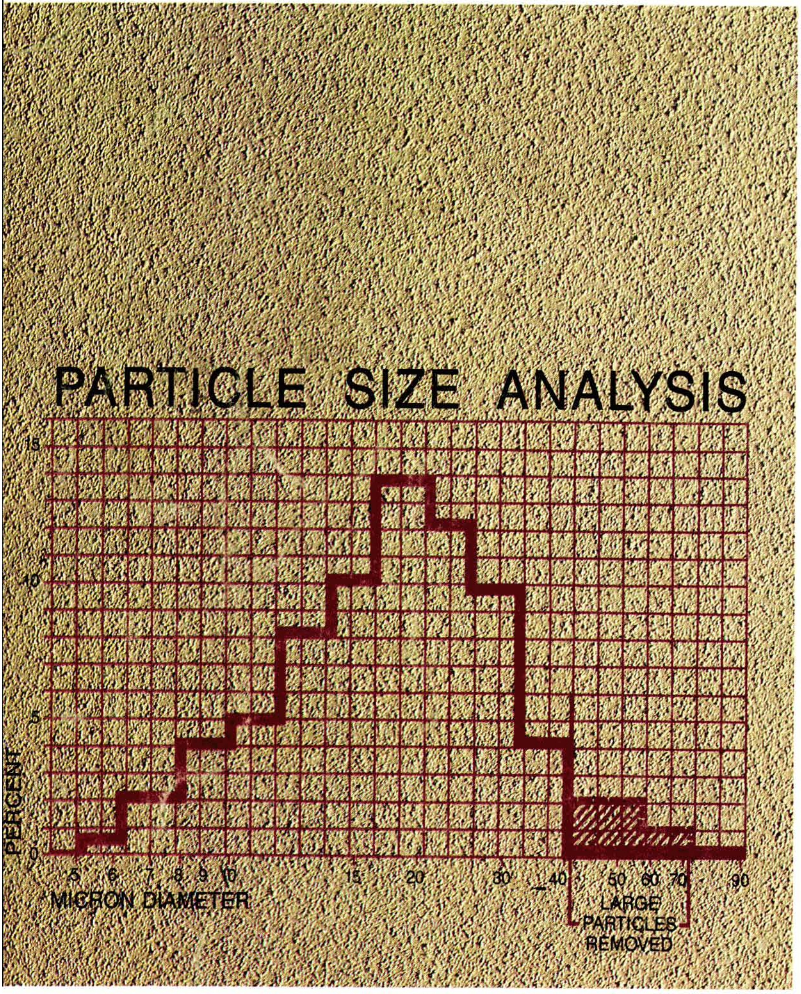

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