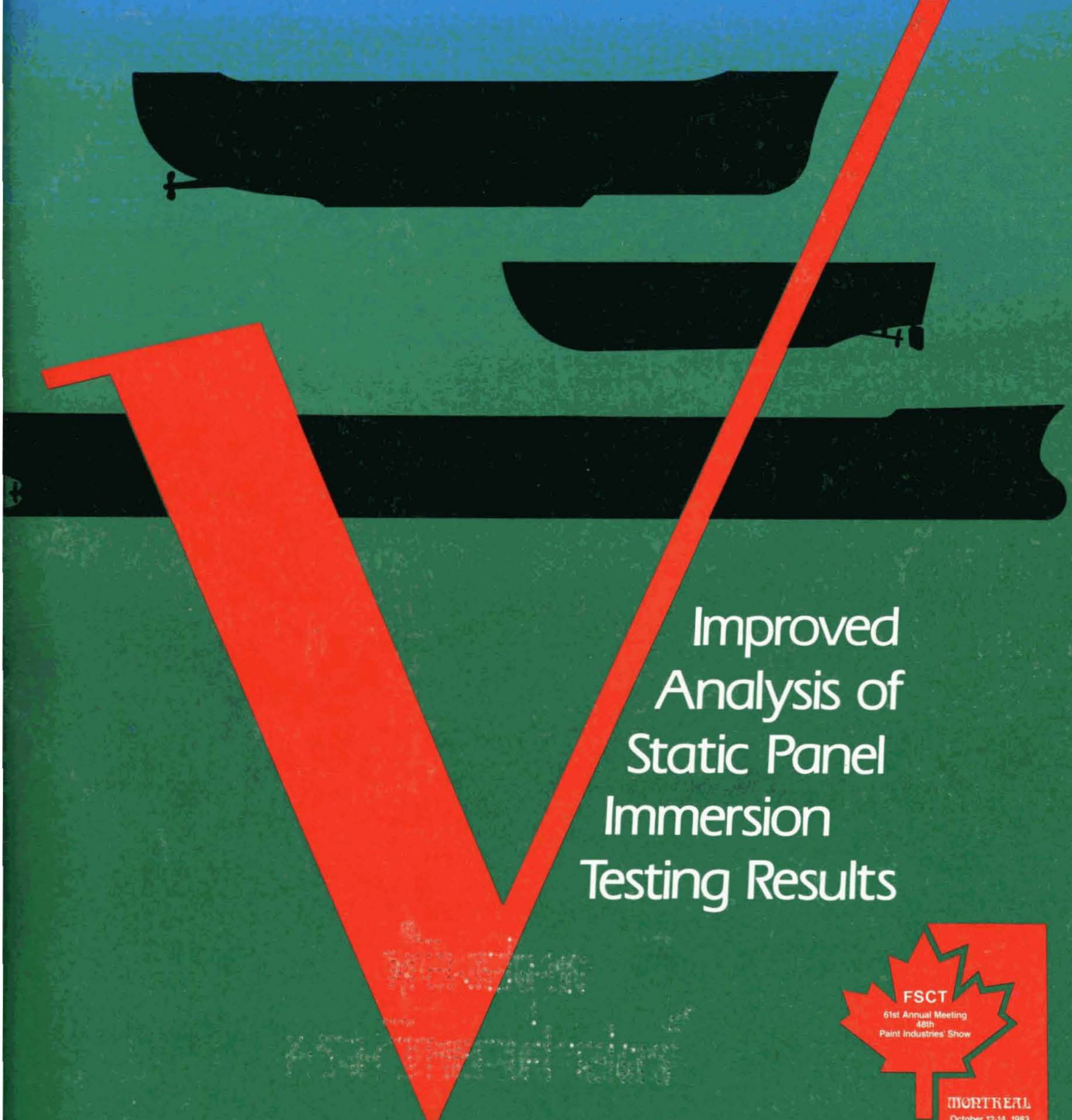
JCTAX 55 (703) 1-108 (1983)

JOURNAL OF COATINGS TECHNOLOGY

AUGUST 1983



Improved Analysis of Static Panel Immersion Testing Results

FOR A LONG TIME OUR COMPETITION DIDN'T HAVE MUCH COMPETITION.

Ten years ago, suppliers of conventional acrylics had a pretty fat situation. They numbered few, while paint makers who needed their products numbered many.

Which was great for them, but not so great for paint makers.

Then came UCAR Acrylics. New acrylics that delivered the performance of conventional acrylics but at a much lower cost.

Which was great for paint makers because they could still make paints as good as ever, but at profits that were better than ever.

Not so great for suppliers of conventional acrylics, because all of a sudden they had some real competition. The kind of competition that's convinced over 140 paint makers to switch to UCAR Acrylics.

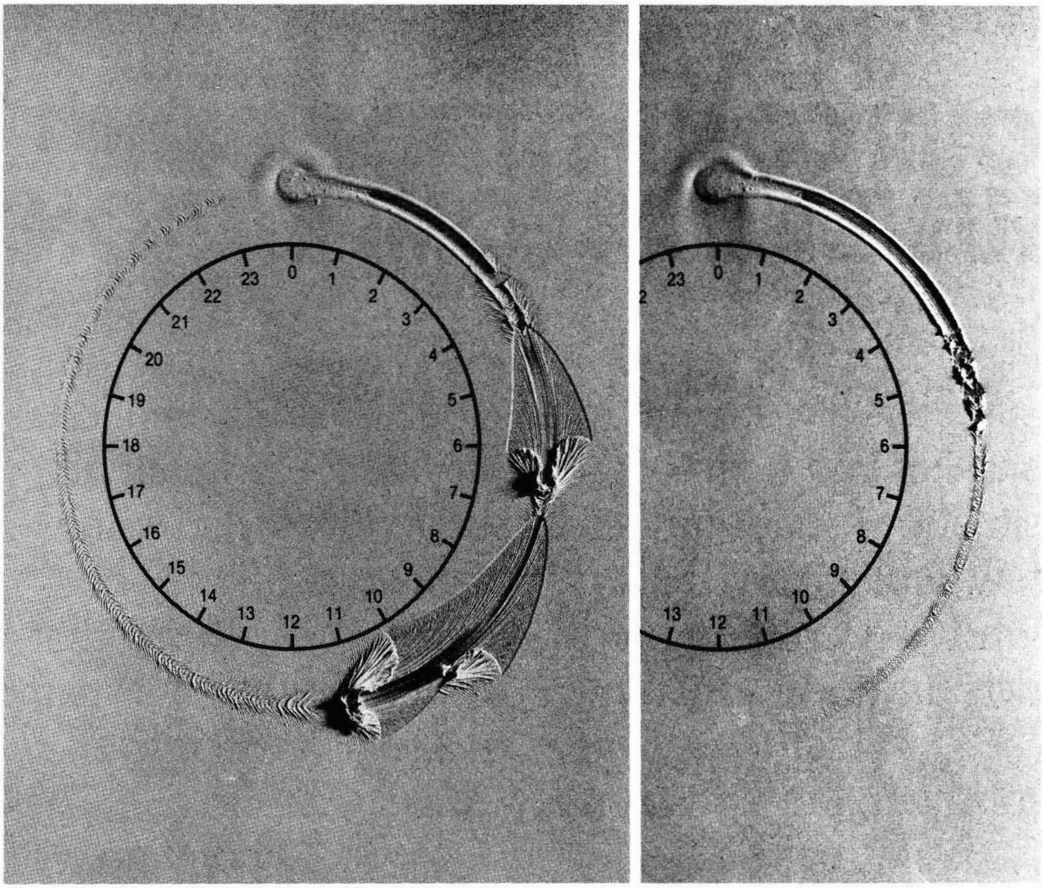
To be convinced yourself, contact your local Union Carbide Sales Representative, or write to Dept. K3442, Danbury, CT 06817.

What we can do for your paints and your profits will make you purr like a kitten.

UNION CARBIDE

Coatings Materials

UCAR is a Registered Trademark of Union Carbide Corporation.



On the left, a high-solids alkyd coating without ACTIV-8 surface-dried in less than 5 hours and through-dried in 23 hours. On the right, the identical formulation with ACTIV-8 took less than 9 hours to through-dry.

AUGUST 1983

jct JOURNAL OF COATINGS TECHNOLOGY

Federation of Societies for Coatings Technology
YE OLDE PAINT STONE

VOLUME 55 NUMBER 703

Technical Articles

Federation News

Departments

BPA Membership Applied for May 1982

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

Second class postage paid at Philadelphia, PA and at additional mailing offices. POSTMASTER: Send address changes to JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

Subscriptions: U.S. and Canada—1 year, $20; 2 years, $37; 3 years, $52. Europe (Air Mail)—1 year, $40; 2 years; $77; 3 years, $112. Other countries—1 year, $30; 2 years, $57; 3 years, $82.

Welcome to

THE TONE AGE.

TONE™ Polymeric Intermediates is the new name of our broad range of caprolactone-based products especially designed for today's high performance coatings. Among them, you'll find: □ a completely new difunctional monomer for improving the flexibility, impact resistance and durability of higher solids acrylic or vinyl copolymer coatings □ a broad spectrum of multifunctional polyols for producing high-quality polyurethanes, or for flexibilizing and upgrading the properties of thermoset coatings □ low viscosity reactive diluents for high solids thermoset coatings that achieve an overall balance of properties as required for automotive and other metal finishes.

TONE Polymeric Intermediates help you keep pace with the ever-changing demands of industrial coatings. In addition to our current collection of TONE products, we have more on the drawing board. And our technical staff is ready to provide assistance to help you meet your needs.

For complete information, just write Union Carbide, Department M1553, Danbury, CT 06817. We'll show you how great it can be living in the TONE Age.

UNION CARBIDE

SPECIALTY POLYMERS & COMPOSITES

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) 545-1506.

Annual dues for Active and Associate Members of the Federation of Societies for Coatings Technology is $15.00. Of this amount, $10.00 is allocated to a membership subscription to this publication. Membership in the Federation is obtained through prior affiliation with, and payment of dues to, one of its 26 Constituent Societies. Non-member subscription rates are:

	U.S. and Canada	Europe (Air Mail)	Other Countries
1 Year	$20.00	$ 40.00	$30.00
2 Years	$37.00	$ 77.00	$57.00
3 Years	$52.00	$112.00	$82.00

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

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

A Guide for Authors is published in each January issue.

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

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

Comment

Preserving Our Industry's Symbol

The Boston Stone [*see pages 42–43 in this issue*] is the earliest known implement of the paint industry in America and the basis for the Federation's logo. The Stone still sits today at the base of a building in Boston—although much of the larger piece has been lost during the mysterious history of this famous landmark in the Back Bay City.

The New England Society has decided that it is time to take action about preserving and protecting the nearly 300-year-old Stone from further damage and deterioration by the elements, both human and natural.

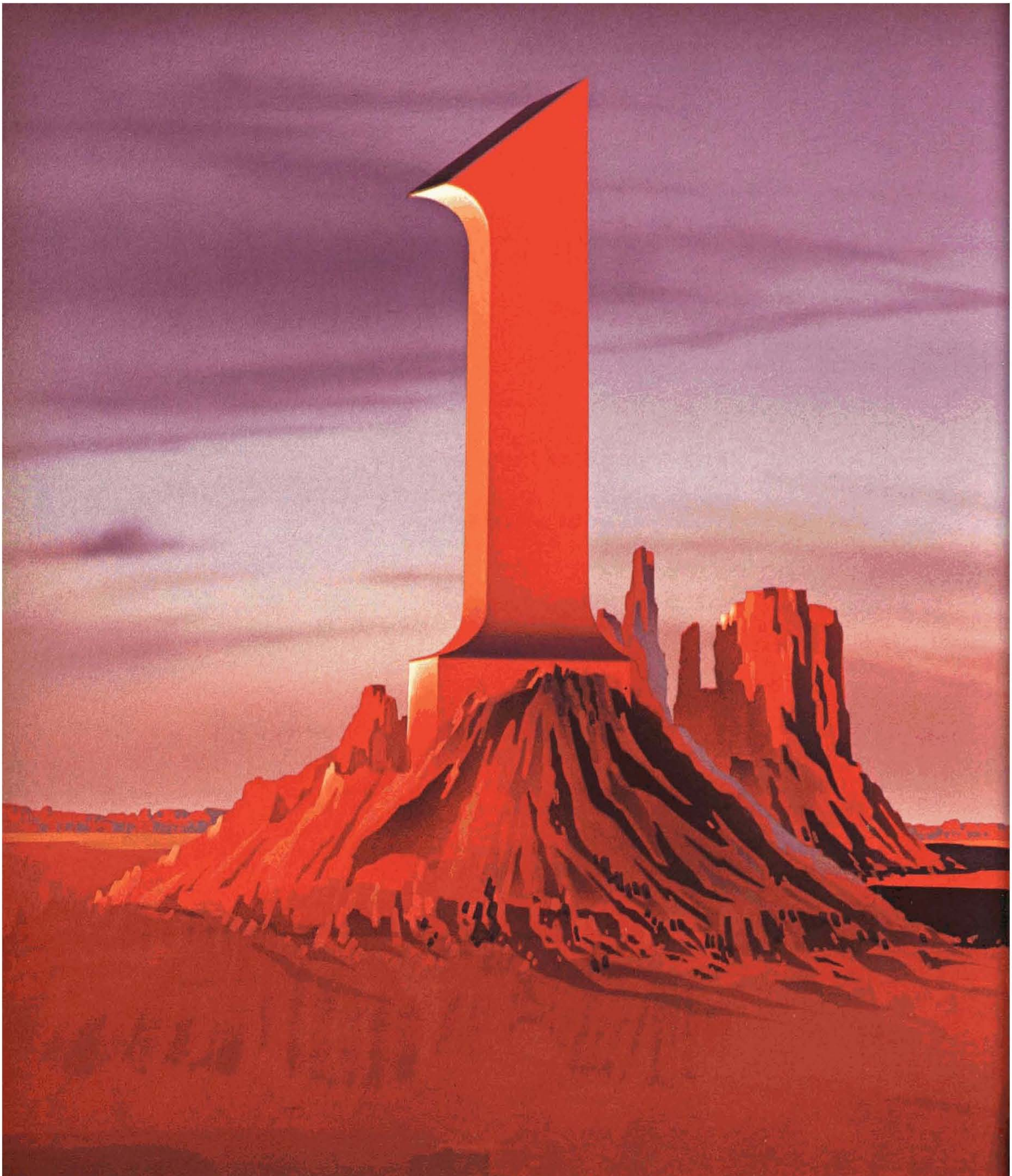
New England has embarked on a two-phase program, the first of which will be to establish—through research conducted by the New England Society for the Preservation of Antiquities—the true background and historical significance of the Stone. Included will be a geologic identification to determine its source.

Following that, an evaluation will be made by the NESPA for preserving the Stone and perhaps moving it to a more secure location.

New England, other Societies, and the Federation have donated funds toward the first step. Additional contributions are anticipated.

The person behind this project is the Immediate Past-President of the New England Society—Bob Modrak, of Benjamin Moore & Co., Box 416, Milford, MA 01757. Bob is a dedicated individual and will get the job done. He deserves our support.

Frank J. Borrelle,
Executive Vice-President



Spectrogard Automatch™ System

The color matching system you've been waiting for...

Compare the Spectrogard Automatch™ System with other color matching systems. You'll find there's no comparison. The Spectrogard Automatch System is the most significant innovation in computer color matching in recent years. It offers advanced capabilities not available on other systems.

You've Waited Long Enough

The Spectrogard Automatch System is a complete color matching system with formulation, batch correction and quality control capabilities. It has been designed with you—the Colorist—in mind:

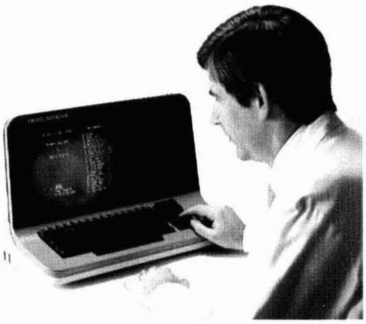
Simple to Operate/User Friendly—The first color matching system designed to communicate with the Colorist in his own language. Fully menu driven, users can learn to operate the system in less than 30 minutes.

Automatic Selection of Colorants—For the first time, an operator need not preselect colorants. Up to 72 colorants can be evaluated for each match in minutes instead of hours.

Lowest Cost Colorant Formulation—Your entire colorant inventory is "shopped" on every match. You're always assured of the lowest cost formulation.

A Complete Color Matching System

The Spectrogard Automatch is a comprehensive system consisting of an Advanced Digital Computer, Spectrogard™ Color Sensor, Automatch™ Software and a high-speed Printer/Plotter.



Two Instruments in One—A complete color matching system and a quality control tool for checking incoming raw materials and finished products.

Compact, Table-Top System—Easily installed without special facilities, auxiliary air conditioning or power utilities.

Total Customer Commitment

The Gardner name represents high-quality products, innovative technology and worldwide service and applications support.

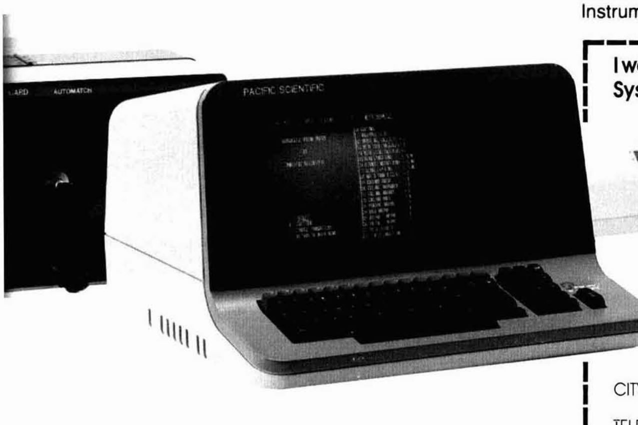
An Affordable Color Matching System

Compare the Spectrogard Automatch System for yourself. You'll find this unique color matching system offers more capability and features than systems costing twice as much. Write or call today for information or a demonstration.

PACIFIC® SCIENTIFIC

Gardner/Neotec
Instrument Division

2431 Linden Lane
Silver Spring, MD 20910 USA
Tele: (301) 495-7000
Telex: 908161 PACSCI UR



I want to compare the Spectrogard Automatch™ System for myself.

☐ Send Me Information

☐ Have a Representative Contact Me

Mail to: Pacific Scientific
2431 Linden Lane
Silver Spring, MD 20910

NAME ____________________

TITLE ____________________

CO. ____________________

ADDRESS ____________________

CITY/STATE ______________ ZIP ________

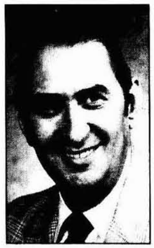
TELE: ____________________

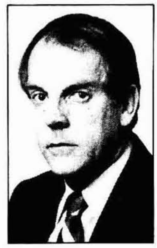
Federation News

Joseph A. Bauer, of Louisville; William Mirick, of C-D-I-C; Are Nominated to Federation Officer Positions of 1983–84

Joseph A. Bauer, of Porter Paint Co., Louisville, KY, has been nominated for the position of President-Elect of the Federation of Societies for Coatings Technology. Mr. Bauer, currently Treasurer, is a Past-President of the Louisville Society and was the Society Representative to the Federation Board of Directors for 10 years. At the Federation level, Mr. Bauer has served on the Executive, Nominating, and Program Committees. He joined Porter Paint in 1952 and is a graduate of the University of Louisville.


J.A. Bauer


W. Mirick


D.R. Pawsey


N.S. Estrada

William Mirick, of Battelle Columbus Laboratories, Columbus, OH, has been nominated for the position of Treasurer. Mr. Mirick is a Past-President of the C-D-I-C Society and has served as the Society Representative to the Federation Board since 1975. He is a past member of the Federation Executive Committee, and has served as Chairman of the Annual Meeting Program Awards Committee. A researcher at Battelle, he joined the Laboratories in 1956. He attended Ohio State University.

The current President-Elect, Terryl F. Johnson, of Cook Paint & Varnish Co., Kansas City, MO, will assume the Presidency at the close of the 1983 Annual Meeting, October 14, in Montreal, Quebec.

The Nominating Committee also submitted the names of candidates for Board of Directors and Executive Committee positions.

Executive Committee

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

Deryk R. Pawsey, Area Sales Manager of Rohm and Haas Canada Inc., Vancouver, B.C., Canada. He has been the Pacific Northwest Society's Representative to the Federation Board since 1980. Mr. Pawsey is a Past-President of the Society and served on its Technical Committee which developed the "Master Painters and Decorators Specification Manual." He has been Chairman of the Federation Paint Show Committee for the past five years and has been a member of the Corrosion, Finance, and Technical Information Systems Committees and the Editorial Review Board of the JCT.

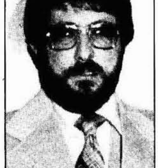
Board of Directors

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

Neil S. Estrada, recently retired from Reichhold Chemicals, Inc., San Francisco, CA. He is a Past-President of the Federation (1977) as well as the Golden Gate Society. He also served as Society Representative to the Federation Board from 1970–74. As Society Technical Committee Chairman he was active in representing the coatings industry during California's "Rule 66" hearings. He has been Chairman of the Federation Investment Committee for two years.

Board of Directors as Members-at-Large (Two-year term; two to be elected):

Ted Favata, Plant Manager of Triangle Coatings Co., Berkeley, CA. Mr. Favata, is a Past-President of the Golden Gate Society and served as General Chairman of the 1983 Western Coatings Societies Symposium. He is Chairman of the Society's Educational Committee and a member of the Awards and Technical Committees. Mr. Favata, a graduate of San Jose State College, is Vice-Chairman of the Federation Educational Committee.

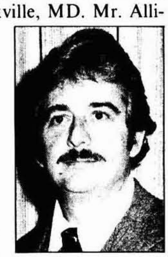

T. Favata

Al Heitkamp, Senior Research Scientist at Cargill, Inc., Minneapolis, MN. Mr. Heitkamp is a Past-President of the Northwestern Society, and has served on its Technical Committee and as Chairman of the annual symposium. He is Chairman of the Federation's Materials Marketing Awards Committee and serves on the A.F. Voss/American Paint & Coatings Journal Awards Committee. He is a graduate of the University of Minnesota.


A. Heitkamp

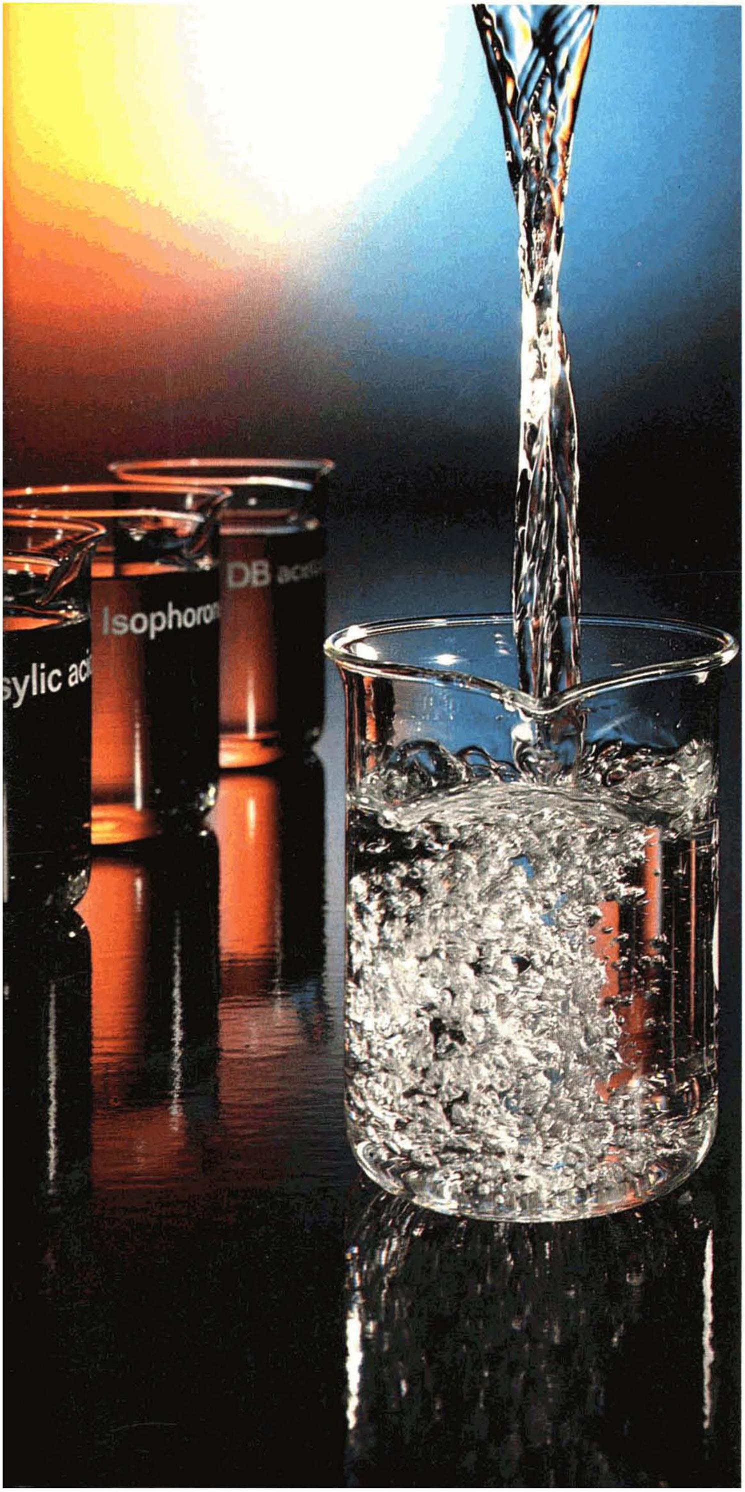
A third candidate for Board Member-at-Large was nominated from the floor by the Baltimore Society:

Gordon Allison, Secretary, Treasurer, and Technical Director of McCormick Paint Works, Rockville, MD. Mr. Allison is a Past-President of the Baltimore Society and served as Chairman of the Society's Educational Committee and as a member of the Technical and Awards Committees. At the Federation level, Mr. Allison has been Chairman of the Program Awards and Host Committees. He is a graduate of the Rutherford College of Technology, in England.


G. Allison

Voting will take place on October 11 at the Federation's Annual Meeting in Montreal, Quebec.

Switch to DuPont DBE*...get major savings in solvent costs.



Coatings formulators have saved up to 45% with this readily available solvent.

Try Du Pont's Dibasic Ester solvent in place of glycol ethers, glycol ether acetates, and high-boiling ketones and aromatics to develop paint formulations that produce high performance finishes...formulations that can result in major savings in solvent costs.

You'll discover that DBE is compatible with most common resin systems. Also, Dibasic Ester solvent can give you higher solids formulations without adversely affecting paint rheology. In fact, DBE has been found to improve the rheology of high solids coating systems by reducing viscosity and improving leveling properties. This makes DBE suitable for a wide range of industrial and automotive coatings.

Along with cost reduction and versatility, DBE solvent is exempt from Rule 442 (photochemically nonreactive) and can be stored indoors without restriction.

Get assistance in your R&D evaluation.

Let us show you how you can use Du Pont's DBE in your coating application. We can help you formulate a DBE blend tailored to fit your existing paint system or a new paint line. For further information and samples, write: Du Pont Company, Room G39261, Wilmington, DE 19898.

*Mixed dibasic esters of adipic, glutaric and succinic acids.

DU PONT

REG. U.S. PAT & TM OFF

Abstracts of Papers in This Issue

IMPROVED ANALYSIS OF STATIC PANEL IMMERSION TESTING RESULTS—A.M. Becka

Journal of Coatings Technology, 55, No. 703, 51 (Aug. 1983)

The static panel immersion test for antifouling coatings can be improved to account for biofouling variability. Multiple static exposure panels of two Navy antifouling paints are examined to determine the distribution of paint failure data. Statistical analysis using frequency histograms, indicates that 10–12 replicate panels are required to characterize the time to failure at the 95% confidence level, for any single coating system. Transformation of the test results using the square root function will allow for a more reliable evaluation of data from multiple identical exposure panels.

ISOCYANATOETHYL METHACRYLATE: A HETEROFUNCTIONAL MONOMER FOR POLYURETHANE AND VINYL POLYMER SYSTEMS—M.R. Thomas

Journal of Coatings Technology, 55, No. 703, 55 (Aug. 1983)

Isocyanatoethyl methacrylate (IEM) is a heterofunctional monomer that combines the versatility of a vinyl polymerizable double bond for acrylic polymer chemistry with a reactive isocyanate group for urethane reactions. The methacrylate group of IEM can be homopolymerized or copolymerized with a large number of other vinyl monomers to produce a polyisocyanate of controlled molecular weight and retained isocyanate functionality. In a second mode, the isocyanate group can react with active hydrogen-containing compounds or polymers to provide pendent methacrylate groups capable of vinyl polymerization of crosslinking with free radical initiators generated chemically or by radiation. Reaction kinetics as well as a discussion of applications for IEM are included.

STRUCTURE-PROPERTY RELATIONSHIPS FOR RADIATION CURABLE COATINGS—A. Priola, F. Renzi, and S. Cesca

Journal of Coatings Technology, 55, No. 703, 63 (Aug. 1983)

The influence of some modifications of a typical epoxy-acrylic resin on UV cured films was investigated. Mechanical properties of free films and performance properties of films coated on steel sheets were determined. The properties of free films were evaluated by stress-strain diagrams and dynamic-mechanical analysis. A first modification of the resin was obtained by employing reactive diluents having different molecular structure and acrylic functionality, i.e., EHA, HBA, NVP, DEGDA, PEGDA, and TMPTA. It was observed that EHA, HBA, and PEGDA give rise to the best flexibility, while NVP increases the Tg value of the film. DEGDA and TMPTA increase the Tg and the mechanical properties of the film. Another type of modification was obtained by introducing flexible segments in the polymer chain, i.e., diethylenglycol polycarbonate or polyethylene oxide. The result was an increase of the film flexibility and a decrease of the Tg value and mechanical properties. Finally, the influence of a chain-transfer agent, lauryl thioglycolate, was studied. It modified the mechanical properties of the free films and increased their flexibility, but the same effects were not observed when the film was coated on steel sheets. Chemical resistance and weathering of the prepared coatings were also investigated.

ACRYLIC COPOLYMER OLIGOMERS FOR HIGH SOLIDS COATING RESINS—D. Rhum and P.F. Aluotto

Journal of Coatings Technology, 55, No. 703, 75 (Aug. 1983)

The preparation of low molecular weight acrylic ester functional copolymers, intended for application as high solids coating resins, was accomplished via an experimental procedure which obviated the need for active chain transfer agents such as sulfur compounds or haloalkanes. Tetrapolymers containing the functional monomers hydroxypropyl acrylate and methacrylic acid were prepared by free radical polymerization at high temperature in selected solvents. Degree of polymerization was controlled by chain transfer with the relatively inactive solvents such as alkyl aromatics, high boiling ethers, and benzyl alcohol. The most effective solvent for limiting molecular weight was benzyl alcohol. The copolymers met a viscosity standard for hot spray application, and were cured with melamine resins to form hard and glossy coatings.

DESIGN OF WATERBORNE COATINGS FOR THE CORROSION PROTECTION OF STEEL. PART III: EFFECT OF SURFACTANTS IN AN AQUEOUS AIR DRY COATING—New England Society for Coatings Technology

Journal of Coatings Technology, 55, No. 703, 81 (Aug. 1983)

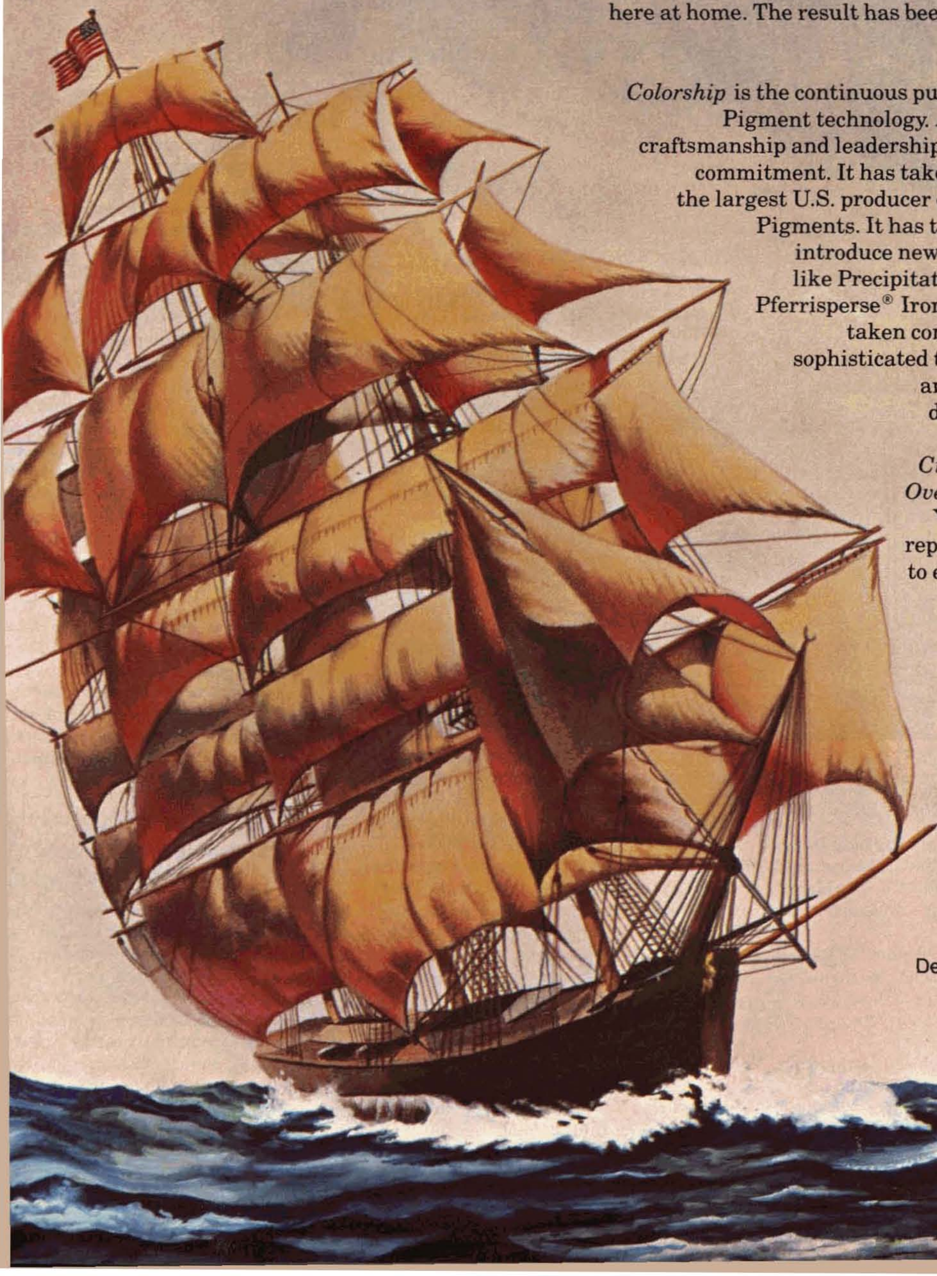
Anionic, cationic, nonionic, and a nonionic-anionic blend of 10 surfactants were evaluated at three concentration levels in an aqueous coating for their effect on coating performance. Dispersant efficiency was assessed, and humidity and salt fog exposure tests were conducted to evaluate the additives' effect on dry film properties. Only the nonionic-anionic blend surfactant showed no deleterious effect on coating performance.

CREATIVE COLORSHIP FOR OVER A CENTURY

Representative of American innovation and excellence, the Yankee Clipper Ship set the standard in ocean sailing vessels during the 19th century. At the same time America was demonstrating its leadership on the high seas, Pfizer was establishing a tradition of leadership in Pigment technology here at home. The result has been *Creative Colorship For Over a Century.*

Colorship is the continuous pursuit of excellence in Pigment technology. As with seamanship, craftsmanship and leadership, *Colorship* requires commitment. It has taken commitment to be the largest U.S. producer of quality Iron Oxide Pigments. It has taken commitment to introduce new innovative products like Precipitated Kroma® Reds and Pferrisperse® Iron Oxide Slurry. It has taken commitment to provide sophisticated technical service and an extensive sales and distribution network.

Creative Colorship For Over a Century, like the Yankee Clipper Ship, represents commitment to excellence. But when you're setting the standard, there's no other way.



Pfizer

MINERALS PIGMENTS & METALS DIVISION

Dept. 2C-12 • 235 E. 42 Street
New York, N.Y. 10017

CMA Honors Member Companies for Outstanding Safety Records

The Dow Chemical Co., Vulcan Materials Co., and Stepan Chemical Co. were honored by the Chemical Manufacturers Association for their outstanding safety records.

In presenting the Lammot du Pont Safety Award bronze plaques, William G. Simeral of the Dupont Co., outgoing chairman of the CMA board of directors, praised the companies for their excellent improvement in safety.

The awards are made to CMA member companies which have shown, in their respective size categories, the greatest percentage reduction in total recordable incidence rates of occupational injuries, deaths, and illnesses during the past five years. In addition to the reduction in injury rates, a company's total recordable incidence and severity rates for the award year must not exceed the average for all companies in the same category. The awards are based on the Occupational Safety and Health Administration's method of recording occupational injuries and illnesses, mandatory for government reporting.

The safety awards are presented to: companies working more than 20 million exposure hours annually; companies working two to 20 million exposure hours annually; and companies working less than two million exposure hours annually.

Paul F. Oreffice, President of The Dow Chemical Co., accepted the award as large company winner. W. Houston Blount, President and Chief Executive Officer accepted the award for Vulcan Materials Co. in the mid-size category, and Charlie Riley, Vice-President, manufacturing and engineering, accepted the award for Stepan Chemical Co. in the small company category.

The awards are named for the late Lammot du Pont, a former chairman of the DuPont Co., and were established in 1950 "to inspire and encourage member companies to improve and effectuate their industrial safety programs to prevent personal injuries."

Lilly Purchases Moran Div.

Lilly Industrial Coatings, Inc., Indianapolis, IN, has purchased the assets of Moran Div. of Carboline Co. The Moran Div. produces coatings for general metal products.

According to Lilly President J. Robert Pickering, Moran's sales to manufacturers of automotive components will expand Lilly's marketing effort to the auto industry.

Lilly intends to hire Moran's sale force and technical staff and move the manufacturing operation from Carboline's facility, Xenia, OH, to Lilly's Indianapolis plant.

NPCA Supports Reauthorization of TSCA

The Toxic Substances Task Force of the National Paint and Coatings Association has adopted a policy favoring reauthorization of the Toxic Substances Control Act without substantive changes.

A position paper on the Act developed under the Task Force's direction will be submitted to Congress for the public record shortly. Reauthorization hearings are now under way.

The paper reviews the record of the Environmental Protection Agency's (EPA) implementation of TSCA, finding the rules generally reasonable while pointing out some specific concerns.

NPCA's position paper states that EPA has not distinguished between processors of chemicals and users of chemicals. Additionally, the paper states that when EPA has recognized the distinction between the processors of chemicals and manufacturers of mixtures it has failed to make any substantive finding that the information that would be required from manufacturers of mixtures would be necessary for the effective enforcement of the Act as required by TSCA.

Finally, NPCA stated its intention to seek exemptions for polymers (which has already been proposed by EPA) and for manufacturers or processors of mixtures who under Section 8(c) must maintain records about allegations of significant adverse reactions associated with individual components of such mixtures.—NPCA *Coatings*

Clorox to Purchase Du Pont's Consumer Paint Business

The Du Pont Co. has announced plans to sell its consumer paint business to The Clorox Co. of Oakland, CA. Clorox plans to market the consumer paint lines through its Olympic Stain Division's established finishes business.

A letter of intent has been signed which provides for Clorox to purchase patents and technology, trademarks, including a license to use the "Lucite" trademark for consumer paints, and essentially all other assets of Du Pont's consumer paint business. No manufacturing facilities are included in the purchase. The agreement does not affect other products Du Pont sells under the "Lucite" trademark, including automotive acrylic lacquer and molding resins. Du Pont expects that Olympic will offer employment to some members of the consumer paint marketing organization.

The move will permit Du Pont to concentrate resources on performance coatings, where its technological strength provides a competitive advantage. Performance coatings include finishes for automotive original equipment and the aftermarket, for maintenance and marine applications, and for special industrial applications.

Du Pont's consumer paints are manufactured at the company's Fort Madison, IA, plant. To insure continuity of supply and customer service, Du Pont will continue to manufacture the consumer paint products for Olympic for approximately two years.

Southern Protective Products Becomes Superior Sealants, Inc.

At the stockholders meeting of Southern Protective Products, Atlanta, GA, a vote was taken to change the company's name to Superior Sealants, Inc.

The stockholders of the 71-year-old manufacturer of caulking compounds, adhesives, and industrial coatings, agreed that the name change will better indicate the unique quality of their product line and reduce any concerns of a restricted geographical area since the company now markets its products nationwide.

PRELIMINARY PROGRAM

1983 ANNUAL MEETING and PAINT INDUSTRIES' SHOW

Place Bonaventure

Montreal, Que., Canada

October 12-14

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

Preliminary Program

WEDNESDAY, OCTOBER 12

OPENING SESSION

(10:00–10:30)

Sixty-First Annual Meeting of the Federation of Societies for Coatings Technology opened by President A. Clarke Boyce

Invocation and In Memoriam

Welcome: Bert Papenburg, President of Montreal Society for Coatings Technology

Horace Philipp, Chairman of the Host Committee

Peter A. Hiscocks, Chairman of the Program Committee

Deryk R. Pawsey, Chairman of the Paint Industries' Show Committee

Introduction of Distinguished Guests

Report of President Boyce

E. W. FASIG KEYNOTE ADDRESS

(10:30–11:30)

Keynote Address by Jean-Marc Chaput, motivational speaker and author of the book, "Living is Selling."

INNOVATIONS IN COATINGS

(2:00–5:00)

USE OF EDP-SYSTEMS IN A PAINT MANUFACTURING COMPANY—POSSIBILITIES, PROBLEMS, AND GAINS—Robert Adahl, Teknos-Maalit OY, Helsinki, Finland (Presented on behalf of SLF: Federation of Scandinavian Paint and Varnish Technologists).

THE PHENOMENOLOGICAL APPROACH TO ADHESION—Ivar P. Thomassen, The O'Brien Corp., South Bend, IN.

ONE COAT EMULSION PAINT—Leslie A. Simpson, Tioxide UK Limited, Cleveland, England (Presented on behalf of OCCA: Oil and Colour Chemists' Association).

RENEWABLE RESOURCES FOR THE COATINGS INDUSTRY—II: STRATEGIC AND COMMERCIALLY AVAILABLE RAW MATERIALS—Chicago Society for Coatings Technology. Presented by K. P. Murray, DeSoto, Inc., Des Plaines, IL.

NOVEL, WATER-BORNE COATINGS DERIVED FROM EPOXY RESINS—Donald E. Brody, Skeist Laboratories, Inc., Livingston, NJ.

WATER-BASED AEROSOLS—Los Angeles Society for Coatings Technology. Presented by Dodwell DeSilva, Lawson Chemical Prod. Co., Torrance, CA.

SYMPOSIUM ON TESTING AND PERFORMANCE

(2:00–4:30)

PERFORMANCE COMPARISON OF EXTERIOR FLAT FINISHES ON HARDBOARD SIDING—Kansas City Society for Coatings Technology. Presented by Roger Haines, Farmland Industries, Inc., N. Kansas City, MO.

CHROMATOGRAPHIC CHARACTERIZATION OF EPOXY RESINS, D.R. Scheuing, Midland Div., The Dexter Corp., Waukegan, IL.

TRANSFORMATION OF LIQUID TO AMORPHOUS SOLID: EFFECT OF REACTION MECHANISM ON THE TIME TO VITRIFY FOR LINEAR AND NETWORK POLYMERIZATION—Marc T. Aronhime and J. K. Gillham, Dept. of Chem. Eng., Princeton University, Princeton, NJ.

PROTECTION OF MILDEWCIDES AND FUNGICIDES FROM ULTRAVIOLET LIGHT INDUCED PHOTO-OXIDATION—Peter D. Gabriele and Robert M. Ianucci, Additives Dept., CIBA-GEIGY Corp., Ardsley, NY.

SEDIMENTATION OF SUSPENSIONS—Montreal Society for Coatings Technology. Presented by Luigi Cutrone, Tioxide Canada Inc., Sorel, Quebec, Canada.

Visit the Largest Paint Show
In Federation History
At the Place Bonaventure

Wednesday, October 12—11:30 am–5:30 pm

Thursday, October 13—9:30 am–5:30 pm

Friday, October 14—9:30 am–3:00 pm

THURSDAY, OCTOBER 13

COMPUTER BASICS FOR THE COATINGS INDUSTRY-I

(9:00–11:30)

Moderator—Alan Brandau, DeSoto, Inc., Des Plaines, IL.

IBM SOFTWARE FOR GENERATING COMPUTERIZED FORMULATIONS AND BATCH TICKET PREPARATION—Donald Erwin, Erwin, Schafer & Associates, Louisville, KY.

TURNKEY COMPUTER SYSTEMS FOR SMALL AND LARGE PAINT COMPANIES—James DeGroff, Applied Color Systems, Inc., Princeton, NJ.

PERSONAL COMPUTERS FOR INVENTORY SYSTEMS—John Wallerius, IBM Personal Computer Systems, Rolling Meadows, IL.

COLOR CONTROL WITH THE SMALL COMPUTER—Hugh R. Davidson, Davidson Colleagues, Tatamy, PA.

SOFTWARE AVAILABLE FOR MICROCOMPUTERS—Richard Parizeault, Radio Shack Div. of Tandy Corp., Montreal, Canada.

MANUFACTURING COMMITTEE SEMINAR ON IMPROVED PROFITABILITY THROUGH EFFICIENT CLEANING, RECYCLING, AND RECLAMATION TECHNIQUES

(9:00–12:00)

Discussions will focus on profitable resource reclamation techniques in key areas of coatings manufacture. Open-forum period for audience participation will follow speaker presentations.

TANK CLEANING—(Moderator) Richard E. Max, Synkote Paint Co., Elmwood Park, NJ.

A Tank Cleaning Plant for the Small Paint Plant—Alun G. Morris, L. V. Lomas Chemical Co., Mississauga, Ontario, Canada.

WASTE DISPOSAL—(Moderator) Larry Kytasaari, Tnemec, Inc., North Kansas City, MO.

Waste Solvents as Fuel for Cement Kiln Operation (Incineration)—Melvin C. Eifert, Systech Corp., Xenia, OH.

Redistillation and Recovery of Waste Solvents—Ken O'Morrow, Oil and Solvent Process Co., Azusa, CA.

SOLVENT RECOVERY AND RECLAMATION (IN-HOUSE—(Moderator) Joseph P. Walton, Jamestown Paint & Varnish Co., Jamestown, PA.

Mechanics and Mechanism of Small Scale Distillation Equipment—Earl Pifer, Finish Engineering Co., Erie, PA.

Economics of Small Scale In-House Solvent Distillation—Michael J. Schmutzer, Disti, Inc., New York, NY.

Wiped Film Evaporators—Anthony Bellavia, The Pfaudler Co., Rochester, NY.

A CRITIQUE AND HISTORICAL OVERVIEW OF THE PAINT MANUFACTURER RECYCLING WASTES—Gabriel Malkin, P.E., Consulting Engineer, Westfield, NJ (former Chief Engineer, Benjamin Moore & Co.).

COMPUTER BASICS FOR THE COATINGS INDUSTRY-II

(2:00–3:30)

Moderator—Alan Brandau, DeSoto, Inc., Des Plaines, IL.

ELECTRONIC SPREADSHEETS VS. FINANCIAL MODELING SOFTWARE—Steve Weinburg, Digital Equipment Corp., Rolling Meadows, IL.

LABORATORY MANAGEMENT SOFTWARE—Lloyd Kusack, Hewlett Packard, Rolling Meadows, IL.

UTILIZATION OF COMPUTERS IN THE COATINGS INDUSTRY—New York Society for Coatings Technology. Presented by Saul Spindel, D/L Laboratories, New York, NY.

Following the formal presentations, speakers will demonstrate computer hardware, and attendees will be given opportunity to take part in "hands-on" learning demonstrations and problem solving.

The Old City of Montreal will be the focus of the Spouses' Tour on Thursday. Also included is Olympic Park, Mount Royal, and lunch.

THURSDAY, OCTOBER 13

(Continued)

CORROSION COMMITTEE PANEL DISCUSSION ON AIR-DRY AQUEOUS BINDERS FOR ANTI-CORROSIVE COATINGS

(2:00–5:00)

Representatives from various resin manufacturers will present brief discussions of current technology to help fulfill market needs through a comparison of air-dry aqueous binders.

Moderator—Richard E. Max, Synkote Paint Co., Elmwood Park, NJ.

Al Heitkamp, Cargill, Inc., Minneapolis, MN.

Thomas M. Powanda, Celanese Chemical Co., Inc., Summit, NJ.

Richard Albers, Deft, Inc., Irvine, CA.

Marvin L. Caine, ICI Americas Inc., Wilmington, DE.

R. N. Washburne, Rohm and Haas Co., Philadelphia, PA.

Carol J. Williams, Spencer Kellogg Div., of Textron, Inc., Buffalo, NY.

Moderator and speakers will assemble as a panel for an open-discussion period following presentations.

SEMINAR ON FORMULATION

(2:00–4:30)

HIGH SOLIDS MILL BASE DESIGN FOR HIGH SPEED DISPERSION—Luigi Cutrone, Tioxide Canada, Inc., Sorel, Quebec, Canada.

PIGMENT VOLUME CONCENTRATIONS AND AN INTERPRETATION OF THE OIL ABSORPTION OF PIGMENTS—H. F. Huisman, PD Magnetics B.V., Oosterhout, The Netherlands.

PRACTICAL RHEOLOGICAL STUDY OF LATEX GLOSS ENAMELS—Los Angeles Society for Coatings Technology. Presented by Carl Thompson, Durachrome Products, Inc., Anaheim, CA.

EFFECT OF GLYCOL ETHER CO-SOLVENTS ON THE DRY OF WATER-REDUCING ALKYDS—Toronto Society for Coatings Technology. Presented by Andy Jones, Degussa Canada Ltd., Burlington, Canada.

FILM FORMATION AND RHEOLOGY OF POWDER COATINGS—P. G. de Lange, Teteringen, The Netherlands (Presented on behalf of NVVT, the Dutch Section of FATIPEC: Federation of Associations of Technicians in the Paint, Varnish, Lacquer, and Printing Ink Industries of Continental Europe).

Site of the 1983 Annual Meeting, Montreal is an exciting blend of Old World and modern metropolis. The St. Lawrence River is in the background.

FRIDAY, OCTOBER 14

SYMPOSIUM ON TESTING AND PERFORMANCE

(9:00–10:30)

NONDESTRUCTIVE DATING OF PAINTINGS WITH ENERGY DISPERSIVE X-RAY EMISSION SCANNING ELECTRON MICROSCOPY—Stephen J. Callan and James D. Stoffer, *Chemistry Dept., University of Missouri-Rolla, Rolla, MO.*

CHARACTERIZATION OF IN-FLIGHT PARTICLES DURING SPRAYING OF WATER-BORNE COATINGS—Houston Society for Coatings Technology. Presented by Ken Confer, Sunbelt Chemical Co., Houston, TX.

AMBIENT HEAT STABILITY VS. AMBIENT AGING TEST—A CORRELATION STUDY—Los Angeles Society for Coatings Technology. Presented by V. C. Jenkins, Ellis Paint Co., Los Angeles, CA.

COLOR AND APPEARANCE

(9:30–10:30)

CHEMISTRY OF THE AZO PIGMENT DYES—James Grey, C.A., Venezolano de Pigmentos, Valencia, Venezuela.

NUMERICAL COLOR CONTROL FOR EXTERIOR AUTOMOTIVE COATINGS—Susan A. Schultz, Marcus Chao, and Brian Hake, Fisher Body Div., General Motors Corp., Warren, MI.

MATTIELLO LECTURE

(10:30–11:45)

THE OBSTACLE COURSE FROM MILL BASE TO FINISHED PRODUCT—Frederick K. Daniel, Coatings Consultant, Princeton, NJ.

FEDERATION LUNCHEON

(11:45)

Grand Salon, *Queen Elizabeth Hotel*

Presentation of the George Baugh Heckel and Paint Show Awards

Winners of other Federation awards to be announced

Featured Speaker: David Broadfoot, Canadian humorist

ENVIRONMENTAL CONTROL COMMITTEE PRESENTATION ON HOW GOVERNMENT REGULATIONS AFFECT THE COATINGS INDUSTRY

(2:00–4:00)

Speakers will present an overview of environmental regulations in Canada, Europe, and the United States and their impact on the coatings industry. Open-forum period for audience participation will follow.

Al Marchetti, Canadian Paint and Coatings Association, Montreal, Quebec, Canada.

Ken Zacharias, National Paint and Coatings Association, Washington, DC.

V. C. Jenkins, Ellis Paint Co., Los Angeles, CA.

Lawrence N. Streff, PPG Industries, Inc., Allison Park, PA.

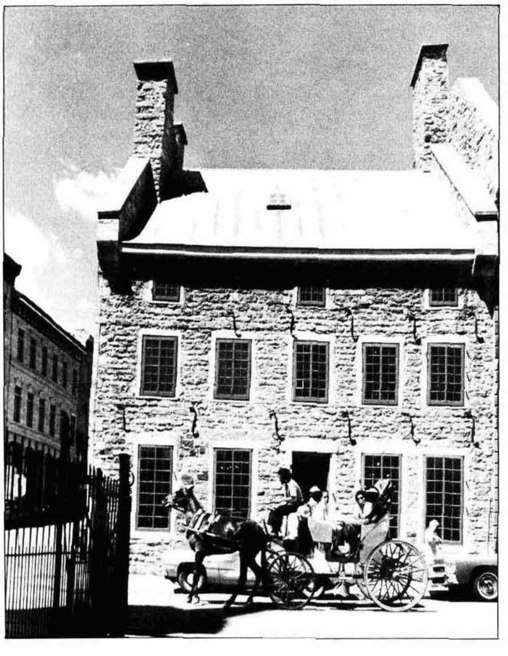
ANNUAL BUSINESS MEETING

(4:00–5:00)

Annual Business Meeting of the Federation

Presentation of these awards: Roon Foundation . . . American Paint & Coatings Journal / A.F. Voss . . . Materials Marketing Associates . . . Program Committee . . . Ernest T. Trigg

Installation of Officers, 1983–84



OTHER CONVENTION INFORMATION

PAINT INDUSTRIES' SHOW

In its initial appearance in Canada, the 48th Annual Paint Industries' Show will feature the exhibits of over 170 supplier companies who have purchased all available booth space making the 1983 Paint Show the largest in Federation history.

The Show will be held in conjunction with the 61st Annual Meeting of the Federation at the Place Bonaventure in Montreal, Quebec.

Exhibit hours will be 11:30 am to 5:30 pm on Wednesday, October 12; 9:30 am to 5:30 pm on Thursday, October 13; and 9:30 am to 3:00 pm on Friday, October 14.

The Paint Show is the only national exhibit of raw materials, and equipment used in the manufacture of paints and related coatings, and participating firms will have their top technical personnel on hand to discuss the latest developments in coatings manufacturing technology. The list of current exhibitors is on page 23.

REGISTRATION

Advance registration is available at $50 for members and $65 for nonmembers. Fee for spouses activities is $35 in advance.

Once again there will be a special advance only registration fee of $25 each for retired members and their spouses.

On-site registration fees will be $60 full time and $40 one day for members. Nonmember fees will be $75 full time and $50 one day. Spouses registration will be $45 on-site.

Cash payment of on-site registration fees will be accepted in Canadian currency only at the then current rate of exchange. A currency exchange booth will be available in the registration area. Checks in both U.S. and Canadian funds will be accepted.

Registration forms were mailed to all members in April and are included in this issue (see pages 24–30).

FEDERATION LUNCHEON

The Annual Federation Luncheon will be held on Friday at the Queen Elizabeth Hotel.

Presentations will be made to the recipients of the George Baugh Heckel Award (outstanding individual who has contributed to the advancement of the Federation) and the Flynn Awards (firms judged to have the best exhibit booths in the 1983 Paint Industries' Show). Announced will be the winners of the Annual Meeting awards, including the winning entries in the Roon Awards Competition.

Featured entertainment will be Dave Broadfoot, Canada's premier comedian and satirist. Winner of the many media awards for his performances, *Variety* calls him "Canada's Bob Hope." Appearing before 120 conventions a year, Mr. Broadfoot has given command performances before President Reagan and Her Majesty Queen Elizabeth.

Tickets at $20 each are available both in advance and on site in the registration area.

SPOUSES' PROGRAM

A schedule of activities has been planned for each day for spouses attending the Annual Meeting, and a Hospitality Suite will be maintained at the Queen Elizabeth Hotel.

A get acquainted Wine and Cheese Social is scheduled for Wednesday afternoon.

On Thursday, a continental breakfast will precede a fascinating tour of Montreal, which will include historical sites, Olympic Park, and lunch and shopping in beautiful Old Montreal.

Continental breakfast will again be available on Friday morning.

HEADQUARTERS HOTEL

The Queen Elizabeth will serve as headquarters hotel. Other hotels with blocks of rooms set aside for the Annual Meeting are the Hotel Bonaventure, L'Centre Sheraton, Regence Hyatt Montreal, Chateau Champlain, Hotel Meridien Montreal, Ramada Inn, Holiday Inn Downtown, and the Mt. Royal.

WALKING TO PLACE BONAVENTURE

The best way to walk to Place Bonventure from any hotel is on the street level. You can also walk to PB via Montreal underground, but the route is circuitous. All program sessions will be held in the Bonaventure Hotel which is situated on the top two floors of PB. Elevator service to the hotel is available at all entrances to PB and also inside the exhibition hall.

ROOM RESERVATIONS

All requests for rooms and suites must be sent to the Federation office on the official housing form which has been mailed to all members and is included in this issue (see pages 24–30). Additional housing forms are available from the Federation headquarters office.

BOARD MEETING

The Fall Board of Directors Meeting of the Federation will be held at the Queen Elizabeth Hotel on Tuesday, October 11.

SPEAKERS' BREAKFAST

A breakfast and briefing for each day's program participants will be held at the Bonaventure Hotel on Wednesday, Thursday, and Friday.

PUBLICATION OF PAPERS

No *Proceedings* is offered of papers presented at the Annual Meeting, nor are reprints of presentations available. The JOURNAL OF COATINGS TECHNOLOGY has prior rights to the publication of all papers presented at the Annual Meeting.

PROGRAM STEERING COMMITTEE

Chairman Peter Hiscocks, of C-I-L Paints, Inc., Toronto; Darlene Brezinski (Vice-Chairman), of DeSoto, Inc., Des Plaines, IL; N. Bradford Brakke, Lilly Industrial Coatings, Inc., Templeton, MA; Glenn Cunningham, PPG Industries, Inc., Allison Park, PA; John Flack, International Paints Ltd., Outremont, Quebec, Canada; and F. Louis Floyd, Glidden Coatings & Resins Div. of SCM Corp., Strongsville, OH.

HOST COMMITTEE

Members of the Montreal and Toronto Societies are serving on the Host Committee under the General Chairmanship of Horace S. Phillip, Sherwin-Williams Co. of Canada, Montreal. Assisting him are: *(Program Operations)* Arthur Hagopian, CIL Paints, Inc.; *(Information Services)* Dennis H. Yokota, Consultant; *(FSCT Booth)* Andrew J. Jones, Degussa Canada Ltd.; *(Registration)* Jean Brunet, Van Waters & Rogers Ltd.; *(Language)* Andre Lamarre, Hercules Canada Ltd.; and *(Publicity and Spouses' Program)* Robert O. Payette, L.V. Lomas Chemical Co. and Ruth Malone.

1983 Paint Industries' Show

Current List of Exhibitors

Aceto Chemical Co., Inc.
Air Products & Chemicals, Inc.
Alcan Ingot and Powders
Aluminum Co. of America
C. M. Ambrose Co.
Angus Co.
Applied Color Systems, Inc.
ARCO Chemical Co.
Ashland Chemical Co./Ashland Chem. Canada
Atlas Electrical Devices Co.

B.A.G. Corp.
BASF Wyandotte Corp.
Bausch & Lomb
Beltron Corp.
Berol Chemicals, Inc.
Blackmer Pump Div., Dover Corp.
Bowers Process Equipment, Inc.
Brookfield Engineering Labs., Inc.
Buckman Laboratories, Inc.
Burgess Pigment Co.
Byk-Mallinckrodt USA, Inc.

Cabot Corp.
Canada Colors & Chemicals Ltd.
Canada Talc Industries Ltd.
Canadian Paint & Ctgs. Association
Cargill, Inc.
CDI Dispersions
Celanese Chemical Co., Inc.
Celanese Specialty Resins
CEM Corp.
Certified Equipment Mfg. Co.
Chemical & Engineering News (ACS)
Chemische Werke Huels AG
Chicago Boiler Co.
Chromalloy, Ind. Minerals Div.
Clawson Tank Co.
Color Corp. of America
Columbian Chemicals Co.
Continental Fibre Drum Co.
Cordova Chemical Co. of Michigan
Cosan Chemical Corp.

Daniel Products Co.
Data Decisions, Inc.
Degussa Corp.
Frank E. Dempsey & Sons Ltd.
Diamond Shamrock Corp., Process Chem. Div.
Disti, Inc.
D/L Laboratories
Dominion Colour Co. Ltd.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
Drew Chemical Corp.
DSET Laboratories, Inc.
DuPont Canada Ltd.

Eastman Chemical Products, Inc.
Ebonex Corp.
Eiger Machinery, Inc.
Elektro-Physik, Inc.
EM Chemicals
Engelhard Corp., Minerals & Chem. Div.
Epworth Manufacturing Co., Inc.
Erwin, Schafer & Associates, Inc.

Fawcett Co., Inc.
Fed. Socs. Coatings Technology
Felco Industries Ltd.
Filter Specialists, Inc.
Freeport Kaolin Co.
Fricke Enterprises

GAF Corp.
Georgia Kaolin Co.
W.R. Grace & Co., Davison Chem. Div.
Graco, Inc.
Gregory Industrial Trucks

Halox Pigments, Div. Hammond Lead Prods.
Harshaw Chemical Co.
Henkel Corp., Chemical Specialities
Henkel Corp.
Hercules Incorporated
Dr. Hans Heubach Gmbh & Co. KG
Hilton-Davis Chemical Group
Hockmeyer Equipment Corp.
Hooker Industrial & Specialty Chemicals
Hoover Universal, Inc.
J. M. Huber Corp.
Hunter Associates Lab., Inc.

ICI Americas, Inc.
Ideal Manufacturing & Sales Corp.
Indusmin Ltd.
International Minerals & Chem. Corp.
Interstab Chemicals, Inc.
ISC Alloys Ltd.

Johnson Wax

Kay-Fries, Inc.
Kay Publishing Co. Ltd.
Kenrich Petrochemicals, Inc.

Laporte (United States) Inc.
Leneta Co.
Liquid Controls Corp.
Lorama Chemicals, Inc.

3M Co., Commercial Chemicals Div.
Macbeth Div., Kollmorgen Corp.
Manville Products Corp., Filt. & Min.
McCloskey Varnish Co.
Meadowbrook Corp.
Mearl Corp.
Merck & Co., Inc./Calgon Corp.
Miller Paint Equipment, Inc.
Mineral Pigments Corp.
Mini FIBERS, Inc.
Minolta Corp.
Mobay Chemical Co.
Modern Paint and Coatings
Morehouse Industries, Inc.
Myers Engineering

Nalco Chemical Co.
National Assn. of Corrosion Engineers
Netzsch Incorporated
Neville Chemical Co.
NL Chemicals/NL Industries, Inc.
Northern Pigment, Div. of CCMC Ltd.
Nuodex, Inc.
NYCO, Div. of Processed Minerals, Inc.

Ore & Chemical Corp.
Ottawa Silica Co.

Pacific Scientific Co., Gardner/Neotec
Paint Research Institute
Penn Color, Inc.
Pennsylvania Glass Sand Corp.
Pfizer, Inc., MPM Div.
Plad Equipment Co. Ltd.
Plastican, Inc.
Polyvinyl Chemical Industries, Inc.
PPG Industries, Inc.
Premier Mill Corp.
Purity Zinc Metals Co. Ltd.

Q-Panel Co.

Reichard-Coulston, Inc.
Reichhold Chemicals, Inc.
Reichhold Ltd.
Reliance Products Ltd.
Rohm and Haas Co.
Russell Finex, Inc.

Sandoz Colors & Chemicals
Semi-Bulk Systems, Inc.
Shamrock Chemicals Corp.
Sherwin-Williams Container Div.
Silberline Manufacturing Co., Inc.
Southern Clay Products, E.C.C. America
South Florida Test Service, Inc.
Spencer Kellogg, Div. of Textron, Inc.
Standard Container Co.
Sun Chemical Corp., Pigments Div.
Synray Corp.

Technology Marketing Corp.
Thibaut & Walker Co., Inc.
Thiele Engineering Co.
Tioxide Canada, Inc.
Triangle Imex Ltd.
Troy Chemical Corp.

Union Camp Corp.
Union Carbide Corp.
Union Chemicals Div., Union Oil Co.
United Catalysts, Inc.
Universal Color Dispersions
University of Detroit
University of Missouri-Rolla

R. T. Vanderbilt Co., Inc.
Vorti-Siv Div., M&M Machine, Inc.

Wacker Chemical Co.
Warren Rupp Co.
Weathering Research Service Co.
Wellco Products & Itasco Ind.
Wilden Pump & Engineering Co.
Witco Chemical Corp.

Carl Zeiss Canada Ltd.

Federation of Societies for Coatings Technology

1983

61st ANNUAL MEETING

48th PAINT INDUSTRIES' SHOW

Federation of Societies for Coatings Technology

YE OLDE PAINT STONE 1737

MONTRÉAL

Place Bonaventure

October 12, 13, 14

1983 Annual Meeting
Paint Industries' Show
October 12, 13, 14
Place Bonaventure
Montreal, Quebec, Canada

TO OUR MEMBERS AND FRIENDS:

As the fifth Canadian President of the Federation, it is a distinct pleasure and privilege for me to invite you to the first Annual Meeting and Paint Industries' Show to be held in my native country.

The two host Societies—Montreal and Toronto—are eagerly awaiting this event and have been very busy in making arrangements so that you will have an enjoyable and memorable visit to the beautiful city of Montreal.

The Paint Show, which we expect will be the biggest ever, will be held in one of Canada's top showplaces, Place Bonaventure. This magnificent building, truly a city within a city, sits on top of another city within a city—Place Ville Marie.

Program sessions will be geared to the theme of the meeting, "Knowledge Applied Profitably." The selection of papers, workshops, and seminars being arranged by Peter Hiscocks and his Program Committee will send you home with a pocketful of ideas to put to profitable use in your companies.

On behalf of the 800 Canadian members associated with the Montreal, Toronto, Detroit, Northwestern, and Pacific Northwest Societies . . . Bienvenue a Canada.

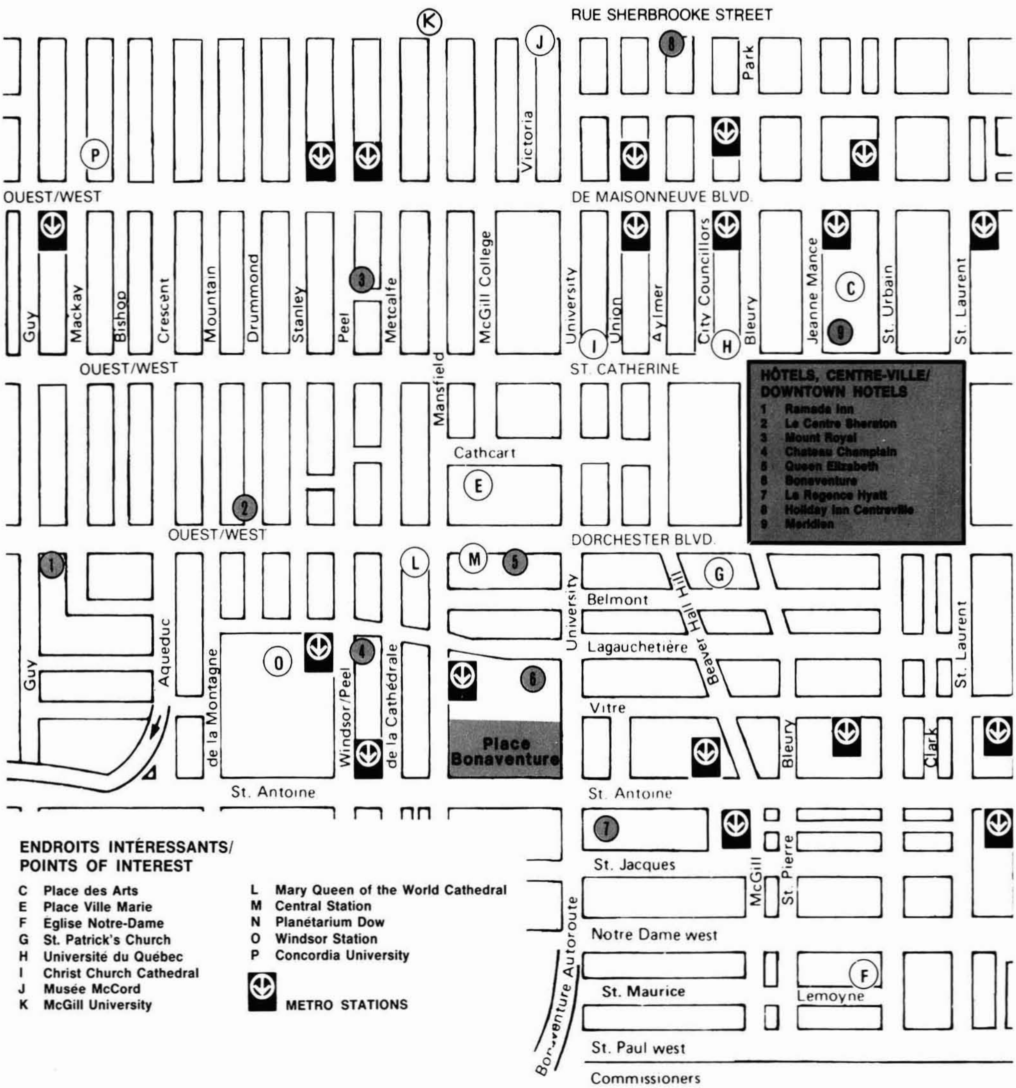
A. Clarke Boyce
President
Federation of Societies
for Coatings Technology

HOTEL INFORMATION AND RATES

All Rates are in Canadian Funds

Hotel	Singles	Doubles Twins	Parlor & 1 Bedroom	Parlor & 2 Bedrooms	Parlor & 3 Bedrooms
QUEEN ELIZABETH*	$79	$89	*$208/220/246 271/280	$376/382/305 420	$544/635
HOTEL BONAVENTURE*	$95	$105	$250/400	$475	$525
L'HOTEL CENTRE SHERATON	$83	$96	$200/426	$430	
REGENCE HYATT MONTREAL	$83	$95	$164/220/330 480/600	$184/220/330 480/600	
CHATEAU CHAMPLAIN	$84	$96	$210/275	$375	
HOTEL MERIDIEN MONTREAL	$78	$88			
RAMADA INN	$59	$69			
HOLIDAY INN DOWNTOWN	$68	$74	$105		
MT. ROYAL	$53	$63			

*Requests for accommodations at either the Queen Elizabeth or the Bonaventure will be limited to five rooms per company. A parlor counts as one room.



FSCT 1983 ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
PLACE BONAVENTURE, MONTREAL, QUEBEC, CANADA
OCTOBER 12, 13, 14 (Wednesday, Thursday, Friday)

APPLICATION FOR HOTEL ACCOMMODATIONS

MAIL TO:	**Fed. Socs. Coatings Tech.** **1315 Walnut St.—Dept. H** **Philadelphia, PA 19107**

All reservations will be processed by the Montreal Convention and Visitors Bureau.

Please indicate below the type of accommodations desired and choice of hotels. Assignments will be made in accordance with prevailing availability. Three to four weeks after mailing this application you will receive a confirmation from the hotel to which you have been assigned.

To make any inquiries regarding hotel reservations, please observe the following procedure:

Prior to Receiving a Confirmation: Phone the Housing Supervisor of the Montreal Convention and Visitors Bureau. (514-871-1129).

After Receiving a Confirmation: Phone the Reservations Dept. of the hotel. (Phone numbers are given in this brochure).

All reservations will be held until 6:00 p.m. and none can be guaranteed after September 12.

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

CHOICE OF HOTELS:
1st
2nd
3rd
4th

NAMES AND ADDRESSES OF ROOM OCCUPANTS AND DATES OF ARRIVAL/DEPARTURE

Type of Room	Name / Address	Dates Arrive	Dates Depart

Please Type Additional Reservations on a Separate Sheet and Attach to This Form

SEND CONFIRMATION FOR ALL RESERVATIONS TO:

Name______________________________

Company______________________________

Address______________________________

City _______________ State or Province_______________

Country _______________ Mailing Code _______________

Note: Requests for accommodations at either the Queen Elizabeth or the Bonaventure will be limited to five rooms per company. A parlor counts as one room.

MONTRÉAL

THE CITY

There's no place like Montreal. Here you'll discover a blend of the best of French and English, of European and North American ways. Montreal is the second largest French-speaking city in the world, and wholly cosmopolitan.

The old and new co-exists comfortably in Montreal, and for all its respect for tradition, this is one of the world's best planned cities. Montreal is a major international business center, a major university center, and the largest inland port in the world. And, it is also a city of arts, home to La Place des Arts, one of the world's best-known entertainment centers.

The "City Below" is Montreal's answer to downtown congestion. Instead of building skyscrapers in the air and chaos on the ground, Montreal put into action an idea first suggested more than 500 years ago by Leonardo da Vinci—a multilevel city which separates people from traffic so that both can move freely: cars and trains through separate tunnels and free-ways, pedestrians through their own enclosed, air-conditioned streets.

The City Below stretches eight miles beneath the avenues of Montreal. Brief, silent (rubber-tires) Metro rides lead to boutiques, department stores, hotels, restaurants, theatres, art galleries and more.

OLD MONTREAL

People frequently portray Montreal as "a little bit of Europe in North America." This description is particularly applicable to that part of the city known as "Old Montreal," the site of the early colonization of the region. The first permanent settlement of Montreal was established by the French explorer, De Maisonneuve in 1642. The early history of French Canada is preserved through the existence of many of the original structures, as well as statues and plaques commemorating the exploits of early explorers, settlers, and military figures.

A stroll through Old Montreal is a treat for even the most casual observer. Some of the oldest and most beautiful architecture in North America is to be found in this quarter.

WEATHER

During the month of October, Montreal's climate ranges from a low of 46° to a high of 57°. Medium to heavy-weight apparel will keep you comfortable. Autumn draws out the best in Mother Nature. Bring your camera to capture the "gold rush" in thick autumn foliage.

Place Bonaventure

AIR TRANSPORTATION

Two major airports serve the city: Dorval, located 16 km (10 miles) from downtown, which handles flights to and from all points in Canada and the U.S.; Mirabel, some 55 km (35 miles) from downtown, for international passenger traffic.

THINGS TO DO

Montreal's 5,000 restaurants, of which more than 100 are internationally rated, serve dishes and specialties from all corners of the earth, making Montreal a gourmet's paradise.

Exquisite French cuisine, wholesome French Canadian dishes and quick snacks are readily available throughout the city, providing quality, variety and convenience.

Vegetarians and health food enthusiasts will find that Montreal leads the way in the preparation and service of specialty foods. Kosher and seafoods also number among Montreal's specialties. The city's culinary shops and delicatessens offer meats, cheeses and other specialties from all over the world.

Montreal has justly earned its reputation as a "city of the world," where life is "a la Quebecoise," at an American pace, with a touch of European charm. It is stimulating, exciting and truly cosmopolitan.

GETTING THERE

If you are a citizen or permanent resident of the U.S., you can cross the Canadian border and return without any difficulty or delay. Passports or visas are not required. Native-born U.S. citizens should carry identification papers such as a birth, baptismal or voter's certificate, and proof of residence. Naturalized U.S. citizens should carry a naturalization certificate or other evidence of citizenship.

After 48 hours in Canada, U.S. residents may take home, duty free, $300 worth of goods for personal and household use. These must accompany the traveler. Family members traveling together may combine their personal exemptions.

PLACE BONAVENTURE

Place Bonaventure is a city within a city. It's a trade city: marketplace of the world's buyers and sellers, showplace for the merchandise of many nations and a rich source of information on trade and tourism.

It covers a six-acre multilevel site, containing not only the Exhibition Hall, where Paint Show exhibits will be on display, but a busy, bustling, boutique-filled Shopping Concourse, complete with stores, bars, restaurants, movies, entertainment, activities and services. And, atop the Place Bonaventure complex, is Hotel Bonaventure with its rooftop gardens.

1983 ADVANCE REGISTRATION

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

1315 Walnut St., Philadelphia, PA 19107

C / U / V	Office Use Only
	Date received ______
	Amount $ ______
	Check No. ______

Please fill out this form and mail with a check in the correct amount (made payable to the FSCT) to the Federatio address shown above. All checks must be payable in U.S. Funds, and in U.S. Banks. Any that are not will be returned Deadline date for advance registration is September 9. None will be accepted after that date.

INDUSTRY REGISTRATION FEES:

A ☐ MEMBER $50.00

Please name the Society in which you are a paid-up member:

______
Society

B ☐ NON-MEMBER $65.00

G ☐ SPECIAL FEE FOR RETIRED MEMBERS $25.00

______
Society

INFORMATION FOR REGISTRATION BADGE:

NICKNAME

FIRST NAME LAST NAME

BUSINESS AFFILIATION

STREET

CITY STATE *(U.S. only)*

MAILING ZONE COUNTRY (OTHER THAN U.S.)

BUSINESS CLASSIFICATION DATA FOR THE ABOVE REGISTRANT:

Please Check One Block Only Under Company And Under Position

YOUR COMPANY (CHECK ONE BLOCK ONLY)

- AA ☐ Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants
- BB ☐ Manufacturers of Raw Materials
- CC ☐ Manufacturers of Equipment and Containers
- DD ☐ Sales Agent for Raw Materials and Equipment
- EE ☐ Government Agency
- FF ☐ Research/Testing/ Consulting
- GG ☐ Educational Institution/ Library
- HH ☐ Paint Consumer
- JJ ☐ Other

YOUR POSITION (CHECK ONE BLOCK ONLY)

- KK ☐ Management/ Administration
- LL ☐ Manufacturing and Engineering
- MM ☐ Quality Control
- NN ☐ Research and Development
- PP ☐ Technical Sales Service
- QQ ☐ Sales and Marketing
- RR ☐ Consultant
- SS ☐ Educator/Studen Librarian
- TT ☐ Other

SPOUSES REGISTRATION AND INFORMATION FOR REGISTRATION BADGE:

D ☐ SPOUSE $35.00

SPECIAL FEE FOR THE SPOUSES OF RETIRED MEMBERS ONLY:
H ☐ $25.00

NICKNAME

NAME

ADDRESS

CITY STATE

MAILING ZONE COUNTRY (OTHER THAN U.S.)

TICKETS FOR FEDERATION LUNCHEON, FRIDAY, OCTOBER 14 ($20 each)

Z ☐ NUMBER OF TICKETS REQUIRED ______ @ $20.00 EACH.

A CHECK IN THE AMOUNT OF U.S. $______(U.S. BANKS) IS ENCLOSED

How to $ave on dispersions without doing a thing.

It's easy—let Nuodex make them for you!

Nuodex has the experience, the equipment and the expert personnel to make all the top quality color dispersions you need, and save you up to 20% or more!

How? Nuodex dispersions eliminate the "hidden costs" of do-it-yourself color dispersions—the cost of carrying unnecessary inventory, slow moving items, obsolete colors, half pails and off-grade batches. Plus the expense of dealing with dust hazards, colorant waste, disposal problems and meeting OSHA, EPA and NIOSH regulations.

Nuodex worldwide has five large colorant facilities, four technical service centers and an R&D facility totally dedicated to our customers' color needs. What's more, we have both industrial and consumer colorant *systems* and can even work with you to develop a custom system.

So why go on making problems for yourself? Buy all the top quality dispersions you need from Nuodex at a considerable savings in time and money. You won't have to do a thing except call or write: Nuodex Inc., Coatings & Colorants, P.O. Box 365, Piscataway, NJ 08854. (201) 981-5000.

Nuodex Color Systems

NUODEX INC.

P.O. Box 365, Piscataway, NJ 08854 (201) 981-5000

Spring 1983 Board of Directors Meeting

Thirty-four members and 22 guests attended the Spring Meeting of the Board of Directors of the Federation of Societies for Coatings Technology, on May 20, 1983, in Cincinnati, OH.

The following were in attendance:

Officers

President	A. Clarke Boyce
President-Elect	Terryl F. Johnson
Treasurer	Joseph A. Bauer

Society Representatives

Baltimore	James A. McCormick
Birmingham	David Lovegrove
Chicago	John T. Vandeberg
C-D-I-C	William Mirick
Cleveland	Fred G. Schwab
Dallas	Carlos Dorris
Detroit	Harry B. Majcher
Golden Gate	A. Gordon Rook
Houston	Willy C.P. Busch
Kansas City	Norman Hon
Los Angeles	Dermont G. Cromwell
Louisville	James Hoeck
Mexico	Antonio Pina
Montreal	Horace Philipp
New England	Charles Hoar
New York	Saul Spindel
Northwestern	Richard L. Fricker
Pacific Northwest	Deryk R. Pawsey
Philadelphia	Carl W. Fuller
Piedmont	Gary Marshall
Pittsburgh	Edward VandeVort
Southern	Berger Justen
St. Louis	Thomas Fitzgerald, Sr.
Toronto	Kurt F. Weitz

Other Members

Rudolph C. Albrecht	Chicago
Morris Coffino	New York
William Dunn	Toronto
Howard Jerome	St. Louis
Elder C. Larson	Houston
Stanley LeSota	Philadelphia
Helen Skowronska	Cleveland

Guests

Ray Connor, Technical Director of the National Paint and Coatings Association.

Dr. Thomas J. Miranda and Dr. Seymore Hochberg, President and Executive Director, respectively, of the Paint Research Institute.

Royal A. Brown, Federation Technical Advisor.

Chuck Reitter, Editor, *American Paint and Coatings Journal.*

The following Society officers who attended the orientation meeting the previous day: Dick Batchelor, of Houston; Fred Foote, of Chicago; Jim Geiger, of Southern; Bob Giery, of St. Louis; Jim Husted, of Piedmont; Mike Iskowitz, of New York; Bill Passeno, of Detroit; Bob Payette, of Montreal; Phil Reitano, of Philadelphia; Ottwin Schmidt, of Pacific Northwest; Clifford Schoff, of Pittsburgh; Harry Scott, of Cleveland; Earl Smith, of Los Angeles; Ed Thomasson, of Louisville; Bob Thomas, of Cleveland; and Ken Trautwein, of Golden Gate.

Bob Burtzlaff, of CDIC.

Staff

Frank J. Borrelle, Executive Vice-President; Thomas A. Kocis, Director of Field Services; Rosemary Falvey, Director of Meetings and Conventions; and Robert F. Ziegler, Editor of the JOURNAL OF COATINGS TECHNOLOGY.

From left to right: Federation President—A. Clarke Boyce; President-Elect—Terryl F. Johnson; and Treasurer—Joseph A. Bauer

Mr. Borrelle called the roll of members and reported all present except the Representatives from the Rocky Mountain and Western New York Societies.

The report of the Fall 1982 Board of Directors meeting was approved as published in the January 1983 JOURNAL OF COATINGS TECHNOLOGY.

In Memoriam

A moment of silence was observed in memory of E. Vernon Ladd, President in 1937-38, who died on January 29, 1983.

Reports of Officers And Staff

PRESIDENT BOYCE

As your 61st President and the fifth Canadian to this office, the first six months of my administration have been extremely busy ones. It has been my pleasure to visit with nine Societies, attend five conventions—four of these with my wife. All visits were extremely valuable to strengthen the bonds between Federation and Societies. Thank you one and all for the hospitality shown to both Marjorie and myself at each of these meetings.

I also attended the annual JPICC meeting, our first seminar in Kansas City, NPCA Spring Board, two Executive meetings, Finance and Investment meetings, Host Committee meeting, Officer Training meeting and the Paint History Committee meeting.

In October I emphasized our highly effective system of control and the strong volunteer system working with our professional staff to meet our "Objectives". Any success that is enjoyed during my term of office is certainly directly due to the dedicated staff personnel, Executive, our committee chairmen and committees, and the members at all levels who make it happen.

In the December issue of JCT, I outlined five challenges ahead of me in 1983. At this time I can truthfully say that volunteers have taken up these challenges and have been addressing them and moving ahead to finish or resolve them. Again my thanks to you volunteers—you are like "PANAM"—you make the going great.

Our 1983 Annual Meeting and Paint Show plans are progressing favorably. The theme of the technical program sessions is "Knowledge Applied Profitably". The program will focus on addressing the issue of access to and understanding of knowledge from the basics to the cutting edge of technology. Canadian flavor will be added this year with outstanding Keynoter and Luncheon speakers.

As I review our situation at mid year, in spite of one of the worst recessions in many years, it is gratifying to see such a healthy condition in the Societies and a positive feeling that the Coatings Industry is moving ahead.

A. CLARKE BOYCE,
President

PRESIDENT-ELECT JOHNSON

Federation activities for the President-Elect start with a reprieve through December and then pick up steam as the year starts to develop.

The first order of business was to attend the January Executive meeting along with the Investment and Finance Committees. This is most appropriate preparation for the following year when the President-Elect will have to account for the financial strength or weakness of the Federation.

Bonnie and I attended the Western Coatings Societies' Biennial Technical Symposium and Show in San Francisco. It was an excellent show and program and allowed us to renew old acquaintances and make many new ones.

Tom Kocis and I visited the Piedmont and Kansas City Societies. We met with their Executive Boards before the meetings.

We also attended the JPICC meeting in April. It is nice to meet with the other paint organizations, to share problems and learn from others.

I attended the April Trustees meeting of PRI. This allowed me the opportunity to meet the new Trustees and follow PRI projects.

I am in the process of completing my committee Chairman selection and will have it completed by mid-summer.

TERRYL F. JOHNSON,
President-Elect

TREASURER BAUER

The primary duty of the Treasurer is to monitor the finances of the Federation. Thanks to a dedicated and competent staff this task is made easy. The office of the Treasurer provides a valuable learning experience not only for the financial transactions but for all other worthwhile activities of the Federation.

The first quarter report is in order and it indicates that we are operating within the '83 budget. We expect to continue within the budget for the balance of the year, but this could prove to be a real challenge. This can be made easy if we have a successful Annual Meeting and Paint Show in Montreal. All signs indicate this will become a reality.

Your Treasurer's activity since November has been minimal. Most of my travel has been as Trustee and Treasurer of PRI. These two Trustee meetings have been enjoyable and enlightening. Most of the Trustees are new and have spent a lot of time becoming familiar with the mildew consortium and other PRI projects. This is a confident group of people and I am proud to be associated with them.

An ad hoc committee has been appointed to investigate fund raising for PRI. I am a member of this committee and we had one meeting at the NPCA headquarters in Washington. We are investigating professional fund raising help.

As Federation Treasurer, I had no Society visit scheduled. However, along with Louisville Society officers, I did attend the CDIC Society meeting which was visited by the Federation in March.

JOSEPH A. BAUER,
Treasurer

EXECUTIVE VICE-PRESIDENT BORRELLE

Even though 1982 was a tough year in all quarters, it turned out to be a fairly good one for the Federation, in spite of a small deficit. In February 1983, $50,000 (including the Correspondence Course refund) was transferred from operations to the Federation's permanent investment trust at Girard Bank. So far in 1983, activities are moving satisfactorily.

1983 BUDGET

In January, the Finance and Executive Committees approved a balanced budget of $1,357,500. As budgeted, the income/expense allocations are:

Income: Publications—34%; Annual Meeting and Paint Show—52%; Membership Dues—7%; Educational Activities—2%; and Miscellaneous—5%.

Expense: Headquarters Office/Administration—35%; Publications—27%; Annual Meeting and Paint Show—20%; Educational Activities—10%; and Officers/Board/Committees—8%.

Board Members (left to right): Carlos Dorris (Dallas); Harry B. Majcher (Detroit); A. Gordon Rook (Golden Gate); and Willy C.P. Busch (Houston)

PUBLICATIONS

JCT: Advertising page sales fell off 15% in 1982 and even though this year is off to another slow start, the future picture appears a little brighter. Technical papers are always in good supply.

Year Book: The 1983 edition was mailed on March 1 and 2. Thanks are extended to the Society Treasurers and Rosemary Falvey and other staffers for making this early release possible.

Series Units: The manuscript of "Statistics for the Coatings Industry" has been received and is being reviewed by the Publications Committee. Fred Daniel continues work on "Dispersion Problems."

Brochure on Paint Quality: Sales of the Southern Society's "Latex Interior Flat Paint" have leveled off and some 20,000 copies remain from the initial press run. Southern is in the early stages of the next brochure on Exterior Latex Paints.

Annual Guide to Courses: Tom Kocis has assembled this handy reference to educational courses for 1983. The publication has grown so that we placed a $5.00 price tag on copies beyond the initial complimentary distribution to the Societies.

All other publications are moving off the shelves at a satisfactory rate.

MEMBERSHIP SERVICES

7,000 Mark: The names of about 6,700 members were published in the 1983 Year Book. Since publication, another 150 have been added to the rolls. The 7,000-member-mark is not far off.

Activities Brochure: This information brochure about the Federation was updated and all members were mailed a copy in April. Bulk copies will be sent to the Societies. Also, every new member whose application is received at the Federation Office receives one along with a letter of welcome from the Executive Vice-President.

Membership Certificates: A Federation membership certificate, for use by the Societies, has been completed and quantities will be mailed to the Societies. The certificates will be customized to include the Society—but—each Society has the responsibility of filling out other data on the certificate.

ANNUAL MEETING AND PAINT SHOW

The 1982 Paint Show was the second biggest: 169 paid exhibitors in 36,498 net paid square feet. The top was 1981 with 169 exhibitors in 38,186 feet. Registered attendance from 1981 to 1982 fell off about 550 to 5,100.

Right now, the 1983 Paint Show will be the new record-breaker. As big as the Place Bonaventure exhibit hall is, it does not have large meeting rooms. Therefore, the program sessions will be held upstairs in the building in the ballroom of the Bonaventure Hotel. The Federation headquarters hotel will be the Queen Elizabeth.

PAINT RESEARCH INSTITUTE

In our assigned administrative role with PRI, we have cooperated closely with President Thomas J. Miranda and Dr. Seymore Hochberg, the Executive Director.

COMMITTEE LIAISON

Tom Kocis' activities with the Corrosion, Educational, Environmental Control, Manufacturing, Mattiello Lecture, and Technical Advisory Committees will be covered in his report.

FIRST SEMINAR

Attendance at the Federation's first seminar—"Efficient Operation of an Up-to-Date Paint and Coatings Lab"—was 105, plus speakers. Although we had hoped for more, the seminar was successful, particularly for those who attended. We extend our thanks to Technical Advisor Roy Brown who arranged the excellent program. And our thanks, too, to the speakers who made the first seminar possible.

OFFICER/STAFF VISITS

So far during the current administrative year, Officer/Staff visits have been made to the monthly meetings of: Baltimore, Chicago, Toronto, Mexico, Philadelphia, CDIC, Piedmont, and the Montreal Societies.

Also attended were the Western Coatings Societies Symposium and Show, the Southern Society annual meeting, and the Southwestern Paint Convention.

MISCELLANY

Financial Reporting: The Federation's recordkeeping/reporting are now on computer—through a service provided by our auditing firm. Discussions regarding an in-house computer have been held and will continue with the objective of maintaining our own JCT subscription files and Federation membership records.

Federation Office: Space adjacent to the Federation Office became available and was picked up to provide the much-needed room for both staff and equipment. Total space is now about 4,100 square feet.

Federation Exhibit: We had an exhibit in the West Coast Symposium and Show. The space was donated by the duPont Co.

FRANK J. BORRELLE,
Executive Vice-President

DIRECTOR OF FIELD SERVICES KOCIS

COMMITTEE LIAISON

Corrosion—Committee met March 15, in New York, to discuss current and proposed activities. Principal agenda item was consideration of a topic for a Committee-sponsored presentation at the 1983 Annual Meeting. This will be an all-day seminar on Air-Dry Aqueous Binders for Anti-Corrosive Coatings, featuring speakers from supplier firms, each to discuss performance of products of their company's manufacture designed to help fulfill market needs.

The Committee reaffirmed its interest in maintaining liaison with PRI efforts in corrosion control activities; list of names was compiled for prospective companies to contact for participation in planned corrosion consortium, to be forwarded to PRI Executive Director.

List of potential corrosion-type projects was selected for Society Technical Committee consideration, for presentation and discussion by the Chairman at the April 28 & 29 meeting of the TAC/Society Technical Committee Chairmen.

Efforts continuing to promote closer contact and communications with other organizations concerned with corrosion-related activities.

Manufacturing—Activities were discussed at meeting of Steering Committee in St. Louis, March 23. The Committee will sponsor a seminar at the 1983 Annual Meeting on ways to improve profitability through resource reclamation. Focus will be on tank cleaning, solvent recovery, and waste disposal.

Tour of paint plant or supplier company facility in Montreal area is also planned for Annual Meeting; this would be day before opening of AM, and would be limited to Steering Committee members and Society Manufacturing Committee Chairmen.

Kansas City Society slide/tape production of "Operation of a Vertical Sandmill" has been revised and updated, and will be readied for presentation at the Annual Meeting. KC has also submitted report, for publication in JCT, on survey conducted on Filtration Procedures Used in Resin Manufacture.

Committee reaffirmed its desire to stimulate interest in manufacturing-type activities through publications of a periodic newsletter; Societies are encouraged to report on their programs as requisite for such an effort. Societies are also encouraged to include manufacturing presentations in their monthly programming schedule.

Program—Planning for the 1983 Annual Meeting program got underway at an organizational meeting in Washington, in conjunction with last year's AM, and at a follow-up meeting in Toronto, December 7.

Theme for the '83 event in Montreal is "Knowledge Applied Profitably," and presentations are being developed to address how to gain access to, and understanding of, the wealth of technical knowledge currently available.

In this regard, the Committee is developing a full-day symposia on the topic, "There IS a Computer in Your Future," which will feature in-depth presentations on how computer technology can assist in the acquisition and application of such knowledge. Concurrent sessions are planned for Wednesday afternoon, all-day Thursday, and Friday morning (preceding the Mattiello Lecture), with a single session planned for Friday afternoon.

Presentations are planned by the Corrosion, Manufacturing, and Environmental Control Committees, and these along with anticipated papers for the Roon Awards competition, Society papers, and those from overseas organizations, plus submissions in response to the Call for Papers, should provide an ample supply for the programming.

Educational—Steering Committee met with Society Educational Committee Chairmen in Detroit on April 15. Representatives from 17 Societies attended. Prime topic of discussion was promotion of careers in coatings industry. Subcommittee will develop data on job opportunities for chemists and technicians, and will recommend program for promoting and publicizing. This would include literature handouts, slide/tape programs, and printed reference material for "on-site" presentations to student groups.

Three Societies have expressed interest in cooperative research program proposed by PRI, in which matching funds would be made available for approved project with local colleges. They plan to develop formal presentation to Trustees for consideration.

Annual update of "Guide to Coatings Courses, Symposia, and Seminars" was published and distributed in January.

Technical Advisory—A meeting of the TAC with Society Technical Committee Chairmen was held April 28 & 29 in Kansas City, attended by representatives from 19 Societies. Chairman Bill Holmes distributed copies of reference booklet he developed, to assist Technical Committee Chairmen in recruiting, motivating, and guiding members in project work. Included are sections on selecting members, choosing a project and getting the work started, making use of available local resources, organizing for a successful effort, and writing the paper upon completion of the project.

Based on project work completed, or nearly so, a total of nine Societies expressed intent to present papers at the 1983 Annual Meeting in Montreal.

Update report on status of mildew testing project being pursued in conjunction with the PRI Mildew Consortium noted that five Societies currently have polymer containing anchored biocide, to be formulated into paint system for testing. Another half dozen Societies are awaiting shipment of polymer. After last batch of polymer has been provided to interested Societies, each will be provided with protocol for formulating paints and conducting outdoor exposure tests.

MISCELLANEOUS

Liaison and staff support also provided in arranging for and attending January and April meetings of PRI Trustees, and meetings of the Ad Hoc Committee on Paint History and the 1984 Mattiello Lecture Committee, as well as lending assistance to the activities of the Environmental Control, Roon, AP&CJ, and MMA Awards Committees. . . . Assistance also provided in planning, promotion, and on-site considerations for the Paint Lab Seminar. . . . Updating underway for annual edition of "Talks Available to Constituent Societies," to be distributed in May.

THOMAS A. KOCIS,
Director of Field Services

TECHNICAL ADVISOR BROWN

My first year as Technical Advisor to the Federation has been both challenging and rewarding. We have begun some activities which I believe will benefit technical and manufacturing personnel as well as the entire paint and coatings industry. It is our objective to help the Federation achieve the stature and recognition it deserves for the many excellent programs and activities it generates.

NATIONAL SEMINAR

The first Federation National Seminar was held in Kansas City, April 26-27, 1983. The seminar was entitled, "The Efficient Operation of an Up-to-Date Paint and Coatings Laboratory." Fifteen well known professionals from our industry addressed subjects on which they are authorities. All written papers were received and printed at Federation headquarters for distribution to seminar attendees. We believe this program to be of great value to the technical people of our industry.

It was a thoroughly first class operation. The speakers did an excellent job and imparted useful information. There were many questions from the audience and the discussion periods were lively. The moderator, Howard Jerome, did an excellent job and handled things effectively. The Federation officers as well as the Kansas City Society representatives were supportive and helpful.

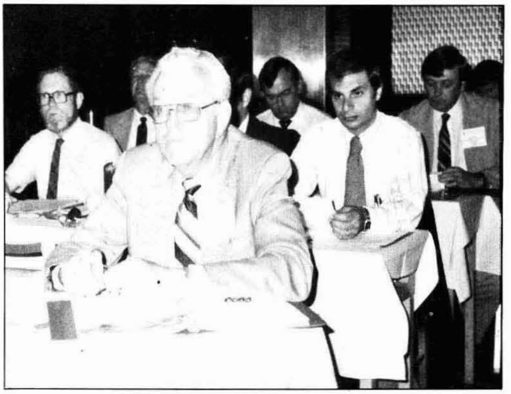
For the most part, the audience was made up of technical directors, supervisory and management personnel. I believe we made a good impression on the right group of people for future seminars. It also demonstrates that the Federation is making an effort to upgrade our image as a technically competent industry which produces high quality products.

PAINT RESEARCH INSTITUTE

Although I no longer am a Trustee of PRI, I attend Trustee meetings as a Federation representative. The PRI Questionnaire Survey which we made in 1982–83 is completed. Respondents (278) mailed in completed questionnaires and the results are being tabulated and interpreted. Preliminary reports have been made to the PRI Trustees and I am working on an article which will be published in the JOURNAL OF COATINGS TECHNOLOGY. The article will describe the input furnished by questionnaire respondents. Although such research areas as Waterborne and High-solids Coatings, Corrosion of Steel and Waste Recycling are high industry priorities, many other areas of needed research have been highlighted by respondents.

I attend Mildew Consortium (PRI) committee meetings as FSCT liaison and write reports for PRI Trustees and FSCT Executive Committee members. Research emphasis is still directed toward the development of a fungicide-anchored polymer which will permit gradual release of the fungicide to protect the paint film over a long period of time. Recent reports from the Australian Department of Defence indicates encouraging results from paint exposures in which a polymer-anchored fungicide was used. More details are being sought from Australian authorities. The mildew problem on painted surfaces in the United States continues to be a major problem for paint manufacturers as well as home owners. It is a very old and complicated problem which seems to grow worse as newer paints provide longer exterior life. The mildew problem is not one which is likely to be solved quickly, but its eventual solution will greatly benefit our industry.

Five Societies are presently participating in the mildew research work by preparing paints and exterior exposures.



Participants from the previous day's Society Officer's meeting were in attendance (left to right): Clifford Schoff (Pittsburgh); Earl Smith (Los Angeles); Jim Geiger (Southern); Phil Reitano (Philadelphia); and Dick Batchelor (Houston)

PAINT QUALITY

Emphasis by the Federation on the advantages of using high quality paints and efforts to educate the paint user is having an effect on the industry. One now sees many national television and newspaper advertisements describing the "quality" of paint products. The "Know Paint Quality Before You Buy" brochure on interior latex paints prepared by the Southern Society is a popular dealer and consumer item. Another brochure on exterior paint quality is in draft stage. I think the "emphasis on quality" activity is a good thing for our industry.

COMMITTEES

I attend regularly the meetings of the Technical Advisory, the Educational, Manufacturing, and Corrosion Committees. I offer ideas, advice, and assistance as requested, and work with Tom Kocis on the activities of these groups. I act as liaison between the Society Technical Committees and the Mildew Consortium Steering committee in mildew research work.

TEST INSTRUMENT— TEST METHOD EVALUATION

I suggested and outlined a Federation Project which would permit interested companies to compare the reproducibility of their quality control test method results and their test instruments' performance with others involved in the project.

This project has been approved by the Federation Executive Committee on the basis that the project be self-supporting and would not require Federation funds. Each cooperating company would be charged a nominal fee to cover the costs of sample preparation, test methods, packaging and shipping. Arrangements with a paint manufacturer to prepare samples for shipment to cooperators will be made soon, and information on the project will appear in the JCT. Those companies and organizations who wish to participate can then indicate their desire to do so. The objective of the project is to help companies recognize the existence of off-standard instruments, to highlight the need for better test methods, and to promote better quality control throughout our industry.

It has been a pleasure working with the Federation officers and Staff. I appreciate the cooperation and help of Frank Borrelle, Tom Kocis, and the other staff members in Philadelphia.

ROYAL A. BROWN,
Technical Advisor

Board Members (left to right): Richard L. Fricker (Northwestern); Saul Spindel (New York); Charles Hoar (New England); and Horace Philipp (Montreal)

Paint Research Institute

PRESIDENT MIRANDA

The Paint Research Institute has completed its period of transition with the appointment of Dr. Seymore Hochberg as Executive Director who replaced Dr. Raymond Myers, Director Emeritus. New trustees include Dr. Joseph V. Koleske and Dr. Howard Bender who also serves as Secretary. The Board reflects a good balance of research orientation.

The new Board has revised the objectives of PRI to reflect a strong emphasis on advancing knowledge to the technology of coatings by supporting research at colleges and universities through the granting of fellowships and to aid in dissemination of the results to the public through scientific publications and lectures.

A review of PRI programs indicated that some changes are necessary. This is now underway as follows:

Mildew Consortium—Dr. Charles Yeager was invited to present an overview of the Mildew Program at the Board of Trustees meeting on April 14. Dr. Yeager will prepare a summary of the current status and future of the Mildew Program for publication in the JCT. Dr. Yeager will work closely with Dr. Hochberg to firm up communications and establish better control of the fellowship programs with a strong emphasis on relevant results for the coatings industry. A program is now under way to test coatings containing a mildewcide developed under PRI sponsorship.

Corrosion—The Board of Trustees, after careful review, has voted against continuing the consortium approach to corrosion. This has come about because of lack of sufficient support from industry. In its stead we plan to seek out meaningful fellowships related to corrosion which would be funded by PRI. The need to establish test criteria related to actual field correlation was stressed.

Fellowships—Fellowships will be funded on the basis of quality and relevance to coatings. We shall look for and grant fellowships to researchers who have a good record of achievement and who can contribute most to the mission of PRI. In this regard we have funded a fellowship at Princeton with Dr. John Gillham to study mechanical properties of crosslinked polymers.

Dr. Hochberg presented a portfolio of fellowship proposals for review by the Board. In addition he has developed a long range plan of research topics for future consideration. Topics include Aqueous and High Solid Coatings, Corrosion, Accelerated Testing, Stabilization of Coatings against Degradation Outdoors, and Quality Control Related to Coatings as well as an application portfolio. Emphasis will also be on educational efforts to relate PRI results to the industry.

Communications—A major effort has been launched to improve communications internal and external. This effort includes a strong communication link between the President and Executive Director, Federation and the Board of Trustees. Tighter control is now exercised so that fellowship recipients must be in contact with the Executive Director on matters within the province of the Board of Trustees.

Fellowship guidelines will be spelled out in writing by the Executive Director so that a definite followup can be made to grantees to insure that PRI receives adequate return on our investment. This will include timetables, deadlines, and publication guidelines.

Dr. Hochberg has been requested to arrange for PRI fellowship recipients to make presentations at selected Societies to present in a meaningful way the area of research of the investigator and/or his current PRI project. This should improve the relations between the local Societies and PRI.

In order to improve communications with the Federation we have invited the President and President-Elect of the Federation to attend alternate Board Meetings. President-Elect Terryl Johnson was present at this meeting.

Fund Raising—A committee headed by Colin Penny has met and made a preliminary proposal for fund raising. The discussion was postponed to the next Board meeting in deference to Mr. Penny's absence at this meeting. Meanwhile, Roy Brown will continue to explore other approaches to fund raising. This is a major concern of PRI and must be addressed with urgency.

By-Laws—A proposed revision of the PRI By-Laws was presented to and approved by the Board.

THOMAS J. MIRANDA,
President

[At this point, Dr. Miranda called upon Mr. Brown, FSCT Technical Advisor, to update the Board on Society involvement in the mildew testing program.

Mr. Brown said that although problems with paint gelation occurred with the initial batch of polymer, another batch has been made and a protocol developed for formulation. This polymer will be sent to the participating Societies in order of request (Southern, Chicago, Los Angeles, Cleveland, New York, New England, Louisville, and Kansas City).

The Societies will receive: (1) the blank polymer (control); (2) the active polymer; (3) the additive (pentachlorophenol); and (4) the protocol for formulation.]

EXECUTIVE DIRECTOR HOCHBERG

The research programs supported by the PRI consist of those of the Mildew Consortium and several Fellowships.

The Mildew Program—The Mildew Consortium is supervised by Dr. Charles Yeager and delegates from the Consortium. The membership of the Consortium includes eight companies—Buckman, Cosan Chemical, DuPont, Glidden, NPCA, Rohm & Haas, PPG Industries, and Troy Chemical—each having contributed $5,000 per year.

Current programs and their termination dates (one subject to renewal) are as follows: U. of Missouri—termination date June 1983, U. of Illinois—June 1983, Memphis State—September 1983, National Bureau of Standards—June 1983, Massachusetts Institute of Technology—June 1983. It is expected that of these contracts only that of Professor Crang at the U. of

Illinois will be renewed. The testing program at Memphis State will be continued only as required, and if possible.

Professor R. M. Fitch, of the University of Wisconsin, will start another research program to modify the rate of release of fungicides from their polymeric compounds in paint.

The research program consisted of some synthetic work and a substantial amount of physiological work on the mildew organisms. The synthetic program resulted in polymer latices containing pentachlorophenol, incorporated as part of the polymer. Our synthetic work was continued by the Australian Department of Defence.

Our own synthetic work was delayed by some wrong starts in preparing polymer latices suitable for water-based coatings. The Australians were not delayed. Their paint showed initially poor mildew inhibition, but after 18 months of exposure, they showed performance equal to that of their best commercial product.

The biological work of the Consortium was of good quality but did not yield useful results on the growth of the organisms or on the formation of melanin in the organisms. We did learn, however, how to test the ability of a coating to resist mildew growth in the laboratory—a worthwhile result. Professor Crang's work with electron microscopy will help us understand the effects of sub-lethal doses of mildewcide, and is impressive technically.

Corrosion Program—Plans for a consortium for the study of corrosion-inhibitive pigments at Lehigh University have been dropped by the Trustees of the PRI for lack of sufficient interest. Efforts to engage in corrosion research, considered important to the industry, will be pursued under a fellowship program.

Other Current Fellowships—A fellowship for $10,000 with Princeton's Professor Gillham is now underway. The objective is the elucidation of the cure processes of enamels. Such work will clarify cure problems of water-based and high-solids finishes.

A verbal agreement has been made for a fellowship with Professor G. D. Parfitt at Carnegie-Mellon University for the study of the strength of pigment flocs in coatings. This study should bear on the development of high gloss coatings in systems containing dispersions of fine particles, for example, automotive and industrial coatings.

The Crang and Fitch fellowships, mentioned in connection with the mildew program, and the Parfitt and Gillham fellowships complete PRI's current commitments to fellowships.

Notices asking for applications for the Gerhart Fellowship (contributed by PPG) were distributed, but no applications have yet been received.

University-Local Society Cooperative Research—The PRI wants to improve communications with local Societies and to increase their connection with local universities. The PRI program to help local Societies pay for research costs at local universities was communicated but it has not met as yet with any specific requests for money. Three Societies—Philadelphia, New England, and Piedmont—have expressed interest, but their committees have not yet asked for funds. One problem seems to be the long periods between meetings at which decisions are made within the Society.

Professor Gillham and Professor Parfitt have agreed to give or to have their graduate students give talks to local Societies as part of their research programs. Other fellowship supervisors will also be asked to participate.

Future Fellowships—Problems in water-based and high-solids coatings have been enumerated along with the need for fundamental information that would bear on these problems. Lists of these problems will be distributed to the universities for proposals. Support for the proposals will be sought from suitable industrial and other sources. A similar description of problems of paint application has been prepared for study by prospective research organization personnel.

SEYMORE HOCHBERG,
Executive Director

PRI BY-LAWS

[*Amendments to the PRI By-Laws (dated February 15, 1963) were approved by the PRI Board of Trustees on April 14, 1983. Most of the changes are of a "housekeeping" nature. PRI By-Laws require that amendments be approved also by the Members of the Corporation (Federation Board of Directors). Upon motion duly made, seconded, and approved, the amendments to the PRI By-Laws were approved by the Federation Board.*]

Review of Actions Of Executive Committee

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

The actions of the Executive Committee (at meetings of November 6, 1982 and January 28, 1983) were included with the minutes mailed previously to Board Members. The actions at the May 18, 1983 meeting of the Executive Committee were presented to the Board during the present meeting.]

The actions are as follows:

NOVEMBER 6, 1982

That $37,000 be appropriated to Federation Committees (Account 677), during 1982–83.

That $9,200 be appropriated to the Educational Committee (Account 750), during 1982–83.

That Federation Staff salaries be increased, effective November 18, 1982, and that the salary budget for 1983 be set at $295,000.

JANUARY 28, 1983

That the PRI Statement of Income ($141,460) and Disbursements ($161,694) for 1982 be accepted.

That the Federation President and President-Elect each attend one meeting of the PRI Trustees yearly.

That the Federation Estimated Statement of Income ($1,208,800) and Expense ($1,201,400) for 1982 be accepted.

That the services of Royal A. Brown as Federation Technical Advisor be continued from January through December 1983.

That the dates of the 1984 Annual Meeting and Paint Show in Chicago be changed to October 24–26.

That the Federation Technical Advisor proceed with his proposed "Evaluation Program for Test Methods and Instruments."

That the recommendations of the Publications Committee Task Force on the Series on Coatings Technology be accepted.

That the following recommendations of the Finance Committee be approved:

(1) That the four recommendations of the Investment Committee be implemented.

(2) That Annual Meeting registration fees be increased $10 across the board (excepting advance registration of retired members and spouses—$5).

(3) That the Annual Meeting Luncheon fee be increased from $15 to $20.

(4) That Federation dues for Active, Associate, and Society Honorary Members be increased from $15 to $20 beginning in 1985.

(5) That the Federation appropriate $55,000 to PRI in 1983.

(6) That the PRI operating budget for 1983 (Income—$145,000; Disbursements—$143,000) be accepted.

(7) That the scholarships to five universities for 1983-84 stand at the 1982 appropriation, $18,000 (less $1,500 to NDSU).

(8) That the appropriation for Corrosion Projects in 1983 be $5,000; and the grant to SSPS be $1,500.

(9) That, in cooperation with the New England Society, $500 be appropriated toward the restoration/preservation of the Boston Stone.

(10) That the price of individual copies of booklets in the Federation Series on Coatings Technology be increased from $2.50 to $3.50.

(11) That $2,000 be appropriated in 1983 toward the preparation of a Book on Paint History.

(12) That the 1983 Operating Budget of the Federation be as submitted by staff: Income—$1,357,500; Expense—$1,357,500.

MAY 18, 1983

That a vote of commendation and thanks be extended to those responsible for the success of the Federation's first seminar—"Efficient Operation of an Up-to-Date Paint and Coatings Laboratory"—and that discussions begin soon for the next one to be sponsored by the Federation.

That the 1984 President and spouse, and the Executive Vice-President and spouse, represent the Federation at the Birmingham Club meeting and at the FATIPEC Congress in September 1984.

[*All of the above actions of the Executive Committee were approved by the Board of Directors on May 20, 1983.*]

Amendments To By-Laws

This report summarizes the actions of the Federation Board of directors with regard to the proposed amendments to the By-Laws and Standing Rules.

Presented for Adoption

The following amendment to the By-Laws was given first reading at the November 2, 1982 Board of Directors meeting and was presented for adoption.

ARTICLE IV—NOMINATIONS AND ELECTIONS

A. (2) NOMINATIONS

WHEREAS the Baltimore Society has requested that nominations for Federation elective offices be permitted from the floor at the Spring Board of Directors meeting, be it

RESOLVED that By-Laws Article IV, Section A, Paragraph (2) be amended as follows:

"(2) The report of the Nominating Committee shall be announced at the Spring Board of Directors meeting. Nominations for any elective office may also be made from the floor by any Society Representative at the Spring meeting, or by a petition signed by 25 Active Members and forwarded to the Federation Executive Vice-President in time for publication in the August *Journal of Coatings Technology*, in which the slate of nominees shall be published. The Federation Executive Vice-President shall place such nominees-by-petition in nomination at the Fall meeting of the Federation Board."

"(3) Nominations for any elective office may also be made from the floor by any Society Representative at the Fall Board Meeting, prior to the election of Officers."

[*A motion was duly made and seconded that Paragraph (3) be eliminated. The motion was carried. Article IV was then adopted as amended, and became effective immediately.*]

Presented for First Reading

The following amendment to the By-Laws was presented for first reading.

AMENDMENT TO BY-LAWS AND STANDING RULES
RE: EQUAL VOTING AND OFFICE-HOLDING PRIVILEGES

WHEREAS the Pittsburgh Society has proposed that the existing Federation By-Laws and Standing Rules be amended to extend equal voting and office-holding privileges to all Federation Active and Associate members while still maintaining the existing classes of membership, and

WHEREAS the Federation Ad Hoc Committee on Federation Voting and Office-Holding Privileges studied this proposal and recommended to the Board of Directors that an orderly course of change be enacted, beginning with the right of each Constituent Society to determine the rights and privileges of its own members in the affairs of the Constituent Society, be it

RESOLVED that Article II, Section B, MANAGEMENT OF INTERNAL AFFAIRS, be amended to read as follows:

"(1) Subject to these By-Laws and the Standing Rules of the Federation, each Constituent Society shall have entire control of its own internal affairs.

"(2) The term Voting Member as used in these By-Laws and the Standing Rules of the Federation shall be construed to mean Active Member unless defined otherwise by the Constitution and/or By-Laws of the Constituent Society.

"(3) Each Constituent Society shall operate in accordance . . . violate these laws.

"(4) It shall be the duty . . . discussions held."

BE IT FURTHER RESOLVED that the By-Laws and Standing Rules of the Federation be amended as follows [deletions in parentheses, ( ), additions in italics]:

"IV A. (2) . . . Nominations for any elective office may also be made from the floor by any Society Representative at the Spring meeting, or by a petition signed by 25 (Active) *Voting* Members and forwarded to the Federation Executive Vice-President in time for publication in the August . . .

"IV B. (1) The (Active) *Voting* Members of each Constituent Society shall elect one Society Representative every third year who shall be an Active Member of said Society . . .

"XI A. ORIGINATION

Proposals to amend these By-Laws may be originated by:

"(6) The petition of ten or more (Active) *Voting* Members, each of two or more Constituent Societies being represented by at least five (Active) *Voting* Members in the petitioning group.

Board Members (from left): Edward Vandevort (Pittsburgh); Gary Marshall (Piedmont); Carl Fuller (Philadelphia); and Deryk R. Pawsey (Pacific Northwest)

"SR II C. (1) An applicant for Active Membership must be proposed by (an Active) a *Voting* Member and be endorsed by another (Active) *Voting* Member . . . Election to membership shall be by a two-thirds favorable vote of the (Active) *Voting* Members present and voting at a regular Society meeting . . .

"(2) An applicant for Associate Membership must be proposed by (an Active) a *Voting* Member and be endorsed by another (Active) *Voting* Member. The application shall be processed in the same manner as an application for Active Membership.

"(3) An applicant for Educator and Student Membership must be proposed by (an Active) a *Voting* Member and be endorsed by another (Active) *Voting* Member. The application shall be processed in the same manner as an application for Active Membership.

"(4) An applicant for Retired Membership . . . subject to election to membership by two-thirds vote of the (Active) *(Voting)* Members present and voting at any regular meeting of the Society. The application shall be processed in the same manner as an application for Active Membership.

"SR II D. Nominations for Honorary Membership may originate with any Constituent Society and shall require a 90 percent favorable vote of all (Active) *Voting* Members present . . ."

[*Since the Standing Rules require but one reading only, the By-Laws amendments were presented for first reading. They passed—29 for, 6 against. The By-Laws and Standing Rules will be presented for adoption on October 11, in Montreal.*]

Presented for First Reading

ARTICLE VIII—DUES

WHEREAS the Federation Board of Directors has approved a dues increase from $15.00 to $20.00, beginning in 1985 (1984-85 Fiscal Year), for Active, Associate, and Society Honorary Members, be it

RESOLVED that By-Laws Article VIII, Sections A and C, be amended as follows:

A. ACTIVE, ASSOCIATE, AND SOCIETY HONORARY MEMBERS

Each Constituent Society shall pay to the Federation office annual dues of twenty dollars ($20.00) in U.S. funds per capita for each Active, Associate, and Society Honorary Member of the Constituent Society.

C. EDUCATOR AND STUDENT MEMBERS

Each constituent Society shall pay to the Federation office annual dues, equal to one-half the amount established for Active Members, for each Educator and Student Member of the Constituent Society.

[*The amendment was passed unanimously for first reading. It will be presented for adoption on October 11.*]

Nominations

The Nominating Committee places the following persons in nomination for office with terms to become effective October 15, 1983:

President-Elect: Joseph A. Bauer, of the Louisville Society. (Porter Paint Co.) One-year term. He is currently Treasurer.

Treasurer: William Mirick, of the CDIC Society. One-year term. (Battelle Memorial Institute).

Executive Committee: Deryk R. Pawsey, of the Pacific Northwest Society. (Rohm and Haas Canada Ltd.). Three-year term.

Board of Directors (Members-at-Large): Ted Favata, of the Golden Gate Society (Triangle Paint Co., Inc.); and Al Heitkamp, of the Northwestern Society (Cargill, Inc.) Two-year term for each.

Board of Directors (Past-President Member): Neil S. Estrada, of the Golden Gate Society (Retired). Two-year term.

Elections will take place during the Board of Directors meeting on October 11, 1983, in Montreal, Que., Canada.

Members of the Nominating Committee are: Past-President Michael W. Malaga; Society Representatives Saul Spindel, Daniel Toombs, Kurt Weitz; and the Chairman.

HOWARD JEROME,
Chairman

Mr. McCormick placed Gordon Allison, of the Baltimore Society (McCormick Paint Works) in nomination as a Member-at-Large on the Board of Directors (two-year term).

There will therefore be three candidates for the two available positions on the Board.

Old Business

FEDERATION'S FIRST SEMINAR

The Federation's first national seminar was held in Kansas City, April 26-27 with the topic, "The Efficient Operation of an Up-to-Date Paint and Coatings Laboratory." Although there was a financial loss, the seminar was extremely successful in all other ways. The Executive Committee and Board of Directors have directed Staff to begin discussions for another seminar.

[*For additional information on the seminar, please see the Technical Advisor's report.*]

MEMBERSHIP CERTIFICATE

Mr. Borrelle reported that the Membership Certificates requested by the Board of Directors had been mailed to each Society. Additional copies are available upon request at no charge. Although the certificates are customized for each Society, the incorporation of the member's name and officer signatures and dates are the responsibility of each Society.

The Staff will work on pressure-sensitive year stickers which can be passed out in succeeding years.

The Staff will also design a similar certificate for 25-year members.

FEDERATION OFFICE BUILDING

Invited to the meeting was Jack McCombs, of the real estate appraising firm of H. Bruce Thompson, Jr. and Associates, Inc., Bryn Mawr, PA. On September 2, 1982, this firm submitted a report which compared all aspects of rental vs. ownership of office space, including a projection of costs through 1994. Both Mr. McCombs and Mr. Thompson attended the Executive Committee meeting of January 28, 1983 and amplified their earlier conclusions that, from a monetary standpoint and all things being equal, owning is more desirable than leasing. At the Board meeting, Mr. McCombs reviewed and updated the September analysis and showed some slides of buildings currently available in downtown Philadelphia.

The Board of Directors instructed the Executive Committee to take the matter of a Federation Office Building under advisement and to present a recommendation to the Board at the October 11, 1983 meeting.

NPCA AND JOINT CONVENTIONS

Mr. Borrelle recalled that on May 29, 1980, he wrote to the NPCA, as instructed, and advised NPCA of the Federation's position regarding its Annual Meeting and Paint Industries' Show (AM&PS) and the reasons for deciding to split away from the annual joint and back-to-back arrangement. Another letter was written on August 13, 1980, following a visit to Washington, D.C. and discussions with NPCA staff. Both letters expressed interest in holding discussions in hopes of reaching a mutually-acceptable compromise. There was no formal response from NPCA and the issue has been dormant since then.

On April 18, 1983, at the Joint Paint Industries Coordinating Committee (JPICC) meeting in St. Louis, Mr. Thomas, Executive Director of NPCA, spoke to the Federation Officers and Mr. Borrelle and indicated a desire to get the conventions back together again, wherever and whenever possible.

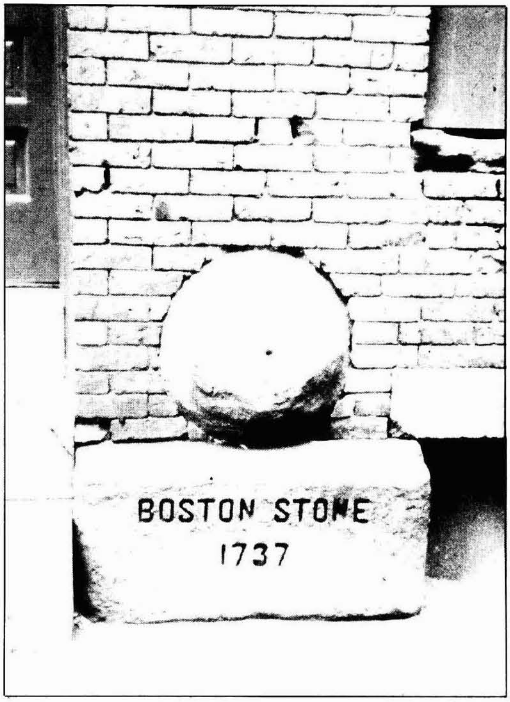
Mr. Boyce reported that he had attended the NPCA Board meeting on April 28, 1983, at which time the NPCA Industry Suppliers Committee requested that NPCA "reestablish renewed communications with the FSCT to insure that all possible options to the current meeting configuration be explored."

Mr. Borrelle concluded that Mr. Thomas had phoned him in early May and that he will go to Washington on May 25 to meet with Mr. Thomas on this matter.

NOMINATION OF PRI TRUSTEES

Because of the review of PRI activities/organization at the time by the Federation Ad Hoc Committee on PRI, the following amendment to the By-Laws (Article III-Organization) was tabled on May 15, 1981 (after having passed first reading on October 28, 1980): That an additional duty be added to the Office of Federation President—"Nominate annually the Trustees of the Paint Research Institute."

The Executive Committee was requested to check the current status of the proposal.



The Boston Stone (shown above and lower right of facing photo) is the subject of a New England Society committee formed to establish the historical background and significance of the

New Business

COMMITTEE ON COMPUTERS

Mr. Schwab suggested that since the computer is now an integral part of the industry, perhaps the time is now right for the establishment of a Federation committee on computers and their relationship and usefulness to the coatings industry. The committee could provide guidance to local Societies and long-range planning.

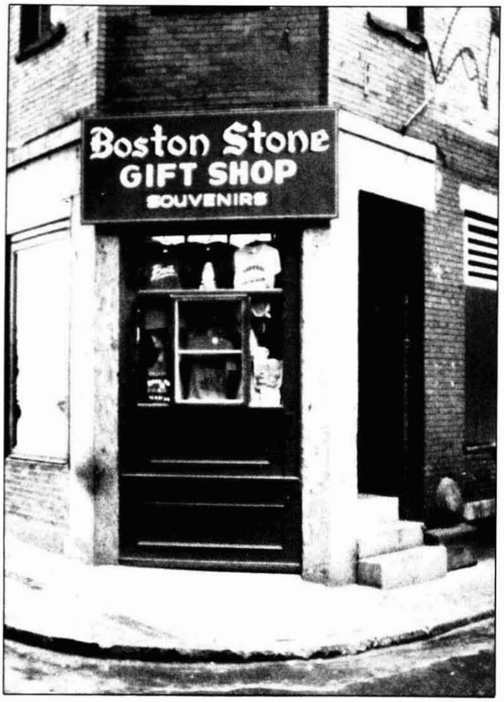
FUTURE PLANNING COMMITTEE

Mr. McCormick suggested that the Executive Committee establish a Future Planning Committee as a permanent committee of the Federation.

Society Business

BOSTON STONE

The New England Society is investigating ways and means of preserving this historical symbol of the paint industry. In this regard, Robert Modrak, Past-President of the Society, is chairing a committee of Society members who have approached the New England Society for the Preservation of Antiquities for the purpose of establishing the true background and historical significance of the Boston Stone.



Stone. Contributions are being accepted by the New England Society from the other Societies and the Federation for the continuation of their work (see story below)

Mr. Hoar said that this initial study will cost about $4,500. The New England Society has appropriated $500 toward the study and Mr. Modrak wrote to the other Societies relating the purpose of the study and requested contributions. The Federation has contributed $500 to the project. At the meeting several Societies indicated they will financially support New England's efforts.

The second phase of the project would undertake the preservation of the Boston Stone which now is encased in the facade of a building and is exposed to the elements.

[*A motion was made by the Representative of the New York Society, Mr. Spindel, that the Federation furnish the funds ($4,500) required for the first phase. When put to a vote, it was defeated.*]

The Boston Stone

The Stone was originally a paint mill imported from England around 1700 by a painter, Thomas Child. Later it was used as a landmark or central point from which distances from Boston were measured. The Boston Stone seemed to have acquired its name from the famous London stone from which directions were given to shops in the vicinity.

The Boston Stone is the earliest known implement of the paint industry in America. The round stone above was rolled back and forth in the trough of the larger stone underneath, in which the oil and pigment were ground. The round stone was discovered in digging the foundation of this building and the trough served as a cornerstone to protect the building from injury by carts.

Historical records indicate that Benjamin Franklin and Paul Revere lived near the Boston Stone, which may have figured as a center of their activities while at play.

BOARD OF DIRECTORS FOLDERS

Mr. Philipp, of Montreal, requested that the folders containing the reports for this meeting be mailed to members three weeks in advance of the meeting instead of the customary two. Other Board members agreed.

Committee Reports

A. F. VOSS/APJ AWARDS

Details were sent in December to all Society Presidents and Technical Committee Chairmen concerning the rules governing the competition for the A. F. Voss/APJ Awards. This letter indicated that Technical Committees preparing papers for the Annual Meeting should indicate intent to compete for the Award by May 1 and submit copies by July 30. In addition, the categories used for judging were outlined and a guide to authors for the JCT was enclosed.

A follow-up letter in February was sent to remind Technical Committee Chairmen of the deadlines.

At this writing, the Montreal and Dallas Societies have indicated their intent to compete for the Award, and I would expect additional Societies to indicate their intent as the deadline approaches.

CARL J. KNAUSS,
Chairman

CORROSION

The Corrosion Committee sponsored a workshop-panel discussion at the 1982 Annual Meeting entitled "Performance of Non-Lead, Non-Chrome Pigments in Aqueous and Non-Aqueous Anti-Corrosive Coatings." The panel consisted of presentations by representatives of four leading manufacturers of non-lead, non-chrome pigments followed by a question and answer session. The session was attended by about 75–100 persons and, judging by the comments made after the workshop, the session was very well received.

The committee is currently making arrangements to sponsor a workshop at the 1983 Annual Meeting entitled "Air Dry Aqueous Binders For Anti-Corrosive Coatings." Speakers from about 10 resin manufacturers will each make 10–12 minute presentations on the performance of products of their manufacture. There will be no constraints and the use of trade names will be permitted. It is anticipated that two, two-hour sessions will be required for this presentation.

About two dozen contacts were referred to Dr. Seymore Hochberg, Executive Director of PRI, as potential sponsors for the Corrosion Consortium.

SAUL SPINDEL,
Chairman

DEFINITIONS

ASTM, D01.16 Definitions Committee has been a major source of definitions for the *Paint/Coatings Dictionary*. Since I also chair this committee, it continues to be an active source for our second edition. Some of the members, of course, are also Federation members. The definitions generated by this committee are critically reviewed by ASTM's Committee on Terminology, who keep us honest and see to it that we conform to the rules of a proper definition.

STANLEY LESOTA,
Chairman

EDUCATIONAL

The annual Educational Committee meeting was held at the Sheraton Washington Hotel during the Annual Meeting in Washington, D.C. The meeting was presided over by J. A. Hoeck, Chairman, and was held primarily for the "Educators" of the Federation. The following Universities were represented: University of Southern Mississippi; University of Missouri, Rolla; Eastern Michigan University; University of Louisville; and Kent State University.

This luncheon serves as a meeting place for the exchange of ideas to promote and improve our educational commitment to the coatings industry.

At last year's meeting (Detroit, April 16, 1982), the Educational Committee recommended that a sub-committee be formed to review requests for scholarship funding and, based on these requests, make recommendations to the Board of Directors for future funding. This recommendation was approved by the Federation Executive Committee and Board of Directors, April 30, 1982. "Procedures for administering Federation Scholarship Program" were drafted and implemented. In December 1982, after reviewing the requests for scholarship funding, the sub-committee made recommendations to the Board of Directors for scholarship funding for 1983-84.

The Federation Board of Directors has approved a total of $18,000 for scholarship funding for the 1983-84 academic year, and scholarship funds have been awarded to these Universities: University of Southern Mississippi—$6,000; North Dakota State University—$6,000; University of Detroit—$2,000; Kent State University—$2,000; University of Missouri, Rolla—$1,000; and Eastern Michigan University—$1,000.

This year's annual Educational Committee meeting was held at the Hilton Airport Inn, Detroit, MI., on April 15, 1983. The meeting was presided over by the Chairman, James A. Hoeck.

Highlights of the Educational meeting are as follows:

(a) Review of Federation and Society Scholarship Programs.
(b) Walter Kolanitch, Montreal Society, is investigating the possibility for an Educational Committee presentation at the 1983 annual meeting.
(c) A sub-committee was formed to "promote career opportunities in the coatings industry."
(d) Society Reports: Reports on the annual activities in each Constituent Society.

JAMES A. HOECK,
Chairman

ENVIRONMENTAL CONTROL

As Chairman of the Environmental Control Committee, I have attended all meetings of the NPCA Hazardous Waste/ Water Quality Task Force and one meeting of the Air Quality Task Force.

The committee is planning a program at the Annual Meeting and is currently seeking speakers on the topic, "How Governmental Environmental Health and Safety Regulations Affect the Coatings Industry." Areas to be covered are the United States, Mexico, Canada, and England/Europe.

SIDNEY J. RUBIN,
Chairman

MANUFACTURING

The Federation Manufacturing Steering Committee met March 23, 1983 in St. Louis. The attendance was excellent and a full agenda was covered during the meeting.

The prime topic was a discussion of the subject matter for a Manufacturing Committee Seminar at the Annual Meeting in Montreal in October. The Committee's final decision was the following topic:

"Recycle Your Profits"—Improved profitability through efficient cleaning, recycling, and reclamation techniques.

Speakers are now being selected to address the subjects of tank cleaning, waste disposal, and economical solvent recovery and reclamation. The Committee is working with the Federation Program Committee in this regard and it is felt this topic is very appropriate for the theme of this year's AM.

The Manufacturing Committee's seminar at the '82 AM was critiqued. This program, on computers, was our most successful in recent years with the best attendance of any session at the AM. The Committee also reviewed the plant visitation conducted at the Duron facility in Beltsville. It was agreed that this was a complete success and plans have been made to tour an NL Industries (TiO_2) plant in suburban Montreal on October 11 in conjunction with this year's AM and PS.

The Committee also spent some time reviewing the audiovisual program. An excellent A/V on sand mills was presented for critique by the Kansas City Society. With some minor changes this should be available at the Paint Show.

The Manufacturing Committee is alive and well. It stands ready to meet any challenges which the Federation can give it.

RICHARD E. MAX,
Chairman

MMA AWARDS

The 1983 MMA Awards were given to the following Societies:

Category A:	Southern Society (Two Society Entries)
Category B:	Tie: Northwestern Society New England Society (Five Society Entries)
Category C:	Birmingham Society U.K. (One Society Entry)

For 1983 there were 10 Societies sending letters of intent to compete with eight Societies sending in their entries for judging.

One change was made in 1983; to add Society Presidents-elect to the mailing list of correspondence. This should help in having incoming Society Presidents aware of the MMA Award sooner in their careers.

As of March 20, 1983, four Societies have indicated their intent to submit entries for 1983.

The following are serving on the committee for 1983 and will judge entries: Rudolph C. Albrecht—Chicago; Gary Currier—Piedmont; Gary Gardner—Louisville; Raymond C. Uhlig—Pittsburgh; and Allen R. Yerby—Los Angeles.

The committee anticipates no need of Federation funds for 1983 operation other than the plaques coordinated with the MMA by Frank Borrelle. Tom Kocis and Frank Borrelle are extremely helpful in this award program.

AL HEITKAMP,
Chairman

PUBLICATIONS

The Publications Committee and the Editorial Review Board are scheduled to meet on May 11, 1983. The following has been accomplished:

(1) The Ad Hoc Committee on Booklets has completed a plan for restructuring the Education Series and will be meeting in the first half of 1983 to develop an implementation strategy for this important series.

(2) Manuscript flow has been good.

(3) Additions have been made to the Editorial Review Board to strike a good balance of our reviewing needs.

(4) The new review forms have been well accepted by the Reviewers and have been of good value in carrying out reviews.

(5) Foreign articles are being reprinted in JCT.

(6) The "Open Forum" column is now a regular feature.

(7) "Humbug from Hillman" is ongoing.

(8) Reviews are being carried out within the presented time period.

(9) A more detailed report will be published following the next meeting of the Publication Committee.

THOMAS J. MIRANDA,
Chairman

ROON AWARDS

The Committee proceeded early in 1983 with publicity and editorials in both the JOURNAL OF COATINGS TECHNOLOGY and the *American Paint & Coatings Journal*, relative to the Roon Award submissions. In addition, available prize money for the 1983 awards was also increased over 1982 funding.

Response has been good, although not equal to the past year. Fourteen commitments and abstracts have been submitted. Based on the abstracts, the diversity of papers will make an excellent contribution to the 1983 annual program. Papers will be reviewed early in June to select those which will be contributing to the program. Award winning papers will be determined by September 1.

DARLENE BREZINSKI,
Chairman

TECHNICAL ADVISORY

The Technical Advisory Committee has only held one meeting since the last report to the Board at the last Annual Meeting. This was a breakfast meeting held in Washington during the Annual Meeting, and was attended by 15 persons. Brief reports were heard from the Society Technical Representatives that were present. In addition, the group was updated on the progress being made in the preparation and distribution of the biocidally active polymer. More problems have been encountered in polymer manufacture; resolution appears to be forthcoming with time.

Several additional ideas were mentioned for Society technical projects; this coupled with the published "brainstorming" results from the Spring '82 meeting and the PRI questionnaire seem to give plenty of topics for consideration.

Plans are underway to publish a handbook for use by Society Technical Directors to be ready by the next Spring Meeting of Technical Directors of the Constituent Societies.

Activity continues at a fairly reasonable pace, with a number of papers on the program for Washington, and several projects still "cooking" to produce other papers in the future.

W. F. HOLMES,
Chairman

TECHNICAL INFORMATION SYSTEMS

The Technical Information Systems Committee continues to assist Federation members, other Federation committees, and Federation Staff in all possible ways.

HELEN SKOWRONSKA,
Chairman

DELEGATE TO IUPAC

The recent activities of the Supported Polymer Film (SPF) Group, Macromolecular Division (MAD), International Union of Pure and Applied Chemistry (IUPAC) were reported in the December 1982 issue of the JOURNAL OF COATINGS TECHNOLOGY.

Since the official Federation Delegate to IUPAC will be unable to attend the April 28–29 meeting in Zurich because of illness, David Lovegrove, of the Birmingham Club, will again try to attend as an alternate.

Among the projects to be discussed at the Zurich meeting are: Adhesion, Stability of amino resin containing systems, Analysis of emulsion paints, and Characterization of cure in relation to performance properties of coatings.

A detailed report of the Zurich meeting will be submitted to the JCT for publication as soon as available.

MILTON A. GLASER,
Delegate

DELEGATE TO NACE

This Delegate attended the annual meeting of The National Association of Corrosion Engineers which took place on April 18 to 22, 1983 in Anaheim, CA.

Over 300 papers on a wide variety of topics related to corrosion were presented in the week-long meeting. The papers of closest interest to the coatings industry were grouped in a symposium sponsored by Group Committee T-6 on protective coatings and linings. The symposium was chaired by Dr. J. A. Bruno, Director of Research of the Steel Structures Painting Council in Pittsburgh, Pa. Among the papers presented, the following were of particular interest:

"Influence of Surface Preparation Upon Performance of Protective Coatings in Atmospheric Environments"

This paper, presented by Mr. K. B. Tator, was actually the yearly update on the ongoing work of the project conceived, developed, and carried by NACE's Committee T-6H-15. The care in planning execution and data handling of this project is likely to make it the definitive work on the subject for years to come.

"Surfaces, Adhesion, Coatings"—C. G. Munger

Useful thoughts on coatings performance and failure.

"Zinc Coated Abrasives Widen the Operating Window For Surface Preparation"—P. J. Robinson

Described the interesting approach of producing abraded surfaces for painting with aggregate which has been coated with zinc, thus depositing zinc in the process of surface preparation.

"Influence of Surface Preparation on Coatings Performance and Cathodic Protection"—N. W. Kendig, F. Mansfeld and S. Tsai

"Avoiding Pitfalls of Protective Coatings, Selection and Application"—J. Lichtenstein

A review of the proper procedures for specifying paint.

"Paints, Coatings and Linings for the Utility Industry"—J. R. Cavallo and C. H. Holl

"Comparative Evaluation of Coating Systems Utilizing Zinc as a Primer, Including Different Surface Preparations for Hot-Dip Galvanizing"—R. M. Lascock

An interesting comparison of two widely different methods to apply zinc on a surface.

"The Corrosion Survey—And Engineer's Guide To Maintenance Painting Specification"—F. J. Windler

"Inspection: The Last Line of Defense"—W. P. Harper Lack of proper inspection is widely recognized as one of the major causes for coatings failure in the field and Mr. Harper's paper was timely in view of the renewed interest in inspector qualification.

Group Committee D-6 in charge of protective coatings and linings held also several committee meetings:

T-6A—Coatings and Lining Materials for Immersion Service,

T-6A-53—Electroless Nickel Coatings,

T-6G—Surface Preparation for Protective Coatings,

T-6H—Coating Materials for Atomospheric Service,

T-6H-15—Effects of Surface Preparation on Service Life of Protective Coatings,

T-6H-39—Coatings for Concrete Surface in Atmospheric Exposure,

T-6H-42—Petroleum-Based Coatings,

T-6Q—Quality Assurance of Protective Coating Materials and Their Application.

CORROSION/83 was enhanced by a trade exhibit and show featuring over 300 exhibitors offering a variety of products and services against corrosion including coatings, to cathodic protection, alternate materials, and testing instruments.

The main lecture at the NACE meetings is the Plenary lecture which is generally delivered by a well-known personality in the industry. The Program Committee had nominated Dr. Sidney Sussman to present the 1983 Plenary lecture and Dr. Sussman had chosen the subject of "Water Systems Corrosion, a Chemical Engineering Problem." Dr. Sussman unfortunately passed away prematurely and another speaker was not designated. Instead, a panel of experts on the topic of Water Systems Corrosion, took the place of the lecture.

Another note of interest to the coatings community is that Dr. Henry Leidheiser, Professor of Chemistry and Director of the Center for Coatings Research at Lehigh University, Bethlehem, PA, was awarded the Willis Rodney Whitney Award by NACE in recognition of his multiple contributions to the science of corrosion. This is a well deserved recognition and underscores the fact that Dr. Leidheiser is a most appropriate leader for the work on corrosion currently being contemplated by the PRI.

In a note unrelated to the Anaheim meeting, it should be of interest to coatings technologists that NACE has launched a program to train and certify coatings inspectors. This program fills a need in the industry which hopefully will result in a higher quality of application.

T. GINSBERG,
Delegate

DELEGATE TO SSPC

A total of 15 Advisory Committees met during the two day meeting. The minutes of each meeting are summarized below:

SURFACE PREPARATION

The Task Group on Visual Standards for the Preparation of Previously Coated Steel has been reactivated.

The 1982 SSPC Surface Preparation Specifications are being disputed by the marine industry and various architects and engineers. A Task Group was formed to review and modify the specifications in order to eliminate discrepancies and ambiguous statements.

Bare Metal Power Tool Cleaning—The Task Group discussed means of developing a specification. It was decided to follow a stepwide approach as follows:

(1) Include a set of guidelines in the new SSPC surface preparation manual.

(2) Develop a specification based on the evaluation of the results of a test program.

(3) Develop visual standards at a future date.

The following tentative definitions for surface cleanliness were agreed upon:

Level A—Remove all rust, loose mill scale, coatings and other contaminants except for pitted areas.

Level B—Remove all rust, coating contaminants and all but tightly adhering mill scale.

Level C—Remove all rust, coating contaminants and mill scale.

The panel test program was reviewed. Some 1400 panels have been prepared using six cleaning methods and coated with five paint systems. SSPC will include them in the PACE II exposure program.

The following observations were made during this program:

(1) The non-woven abrasive disc was most efficient resulting in better cleanliness than SSPC-SP 3 "Power Tool Cleaning."

(2) The best cleanliness was achieved by use of a rotary peening device followed by the non-woven abrasive disc. However, the production rate was very slow.

(3) Needle guns were found to be slow and inadequate in cleanliness.

Centrifugal Blast Cleaning—The Task Group reviewed Draft #3 of "Guidelines for Centrifugal Blast Cleaning." Draft #4 will be prepared including the minor changes suggested and will be circulated for review.

Wet Blast Cleaning—The Task Group reviewed Draft #1 of the following Guides:

Part One: "Procurement Guidelines for an Optimum High-Pressure Water Blasting Unit".

Part Two: "Waterblasting Processing Guidelines".

Draft #2 will be prepared including the changes agreed upon and will be circulated for review.

ZINC-RICH PRE-CONSTRUCTION PRIMERS

The Committee discussed the development of a specification on "Weld-through Inorganic Zinc Primers." SSPC Paint 20 will be used as a guide. The first draft will be submitted for review prior to the next meeting.

ZINC-RICH (GENERAL)

The following new SSPC guides and specification were reviewed:

SSPC Guide 12.00—"Guide for Selecting Zinc-Rich Painting Systems".

SSPC Paint System Guide 12.01—"One-Coat Zinc-Rich Painting System".

SSPC Paint 20.00—"Zinc-Rich Primers".

A presentation was given on zinc-rich coatings for faying surfaces. The committee agreed to await results of the AISC Research Council on Structural Connections report before starting any work on this specification.

ZINC-RICH PERFORMANCE SPECIFICATIONS

Results of the SSPC salt fog and bullet hole tests were distributed. They will be compared with data from the following studies: SSPC Zinc-Rich topcoating study; SSPC Golden Gate Bridge studies; and NASA study on Zinc-Rich Primers.

The results obtained will be distributed for review.

TOPCOATING ZINC-RICH

Draft #2 "Guide to Topcoating Zinc-Rich Primers" was distributed for review. Final review will be made by mail.

VINYLS

Draft #1 for "High-Build Vinyl Topcoat for Zinc-Rich Primers" was distributed for review. The suggestions made will be incorporated in Draft #2 and circulated for review and ballot.

WATER-MISCIBLE COATINGS

The status of water reducible primers in Pace I was reviewed.

Draft #1 "Water Miscible Primer for Steel Surfaces" was discussed. The modified draft will be distributed for review.

Samples essentially meeting the new draft specification will be solicited for test.

MARINE COATINGS

The new SSPC Painting System Guides—19.00, 20.00, 21.00 and 22.00 were circulated for review.

Polyurethanes will be considered for inclusion in the following guides: (a) PS Guide 20.00 "Guide for Selecting Painting Systems for Boottopping." (b) PS Guide 21.00 "Guide for Selecting Painting Systems for Topsides."

The following paragraphs will be prepared for inclusion in PS Guide 19.00 "Guide for Selecting Painting Systems for Ship Bottoms": 5.8—Proprietary Anti-Fouling Paints; 5.8.1—Conventional Anti-Fouling Paints; 5.8.2—Scrubbable Anti-Fouling Paints; 5.8.3—Ablative Anti-Fouling Paints; 5.8.3.1—Leaching Type; and 5.8.3.2—Copolymer Type.

Copies of MARAD specifications were circulated for review to determine whether they can be used for SSPC Standard Ship Specifications.

MAINTENANCE REPAINTING

The SSPC-PA Guide 4 "Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems" was reviewed.

Draft #1 of the "Decision Tree" was also reviewed and discussed in an attempt to improve the guide in arriving at a decision on the best approach to repainting.

The following Task Groups were formed: Inspection of condition or survey; Identification of old coatings and compatability; Repair techniques including surface preparation; Cost effectiveness or lifetime cost; Maintenance painting philosophy; Bibliography; and Safety/environmental concerns.

PACE III

Pace III differs from PACE I and II in that fees will be charged for submission of samples.

The objective of PACE III will be "To evaluate performance of coatings that provide potential improvements in the state of the technology".

The following Task Groups were formed: Develop Criteria for Accepting Coatings for PACE III; and Product Identity and Reporting of Data.

FHWA BRIDGE PAINTING RESEARCH

The following projects were reviewed:

"Coatings for Non-blast Cleaned Metal"—Data developed to date demonstrate that treatment with steam and a detergent before wire brushing significantly reduces the contamination of the surface by chlorides and sulfates.

"Cleaning Steel with a Cavitating Water Jet"—Cleaning rates are slower than blast cleaning, but waste disposal costs are minimized.

"Reliability Analysis for Predicting Paint Performance from Accelerated Tests"—Rust formation under the coating was found to proceed more quickly as the temperature increased. An attempt is being made to develop mathematical equations to predict failure at other temperatures than that used during accelerated testing.

NEW SPECIFYING METHODS

The first draft of a questionnaire on "Laboratory Accelerated Test Methods for Determination of Corrosion Protection of Coating Systems on Steel" was reviewed and discussed. It was agreed that it should be expanded to include application techniques and to enable answering most of the questions with "Yes/No".

A second draft will be prepared and circulated for review.

REHABILITATING PUBLIC STRUCTURES

The scope of this committee will be to advise SSPC regarding a symposium on painting of public structures to include co-sponsorship, topics and a timetable.

Note: "A symposium on "Painting Public Structures" will be held in December 1983. The Federation will be a co-sponsor.

NEW SSPC PUBLICATIONS

The present long term plans for SSPC publications include the following:

A major text every 18 to 24 months, e.g., 1983—Vol. 3: A "Surface Preparation" manual; 1984—"Painting Public Structures"; and 1985—"Maintenance Painting".

Monographs every 10 months, e.g., Painting Food Plants; Painting Water and Waste Treatment Plants; and Failure Analysis.

It is recommended that monographs be prepared by at least two co-authors from different companies in order to minimize any possible bias and that drafts be subjected to peer review prior to publication.

AWARDS

The following awards were presented: *Award of Merit*—John C. Murphy, President of SSPC; and *Certificate of Recognition*—Kenneth B. Tator, Chairman of the Research Committee.

SIDNEY B. LEVINSON,
Delegate

The next meeting of the Board of Directors will be held on Tuesday, October 11, 1983, at the Queen Elizabeth Hotel, Montreal, Que., Canada

EASTERN AIR LINES AND AIR CANADA MAKE IT EA$Y TO FLY TO MONTREAL

The Federation of Societies for Coatings Technology has appointed Eastern Air Lines and Air Canada as the official carriers for the Federation's 1983 Annual Meeting and Paint Industries' Show at Place Bonaventure, Montreal, Que., Canada, October 12-14.

Both airlines have established special discount fares for those who make reservations by calling the airline's special toll-free number listed below.

Take advantage of this special arrangement and phone the 800 number now and ask for the special fares from your city to Montreal.

EASTERN

800-327-1295

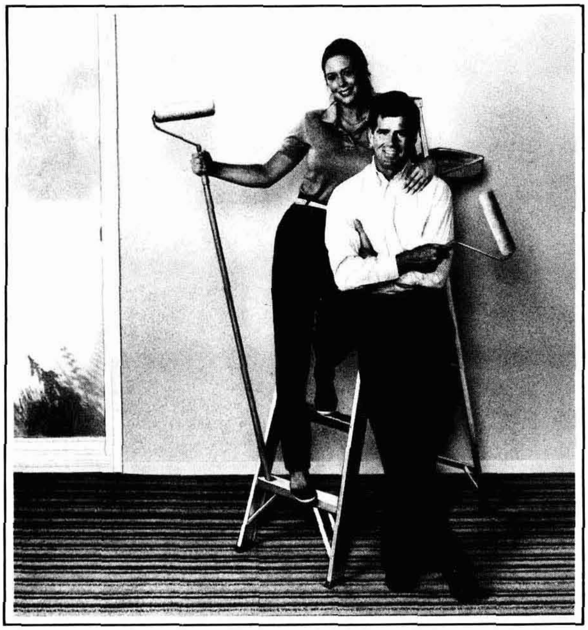
(In Florida 800–432–1217)

AIR CANADA

800-845-5700

(In Canada 800–361–7585)

CHEAPER & BETTER



Your customers will be happy to find that you've improved the spatter resistance in your interior flat paints.

You will be happy to find that you've reduced RMC while improving paint application properties.

How is this possible?

A new low cost thickener, Acrysol® TT-935, an easily incorporated emulsion, is now available that can provide the following benefits to manufacturers of interior flat paints.

- **reduce raw material and handling costs**
- **excellent spatter resistance**
- ***superior film build***
- **outstanding viscosity profile vs. that attained with *competitive thickeners***

Furthermore, Acrysol TT-935 resists loss of paint viscosity because of microbial growth during long term storage on the shelf.

Low cost, excellent performance and handling properties, all found in one thickener — Acrysol TT-935. See for yourself if Acrysol TT-935 will outperform the current thickeners in your interior flat formulations. Contact your local Rohm and Haas Technical Representative for a sample or additional technical information or write to Marketing Services, Rohm and Haas Company, Independence Mall West, Philadelphia, PA 19105.

ROHM AND HAAS
PHILADELPHIA, PA 19105

ANNOUNCING A NEW LOW COST THICKENER FOR INTERIOR FLAT PAINTS THAT ARE EASIER TO APPLY.

Improved Analysis Of Static Panel Immersion Testing Results

Anne M. Becka
David W. Taylor Naval Ship Research and Development Center*

The static panel immersion test for antifouling coatings can be improved to account for biofouling variability. Multiple static exposure panels of two Navy antifouling paints are examined to determine the distribution of paint failure data. Statistical analysis using frequency histograms, indicates that 10–12 replicate panels are required to characterize the time to failure at the 95% confidence level, for any single coating system. Transformation of the test results using the square root function will allow for a more reliable evaluation of data from multiple identical exposure panels.

INTRODUCTION

Research into the development of improved antifouling shipbottom coatings relies to a great extent upon static panel immersion tests to screen developmental materials.[1] This screening test has traditionally provided an inexpensive quantitative method to evaluate a coating's antifouling effectiveness and is used on a pass/fail basis prior to selection of a paint system for shipboard evaluation. If the data provided by this screening test are insufficient to give a clear indication of the potential value of a developmental coating, quality paints may not be identified and poor paints may go on to unnecessary further, more expensive, testing.

The present static testing procedure is to expose one or two 10″ × 12″ test panels coated with an experimental antifouling formulation at one or both of the Navy's exposure sites (Miami and Pearl Harbor). These panels are then evaluated on a quarterly basis for antifouling effectiveness. When the coating has exhibited significant fouling indicative of coating failure, the test is ended. The results of the test on these one or two panels will often determine whether a coating will be pursued for further development.

Schoener[2] recently examined the variability of biofouling on nontoxic surfaces. This study indicates that a significant amount of variability can be observed on identical nonmetallic samples exposed under the same conditions. Her analysis indicates that six to 10 test items are required to reduce the biofouling variability to ±25% on nontoxic test surfaces at any one exposure location.

To determine if similar biofouling variability is exhibited in the static panel performance evaluation of antifouling paint panels, statistical evaluation of available test results has been performed. By examining the results of static panel immersion tests of two Navy standard antifouling paints, the present methodology of the static panel immersion test[1] can be improved. Specifying the number of panels required to minimize the effects of the biofouling variability and to characterize other coating failure mechanisms are goals of this study.

METHODS

Over the past several years a number of 10″ × 12″ steel panels of Navy Formulas F121/63 (MIL-P-15931D), vinyl/rosin cuprous oxide, and F170 (DOD P-24588) carboxylated vinyl tributyltin fluoride/bis (tributyltin) oxide antifouling paints have been exposed as controls for antifouling paint tests. These panels were prepared using either the Navy Formula F119 (MIL-P-15929C) vinyl red lead primer system or the Formula F150 (MIL-P-24441) polyamide epoxy primer system. The panels were exposed between 1975 and 1977 and panel antifouling performance results indicating degree of biofouling present at three-month intervals were maintained. All panels were exposed in Biscayne Bay, Miami, Florida.

* Environmental Materials Branch, Bethesda, MD 20084.

Table 1—Distribution Statistics: F121 Paint Over F119 Primer

Set	1	2	3	4
Data transformation	None	Square Root	Natural Log (ln)	Log
Mean	33.42	5.76	3.493	1.418
Standard deviation	6.14	.53	.187	.027
Standard error	1.77	.15	.054	.008
Skewness	.13	−.06	−.257	−.217
Kurtosis	−.55	−.47	−.287	−.332
No. of samples	12	12	12	12
X^2 value	4.063	4.063	14.15	36.56

Table 2—Distribution Statistics: F121 Paint Over F150 Primer

Set	5	6	7	8
Data transformation	None	Square Root	Square Root (<25 months)	Square Root (>25 months)
Mean	29.08	5.30	4.34	6.00
Standard deviation	10.47	1.01	−.88	.56
Standard error	2.05	.20	−.40	.14
Skewness	.00	−.34	.18	−.18
Kurtosis	−.93	−.62	.61	−.78
No. of samples	26	26	11	15

The panel biological fouling results were analyzed and a drop of 60% antifouling effectiveness was selected as indicative of a significant onset of biological growth and consequent coating failure. The test results were evaluated as each panel having two individual sides. Seven panel sides which had not yet fouled to 60% antifouling effectiveness were included in the analysis.

RESULTS AND DISCUSSION

All panel antifouling test results were analyzed using the frequencies subroutine of the SPSS computer statistics package.[3] The statistics generated by the program characterize the distribution of the data. These statistics include the mean; the standard deviation which measures the degree of dispersion of the test results about the mean; and the standard error of the mean which is a measure of the degree of deviation of the sample mean from an expected but unknown population mean. The shape of the distribution curve is characterized by the skewness (positive value indicates results are clustered to the left and negative value indicates results are clustered to the right), and the kurtosis (positive value indicates the curve is narrower than a normal curve and negative value broader than a normal curve). Additionally, separate sample sets can be compared by using a one-way analysis of variance. This test compares the means of two samples sets and determines whether the sets are statistically different.

Using the criteria of months to 60% antifouling effectiveness, and panels which were coated with the F121 antifouling coating and F119 primer system, 12 sides of panels were identified. The results of the distribution statistics are shown in *Table* 1. The relatively high value

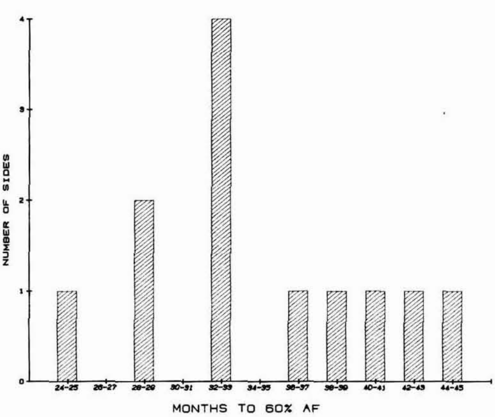


Figure 1—Months to 60% effectiveness of F121 over F119

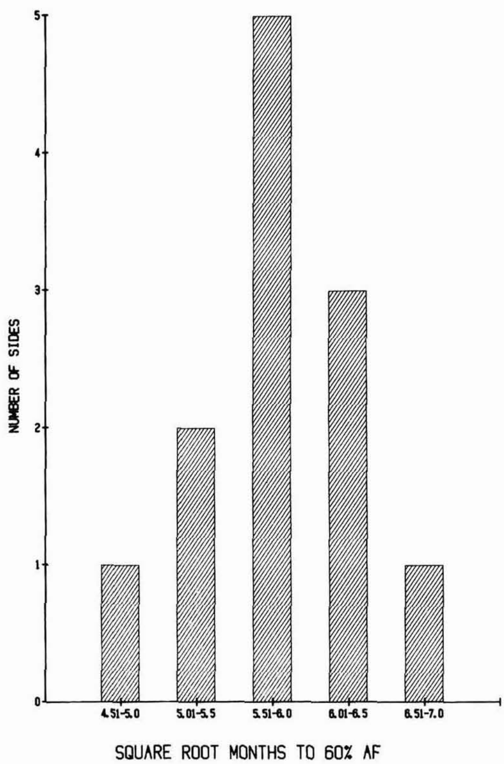


Figure 2—F121 over F112 (data transformed using square root function)

Table 3—Distribution Statistics: F170 Paint Over F150 Primer

Set	9	10
Data transformation	None	Square Root
Mean	29.31	5.32
Standard deviation	10.79	1.05
Standard error	2.70	.26
Skewness	.20	−.52
Kurtosis	1.43	.85
No. of samples	16	16

of the standard deviation indicates that the histogram is widely dispersed about the mean as can be readily observed in *Figure* 1.

One method of correcting deviations of distribution is to use simple mathematical transformations of the test results. In the case of the well defined system of F121 antifouling paint over F119 primer, a normal distribution was not exhibited by the fouling test results. In an attempt to obtain the normal distribution, various transformations of the test results were performed. The square root, natural logarithm (ln), and logarithm (log) were all performed on this data with the results as shown in *Table* 1.

Table 4—Analysis of Variance

Set	F Value	Significance
7 vs. 8	52.09	99+%
2 vs. 8	1.34	None

The skewness value is lowest for the square root transformation. The kurtosis value is lowest in the logarithmic transformations, but both these transformations yielded high skewness values. The X^2 (Chi-square) value indicating goodness-of-fit was lowest for the untransformed and square root transformations. The values indicated that these sets of data approximate the normal distribution with over 95% confidence. Due to the lower skewness value in the square root transformation, this treatment of test results was selected as the basis for further analysis. This was not a totally unexpected conclusion in that the square root of time often characterizes similar diffusion processes such as cathodic electrodeposition.[4]

The histogram plot of the transformed test results, shown as *Figure* 2, demonstrates the more normal distribution of these transformed results. This well-defined,

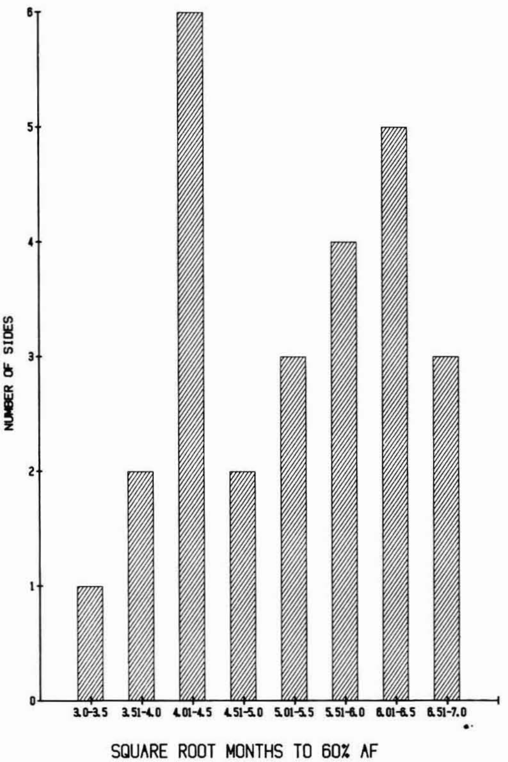


Figure 3—F121 over F150 (data transformed)

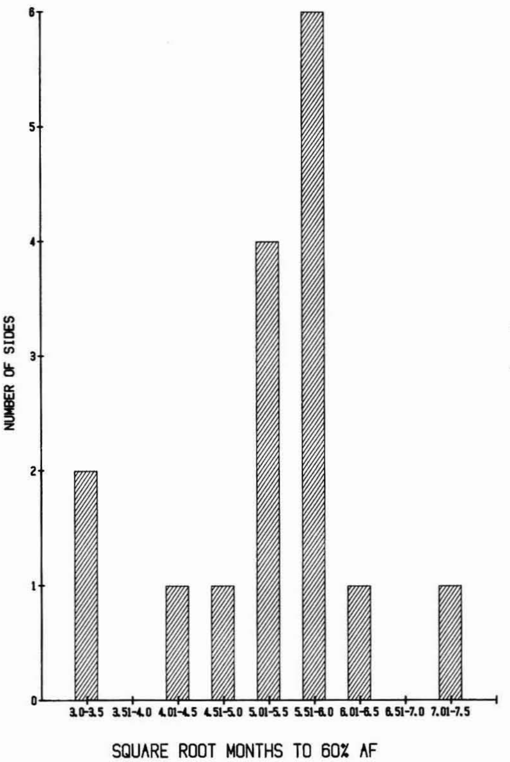


Figure 4—F170 over F150 (data transformed)

predictable system required 12 panel sides (six panels) to exhibit this distribution of time to failure.

This method of data transformation was then applied to test results from 26 sides of panels coated with the F121 antifouling coating over the F150 primer system. The distribution statistics of this analysis are shown in *Table* 3. As can be seen from the table, the distribution statistics of kurtosis, skewness, and standard deviation as well as the population statistic of standard error were significantly higher for this system as compared to the F121/F119 system. When the histogram of the test results was plotted in *Figure* 3, the reason for this high value became apparent. The test results appear to exhibit two separate distributions, the first is the set of those values less than 25 months, and the second is the set of those values greater than 25 months. An analysis of variance comparing these two sets provides an F-value of 52.1, indicating that the populations are in fact different at the 99+% confidence level, *Table* 4. When these two sample sets were examined individually, distribution statistics dropped significantly as seen in *Table* 2. When the right hand distribution (values >25 months) was compared to the distribution of the F121 over F119 primer system using a one-way analysis of variance, an F value of 1.34 was obtained. This indicates that these two populations are not significantly different even at the 95% confidence level. Therefore, the long-life distribution of the failure results may be attributed to the failure mechanism of depletion of the antifouling coating as seen in the F121/F119 system. The short-life distribution of the failure data may be attributed to a second failure mechanism such as the often-observed intercoat and substrate adhesion failures of the F150 primer system. This paint system required 26 panel sides (13 panels) to identify this apparent dual failure mechanism. Statistically there are two populations present, but until further testing is performed the actual coating failure mechanisms attributable to these two populations cannot be identified.

The final paint system analyzed was the F170 antifouling coating over the F150 primer system. As can be seen in *Table* 3, all the distribution statistics for this system indicated that the test results were far from approaching a normal distribution. The abnormal distribution of these test results most readily can be seen in the histogram plot of *Figure* 4. Obviously, the 16 panel sides (eight panels) were insufficient to define the mean time to failure in this paint system and additional exposure panels would be required to define the behavior of this coating system.

CONCLUSIONS

Based on evaluation of the results of panel immersion tests of two Navy standard antifouling paints, at least 10-12 replicate panels of experimental paints are required to statistically eliminate the effects of biofouling variability. The initial use of this increased number of replicate panels and transformation of the exposure tests using the square root function will help provide better antifouling coatings by providing a more reliable evaluation procedure.

ACKNOWLEDGMENT

The author wishes to thank Thomas Radakovich, of David Taylor Naval Ship R&D Center, for maintaining and providing the panel performance data upon which this analysis is based.

References

(1) ASTM D3622-78a, "Standard Method for Testing Antifouling Panels in Shallow Submergence."
(2) Schoener, A., "Replicate Fouling Panels and Their Variability," presented at ONR Symposium on Marine Biodeterioration, April 20-23, 1981.
(3) Nie, N., et al., "SPSS—Statistical Package for the Social Sciences," 2nd Edition. McGraw-Hill Book Co., NY (1975).
(4) Pierce, P.E., "The Physical Chemistry of the Cathodic Electrodeposition Process," JOURNAL OF COATINGS TECHNOLOGY, *53*, No. 672, 53 (1981).

Isocyanatoethyl Methacrylate: A Heterofunctional Monomer for Polyurethane And Vinyl Polymer Systems

Mary R. Thomas
Dow Chemical U.S.A.*

Isocyanatoethyl methacrylate (IEM) is a heterofunctional monomer that combines the versatility of a vinyl polymerizable double bond for acrylic polymer chemistry with a reactive isocyanate group for urethane reactions. The methacrylate group of IEM can be homopolymerized or copolymerized with a large number of other vinyl monomers to produce a polyisocyanate of controlled molecular weight and retained isocyanate functionality. In a second mode, the isocyanate group can react with active hydrogen-containing compounds or polymers to provide pendent methacrylate groups capable of vinyl polymerization or crosslinking with free radical initiators generated chemically or by radiation. Reaction kinetics as well as a discussion of applications for IEM are included.

INTRODUCTION

$$H_2C{=}\underset{\displaystyle CH_3}{\underset{|}{C}}{-}\overset{\displaystyle O}{\overset{\|}{C}}{-}O{-}CH_2{-}CH_2{-}N{=}C{=}O$$

Isocyanatoethyl methacrylate (IEM) is a difunctional monomer with a reactive isocyanate group and a vinyl polymerizable double bond. The chemistry of either functionality can be exploited independently without affecting the latent utility of the other group.

A heterofunctional monomer of the IEM type is a logical addition to the acrylic and methacrylic ester class of monomers. Currently, the most useful heterofunctional monomers are the hydroxy alkyl (meth)acrylates, which helped revolutionize the production and industrial use of thermosetting coatings 20 years ago. Today, IEM offers attractive potential for exploration as a link between polyurethane technology and acrylic polymer systems. It provides a way to achieve a fast, low energy cure in thermoset coatings.

The composition of IEM was first revealed by Rohm and Haas in 1955 [1] when the isocyanate esters of acrylic, methacrylic, and crotonic acids were described. The formation of polymers and copolymers of IEM with other vinyl monomers was also discussed. In the late 1950's, Bayer researched the monomer, patented a process,[2] and described applications.[3] Through the 1960's and 70's, further patents appeared on the use of IEM in a variety of systems. References 4–12, which are not all-inclusive, give a broad picture of continuing research into the utility of IEM.

Recently, IEM has been produced by The Dow Chemical Co. through oxazoline chemistry. IEM is a high purity derivative of commercially available ethyl oxazoline. With the increasing availability of IEM, more information has appeared in the literature, notably on coatings applications.[13-18]

Acrylic latexes containing oxime-blocked IEM[19] in single component systems demonstrate crosslinking through the isocyanate function. They also crosslink in two component coatings by reaction of the isocyanate with hydroxyl-containing polymers in the presence of tin catalysts, and with carboxyl-containing polymers without catalyst.[19] A large number of IEM-blocked derivatives have been characterized and their utility demonstrated in copolymers. These investigations will be reported later.

Published, in part, in the Preprint Booklet of the 183rd meeting of the American Chemical Society, and reprinted here by permission of the ACS, the copyright owner.
*Organic Chemicals Dept., Midland, MI 48640.

Table 1—Reactivity of IEM and Other Isocyanates With 1-Butanol in Dilute Solution

Isocyanate	k_{cat}[a]
H12MDI, 4,4'Dicyclohexylmethane diisocyanate	6
IPDI, Isophorone diisocyanate	8
HDI, Hexamethylene diisocyanate	10
Desmondur N-75, Trifunctional aliphatic isocyanate (25% solvent)	14
Desmondur N-100, Trifunctional aliphatic isocyanate	18
IEM, Isocyanathoethyl methacrylate	19
1-BuNCO, 1-Butyl isocyanate	14
Mondur® TD, Toluene diisocyanate (65/35, 2,4/2,6 isomer)	25
Mondur TD-80, Toluene diisocyanate (80/20, 2,4/2,6 isomer)	28
Mondur TDS, Toluene diisocyanate (100%, 2,4 isomer)	30
MDI, 4,4'Diphenylmethane diisocyanate	147

Conditions:
- Alcohol: 1-Butanol
- Temp.: 25°C
- Catalyst: Dibutyl tin dilaurate
- Solvent: 2-Ethoxyethyl acetate[b] (100–130 ppm H_2O)
- IEM: Lot 01230 (345 ppm hydrolyzable chloride)

(a) Units of k_{cat} are $kg^{1.5}/mole^{1.5}/min$.
(b) Recent toxicological studies point out that certain ethylene-based glycol ethers cause testicular damage and birth defects in rabbits and rats at certain levels of exposure. Users of these materials should consult the producer for toxicological information and direction for their appropriate use.
Mondur is a trademark of Mobay Chemical Co.

CHEMICAL PROPERTIES

Monomeric Isocyanate Group

The isocyanate group of IEM is very similar to other aliphatic isocyanates with respect to its reactivity with primary alcohols. Very low levels (0.2% based on solids) of catalysts such as dibutyl tin diacetate and dibutyl tin dilaurate promote this reaction effectively. *Table* 1 presents the relative isocyanate reactivity of monomeric IEM with other commercial isocyanates with respect to one model compound—1-butanol.[21]

Polymerized IEM Isocyanate Reactivity

The reactivity of the pendent isocyanates of IEM homopolymerized or copolymerized with acrylic or styrenic monomers remains fairly high.[21] *Table* 2 shows, for example, that the reaction rate of 1-butanol with polymerized IEM is about one-half that of monomeric IEM when using dibutyl tin dilaurate as catalyst. The copolymer is a random copolymer of IEM with methyl methacrylate (MMA) (50/50). The molecular weights of these polymers are about 20,000.

The retention of the NCO functionality can be in the range of 95%, provided active hydrogen-containing impurities and water are scrupulously excluded from the vinyl polymerization.

Effect of Hydrolyzable Chloride

The presence of chloride ion, including that available through hydrolysis (e.g., IEM-carbamoyl chloride), directly affects the rate of the NCO reaction with primary hydroxyl.[21] The rate increases with chloride concentration to just above 500 ppm concentration and decreases thereafter (See *Figure* 1).

The effect of hydrolyzable chloride in 1-butyl acetate using dibutyl tin dilaurate as a catalyst was studied. The reaction rate constant increases with an increase of hydrolyzable chloride, done by adding IEM-carbamoyl chloride in the reaction system. This effect on the catalysis of the IEM/1-butanol reaction is probably due to the interaction of the reactive chloride with the dibutyl tin dilaurate catalyst through ligand exchange.

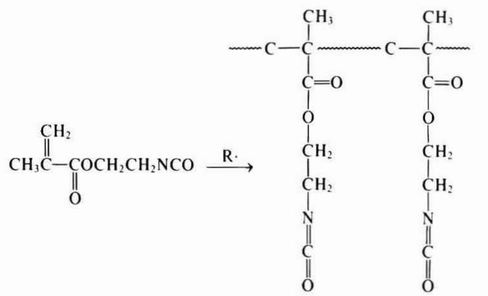
Reactivity of IEM Vinyl Group

Relative reactivity ratios have been determined for IEM/styrene and IEM/butyl acrylate[22] and are compared in *Table* 3 with those of methyl methacrylate.[23] In addition, IEM/methyl methacrylate relative reactivity ratios are given.[22]

The relative reactivity ratios of IEM and methyl methacrylate are very similar. Therefore, the relative reactivity ratio for methyl methacrylate in a resin polymerization with other vinyl monomers can be used to approximate that of IEM.

APPLICATIONS

Applications of Polyisocyanate



IEM can be considered a typical vinyl monomer, capable of either homo- or copolymerization by free radical initiation. For example, polymerization of IEM has been conducted in dry solvents using AIBN (azobisisobutyronitrile) initiator. The homopolymer has good stability under ambient conditions and shows a glass transition temperature of 60°C by differential scanning calorimeter (DSC). Retention of 90–95% of isocyanate functionality in the polymer is assured when water and active hydrogen-containing compounds are avoided.

With its very high percentage of isocyanate functionality (27% in the monomer), IEM will generally be used as a comonomer. A typical solution polymerization is described in the Appendix.

Moisture Cure

An acrylic polymer film can be crosslinked using a moisture cure at room temperature. *Table* 4 presents typical characteristics of such a coating.[24] The tack-free time, which in this case was less than five minutes, is a function of film thickness, relative humidity, and catalyst concentration and type. The other properties were determined after 16 days. Film characteristics depend upon the monomers chosen for the copolymer.

Two-Component Urethane

Using a polyisocyanate polymer, as shown in the moisture cure example above, in combination with a hydroxyl-containing second component, can produce a thermoset coating cured at either room temperature or slightly elevated temperatures. A wide variety of hydroxyl-containing polymers and resins can be used. The polyisocyanate component can, through choice of comonomers and molecular weight, be a contributor to the flexibility, hardness, and elasticity of the final coatings. Sprayable systems can be formulated by making polyisocyanate oligomers—low molecular weight polymers which have a low viscosity.

The patent literature describes two ways of obtaining low molecular weight species with IEM monomers ($\underline{M}w$= 500-10,000 and $\overline{M}w$ = 500-10,000).[14,15] Chain transfer agents and high initiator radical concentration are shown to control molecular weight in these polymers. The patents also describe the coating properties and weatherability compared with the commercial systems now available. For example, comparative gloss retention exposures in Florida show that the mercaptyl chain transfer agent approach to limiting molecular weight in the IEM-containing acrylic nearly equals the Desmondur® N cured films, and the high initiator approach to such limitation surpasses the Desmondur N-cured film.

Table 2—Reactivity of IEM-based Polymeric Isocyanate with 1-Butanol

Isocyanate	k_{cat}[a]
IEM Monomer	19
IEM Homopolymer	10
Copolymer of IEM-MMA	9

Conditions:
Solvent: 2-ethoxyethyl acetate[b]
Catalyst: dibutyl tin dilaurate
Temp.: 25°C
Alcohol: 1-butanol

(a) Units of k_{cat} are $kg^{1.5}/mole^{1.5}/min$.
(b) Recent toxicological studies point up that certain ethylene-based glycol ethers cause testicular damage and birth defects in rabbits and rats at certain levels of exposure. Users of these materials should consult the producer for toxicological information and direction for their appropriate use.

Two-Component Epoxy

Hydroxyl groups contained in epoxy resins can be reacted with polyisocyanates.[18] Coatings made with an IEM-containing acrylic copolymer (EA/MMA/IEM: 35/35/30) reacted with D.E.R.® 661 epoxy resin with the NCO/OH equivalents at 1:1 exhibit typically tough epoxy properties. The catalyst was lead octoate at 0.4% (based on solids). Curing at 100°C for 15 minutes resulted in hard, glossy coatings. *Table* 5 shows weathering properties of this film at 0 and 1,000 hours exposure in a Xenon lamp Weather-O-Meter.® No yellowing or chalking could be detected at 1,000 hours exposure.

Use of Polyisocyanate as Graft Site

A Rohm and Haas patent[4] describes the use of IEM in a copolymer to act as the graft site for amine terminated polystyrene. In this way, dissimilar polymers can be reacted to give polymer compositions with unusual rheology.

The reaction and subsequent binding of molecules or metal ions by the isocyanate could be useful in controlling mobility of those molecules or ions. They could be used as polymer additives, or as toxicants or medicants to produce bioactive systems. The materials, bound to the polymer backbone, could be more effectively delivered to the specific site without loss to the environment.*

Desmondur is a trademark of Mobay Chemical Co.
D.E.R. is a trademark of The Dow Chemical Co.
Weather-O-Meter is a trademark of Atlas Electric Devices Co.

Summary of Applications of Polyisocyanate

IEM-containing vinyl copolymers can be utilized as versatile polyisocyanates for urethane coatings, either self-curing or with polyols, in addition to hybrid systems where the second component may be a *hydroxyl*-containing epoxy, polyester, etc. Any compatible

*For a broader discussion of this concept, see the ACS Symposium on Biological Activity of Polymers Div. of Organic Coatings and Plastics Chemistry, Preprints, Volume 44, Atlanta, GA, March, 1981.

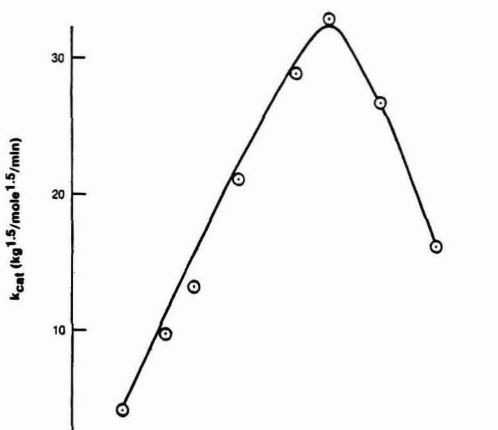


Figure 1—Hydrolyzable chloride effect on the IEM-1-butanol reaction. Conditions: Catalyst—dibutyl tin dilaurate (0.01–0.1 mmoles/kg); Solvent—1-butyl acetate (150 ppm H_2O); Temperature—25°C

Table 3—Relative Reactivity Ratios

Temperature	M_1	M_2
110°C	IEM $R_1 = 0.49$	Styrene $R_2 = 0.54$
99°C	Methyl Methacrylate $R_1 = 0.48$	Styrene $R_2 = 0.54$
115°C	IEM $R_1 = 1.62$	Butyl Acrylate $R_2 = 0.13$
60°	Methyl Methacrylate $R_1 = 1.74$	Butyl Acrylate $R_2 = 0.20$
115°	IEM $R_1 = 1.04$	Methyl Methacrylate $R_2 = 0.74$

Table 4—Moisture Cure of Ethyl Acrylate/Methyl Methyacrylate/IEM Copolymer

(35/35/30, Mw about 10,000)

	Substrate	
	Steel Panel	ABS 2mm Sheet
Tack-free time (min)	<5	<5
Reverse impact (in.-lb)	~30	—
MEK solvent resistance (double rubs, 2 lb pressure)	>200	>200
% Adhesion lost (crosshatch test) ...	<3	0
Pencil hardness	2H	2H

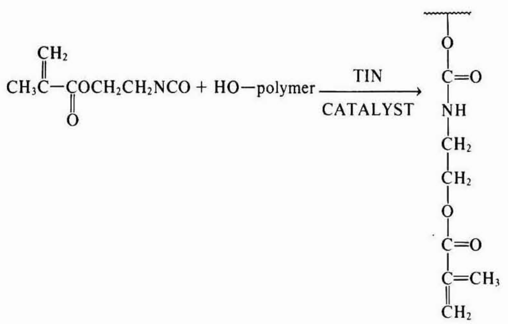
Conditions of Cure:
0.1% dibutyl tin dilaurate
25°C, 16 days, 65% R.H.

polymeric material with a controlled sequence of hydroxyl groups can be crosslinked by this polyisocyanate. In addition, the isocyanate group can be utilized as a graft site to bind dissimilar polymers, bioactive materials, polymer additives, and dyes.

Pendent Vinyl Reactions

The reaction of the isocyanate portion of the IEM monomer proceeds readily under mild conditions with hydroxyl, mercaptyl, or amine hydrogens, thus permitting the synthesis of vinyl-substituted reactive materials. Since the reactions are essentially of the addition type, there should be *no co-products formed*, and purification of the final product may not be required.

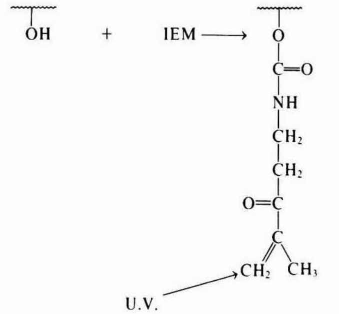
These can be further utilized as graft sites for crosslinking with radical initiators or by irradiation in the form shown.



Once the isocyanate is reacted with active hydrogen-containing compounds using urethane catalysts such as dibutyl tin dilaurate or amine, aqueous or protic solvents can be used for polymerization of the vinylic double bond.

Application of Pendent Vinyl Groups

The addition of IEM monomers to a hydroxyl-containing polymer to produce a photo relief system was illustrated in a patent issued to AGFA.[11] IEM was reacted with hydroxy propyl cellulose in conjunction with aryl carboxylic acid imides to produce a light-sensitive, crosslinking photographic material.



Cure through double bond

A One-Step Replacement Of Diisocyanate-Adduct Preparations

Toluene diisocyanate/hydroxy alkyl (meth)acrylate adducts are commonly used to append active vinyl groups to "core" molecules for radiation or free radical cure systems. IEM can be reacted with polymer hydroxyls quantitatively, often without catalyst and, if the resin is a liquid, without a solvent. This is an easy way to control the reaction, yielding a very clean product for subsequent use in free radical or radiation cured systems.

Radiation Cured Coatings

Tefertiller, et al. have shown that IEM can be used to produce polyethers with pendent vinyl groups[17] which can be utilized for flooring materials, wood paneling, and on paper, plastic, or sheet metal where weatherability of the coating is necessary. The coatings are relatively hard, tough, abrasion and chemical resistant with good adhesion to the substrate. *Table* 6 shows properties of radiation cured coatings utilizing urethane polyethers obtained from reaction of hydroxy terminated polypropylene glycol, IEM, and various reactive monomer diluents. The coated panel travelled 30.5 meters per minute under the radiation source—three 100 watt lamps. The coatings were covered with polyethylene terephthalate film during the exposure. The photo-initiator was benzoin ether added at three parts per hundred. The coatings showed good resistance to staining by mustard, lipstick, and ink.

Anaerobic Adhesive Application

By functionalizing dihydroxyl or diamine compounds—such as tetraethylene glycol—with IEM, similar adducts are formed that may be formulated in anaerobic adhesive systems which are particularly useful in bonding two metal surfaces. These adhesives are stabilized for storage with an oxygen-assisted inhibitor for free radical polymerization.[25] The formulation also contains an initiator and in some cases an activator. The anaerobic adhesive becomes reactive when the inhibitor is consumed or is inactivated by the exclusion of oxygen.

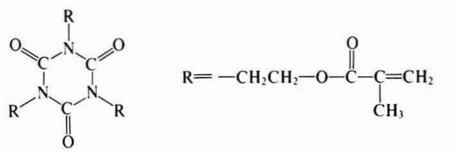
Summary of Applications For Pendent Vinyl Groups

The isocyanate group can be used to functionalize any molecule or polymer to produce a vinyl group, which can be utilized in further reactions—as in a polymer or as part of a matrix—by crosslinking initiated by free radicals generated by radiation or chemical means. The versatility of this functionalizing monomer is limited only by the activity of the methacrylate group.

IEM DERIVATIVES

Trimerization of IEM

IEM monomer has been trimerized by trialkyl or triarylphosphines to produce trimethacrylate isocyanurate in acetonitrile as a solvent. This is a white crystalline solid compound which melts at 81.5°–82.5°C. As an alternative for triallyl isocyanurate, the IEM trimer would provide high thermal stability in crosslinked plastic coatings or foams. It has been tested as a crosslinking component for urethane-acrylate coatings.



Formation of Urea

Catalyzed hydroxyl reactions with IEM are much faster than the well-known reaction of water (one mole) with isocyanate (2 moles) which yields urea. The IEM-reaction could be used to advantage when a crosslinking system is desired. However, it will often cause gelling problems when the monomeric and polymeric systems containing isocyanate have not been rigorously protected from water contamination. The urea compound from monomeric IEM is a white solid with a melting point of 60°–70°C. It is soluble in most hydrogen bonding or polar solvents, but it is only slightly soluble in IEM monomer.

Table 5—An Epoxy/Acrylic Hybrid Coating

Exposure Time (hrs)[a]	Hardness[b]	Solvent Resistance[c]	Toughness[d]	% Adhesion Loss[e]	Gloss (60°)[f]
0	4H	>100 MEK	8	1	90
1000	6H	>100 MEK	4	2	90

(a) Xenon lamp Weather-O-Meter, ASTM D-822.
(b) Pencil Hardness—lead that would not penetrate film.
(c) Methyl ethyl ketone double rubs to failure with 32 oz gauze covered hammer.
(d) Reverse impact—minimum inch-pounds causing failure.
(e) Cross hatch adhesion—% of coating lost.
(f) By ASTM D-1455.

BLOCKED IEM MONOMERS AND POLYMERS

Blocked isocyanate compounds have been used in coatings and related industries for many years. A number of IEM adducts have been made in Dow laboratories. The results of these studies will be published in the near future.[20]

TOXICITY

Inhalation

Acute vapor inhalation tests have shown IEM to be an upper respiratory irritant at very low concentrations. Even short exposures could be harmful. The LC50 for one hour for rats is 25 ppm. Extreme care should be taken to avoid breathing IEM vapors, which may produce allergic asthma.

Based on our present level of experience, Dow recommends the average eight-hour working environment not exceed 0.025 ppm.*

Ingestion

The single dose oral toxicity of the test material is low; the LD50 for rats is approximately 670–2000 mg/kg when dosed as a 10% solution in corn oil. Undiluted material would irritate and might burn mucous membranes.

* These conclusions are based upon range finding toxicological tests and are limited to precautions for industrial handling of the material. Development of specific uses will require consideration of the potential for human exposure and the need for further toxicological studies.

MARY THOMAS is a Research Leader in the Organic Chemicals Department, Dow Chemical U.S.A., Midland, MI. Over the last 10 years, she has participated in several coatings technology projects involving monomers produced by Dow. She is a member of ASTM, Committees D-1 and D-14, and a member of the Polymer Chemistry Division and the Division of Organic Coatings and Plastics Chemistry of the American Chemical Society.

Table 6—Radiation Cured Coatings

Polyol Type[a]	Mole Ratio	Crosslinker[b]	Radiation Passes	Hardness	Solvent Resistance MEK Rubs	Toughness Rev. Impact in-lb
A PPG400	2:1	TMPTA	5	HB	>100	4
B GPPG260	3:1	PEA	1	4H	>100	>4
C PO-EO4700 GPPG260	3:1	TMPTA	3	3H	>100	10
D PO-EO4700 PPG400	3:1 2:1	TMPTA	3	2H	>100	40
E GPPG260	1:0.67	None	1	2H	>100	12

(a) PPG400—polypropylene glycol (molecular weight 400). GPPG260—glycerine initiated polypropylene glycol (mol. wt. 260). PO-EO4700—glycerine initiated polyalkylene glycol made from propylene oxide and ethylene oxide (mol. wt. 4700). In C and D, the IEM terminated polyols were used 1:1.
(b) TMPTA—trimethyl propane triacrylate. PEA—phenoxyethyl acrylate. Concentration used: 20 parts per hundred in A–D.

Eye Contact

IEM has an extremely severe effect upon the eyes. Direct contact with the material may result in tissue destruction leading to permanent vision impairment. Special precautions must be taken to prevent eye contact with this material. Chemical workers' goggles are essential when working with IEM. If contaminated, eyes must be flushed immediately with plenty of flowing tap water for at least 30 minutes. Medical attention must be obtained immediately.

Skin Contact

Brief skin contact with IEM, especially if the material is confined under clothing, can result in moderate redness, moderate swelling, and a moderate chemical burn. The LD50 for rabbits is between 1000 and 2000 mg/kg. Toxic amounts of the material could be absorbed, especially upon *gross confined exposure.* Precautions must be taken to prevent any skin contact with this material. Protective clothing which is impervious to IEM must be worn whenever the likelihood of skin contact exists. Caution: IEM will penetrate rubber suits in 10 minutes. If skin contact should occur, all contaminated clothing, including shoes, must be removed immediately and the affected skin area flushed thoroughly with water from a safety shower or other suitable device. Clean the skin with soap and plenty of water. Medical attention should be obtained. Contaminated clothing or shoes must be destroyed since complete decontamination is unlikely. Isocyanate compounds may also be skin sensitizers.

Further References on Toxicity

For safe practice, users of this monomer should consult the brochure "Safe Handling and Storage of Isocyanatoethyl Methacrylate," and the Material Safety Data Sheet on IEM available from The Dow Chemical Co., Organic Chemicals Dept., Midland, MI 48640.

CONCLUSIONS AND SUMMARY

Isocyanatoethyl methacrylate (IEM) is a versatile heterofunctional monomer with simple chemistry for urethane and acrylic vinyl systems. It provides dual functionality with many identified applications. Urethane type crosslinking is given by pendent isocyanates in polymers and resins when the vinyl group is copolymerized with vinyl monomers. The isocyanate group may be used to provide a molecule, resin, or polymer with vinyl functionality for further free radical reaction.

References

(1) Bortnick, N.M., U.S. Patent No. 2,718,516, Rohm and Haas (1955), Isocyanato esters of acrylic, methacrylic and crotonic acids.
(2) Holtschmidt, H., U.S. 2,821,544, Bayer (1958), Production of alkylisocyanate esters of 2-alkenoic acids.
(3) Dietrich, W., Bayer, O., Rinke, H., and Siefken, W., British Patent No. 822,861 (1956).
(4) Graham, R.K., U.S. Patent No. 2,882,259, Rohm and Haas (1959). Segmented polymers prepared by reaction of IEM copolymers with amine terminated polystyrene.
(5) Suling, C.H. and Kuntz, E., U.S. Patent No. 3,299,007, Bayer (1967). Interpolymer of acrylonitrile, a masked isocyanate and a hydroxyl substituted monomer and a process for making same. Copolymers of blocked IEM and hydroxyl containing vinyl esters and amines which thermally cure at 130°C.
(6) Suling, C.H. and Kuntz, E., U.S. Patent No. 3,453,223, Bayer (1969). Graft copolymers are prepared by copolymerizing acrylonitrile and t-butanol blocked IEM with polyvinyl alcohol at 55°C. The polymers crosslink thermally at 125–140°C.
(7) Schnell, H., Malamet, G., and Krimm, H., British Patent No. 1,187,194 and 1,187,195, Bayer (1970). Polymers are made with bis (phenol)-A blocked IEM to give copolymer systems which will thermally deblock and flow.
(8) British Patent No. 1,202,777, Bayer (1970). IEM monomer is blocked with acetone oxime which will thermally deblock at 138–150°C.
(9) Wood, H.W., British Patent No. 1,322,971, Ilford (1970). IEM bisulfite can be used to block polymers and copolymers which are claimed to be water soluble. Deblocking is claimed to take place at relatively low temperature (50°C). Sulfoethyl methacrylate copolymers are made which cure silver/gelatin emulsions.
(10) Quiring, B. and Wagner K., British Patent No. 1,354,783, Bayer (1971). An air or stove-drying lacquer binder may be made from IEM in copolymer with isocyanate pendent which may be used as graft site for polyester polyol, amino functional polymer or polymers containing hydroxyl or carboxyl groups.

(11) Rosenkranz, H.J., U.S. Patent No. 3,782,950, AGFA (1974). IEM is reacted with hydroxypropyl cellulose to give light sensitive, crosslinking photographic material in conjunction with aryl carboxylic acid imides. A relief area is obtained after removing the unexposed areas.
(12) Rosenkranz, H.J., Rudolph, H., Wolff, E., and VonRintelen, H., U.S. Patent No. 3,928,299, Bayer (1975). Polymers which contain urethane groups and which are crosslinkable by vinyl polymerization. Vinyl polymers containing pendent hydroxyls are reacted with IEM to give light sensitive photographic materials.
(13) Walus, A., U.S. Patent No. 4,273,690, DuPont (1981). Coatings using acrylic copolymer with IEM to graft alkyd resin side chains through hydroxyl or carboxyl group to acrylic backbone.
(14) Simms, J. A., U.S. Patent No. 4,291,632, DuPont (1980). Low molecular weight isocyanato-acrylic copolymers. Low molecular weight copolymers are prepared with high levels of IEM. They are used as hardeners for weatherable 2-component urethane paints.
(15) Brixius, D.W. and Simms, J.A., U.S. Patent No. 4,222,909, DuPont (1980). Coating compositions comprising isocyanate functional polymers containing a thermal thioalkyl group. Low molecular weight copolymers are prepared with high levels of mercaptan chain transfer agent which becomes incorporated into the polymer system.
(16) Hertler, W.R., U.S. Patent No. 4,251,421, DuPont (1980). Coating compositions containing polymers with isocyano groups and nickel oligomerizations catalysts. Crosslinking film groups and a nickel oligomerization catalysts for use in ambient cure finishes.
(17) Tefertiller, N.B., Burdett, K., and Harris, R.F., U.S. Patent No. 4,233,425, Dow (1980). Addition polymerizable polyethers having pendent groups for radiation or chemically curable coatings. Urethanes are prepared from polyether polyol and IEM monomer or similar isocyanate alkyl ester of an α, β-ethylinically unsaturated carboxylic acid.
(18) Oriel, S.L., Tefertiller, N.B., Bozzelli, J.W., and Regulski, T.W., U.S. Patent No. 4,264,748, Dow (1980). Curable composition containing an epoxy resin with active hydrogens and an addition copolymer of IEM containing isocyanate pendent groups.
(19) Saunders, F.L., "Latex Compositions Containing Blocked Isocyanatoethyl Methacrylate," to be published.
(20) Regulski, T.W. and Thomas, M.R., "Two Parts on Isocyanatoethyl Methacrylate Blocked Derivatives," to be published.
(21) Frisch, K.C., Kresta, J., and Wongkamolsech, K., University of Detroit, Polymer Institute, to be published.
(22) Frisch, K., Kresta, J., and Wongkamolsech, K., University of Detroit, Polymer Institute, K. Frisch, Jr., G. Stuk, J. Bozzelli, Dow Chemical, Unpublished data.
(23) Brandrup, J. and Immergut, E.H., "Polymer Handbook," 2nd Edition, J. Wiley & Sons, New York 1975.
(24) Oriel, S.L. and Flowers, J.M., Dow Patents Pending.
(25) Hoffman, D., U.S. Patent 4,320,221, Dow (1982), Addition polymerizable isocyanate-polyol anaerobic adhesives.

APPENDIX

Following is a typical solution polymerization for preparing a copolymer containing 30% by weight of IEM with 35% ethyl acrylate (EA) and 35% methyl methacrylate (MMA):

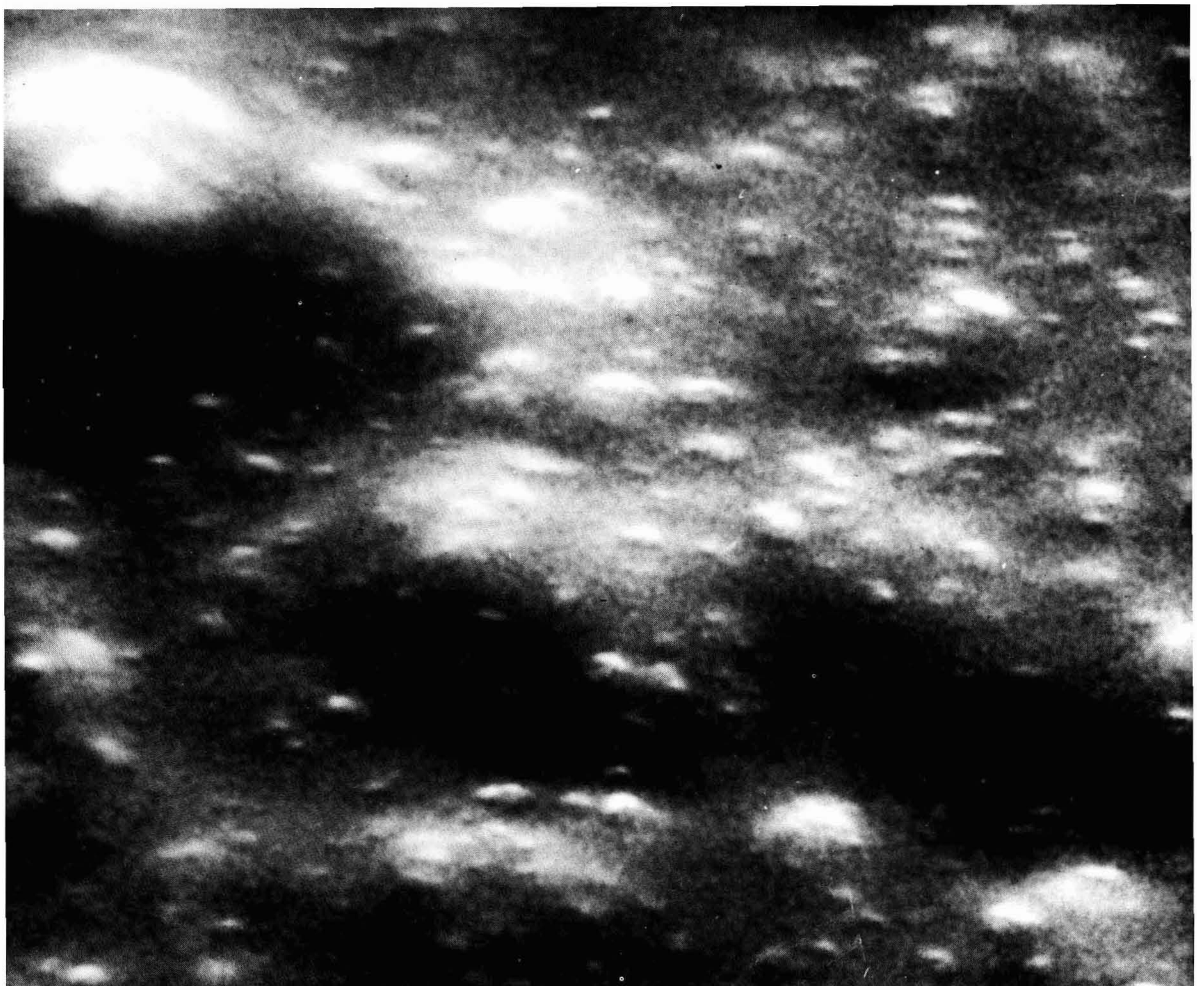
One hundred grams of urethane grade 2-ethoxyethyl acetate, predried over molecular sieves, is heated to 115°C in a pre-oven-dried, dry nitrogen purged, 3-necked 500 mL round bottomed flask. A mixture of sieve-dried EA (35g), sieve-dried MMA (35g), IEM (30g), and VAZ064® azobisisobutyronitrile (2% based on monomer concentration) is added drop-wise to the stirred, heated solvent over a two-hour period and then post-reacted with azobisisobutyronitrile (0.5g) in 25 mL of 2-ethoxyethyl acetate* added over three hours while maintaining the temperature at 115°C. Typically, >99.0% of the IEM will be polymerized, and the polymer will have an molecular weight of ~10,000.

Polymers prepared by this method will contain >90.0% of the theoretical isocyanate. Glass and stainless steel are suitable scale-up reactor materials.

To determine molecular weights, the dissolved polymer should be post reacted with excess dry methanol at 65°C for two hours, precipitated with hexane and dried in a vacuum oven at 60°C for three hours.

VAZ064 is a trademark of E.I. du Pont de Nemours & Co., Inc.

*Recent toxicological studies point out that certain ethylene-based glycol ethers cause testicular damage and birth defects in rabbits and rats at certain levels of exposure. Users of these materials should consult the producer for toxicological information and direction of their appropriate use.



Actual 2000X photomicrograph of a coating containing PPG Lo-Vel

Structure-Property Relationships For Radiation Curable Coatings

A. Priola, F. Renzi, and S. Cesca
ASSORENI*

The influence of some modifications of a typical epoxy-acrylic resin on UV cured films was investigated. Mechanical properties of free films and performance properties of films coated on steel sheets were determined. The properties of free films were evaluated by stress-strain diagrams and dynamic-mechanical analysis. A first modification of the resin was obtained by employing reactive diluents having different molecular structure and acrylic functionality, i.e., EHA, HBA, NVP, DEGDA, PEGDA, and TMPTA. It was observed that EHA, HBA, and PEGDA give rise to the best flexibility, while NVP increases the Tg value of the film. DEGDA and TMPTA increase the Tg and the mechanical properties of the film. Another type of modification was obtained by introducing flexible segments in the polymer chain, i.e., diethylenglycol polycarbonate or polyethylene oxide. The result was an increase of the film flexibility and a decrease of the Tg value and mechanical properties. Finally, the influence of a chain-transfer agent, lauryl thioglycolate, was studied. It modified the mechanical properties of the free films and increased their flexibility, but the same effects were not observed when the film was coated on steel sheets. Chemical resistance and weathering of the prepared coatings were also investigated.

INTRODUCTION

Curing of acrylic monomers and oligomers by UV radiation is increasing in industrial importance, in particular for coating of wood, paper, plastics, and tin plate and for curing ink. The advantages of using UV irradiation technology are high productivity, low energy consumption, and low environmental pollution. There are some unsolved problems that presently prevent larger applications of this new technology. Of particular importance are the mechanical properties of films resulting from UV curing, adhesion to substrates, and protecting characteristics. In fact, these properties are usually lower than those obtainable with thermal coating.

Some reviews[1] and several studies on the general characteristics of UV coatings and the modification of their properties by different additives have been reported.[2-4] However, systematic investigations concerning structure property relationships seldom have been published,[5,6] despite their usefulness in solving the problems mentioned above.

In this work we have examined systematically some possibilities of modifying the properties of a typical epoxy-acrylic resin and the correlation between some fundamental properties and the chemical structure of the products used. These properties have been determined on both free films and films coated on steel sheets and the two series of data have been compared.

EXPERIMENTAL

Materials

The reactive diluents, listed in *Table* 1, are commercial products used as received.

Resin A was prepared by acrylation of a commercial sample of bisphenol-A-diglycidyl-ether (DGEBA) having an epoxide equivalent of 195, according to the conditions reported elsewhere.[5]

Resin B was prepared as follows. A sample of diethylenglycol polycarbonate (DEGPC) having $\overline{M}_n = 450$ and an $-OH$ content of 7.5% was used; it had been prepared by alcoholysis of diethyl carbonate by diethylenglycol. Actually, 9.8 g (0.1 mole) of maleic anhydride was added to 23 g (0.1 $-$ OH equivalent) of DEGPC dissolved in ethyl acetate and the solution was heated under stirring up to 90°C and maintained at this temperature for 5 hr. Subsequently, 39 g of DGEBA resin, having an epoxide equivalent of 195, were added simultaneously with 1.0 cm^3 of benzyl-dimethyl-amine and the solution was kept

*Polymer Research Laboratories, San Donato Milanese, 20097, Italy. Prof. Priola's present address is Dept. of Materials Science and Chemical Engineering, Politecnico di Torino—10129, Torino, Italy.

Table 1—Some Properties of the Reactive Diluents Used

Reactive diluent	Unsaturate equivalent	Functionality	η 25°C (cps)
1-ethyl-hexyl-acrylate, EHA	184	1	~10
4-hydroxy-butyl-acrylate, HBA	142	1	10
N-vinyl-pyrrolidone, NVP	111	1	12
Diethylene-glycol-diacrylate, DEGDA	107	2	13
Polyethylene-glycol (400)-diacrylate, PEGDA	254	2	46
Trimethylol-propane-triacrylate, TMPTA	98	3	86

at 90°C for 4 hr. Finally, 7.2 g of acrylic acid were poured into the mixture and the reaction continued at 80°C for 7 hr. At the end, the solvent was removed by distillation in vacuo. The final resin showed an acid number of 15. The curve obtained from GPC analysis is reported in *Figure* 1.

Resin C was prepared as described for Resin B, but a commercial sample of polyethyleneglycol having $\overline{M}_n$ = 400 was used as starting oligomer, instead of DEGPC. After removal of solvent, the final resin showed an acid number of 7.5. The GPC diagram of the product is shown in *Figure* 2.

Both resin B and C have been used in solution with 20% of DEGDA because of their high viscosity. Lauryl thioglycolate (LT) was prepared by esterification in benzene of lauryl alcohol with thioglycolic acid in the presence of traces of p-toluene sulfonic acid. The water formed during esterification was separated with a Markusson head. The reaction product was then distilled in vacuo (b.p. = 140-4°C at 0.2 mm Hg) and characterized by IR and NMR analysis.

Curing

The resins, mixed with 5% b.w. of photoinitiator (Darocur 1173, i.e., 2-hydroxy-2-methyl-1-phenyl propanone-1), were coated on sheets of sanded steel to obtain a thickness of about 30 μm.

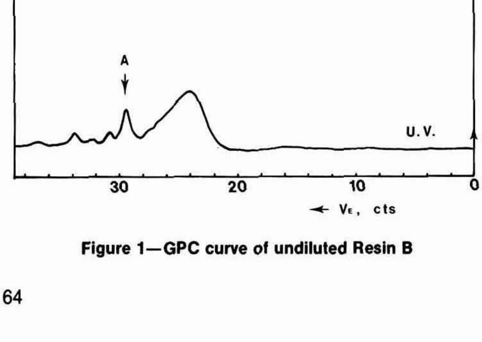


Figure 1—GPC curve of undiluted Resin B

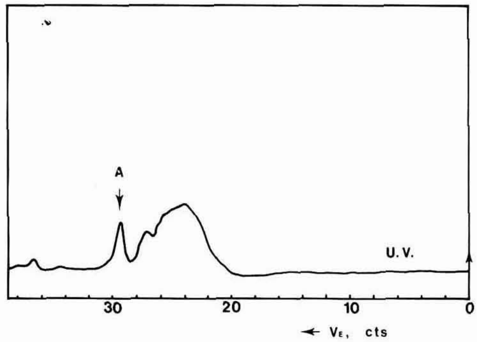


Figure 2—GPC curve of undiluted Resin C

The mechanical properties of samples were determined on free films prepared by applying the curing mixture on a glass plate, passing it under the UV lamp (see below), peeling the film from the glass plate and completing the curing process by irradiating both the sides of the film.

Both the coated sheets and the free films were irradiated by using an IST-200/1 Labor Hildebrand instrument equipped with a 80 W cm^{-1} medium pressure mercury lamp, at a distance of 11 cm. The samples were passed under the lamp 20 times with a belt speed of $24 m.min^{-1}$. After 20 passes, the sample hardness had reached an asymptotic maximum value.

The kinetics of curing were investigated by measuring the intensity of the IR absorption band (Perkin Elmer model 225 instrument) occurring at 1633 cm^{-1}. This band is due to the double bonds present in the curing mixture. In practice, thin films were coated on a NaCl plate and

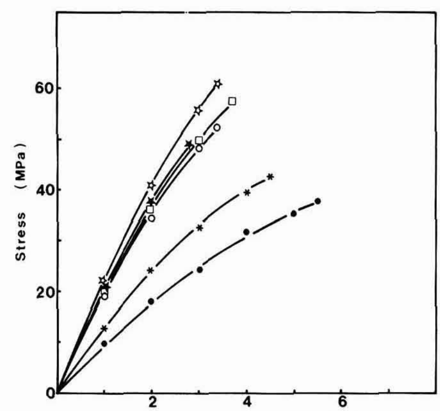


Figure 3—Stress-strain curves relative to free films (thickness 300 μm); ☆ Resin A pure; ● Resin A—EHA (20% mixture); * Resin A—HBA (20% mixture); ○ Resin A—NVP (20% mixture); □ Resin A—DEGDA (20% mixture); * Resin A—PEGDA (20% mixture); ★ Resin A—TMPTA (20% mixture)

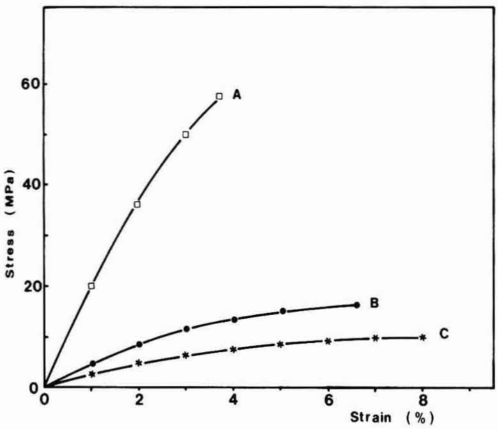


Figure 4—Stress-strain curves relative to free films from Resin A, B, and C diluted with 20% of DEGDA. ☆ Resin A; ● Resin B; * Resin C

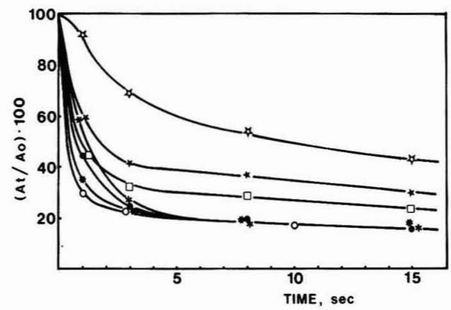


Figure 6—Kinetic curves pertaining to Resin A—reactive diluents mixtures. Relative value of the absorbance at 1633 cm^{-1} vs the irradiation time. ☆ Resin A pure; ● Resin A—EHA (20% mixture); * Resin A—HBA (20% mixture); O Resin A—NVP (20% mixture); □ Resin A—DEGDA (20% mixture); * Resin A—PEGDA (20% mixture); ★ Resin A—TMPTA (20% mixture)

submitted to irradiation for increasing periods of time under a 500 W medium pressure mercury lamp at a distance of 12 cm using an experimental device similar to that previously reported.[7]

Testing Methods

The mechanical properties of free films were measured with an Instron Tensile tester using a gauge length of 50 mm and 5 mm/min strain rate. The curves shown in *Figures* 3, 4, and 5 are typical stress-strain curves. The film thickness was 0.30 mm.

The dynamic-mechanical properties were measured with a Rheovibron instrument DDV-II at 110 Hz. The size of the specimen strips was: 0.2 × 6.0 × 0.02 cm. The thickness of samples was chosen on the basis of the instruments' requirements for achieving accurate measurements.

The values of Tg were obtained from the maximum tan δ vs temperature curves.

The gel percentage was determined by the weight difference of the sample after 24 hr immersion in CH_2Cl_2.

The amount of shrinkage occurring during UV curing was determined by using the following equation:

$$\Delta V = \frac{\text{density after curing—density before curing}}{\text{density after curing}} \times 100$$

Absolute viscosity determinations were performed at 25° C by using a Brookfield Thermocell viscometer.

König hardness was evaluated according to FN Unichim 91 standard.

Adhesion measurements were performed according to the standard cross-cut method (DIN 53151), making the cross-cut incision followed by tape test.

The impact resistance and the impact flexibility

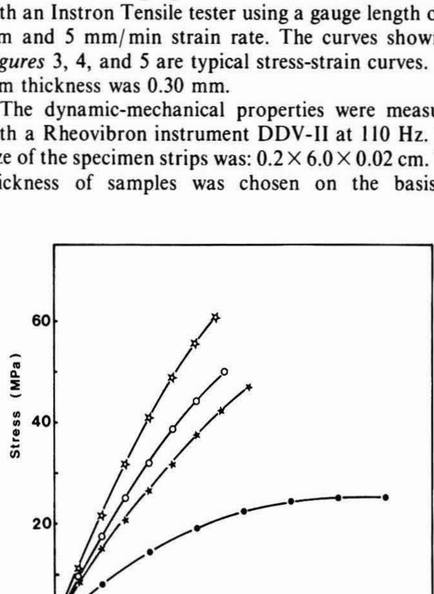


Figure 5—Stress-strain curves relative to free films from Resin A—LT mixtures. ☆ Resin A pure; O Resin A—5% LT; ★ Resin A—10% LT; ● Resin A—15% LT

Table 2—Properties of Free Films Obtained from Resin A And 20% b.w. Mixtures with Reactive Diluents

	Resin A	EHA	HBA	NVP	DEGDA	PEGDA	TMPTA
Gel (%)	96.1	93.7	95.1	95.9	96.1	95.9	98.6
Shrinkage (%)......	6.3	5.1	6.5	3.8	8.6	6.0	6.4
Tensile strength (MPa) ...	61.0	37.5	—	52.5	57.5	42.5	49.0
Elongation at break (%)......	3.4	5.5	—	3.4	3.7	4.5	2.8
Tg (°C)	122	100	100	138	130	106	146
E′ (MPa)[a]...	65	38	63	53	80	74	170

(a) at 170°C.

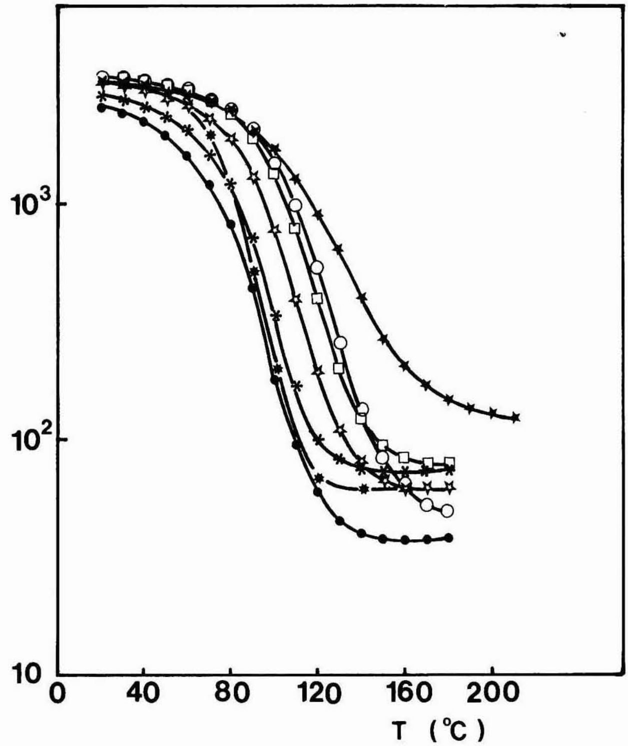


Figure 7—Dynamic moduli at 110 Hz vs temperature. ☆ Resin A pure; ● Resin A—EHA (20% mixture); ✱ Resin A—HBA (20% mixture); O Resin A—NVP (20% mixture); □ Resin A—DEGDA (20% mixture); * Resin A—PEGDA (20% mixture); ★ Resin A—TMPTA (20% mixture)

measurements were carried out with a Gardner Impact tester (ASTM D 2794) and G.E. Impact Flex. tester (FT MS 141-6226), respectively. Water absorption was determined by measuring the weight difference of the film after 24 hr immersion in distilled H_2O at 25°C.

Weathering measurements were carried out with an Atlas instrument equipped with a 6000 W Xenon lamp, at 63°C and with 50% relative humidity. Chemical resistance was evaluated at room temperature by placing drops of different chemicals on the film. The droplets were covered with a watch glass to prevent evaporation, and the effect was noted after 24 hours.

GPC analysis was carried out with an ALG-GPC Waters Instrument model 201 using THF as a solvent at room temperature with the following set of Ultra-Styragel columns: 100, 100, 500, 1000 Å.

Molecular distillation operations were performed with a Leybold KDL1 Instrument.

RESULTS AND DISCUSSION

Influence of Reactive Monomers

The reactive diluents used in the study and some of their characteristics are listed in *Table* 1. EHA, HBA, and NVP were chosen to evaluate the influence of the molecular structure, the presence of hydroxyl groups, and the presence of unsaturation different from the acrylic unsaturation. Among bifunctional monomers we have selected DEGDA and PEGDA having the same structure but different molecular weights. Finally TMPTA was chosen as a typical trifunctional monomer.

The influence of reactive diluents on the kinetics of disappearance of unsaturation was investigated by IR spectroscopy. Results are shown in *Figure* 6 where the behavior of the reference, Resin A, and its mixtures with 20% b.w. of different diluents are compared. It is evident that, under the conditions adopted, 60% of the acrylic unsaturation of Resin A is converted within the first 10 seconds. Each reactive diluent increases the rate of disappearance of unsaturation and also increases the asymptotic conversion value. The capability of increasing the overall kinetics of curing varies according to the the following order: NVP > HBA ≃ EHA ≃ PEGDA > DEGDA > TMPTA. Therefore, the lower the acrylic functionality, the higher the flexibility contributed by the diluent in the film and, hence, the higher the conversion rate of all the unsaturation present in the curing mixture.

These results may be interpreted by representing the reactive diluents as plasticizers which permit a higher mobility of the reactive species present in the film. This postulate is in agreement with previously reported data obtained by means of DSC analysis.[8] Evidently, attaining a different final unsaturation conversion also implies

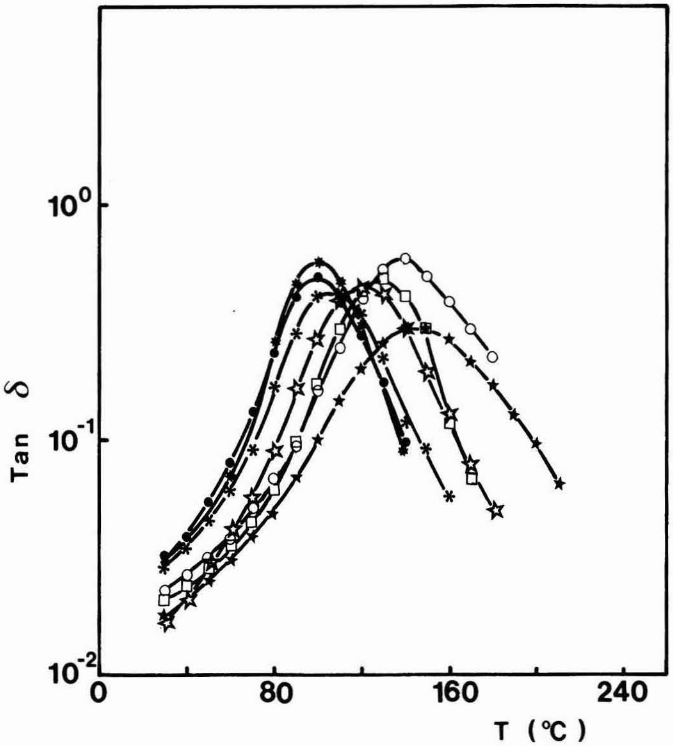


Figure 8—Tan δ at 110 Hz vs temperature. ☆ Resin A pure; ● Resin A—EHA (20% mixture); ✱ Resin A—HBA (20% mixture); ○ Resin A—NVP (20% mixture); □ Resin A—DEGDA (20% mixture); * Resin A—PEGDA (20% mixture); ★ Resin A—TMPTA (20% mixture)

the attaining of different crosslink density in the final network. This factor may be important in interpreting the results of the paint performance tests, reported below, which were carried out on specimens irradiated until the maximum hardness value was reached. Unfortunately, it was impossible to accurately determine the final degree of conversion in these samples.

Figure 3 shows the stress-strain diagrams obtained with free films resulting from Resin A and its mixtures with the reactive diluents listed in *Figure* 6. Tensile strength and elongation at break data, pertaining to the samples of *Figure* 3, are also reported in *Table* 2. The order of values of tensile strength, which are an index of the specimen cohesion, are as follows: Resin A > DEGDA > NVP ≃ TMPTA > PEGDA > EHA.

Conversely, the elongation at break, which may be considered an indication of the sample flexibility, varies according to the following order: EHA > PEGDA > DEGDA ≃ NVP ≃ Resin A > TMPTA. These results suggest that greater flexibility is obtained with monofunctional diluents such as EHA or with difunctional diluents that have a high unsaturation equivalent such as PEGDA.

The behavior of NVP is different from that of other monofunctional monomers probably because of its high polarity and rigidity of the resulting chain. Results

Table 3—Properties of Films From Resin A and Its Mixtures With Reactive Diluents, Coated on Steel Sheets

		EHA			HBA		NVP			DEGDA			PEGDA			TMPTA		
Resin A (%)	100	90	80	60	80	60	90	80	60	90	80	60	90	80	60	90	80	60
Reactive diluent (%)	0	10	20	40	20	40	10	20	40	10	20	40	10	20	40	10	20	0
$\eta^{25°C}$ (Poise)	57000	480	62	3	197	20	1000	135	5	690	102	8	—	388	25	1900	550	76
Adhesion (%) (cross-hatching)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Tape adhesion (%)	30	0	5	30	0	40	0	5	40	0	0	0	0	0	20	0	0	0
König hardness	139	152	140	75	157	45	140	170	160	175	173	168	134	145	73	156	173	175
Impact resistance (kg·cm)	2.5	2.5	2.5	17.5	2.5	150	2.5	2.5	2.5	2.5	3.5	3.5	2.5	2.5	75	2.5	2.5	2.5
Impact flexibility (%)	0.5	1	2	5	2	20	0.5	0.5	0.5	0.5	0.5	1	0.5	1	40	0.3	1	0.5

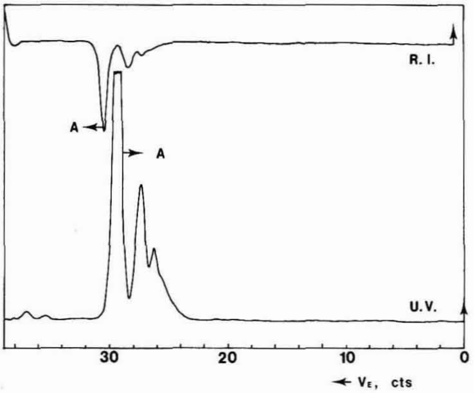


Figure 9—GPC curve of undiluted Resin A (UV and RI detector)

Table 4—Properties After UV Curing of Free Films Obtained from Modified DGEBA Resins Diluted With 20% b.w. of DEGDA

	Resin A	Resin B	Resin C
Gel (%)	96.1	94.0	92.0
Shrinkage (%)	8.6	3.6	3.5
Tensile strength (MPa)	57.5	16.3	10.0
Elongation at break (%)	3.7	6.6	8.0
Tg (°C)	130	90	70
E′ (MPa)[a]	80	48	47

(a) at 170°C.

concerning the use of this peculiar monomer have been reported elsewhere.[2-4]

The results now discussed can be better interpreted by examining the dynamic-mechanical spectra reported in *Figures* 7 and 8.

At low temperatures the values of storage modulus, E′, tend to coalesce, while at high temperatures the E′ values of different samples are ordered as follows (*Figure* 7): TMPTA > DEGDA > PEGDA > Resin A ≃ HBA > NVP > EHA.

The value of E′ increases when the crosslink density of the network, depending on the monomer functionality, increases.[5,9] The peak in the plot of tanδ vs T has been used to evaluate Tg.[10] According to *Figure* 6, the order of decreasing Tg is: TMPTA > NVP > DEGDA > Resin A > PEGDA > HBA ≃ EHA. Therefore, the value of Tg of cured Resin A is lowered with monofunctional diluents and PEGDA, whereas the use of DEGDA and TMPTA causes an increase in crosslink density and hence of Tg. The behavior of NVP is different from that

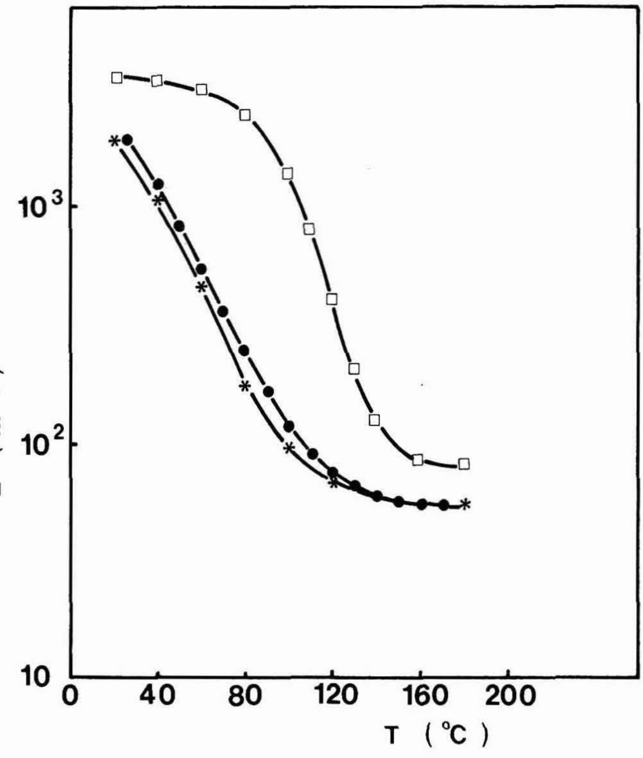


Figure 10—Dynamic moduli at 110 Hz vs temperature for the Resins A, B, and C diluted with 20% of DEGDA. ☆ Resin A; ● Resin B; * Resin C

of other monofunctional diluents as was observed with the stress-strain data mentioned above.

Table 2 also shows the values of the volume shrinkage observed during film curing. The ranking of the data is between 6 and 8.6 % and differences can be foreseen only in part on the basis of the structure and the acrylic functionality of the reactive diluent. In fact, the degree of conversion of unsaturations is probably incomplete (in particular in the case of TMPTA), and it may reach different levels depending on the type of diluent used.

Some performance properties pertaining to films of Resin A coated on steel sheets and to films obtained from Resin A mixed with different percentages of different diluents are reported in *Table* 3. The tape adhesion data indicate that the UV cured Resin A adheres to steel only in part and this tendency is depressed by the presence of modest amounts (10–20%) of monofunctional diluents. Only when the percentage of the reactive diluent reaches 40% do we observe tape adhesion values close to that of the pure Resin. Under the conditions adopted, bi- and tri-functional diluents display worse adhesion behavior than the monofunctional ones. Several factors, such as viscosity, substrate wetting, and film flexibility, can influence the complex adhesion behavior of a coating system.[6] Hardness and impact test results are also given in *Table* 3. Film hardness decreases when monomers which decrease Tg of the film (EHA, HBA, PEGDA) are used, while the opposite occurs with other reactive diluents (NVP, DEGDA, TMPTA). The impact and flexibility resistance, vary as follows: HBA $\simeq$ EHA $\simeq$ PEGDA > DEGDA $\simeq$ NVP $\simeq$ Resin A $\simeq$ TMPTA, in agreement with the order observed above for the elongation at break of free films.

Finally, it can be noted that EHA and NVP induce the sharpest lowering of the mixture viscosity before curing.

Modification of the Oligomer Structure

The results discussed in the previous section have been obtained by using a typical epoxy-acrylic resin (denoted Resin A) obtained by acrylation of a liquid epoxy resin; its GPC diagram is reported in *Figure* 9. It shows a peak A largely prevalent, which was attributed to the diacrylate of bisphenol-A-diglycidyl-ether (DGEBA). This peak assignment was made by comparison with the pure product obtained by molecular distillation from Resin A. The residual peaks may be attributed to modest amounts of higher homologues.

Subsequently, the structure of Resin A was modified by introducing flexible segments along the oligomeric chain, as described in the Experimental Section. Two flexible segments were used: (a) diethylenglycol polycarbonate (DEGPC) having $\overline{M}_n = 450$ (Resin B), and (b) polyethyleneoxide (PEO) having $\overline{M}_n = 400$ (Resin C).

The corresponding GPC diagrams of the final products are shown in *Figures* 1 and 2, respectively. Both diagrams show the presence of residual diacrylate of

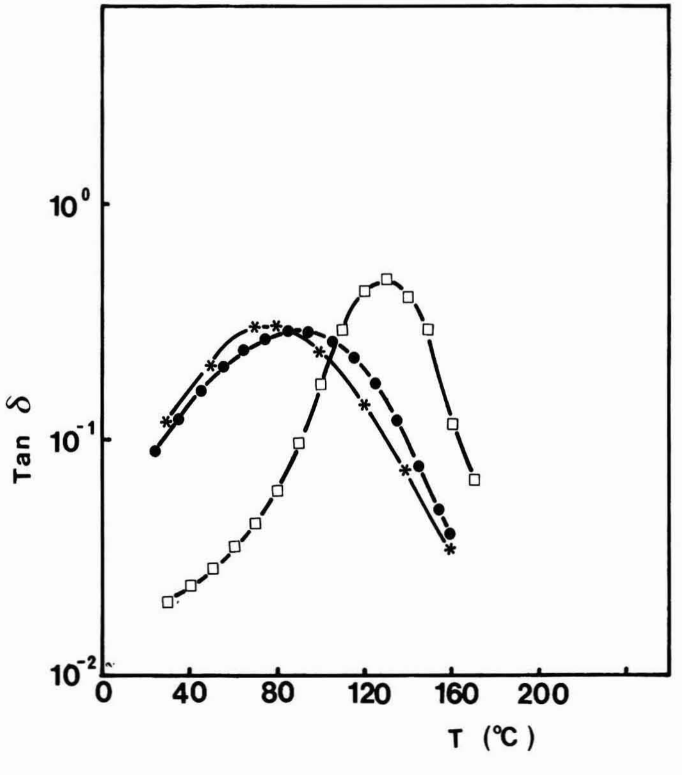


Figure 11—Tan δ at 110 Hz vs temperature for the Resins A, B, and C diluted with 20% of DEGDA. ☆ Resin A; ● Resin B; * Resin C

Table 5—Properties of Films from Modified DEGBA Resins Diluted with 20% b.w. of DEGDA and Coated on Sheets of Steel

	Resin A	Resin B	Resin C
Adhesion (%) (cross-hatching)	100	100	100
Tape adhesion (%)	0	40	10
König hardness	173	78	77
Impact resistance (kg · cm)	3.5	5	27.5
Impact flexibility (%)	0.5	5	20

Table 6—Properties of Films Obtained from Mixtures Of Resin A with Lauryl-Thioglycolate (LT)

Resin A (%)	100	95	90	85
LT (%)	0	5	10	15
Gel (%)	96.1	94.3	93.7	92.1
Sulfur content[a] (%)	—	0.59 (0.61)	1.09 (1.22)	1.52 (1.83)
Tensile strength (MPa)	61.0	50.0	47.0	25.0
Elongation at break (%)	3.4	3.6	4.1	7.0
Tg (°C)	122	107	93	83
E′ (MPa)[b]	65	35	33	25

(a) of the gel fraction; in brackets the calculated value.
(b) at 170°C.

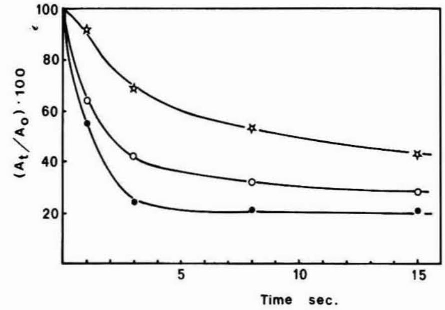


Figure 12—Kinetic curves relative to Resin A—LT mixtures. Decrease of unsaturations vs irradiation time. ☆ Resin A pure; ○ Resin A—5% LT; ● Resin A—15% LT

DGEBA, illustrating that the chain extension of the epoxy resin was not complete. The final values of the acid numbers (see Experimental Section) agree with these results.

Therefore, the average molecular structure of the modified resins can be represented as follows: Resin B: Acry-DGEBA-MA-DEGPC-MA-DGEBA-Acry ($\overline{MW} \simeq 1500$), and Resin C: Acry-DGEBA-MA-PEO-MA-DGEBA-Acry ($\overline{MW} \simeq 1450$), where MA = maleic anhydride and Acry = acrylic acid.

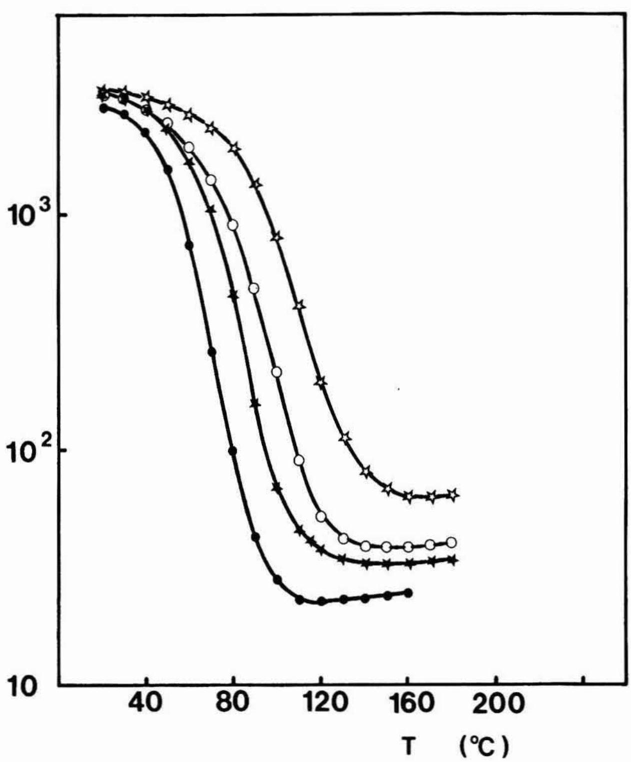


Figure 13—Dynamic moduli at 110 Hz vs temperature. ☆ Resin A pure; ○ Resin A—5% LT; ★ Resin A—10% LT; ● Resin A—15% LT

Because of the high viscosities of Resins B and C, they were diluted with 20% b.w. of DEGDA and hence, the comparison with Resin A is carried out with the analogous mixture.

Figure 4 shows the stress-strain curves obtained from free films cured by UV irradiation of the three resins. A sharp drop of modulus and tensile strength is evident in *Figure* 4, while the elongation at break of films of Resin B and C increases (see also *Table* 4).

The results of dynamic-mechanical analysis are reported in *Figures* 10 and 11. They indicate, in agreement with previous data, a decrease in modulus and Tg value of films of Resin B and C. These decreases are attributed to a decrease of the crosslink density arising from the increase of MW of the modified resins with respect to Resin A. Free film data obtained from Resins A, B, and C are collected in *Table* 4, while *Table* 5 shows the data of the same formulations coated on steel sheets. It is worth noting that the modifications introduced in Resin A causes an increase of the tape adhesion, impact resistance, and flexibility value while the data of hardness decrease.

Influence of a Chain-Transfer Agent

It is known that chain-transfer agents can change the structure of the network by changing the chain length of the polymer.[3-5,11]

In our work, we have used lauryl thioglycolate (LT) as chain-transfer agent because of its high reactivity, good compatibility with the resin, and absence of odor.

Preliminary runs have shown that LT, under the typical conditions of UV curing adopted herein, is almost quantitatively bonded to the resin network. In fact, the content of sulfur of the insoluble fraction (UV cured) is practically coincident with that of the initial mixture (*Table* 6). Therefore, we have investigated the influence of the presence of different amounts of LT, i.e., 5–15% b.w., upon the properties of cured Resin A as a free film and as a film coated on steel sheets.

Figure 12 shows the rate of disappearance of unsaturation, studied by IR spectroscopy, in the presence of LT. The addition of the chain-transfer agent increases the reaction rate and the final level of conversion of unsaturation. The stress-strain diagrams pertaining to films obtained with different amounts of LT are reported in *Figure* 5. The increase of the percentage of LT reduces the values of modulus and tensile strength while those of the elongation at break increase. These results are clearly consistent with dynamic-mechanical analysis shown in *Figures* 13 and 14 (see also *Table* 6). The values of performance properties of films coated on steel plates are collected in *Table* 7. According to these experiments, the presence of LT clearly induces a drop of hardness of the coating, but the other properties of the film are practically unchanged. Therefore, some property of the film

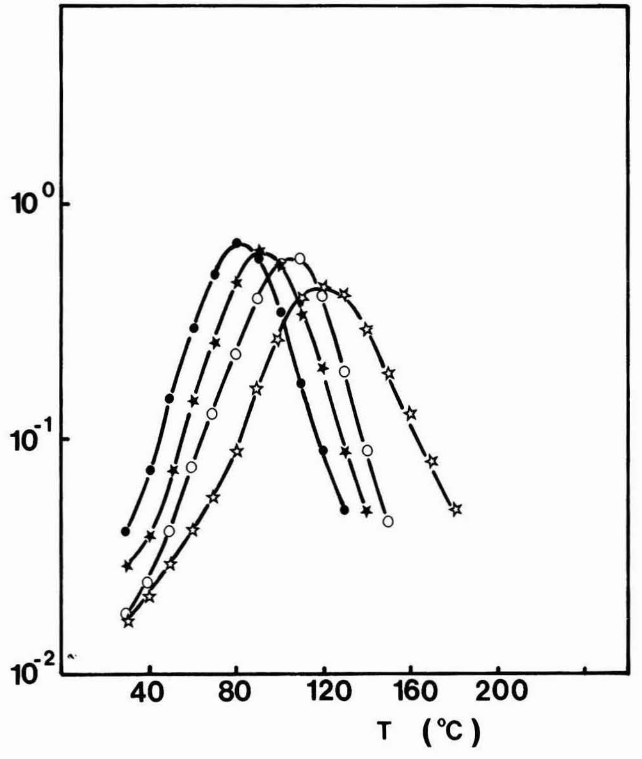


Figure 14—Tan δ at 110 Hz vs temperature. ○ Resin A—5% LT; ★ Resin A—10% LT; ☆ Resin A pure; ● Resin A—15% LT

Table 7—Properties of Films from Resin A And Lauryl-Thioglycolate (LT) Mixtures Coated on Sheets of Steel

Resin A (%)	100	95	90	85
LT (%)	0	5	10	15
Adhesion (%) (cross-hatching)	100	100	100	100
Tape adhesion (%)	30	30	40	20
König hardness	139	137	110	80
Reverse impact resistance (kg · cm)	2.5	2.5	2.5	2.5
Impact flexibility (%)	0.5	0.5	1	1

coated on a substrate, e.g. its flexibility, is different from that of the free film (cf. *Tables* 6 and 7).

Similar results have been previously reported and discussed.[12]

Chemical Resistance of Coatings And Their Weathering

Table 8 shows the behavior of films coated on steel sheets, obtained from Resin A by adding 20% b.w. of different reactive diluents and 10% of LT, in the presence of some chemical agents and solvents. The presence of NVP reduces resistance to alkali, acids, and water. Also, PEGDA based coatings do not display good performance towards H_2O and HNO_3. Conversely, the other reactive diluents, reported in *Table* 8, have practically no influence on the film, apart from the resistance to HCl which is increased by the presence of each monomer. The presence of LT (10% b.w.) slightly reduces the resistance to acids and alkali.

Table 9 shows the results of tests similar to those of *Table* 8 obtained with Resin B and C (diluted with 20% b.w. of DEGDA) and compared with Resin A. The performance of Resin B and C towards acids, alkali, and H_2O absorption is worse than that of the reference resin, while the resistance to solvents is good.

Measurements of weathering have given the results shown in *Table* 10. Therefore, Resin B displays the best behavior in a typical weathering test, and this result agrees with the reported data of chemical stability and

Table 9—Chemical Resistance of Coatings From UV Cured Modified DGEBA Resins

	Resin A[a]		Resin B		Resin C	
	A	B	A	B	A	B
NaOH 10%	G	G	Is	Is	Is	Is
HCl 25%	9	9	S	S	Is	Is
HNO_3 25%	G	G	Is	Is	Is	Is
1-Butanol	G	G	G	G	G	G
Methyl-isopropyl-ketone	G	G	G	G	G	G
Water absorption (%)	1.7		1.6		4.6	

A = general aspect
B = blistering

G = good
S = sufficient
Is = insufficient

(a) For comparison purposes, 20% of DEGDA was added to Resin A in order to obtain the same mixtures of Resin B and C (See Experimental).

resistance to radiation[13] of the carbonate group present in the flexible segment of this resin. Conversely, the introduction of LT in the final network clearly reduces the resistance of the coating to weathering.

CONCLUSIONS

The best flexibility has been observed in both free films and films coated on steel sheets when the following reactive diluents have been used: EHA, HBA, and PEGDA. Conversely, NVP, which is a monofunctional monomer, does not give rise to a flexible network but increases the Tg value, modulus, and tensile strength.

An interesting modification of the structure of the resin was obtained by introducing in the chain a diethylenglycol polycarbonate segment (Resin B) which enhances the flexibility and weathering resistance of film.

The use of LT as chain-transfer agent causes an increase in the rate of curing and increases the flexibility of free films. The same film, when coated on steel plates, shows a hardness decrease without modification of

Table 8—Chemical Resistance of Coatings From UV Cured Mixtures Of Resin A and Reactive Diluents or Lauryl-Thioglycolate

			EHA		NVP		DEGDA		PEGDA		TMPTA		LT	
Resin A (%)	100		80		80		80		80		80		90	
Reactive diluent of LT (%)	0		20		20		20		20		20		10	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
NaOH 10%	G	G	G	G	Is	Is	G	G	G	G	G	G	Is	G
HCl 25%	S	S	G	G	Is	Is	G	G	G	G	G	G	G	G
HNO_3 25%	G	G	G	G	Is	Is	G	G	Is	Is	G	G	S	G
1-Butanol	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Methyl-isobutyl-ketone	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Water absorption (%)	1.2		1.2		3.1		1.7		2.7		1.4		1.2	

A = general aspect
B = blistering

G = good
S = sufficient
Is = insufficient

Table 10—Weathering Behavior[a] of Coatings Obtained from Different UV Cured Formulations Based on Epoxy-acrylic Resins

Formulation	Yellowing	General Aspect[b]
Pure Resin A	Is	S
80% Resin A + 20% EHA	S	G
80% Resin A + 20% NVP	S	G
80% Resin A + 20% DEGDA	Is	S
80% Resin A + 20% PEGDA	S	G
80% Resin A + 20% TMPTA	Is	Is
90% Resin A + 10% LT	Is	Is
Pure Resin B	G	G
Pure Resin C	Is	S

(a) After 1000 hr exposure. Is = insufficient, S = sufficient, G = good.
(b) Based on loss of gloss, crazing, and blistering.

other properties, i.e., adhesion, impact resistance, and flexibility.

Specific interactions occurring at the coating-substrate interface may exert an influence and modify the behavior of the film coated on the substrate.

References

(1) Pappas, S.P., Ed, "UV Curing: Science and Technology", Technology Marketing Corp., Norwalk, CT, 1978.

(2) Levy, N. and Massey, P.E., *Polym. Eng. Sci.*, *21*, 406 (1981).

(3) Barclay, R. and Schmidue, C.J., *J. Rad. Curing*, *4*, August 4 (1977).

(4) Howard, D.D. and Martin, B., *J. Rad. Curing*, *4*, May 8 (1977).

(5) Giuliani, G.P. and Priola, A., *Polymer*, *23*, 761 (1982).

(6) van Neerbos, A., Hoefs, C.A.M., and Giezen, E.A., Preprint XV FATIPEC Congress, Amsterdam, 1980, Vol. I, p. 319.

(7) Collins, G.L., Young, D.A., and Costanza, T.R., "Reactions of UV Curable Resin Formulations and Neat Multifunctional Acrylics. I: Apparatus and Procedure," Journal of Coatings Technology, *48*, No. 618, 48 (1976).

(8) Moore, J.E., in "Chemistry and Properties of Crosslinked Polymers," S.S. Labana, Ed., Academic Press, New York, NY, 1977, p. 537.

(9) Yeo, J.K., Sperling, L.H., and Thomas, D.A., *J. Appl. Polymer Sci.*, *26*, 3977 (1981).

(10) Murayama, T., *Polym. Eng. Sci.*, *22* (22), 788 (1982).

(11) Oraby, W. and Walsh, W.K., *J. Appl. Polymer Sci.*, *23*, 3243 (1979).

(12) Corti, H., Fernandez-Prini, R., and Gomez, D., *Progr. Org. Coat.*, *10*, 5 (1982).

(13) Muller, E., *Angew. Makromol. Chem.*, *16*, 117 (1971).

Acrylic Copolymer Oligomers For High Solids Coating Resins

David Rhum
Pfizer, Incorporated*

and

Patrick F. Aluotto
Inmont Corporation†

The preparation of low molecular weight acrylic ester functional copolymers, intended for application as high solids coating resins, was accomplished via an experimental procedure which obviated the need for active chain transfer agents such as sulfur compounds or haloalkanes. Tetrapolymers containing the functional monomers hydroxypropyl acrylate and methacrylic acid were prepared by free radical polymerization at high temperature in selected solvents. Degree of polymerization was controlled by chain transfer with the relatively inactive solvents such as alkyl aromatics, high boiling ethers, and benzyl alcohol. The most effective solvent for limiting molecular weight was benzyl alcohol. The copolymers met a viscosity standard for hot spray application, and were cured with melamine resins to form hard and glossy coatings.

INTRODUCTION

The coatings industry has been faced with a pressing challenge to develop new technology in recent years. The energy crisis and the environmental protection movement have affected society in general, and the coatings industry in particular. Several techniques have been developed to minimize energy requirements of coating processes and to reduce polluting emissions. High solids liquid formulations are among these new approaches. The preparation of acrylic ester copolymer oligomers suitable for a demanding application technique, hot spray at ≥80% volume solids, has been carried out and will be described.

A high solids coating resin must be of low molecular weight to give a low viscosity, sprayable solution, and must contain chemically active groups in order to undergo molecular weight buildup and network formation during the curing reaction.[1,2] The rate equations describing free radical polymerization suggest several methods by which low molecular weight can be obtained. Equation (1), for kinetic chain length, ν, indicates that a process may be directed to produce a lower molecular weight product by maintaining the monomer concentration, [M], low and maintaining the rate of initiation, fk_d [I], high.[3]

Equation (2), for number average degree of polymerization, $\bar{P}_n$, as affected by chain transfer with solvent, indicates how the kinetic chain length may be partitioned among more than one growing chain.[3]

$$\nu = \frac{k_p[M]}{2(fk_d k_t [I])^{0.5}} \tag{1}$$

ν = kinetic chain length
k_p = rate constant for polymerization
[M] = monomer concentration
f = initiator efficiency
k_d = rate constant of initiator decomposition
k_t = rate constant of termination
[I] = initiator concentration

$$\frac{1}{\bar{P}_n} = \frac{1}{\bar{P}_n^o} + C_s\frac{[S]}{[M]} \tag{2}$$

$\bar{P}_n$ = number average degree of polymerization with chain transfer.
$\bar{P}_n^o$ = number average degree of polymerization in the absence of chain transfer.
[S] = solvent concentration
[M] = monomer concentration
C_s = chain transfer constant to solvent.

*Howmedica Div., Corporate Research & Development Labs, Eastern Point Rd., Groton, CT 06340.
†Container Coatings Div., Cincinnati, OH.

Table 1—Chain Transfer Constants, C_s, For Methyl Methacrylate (M) and Styrene (S) Polymerization

Transfer Agent	Monomer	C_s	T°C
RSH	M	0.4–8	60
	S	1–20	100
$BrCCl_3$	M	3	30
	S	1–250	80
CCl_4	M	0.00025	80
	S	0.01	60
Cumene	M	0.002	80
	S	0.00025	100
n-Butanol	M	0.00003	80
	S	0.0001	60
Benzyl ether	M	0.0008	60
	S	0.0062	60

Table 3—Polymer Composition and Properties

Monomer	Wt. %
Butyl acrylate	40
Styrene	37
Hydroxypropyl acrylate	21
Methacrylic acid	2
Characterization	**Value**
Viscosity (10% Xylene, 70°C)	200 cp
Melamine cure (30%, 130°C, 20 min.)	
Pencil hardness	H
Gardner rev. impact	8 in lb
Xylene spot (1 min)	OK
Overbake (170; ½ hour)	OK

The most effective chain transfer agents, that is, those with the highest transfer constants, C_s, are mercaptans and polyhalo alkanes; they are frequently used to obtain a desired molecular weight from a polymerization reaction.[4,5] We were constrained from using either mercaptans or polyhalomethanes by the performance requirements of the products, which had to be free of odor, have good light stability, and have good thermal stability as manifested in an overbake test of a cured film. Copolymers of suitable low molecular weight for high solids, $\overline{M}n$ = 500-2000, when prepared with a mercaptan chain transfer agent, had unacceptable odors and poor light stability;[6] copolymers whose molecular weight had been regulated by polyhalo compounds such as bromotrichloromethane or carbon tetrachloride yellowed on over-baking at 170°C for 2 hours. Other organic molecules are known to be active in chain transfer, for example, compounds with benzylic or allylic hydrogens, ketones, ethers, etc. They have in common the structural feature that upon hydrogen abstraction by a growing radical chain, they form a stabilized radical. Nevertheless, the value of C_s for such molecules are 10^{-3} to 10^{-4} as large as those of the good chain transfer agents.[7] This is shown in *Table* 1, where transfer constants of methyl methacrylate and styrene with several transfer agents are tabulated.

The terms of the problem became, then, to obtain the desired products by use of weak chain transfer agents and by selecting reaction conditions using the kinetic equations as a guide. Furthermore, since the activation energy for chain tranfer is higher than that for monomer addition, higher polymerization temperatures would lead to higher values of C_s, and would be favorable for forming lower molecular weight products.

Table 2—Composition of Solvesso 150

Aromatics	Vol. %
C_9	1.2
C_{10}	54.3
C_{11}	18.5
C_{12}	1.8
Indans	16.0
Naphthalenes	5.2
Non Aromatics	3.0
Boiling range 190°C-210°C	

EXPERIMENTAL

MONOMERS: Commercial grade monomers were used without further purification. They include styrene, ethyl acrylate, butyl acrylate, hydroxypropyl acrylate, hydroxypropyl methacrylate, acrylic acid, and methacrylic acid.

INITIATORS: Benzoyl peroxide, dicumylperoxide.

SOLVENTS: Used as received; ACS grade or commercial samples such as Solvesso® 150.

TYPICAL POLYMERIZATION PROCEDURE: A monomer mixture consisting of 555 g styrene, 600 g n-butyl acrylate, 315 g hydroxypropyl acrylate, and 30 g methacrylic acid, containing 75 g (4.7%) dicumyl peroxide was added during 6.2 h to 1500 g of rapidly stirred benzyl alcohol contained in a glass reactor equipped with an efficient reflux condenser. The temperature in the reactor was maintained at 185°C during the addition and for a brief period afterwards. Solvent and unconverted monomer were stripped under a vacuum of 1-10 torr at a pot temperature of up to 200°C. A clear, viscous resin remained when the flask was cooled to room temperature.

PRODUCT CHARACTERIZATION: Viscosities of resins, reduced with 10% xylene, were determined at 70°C in a Contraves Rheomat concentric tube viscometer. The target viscosity, related to sprayability, was 200 centipoise. Molecular weights were determined by osmometry.

Coatings were formulated with 4.38 parts Cymel® 300 per 10 parts resin and cured at 130°C for 20 min to give hard, glossy, solvent-resistant finishes on steel. Over-

Solvesso is a registered trademark of Humble Oil & Refining Co., Houston, TX.
Cymel is a registered trademark of American Cyanamid Co., Wayne, NJ.

bakes at 170°C for 20 min were examined for yellowing. Pencil hardness and Gardner reverse impact strength were determined.

RESULTS

Using the polymerization procedure and monomer composition described above, it was found possible to vary the molecular weight of the product resins within the desired range as a function of the reaction solvent, and obtain solutions of the product resins at very high solids levels which met the viscosity targets.

Reaction Solvent—Effect on Molecular Weight

Several types of reaction solvent were evaluated for their efficacy in molecular weight limitation, consistent with their not having a deleterious effect on the other use properties of the resin. These solvents included alkylated aromatics, ethers, and benzyl alcohol. The alkyl aromatic most extensively employed was Solvesso 150, which is a mixture of aromatics; the composition of Solvesso 150 is given in *Table 2*.

The ethereal solvents studied included diethylene glycol, dipropylene glycol, and diethylene glycol diethyl ether.

The most effective reaction medium for producing polymers of lowest molecular weight was benzyl alcohol. The monomer composition and characterization data of a typical product resin and coating obtained from a polymerization conducted in the presence of benzyl alcohol is shown in *Table* 3. The composition of the polymers were not optimized for functionality or T_g, which would have been necessary in order to obtain the best values of physical properties such as impact resistance, hardness, and solvent resistance.

Polymerizations conducted in pure ether solvents gave polymers of higher molecular weight than polymerization in which benzyl alcohol was used as the solvent. Mixtures of solvents gave intermediate values of product viscosity and molecular weight as shown in *Figure* 1.

Aromatic solvents, i.e. Solvesso 150, were also not as effective as benzyl alcohol for producing low molecular weight; mixture of the two solvents gave intermediate values, as shown in *Figure* 2.

Reaction Temperature—Effect on Molecular Weight

The molecular weight of the product was found to vary as a function of the reaction temperature in accordance with the expectation that the activation energy for chain transfer is higher than that of polymerization. *Figure* 3 shows the decrease in viscosity of the product (reflecting the decrease in molecular weight) with increasing temperature of polymerization. An Arrhenius plot of log viscosity vs reciprocal absolute temperature gives a value of 10.4 kcal/mole for the activation energy of viscosity decrease. Since, at low molecular weights, viscosity is proportional to molecular weight (and assuming that the effect of the 10% xylene solvent on the measurements can be ignored), 10.4 kcal/mole is also the value of the difference in activation energies for chain transfer and propagation.

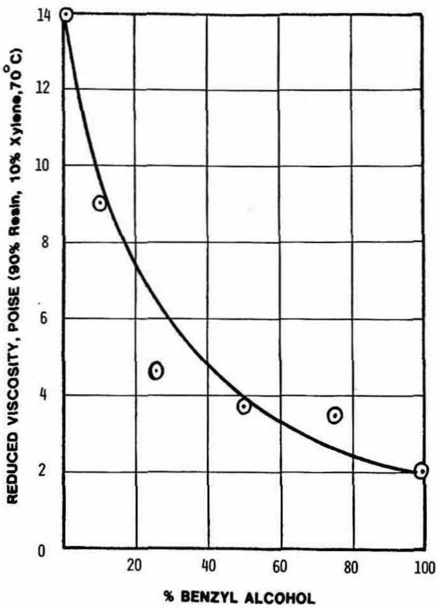


Figure 1—Viscosity of acrylic resins prepared in diethylene glycol-benzyl alcohol solvent

Final Resin Concentration—Effect on Molecular Weight

In this practical system of resin synthesis, an important factor affecting the molecular weight of the product

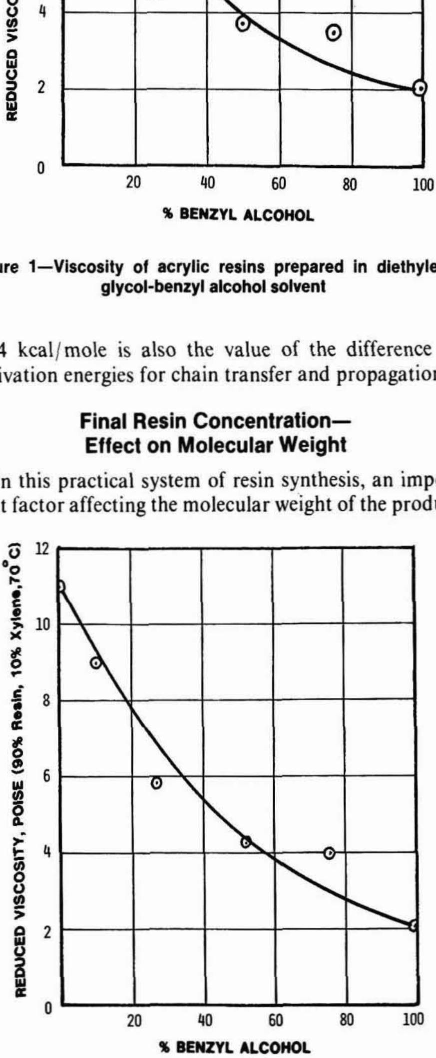


Figure 2—Viscosity of acrylic resins prepared in Solvesso 150-benzyl alcohol solvent

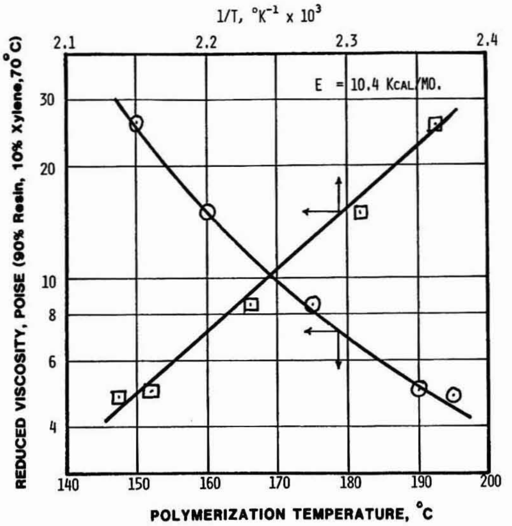


Figure 3—Effect of polymerization temperature on resin viscosity (67% final reaction solids)

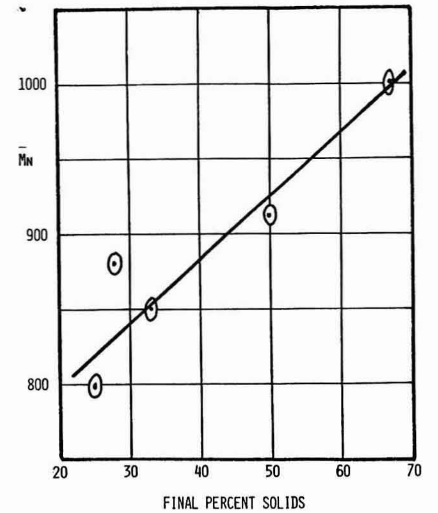


Figure 4—Effect of final resin concentration in polymerizer on molecular weight

is the final concentration of product in the reaction mixture. The higher the final solids, the higher the overall molecular weight of the product, as shown in *Figure* 4. The molecular weight of the polymer being formed increases as the concentration of chain transfer solvent decreases during a reaction because of the constant feed of monomer, and because of chain transfer to polymer.

DISCUSSION

Oligomeric styrene-acrylic copolymers suitable for high solids product development were prepared by applying the principles of free radical polymerization kinetics in a straight-forward fashion. Monomer concentration was kept low, rate of radical generation was kept high, chain transfer was encouraged by operating at high temperature, and solvent media having chain transfer propensity was employed in large excess. The most active chain transfer solvent employed was benzyl alcohol.

Indirect evidence for the incorporation of benzyl alcohol moieties in the polymer chain was found in the infrared spectrum of the resin and in the distillate of reaction solvent obtained during resin isolation. A carbonyl absorption was observed at 1775 cm^{-1}, which was interpreted as indicating the presence of a five-membered ring lactone, and butyl alcohol was found in the solvent stripped at the conclusion of the preparation. The butanol was identified by comparison of its retention time with a known sample using gas chromatography. These observations are consistent with the following reaction sequence:

$$R\cdot + \phi CH_2OH \longrightarrow RH + \phi\dot{C}HOH \quad (3)$$

$$\phi\dot{C}HOH + CH_2{=}CHCO_2C_4H_9 \longrightarrow \phi CH(OH)CH_2\dot{C}HCO_2C_4H_9 \quad (4)$$

$$\phi CH(OH){-}CH_2{-}\dot{C}HCO_2C_4H_9 + M \longrightarrow \phi CH(OH)CH_2CH(CO_2C_4H_9){-}M\cdot \quad (5)$$

$$\phi CH(OH)CH_2CH(CO_2C_4H_9)M_x \longrightarrow \phi{-}\underset{\diagdown CH_2 \diagup}{CH{-}O{-}C({=}O){-}CH}{-}M_x + C_4H_9OH \quad (6)$$

The radical derived from benzyl alcohol by chain transfer (equation (3)) initiates a polymer chain by adding to butyl acrylate (equation (4)). The chain grows by addition of monomer (equation (5)) and undergoes intramolecular cyclization to form the observed five-membered ring lactone and liberate butyl alcohol (equation (6)).

The monomer ratio in an oligomeric resin intended for a given application will not be the same as that in a solution resin of conventional molecular weight. To obtain sufficient functionality per chain to insure formation of a network structure in cure, higher levels of functional monomers must be employed in high-solids resins.[8] This will lead to a more highly crosslinked structure and it may be necessary to compensate by shifting the balance of hard and soft monomers to include a greater proportion of soft monomer in order to obtain optimum properties. It should also be noted that, because of the low viscosity of high solids systems at cure temperatures, in general, reformulation with solvents and thixotropes is necessary.[9-12]

A number of resin formulations that were modeled on the monomer ratios used in conventional automotive,

DR. DAVID RHUM is Senior Research Investigator at the Corporate Research Laboratory of the Howmedica Div. of Pfizer, Inc. Groton, CT, where he is working on polymers for use in surgery. He has also been on the research staff at the Celanese Research Co., The Airco Central Research Dept., and The Esso Research and Engineering Co. He received his Ph.D. in organic chemistry in 1961 from Columbia University.

DR. PATRICK F. ALUOTTO, Manager of Resin Development, Container Coatings Div. of Inmont Corp., Cincinnati, OH, received the B.S. Degree from St. Peter's College and the M.S. and Ph.D. Degrees from the University of Maryland. Prior to joining Inmont in 1972, he was employed as a Research Chemist at the Celanese Research Co., Summit, NJ.

appliance, primer, can, and maintenance coatings were prepared using the technique described. Several of these resin variants had higher levels of hydroxyl or carboxyl functionality than the basic formulation used for most of this work, and the higher resulting resin polarity was reflected in somewhat higher viscosities. The increase in viscosity of coating resins with higher hydroxyl and/or carboxyl content has been observed in other coating systems.[13,14]

CONCLUSIONS

This work has demonstrated that styrene-acrylic oligomeric high solids resins can be prepared without the use of molecular weight regulators that lead to property deficiencies.[15] A preparative method comprising continuous addition of monomer mix and free radical initiator to stirred solvents such as benzyl alcohol, diethylene glycol, or Solvesso 150 was effective in generating resins in the molecular weight range 800-1000 which were curable with melamine resins.

SUMMARY

Acrylic copolymer high-solids coating resins were prepared by free radical polymerization using a procedure designed to maximize chain transfer with solvent. High temperature, continuous addition of monomer and initiator, and solvents such as benzyl alcohol, ethers, or aromatics were used. The very active molecular weight regulators such as mercaptans and halides were not used in the process since their use resulted in products with performance deficiencies. Oligomeric tetrapolymers of styrene, acrylic esters (e.g., butyl acrylate), hydroxy-functional acrylic esters (e.g., hydroxypropyl acrylate), and carboxy-functional monomers (e.g., methacrylic acid) were prepared and cured with melamine to give coatings on steel with color stability in overbake.

ACKNOWLEDGMENTS

We would like to thank the Celanese Corp. for permission to publish this work. We express our appreciation to Lawrence Foreman for valuable assistance, and to Drs. A.B. Conciatori and K.F. Wissbrun for constructive advice.

References

(1) Spinelli, H.J., Preprints, Div. of Organic Coatings and Plastic Chemistry, American Chemical Society 184th National Meeting, *47*, 529, (1982).

(2) Bauer, D.R. and Budde, G.F., Preprints, Div. of Organic Coatings and Plastics Chemistry, Americal Chemical Society 180th National Meeting, *43*, *59*, (1980).

(3) Flory, P.J., "Principles of Polymer Chemistry," Cornell University Press, Ithaca, NY, 1953, p. 133 ff.

(4) Rehberg, C.E. and Siciliano, J., *Industrial and Engineering Chemistry*, *44*, 2864 (1952).

(5) Ali, M.D., Mark, H.F., and Mesrobian, R.B., *Ind. Eng. Chem.*, *42*, 484 (1950).

(6) Hicks, D., Celanese Corp., Private Communication.

(7) "Polymer Handbook (2nd Ed.)," Brandrup, J., and Immergut, E.H., Eds.; Sect. II-6, p. 105ff, Young, L.J., Ed. Wiley-Interscience, NY, 1975.

(8) Bauer, D.R. and Dickie, R.A., "Cure Response in Acrylic Copolymer/Melamine Formaldehyde Crosslinked Coatings," JOURNAL OF COATINGS TECHNOLOGY, *54*, No. 685, 57 (1982).

(9) Hill, L.W., Kozlowski, K., and Sholes, R.L., "Theory and Practice of Viscosity Reduction in High Solids Systems," JOURNAL OF COATINGS TECHNOLOGY, *54*, No. 692, 67 (1982).

(10) Ellis, W.H., "Comparative Solvent Evaporative Mechanisms for Conventional and High Solids Coatings," JOURNAL OF COATINGS TECHNOLOGY, *55*, No. 696, 63 (1983).

(11) Bauer, D.R., Briggs, L.M., and Dickie, R.A., *Ind. Eng. Chem. Prod. Res. Develop*, *21*, 686-690 (1982).

(12) Hannon, M.J., Rhum, D., and Wissbrun, K.F., "Model for the Correlation of Rheological Measurements with the Leveling and Cure of Thermosetting Powder Coatings," JOURNAL OF COATINGS TECHNOLOGY, *48*, No. 621, 42 (1976).

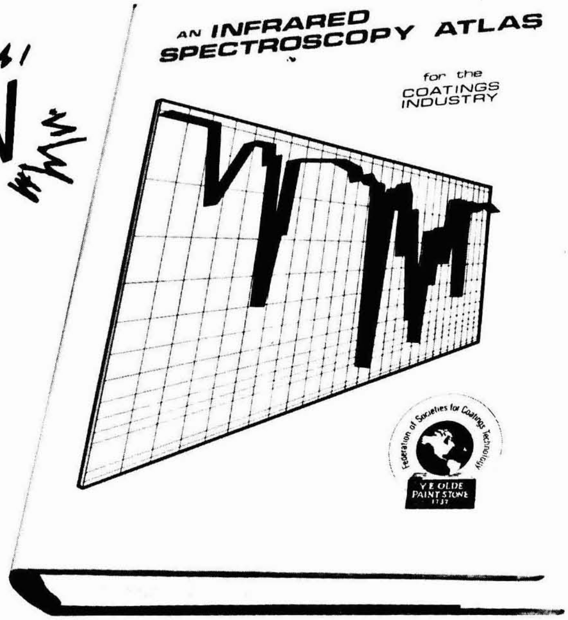
(13) Gibbons, D.V. and Leary, B., "Thermosetting High-Solids Coatings. Two Novel Types," JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 625, 53 (1977).

(14) Schreiber, H.P. and Thibault, G., "Rheological Properties of Styrene/Acrylic Polymers," JOURNAL OF COATINGS TECHNOLOGY, *50*, No. 646, 56 (1978).

(15) Rhum, D. and Aluotto, P.F., U.S. Patent 4,075,242.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

Announces the



896 Pages
Over 1,400 Spectra
Over 1,500 References

This revised and expanded 896-page book (by the Chicago Society for Coatings Technology) contains a compilation of 1433 spectra, fully indexed, of materials commonly used in the coatings industry. Spectra of many recently marketed materials are included, as well as examples of Fourier transform infrared spectra.

The text consists of nine fundamental and comprehensive chapters including theory, qualitative and quantitative analysis, instrumentation, IR instrumentation accessories, and sample preparation. A chapter concerning applications contains a comprehensive text which should be invaluable to anyone practicing infrared spectroscopy.

A fully indexed literature survey contains over 1500 references and represents the most complete bibliography published in this type of text. It is organized into sections, such as theory, reviews, instrumentation, experimental techniques, compilation of spectra, and pigment applications, and each section is in chronological order.

8½ × 11 in., case-bound. ISBN 0-934010-00-5

AN INFRARED SPECTROSCOPY ATLAS

Check one: ☐ **$75.00—Federation Member** ☐ **$100.00—Non-Member**

(Shipping Charges Extra)

TERMS OF ORDER

→ PLEASE MAKE ALL CHECKS PAYABLE IN U.S. FUNDS ←

PREPAID ORDER:	ORDERS REQUIRING BILLING:
Postage and handling charges are included in the price.	Postage and handling charges will be added to the price.

Name ______________________________

Company ______________________________

Address ______________________________

City ______________ State ______________ Zip Code ______________

PLEASE MAKE ALL CHECKS PAYABLE IN U.S. FUNDS

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

Pennsylvania residents please add 6% sales tax

AVAILABLE IN THE U.K. FROM:

Birmingham Paint, Varnish and Lacquer Club

c/o Mr. Ray Tennant, Carrs Paints Limited, Westminster Works, Alvechurch Rd.

Birmingham B31 3PG, England

Design of Waterborne Coatings For the Corrosion Protection of Steel

Part III: Effect of Surfactants in an Aqueous Air Dry Coating

Maureen M. Lein, Bradford Brakke, Gary Keltz, M.P.Kiezulas, Cynthia M. Leavy, Robert Marderosian, and David Withington

New England Society for Coatings Technology Technical Committee

Anionic, cationic, and nonionic surfactants, and one nonionic-anionic blend of nine surfactants were evaluated at three concentration levels in an aqueous coating for their effect on coating performance. Dispersant efficiency was assessed, and humidity and salt fog exposure tests were conducted to evaluate the additives' effect on dry film properties. Only the nonionic-anionic blend surfactant showed no deleterious effect on coating performance.

INTRODUCTION

A great deal of research effort has gone into the development of latex industrial coatings over the past 10 years, making the present day products far superior to those available in the 1960's. In the area of industrial coatings, acrylic latex systems have been employed as industrial maintenance coatings for approximately 10 years.[1] This application requires the coating system to protect the metal substrate from mild atmospheric corrosion degradation.

With acrylic latex systems, formulators have developed considerable experience in industrial maintenance coatings and have demonstrated the effectiveness of acrylics in protecting metal surfaces from corrosion, for allowing application over less thoroughly cleaned surfaces, and for the reduction of toxic and flammable materials. However, much remains to be done to develop better corrosion resistant waterborne coatings.

The scope of this work includes the evaluation of surfactants in an acrylic latex coating system, and includes the application of this system onto a metal substrate. This work is a continuation of the earlier work done[2,3] by the New England Society on the design of an aqueous acrylic coating for the corrosion protection of steel.

Presented at the 60th Annual Meeting of the Federation of Societies for Coatings Technology in Washington, DC, November 4, 1982 by Cynthia M. Leavy.

MATERIALS AND METHODS

A white aqueous acrylic formulation was prepared by dispersing titanium dioxide with a high speed impeller in a portion of the acrylic vehicle, a dispersant, and defoamer. Five of the surfactants to be assayed were added in the grind portion, at 0.5%, 1.0%, and 1.5% by weight of surfactant on pigment.

The letdown contained additional acrylic vehicle, coalescing solvents, a flow agent, defoamer, and a flash rust inhibitor. The remaining five surfactants were added in the let down, as recommended by the manufacturers (see *Table* 2 for formulation constants, *Tables* 3 and 4 for composition), again at levels of 0.5%, 1.0%, and 1.5% by weight on pigment.

Each coating was drawn down on a cold rolled steel panel (SAE 1010 low carbon, one quarter hard) using a 3-mil Bird applicator. All panels for salt spray and humidity resistance testing were Q-Panel Type QD (smooth finish, ASTM D609-3B).

The panels to be exposed to salt spray and humidity were aged at room temperature for a minimum of four weeks. For salt spray testing, the coated steel panels were scribed as in ASTM D1654 and tested as in ASTM B117. Overall rusting (ASTM D610) and blistering (ASTM D714) were evaluated, as well as rusting and blistering at the scribe (ASTM D1654) after 100 hours.

Humidity resistance testing was performed by exposing the panels to 95 ± 5% relative humidity at 42°-48°C for 100 hours. Panels were evaluated for rusting and blistering according to ASTM D610 and ASTM D714, respectively.

Table 1—Physical Properties of the Various Surfactants

Tradename	Chemical Type	Non-volatile (%)	Sp. Gr. 25 mL/ 25°C	Lb./Gal (at 25°C)	Physical Form[a]
Nonionic:					
Triton® CF-10	Alkyl aryl ether	100	1.05	8.80	C.A.L.
Interwet® 33	Glycol ester of a fatty acid	100	1.02	8.40	C.A.L.
Hyonic® PE-260	Alkyl phenol ethoxylate	99	—	8.50	C.L.
Anionic:					
Triton® GR-7M	Sulfonated alkyl ester	64	1.01	8.40	C.A.L.
Nopcosperse® 44	Sodium salt of polyacrylic acid	35	1.24	10.30	L.A.L.
Nopcosperse® 644A	Ammonium salt of polyacrylic acid	35	1.12	9.80	L.A.L.
Hamposyl® 0[b]	Sodium lauroyl sarcosinate	—	—	—	D.Y.L.
Nuosperse® HOH	Sodium salt of polymeric carboxylic acid	25	1.13	9.42	L.Y.L.
Cationic:					
Alkaterge® E	Substituted oxazoline	100	0.93	8.34	A.L.
Blend:					
Witco® 912	Fatty acid ethoxylates/ sulfonated salts	100	0.99	8.26	A.L.

(a) Physical Form and Color described as: C.A.L. = Clear amber liquid, C.L. = Colorless liquid, L.A.L. = Light amber liquid, D.Y.L. = Dark yellow liquid, L.Y.L. = Light yellow liquid, and A.L. = Amber liquid.
(b) Amphoteric surfactant: anionic capacity at a pH of 8.5.

Table 2—Formulation Constants for the Aqueous Acrylic Coating Formulations

Formulation Constant	Value
pH[a]	8.5
Pigment volume concentration (%)	25.0%
Pigment-to-binder ratio	60/40
Non-volatile (wt %)	44.6%
Dispersant on pigment[b] (wt %)	1.5%
Surfactant on pigment (wt %)	0.5%
	1.0%
	1.5%

(a) Each coating formulation was adjusted to the value of 8.5 with ammonia to bring the value up-scale and with formaldehyde to bring the value down-scale.
(b) Tamol® 165.

RESULTS AND DISCUSSION

The physical properties of the 10 surfactants tested are listed in *Table* 1. The surfactants have been divided into their chemical classes: anionic, nonionic, cationic, and blends. The pHs of the test paints after the surfactant additions ranged from 8.3-8.9, and were adjusted to 8.5 to minimize performance variations due to pH. Hegman grind values were determined for all test coatings, but differences were negligible.

Assessment of Dispersant Efficiency

The efficiency of a dispersant is commonly measured in terms of its effects on lowering either (a) the surface tension of the suspension or (b) the rheological properties (viscosity) of the suspension.[4-8] The latter technique was employed in this surfactant study.

The method used to determine a coating system's surfactant needs is known as the Pigment Demand Curve. This technique plots the viscosity change resulting from incremental additions of dispersant. As the pigment de-agglomerates, the viscosity decreases to a minimum; then as the pigment flocculates, the viscosity increases. The optimum dispersant requirement is at the point of minimum viscosity. The pigment demand curve is a graphic and useful means of evaluating dispersants as to the optimum level of a particular dispersant required, and also allows comparison of different dispersants. The ideal dispersant provides the lowest viscosity at the lowest dispersant level and shows a minimal viscosity increase as the dispersant level increases.

Nonionic Surfactants

In studying the effects of surfactants in dispersing the pigment particles, it is important to focus on the hydrophilic portion of the surfactant, since the polar end of the molecule will adsorb at the aqueous/nonaqueous interface.[4-6] Nonionic surfactants do not ionize in aqueous systems but rather form hydrates in water, primarily by hydrogen bonding. Nonionic surfactants affect pigment dispersion through steric hindrance. An adsorbed layer of surfactant on the pigment particle surface interposes a mechanical barrier between approaching pigment particles.[9,10]

Triton® CF-10 belongs to the alkyl aryl polyether group of nonionic surfactants, and has the chemical structure octyl phenoxy polyoxyethyl benzyl ether. The hydrophilic portion of this product consists of ether linkages, and the polar portion being of the polyoxyethylene type $(-OCH_2CH_2)_n$, where 'n' is equal to 12.6 moles of ethylene oxide. More than likely, the (OCH_2CH_2) groups are centrally located between the $(C_{14}H_{21})$ chain on one end, and the (C_7H_7) chain on the other end. With the let-down values graphically illustrated in *Figure* 1, a typical pigment demand curve is observed with the lowest viscosity of 215 cps exhibited at the 1.0% concentration level. With the increase in surfactant concentration from 1.0% to 1.5%, the curve

Table 3—Aqueous Acrylic Formulation with Surfactants Added to the Grind Paste

Materials for Grind Paste	A	B	C
Rhoplex® WL-81 (41.5%)	116.9 g	———>	
Tamol® 165 (23.0%)	5.2 g	———>	
Surfactant	(see below)		
Deefo® 806-102	0.9 g	———>	
Titanium dioxide (Zopaque® RCL-9)	76.3 g	———>	

Grind the above with a high-speed impeller at 3400 rpm for 20 minutes. At slow speed, let-down as follows:

Materials for Letdown	A	B	C
Rhoplex WL-81 (41.5%)	31.3 g	———>	
Water	56.3 g	———>	
Butyl Cellusolve	23.8 g	———>	
Texanol®	2.4 g	———>	
Deefo 806-102	0.1 g	———>	
DC-14	0.3 g	———>	
Ammonia (28%)	1.2 g	———>	
Ammonium Benzoate (10%)	6.2 g	———>	

Surfactants added in the following levels:

Surfactants Added to the Grind Paste	A	B	C
Triton CF-10 (100%)	0.55 g	1.12 g	1.68 g
Nopcosperse 44 (33%)	1.83 g	3.66 g	5.49 g
Nopcosperse 644A	1.83 g	3.66 g	5.49 g
Alkaterge E	0.64 g	1.28 g	1.92 g
Nuosperse HOH	2.56 g	5.12 g	7.68 g

Table 4—Aqueous Acrylic Formulation with Surfactants Added to the Letdown

Materials for Grind Paste	A	B	C
Rhoplex WL-81 (41.5%)	116.9 g	———>	
Tamol 165 (23.0%)	5.2 g	———>	
Deefo 806-102	0.9 g	———>	
Titanium dioxide (Zopaque RCL-9)	76.3 g	———>	

Grind the above with a high-speed impeller at 3400 rpm for 20 minutes. At slow speed, let-down as follows:

Materials for Letdown	A	B	C
Rhoplex WL-81 (41.5%)	31.3 g	———>	
Water	56.3 g	———>	
Butyl Cellusolve	23.8 g	———>	
Texanol®	2.4 g	———>	
Deefo 806-102	0.1 g	———>	
DC-14	0.3 g	———>	
Ammonia (28%)	1.2 g	———>	
Surfactant	(see below)		
Ammonium Benzoate (10%)	6.2 g	———>	

Surfactants added in the following levels:

Surfactants Added to the Letdown	A	B	C
Witco 912	0.38 g	0.76 g	1.15 g
Hyonic PE-260	0.38 g	0.76 g	1.15 g
Interwet 33	0.38 g	0.76 g	1.15 g
Hamposyl O	0.38 g	0.76 g	1.15 g
Triton GR-7M	0.59 g	1.19 g	1.80 g

markedly increased from 215 cps to 600 cps, which is undesirable because of the flocculation potential of the pigment particles.

Interwet® 33 is a glycol ester of a fatty acid with a chemical structure of polyoxyethylene oleate. The hydrophilic portion of this product consists of ether and ester groups, with the polar portion being of a polyoxyethylene type $(-OCH_2CH_2)_n$, where 'n' is equal to 11.5 moles of ethylene oxide. The hydrophilic groups are located at the end of the hydrophobic hydrocarbon chain. The graphical representation of these values in *Figure* 1 shows an almost linear curve indicating that the surfactant concentration should have been lowered in order to obtain the initial viscosity inversion slope of the pigment demand curve. Nevertheless, the 0.5% fractional surfactant concentration exhibited the lowest viscosity value at 120 cps.

Hyonic® PE-260 belongs to the octyl phenol group of nonionic surfactants with its chemical structure alkyl phenoxy polyoxyethylene ethanol. The hydrophilic portion of this product lies in its ether and hydroxyl groups, with the polar portion being of polyoxyethylene type $(-OCH_2CH_2)_n$, where 'n' is equal to 13 moles of ethylene oxide. The hydrophilic portion is located at the end of the hydrophobic chain. As can be seen in *Figure* 1, this surfactant exhibited a typical pigment demand curve with the 1.0% concentration level being the lowest viscosity with 236 cps. In addition, the sharp increase in viscosity from 236 cps to 720 cps indicated the potential for flocculation of the pigment particles.

The nonionic surfactants exhibited excellent dispersing properties for the titanium dioxide pigment particles. With an increase in the hydrophilic portion of these surfactants, e.g., the mole percent of ethylene oxide, the wetting properties of the pigment particles were also increased. Polyoxyethylene oleate (a glycol ester of a fatty acid) exhibited the best pigment dispersion, even though its ethylene oxide content was lower than the control surfactant formulation. Perhaps the weight percent of the hydrophilic portion, as compared to its hydrophobic portion in the surfactant molocule, might affect pigment dispersion more than the absolute chain length of the hydrophilic portion.

Anionic Surfactants

The anionic surfactants inonize in aqueous systems and preferentially adsorb negative ions at the pigment surface.[4-6] Thus, the electrostatic repulsion between two approaching pigment particles is due to the like charges adsorbed at the pigment/vehicle interface.[11,12]

Triton GR-7M belongs to the sulfonated alkyl ether group of anionic surfactants, having the chemical structure of dioctyl sodium sulfosuccinate. The sulfonated hydrophilic portion of the molecule (SO_3^-Na+) contributes negative ions to the pigment particle surface.

From the graphical representation of the pigment demand curve, the surfactant dramatically decreased the viscosity of the coating formulation to 120 cps at the 1.0% concentration level. The viscosity increase from the 1.0% to 1.5% concentration level was lower than any of the

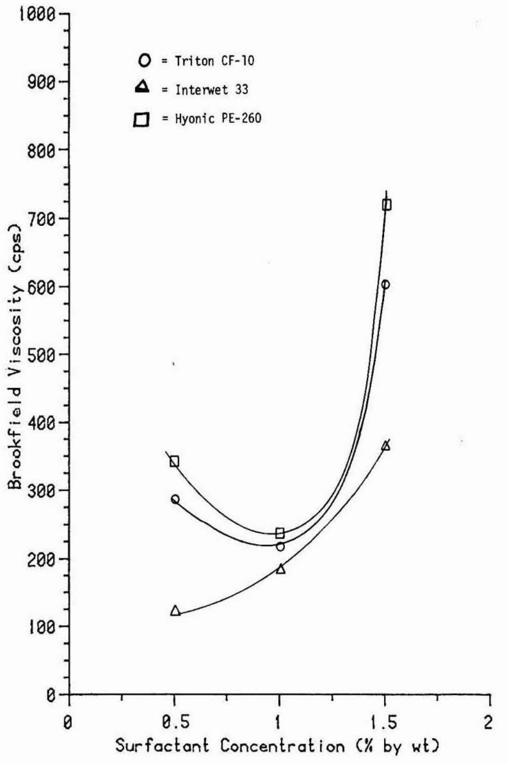


Figure 1—Pigment demand curve - nonionics

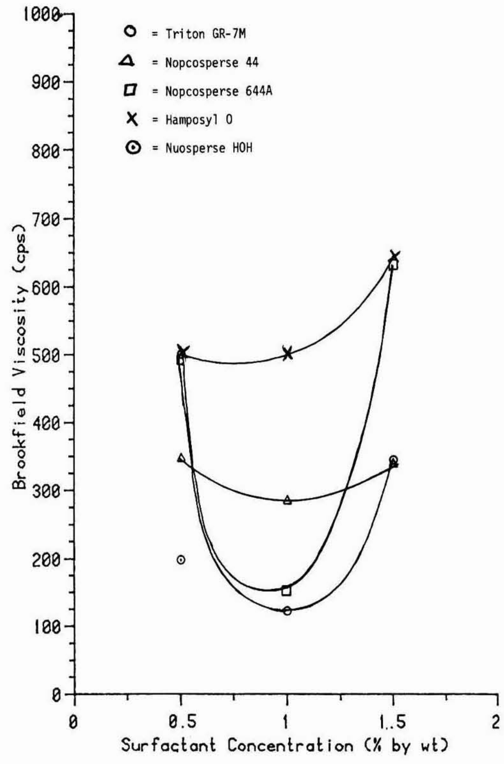


Figure 2—Pigment demand curve - anionics

other surfactants described to this point. This means the potential for flocculation of the pigment particles was not as severe, but still a flatter curve would be desirable. The Triton GR-7M proved to be a better wetting agent than the Triton CF-10 surfactant for the acrylic latex coating formulation.

Nopcosperse® 44 and Nopcosperse 644A are both polyelectrolytes, with the former being a sodium salt of a polyacrylic acid, and the latter being an ammonium salt of a polyacrylic acid. The hydrophilic portions of both anionic surfactants are the alkali carboxylated structures (COO^-Na^+ and $COO^-NH_4^+$, respectively). The Brookfield viscosity values for Nopcosperse 44 give a typical pigment demand curve. Viscosity decreased slightly from 345 cps to 280 cps, as the surfactant concentration was increased from 0.5% to 1.0%. As the surfactant concentration was increased to 1.5%, the viscosity increased to 330 cps. This atypical curve may indicate a low potential for flocculation.

With the Nocosperse 644A surfactant, a marked decrease in viscosity was exhibited from the 0.5% to 1.0% concentration levels with values of 490 cps and 150 cps, respectively. The viscosity dramatically increased to 640 cps as the concentration level of the surfactant was increased to 1.5%. The demand curve is depicted in *Figure* 2, with the sharp hyperbolic curve demonstrating a high potential for pigment particle flocculation when above the optimum level of surfactant of 1.0%.

Hamposyl® O belongs to the sodium lauroyl sarcosinate group of anionic surfactants. Again, the hydrophilic portion of the anionic surfactant is in the carboxylated structure of the molecule (COO^-). The viscosity plateau was exhibited at the 0.5% and 1.0% concentration levels but the slope of the curve increased at the 1.5% level, as seen in *Figure* 2. It is difficult to comment on the potential for flocculation since the initial viscosity inversion slope of the curve was not depicted, but it is observed that the increase of surfactant from 0.5% to 1.0% did not affect the viscosity of the coating formulation.

Nuosperse® HOH is the sodium salt of a polymeric carboxylic acid with the chemical structure sodium salt of a maleic anhydride copolymer. The hydrophilic portion of this product is the alkali carboxylated structure (COO^-Na^+). There are no comments about the Nuosperse HOH surfactant since, at two out of the three fractional concentrations tested, the surfactant flocculated the coating formulation.

Generally, the anionic surfactants exhibited good dispersing powers for the titanium dioxide pigment

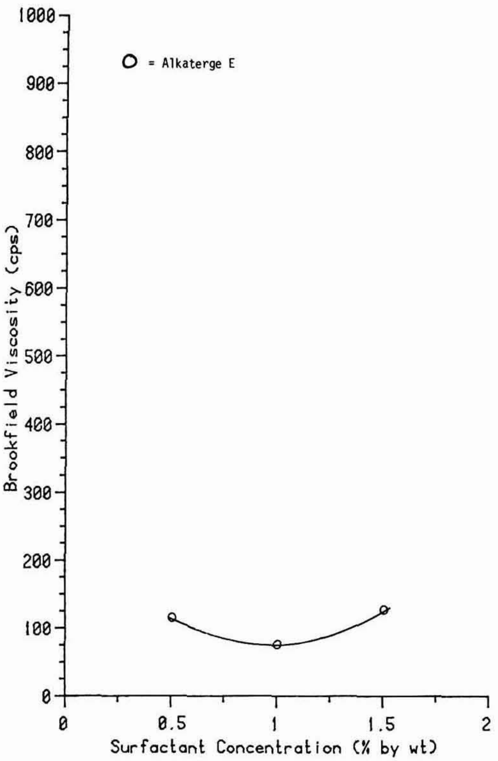


Figure 3—Pigment demand curve - cationic

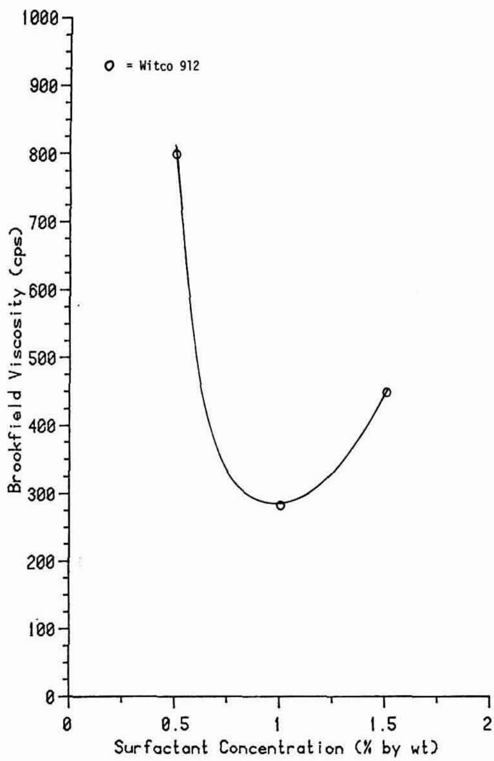


Figure 4—Pigment demand curve - blend

particles. However, with the exception of Nopcosperse 44, the pigment demand curves indicated sharp hyperbolic curves, with an increased viscosity growth above the lowest-viscosity concentration level. The anionics exhibited a high potential to flocculate the pigment particles at the higher surfactant level, comparable to the control surfactant formulation.

Cationic Surfactant

A cationic surfactant ionizes in aqueous systems and imparts positive ions to the pigment particle surface.[4-6] With the positive charge preferentially adsorbed at the pigment surface, oppositely charged solution ions are attracted to the pigment/vehicle interface which result in a charged double-layer between the approaching pigment particles.[11,13]

Alkaterge® E belongs to the oxygen-containing amines category, having the chemical structure of a substituted oxazoline. The general formula of this surfactant is RNR_3^+, where 'R' is an alkyl radical. As depicted in *Figure* 3, this surfactant exhibited a pigment demand curve with a nearly flat hyperbolic curve. This surfactant exhibited good pigment particle dispersion, and this type of curve is indicative of a low potential for flocculation.

Blend of Surfactants

The selection of a bi-polar compound enables the water envelope around the pigment particle surface to be extended further from the pigment surface. The surface seeking groups are either of opposite charge or a dipole of opposed direction.[4-6] It is important that the 'tail' projecting into the solution be another dipole group or slightly dissociated ionic group. The enlistment of water molecules by the part of the surfactant that extends into the aqueous solution assists in effecting a pigment dispersion.[9-11]

Witco® 912 is a nonionic-anionic blend of polyoxyethylene esters of carboxylic acid and sulfonated salts. It is more than likely that the hydrophilic groups of the nonionic surfactant, such as the ester and polyoxyethylene groups, are attracted to the pigment/vehicle interface. The 'tail' projecting into the solution is probably the higher dissociated ionic group of the anionic sulfonated salts ($SO_3^-Na^+$). With this phenomenon at the pigment particle surface, the water envelope is increased and sterically hinders close particle-to-particle approach.

As depicted in *Figure* 4, the surfactant blend reduced the initial viscosity of 800 cps to 280 cps as the surfactant

Table 5—Effect of Surfactants on Humidity Resistance[a]

Surfactant Chemical Type	Level (%)	Rusting Rating	Rusting Qual. Effect[b]	Blistering Rating	Blistering Qual. Effect
Nonionics:					
Octyl phenoxy polyoxyethyl benzyl ether[c]	0.5	10	Control	MD-8	Control
	1.0	10	Control	D-8	Control
	1.5	10	Control	D-8	Control
Polyoxyethylene oleate	0.5	10	0	NE	+
	1.0	10	0	NE	+
	1.5	10	0	MD-8	0
Alkyl phenoxy polyoxyethylene ethanol	0.5	10	0	MD-8	0
	1.0	10	0	MD-8	0
	1.5	10	0	D-8	0
Anionics:					
Dioctyl sodium sulfosuccinate	0.5	10	0	M-8	0
	1.0	10	0	M-8	0
	1.5	10	0	D-8	0
Sodium salt of polyacrylic acid	0.5	8	–	F-8	0
	1.0	7	–	F-8	+
	1.5	7	–	F-8	+
Ammonium salt of polyacrylic acid	0.5	2	---	MD-8	0
	1.0	4	---	F-8	+
	1.5	4	---	F-8	+
Sodium lauroyl sarcosinate	0.5	10	0	NE	+
	1.0	10	0	F-8	+
	1.5	10	0	F-8	+
Sodium salt of maleic anhydride copolymer	0.5	2	---	MD-6-8	0
Cationics:					
Substituted oxazoline	0.5	10	0	D-8	0
	1.0	10	0	M-8	0
	1.5	10	0	MD-8	0
Blends:					
Fatty acid ethoxylates and sulfonated acids	0.5	10	0	NE	+
	1.0	10	0	NE	+
	1.5	10	0	NE	+

(a) Humidity resistance rated by ASTM D610: (10) = no rust. Blistering was rated by ASTM D714: F = few, M = medium, D = dense, and NE = none evident. Number signifies blister size with (8) being the smallest and (2) being the largest.
(b) For qualitative effect: 0 = same as control, (+) = improvement over control by 2 units, (–) = worse than control, and (---) = much worse than control.
(c) Control Formulation with Triton CF-10 Surfactant.

concentration was increased from 0.5% to 1.0%. However, the viscosity increased to 445 cps at the 1.5% concentration level. The curve depicts a minimum viscosity growth as the surfactant concentration was increased from 1.0% to 1.5%. This minimal growth in the viscosity curve was among the lowest of all the surfactant types evaluated and indicates that the blend of nonionic-anionic surfactants may be the optimum in dispersing the titanium pigment particles for the acrylic latex formulation, by reducing the flocculation potential at the higher concentration levels.

EFFECTS OF SURFACTANTS ON HUMIDITY RESISTANCE

The most critical consideration in formulating a coating for corrosion protection of steel is to assure adhesion in the presence of water and hydroxyl ions. The 10 different types of surfactants at three concentration levels were evaluated in the acrylic latex coating formulation for their effect on the humidity resistance in protecting the steel substrate against corrosion. Concentration level of the surfactant can have a dramatic effect on the corrosion protective coating systems, since they are water-sensitive and thus tend to allow more water to permeate through the coating film. The evaluation of the surfactants employed in this study will follow.

Nonionic Surfactants

As shown in *Table* 5, the octyl phenoxy polyoxyethylene benzyl ether surfactant (Triton CF-10 control) exhibited no corrosion at all three surfactant concentration levels. The blistering frequency and size increased as the concentration level of surfactant increased. With no evidence of rust beneath the blisters, it can be assumed they were formed merely by the water vapor pressure.

The occurrence of corrosion for the polyoxyethylene oleate (Interwet 33) nonionic surfactant was negligible at each surfactant concentration level, and was comparable to the control in its coating properties. The occurrence of blistering may again be due to the water vapor pressure, since corrosion was not evident at the steel surface. The alkyl phenoxy polyoxyethylene ethanol surfactant (Hyonic PE-260) was equivalent to the control. No corrosion was evident beneath the blisters at any of the surfactant levels tested. Again, the blistering may be due simply to water vapor pressure.

Of the three nonionic surfactants evaluated in the acrylic latex formulation, the polyoxyethylene oleate (Interwet 33) demonstrated the best wetting properties in dispersing the pigment particles, and it also improved the protective properties of the barrier coating film. With the better wetting properties, the occurrence of pores (or entry points for the water molecules) was minimized in the coating film.

Anionic Surfactants

The dioctyl sodium sulfosuccinate (Triton GR-7M) anionic surfactant was comparable to the control system in its resistance to water vapor and blistering of the coating film, as evident from the data given in *Table* 5. The anionic surfactant was more efficient in dispersing the pigment particles and protecting the film from water permeation.

At all three surfactant concentration levels, the sodium salt of polyacrylic acid (Nopcosperse 44) exhibited comparable corrosion to the control system at the steel surface, but compared to the control system, Nopcosperse 44 showed a reduction in blistering at the 1.0% and 1.5% levels. This is, at best, a slight improvement.

The ammonium salt of polyacrylic acid surfactant (Nopcosperse 644A) showed corrosion at all surfactant concentration levels, with the most severe corrosion at the lowest level. Blistering was also most severe at this concentration level. On the basis of blistering size and frequency, Nopcosperse 644A proved to be slightly more effective. Even though the ammonium salt surfactant exhibited better wetting than its sodium salt counterpart, the presence of the ammonium ions had a negative influence on the barrier film properties of the acrylic latex formulation.

The corrosion resistance properties of the acrylic latex formulation with the sodium lauroyl sarcosinate surfactant (Hamposyl O) were comparable to the control system, with no corrosion apparent at any of the concentrations tested. This surfactant type proved better in blistering resistance, as compared to the control system. Of the anionic surfactants evaluated in the coating formulation, the sodium lauroyl sarcosinate exhibited the best corrosion and blistering resistance properties.

The barrier film properties of the coating film with the sodium salt of maleic anhydride copolymer (Nuosperse HOH) were extremely poor at the 0.5% concentration level as compared to the control surfactant system. The higher concentration levels caused the coating to flocculate, and thus they could not be applied to the steel panels. It may be speculated that the sodium salt concentration is critical in effecting pigment particle dispersion and overall protective film properties in a coating film.

Cationic Surfactant

The substituted oxazoline surfactant (Alkaterge E) demonstrated corrosion resistant properties at each concentration level that were comparable to the control surfactant system. The frequency and size of blistering decreased and this surfactant exhibited minimal water permeation at the 1.0% level, the lowest viscosity of the three concentration levels tested. Even though most cationic surfactants are incompatible with aqueous coating formulations, the substituted oxazoline demonstrated proficiency in dispersing the pigment particles and protecting the steel substrate from corrosion attack.

Blend of Surfactants

Of all the surfactant types evaluated in this study, the blend of fatty acid ethoxylates and sulfonated salts (Witco 912) provided the best protective properties for the acrylic coating formulation. As seen in *Table* 5, there was no evidence of blistering at any surfactant concentration tested as compared to the control. The nonionic-anionic surfactant blend was effective in establishing excellent pigment dispersion through its bi-polar structure, thus minimizing the occurrence of pores in the coating film. Here, the permeation of water to the metal/coating interface was minimized.

In reviewing the results, the blend of fatty acid ethoxylates and sulfonated salts demonstrated the best surfactant performance in the acrylic latex formulation in protecting the steel substrate from atmospheric corrosion.

EFECTS OF SURFACTANTS ON SALT SPRAY RESISTANCE

Among all exposure tests for organic coatings the salt spray test is probably the most common one for testing corrosion resistance of coatings.

Nonionic Surfactants

As seen in *Table* 6, the control surfactant system with octyl phenoxy polyoxyethylene benzyl ether (Triton CF-10) exhibited severe corrosion of the steel substrate when applied as a protective coating. The amount of undercutting (the corrosion of the exposed steel substrate from the scribed mark) was 1/2 in., indicating that the coating formulation provided little protection to the steel once the corrosion began. Surprisingly, no loss of adhesion was evident on the test specimens.

The polyoxyethylene oleate surfactant (Interwet 33) exhibited excellent corrosion resistant properties as compared to the control. With blistering frequency being lower than the control system, it became evident that there was less water permeation through the coating film. Therefore, the occurrence of corrosion cells was reduced. The amount of undercutting was 5/8 in. for the 0.5% and

Table 6—Effect of Surfactants on Salt Spray Resistance[a]

Surfactant Chemical	Level	Rusting		Blistering		Scribe	
		Rating	Qual. Eff.[b]	Rating	Qual. Eff.	Under-cut	Adh. Loss[c]
	(%)	Face/ Scribe		Face/ Scribe		Inches	
Nonionic:							
Octyl phenoxy polyoxyethylene benzyl ether[d]	0.5	2/5	Ctl.	M6/MD4	Ctl.	1/2	NE
	1.0	2/5	Ctl.	MD6/D4	Ctl.	1/2	NE
	1.5	3/5	Ctl.	MD6/D4	Ctl.	1/2	NE
Polyoxyethylene oleate	0.5	9/6	+/0	F6/M4	0	5/8	NE
	1.0	8/6	+/0	M6/MD4	0	5/8	NE
	1.5	9/9	+	M4/MD4	0	0	NE
Alkyl phenoxy polyoxyethylene ethanol	0.5	9/10	+	F6/F-M6	0	3/8	NE
	1.0	7/8	+ •	F4/MD4	0	3/8	MOD
	1.5	7/8	+	M4/MD4	0	3/8	MOD
Anionic:							
Dioctyl sodium sulfosuccinate	0.5	3/7	0	D6-8/MD6	0	0	MOD
	1.0	3/7	0	M4-6/MD6	0	0	MOD
	1.5	3/6	0	D4/MD4	0	0	MOD
Sodium salt of polyacrylic acid	0.5	2/6	0	D4/D4	0	UND[d]	NE
	1.0	1/6	0	D4/D4	0	UND	NE
	1.5	2/10	0/+	D4/D4	0	UND	NE
Ammonium salt of polyacrylic acid	0.5	4/7	0	D8/MD4	0	1/4	DEF
	1.0	3/6	0	D4/F4	0	1/4	DEF
	1.5	2/6	0	D4/F4	0	1/4	DEF
Sodium lauroyl sarcosinate	0.5	8/10	+	F4/F-M8	0	1/8	OFF
	1.0	6/6	+/0	F8/M4	0	1/4-1	OFF
	1.5	7/6	+/0	F-M6/M4	0	Complete	OFF
Sodium salt of maleic anhydride copolymer	0.5	1/6	0	D8/D8	—	UND	MOD
	1.0[e]						
	1.5[e]						
Cationic:							
Substituted oxazoline	0.5	3/3	0	MD4/MD4	0	3/8-1/2	MOD
	1.0	3/3	0	MD4/MD4	0	1/4	MOD
	1.5	4/4	0	M4/M4	0	1/4	MOD
Blend:							
Fatty acid ethoxylates and sulfonated acids	0.5	9/10	+	F6/M6	+	3/8	NE
	1.0	9/10	+	F6/M6	+	5/16	NE
	1.5	9/10	+	F6/M6	+	1/8	NE

(a) Salt spray resistance related by ASTM D610: (10) = no rust. Blistering was rated by ASTM D714: F = few, M = medium, D = dense, and NE = none evident. Number signifies blister size with (8) being the smallest and (2) being the largest.
(b) For qualitative effect: 0 = same as control, (+) = improvement over control by 2 units, (−) = worse than control, and (---) = much worse than control.
(c) Adhesion loss of coating film on steel substrate.
(d) Undetermined amount on panel.
(e) Coating Formulations Flocculated.

1.0% surfactant concentration levels, giving better corrosion resistance properties once the corrosion began.

The optimum corrosion resistant properties of the coating formulation with alkyl phenoxy polyoxyethylene ethanol nonionic surfactant (Hyonic PE-260) were exhibited at the 0.5% concentration level. There were few blisters on the film surface indicating a low permeation of water to the metal/coating interface. This surfactant type exhibited the least amount of undercutting, with a value of 3/8 in. as compared to the other two nonionic surfactants. At the higher surfactant levels, 1.0% and 1.5%, the corrosion resistant properties of the coating film were not as good but were much improved over the control. It was noted that at these higher levels adhesion was only moderate.

Anionic Surfactants

All of the anionic surfactants evaluated in this study and listed in *Table* 6 proved to be lower in their overall corrosion resistant properties as compared to the control surfactant formulation. With the dioctyl sodium sulfosuccinate surfactant (Triton GR-7M), the corrosion was comparable to the control surfactant formulation. Blistering frequency and size were higher than the control. This resulted in moderate adhesion of the coating film to the substrate. Therefore, this surfactant provided poor corrosion resistant and poor water permeation properties. There was no undercutting measured at the scribe. Thus, the coating was at least responsible for stopping the lateral movement of corrosion from the bare steel scribe mark.

Both of the salts of polyacrylic acid (Nopcosperse 44 and 644A, sodium salt and ammonium salt, respectively) exhibited poor corrosion resistance when present in the formulation. The water permeation of the sodium salt of polyacrylic acid was high, as evident from the blister size for each concentration level tested. However, there was no loss in adhesion. The amount of undercutting was very extensive and, therefore, could not be determined. The ammonium salt of polyacrylic acid exhibited a definite loss in adhesion. The amount of undercutting was measured at 1/4 in., which demonstrated improved corrosion resistance at the scribe compared to its sodium salt counterpart. Overall, these polyelectrolyte surfactants were not effective in resisting permeation of water and/or ionic species.

The sodium lauroyl sarcosinate (Hamposyl O) formulation exhibited excellent corrosion resistance compared to the control surfactant formulation. Water permeation of the coating film was low, as indicated by the frequency and size of blistering. However, the amount of undercutting increased from 1/8 in. to 1 in. to complete as the surfactant concentration level was increased. This indicated the coating formulation did not stop the lateral spread of corrosion once it began at the scribe. The loss of adhesion was dramatic at each tested level, with the coating film lifting completely off the substrate.

Corrosion resistance of the test coating, including the sodium salt of maleic anhydride copolymer (Nuosperse HOH), was the worst of all the anionic surfactants evaluated in this study. High permeation of water molecules through the coating film produced a large number of small blisters. The adhesion to the steel surface was moderate. The amount of undercutting from the scribe was undeterminable, indicating the inability of this surfactant to retard the lateral spread of corrosion at the concentration level of 0.5%. It would be necessary to reformulate the acrylic coating formulations with lower concentrations of this surfactant to establish its overall corrosion resistant properties.

Cationic Surfactant

With the addition of the substituted oxazoline (Alkaterge E) to the acrylic latex coating system, the corrosion resistant properties were comparable to the control surfactant formulation, therefore being ineffective. Results are listed in *Table* 6. The water permeation of the coating film with this surfactant type gave medium-dense '4' blistering with a resulting moderate loss in coating film adhesion to the substrate. The amount of undercutting varied from 3/8 to 1/4 in. for the concentration levels studied. The undercutting results were better than the control formulation.

New England Society's Technical Committee

Maureen M. Lein, Chairperson ..... Raffi and Swanson
Bradford Brakke .... Lilly Industrial Coatings
Gary Keltz .... Polyvinyl Chemical Industries
M.P. Kiezulas .... Aguadilla, P.R.
Cynthia M. Leavy .... General Electric
Robert Marderosian ...... Cypress Color and Chemical
David Withington .... Tra-Con

Blend of Surfactants

The blend of fatty acid ethoxylates and sulfonated acids (Witco 912) exhibited the best corrosion and water resistance of all the surfactant types evaluated. This is evident in *Table* 6 where the data clearly show the dramatic improvement over the control surfactant and other formulations. Corrosion was almost negligible on the coating film. Blistering was rated at few-'6', indicating the least water permeation. In addition, the amount of undercutting was lower than the control surfactant formulation, and exhibited only 5/8 in. at the concentration level of 1.0%. This surfactant type provided a lower potential for the ionic species to migrate through the polymer film and ultimately reach the metal/coating interface. Because of its bi-polar structure, the surfactant may bind with the metal oxide surface to provide a highly structured barrier between the coating film and metal surface, resulting in less corrosion attack on the metal substrate. The blend of fatty acid ethoxylates and sulfonated acids clearly exhibited the most favorable corrosion resistant properties when added to the acrylic latex coating system.

SUMMARY

The nonionic-anionic blend was the best choice of surfactant for this acrylic latex coating formulation. Its dispersion effectiveness may be due to its chemical structure, since it is a bi-polar molecule. In addition, the surfactant may also react with the metal oxide surface, producing a highly structured barrier film at the metal/coating interface.

Because of the possible sensitization of the film to water and salt fog, care in selection as well as concentration must be taken into account in choosing a surfactant.

ACKNOWLEDGMENT

The New England Society for Coatings Technology would like to give special thanks to Polyvinyl Chemical Industries for providing laboratory time, meeting facilities and test equipment.

References

(1) Pezzuto, M. and Fitzwater, J., *Modern Paint and Coatings,* No. 6, 68 (1978)

(2) New England Society for Coatings Technology, "The Design of Waterborne Coatings for the Corrosion Protection of Steel, Part I: A Survey of Various Factors that Affect the Corrosion Protection of Coatings on Steel", JOURNAL OF COATINGS TECHNOLOGY, *53,* No. 683, 27, (1981).

(3) New England Society for Coatings Technology, "The Design of Waterborne Coatings for the Corrosion Protection of Steel, Part II: Evaluation of Some Chemicals as Flash Rust Inhibitors in an Aqueous Air Dry Coating", JOURNAL OF COATINGS TECHNOLOGY, *54,* No. 684, 63, (1982).

(4) Patton, T.C., "Pigment Dispersion," *Paint Flow and Pigment Dispersion,* 2nd Edition, John Wiley and Sons, New York, (1979).

(5) Patton, T.C., "Interface Activity," *Ibid.*

(6) Conley, R.F., "Design Functionality and Efficiency of Pigment Dispersants in Waterborne Paints," JOURNAL OF PAINT TECHNOLOGY, *46,* No. 594, (1974).

(7) Stevens, C.E., "Organic Chemistry of Surfactants," *J.O.C.C.A.,* No. 57, 19 (1975).

(8) Kiselev, A.V., "Effect of Geometric Structure of Oxide Particle," *Disc. of Faraday Soc.,* 52, (Oct. 1971).

(9) Schlick, M.J., *Nonionic Surfactants,* Vol. I, Marcel Dekker, Ind., New York, (1967).

(10) Munera, G., "Absorbtion of Water on Hydroxylated Rutile," *Disc. of Faraday Soc.,* 52, (1971).

(11) Schwartz, A.M., "Physical and Colloidal Chemistry of Surfactants in Theory and Practice," *Surface Active Agents,* Vol. II, Interscience Publishers, Inc. New York, (1958).

(12) Linfield, W.M., *Anionic Surfactants,* Vol VII, Part I, Marcel Dekker, Inc., New York, (1976).

(13) Jungerman, Eric, *Cationic Surfactants,* Vol. IV, Marcel Dekker, Inc., New York, (1979).

Tradename References

Alkaterge	Commercial Solvents Corp.
Deefo	Ultra Adhesives, Inc.
Hamposyl	W.R. Grace, Hampshire Chemical Div.
Hyonic, Nopcosperse	Diamond Shamrock Corp.
Interwet	Interstab Chemicals, Inc.
Nuosperse	Nuodex, Inc.
Rhoplex, Tamol, Triton	Rohm and Haas Co.
Texanol	Eastman Chemical Products, Inc.
Witco	Witco Chemical Corp.
Zopaque	Glidden Pigments/SCM Corp.

CLEVELAND .... MAY

"Past-Presidents' Night; Awards Night; and Election of Officers"

Twenty-two Society Past-Presidents representing a time span of more than a quarter of a century were honored guests. Other honored guests in attendance were Federation President A. Clarke Boyce and his wife Marjorie, and Federation Executive Vice-President Frank Borrelle and his wife Rose. Also attending the meeting were Cleveland Area School Science Fair Winners, who were presented with awards and who gave brief descriptions of their projects.

Society Past-Presidents, representing a time span of more than a quarter century, were honored guests of the Cleveland Society at its May meeting

Mike Malaga presented the Dr. Frank Selden Award to Dr. Raymond R. Myers, of Kent State University, and Society Honorary Member, in recognition for his distinguished service to the coatings industry and to the Society. The Award is made from a trust fund that was originally set up from funds contributed by George Selden to honor the memory of his father.

Dr. John C. Weaver, Consultant and Lecturer in Case Institute of Technology's macromolecular science department, and Dr. Scott E. Rickert, Associate Professor of macromolecular science at Case Western Reserve University, received Outstanding Achievement Awards from the Cleveland Technical Societies Council.

1983–84 Officers elected were: President—Harry Scott, of Glidden Coatings and Resins Div., SCM Corp.; President-Elect—Richard Horger; Secretary—Robert Thomas, of PPG Industries, Inc.; Treasurer—Madelyn Harding, of Sherwin-Williams Co.; Assistant Treasurer—Scott Rickert; and Society Representative—Fred Schwab, of Coatings Research Group, Inc.

RAYMOND PODLEWSKI, *Secretary*

GOLDEN GATE .... MAR.

"Epoxy Resin Coatings"

Dr. Bauer, of Shell Development Co., presented a talk entitled "RECENT DEVELOPMENTS IN EPOXY RESIN COATINGS."

Dr. Bauer stated that 42% of all epoxy resins go into coatings. Presently, there is less emphasis on solution coatings and heavy emphasis on high solids and water-borne coatings.

Excellent water-borne systems have been developed for electrodeposition and baking systems. Water-borne ambient cure coatings are the weakest area at this time, said Dr. Bauer.

A new development is a weatherable epoxy resin which exhibits excellent chalk resistance and resistance to yellowing compared to conventional systems.

High solids systems have been developed for both baking and ambient cure. These systems have properties comparable to conventional systems, said Dr. Bauer.

ROBERT MILLER, *Secretary*

GOLDEN GATE .... APR.

"Formulating a Solvent-Based Compliance Coating"

"FORMULATING A SOLVENT-BASED COMPLIANCE COATING" was presented by Dr. Henry W. George, an International Consultant.

Dr. George spoke primarily of attempts to meet the requirements of regulations regarding limited V.O.C. emissions when coating miscellaneous metal parts and products. The three options open to formulators are water-base, high solids, and compliance solvents.

In the Western states, except Colorado, methylene chloride and 1,1,1 trichloroethane have been exempted from solvent limitations, stated Dr. George. These two chlorinated solvents can be used in unlimited quantities and are treated like water for purpose of calculations. Properly formulating with exempt solvent will reduce V.O.C. and raise the flash point while maintaining all other properties. A potential hazard has been found when using chlorinated solvents with aluminum equipment. There may be a reaction causing an explosion. A customer can determine if there is any aluminum in their equipment by calling 800-221-8300 which is a Hot Line to Dow Chemical. Dow will in turn notify the equipment manufacturer who will call the customer back, said Dr. George.

ROBERT MILLER, *Secretary*

KANSAS .... MAY

"Federation Officer Visit"

Honored guests attending the meeting were Federation President-Elect Terryl Johnson and Director of Field Services Thomas Kocis. Also in attendance were Society Honorary Members Lawrence Schulte, J.C. Leslie, and John Ormsby, who will retire from Farmland Industries. Science Fair Award winners and their families were also present.

Officers elected for the 1983-84 year were: President—Gene Wayenberg, of Tnemec Co., Inc.; Vice-President—Melvan Boyer, of Patco Coating Products; Secretary—Dennis Mathes, of Cook Paint & Varnish Co.; and Treasurer—Steve Bussjaeger, of Davis Paint Co.

At the Cleveland Society's meeting, Dr. Raymond R. Myers (left) University Professor at Kent State University, was presented the Dr. Frank Selden Award. Dr. Myers was honored for his service as Research Director of the Paint Research Institute from 1964–82. He is presently Research Director Emeritus

President Elect Terryl discussed plans for the future and also took a look at the past of the Federation. He talked about the Spring meeting in Cincinnati.

Mr. Johnson discussed the Federation's first seminar in Kansas City and told of a second possible seminar on manufacturing. He also discussed PRI, the Boston Stone, and the up-coming Paint Show in Montreal, Canada.

Thomas Kocis discussed and showed slides on the various activities of the Federation. Especially interesting were the slides which showed, in pie form, income and expenses of the Federation. Slides also showed publications and services available from the Federation. They illustrated the various committees in action and Mr. Kocis discussed each of these. He touched on the Paint Research Institute (PRI) and their objectives.

The Montreal Paint Show was discussed, as was the past show in Washington. Slides showing Montreal and the hotels were shown. Mr. Kocis urged as many people as possible to attend the Paint Show and thanked the Kansas City Society for all of its help in the past.

GENE A. WAYENBERG, *Secretary*

LOS ANGELES .... MAY

"Awards Night"

A moment of silence was observed for Daniel C. Patch, of Crossfield Products Corp., and William Dabbs, who recently died.

Awards Chairman Donald Jordan presented 25-year pins to the following members: Gene E. Alley, E.T. Horn Co.; Wally Brede, Spencer-Kellogg Div., Textron, Inc.; Tom Donohoe, TCR Industries, Inc.; Al Drzewinski, Decratrend Corp.; Vern Filter, P.F.I.; Maurice Gould Whittaker, Ram Chemicals; Henry Jacoby, Specialty Coatings, Inc.; Kent Little, Retired; Bert Osen, Behr Process, John Prinz, Sinclair Paint Co.; and Kevin Worrall, Textured Coatings of America.

Lloyd Haanstra, Environmental Chairman, discussed that on May 18th in the Bay Area, a Public Hearing is being held to revise The Bay Area Architectural rule to possibly extend the 380 gms/litre through 1986. Specially exempted catagories will be discussed. The proceedings are important to our section, because what happens in the Bay Area will probably affect our district. Also, our paint course has a special evening on May 26th to discuss how to formulate for CARB regulations and how to calculate VOC. Mr. Haanstra discussed a visit to the Southcoast Laboratory, and observation of how they arrived at their determinations of VOC. It is important to get duplicatable results between industry and the CARB laboratory, stressed Mr. Haanstra.

Bud Jenkins, Technical Committee, discussed a questionnaire that covers a request for data on heat stability of paint vehicles. The information can cover both water or solvent thinned paints. This information will be used by the Committee in compiling some papers they are working on at present.

President Romer Johnson discussed the need for committee members and contributors for the upcoming work to be done in the preparation of a textbook to cover the Paint Course, under the chairmanship of Trev Whittington.

Elio Cohen, of Daniel Products Co. presented "COMPOSITE VS SINGLE DISPERSANTS IN COLORANTS AND COATINGS."

Mr. Cohen discussed the use of pigment dispersants to enhance pigment loading in mill bases, reduce the mechanical energy needed to break up pigment agglomorates, speed up the dispersion process, impart stability, and improve the rheology of the finished product.

Certain dispersant combinations are more effective than a single dispersant in any given application, and are always more broadly useful, said Mr. Cohen. This applies to solvent as well as water thinnable systems.

Q. How does your combination dispersant affect water sensitivity in the final coating?

A. The dispersant will not affect water sensitivity if it is not used in excess.

Q. Doesn't too much of the surfactant contribute to the water paints being water sensitive?

A. Yes.

Q. Pigment seeding is sometimes a problem. What blend of vehicle to wetting agent is best?

A. Consider solvent or water thinnable. In solvent system, use 2.2/1 PP vehicle solids to pigment solids. To this use 2 to 5% surfactant to do the job. In water systems where we do not have the solids, we actually need only 1% surfactant/pigment to do the job.

Q. Can optimum results of a paste be made without a binder?

A. You can disperse with solvent alone. It needs to be stabilized with about 10% dispersant. You have to be careful when adding the binder when reducing the batch to keep from shocking the system.

Q. What type of dispersants work well in conjunction with each other?

A. Dispersant houses probably do not know.

Q. In water paints, do you consider a grinding additive such as Rohm and Haas I 98 or Byk VP 156 as dispersants? How do they interact with your dispersants?

A. Do not know. We do not use these.

Q. In grinding phthalo blue through sandmill do you need to use a combination of wetting agent and dispersant in order to get the maximum tinting strength? How much dispersant (minimum) do you need?

A. For sandmill, you can use one dispersant. You need 2–3% dispersant based on pigment concentration. In our use of sandmills, we couldn't get enough tinting strength. Therefore, we had to use an attritor.

MICHAEL GILDON, *Secretary*

LOS ANGELES .... JUNE

"Solvent Evaporative Mechanisms"

A moment of silence was observed for Roy Anderson, of the Roy Anderson Paint Co., who recently died.

Lloyd Haanstra presented the Environmental Report. At the Public Hearing in the Bay Area, it was passed to extend to September 1986 the Architectural Coating rules, which include: 380 gms/litre for nonflats, and 250 gms/litre for flat coatings. According to Mr. Haanstra, there were also changes in the Exempt Categories.

In June, at the SCAQMD Headquarters, there will be a workshop to cover four important points. These four points might cause problems, as the SCAQMD is not in agreement with the Task Force. The four major points that have arisen are not in conformity with the rest of the State, said Mr. Haanstra. They are:

(1) They want to eliminate the small business exemption by September 1983. This changes the rule that called for September 1984 as the date for eliminating this exemption.

(2) They want to extend the rule to 1985 instead of 1986.

(3) The 14 Exempt Categories that had an interim limit of 1984, with a final limit in 1989, the South Coast Body proposes to have the final limit in 1987.

(4) For flats and nonflats they want to eliminate the present exemption that exists for containers of 1 litre or less.

Al Seneker announced a workshop on Rule 1107 and a workshop on covering fees.

Don Jordan, Awards Chairman, presented Outstanding Service Awards to: Fred Croad, Tnemec Co., Inc.; George Kashmer, Dunn-Edwards Co.; Robert Koperek, Mobil Chemical Co.; John Plant, John K. Bice Co., Inc.; Tony Rumfola, TCR Industries, Inc.; Al Seneker, Ameron Corporate Research; Richard Sutherland, E.T. Horn Co.; Geneva Wells, H.M. Royal Inc.; and Jerry West, Devoe Marine Coatings.

A 50-Year Membership pin was presented to Carl Howson, Society Past-President (1930-31).

Also, Honorary Membership was awarded to Clarence Meyers, a 50-year member.

The slate of officers for the 1983-84 term include: President—L. Lloyd Haanstra, of Ameritone Paint Corp.; Vice-President—Earl Smith, of Spencer-Kellogg Div., Textron, Inc.; Treasurer—Michael Gildon, of Guardsman Chemicals, Inc.; and Secretary—Henry J. Kirsch, Trans Western Chemical.

William H. Ellis, of Chevron Research Co., presented "COMPARATIVE SOLVENT EVAPORATIVE MECHANISMS FOR CONVENTIONAL AND HIGH SOLIDS COATINGS." His presentation was awarded first prize in the 1982 Roon Awards Competition at the Federation's Annual Meeting, in Washington, DC.

Mr. Ellis showed that even though solvent volatility has been used to control initial flow and resulting qualities of a conventional coating, high solids solvent volatility does not follow the usual course. He explained how to develop a precise method to determine and use the transition point of the resin and solvent used.

Mr. Ellis covered conventional resins, high solids, and bodied linseed oil. He showed that in conventional alkyds, formulated at resin concentrations below the transition point, solvent volatility can be used. In high solids, formulated at resin concentrations above the transition point, solvent volatility cannot be used to control setting and other initial flow properties.

MICHAEL GILDON, *Secretary*

The Cleveland Society awarded Dr. Scott E. Rickert (left), of Case Western Reserve University, with its Technical Achievement Award. Dr. John C. Weaver, of Case, was presented with the Society's Distinguished Service Award

NEW YORK .... MAY

"Low Energy Curing"

Elected to office for the 1983-84 year were: President—Herbert Ellis, Jr., D.H. Litter Co., Inc.; Vice-President—Michael Iskowitz, International Paint; Secretary—Raymond Gangi, Woolsey Marine; and Treasurer—Kenneth DePaul, Whittaker, Clark & Daniels.

Honored guests in attendance were Federation Executive Vice-President Frank Borrelle and Federation Director of Field Services Thomas Kocis.

Sidney Rubin, Chairman of the Awards Committee, presented Saul Spindel, of D/L Laboratories, with the PaVac Award.

Dr. Peter Pappas, of North Dakota State University and 1983 PaVac Lecturer, spoke on "Low Energy Curing, Physical Organic Chemistry and Creativity."

The best thermosetting coating is stable for a long time at ambient temperatures but will convert rapidly at a low baking temperature or with a very short bake cycle. Arrhenius discovered that if one plots the log of the reaction rate against the reciprocal of the temperature, the result is a straight line, said Dr. Pappas. This is ideal for extrapolation of data. Since the function is linear, the concepts of slope—Y-intercept are applicable. Calling the slope E_a and the Y-intercept the A value, temperature increases toward the origin, the rate increases away from the origin; hence, the slope is a measure of how fast the rate of reaction changes with temperature. The steeper the slope the faster the rate of reaction, stated Dr. Pappas.

If two reactions have the same intercept but different slope, the one with the steeper slope at any given temperature will have a lesser rate of reaction than the reaction with the flatter slope, Dr. Pappas said.

Consider reactions with the same slope but different Y-intercepts. In this case, at all temperatures the rate of reaction of the higher Y-intercept will be greater than that of the lower.

Dr. Pappas said that the ideal situation is to increase both slope and intercept, thus at low temperature one would have stable slow rate reactions but at elevated temperatures rapid rates of reaction.

According to Dr. Pappas, this leads to a few questions, namely: (1) Can we characterize a coating curing system in terms of some ambient stability and some cure conditions by E_a and A values? and (2) If we can do that, will that be helpful in designing the reactive part of a curing system?

Since it is not possible to define a curing system by one set of E_a and A values because initially reaction rate depends on the reactivity of the functional group, as viscosity builds up the rate depends more on diffusion, an approach to calculate E_a and A values before diffusion sets in has long been established. These values help determine storage stability and cure rate requirements as well as aiding catalyst selection.

A six month stable system was examined, explained Dr. Pappas. It had a cure rate of 175°C (347°F). This shows that in order to have a system with good storage and low temperature cure, we need a high E_a value and a high A value. The highest A value observed is of the order of 10^{16}. Therefore, A is equal to or less than 10^{16}. For 100°C A is 10^{24}. Therefore, we can conclude that there is no known reaction that will have six month stability and cure at 100°C.

Can we get around this factor of 10^{16}? For most reactions, the reaction occurs at all temperatures but, of course, at different rates for each temperature. There are, however, exceptions such as phase changes like melting. An example of such a system would be where the catalyst melts at an elevated temperature. No reaction occurs until melting begins. This system is stable until the catalyst melts and if the melt temperature is close to the cure temperature, then we have an almost perfect system. This area is the place to look at for the future, Dr. Pappas said.

MICHAEL ISKOWITZ, *Secretary*

NORTHWESTERN .... MAY

"Quality"

Society Vice-President Herbert Davidson, of Spencer Kellogg Div., Textron, Inc., has resigned from his post and announced that he will not be able to serve as 1983-84 President.

Officers for the 1983-84 term are: President—Robert Mady, of George C. Brandt, Inc.; Vice-President—Richard Johnson, of Cargill, Inc.; and Secretary—Alfred Yokubonis, of Celanese Polymer Specialities Div. The position of Treasurer is still open.

Dr. Zeno W. Wicks, Jr., of North Dakota State University, was awarded Honorary Membership in the Society.

Ron Hemann, of 3M Co., discussed "QUALITY" and how his company is approaching quality.

Mr. Hemann explained how foreign countries have surpassed the United States when it comes to quality. He also discussed the philosophy of quality and its concepts. The cost of quality was also stressed by Mr. Hemann.

ROBERT MADY, *Secretary*

PHILADELPHIA .... MAY

"Water-Borne Coatings for Plastics"

The slate of officers for the 1983–84 term are: President—Frank Bartusevic, of Chapman Industrial Finishes; President-Elect, William Georgov, of J.M. Huber Corp.; Secretary—Robert Tozer, of Delkote, Inc.; and Treasurer—Philip Reitano, of Kay Fries, Inc.

A 25-year pin was awarded to Eugene H. Ott, a retired Society member.

The Education Committee recognized Seymour Hochberg and thanked him for serving as instructor for ACS paint course.

"WATER-BORNE COATINGS FOR PLASTICS—THE BEST ALTERNATIVE" was discussed by Gail Pollano, of Polyvinyl Chemical Industries.

Ms. Pollano introduced her subject by briefly reviewing the birth and development of plastics over the years. Using slides, she explained that coatings were originally developed for decorative purposes, but now are designed to serve or provide functional properties.

Ms. Pollano covered ways of improving adhesion to plastic substrates as well as wetting and surface tension. She mentioned the use of proper ingredients vital to achieve end properties desired.

Hardness of water-borne systems was reviewed and correlated to Tukon, Sward, and Pencil tests normally used in the industry. Hardness can be affected by using improper solvent, pigment, and plasticizer, said Ms. Pollano.

Water-borne systems have improved tremendously over the years and are now ready to serve the industry, stated Ms. Pollano.

Ms. Pollano concluded the talk by stating that: (1) Plastics are growing, (2) Water-reducible systems can overcome problems associated with solvent systems; (3) Proper use of ingredients play a key role in performance; and (4) New resins are available.

Q. Can you recommend any antifoam agents?

A. We have specific recommendations for specific resins—we will gladly review them.

Q. What about polypropylene film?

A. This is a real problem area and needs specific guidance.

WILLIAM GEORGOV, *Secretary*

PIEDMONT .... MAY

"Solvents for High Solids Coatings"

R. Readshaw, of the Union Carbide Corp., spoke on "SOLVENTS FOR HIGH SOLIDS COATINGS."

Mr. Readshaw explained that, in the past, solvents were looked upon as vehicles to transfer resins or coatings onto substrates. With the advent of VOC regulations and high solids coating, solvents now can be considered in the role of additives. As we reduce the amount of carrier we can use in high solids coatings, the choice of suitable solvents also becomes limited, stressed Mr. Readshaw. We are forced to rely heavily on medium and slow active solvents. In electrostatic spray, the key to good application is electrical balance of the coatings. Although hydrocarbons have high electrical resistivities, they are usually poor or nonsolvents for resins, said Mr. Readshaw. There, ketones and esters are solvents of choice. Primary amyl acetate with its slow evaporation rate and electrical resistance of greater than 20 meg-ohm per cm^2 is specially recommended for this end use. Whether used singly or as additives in a coating, p-amyl acetate is able to raise the resistance of many formulations. By altering the electrical balance of a coating, it also changes the spray quality and transfer efficiency of the coating due to better coating breakup or atomization, lower current draw, and better wrap around, explained Mr. Readshaw.

High surface tension causes substrate wetting problems, crawling, and cratering in high solids coatings. By manipulating the solvent system along with judicial use of additives, surface tension problems could be minimized, Mr. Readshaw added. Within the different classes of oxygenated solvents, surface tension varies widely. Di-isobutyl ketone is very effective in lowering the surface tension of a coating. By itself DIBK is a poor solvent. Sometimes one has to balance the viscosity reduction need with the wettability need of a coating. Ketones are naturals in high solids formulations. They have high solvency, low density, and certain branched ketones such as MIBK and DIBK which have low surface tensions as well. Further, he said, at Union Carbide in choosing a solvent blend for a coating rather than depending solely on solvent volatility data, they have come to rely heavily upon the evaporation profile of the total solvent system. The profile is generated from a wind-tunnel which gives a graph of weight less per unit of time. He demonstrated that two solvent systems with relative evaporation rates of 42 and 25 can have a closely matched evaporation profile.

PHILIP WONG, *Secretary*

SOUTHERN (Memphis Section) .... MAY

"Election of Officers"

The following section officers were elected for the 1983–84 term: Chairman—Brian Budzien, of Lilly Industrial Coatings; Vice-Chairman—Robert Clark, of Mid-American Paints; Secretary-Treasurer—John Harper, of Burk-Hall Paints; and Social Chairman—Scott Hanus, of Union Chemical, Resin Div.

BRIAN BUDZIEN, *Chairman*

ST. LOUIS .... MAY

"Manufacturing Night"

The following officers were elected for the 1983–84 year: President—Robert Giery, of Spatz Paint Industries, Inc.; Vice-President—William Truszkowski, of Mozel Chemical Products Co.; Secretary—Charles Grubbs, of Rockford Coatings; Treasurer—Merle Held, of Cyprus Industrial Minerals; and Assistant Treasurer—Al Zanardi, of U.S. Paint Div., Grow Group, Inc.

A moment of silence was observed for John Libera, a long-time Society member who passed away.

The donation of used equipment and books, etc. to the University of Missouri-Rolla, Rolla, MO was discussed.

Howard Jerome, Federation Past-President, presented a detailed report on the Federation's first seminar held in Kansas City, MO.

A slide presentation entitled "A Batch Operated Mini-Media Mill" which was prepared by the New York Society was given. Also, the Montreal Society's presentation on "High Speed Dispersion" was presented.

WILLIAM A. TRUSZKOWSKI, *Secretary*

Meetings/Education

'Talks Available' Booklet Offers 70 Presentations

The 1983-84 listing of "Talks Available for Constituent Societies" contains a total of 70 presentations which are available for the upcoming meeting season. Divided into eight subject headings, the booklet presents 20 new titles.

The booklet, compiled and distributed to the Societies by the Federation, includes for each presentation: (1) Title; (2) Name of speaker; (3) Company affiliation; (4) Geographic areas where the talk is available; (5) Equipment needed; (6) Abstract; (7) Biographical sketch of the speaker; and, if applicable, (8) Where and when talk has previously been given.

The following presentations are listed:

Additives

"Role of Acetylenic Glycols in Water-Borne Coatings"—Air Products & Chemicals, Inc.

"Anti-Microbials Used in Coatings and Plastics"—Nuodex Inc.

Colors and Pigments

"List of Five Presentations on Color Control and Appearance"—Applied Color Systems, Inc.

"Improved Color Communications for the Coatings Industry"—Applied Color Systems, Inc.

"Computer Color Formulation: How to Maximize Your Investment"—Bausch & Lomb/Diano.

"Enhanced Performance in Lower Cost Latex Flats"—Burgess Pigment Co.

"Quality with Thermo-Optic Silicates as the Foundation"—Burgess Pigment Co.

"Colorant Formulation: Pigment Selection"—CIBA-GEIGY Corp.

"Practical Application of Kubelka-Munk Theory for the Near Infrared Region"—CIBA-GEIBY Corp.

"A New Mineral for Coatings"—Cyprus Industrial Minerals Co.

"An Update on Talc in Coatings"—Cyprus Industrial Minerals Co.

"Talc—That Crazy White Stuff"—Cyprus Industrial Minerals Co.

"Composite vs. Single Dispersants in Colorants and Coatings"—Daniel Products Co.

"An Overview of Lead Chromate Pigments"—Dominion Colour Company Ltd.

"Extenders—The Inorganic Backbone of Flats and Primers"—Engelhard Corp., Minerals & Chemicals Div.

"Light Scattering Extenders"—Engelhard Corp., Minerals & Chemicals Div.

"Discrete Pigment Particle Technology"—Hilton-Davis Chemical Co.

"List of Four Presentations on Color and Color Control"—Macbeth Div. of Kollmorgen Corp.

"Diatomite—For the Coatings Industry"—Manville Corp., Filtration & Minerals Div.

"Colloidal Silica—A Unique Pigment for the Coatings Industry"—Nalco Chemical Co.

"Organic Pigments: Past, Present, and Future"—Sun Chemical Corp.

"Organoclays: A New Look at a Mature Product"—United Catalysts Inc.

Production

"The 'Whys' and 'Wherefores' of Cartridge Filtration in the Coatings Industry"—AMF Cuno Div.

"Portable Shipping Containers—Past, Present, and Future"—Clawson Tank Co.

"Carbon Black in Aqueous Coating Applications"—Columbian Chemicals Co.

"Dispersion of Carbon Black in Coating Systems"—Columbian Chemicals Co.

"Computerized Materials Requirement Planning for Small and Large Paint Companies"—Marblehead Testing Labs.

"An Irreverent Look at Computers and Their Relationship to the Lab, Sales, Office and the Boss"—Marblehead Testing Labs Inc.

"Will Laser Computerized Technology Solve the Dispersion Problem?"—Marblehead Testing Labs Inc.

"Advances in the Milling of Magnetic Dispersions"—Netzsch Inc.

"Particle Size Reduction Techniques, Agitator Media Mills"-Netzsch Inc.

"Inerting for Safety in Coatings Plants"—Neutronics, Inc.

"Latex Paint Spoilage vs. Plant Housekeeping"—Nuodex Inc.

"High-Speed Paint Filling"—Pfaudler Co., Subsidiary of SOHIO.

"Horizontal Media Mills"—Premier Mill Corp.

"Powder Handling with the Air-Pallet® Semi-Bulk Container System"—Semi-Bulk Systems, Inc.

"Attritor Grinding and Dispersing Equipment"—Union Process Inc.

"The Sandpiper"—The Warren Rupp Co.

(Continued on page 97)

New England Society Announces 'Coatings Tech Expo '84'

The New England Society for Coatings Technology will sponsor its 3rd Biennial Convention & Exposition, "Coatings Tech Expo '84," on May 16-17 at the Sheraton Inn & Conference Center, Boxborough, MA.

Featured will be machinery, equipment, container, accessories, trade products, support equipment, and other industrial materials, products, and services for those involved in the coatings industry. The 'Expo' offers an excellent opportunity for suppliers, distributors, and manufacturers representatives to reach prospects and customers.

Society President, John E. Fitzwater, of Polyvinyl Chemical Industries, Inc., and Manufacturing Committee Chairman, George Finn, of New Way Industries, Inc., are working on a comprehensive two-day series of technical and manufacturing sessions for the Seminar Program. Featured lecturers will include prominent industry leaders, specialists, and technicians.

'Coatings Tech Expo '84' Chairman is Paul J. Muller, of the D.H. Litter Co., Inc., P.O. Box 247, Ballardvale, MA 01810. Responsible for expositions is Bruce Ocko, of The Truesdale Co., 108 Holm St., Brighton, MA 02135.

Scandinavian Paint Technologists To Sponsor 11th Congress

The Federation of Scandinavian Paint and Varnish Technologists has announced that its 11th Congress will be held at the SAS Hotel Scandinavia, Oslo, Norway, September 2-4, 1985.

The President of the Scandinavian organization is Guttorn Abelsnes, of Kronos Titan A/S, Boks 8, N-1601 Fredrikstad, Norway.

The technical and scientific program sessions will be under the direction of Paal Ivan, Nodest Industries A/S, Boks 500, N-3001 Drammen, Norway.

Howard Jerome Receives Gateway Service Award At Joint Meeting of St. Louis and Kansas City Societies

Howard Jerome, President of the Federation in 1981–82, received the St. Louis Society's Gateway Service Award on June 11, "in recognition and appreciation for outstanding service and contributions to the St. Louis Society in furthering the goals for which the Society was founded." The award was presented during the joint meeting of the St. Louis and Kansas City Societies at the Lake of the Ozarks.

Mr. Jerome is Vice-President and Technical Director of Spatz Paint Industries, St. Louis. He is a Past-President of the New England Society and the St. Louis PCA and was the Society Representative to the Federation Board from both the New England and St. Louis Societies. He was the third recipient of the Gateway Award. The previous two were Joseph L. Hackney and Dr. Herman Lanson.

Six papers were presented at the technical program sessions of the joint meeting:

(1) "Latex-Water Reducible Blend Systems"—T.A. DelDonno, of Rohm and Haas Co.

(2) "Glycol Ethers and Their Esters"—G. Wasilczyk, of Dow Chemical Co.

(3) "Computer Based Professional Productivity Tools"—W. Sherman, of Digital Equipment Corp.

(4) "Water-Extendible High-Solids Enamels"—R. Johnson, of Cargill, Inc.

(5) "Electrostatic Application of High Technology Coatings"—J. Stauffer, of Randsburg Corp.

(6) "Software Availability for the Coatings Industry"—J. McDermott, of Pocket Data Systems.

Other presentations at the dinner, in addition to the Gateway Award, were: a $500 contribution to the Paint Research Institute from the St. Louis Society and $150 as grants-in-aid to the University of Missouri-Rolla from both the Kansas City Society and the Kansas City PCA.

St. Louis Society officers in charge of joint meeting arrangements were: President Joseph J. Wrobel, Jr., of Ciba-Geigy Corp.; Vice-President Robert J. Giery, of Spatz Paint Industries; and Treasurer Charles L. Grubbs, of Rockford Coatings.

'Talks Available' Offers 70 Presentations

Resins

"AGRISOURCE® Resins in Waterborne Exterior Trade Sales House Paint and Stains"—Cargill, Inc.

"The Versatility of High Solids"—Cargill, Inc.

"Water-Extendible High Solids Enamels"—Cargill, Inc.

"Industrial Lacquers Based on HM-Linear Saturated Polyesters"—Dynamit Nobel of America, Chemical Div.

"HALOFLEX® Chlorinated Vinyl Acrylic Latices"—ICI Americas Inc.

"Aluminum Cross-Linkers for High Solids Coatings"—Manchem Inc.

"Vinylidene Chloride Copolymers for Paint"—Pacific Scott Bader Inc.

"Acrylic Blend Latices"—Rohm and Haas Co.

"Acrylic High Solids Coatings"—Rohm and Haas Co.

Solvents

"Formulating A Solvent-Based Compliance Coating"—Coatings Technology, International.

"Economic Recovery of Solvent Vapors"—DCI Corp.

"Recovery of Paint Wash Solvent—An Economic and Environmental Necessity"—DCI Corp.

"Case Histories of Chlorinated Compliance Coating Evaluations"—Dow Chemical U.S.A.

"Solvent Recovery with the Pfaudler Wiped Film Evaporator Unit"—Pfaudler Div. Sybron.

"Computer Prediction of Evaporation of Aqueous Solvent Blends with Any Number of Cosolvents at Any Humidity"—Shell Development Co.

"Computer Selection of Solvent Blends"—Shell Development Co.

"Evaporation During Sprayout of a Typical Water Reducible Paint at Various Humidities"—Shell Development Co.

Testing

"Current Use and Trends—Accelerated Weathering Tests in the United States"—Atlas Electric Devices Co.

"The Inside-Out Story of Exposure Tests"—Atlas Electric Devices Co.

"Paint Examination Techniques Utilized in the FBI Laboratory"—Federal Bureau of Investigation.

"An Investigation of Abrasion Resistance"—Shamrock Chemicals Corp.

Environmental

Environmental Update"—Sun Chemical Corp.

"Disposal of Hazardous Combustible Waste"—SYSTECH Corp.

Miscellaneous

"Approach to Formulation of Architectural and Maintenance Coatings"—Kurfees Coatings, Inc.

Pacific Scientific to Sponsor Summer Color Seminars

Four, one-day "Color Matching Seminars" will be sponsored by Pacific Scientific, Gardner/Neotec Instrument Div., Silver Spring, MD, in August and September in cities throughout the United States.

The seminars will highlight information about the firm's color matching system and its formulations and quality control capabilities. Individuals will learn how color matching systems can improve product color control and quality while providing significant cost savings and production efficiencies.

Dates and locations of the seminars are as follows: Aug. 23—Downtown Atlanta Hilton, Atlanta, GA; Aug. 25—Galt House, Louisville, KY; Sept. 13—Sheraton Royal, Kansas City, MO; and Sept. 13—St. Louis Airport Hilton Inn, St. Louis, MO.

For further information, contact Janis Van Dyke, Seminar Coordinator, Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Silver Spring, MD 20910.

TO OUR READERS:

The JOURNAL OF COATINGS TECHNOLOGY welcomes any responsible views pertaining to the Coatings Industry, Federation activities, and the editorial content of the JCT. Letters should be brief and signed with the writer's address and company affiliation. Effort will be made to publish JCT author's responses to correspondence in the same issue.

Correspondence should be addressed to: Letters to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

Los Angeles Society to Sponsor 1983–84 Paint Course

The Los Angeles Society for Coatings Technology will sponsor a course in "Paint Technology" from Fall, 1983 to Spring, 1984 at Cal State University, Los Angeles, CA. The Fall Quarter session will begin on September 22.

Intended for people employed in any segment of the coatings field, the course will familiarize the students with current raw materials and with the necessary formulating skills to improve their opportunities for advancement in the coatings industry.

The following course outlines have been developed by the L.A. Society Educational Committee:

Los Angeles Society Educational Committee (left to right): Frank Peters, Paint Course Instructor; Joe King, former Instructor; Melinda Rutledge, Allo Chemical; James Hall, Chairman; Roy Durand, Sinclair Paint; John Plant, John K. Bice Co.; Al Seneker, Ameron; Lloyd Haanstra, Society Vice-President

Fall Quarter

History of Paint; Interior Latex Formulation; Ingredients.

Latex Flat Enamel Formulation; Solids by Weight Calculations; Label Analysis; Raw Materials; Government Specifications.;

Mathematics of Formulation; Solids by Volume; Film Thickness and Spread Rates; Pigment Volume Concentration; CARB Calculation.

Latex Emulsions; Polyvinyl Acetate; Acrylics; Latex Sealers.

White Hiding Pigments; TiO_2 Types and Grades; Extenders; Indices of Refraction.

Latex Paint Additives; Dispersants; Anti-foams; Preservatives; Nonionic Surfactants; Fungicides.

Interior vs Exterior Formulations; Free Binder, Extender Particle Size, UV Resistance; Temperature Extremes, Water Resistance; Dimensionally Stable and Unstable Substrates; Latex Stucco Paint.

Exterior Coatings for Wood; Exterior Acrylic Latex Primers, Topcoats and Stains; Latex Roof Coatings.

Latex Gloss and Semi-gloss Formulations; Deck Paints.

Winter Quarter

Basic Chemistry; Atomic Structure and Periodic Table; Organic Chemistry as Related to Coatings.

Electromagnetic Radiation and Visible Wavelength; Theory of Color; Colored Pigments, Inorganic.

Colored Pigments, Organic.

Solvents.

Oils and Oil-Based Clears and Stains.

Varnishes; Tung Phenolics; Aluminum Paints.

Alkyd Resins; LOA Gloss Enamel.

Fast Dry Enamel; Polyamide Enamel; Paint Additives and Driers.

Alkyd Semi-gloss and Eggshell Enamels.

Spring Quarter

Exterior Primers; Alkyd House Paints and Trim Paints.

Interior Sealers and Undercoaters; Clears, Interior and Exterior Stains; Epoxy Esters; Urethane Esters.

Fast Air Dry Finishes; Chain Stop Alkyds; Vinyl Toluene Alkyds; Styrenated and Rosin Phenolic Alkyds; Acrylic Lacquers.

Theory of Corrosion; Corrosion Inhibiting Primers; Steel Pretreatments.

Nitrocellulose Lacquers and Lacquer Thinners.

Types of Polymerization as Related to Water, Solvent; Alkali and Acid Resistance; Chlorinated Rubber; Vinyls; Epoxies; Urethanes.

Urea Formaldehyde and Melamine Formaldehyde Baking Finishes; Thermosetting Acrylics.

Formulating for CARB; High-Solids Finishes; Water-Borne; Calculating VOC.

Tuition is expected to be $60 per quarter. Registration can be made at the initial class session.

For further information, contact the instructor, Frank Peters, Dunn-Edwards Corp., 4925 E. 52nd Place, Los Angeles, CA 90040.

Industrial Explosion Prevention Seminar To Be Offered by Du Pont, October 25–27

"Industrial Explosion Prevention and Protection," a 2½ day seminar and workshop, will be offered by the Du Pont Co., October 25–27, in Wilmington, DE.

Aimed at industrial and government scientists and engineers, the seminar is designed to help reduce explosions in industrial plants. Fundamentals of explosion prevention and protection, and practical aspects of protecting plant facilities from explosions will be discussed.

Subjects covered in lectures and workshop sessions include flammability limits of gases and vapors, ignition sources and auto-oxidation, explosion pressure and blast effects, flame arresters, behavior of dense stack gases, dust explosions, and explosion investigation.

The seminar is conducted by Dr. Frank T. Bodurtha, a widely recognized expert and author in the field of explosion hazards prevention and protection. Dr. Bodurtha has worked for more than 20 years in explosion prevention and protection in Du Pont's Engineering Department.

The $795 registration fee covers a textbook by Dr. Bodurtha, a manual developed for the seminar, and copies of workshop problems.

Early registration is recommended because course size is limited to 40. Special in-house sessions for a company or institution can be arranged for 30 to 40 persons on a reduced fee basis.

To register, write Industrial Explosion Prevention and Protection, Du Pont Co., Room X-40064, Wilmington, DE 19898.

ISCC to Hold 'Color and Imaging' Conference February 12–15

The Inter-Society Color Council will sponsor its Williamsburg Conference entitled, "Color and Imaging," on February 12-15 at the Williamsburg Lodge, Williamsburg, VA.

According to Conference Chairman, Richard D. Ingalls, of Armstrong World Industries, the conference will cover the most up-to-date technology in a wide variety of applications of color imaging. Opening the session will be W. David Wright, retired professor of Imperial College, England, who will speak on "The History of Color Imaging." Also included in the preliminary program are the following topics and speakers:

"Video Simulation and Photography" —Edward Giorgianni, Eastman Kodak Co.

"Ink-Jet Printing"—Dr. Annette Jaffe, IBM.

"Image-Reproduction Colorimetry"—Milton Pearson, RIT.

"Retroreflective Imaging"—Justin J. Rennilson, Retro-Tech.

"Colorimetric Graphics"—Richard Ingalls and Marjorie Ingalls, Armstrong World Industries.

"Color Proofing Systems"—Richard E. Warner, GATF.

"Holography"—Dr. J. John Gaufield, Aerodyne Research.

"Education in Color Imaging"—Prof. Franc Grum, RIT.

"Video Color Imaging"—Thomas S. Buzak, Tektronics.

A panel discussion reviewing the presentations and their relationship to color and viewing experience will conclude the meeting.

Anyone associated with applications of color imaging and is interested in presenting a 10-minute paper, should send an abstract before October 15 to Conference Chairman, Richard D. Ingalls, Technical Center, Armstrong World Industries, P.O. Box 3517, Lancaster, PA.

For further information, contact ISCC Publicity Chairman, Dr. Fred W. Billmeyer, Jr., Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181.

'Adhesion Fundamentals' To Be Held at SUNY, Nov. 2–4

The Institute in Science and Technology at the State University of New York, New Paltz, NY, will sponsor "Fundamentals of Adhesion: Theory, Practice, and Applications" short course, November 2-4.

Designed for chemists, engineers, material scientists, and physicists, the session will feature the fundamentals of adhesion and the overviews of the latest progress in the science and technology of adhesion. Subjects to be discussed include: molecular forces; thermodynamics of adhesion; kinetics of wetting, surface analytical techniques; and fracture mechanics of adhesive joints. Practical developments of adhesive technology will be discussed by experts in the fields. Application of theories will be demonstrated through group discussions of day-to-day unsolved problems related to science and technology of adhesion.

Course coordinator is Dr. Lieng-Huang Lee, of Xerox Corp.

For additional information, contact Dr. Angelos V. Patsis, Chemistry Dept., SUNY, New Paltz, NY 12561.

People

William Dunn, a Past-President of the Federation (1975–76) has retired after a career of 46 years in the coatings industry. He was associated with several companies from 1937 to 1965, when he formed Dumar Paints & Chemicals Ltd. He sold Dumar some 15 years later and joined Monarch Coatings. Mr. Dunn is a longtime member of the Toronto Society and was its President in 1964 and Society Representative from 1969–71.


W. Dunn


R.R. Myers


F.W. Billmeyer


T. Provder

At the May 17th meeting of the Cleveland Society, **Dr. Raymond R. Myers,** University Professor at Kent State University, was presented the Dr. Frank Selden Award. Dr. Myers was honored for serving as Research Director of the Paint Research Institute from 1964–82. He is now Research Director Emeritus.

Herbert E. Hillman, who has authored the "Humbug" column in the JCT since September, 1980, has retired after 44 years in the coatings industry. At the time of his retirement, he was President of F.O. Pierce Co., Long Island City, NY, and Group Vice-President of RPM, Inc. Mr. Hillman was President of the New York Society in 1952 and received that group's PaVaC and Kienle Awards in 1957 and 1960, respectively. In the Federation, he was Chairman of the Host, Mattiello Lecture, and Roon Awards Committees, a member of the Publications Committee for several years, and a Trustee of the Paint Research Institute. The Hillmans live in Whitingham, VT.

The Midland Div. of the Dexter Corp. has presented **Kanti V. Gandhi** with its 1983 David L. Coffin Award for Outstanding Innovation for his work on "High Solids Polyester Compliance Coating."

Mr. Gandhi, who has been with the Midland Div. since 1968, received a B.S. in Chemistry and an M.S. in Organic Chemistry from the University of Bombay. In 1964, he began his studies in Chemical Engineering at the University of Detroit. He has worked in the field of industrial coatings since 1966. Since 1973, Mr. Gandhi has worked in the areas of water-borne and high solids coatings and in 1980 was promoted to Staff Scientist.

Mr. Gandhi is a member of the Chicago Society.

The Inter-Society Color Council presented **Dr. Fred W. Billmeyer, Jr.,** Professor at Rensselaer Polytechnic Institute, Troy, NY, with its first Service Award in recognition for his service to ISSC, as chairman (1957–64), director (1964–66, 1982–85), vice-president (1966–68), president (1968–70), and secretary (1970–82) of the Subcommittee on Material Standards for Colorimetry.

Dr. Billmeyer is a graduate of the California Institute of Technology and earned a Ph.D in Physical Chemistry from Cornell University. He was employed by the Plastics Department of E.I. du Pont de Nemours & Co., Inc. from 1945 to 1964. In addition, Dr. Billmeyer was Lecturer in High Polymers in the Department of Chemistry, University of Delaware from 1951–1964, and in 1960–61 he was Visiting Professor in Chemical Engineering at the Massachusetts Institute of Technology. In 1964, he assumed the position of Analytical Chemistry at Rensselaer, where his duties included teaching and research in both polymer science and the science of color measurement. In 1984, Dr. Billmeyer will retire from Rensselaer.

Dr. Billmeyer is a member of the New York Society and in 1977 the Federation awarded him with the Armin J. Bruning Award in recognition of his work in advancing the principles of coatings technology through his many activities in the field of color education.

In 1978, ISSC awarded Dr. Billmeyer with its Macbeth Award.

The Valspar Corp., Minneapolis, MN, has announced the promotion of **Michael Spangler** to Merchandising Manager, Consumer Brands. Prior to his appointment, Mr. Spangler had been responsible for the firm's Colony and Masury merchandising departments.

Dr. Theodore Provder has been named Principal Scientist of Glidden Coatings & Resins, SCM Corp., Cleveland, OH. He is the first researcher to be awarded the title. Dr. Provder will be responsible for the direction of advanced research in polymer chemistry, polymer physics, and related computer science.

An eminent scientist, Dr. Provder has contributed significantly to the chemical and coatings industries with more than 50 scientific papers and 140 technical presentations during his 13 years with Glidden. Specifically, his research has led to the characterization of polymers and coatings and the use of computers in applied polymer science.

His accomplishments at Glidden are many and include computer modeling of polymer reactions and the application of mathematics and instrument automation to polymer research. He also established advanced capabilities to separate and characterize the particle size and molecular weight distributions of polymers in coatings, and more recently found new methods for characterizing and modeling the cure of coatings.

Dr. Provder earned his B.S. degree in chemistry at the University of Miami and his Ph.D. in physical chemistry at the University of Wisconsin.

Dr. Provder is a member of the Cleveland Society.

Kenneth G.W. Smith, Manager of the Finishes Div., duPont Canada Ltd., Toronto, Ont., was elected President of the Canadian Paint and Coatings Association during the annual meeting in April. **Arthur D. Roos,** Vice-President and Managing Director of the Glidden Co., Toronto, was elected Vice-President and President-Elect. The 1983 convention of the CPCA will be held in Montreal, September 18–20.

Caryl Sherman has received Cyanamid's Golden Oval Award for outstanding sales achievement in 1982. Ms. Sherman is a Technical Sales Representative for the polymer Products Div. of American Cyanamid Co. An employee with Cyanamid for four years, Ms. Sherman handles sales of resins in the Cleveland, OH area. Ms. Sherman is a member of the Cleveland Society.

Shamrock Chemicals Corp., Newark, NJ, has appointed the A. T. Callas Co., Troy, MI, as sales representatives to service the paint and coatings industry in Michigan. **Alex Callas,** President of the A. T. Callas Co., has been involved in the coatings market for over 30 years as a chemical engineer and marketing representative, and is a Detroit Society member.

Also announced by the firm was the appointment of **Michael R. Oliveri** to the position of Technical Director for Industrial Coatings. Mr. Oliveri recently joined Shamrock after having been Laboratory Manager for the Technical Coatings Div. of Benjamin Moore. He is a New York Society member.

Thomas H. Smouse, Director of Lipid Research for the Protein Technologies Div. of Ralston Purina in St. Louis, MO, has been elected President of the American Oil Chemists' Society for 1983–84. Dr. Smouse, who served as the Society's 1982–83 Vice-President, succeeds **Dr. Karl T. Zilch,** Research Director of the fatty and dibasic acids group at Emery Industries, Inc. in Cincinnati, OH.

Other officers elected include: Vice-President—**Nicholas Pelick,** Supelco, Inc.; Secretary—**Joyce Beare-Rogers,** Department of Health and Welfare, Canada; and Treasurer—**William H. Tallent,** U.S. Department of Agriculture.

Red Devil Paints & Chemicals, Mt. Vernon, NY, has announced the appointment of **Michael Russo** to Eastern Sales Manger.

PPG Industries, Inc., Allison Park, PA, has promoted **Dr. Michael M. Chau** to the position of Research Associate for its Coatings and Resins Div.

Pennsylvania Glass Sand Corp., a subsidiary of International Telephone & Telegraph Corp., Pittsburgh, PA has announced several appointments. **Lawrence G. Burwinkel** has been named Vice-President—Market Development. Appointed Vice-President—Sales was **Jack T. Brady.**

Midland Div., Dexter Corp., Waukegan, IL, has announced several new appointments. **Harold Cole** has been promoted to Senior Group Supervisor. Promoted to Group Supervisor, Analytical Services, was **David R. Scheuing.** Named to the positions of Senior Development Chemists were **Scott Schwandt** and **Wendy Harrison.** Also, **Roy Bogseth** was appointed Project Chemist in the Analytical Services Laboratory. Messrs. Cole and Schwandt are Chicago Society members.

H. Douglas Spruance has been appointed to the sales force of the E-M Co., North Chicago, IL. He is a Chicago Society member.

The 1983 Deane B. Judd-AIC Award was presented to **David Lewis MacAdam,** Professor at the Institute of Optics at the University of Rochester, in recognition of his extensive contributions to the science and technology of color. In particular, Dr. MacAdam's work on spectrophotometry, spectroradiometry, optimal colors, dominant wavelength and excitation purity, uniform chromaticity diagrams and uniform color solids for reflecting objects, perceptible differences in chromaticity and in tristimulus values leading to the well-known MacAdam ellipses and ellipsoids, chromatic adaption, color computations, loci of constant hue and brightness, and colorimetric fundamentals of color reproduction are among the contributions noted for recognition by the Association Internationale de la Couleur.

The board of directors of the Chemical Coaters Association elected the following 1983–84 officers: President—**Floyd Young,** Motor Wheel Corp.; First Vice-President—**Gary Frazier,** Hentzen Chemical Coatings, Inc.; Second Vice-President—**Thomas McCardle,** Kolene Corp.; Secretary—**Bruce Reinhardt,** Nordic Ware Inc.; and Treasurer—**Philip Vadeboncoeur,** Heatbath Corp.

Theodore E. Rogers, President and Chief Executive Officer of NL Industries, Inc., New York, NY, was elected to the additonal post of Chairman of the firm. Mr. Rogers succeeds **Ray C. Adam,** who has announced his plans to retire.

Peter A. LaPlace has been named Vice-President—Business Development for Chemical Coatings Div. of The Sherwin-Williams Co., based in Chicago, IL.

Mark P. Morse, a Consultant in the coatings field and a former Researcher for E.I. du Pont de Nemours & Co., Inc., was named a 1983 recipient of the Award of Merit by the American Society for Testing and Materials. He was cited for his leadership and promotion of the standardization of physical, optical, and durability properties of paint.

Since joining Committee D-1 on Paint and Related Coatings and Materials in 1949, Mr. Morse has served as chairman of various task groups and subcommittees. He was responsible for the development or improvement of numerous standards and, as chairman of D01.17 on Records and Publications, he was able to add a number of available statistical studies to the file of ASTM Research Reports. Mr. Morse also serves on the Executive Subcommittee of D-1 and, in 1980, was awarded the ASTM's Henry A. Gardner Award for outstanding competence.

The Flecto Co., Inc., Oakland, CA, has appointed **Stephen S. Depetris** to Laboratory Manager.

Hempel's Marine Paints, Inc., New York, NY, has announced the promotion of **Roger Woodhull** to Vice-President—Operations. Prior to his appointment, Mr. Woodhull served as Manager of Operations. He is a New York Society member.

Also, Hempel has appointed **W. Bruce Foster** as Sales and Marketing Manager, Industrial Div.

David L. Laney was named Sales and Marketing Representative, Metal Building Products for the Chemical Group of Whittaker Corp., Colton, CA.

Also, **Jeffrey R. Leyh** has been named Vice-President and General Manager of Whittaker's North Brunswick Coatings & Chemical Div., North Brunswick, NJ.

Robert L. Cain has been elected Corporate Vice-President of Witco Chemical Corp. Mr. Cain will continue to serve as General Manager of the company's Inorganic Specialties Div.

The Mearl Corp. has promoted **William R. Lawson** to the position of Technical Sales Representative for the New York and New Jersey areas.

Union Chemicals Div., Union Oil Co. of California, Schaumburg, IL, has promoted **William F. Murphy** to Vice-President, Marketing.

Norma Fleming, Senior Coordinator for non-credit courses in the College of Arts and Sciences at the University of Missouri-Rolla, Rolla, MO, has resigned after 12 years of service. Ms. Fleming will begin her own business in Camdenton, MO.

McWorter, Inc., Minneapolis, MN, has appointed **Robert P. Hislop** Sales Manager.

LanChem Corp., East St. Louis, MO, has appointed **James K. Lee** as Vice-President and Technical Director.

Air Products and Chemicals, Inc., Allentown, PA, has appointed **Andrew E. Cummins** General Manager of the firm's Polymer Chemicals Div.

Superior Sealants, Atlanta, GA, has announced the appointment of **Marx Wolf** as National Accounts Manager.

John D. McAleer, Vice-President and Mid-Atlantic Manager for Burgess Pigment Co., Sandersville, GA, has retired after 32 years with the firm.

Glidden Coatings & Resins Div., SCM Corp. has announced the following appointments. **Thomas F. Wagner** has been promoted to Vice-President—Trade Sales. He was previously Vice-President—Chemical Coatings. Succeeding Mr. Wagner in that position is **Alan W. Allen**. Named to the positions of Regional Directors are **Donald L. Riley**, southeastern region, and **Edward G. Bender**, southwest.

Lord Corp., Chemical Products Group, Erie, PA, has recently appointed a new distributor for Chemglaze® polyurethane coatings. **B. David Flowers**, President of Midlantic Chemicals and Plastics Corp., Cherry Hill, NJ, adds the new responsibilities for Chemglaze coating sales to his present distributorship.

Denis P. Farley has been appointed Technical Sales Representative, based in the New Jersey area, for Neville Chemical Co.

Premier Mill Corp., New York, NY, has named **Edward A. Byrne** as Sales Manager.

Du Pont Co., Wilmington, DE, has announced the appointment of **Donald C. Sutherland** as Director of the Clinical and Instrument Systems Div. Also, named to the division as Instrument Systems Manager is **Dr. J. Stark Thompson.**

William M. DeCrease, Manager, Marketing Div., Lord Corp., Chemical Products Group, Erie, PA, was a featured speaker at INOVA '83, an industrial seminar and convention held in Paris, France, in April. Mr. DeCrease's presentation was entitled "Engineering Adhesive for Tomorrow's Applications."

Dorrance Retterer has joined Ashland Chemical Co., Columbus, OH, as Technical Service Representative with the Specialty Chemicals Division's GLOBRITE Business Center.

Stebbins & Roberts, Inc., Little Rock, AR, has named **Bruce Lively** President. Mr. Lively joined the firm in 1975 and most recently served as Executive Vice-President.

Nalco Chemical Co., Oak Brook, IL, has announced the retirement of **Robert T. Powers,** former President, Chief Executive Officer. Mr. Powers is a 37-year employee with Nalco.

Albert T. Weber has been named Sales Manager in the Chemical Coatings Div. of Pratt & Lambert, Inc., Buffalo, NY.

Obituary

John A. "Jack" Marks, Jr., 60, Product Manager and Sales Representative for Neville Chemical Co., Pittsburgh, PA, died on May 21. A 26-year Neville employee, Mr. Marks was a Pittsburgh Society member.

John E. Bendis, 39, died on April 29. Mr. Bendis was a field merchandising representative for DeSoto, Inc., and had been working in Maui, Hawaii at the time.

Lawrence F. Ribbecke, a veteran Technical Director, died in April. Mr. Ribbecke worked as a Consultant with PLR Consulting Service, Inc., Brooklyn, NY, after he retired in 1982 from the Sapolin Paint Co.

Literature

Air Sampling

Literature is available featuring a new air sampling guide for over 550 chemical and particulate hazards. The guide lists the hazards, which are references to the NIOSH Analytical Method. Recommended sampling procedures are given, including sample time, rate, and volume. Also, lists of NIOSH/OSHA Standards and analytical methods are provided. Contact SKC, Inc., R.D. 1, 395 Valley View Rd., Eighty Four, PA 15330.

Stirrers

Information is available on a range of electronic magnetic stirrers. Features of the stirrers are listed. Contact Voss Instruments, Sheen Instruments Group, 9 Sheendale Rd., Richmond, Surrey TW9 2JL, England.

Silica

A new brochure describes the characteristics of a silica, a specialty product for use in thickening coatings and many other products. The 18-page brochure covers the product's properties, surface chemistry, uses, handling, storage, packaging, shipping, and required health precautions. Information is given on selecting thickeners, how to thicken various systems, and factors that affect thickening. Photographs and charts amplify the text. "Hi-Sil T-600 Silica Thickener" is available from PPG Industries, Inc., 10 North, One Gateway Center, Pittsburgh, PA 15272.

Chemistry Newsletter

A computer aided chemistry newsletter is available offering timely technical tips, helpful information, and new software briefs from users of analytical instrument computer systems. For a free copy of the newsletter, order No. DHN-13, contact Perkin-Elmer Corp., Main Ave., Mail Station 12, Norwalk, CT 06856.

Goniophotometer

Information is available on a distinctness-of-reflected image goniophotometer, which is designed for measuring reflected image qualities of metals, coatings, and plastic materials with high gloss finishes. Literature can be obtained from HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090.

Colorants and Additives

An updated and expanded catalog of colorants and additives used by the paint, coatings, adhesives, and related industries has been recently issued. The 32-page booklet describes over 175 standard products in five general categories: pigment dispersions, pigment dispersing agents, film conditioners, rheology control aids, and miscellaneous additives. The function and potential use of each product is explained. Specifications and compatibility data are provided, as well as the status on FDA compliant products. Suggested starting formulations are included. A chart provides comparative lightfastness, bleed resistance, and heat resistance of the pigments. Copies of the catalog are available from: Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

Instruments

A new brochure describes a complete line of instruments for measuring color, gloss, haze, and other appearance properties of materials. Information is included on spectrocolorimeters, tristimulus colorimeters, glossmeters, hazemeters, and on-line color monitors. For a copy, write HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090.

Wax

A technical booklet provides information on micronized waxes, which are "stir-in" additives for enhancing coating performances. Contact Capricorn Chemicals Corp., Harmon Cove Towers, Suite 8, Secaucus, NJ 07094 for information.

Electrochemical Instruments

A 32-page catalog that features the latest in electrochemical instrumentation has been recently published. The literature presents the broadest line of instruments that can meet all electrochemical needs for the process industries. The catalog is divided into sections that group instruments, systems, accessories, conductivity, and resistivity measurement. All the vital technical information is provided for each product. For a copy of "Electrochemical Instrument Catalog", Catalog 683, write The Foxboro Co., C.K. Tunick, Dept. 124, Foxboro, MA 02035.

Additives

A brochure is available covering properties, coatings formulations, and applications for a complete line of additives. Anti-blocking, abrasion resistance, surface smoothness, dust repellence, water resistance, friction, and slip improvement are discussed. Write Capricorn Chemicals Corp., Harmon Cove Towers, Secaucus, NJ 07094 for additional information.

Filters

A catalog is available offering detailed information on a complete line of industrial filters. Nine different series of filters are described as well typical applications and operating procedures. Write AMF Cuno General Filters Products Div., 400 Research Pkwy., Meriden, CT 06450 for information.

Additive

A new high brightness, excellent whiteness, fine particle size hydrous clay for use in both solvent or water systems is featured in recently issued literature. Recommended uses are listed which include its application for improving hiding and gloss in paints. Information is available from Burgess Pigment Co., P.O. Box 4146, Macon, CA 31208.

Color Systems

Information is available on a color spectrophotometer and a color-matching system which are both used for color analysis, formulation, and matching of such products as dyes, pigments, paints, plastics, and coatings. For literature, contact Bausch & Lomb, 820 Linden Ave., Rochester, NY 14625.

Printing Inks Study

Information has been published on a multiclient study on water-based printing inks, overprint coatings, and the resins used in their manufacture. The study covers flexographic, gravure, and letterpress water-based ink 1982 consumption and growth to 1987. Current and projected consumption is detailed for nine markets. Producers of inks and resins are detailed including estimates of their 1982 production. A copy of the Table of Contents and additional information is available from Hull & Co., Technical Business Research Corp., 5 Oak St., P.O. Box 4520, Greenwich, CT 06830.

Gauge

A new hand-held dry-film coating thickness gauge is featured in recently published literature. Features and application uses of the gauge are highlighted. Contact Magnaflux Corp., 7300 W. Lawrence Ave., Chicago, IL 60656 for information.

Strainers

Information is available on a new line of basket-type line strainers. Highlighted are the strainers' design and application advantages. For literature, contact Viking Pump Div., Houdaille Industries, Inc., Cedar Falls, IA 50613.

Stabilizer

A new heat stabilizer for PVC siding is the subject of recent literature. Features, applications uses, and advantages of the stabilizer are highlighted. Contact Interstab Chemicals, Inc., P.O. Box 638, New Brunswick, NJ 08903.

Flocculent

A new, cationic flocculent, which is liquid and water soluble, is the subject of recently published literature. Suggested applications are detailed. For information, contact W.R. Grace & Co., Organic Chemicals Div., 55 Hayden Ave., Lexington, MA 02173.

Recovery System

An eight-page booklet featuring a solvent recovery system for removal and recovery of volatile organic compounds from air or gas streams is now available. Design of the system is highlighted and commercial installations are listed for such applications as film and fabric coating, and printing and automotive paint spraying. Advantages of the system are also discussed. Copies of the booklet, F-48668A, are available from Union Carbide Corp., Dept. K4436, Danbury, CT 06817.

Viscometry

A new, concise, and easy to understand publication, "Introduction to Practical Viscometry," discusses theory, applications, and instrumentation on the subject of rheology. Intended for the practically minded scientist and technician, this book provides information concerning the basic laws of viscosity and types of viscometers commercially available. It details a variety of substances, material flow properties, and viscosity test parameters, and includes many flow and viscosity curves, charts, diagrams, and examples of common problems. The booklet is obtainable for $10, from Haake Buchler Instruments, Inc., P.O. Box 549, Saddle Brook, NJ 07662.

Oxygen Analyzer

A wall mounted digital oxygen analyzer which accurately reads percentage of oxygen in the 0–35% range with a 0.1 resolution is featured in new literature. Operations and application uses for the analyzer are detailed. Contact Neutronics, Inc., 450 Drew Court, King of Prussia, PA 19406 for information.

Color System

Literature is available featuring a highly advanced spectrocolorimeter with a new software opacity/brightness option which provides opacity or contrast ration calculations as well as brightness data. The system's capabilities and features are discussed. For information, write Pacific Scientific Co., Gardner/Neotec Instrument Div., Silver Spring, MD 20910.

Alumina Trihydrate

A series of high surface area, hydrated alumina with very precise particle size distributions is the subject of new literature. MICRAL ultra-fine alumina trihydrate (ATH) is discussed as are its application uses and benefits. For information, contact Solem Industries, Inc., Subsidiary of J.M. Huber Corp., 5824-D Peachtree Corners E., Norcross, GA 30092.

Book Review

GLOSSAIRE DES TERMES DE PEINTURES, VERNIS & ENCRES/ Glossary of Paint, Varnish & Printing Ink Terms (French-English)

by
M. Voituriez and G. Pierson

Published by
Centre de Preparation
Documentaire a la Traduction
16 rue Beaurepaire
75010 Paris, France
1982, 63 pg., 70 FF franco

Reviewed by
Stanley LeSota
Rohm and Haas Co.
Spring House, PA

This glossary meets the objective stated in its preface: it lists coatings and ink terms both in French and English. The preface also claims that the previous edition was well received and that this edition has been expanded with terms suggested by the readers of the first edition. This appears to be a continuing effort.

There are no definitions in this glossary; it lists the English equivalent of a French term. Only the French terms are in alphabetical order. Perhaps the third edition will follow the Canadian format and list the terms alphabetically in both languages as was done in the *English/French Paints and Coatings Vocabulary* published by L'association Québécoise des Industries de la Peinture in 137 pages. This was also done in the more comprehensive (and more expensive) *Dictionary of Paint, Varnish and Lacquer Terms* by J.J. Raaff, which lists 286 pages of equivalents in English, French, German and Dutch. The French/English lists of terms differ in all three glossaries. Many of the equivalents also differ.

Considerable English jargon is included with its French literal equivalents: some straightforward, let down ≅ dilution; some awkward, slushing oil ≅ huile assurnat une protection temporaire; some questionable, puffiness ≅ difficulte d'application; or attapulgite ≅ kaolin riche en aluminium.

There appears to me a minimum of Franglais. My overall impression is that the English terms are more concise, whereas the French terms are more precise and less prone to jargon.

Despite its limited vocabulary, this pamphlet should be a useful addition/edition to any coatings or ink library—especially to those translating English into French. It complements the other two glossaries. The ideal would be to combine the best of all three in one volume.

Coming Events

FEDERATION MEETINGS

(Oct. 12–14)—61st Annual Meeting and 48th Paint Industries' Show. Place Bonaventure, Montreal, Quebec, Canada. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1984

(May 17–18)—Spring Meetings. Society Officers on 17th; Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Oct. 24–26)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

1984

(Jan. 17–18)—Cleveland Society for Coatings Technology. Joint Manufacturing Committee Symposium with the Cleveland PCA. "Tools for Tomorrow: Increased Profitability Thru Innovative Manufacturing Concepts."

(Mar. 7–9)—Southern Society for Coatings Technology. Fiftieth Anniversary Meeting. Surfside Hotel, Clearwater, FL. (James E. Geiger, Sun Coatings, Inc., 12295 75th St., N., Largo, FL 33543).

(Apr. 12–14)—Southwestern Paint Convention of Dallas and Houston Societies. Shamrock Hilton Hotel, Houston, TX.

(May 3–5)—Pacific Northwest Society for Coatings Technology Symposium. Park Hilton Hotel, Seattle, WA. (Robert Hogg, Preservative Paint Co., 5410 Airport Way S., Seattle, WA 98108).

(May 15–16)—Cleveland Society for Coatings Technology 27th Annual Technical Conference, "Advances in Coatings Technology." (Richard Eley, Glidden Coatings & Resins Div. SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(May 16–17)—"Coatings Tech Expo '84." 3rd Biennial Convention & Exposition sponsored by New England Society for Coatings Technology. Sheraton Inn & Conference Center, Boxborough, MA. (Chairman Paul J. Muller, D.H. Litter Co., Inc., P.O. Box 247, Ballardvale, MA 01810).

1985

(Feb. 26–Mar. 1)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA.

(Apr. 25–27)—Pacific Northwest Society for Coatings Technology Symposium. Empress Hotel, Victoria, B.C. (Ottwin Schmidt, Shanahan's Ltd., 8400 124th St., Surrey, B.C., Canada V3W 6K1).

OTHER ORGANIZATIONS

(Aug. 15–19)—"Advances in Emulsion Polymerization and Latex Technology" Short Course. Schatzalp Berghotel, Davos, Switzerland. (Dr. Gary Poehlein, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332).

(Aug. 17–19)—"Color Control Technology" Seminar sponsored by Applied Color Systems, Inc. Wequasett Inn, Cape Cod, MA. (ACS, Inc., P.O. Box 5800, Princeton, NJ 08540).

(Aug. 22–26)—"Physics and Chemistry of Printing Inks" Short Course. Davos, Switzerland. (Dr. Mohamed S. El-Aasser, Lehigh University, Dept. of Chemical Engineering, Sinclair Lab #7, Bethlehem, PA 18015).

(Aug. 23)—"Color Matching Seminar." Downtown Atlanta Hilton, Atlanta, GA. (Janis Van Dyke, Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910).

(Aug. 25)—"Color Matching Seminar." Galt House, Louisville, KY. (Janis Van Dyke, Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910).

(Aug. 26–30)—International Colour Association's Forsius Symposium on Colour Systems. Kungalv, Sweden. (Fred W. Billmeyer, Jr., Dept. of Chemistry, MRC 217, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Aug. 31–Sept. 8)—20th Commission Internationale de l'Eclairage Congress. RAI Congress Center, Amsterdam, The Netherlands. (U.S. National Committee, CIE, c/o National Bureau of Standards, Washington, D.C. 20034).

(Sept. 13)—"Color Matching Seminar." Sheraton Royal, Kansas City, MO. (Janis Van Dyke Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910).

(Sept. 15)—"Color Matching Seminar". St. Louis Airport Hilton Inn, St. Louis, MO. (Janis Van Dyke Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910).

(Sept. 17–19)—"Color Control Technology" Seminar sponsored by Applied Color Systems, Inc. Atlantic City, NJ. (ACS, Inc., P.O. Box 5800, Princeton, NJ 08540).

(Sept. 18–20)—Canadian Paint and Coatings Association's 71st Annual Convention. Hyatt Regency Hotel, Montreal, Quebec, Canada. (CPCA, 515 St. Catherine St. W., Suite 825, Montreal, Quebec H3B 1B4, Canada).

(Sept. 27–28)—Pulp Chemicals Association's 10th International Naval Stores Conference and Technical Symposium. Westin Peachtree Plaza Hotel, Atlanta, GA. (Pulp Chemicals Association, 60 E. 42nd St., New York, NY 10165).

(Sept. 27–29)—"Radiation Curing in the Printing and Converting Industry" Workshop sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers (AFP/SME). Hershey Hotel, Philadelphia, PA. (Donna Theisen, Administrator, Technical Activities Dept., SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121).

(Sept. 27–30)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency O'Hare, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Sept. 28–Oct. 1)—Oil & Colour Chemists' Association's Silver Jubilee Convention and Exhibition. Southern Cross Hotel, Melbourne, Australia. (O.C.C.A.A., 1983 Pacific Coatings Convention, C/- Tioxide Australis Pty. Ltd., Private Bag 13, Ascot Vale, Victoria, 3032, Australia).

(Oct. 5–6)—"Finishing of Plastics for Functional and Decorative Purposes" Technical Conference. Decorating Division of the Society of Plastics Engineers. Hyatt Regency, Cherry Hill, NJ. (Ed Stumpek, General Electric, One Plastics Ave., Pittsfield, MA 01201).

(Oct. 11)—"Rheology and its Role in Water-Borne Coatings Performance" Short Course. Place Bonaventure, Montreal, Que., Can. (J.E. Glass, North Dakota State University, Dept. of Polymers and Coatings, Fargo, ND 58105).

(Oct. 11–13)—"Finishing '83" sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Cincinnati Convention Center, Cincinnati, OH. (Susan Buhr, AFP/SME Administrator, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Oct. 25–27)—"Industrial Explosion Prevention and Protection" Seminar. Du Pont Co., Wilmington, DE. (Du Pont Co., Room X-40064, Wilmington, DE 19898).

(Oct. 30–Nov. 2)—National Paint & Coatings Association 96th Annual Meeting. Bonaventure Hotel, Los Angeles, CA. (Karen Bradley, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Nov. 2-3)—3rd World Congress on Coatings Systems for Bridges and Steel Structures. Breckenridge Concourse Hotel, St. Louis, MO. (John A. Gordon, Jr., Conference Director, Arts & Sciences, Continuing Education, University of Missouri-Rolla, Rolla, MO. 65401).

(Nov. 2-4)—"Fundamentals of Adhesion: Theory, Practice, and Applications" Short Course. State University of New York, New Paltz, NY. (Dr. Angelos V. Patsis, Chemistry Dept., SUNY, New Paltz, NY 12561).

(Nov. 8-9)—Resins and Pigments Exhibition. Europa Hotel, London, England. (Polymers, Paints & Colour Journal, Queensway House, Redhill, Surrey, RH1 1QS, England).

(Nov. 11-13)—36th National Decorating Products Show. McCormick Place, Chicago, IL. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Dec. 7-8)—"Painting Public Structures: Practices and Economics" Symposium sponsored by the Steel Structures Painting Council. Cocoa Beach, FL. (Dr. Harold Hower, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Dec. 12-14)—"Color Control Technology" Seminar sponsored by Applied Color Systems, Inc. Disneyworld/Epcot Center, FL. (ACS, Inc., P.O. Box 5800, Princeton, NJ 08540).

1984

(Feb. 12-15)—Inter-Society Color Council Conference. Colonial Williamsburg Lodge. Williamsburg, VA. (Fred W. Billmeyer, Dept. of Chemicstry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Feb. 12-16)—14th Australian Polymer Symposium sponsored by the Polymer Div. of the Royal Australian Chemical Institute. Old Ballarat Motor Inn, Ballarat, Australia. (Dr. G.B. Guise, RACI Polymer Div., P.O. Box 224, Belmont, Vic., 3216, Australia).

(Apr.)—"Electrochemical Test Methods of the Protecting Properties of Metals Coatings" Meeting. Genoa, Italy, (Prof. P.L. Bonora, Istituto di Chemica, Fac. Ingegneria—Fiera del Mare Pad. D. 16129 Genova, Italy).

(Apr. 4-11)—"Surface Treatment Exhibition" at the 1984 Hannover Fair, Hannover, West Germany. (Hannover Fairs Information Center, P.O. Box 338, Rt. 22 E., Whitehouse, NJ 08888).

(Apr. 8-10)—Inter-Society Color Council Annual Meeting. Michigan Inn, Southfield, MI. (Fred W. Billmeyer, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Apr. 12-15)—"FARBE 84". Munich Trade Fair Centre, Munich, West Germany. (Kallman Associates, Five Maple Court, Ridgewood, NJ 07450).

(Apr. 24-25)—Electrocoat/84 Conference, sponsored by *Products Finishing* Magazine. Drawbridge Inn, Cincinnati, OH. (Anne Porter, Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(May 1-4)—Painting and Decorating Contractors of America. 100th Anniversary Meeting. New York, NY.

(May 1-3)—Oil & Colour Chemists' Association's 35th Annual Exhibition. London, England. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(May 8-12)—International Coil Coating Exhibition. Halles des Foires de Liege (F.I.L.), Ave. Maurice Denis 4, 400 Liege, Belgium.

Advertisers Index

NOTE: The Advertisers' Index is published for the convenience of our readers and as an additional service for our advertisers. The publisher assumes no liability for errors or omissions.

'Humbug' from Hillman

Letters from Walter B. Maas and Sid Lauren found their way to Humbug's Vermont Nest. A thanks to my faithful friends and contributors.

Dr. Walter Maas, who has spent as much time flying as he has walking over the last 30 or more years, writes on the problems of air travel. Many of our readers probably have had similar thoughts.

Thoughts on Air Travel

Recently I crossed the Atlantic Ocean for the 80th time by air in an overcrowded Boeing 747. Mercifully, the name of the airline shall remain unnamed, because the food was abominable, the service poor, and the long lines in front of the toilets did not add to the comfort of the passengers. As the latter condition prevails also at the Metropolitan Opera, perhaps the airline should not be judged too harshly for it. "It was even worse at Parsifal", as one lady remarked. Parsifal takes about as long as the London-New York flight. As a further refinement, the unfortunate passengers had then to wait about one hour till they could pick up their luggage and were cleared by customers. The only people completely unmoved by all these calamities were a group of Polish immigrants. They are probably used to waiting in lines under even worse conditions.

The old air traveller's thoughts go back to 1956 when he flew to Europe for the first time. In those dark ages of non-jet air travel it took about 14 hours to get from New York to Amsterdam. However, the planes were far more comfortable, the food perfectly decent, and you were pampered with free chocolate, free drinks, and one received a very serviceable travel bag at no charge. Also, the stewardesses seemed prettier and more friendly, but perhaps this is merely nostalgia. I do not wish to sound like a World War I veteran. Their immortal Mademoiselle of Armentiers was probably no more ravishing than millions of other French girls.

Still, we have the strange fact that improved technique does not necessarily bring more comfort. Porters, for example, seem to be an endangered species. At many airports they have completely disappeared, which is strange in an area of high unemployment. In some cities—but by no means everywhere—they were replaced by carts which are again scarce to come by. In some airports there are neither carts nor porters. Perhaps it is silly to complain about such minor discomforts in an age where medical service is difficult to obtain on weekends.

During more than 25 years of airtravel one collects a number of experiences. My worst adventure was a forced landing in Salonic, Greece during a tremendous thunderstorm. On another occasion a motor conked out during the flight over the Sierra Nevada and we had to go back to San Francisco. The most ridiculous incident took place in Prague, Czechoslovakia. I had missed the Moscow-Vienna flight through no fault of my own and was rerouted via Prague. Although I had no intention to stay there, the authorities demanded a transit visa. After long negotiations, I was sent to the visa desk where they asked for a photo to be attached to that document. Of course, I had none on me. Fortunately, I speak a few words of Czech—my mother came from Prague—and the visa officer let me pass. A more unpleasant thing happened to an Austrian chemist who flew from Vienna to Prague. On arrival his suitcase was gone. He spent some uncomfortable days without a change of laundry, etc. He filed a statement of loss and miraculously he got his luggage back several weeks later. In some unexplained way it had been flown to a place called Krasnocar in Soviet Russia.

On one occasion I flew from New York to Prestwick, Scotland to attend a paint chemists convention which took place in East Kilbride, fairly far from the airport. My plane was late and I just about made it to the opening of the lectures. I had a sleepless night on a bumpy plane behind me. I soundly slept through the first three talks but woke to the welcoming speech of the Mayor in full Scottish regalia with a golden chain around his neck. For a second I believed I was still dreaming and had been transplanted to the Middle ages, like Mark Twain's Yankee at King Arthur's court. However, when the mayor mentioned "the coatings industry, one of the greatest ever" I realized I was back in the twentieth century.

• • •

And from Sid Lauren we have . . .

A friend has forwarded the enclosed excerpt from the 1975 edition of that New England standby, *The Old Farmer's Almanac.* I wish I could say that these lapses from good language usage are never echoes in the manuscripts submitted to the JCT's Editorial Review Board!

How to Write Good

Each pronoun agress with their antecedent. Just betwen you and I, case is important. Verbs has to agree with their subjects. Watch out for irregular verbs which has cropped into our language. Don't use no double negatives.

A writer musn't shift your point of view. When dangling, don't use participles. Join clauses good, like a conjunction should. Don't use a run-on sentence you got to punctuate it.

About sentence fragments. In letters themes reports articles and stuff like that we use commas to keep a string of items apart. Don't use commas, which aren't necessary. Its important to use apostrophe's right. Don't abbrev.

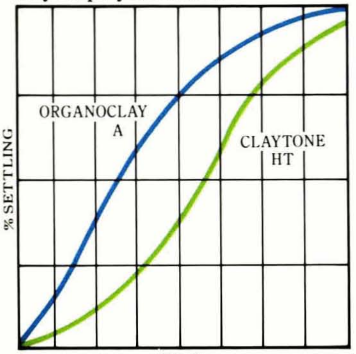
Check to see if you any words out. In my opinion I think that an author when he is writing shouldn't get into the habit of making use of too many unnecessary words that he doesn't really need. And of course, never use a preposition to end a sentence with. Last but not least, lay off cliches.

—*Herb Hillman*

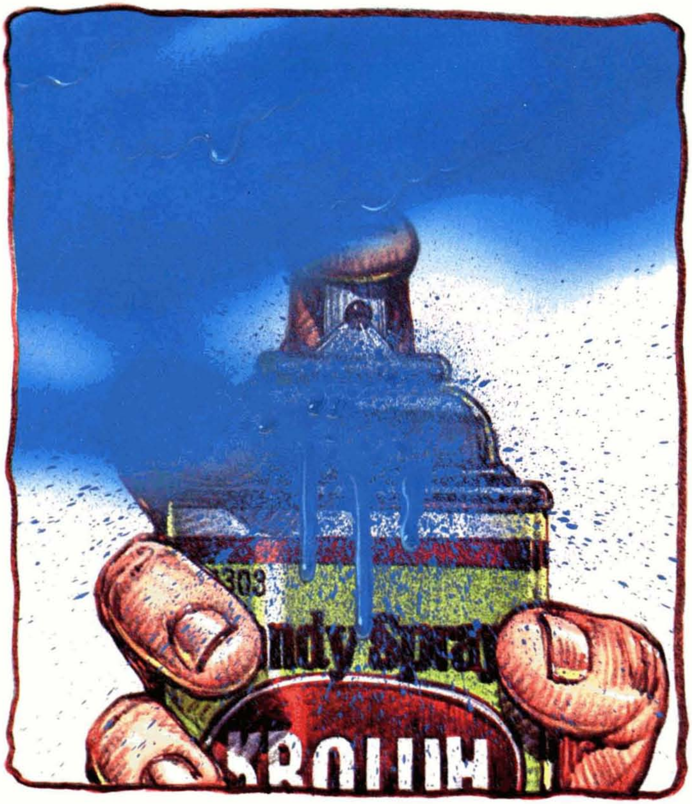
Thixotropic control: a constant battle against time.

Time. It's the biggest challenge thixotropic control faces. Often, the difference between poor and great thixotropic control becomes increasingly evident as time passes by. But now there's no excuse for poor thixotropy—not even time—because Southern Clay Products has developed highly thixotropic CLAYTONE HT. CLAYTONE HT gives coating systems superior suspension properties and excellent sag control—even after months on the shelf.

CLAYTONE HT promotes high shear fluidity while providing excellent sedimentation control. That makes CLAYTONE HT especially useful in two-component and aerosol applications. CLAYTONE HT is fully compatible in wide ranging solvent systems of varying polarity, including most aliphatic and aromatic hydrocarbons, esters, polyethers, ketones, alcohols, vinyl acrylics, natural oil alkyds and two-component enamels (epoxy/polyester, polyester/polyurethane, or acrylic/polyurethane).



With CLAYTONE HT, Southern Clay Products takes the guesswork out of rheological control by ensuring that each and every batch produces consistent viscosity levels. And CLAYTONE HT is designed to save you money. Often, a lesser amount of CLAYTONE HT will produce the same results as a larger amount of a competitive product.



Southern Clay Products

Next time you find yourself battling with thixotropic control, try CLAYTONE HT.

For additional information, call or write. Southern Clay Products, P.O. Box 44, Gonzales, Texas 78629, Tel. (512) 672-2891