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Oven vs. Shelf Stability of Latex Paints

FEBRUARY 1987

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Technical Articles

Federation News

Departments

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.

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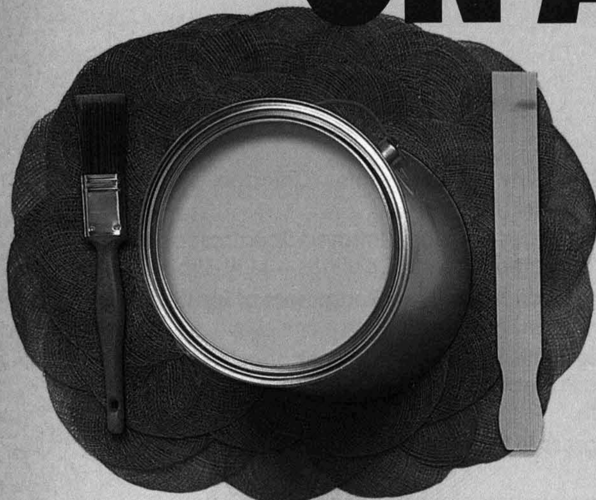
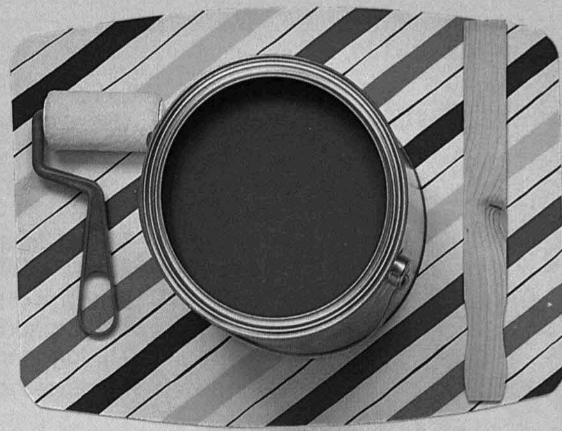
HOW TO MAKE G
ON A FAST FO



ROPAQUE® OP-62 Opaque Polymer. Maintains quality and hiding while reducing costs.



ACRYSOL® RM-825 Rheology Modifier. Highly efficient; excellent flow and leveling, thickening efficiency and film build; low viscosity for easy handling.

TRITON® CA Surfactant. Newest wetting agent; solves color acceptance problems.

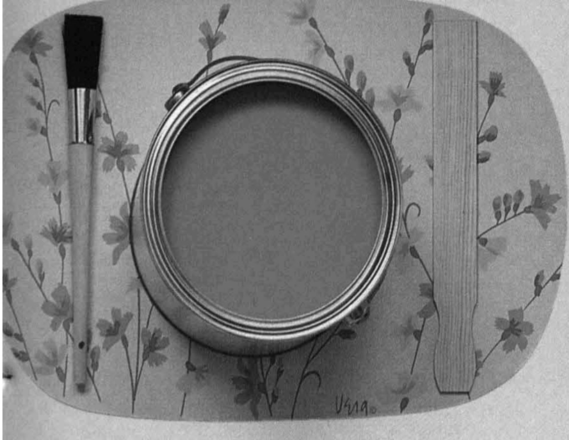
ACRYSOL TT-935 Rheology Modifier. Low-cost HEC substitute; provides improved spatter resistance and film build.

Like the perfect spice that makes a gourmet dish, Rohm and Haas additives can help you maintain the high quality of your paints...and trim some fat from your costs at the same time

The secret is in our variety. No one offers as many additives that save you so much. Each is designed to perform better and more economically. Just add a pinch here, a dash there... and voila!

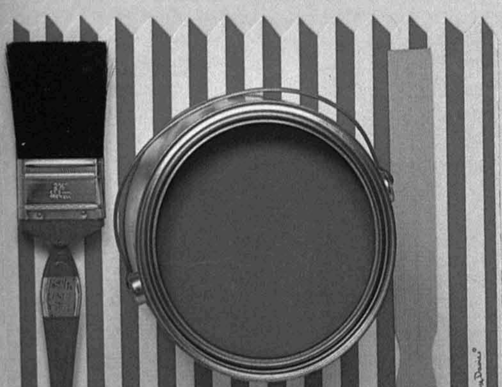
And that goes for all your paints. In fact, the more paint you produce using Rohm and Haas

OURMET PAINTS
OD BUDGET.

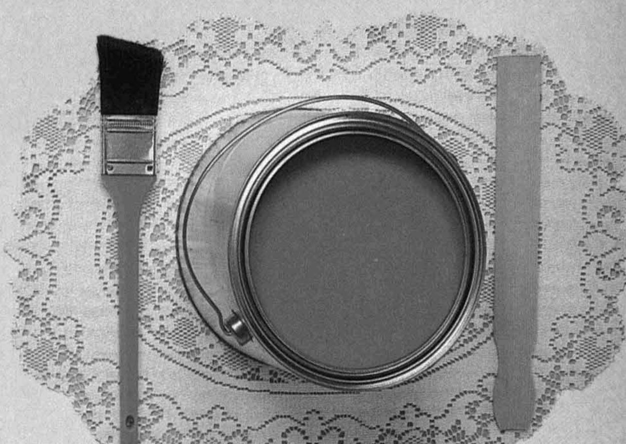


TAMOL® 963 Dispersant. Lowers costs; aids stability, color acceptance and hiding; contributes less foam and color.

TAMOL 983 Dispersant. All the features of TAMOL 963 as well as the added benefit of zinc oxide stability.



SKANE® M-8 Mildewcide. Highly effective; liquid form for easy incorporation into water or solvent-based paints.



KATHON® LX Microbicide. Emulsion storage preservative; can substantially reduce biocide costs.

additives, the more significant the savings. And when purchased in combination with our RHOPLEX® acrylic vehicles, you have the potential to save even more.

To learn more about all the ways you can make gourmet paints on a fast food budget, contact your Rohm and Haas technical representative. Or write our Marketing Services Department, Independence Mall West, Philadelphia, PA 19105.

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PHILADELPHIA, PA. 19105

JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., PA 19107

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

Annual dues for Active and Associate Members of the Federation of Societies for Coatings Technology is $20.00. Of this amount, $13.50 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	$27.00	$ 55.00	$ 40.00
2 Years	$51.00	$107.00	$ 77.00
3 Years	$73.00	$157.00	$112.00

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

SPC: The Better Mouse Trap

In the beginning there was Quality Control. And the Production Manager looked upon it and it was good.

Sure it was good! Manufacture the product as best you can, adhering to tolerances and specifications as closely as possible, and let the QC people at the end-of-the-line catch the imperfections before they are shipped to your customers. If too many batches were "irregular", well, then you make your adjustments and hope you didn't lose too much profit in wasted batches.

But, wouldn't it be great if someone could come up with a system to *do it right the first time*—a better mouse trap so to speak?

Something called "Statistical Process Control" may just fit that bill. By statistically identifying machine and product variables SPC can be used to reduce variation in products and minimize waste. And SPC works best when used in batch processing like the paint industry.

To bring the coatings industry up to date on this important topic, the Federation, through its Professional Development Committee, is sponsoring a series of seminars around the country in March. The two-day seminar will cover all the items needed to gain a good grasp of SPC and how it can work for you.

The seminars will be presented in Chicago, March 2-3; Atlanta, March 9-10; Philadelphia, March 16-17; and Los Angeles, March 30-31. For more information about SPC, turn to page 11 of this issue, or contact Federation headquarters.

Robert F. Ziegler

Robert F. Ziegler,
Editor

Abstracts of Papers in This Issue

OVEN VS SHELF STABILITY OF LATEX PAINTS—Chicago Society

Journal of Coatings Technology, 59, No. 745, 23 (Feb. 1987)

One of the most important features of a coating is how well it stands up to extended storage. This property is particularly crucial in the trade sales area, where a paint may be stored for months or even years before being applied.

One of the most common of accelerated aging tests developed to predict a coating's reaction to long-term storage is the heat aging or "oven stability" test.

The oven stability test assumes that short-term changes of a paint's properties when stored at an elevated temperature (from 120° to 160°F) will accurately predict the long-term changes of a room temperature sample. While most experienced formulators feel this assumption is warranted, a literature search showed little actual documentation of hard data in confirmation. Also, test conditions such as storage temperature, length of test, and time intervals between data points vary widely from company to company. For these reasons, the Chicago Society Technical Committee undertook a study of this test, in an attempt to come up with a standard, usable methodology.

PHOTOACOUSTIC FOURIER TRANSFORM INFRARED SPECTROSCOPY: A NEW METHOD FOR CHARACTERIZATION OF COATINGS—M.W. Urban

Journal of Coatings Technology, 59, No. 745, 29 (Feb. 1987)

A new spectroscopic tool, photoacoustic Fourier transform infrared spectroscopy, can be used to characterize coatings and interfaces. It is a novel technique that allows characterization of surfaces at various depths and provides information on the molecular level. Because of its nondestructive nature, it can be used as a method for early detection of weathering processes, for measurement of the kinetics of UV curing, and for the determination of substrate-coating interactions. Major advantages and applications of this technique are described.

FRACTAL-BASED DESCRIPTION OF THE ROUGHNESS OF BLASTED STEEL PANELS—J.W. Martin and D.P. Bentz

Journal of Coatings Technology, 59, No. 745, 35 (Feb. 1987)

Shot-, grit-, and sand-blasted Keane-Tator comparator leaves were thermographically imaged and their fractal dimension computed. It was found that imaging a heated roughened surface with a thermographic camera provides a good delineation of the peak-to-valley heights of the structures on the surface and that, in general, the computed fractal dimension increased with an increase in profile depth and an increase in the concentration of the crater-like structures. It was also shown that fractals adequately describe an abraded surface in that the computed fractal dimension can be used as input into a simulation model from which most of the perceptually relevant shape structures on the originally imaged surface can be reconstructed.

BEHAVIOR OF PIGMENTS IN UNDERWATER ANTI-CORROSIVE PAINTS WITH CATHODIC PROTECTION—Y.P.S. Nirvan, D. Kumar, and J.H. Jagannath

Journal of Coatings Technology, 59, No. 745, 43 (Feb. 1987)

Protective coatings are used mostly in conjunction with cathodic protection for the preservation of ship hulls against corrosion. The coating plays a significant role in deciding the cost of protection. This paper describes work related to the behavior of pigments in coatings under cathodic protection. Formulations prepared using individual pigments in a chlorinated rubber resin were examined.

Aluminum, zinc chromate, and zinc phosphate-based coatings required low current densities for maintaining a potential of −850 mV(SCE). Adhesion of these coatings to the steel was good and did not exhibit any blistering during the test period. The aluminum pigment, along with extender pigment, demonstrated unsatisfactory behavior. Red lead, barium chromate, and basic lead silico chromate did not behave satisfactorily and required higher protective current densities.

COATINGS PROGRESS IN THE MID 1980's—R.B. Seymour

Journal of Coatings Technology, 59, No. 745, 49 (Feb. 1987)

The large number of articles on coatings progress published during the past two years is indicative of improvements in technology in this field. Paint history, which dates back to the Cro-Magnum period, is over 20,000 years old, but most of the advances in coatings technology have been made during the last half century. The efforts toward reducing VOC emissions in this $9 billion industry have been catalyzed by environmental regulations which started with Rule 66 in 1965. These efforts have resulted in the development of superior water-borne and higher solids coatings, new pigments, new curing techniques, new characterization tools, and many new applications.

Federation News

Program Theme Announced and Papers Invited For 1987 FSCT Annual Meeting in Dallas

The 1987 Annual Meeting of the Federation of Societies for Coatings Technology will feature the theme, "People and Technology: The Cornerstones of Progress," it was announced by Program Chairman William A. Wentworth, of Jones-Blair Co.

The Annual Meeting will be held in conjunction with the Paint Industries' Show at the Dallas Convention Center, Dallas, TX, October 5-7.

The theme focuses on the coatings industry's most valuable resource — people. They provide the creativity and innovation necessary to meet today's challenges. Programming will cover timely issues, including the training of these vital people, as well as technological developments in such areas as coating plastics, manufacturing, and corrosion control. Consideration will be given to papers addressing related topics.

Prospective speakers are invited to present original papers on the theme and its various aspects, and are requested to submit abstracts (150 to 200 words) for review to William A. Wentworth, Jones-Blair Co., P.O. Box 35286, Dallas, TX 75235. *Deadline for receipt of abstracts is March 1.*

Assisting Chairman Wentworth in the program development is a Steering Committee composed of: Richard M. Hille (Vice-Chairman), General Paint & Chemical Co., Cary, IL; John C. Ballard, Kurfees Coatings, Inc., Louisville, KY; Gordon P. Bierwagen, Consultant, Homewood, IL; Gretchen McKay, Milton Hill Associates, Olympia, WA; John J. Oates, Troy Chemical Corp., Newark, NJ; A Gordon Rook, Nuodex, Inc., Pleasanton, CA; and Clifford Schoff, PPG Industries, Inc., Allison Park, PA.

65th Annual Meeting & 52nd Paint Industries' Show
Dallas Convention Center • Dallas, Texas
Monday, Tuesday & Wednesday • Oct. 5, 6, 7, 1987

Special Discount Fares Available from Delta To Annual Meeting

Special arrangements have been made with Delta Airlines to offer discounted fares within the U.S. to/from Dallas, TX, for the October 5-7 Annual Meeting and Paint Industries' Show, at the Dallas Convention Center. These special fares are available only when you call the unlisted toll-free number 1-800-241-6760. Be sure to ask for the lowest fare available. You must give the FSCT Convention number, which is:

U0235

Deadline Nears for Entering 1987 Roon Awards Competition

Prospective entrants in the 1987 Roon Awards competition are reminded that they must advise of their intent to compete by March 1.

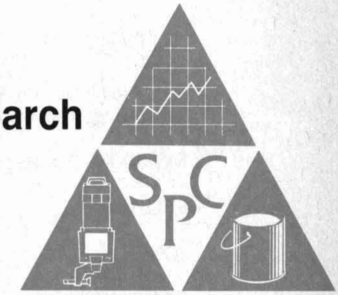
Winners in the competition for the best technical papers presented at the 1987 Federation Annual Meeting (to be held October 5-7 at the Convention Center, Dallas, TX), will share a total of $4,000 in cash prizes.

Sponsored by the Federation's Coatings Industry Education Fund (formerly the Paint Research Institute), the Awards were established in 1957 by the late Leo Roon, founder of Nuodex Products Co. They are supported by funds provided through the Roon Foundation, and are presented to the winning authors at the Federation Annual Meeting each year.

Papers to be considered for the competition are those by individuals associated with the organic coatings industry, including raw material suppliers and educators, which must: (1) Describe original work not previously published or presented; (2) Be directly related to the protective coatings industry; (3) Be of such a caliber that they reflect a step forward in real scientific contribution to the coatings industry; and (4) Be accompanied by clearance for publication.

Those wishing to enter the competition should send a letter of intent, along with the title of their proposed paper and a brief abstract by the March 1 deadline to the Chairman of the Roon Awards Committee, Gary Gardner, Tnemec Co., P.O. Box 1749, Kansas City, MO 64141. Deadline for receipt of manuscript entries is May 15.

Statistical Process Control Application Is Topic of FSCT Regional Seminars in March



The application of Statistical Process Control (SPC) to coatings manufacture will be explored in a series of regional seminars sponsored by the Federation.

To be held during March 1987 under the auspices of the Federation's Professional Development Committee, the seminars are designed to introduce SPC methods to personnel working in coatings manufacturing and related areas (e.g., chemicals, pigments) which employ a batch process.

The seminars will be held in the following areas: Chicago (O'Hare Marriott), March 2-3; Atlanta (Radisson Hotel), March 9-10; Philadelphia (Airport Marriott), March 16-17; and Los Angeles (Torrance Marriott), March 30-31.

The SPC philosophy redirects the responsibility for quality onto production, with the focus on preventing defects from occurring, and emphasizes an understanding of product and machine variability, so that variations may be reduced, thus resulting in consistent product quality from batch to batch.

Seminar instructor, Dr. Peter J. Hunt, President of Productivity Management Consultants, is an expert in the understanding and application of SPC. Dr. Hunt is an Adjunct Professor of Management, College of Business, University of South Florida, and author of *Statistics for Managers: A Text for Decision Makers*, which is currently used by universities at both the undergraduate and M.B.A. levels, as well as by private industry.

Dr. Hunt will emphasize Dr. W. Edwards Demming's concepts, which apply statistics to production samples to reduce variation and minimize waste, and will cover the mathematics of variability, system and special causes, the normal distribution, histograms, control charts and how to determine and use statistical control limits, and quality control sampling to make machine and process adjustments.

The seminar format will be *practical*, rather than theoretical, and will offer a "hands-on" understanding to insure proper implementation. Seminar attendees will participate in summarizing sample data, plotting charts, determining process capability, and interpreting results in terms of the process or machine changes warranted, and will be given a work manual which describes the SPC concepts and formulas discussed and contains all necessary worksheets.

The program will include the following topics:

- Measuring the Cost of Quality
- What is Statistical Process Control?
- Benefits to Be Obtained from SPC
- Construction of Control Charts
- Interpreting Control Charts
- Standard Deviation and Other Measures of Variability
- Examination of Production Processes, Both In and Out of Control
- Comparison of Production Process with Customer Specifications
- Process Capability Analyses
- Introduction to Attribute Charts
- Automotive Industry's SPC Mandate to Its Suppliers
- Establishing Your SPC Program (Identifying Critical Variables to Be Charted, Designing Your Data Gathering Forms, Assigning Responsibilities for Implementing Your SPC System)

Registration fee is $150 for FSCT members; $225 for non-members. The fee includes two continental breakfasts, two luncheons, coffee breaks, workbook, worksheets, and reference materials.

For complete information on the program, registration, and housing, contact the Federation office at (215) 545-1506.

SPC Registration and Housing forms are contained in this issue. See page 12.

SPC Regional Presentations
March 1987

Chicago **March 2-3**	**Philadelphia** **March 16-17**
Atlanta **March 9-10**	**Los Angeles** **March 30-31**

FSCT Publishes Guide To 1987 Coatings Courses

Publication of the 1987 edition of "Guide to Coatings Courses, Symposia, and Seminars" has been announced by the Federation.

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

The listings are updated annually to reflect current information.

Copies of the "Guide" (8½ × 11 in.) are available at a price of $5.00 each (postage paid).

To order, contact Federation of Societies for Coatings Technology, 1315 Walnut Street, Suite 832, Philadelphia, PA 19107 (215/545-1506).

SPC SEMINAR
REGISTRATION FORM

Registration fees: $150 (FSCT members) $225 (Non-Members)

Name Federation Society of Which You Are a Member ________

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

NICKNAME (For Registration Badge) ________

FULL NAME ________

JOB TITLE ________

COMPANY ________ PHONE ________

ADDRESS ________

CITY ________ STATE ________ ZIP ________

Check Appropriate Box
for Seminar You Will Attend: ☐ Chicago ☐ Atlanta ☐ Philadelphia ☐ Los Angeles

No refund for cancelled registrations received less than 5 days prior to seminar

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

IF YOU REQUIRE HOUSING COMPLETE FORM BELOW

Rates Shown Are for Single/Double Occupancy, Per Night

☐ Chicago—March 2-3
O'Hare Marriott ($94/$106)

☐ Philadelphia—March 16-17
Airport Marriott ($92/$98)

☐ Atlanta—March 9-10
Downtown Marriott ($84/$94)

☐ Los Angeles—March 30-31
Torrance Marriott ($80/$90)

NAME ________

ADDRESS ________

CITY ________ STATE ________ ZIP ________

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

Please reserve: Single ________ Double/Twin ________

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

Note: Reservations must be made at least 30 days in advance of seminar to guarantee room availability and rate.

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

Federation of Societies for Coatings Technology
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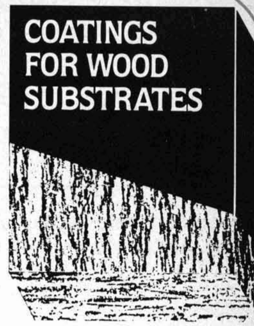

SPRING WEEK '87

Advance Registration and Hotel Reservation Forms

Sponsored by
Federation of Societies for Coatings Technology
and
Pacific Northwest Society for Coatings Technology

April 29–May 2
The Westin Hotel • Seattle, Washington

Featuring
FSCT Seminar on
"Coatings for Wood Substrates"
May 1–2

Spring Week Schedule

Wed., April 29 — FSCT Society Officers Meeting
Thur., April 30 — PNW Golf
FSCT Board of Directors Meeting
PNW Evening Social
Fri., May 1 — FSCT Spring Seminar
Sat., May 2 — Seminar until 12:30 pm
PNW Sports Competition
Closing Dinner Dance

United Airlines has been selected as official carrier for Spring Week '87. Discounts will range from 40%-70% off normal round-trip coach fares. To make reservations, phone 1-800-521-4041, and refer to the Federation's account number—7013-D. Be sure to request the lowest fare available.

FEDERATION MEMBERS ONLY—ADVANCE REGISTRATION
for
SPRING WEEK ACTIVITIES
and
SEMINAR ON COATINGS FOR WOOD SUBSTRATES

Sponsored by FSCT and PNWSCT

Thursday, Friday, Saturday, April 30–May 2, 1987
Westin Hotel, Seattle, Washington

Please complete all applicable sections of this form. Mail with check in the correct amount to FSCT at address below. All checks must be payable in U.S. Funds.

Fed. Socs. Coatings Tech.
1315 Walnut St.
Philadelphia, PA 19107

No advance registrations will be accepted after **April 10.** After that date, the Seminar registration fee (including Saturday Dinner-Dance) will be $135.00. Other fees remain the same.

Membership status is subject to verification by the FSCT Staff. This form and check will be returned to anyone not currently enrolled as a member of the Federation of Societies for Coatings Technology.

MEMBER REGISTRATION

Name ______________________ Nickname for Badge ______________________

Business Affiliation ______________________ Phone ______________________

Address ______________________

City ______________________ State/Province ______________________

Mailing Zone ______________________ Country ______________________

Name of Federation Society In Which You Are A Member ______________________

SPOUSE REGISTRATION

Name ______________________ Nickname for Badge ______________________

City ______________________ State/Province __________ Country ______________________

HOUSING AT WESTIN HOTEL

The confirmation of your reservation will come to you directly from the Westin, located at 1900 Fifth Ave., Seattle, WA 98111. Phone: 206-624-7400. All reservations will be held until 6:00 p.m. None can be guaranteed after April 6, 1987.

Rates: Single or Double ($82.00) Suites: Deluxe P & 1 BR ($350.00)

Check Accommodation Desired: ______ Single ______ Double ______ Suite

Date/Day of Arrival ______________________ Day/Date of Departure ______________________

Note: All room rates are subject to a state sales tax of 7.9% and city room tax of 5.0%.

SCHEDULE OF FEES FOR FEDERATION MEMBERS ONLY

Check Events Desired	Events	Fee Per Person	Write-In Amount Below
	Member		
______	Seminar on "Coatings for Wood Substrates" Friday and Saturday, May 1-2	$110	______
______	Dinner-Dance, Saturday, May 2	Included With Above Fee	
______	Dinner-Social, Thursday, April 30	$ 25	______
______	Golf, Thursday, April 30 (includes lunch)	$ 30	______
	Spouse		
______	Spouses Activities	$ 50	______
______	Dinner-Dance, Saturday, May 2	Included With Above Fee	
______	Dinner-Social, Thursday, April 30	$ 25	______
	(Enclose Check in This Amount)	TOTAL FEES	______

COATINGS FOR WOOD SUBSTRATES

PROGRAM

"REDWOOD — PROPERTIES, USES, PAINTING AND STAINING RECOMMENDATIONS"
Keith Kersell, Technical Services Manager,
The Pacific Lumber Co., San Francisco, CA

"STAINS FOR WOOD SIDING"
Dr. Dale Williamson, Technical Director,
Olympic Home Care Products Co., Seattle, WA

"COATINGS RESEARCH AT THE FOREST PRODUCTS LABORATORY"
Dr. William C. Feist, Project Leader—Wood Surface Chemistry,
U.S. Dept. of Agriculture,
Forest Products Laboratory, Madison, WI

"HARDBOARD SIDING—COMPOSITION AND PROPERTIES. PAINTING RECOMMENDATIONS"
Theodore J. Rieth, Manager, Finishing Tech. Service
Masonite Corp., Towanda, PA

"PLYWOOD—PROPERTIES, USES, AND RECOMMENDED PAINTING PROCEDURES"
Richard Carlson, Associate Scientist,
Research and Development Dept.,
American Plywood Assn., Tacoma, WA

"PAINTING HARDBOARD SIDING"
Stan Vout, Technical Manager for Forest Products Coatings,
Valspar Corp., Minneapolis, MN

"TODAY'S COATING SYSTEMS FOR THE WOOD FURNITURE INDUSTRY"
Robert S. Bailey, Vice-President and General Manager,
Lilly Industrial Coatings, Inc., Indianapolis, IN

"INVESTIGATION OF LATEX STAIN BLOCKING PRIMERS ON WOOD SUBSTRATES"
Fred Marschall, Vice-President of Manufacturing and Research,
DPI Quality Paints, Inc., Clearwater, FL
(*Presented on behalf of the Southern Society for Coatings Technology*)

"THE MILDEW PROBLEM ON PAINTED WOOD SURFACES"
Michael C. McLaurin, Industry Specialist for Coatings,
Buckman Laboratories, Inc., Memphis, TN

"PRESERVATIVE TREATMENTS FOR WOOD AND COATING TECHNIQUES"
Dr. Alan S. Ross, Manager of Product Development—
Protection Products,
Koppers Co., Inc., Monroeville, PA

"THE RESPONSIBILITY OF THE ARCHITECT"
John Greiner, AIA,
Bellevue, WA

"HOW THE HOME BUILDER CAN HELP TO AVOID PAINT PROBLEMS"
Don Bender,
Bender and Chaffey Co., Seattle, WA

Several Open Forum Sessions will also be featured so that attendees will have an opportunity to question the speakers.

SEMINAR SCHEDULE

Friday. . .8:45-3:45   Saturday. . .8:45-12:30

The registration fee includes continental breakfast and lunch on Friday; continental breakfast on Saturday; and copies of the papers.

NON-MEMBERS ONLY—ADVANCE REGISTRATION
for
SPRING WEEK ACTIVITIES
and
SEMINAR ON COATINGS FOR WOOD SUBSTRATES

Sponsored by FSCT and PNWSCT

Thursday, Friday, Saturday, April 30–May 2, 1987

Westin Hotel, Seattle, Washington

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Fed. Socs. Coatings Tech.
1315 Walnut St.
Philadelphia, PA 19107

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NON-MEMBER REGISTRATION

Name ______________________ Nickname for Badge ______________
Business Affiliation ______________________ Phone ______________
Address ____________________________________
City ______________________ State/Province ______________
Mailing Zone ______________________ Country ______________

SPOUSE REGISTRATION

Name ______________________ Nickname for Badge ______________
City ______________________ State/Province ________ Country ________

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Rates: Single or Double ($82.00) Suites: Deluxe P & 1 BR ($350.00)

Check Accommodation Desired: ______ Single ______ Double ______ Suite

Date/Day of Arrival ______________________ Day/Date of Departure ______________

Note: All room rates are subject to a state sales tax of 7.9% and city room tax of 5.0%.

SCHEDULE OF FEES FOR NON-MEMBERS ONLY

Check Events Desired	Events	Fee Per Person	Write-In Amount Below
	Non-Member		
______	Seminar on "Coatings for Wood Substrates" Friday and Saturday, May 1-2	$125	______
______	Dinner-Dance, Saturday, May 2	$ 40	______
______	Dinner-Social, Thursday, April 30	$ 25	______
______	Golf, Thursday, April 30 (includes lunch)	$ 30	______
	Spouse		
______	Spouses Activities	$ 50	______
______	Dinner-Dance, Saturday, May 2	Included With Above Fee	
______	Dinner-Social, Thursday, April 30	$ 25	______
	(Enclose Check in This Amount)	TOTAL FEES	______

Detroit PCA Receives '86 Clark Award For Outstanding Community Service

The Detroit Paint and Coatings Association is the recipient of the Allen W. Clark Award for 1986. The award is presented annually by the National Paint & Coatings Association to a local association for outstanding community service through the NPCA's "Picture It Painted" program.

The Detroit Association was recognized for participating in the Battle Creek, MI, "Paint Blitz" and for pledging its support to the renewal of a YMCA facility in western Detroit.

In its first endeavor, the Detroit PCA joined forces with the cleanup group Keep America Beautiful to launch a citywide one-day painting spree that brought a new coat of paint and minor repairs to 25 homes of the elderly and disabled.

The project received praise when President Reagan sent a letter of commendation to the project team, applauding its spirit of volunteerism. The Detroit PCA also received a Distinguished Service Award from the Keep Michigan Beautiful organization and a nomination for the Michigan State Public Service Award.

With the second project, the Detroit PCA solicited the assistance of the American Society of Interior Designers, who provided a comprehensive design scheme aimed at enlivening the YMCA. The association has already finished painting one floor of the facility and plans to complete the entire project by the end of the year.

The Detroit PCA was selected from approximately 30 entries, a record-breaking high, entered in the Clark competition.

The projects were judged by a panel of trade-press editors on the basis of five criteria: showcasing of industry products, contribution to the community, project publicity and exposure, association initiative, and community support.

Members of Detroit Paint and Coatings Association are congratulated by NPCA Vice President J. Robert Pickering on receiving the 1986 Allen W. Clark award for outstanding community service. Pictured from left are DPCA PIP Chairman Robert Craigie, Mr. Pickering, DPCA Immediate Past President Carl Patterson, DPCA President Fred Boehle, and DPCA Executive Secretary David Sample

Goodyear Expansion Project Continues

The latest phase of a $7 million expansion and modernization project at Goodyear Tire and Rubber Co.'s Wingtack hydrocarbon resin facility in Beaumont, TX, has begun.

When the Wingtack modernization program is completed during the third quarter of this year, production capacity will be expanded by nearly 24%. The modernization program started in 1985 with an investment of $2.6 million. This phase of the expansion project includes an expenditure of $4.2 million.

Goodyear has manufactured Wingtack resins for more than 20 years. They are used primarily in the adhesives industry and as processing aids for the manufacture of various rubber products and coating applications.

NPCA Launches New Paint Contest

The NPCA is working with the National Association of Home Builders to sponsor its newest promotional contest, the Prism Award. The competition was created to recognize the artful use of paint by builders and to showcase winning works to the construction industry and consumers.

The contest, part of the NPCA's "Picture It Painted" public relations campaign, is open to both residential and commercial projects. Entries will be judged by a panel of representatives from building and paint trade publications on the basis of: creative use of color, use of special techniques, and degree to which paint adds to sales appeal.

The awards are scheduled for presentation during the NAHB mid-year convention in Washington, DC, in May. A Steuben crystal prism will be awarded to the winners as a symbol of their colorful craftsmanship.

In addition, a paint workshop on the importance of color in marketing home and commercial constructions is planned for the NAHB meeting.

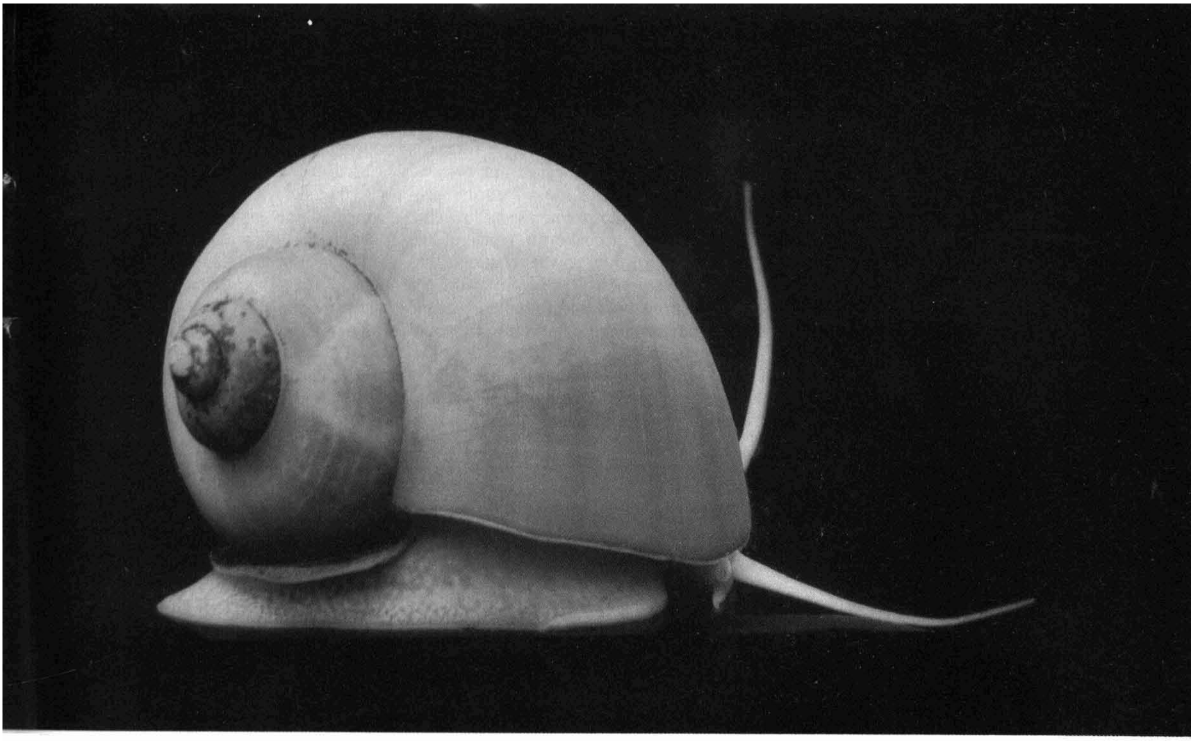
RPM Acquires William Zinsser and American Emulsions Cos.

RPM, Inc., Medina, OH, announced it has entered into an agreement to acquire all the common stock of William Zinsser & Co., Inc., Somerset, NJ.

William Zinsser & Co. is a producer of specialty coatings for the professional and do-it-yourself markets. Sold under the Zinsser brand name are primer-sealers, shellac finishes, and wallcovering specialties. The company will continue to operate under the leadership of Chairman Gardner R. Cunningham and President Robert Senior.

In addition, RPM has acquired all the common stock of the American Emulsion Co., Inc., Dalton, GA. American Emulsions is a producer of specialty coatings and chemicals for the textile, carpet, and paper industries. They market their products throughout the Southwestern United States.

RPM is a diversified manufacturer of products for the waterproofing, corrosion control, and general maintenance markets. They also produce materials for the do-it-yourself homeowner market.



Study Shows Powder and Special Coatings Growth by 1990

United States shipments of coatings will grow 2.2% per year and reach 1.1 billion gallons by 1990, according to the industry study, "Coatings," by The Freedonia Group Inc., Cleveland, OH. Freedonia is an organization specializing in business analysis, proprietary databases, and consulting services.

The study predicts that the industry will gain 7% annually in value of shipments to over $13 billion. Product improvements (upgrading) will be responsible for much of the value gain.

Powder coatings in the product coatings OEM segment will enjoy a 12% annual volume increase, while special purpose coatings will show a larger increase in shipments than the industry overall.

Architectural coatings will continue to hold the largest market share, but will experience the slowest growth based upon market saturation, increased product longevity, and continuing pressures from alternative materials.

Study Project Director William P. Weizer based his analyses and conclusions on interviews with coatings industry personnel, business databases, other primary and secondary sources, and relevant economic indicators. He forecasts that technological advances in portable application systems, faster curing processes, and improvements in low-cure powders will account for much of the expected growth in powder coatings.

EPA restrictions will favor powder application methods and formulations, and cost-performance characteristics and high-quality appearance of powder coatings will also create increased use.

According to "Coatings," special purpose coatings will be the fastest growing industry segment because of increases in specialized applications requiring high performance.

In conclusion, the study states that increased merger activity will take place because of higher capital costs, increased customer sophistication, growing government regulation, changing channels of distribution, and development of global paint markets.

For a copy of the 92-page report, contact The Freedonia Group, Inc., 2940 Noble Rd., Suite 200, Cleveland, OH 44121.

Norcoro Purchased By Del Paint

Del Paint Manufacturing, Oklahoma City, OK, has purchased the formula and the rights to manufacture Norcoro heavy duty maintenance coatings from Reichhold Chemical. Also acquired in the transaction were the trade name, EPA licenses, and a customer list.

Norcoro special coatings, with 30 years of marketing and formulation distribution in the eastern and midwestern U.S., are engineer, EPA, and American Waterworks Association approved. They are used for portable water containers, sewage treatment, and water storage tanks.

Del Paint, a manufacturer and distributor of industrial and architectural coatings for 23 years, plans to produce the new coating formula in its Oklahoma City plant.

Reichhold Chemicals Introduces New Business Unit

The Chemical Coatings Division of Reichhold Chemicals, Inc., White Plains, NY, has formed a new business unit, General Coatings Products. The creation of the new business unit is designed to allow Reichhold to implement new marketing strategy. Clifford Q. Schneider will serve as Vice-President and General Manager of the unit.

Battelle Proposes Study on Treatment And Disposal of Metal-Finishing Wastes

An 18-month program that addresses existing problems with the treatment and disposal of metal-finishing wastes is being proposed by Battelle's Columbus Div., Columbus, OH.

The program will examine the advantages of combining two proven technologies—selective precipitation and selective flocculation—in waste management.

Selected constituents would be precipitated from the used baths and effluents in the proposed Battelle method. Precipitated solids would be separated into different components using selective flocculation technology.

During the program, researchers will examine the effectiveness of selective precipitation and selective flocculation of synthetic mixtures representing wastes containing metals such as nickel, copper, chromium, and zinc.

They will then apply these findings to samples of wastewater obtained from commercially operating metal-finishing plants.

Finally, Battelle will analyze the commercial feasibility of each treatment and disposal process considered.

For more information, contact Dr. Santhana V. Krishnan, Battelle, 505 King Ave., Columbus, OH 43201-2693.

Degussa Opens Allendale Facility

The Applied Research and Technical Service Dept. of Degussa Corp., Teterboro, NJ, officially opened October 30, 1986. Operations at the 21,000 sq ft Allendale, NJ, location started over a year ago.

Analyses, customer formulations and product testing, quality control, new product applications, technical support, and safety advice for the products of the Chemicals and Pigments Divs. are performed at the Allendale facility.

Celanese Corp. Purchased by American Hoechst

American Hoechst Corp., Somerville, NJ, and Celanese Corp., New York, jointly announced the signing of a merger agreement for American Hoechst to acquire Celanese. The boards of both companies unanimously approved the acquisition for a total value of $2.848 billion. The announcement was made by Dieter Zur Loye, President, American Hoechst Corp., and John D. Macomber, Chairman, Celanese Corp.

Celanese is a worldwide producer of chemicals, fibers, and specialty materials. They employed 18,500 people in 1985, 16,000 of whom worked in the United States.

American Hoechst Corp., a wholly-owned subsidiary of Hoechst AG, is a diversified producer of chemicals, pharmaceuticals, plastics, fibers, and graphic arts products. It has 8,000 U.S. employees.

Valspar to Acquire Enterprise Paints

Valspar Corp., Minneapolis, MN, and Insilco Corp., have entered into an agreement in principle under which Valspar will acquire Insilco's Enterprise Paint Cos. Div. Insilico is a manufacturer of products for high technology industries and specialty consumer markets.

The Enterprise Paint Cos. Div.'s consumer coatings include Magicolor, Enterprise, BPS, and Mary Carter. The division has two plants in the Chicago, IL area and a plant in Tampa, FL.

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Oven vs Shelf Stability Of Latex Paints

T.P. Yates, M. Boyer, R. Braunshausen, T.R. Drucker, J. Greenwald, E.F. Marek, F. Foote, G. Olholt, D. Stromberg, and F.S. Scimecca
Chicago Society for Coatings Technology
Technical Committee

One of the most important features of a coating is how well it stands up to extended storage. This property is particularly crucial in the trade sales area, where a paint may be stored for months or even years before being applied.

One of the most common of accelerated aging tests developed to predict a coating's reaction to long-term storage is the heat aging or "oven stability" test.

The oven stability test assumes that short-term changes of a paint's properties when stored at an elevated temperature (from 120° to 160°F) will accurately predict the long-term changes of a room temperature sample. While most experienced formulators feel this assumption is warranted, a literature search showed little actual documentation of hard data in confirmation. Also, test conditions such as storage temperature, length of test, and time intervals between data points vary widely from company to company. For these reasons, the Chicago Society Technical Committee undertook a study of this test, in an attempt to come up with a standard, usable methodology.

INTRODUCTION

One of the most important features of a coating is its shelf life—how well it stands up to extended storage. This property is particularly crucial in the trade sales area where a paint may be stored for months, or even years, before being applied. Obviously, a company cannot wait years before marketing a new product or implementing a formula revision. On the other hand, manufacturing a product without some assurance of stability is courting disaster. Therefore, a number of accelerated aging tests have been developed to predict a coating's reaction to long term storage. One of the most common is the heat aging or "oven stability" test.

The oven stability test assumes that short-term changes of a paint's properties when stored at an elevated temperature (from 120° to 160°F) will accurately predict the long-term changes of a room temperature sample. While most experienced formulators feel that this assumption is warranted, a literature search showed little actual documentation of hard data in confirmation. Also, test conditions such as storage temperature, length of test, and time intervals between data points vary widely from company to company. For these reasons, the Chicago Society Technical Committee undertook a study of this test, in an attempt to come up with a standard, usable methodology.

EXPERIMENTAL DESIGN

In order to exercise a tight control on experimental variables, testing was limited to latex trade sales paints. There were two reasons for this choice: latex paints dominate the trade sales market, and trade sales paints are the coatings most likely to experience long term storage.

Ten companies (a mix of coatings manufacturers and raw materials suppliers) participated in the study. The paints tested included exterior and interior flats, and interior semi-glosses of both high and low quality levels (see *Table* 1). Several paints were deliberately made to be unstable. Each laboratory made a three gallon sample, sending one gallon each to two other labs and keeping the third. Thus, each lab had three samples to test.

Presented at the 64th Annual Meeting of the Federation of Societies for Coatings Technology, in Atlanta, GA, on November 7, 1986 by Mr. Braunshausen.

Table 1—Experimental Design (All Formulas Are Latex Trade Sales Type)

Paint	Paint Type	Formula Characteristics	Expected Stability	Tested by Laboratories
A	White interior flat	Low cost Low volume solids	Poor	4, 5
B	White interior flat	High quality High volume solids	Good	1, 4
C	Interior flat tint base[a]	High quality High volume solids	Good	1
D	White interior semi-gloss	Low cost Low volume solids	Poor	1, 8
E	White interior semi-gloss	High quality High volume solids	Good	8, 10
F	Interior semi-gloss tint base[a]	High quality High volume solids	Poor	8, 9, 10
G	White exterior flat	Low cost High PVC	Poor	9, 10
H	Exterior flat tint base[a] (with alkyd)	High quality Low PVC	Good	2, 3, 10
I	White exterior flat	High quality Low PVC	Good	2, 3, 5
J	White exterior flat with oil modification (with zinc oxide)	High quality High volume solids	Poor	3, 4, 5

(a) All tint bases were shaded to a blue color.

Each gallon was split into 16 half-pints, and tested as follows (see *Table* 2):

(1) Test one sample immediately and discard.
(2) Put five samples each in a:
   a. 120°F oven (some laboratories used 125°)
   b. 130°F oven
   c. room temperature storage area.
(3) Test each sample according to the following schedule:
   a. One 120 and one 130°F oven sample at 1, 2, 3 weeks, 1 month, and 2 months
   b. One room temperature sample at 1, 2, 6, 12, and 18 months.
(4) Perform the following tests on each sample:
   a. Let the sample come to room temperature
   b. Open and examine for syneresis, color float, skinning, or any other gross physical changes
   c. Stir the sample, check the Stormer viscosity and pH
   d. Make a drawdown and check reflectance, color, and gloss
   e. Roll out the paint; check for bubbling or other surface imperfections
   f. Discard the sample.

This procedure ensured that each sample would be used only once; in this way we would see a more accurate model of actual field conditions.

RESULTS AND DISCUSSION

As might be expected in a study of this magnitude and length, some of the laboratories were unable to complete the study or participate fully. *Table* 1 outlines the data actually received on each paint. All 10 of the paints were prepared, two laboratories did not submit any test results, and one paint sample was lost in transit. Four paints were tested by two laboratories, five paints were tested by two laboratories, and one paint was tested in only one laboratory.

Upon review of the data generated by the report, the Committee decided to submit only the Stormer viscosity and pH results to further analysis. These results were more complete, consistent, and objective with the data numerical in form and easily represented graphically.

The data were analyzed in two ways: (1) Shelf and oven aged data available on each paint were averaged (whether single, duplicate, or triplicate sets of data were available) and plotted against time; and (2) Data on each paint at each test condition were plotted against time. *Tables* 3 and 4 summarize the average Stormer viscosity and pH values determined on each paint at each test interval.

Figures 1 through 3 summarize the data reported by three laboratories for Paint A. They graphically present the correlation obtained between laboratories and are typical of the results reported.

The reproducibility among laboratories was generally adequate. Stormer viscosity values were typically within 5 KU's when duplicate samples were tested in different laboratories; pH values were typically within 0.5 units between laboratories. The differences between laboratories appear to be due to calibration or instrument differences. Data received from a given laboratory were generally internally consistent, that is, laboratories testing duplicate samples agreed that samples were stable, decreased, or increased in viscosity and pH with time, even though the absolute values reported may have differed. For this reason, averaging the data received from different laboratories on duplicate samples seemed to be valid.

The Stormer viscosity Krebs Units (KU's) reported by Laboratory #8 had the greatest differences from data reported on duplicate samples, with Laboratory #8's data averaging 12 KU's higher. *Table* 5 contains the data on Stormer viscosity and pH reported on Paint F by all three laboratories evaluating it. The differences in Stormer viscosity between laboratories were the largest reported, while the differences in pH values were typical of those for all ten paints.

The pH values from Laboratory #1 had the greatest average difference from the values reported on duplicate samples. Data ranged from 0.3 to 1.4 units higher.

Table 2—Sample Storage Conditions and Interval Sample Number

Time	Stored on Shelf	@ 120°F	@ 130°F
Initial[a]	1	—	—
1 week	—	2	3
2 weeks	—	4	5
3 weeks	—	6	7
1 month	8	9	10
2 months	11	12	13
6 months	14	—	—
12 months	15	—	—
18 months	16	—	—

(a) Sample tested at beginning of oven stability testing; not necessarily when manufactured.

Table 3—Average Stormer Viscosity, Kreb Units

Paint	Data Sets	Storage Conditions	Test Interval[a] 0	1	2	3	4	5
A........	2	Ambient	95	98	94	97	96	96
	2	120°F	95	96	95	94	94	95
	2	130°F	95	95	94	93	95	91
B........	2	Ambient	104	104	104	105	105	110
	1	125°F	103	105	105	107	106	105
C........	1	Ambient	90	93	95	98	98	102
	1	125°F	90	97	99	101	101	101
D........	2	Ambient	97	98	96	97	96	97
	1	120°F	101	103	102	101	102	102
	1	125°F	96	97	97	97	97	98
	1	130°F	101	107	108	107	101	103
E........	2	Ambient	88	87	85	86	79	84
	2	120°F	88	93	93	97	94	97
	2	130°F	91	98	97	97	100	107
F........	3	Ambient	85	87	84	77	74	75
	3	120°F	85	86	88	89	91	93
	3	130°F	85	90	91	92	96	118
G........	2	Ambient	105	104	107	122	Gelled	
	2	120°F	105	106	107	106	124	Gelled
	2	130°F	105	106	111	114	Gelled	
H........	3	Ambient	86	85	85	86	85	86
	3	120°F	86	87	87	87	89	89
	2	130°F	86	87	87	88	90	96
I........	3	Ambient	83	85	84	86	86	90
	3	120°F	83	88	87	87	90	90
	2	130°F	83	93	94	92	99	105
J........	3	Ambient	94	113	Gelled		—	—
	3	120°F	94	120	Gelled		—	—
	2	130°F	95	128	Gelled		—	—

(a) Test intervals were:
0 = Values obtained at start of testing
For ambient: 1 = 1 month; 2 = 2 months; 3 = 3 months; 4 = 12 months; and 5 = 18 months.
For oven aged samples: 1 = 1 week; 2 = 2 weeks; 3 = 3 weeks; 4 = 1 month; and 5 = 2 months

Table 4—Average pH Value

Paint	Data Sets	Storage Conditions	Test Interval[a] 0	1	2	3	4	5
A.......	2	Ambient	7.9	7.8	7.8	7.6	7.7	7.6
	2	120°F	7.9	7.9	7.7	7.7	7.7	7.7
	2	130°F	7.9	7.9	7.8	7.7	7.7	7.7
B.......	2	Ambient	8.5	8.4	8.3	8.1	8.2	8.2
	1	125°F	8.9	8.7	9.0	9.0	8.8	8.5
C.......	1	Ambient	8.9	8.8	8.4	8.7	8.7	8.6
	1	125°F	8.9	8.7	8.8	8.8	8.3	8.1
D.......	2	Ambient	7.5	7.3	7.1	7.1	7.1	7.1
	1	120°F	7.3	6.7	6.7	6.6	6.4	6.4
	1	125°F	7.7	7.4	7.6	7.3	7.2	6.8
	1	130°F	7.3	6.5	6.5	6.4	6.3	6.2
E........	2	Ambient	7.6	7.9	7.2	7.4	7.2	6.6
	2	120°F	7.6	7.4	7.4	7.3	7.3	7.1
	2	130°F	7.6	7.3	7.1	7.2	7.1	7.0
F........	3	Ambient	8.6	8.4	8.4	8.2	8.1	8.0
	3	120°F	8.6	8.1	8.3	8.1	7.7	7.5
	3	130°F	8.6	8.0	7.9	7.6	7.3	7.0
G........	2	Ambient	8.7	8.8	8.7	8.8	Gelled	
	2	120°F	8.7	8.8	8.7	8.7	8.6	Gelled
	2	130°F	8.7	8.6	8.4	8.3	Gelled	
H.......	3	Ambient	8.7	8.6	8.6	8.5	8.2	8.4
	3	120°F	8.7	8.5	8.2	8.2	7.9	7.6
	2	130°F	8.7	8.3	8.0	7.8	7.5	7.3
I........	3	Ambient	9.3	9.1	9.1	9.0	8.8	8.9
	3	120°F	9.3	9.0	8.9	8.9	8.9	8.9
	2	130°F	9.3	9.3	9.1	8.9	8.9	8.7
J........	3	Ambient	8.9	8.9	Gelled		—	—
	3	120°F	8.9	8.6	Gelled		—	—
	2	130°F	8.8	Gelled	—		—	—

(a) Test intervals were:
0 = Values obtained at start of testing
For ambient: 1 = 1 month; 2 = 2 months; 3 = 3 months; 4 = 12 months; and 5 = 18 months.
For oven aged samples: 1 = 1 week; 2 = 2 weeks; 3 = 3 weeks; 4 = 1 month; and 5 = 2 months

Correlation of Oven and Shelf Aged Samples for Stormer Viscosity

Coatings aged at 120° or 125°F most accurately predicted shelf life performance. A significant viscosity change after eight weeks in the oven would correlate to a significant change in the room temperature sample. However, the direction of the change in the viscosity (gain or loss) could not always be predicted. For Paints E and F, the 120°F samples increased in viscosity, while the shelf samples showed a loss. In these two paints, the two month samples were slightly more accurate in predicting the eventual room temperature problems.

The 130°F test often yielded larger changes at two months than were actually observed at room temperature.

Chicago Society Technical Subcommittee

Thomas P. Yates, *Chairman*... United Coatings, Inc.
Mike Boyer.................... Rohm and Haas Co.
Rick Braunshausen .... The Enterprise Cos.
Thomas R. Drucker .... Graham Paint Co.
John Greenwald .... DeSoto, Inc.
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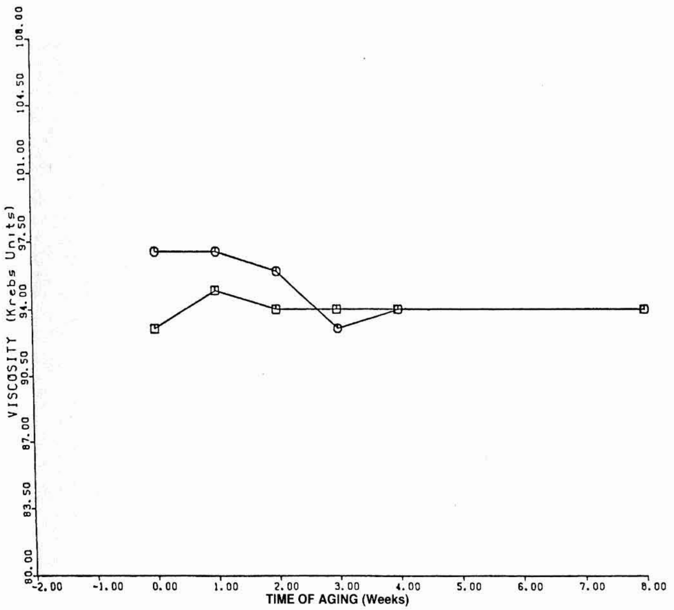

Figure 1—Viscosity (Kreb Units) vs time of aging (weeks) for oven samples of Paint A at 120°F. Legend: ⊡–results from Laboratory #4; ⊖–results from Laboratory #5

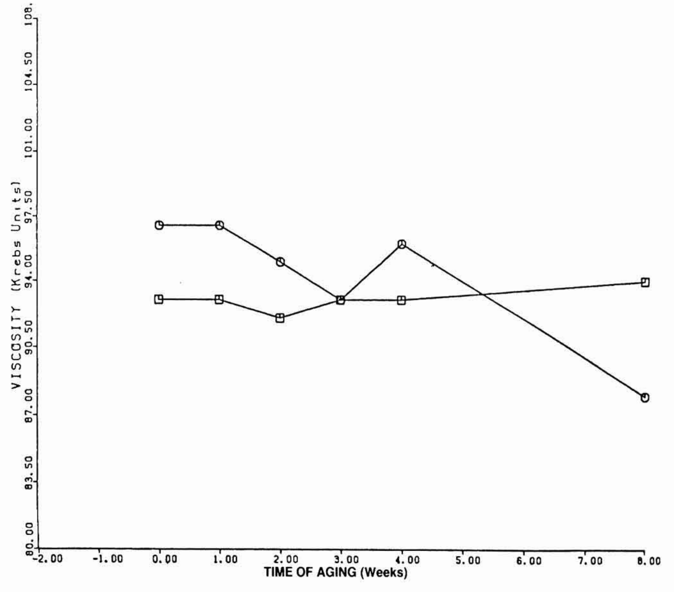

Figure 2—Viscosity (KU's) vs time of aging (weeks) for oven samples of Paint A at 130°F

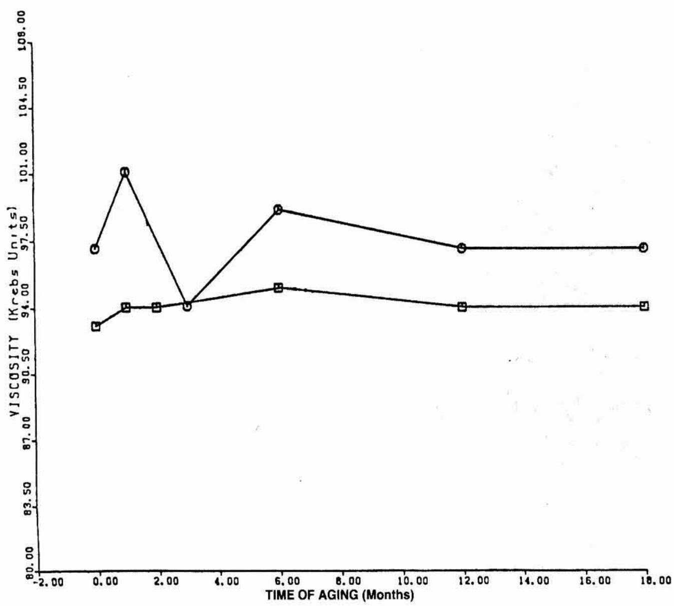

Figure 3—Viscosity (KU's) vs time of aging (months) for room temperature samples of Paint A

Overall, one month seemed adequate to predict whether a paint would have problems. It also failed to predict the direction of the change in Paints E and F.

Correlation of Oven Shelf Aged Samples for pH Values

An examination of the averaged pH data reported in *Table* 4 indicates oven aging tests are also a fairly good predictor of pH changes in room temperature samples. All of the paints tested were initially basic and their pH's were either stable or decreased during the tests. In several cases, oven aging tended to exaggerate the eventual pH drop in the shelf sample with the 130°F test giving a larger pH drop than the 120° or 125°F test.

CONCLUSIONS

As a pass/fail screening for the shelf life stability of new latex products, the oven stability test seems to be a valid method. At this time, however, the data indicates that this is a qualitative rather than a quantitative test.

Oven aging will predict whether there will be significant changes in Stormer viscosity and pH of latex paint samples stored at ambient laboratory conditions. However, tests at 120° to 130°F predict only whether the paint will be stable or will change significantly in viscosity over 18 months at room temperature. The direction or magnitude of the change may vary from that observed in the oven test. In case of Stormer viscosity, paints yielding significant viscosity increases in the oven may either increase or decrease under ambient conditions. In the case of pH, oven aging may exaggerate the amount of pH drop to be expected.

ACKNOWLEDGMENTS

The Committee would like to thank the following companies whose participation made this study possible: DeSoto, Inc.; Enterprise Cos.; General Paint & Chemical Co.; Graham Paint Co.; NL Chemicals; Rohm and Haas Co.; Standard T Chemical; Union Carbide; United Coatings; U.S. Gypsum.

A special thanks to John Greenwald, of DeSoto, for his work in preparing the graphs and tables used in this article.

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Photoacoustic Fourier Transform Infrared Spectroscopy: A New Method For Characterization of Coatings

Marek W. Urban
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A new spectroscopic tool, photoacoustic Fourier transform infrared spectroscopy, can be used to characterize coatings and interfaces. It is a novel technique that allows characterization of surfaces at various depths and provides information on the molecular level. Because of its nondestructive nature, it can be used as a method for early detection of weathering processes, for measurement of the kinetics of UV curing, and for the determination of substrate-coating interactions. Major advantages and applications of this technique are described.

INTRODUCTION

Fourier transform infrared (FT-IR) spectroscopy is regarded as one of the most versatile analytical techniques to be developed over past decades. This is because of the advantages that FT-IR offers over dispersive infrared spectroscopy.[1-5]

Since the very early stages of FT-IR application, the quantitative aspects of infrared spectroscopy have been exploited. Because a computer controls all operations and collected spectra are in a digital form, spectral manipulations such as subtraction, normalization, or integration are the most commonly used techniques to enhance the spectral information. They allow the spectroscopist to perform qualitative and quantitative analysis with a high degree of confidence.

In addition to the fact that a computer controls the performance of the spectrometer and actual data collection, FT-IR spectrometers have also a high energy throughput and sensitivity. Because of these advantages, it was quickly recognized that FT-IR spectroscopy could be used as a unique tool for surface characterization. Several surface sensitive techniques have been developed, among which attenuated total reflectance (ATR), reflection-absorption (RA), and diffuse reflectance (DRIFT) spectroscopy play a key role. These and other surface techniques were developed as a need arose to study specific surface problems. Therefore, each surface technique is not a versatile method and the choice of which technique to use depends on the surface morphology and its optical properties. For example, a poor contact between the sample and the ATR plate limits application of the ATR method to study preferentially soft surfaces such as polymer films or rubber.[6,7] The reflection-absorption method, on the other hand, has been successfully applied to study polymer coatings on highly reflective surfaces of silver, gold, or chromium.[8,9] Powders and fibers can be effectively analyzed using DRIFT technique.[10-12]

Thus, each surface technique has limited applications and, moreover, usually requires sample preparation that can affect the morphology of the surface. The ideal technique would be one which produces an infrared spectrum that retains the characteristics of a transmission spectrum while being subjected to minimal or no sample preparation and which would provide no restrictions on a color or a shape of the surface. The relatively recent application of a 19th century concept, the photoacoustic technique, shows a great potential in overcoming the limitations imposed by other surface FT-IR techniques. Photoacoustic effect was observed for the first time in 1880 by A. Bell[13,14] and, was recently rediscovered by A. Rosencwaig.[15,16] Originally, the photoacoustic effect was ap-

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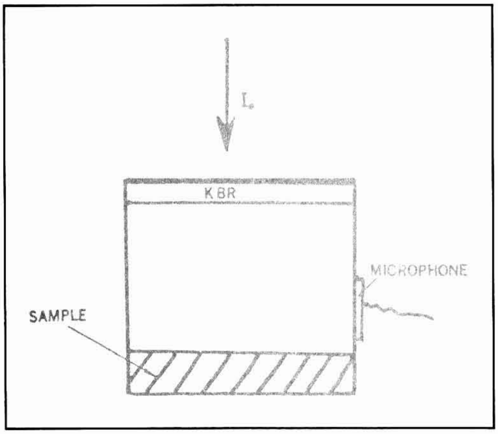

Figure 1—Schematic diagram of the photoacoustic detector

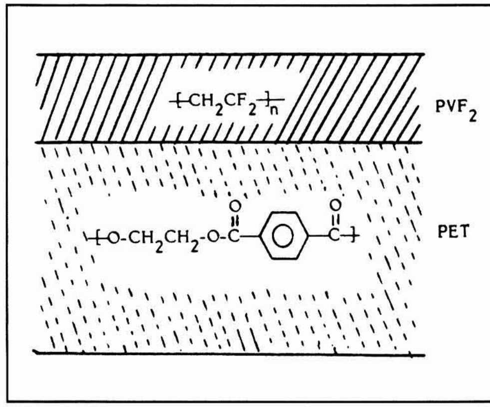

Figure 3—Double layer PVF_2-on-PET films

plied in the ultraviolet and visible region and, soon after, transformed to the infrared region of electromagnetic spectrum.[17,18]

PHOTOACOUSTIC EFFECT IN THE INFRARED REGION

Regardless of the studied region of the electromagnetic spectrum, the principle of the photoacoustic effect remains the same. The photoacoustic effect is produced when intensity-modulated light impinges on a sample placed in an acoustically isolated chamber filled with an inert gas. *Figure* 1 depicts the schematics of the experimental setup. The infrared spectrum is obtained by measuring the heat generated from the sample surface due to absorption processes. When modulated infrared radiation irradiates the surface, the sample absorbs only photons with energy that correspond to allowed vibrational states within the molecular or crystal moiety. A release of the absorbed energy occurs usually in a form of heat generated from the surface. The heat released from the surface causes temperature fluctuations at the sample surface which, in turn, cause a small boundary layer of gas to expand and contract. This gas layer acts as an acoustic piston on the remaining volume of gas which carries the pressure changes to a sensitive microphone. The microphone detects the pressure changes and the generated electrical signal is Fourier transformed and recorded in the form of an infrared spectrum. Gases used in the photoacoustic cell are called coupling gases and must be transparent to infrared radiation as well as chemically inert. Typical gases used in photoacoustic spectroscopy are nitrogen, helium, or argon. Due to its small Brownian motion noise, helium is most commonly used. The influence of highly polarizable inert gases on PA FT-IR spectra will be discussed in the following sections.

As stated above, there are two processes involved in the generation of photoacoustic signal: absorption of light and heat release. This is schematically depicted in *Figure* 2. Thus, the intensity of the photoacoustic signal generated from the surface is a function of optical and thermal properties of the sample. Rosencwaig has classified sam-

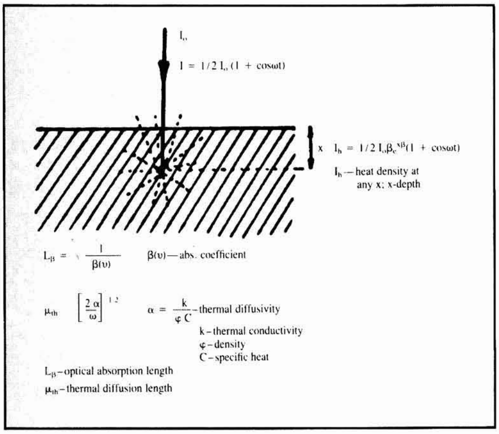

Figure 2—Generation of signal in the photoacoustic effect

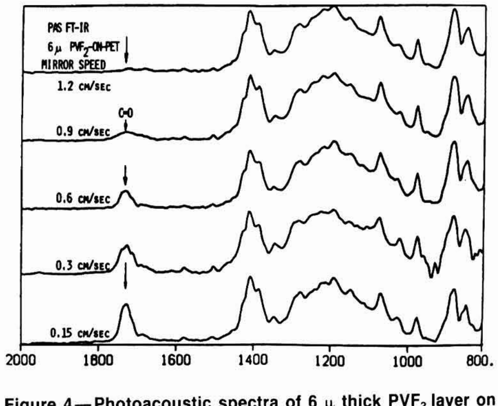

Figure 4—Photoacoustic spectra of 6 μ thick PVF_2 layer on PET obtained with various mirror velocities. [Reproduced by permission from reference (20)]

ples as optically transparent or opaque, and thermally thin or thick (good or poor heat conductors), depending on the relationship between the absorption coefficient and thermal diffusion length.[19] Hence, photoacoustics in general can be considered not only as a spectroscopic method; it is a calorimetric method to measure how much of the electromagnetic radiation absorbed by a sample is converted to heat. Therefore, it can be used to measure an absorption spectrum on one hand, and the thermal properties of the surface on the other. With these spectroscopic and nonspectroscopic capabilities, photoacoustics should find many important applications in the coatings industry.

SURFACE DEPTH PROFILING STUDIES

The classification of materials as optically opaque or transparent and thermally thick or thin as given by Rosencwaig has very important implications.[19] Here, we give only a short outline of the Rosencwaig–Gersho results which are summarized in *Table* 1. As shown in *Table* 1, the magnitude of the photoacoustic signal generated from the surface depends on the modulation frequency of the incident light. For thermally thick and optically transparent materials, this relationship is given by equation (1):

$$PA \propto \omega^{-3/2} \qquad (1)$$

where: PA — photoacoustic signal;
ω — modulation frequency.

According to the theory, a heat that is able to reach the surface is generated within the first thermal diffusion length from the surface and is related to the thermal properties of studied material as well as the modulation frequency. Thermal diffusion length, μ_{th}, is related to modulation frequency, ω, through the following equation:

$$\mu_{th} = [2^{\alpha}/\omega]^{1/2} \qquad (2)$$

where: μ_{th} — thermal diffusion length;
α — thermal diffusivity;
$\alpha = k/\rho C$ (k—thermal conductivity;
ρ — density;
C — specific heat).

According to equation (2), a decrease in modulation frequency causes an increase of the thermal diffusion length and, therefore, the photoacoustic signal that reaches the surface comes from greater depths. This is the basis for surface depth profiling studies. Thus, infrared spectra at various depths can be obtained. In modern FT-IR instruments, the modulation frequency can be easily adjusted by changing the mirror speed of the interferometer.

Urban, et al.[20] have studied a double layer film of PVF_2-on-PET, such as that shown in *Figure* 3. The bottom film, PET, has a characteristic band at 1738 cm^{-1} which is due to the C=O vibration. By monitoring the intensity of this band as a function of mirror velocity, one should be able to determine the penetration depth of infrared light into the surface. *Figure* 4 shows a series of the PA FT-IR spectra obtained with various mirror velocities. It is seen that, as the mirror speed decreases, the intensity of the carbonyl band increases. Thus, the slower mirror velocity (lower modulation frequency) leads to a deeper penetration depth of light into the surface. According to the theory for optically transparent and thermally thick films, such as PVF_2 and PET films, a log-log plot of the integrated intensity of the carbonyl band as a function of modulation frequency (which is proportional to the mirror velocity of Michelson interferometer, V; ($\omega = 4\pi V\nu$) leads to a slope of $-3/2$ (see *Table* 1). *Figure* 5 depicts this relationship and obtained slopes for 6 and 9 μ thick PVF_2 layers on PET are in agreement with the theory. Thus, this model system can be translated to more practical applications, in particular, to study inter-

Table 1—Dependence of Modulation Frequency on Magnitude of the Photoacoustic Signal

	Thermally Thick	Thermally Thin
Sample optically transparent	1. $\mu_{th}>b$, $\mu_{th}<L_\beta$, $PA \propto \omega^{-1}$	1. $\mu_{th}>>b$, $\mu_{th}>L_\beta$, $PA \propto \omega^{-1}$
	2. $\mu_{th}<b$, $\mu_{th}<<L_\beta$, $PA \propto \omega^{-3/2}$	2. $\mu_{th}>b$, $\mu_{th}<L_\beta$, $PA \propto \omega^{-1}$
Sample optically opaque	1. $\mu_{th}<b$, $\mu_{th}>L_\beta$, $PA \propto \omega^{-1}$	1. $\mu_{th}>>b$, $\mu_{th}>>L_\beta$, $PA \propto \omega^{-1}$
	2. $\mu_{th}<<b$, $\mu_{th}<L_\beta$, $PA \propto \omega^{-3/2}$	

where: ω = modulation rate (Hz), β = optical absorption coefficient of the sample (cm^{-1}), $L_\beta = 1/\beta$ = optical absorption length of the sample, b = sample thickness, μ_{th} = thermal diffusion length.

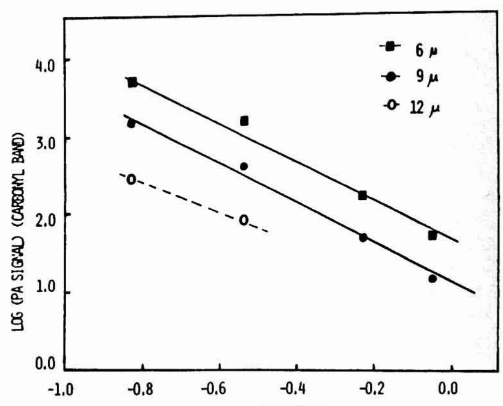

Figure 5—Log-log plot of integrated intensity of the carbonyl band as a function of the mirror velocity: A = 6 μ PVF_2 film; B = 9 μ PVF_2 film; C = 12 μ PVF_2 film. [Reproduced by permission from reference (20)]

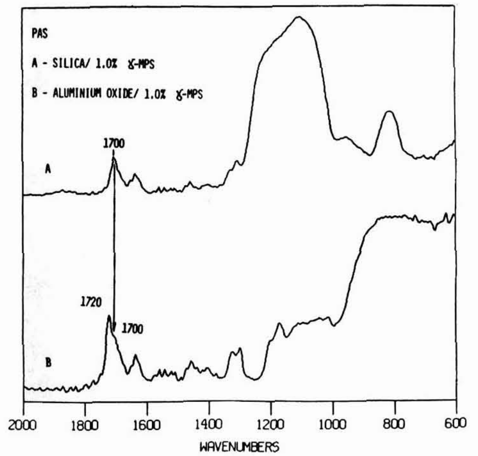

Figure 6—PA FT-IR spectra of silica and alumina treated with 1% γ-MPS solution. [Reproduced by permission from reference (21)]

faces between coatings and substrates. In addition, it may allow one to determine thermal and optical properties as well as the thickness of coatings.

COATING-SUBSTRATE INTERFACE

The structure, environmental stability, and composition of coatings are intimately related to the properties of many materials in their end uses. The surface treatment is particularly important to improve hydrothermal resistance of interfaces in composite materials. To improve this resistance and to increase the bonding between glass fibers and a polymer matrix, the fibers are treated with coupling agents, usually oligomers.

Unlike monomeric species adsorbed on the surface, trifunctional oligomers such as γ-methacryloxypropyltriethoxysilane (γ-MPS), may form multilayers that interact with each other, as well as with the substrate.[21] *Figure* 6 shows PA FT-IR spectra of SiO_2 and γ-Al_2O_3 treated with hydrolyzed γ-MPS solution. Although both spectra show similar features due to the coupling agent, the relative intensities of the carbonyl bands are different. Each spectrum shows two carbonyl bands: the band at 1700 cm^{-1} is due to the hydrogen-bonded carbonyl groups, whereas the 1720 cm^{-1} band is due to free C = O (nonbonded) species. It is apparent that the relative intensities of these bands are different. The 1720 cm^{-1} band is stronger when γ-MPS is deposited on γ-Al_2O_3. The same band, however, becomes weaker when γ-MPS is deposited on SiO_2. The opposite behavior shows the band at 1700 cm^{-1} (hydrogen-bonded carbonyls). This observation is consistent with the fact that the alumina surface has less hydroxyl groups present on the surface. The above example clearly demonstrates that PA FT-IR spectroscopy can be applied to monitor bonding between coatings and metal oxide surfaces. Moreover, it can be used to quantitatively determine surface functionality and reactivity. A quantitative analysis of both bands as a function of γ-MPS concentration on γ-Al_2O_3 surface is shown in *Figure* 7. In the 0-1% concentration range, the hydrogen-bonded carbonyl band at 1700 cm^{-1} increases rapidly, whereas the free C = O intensity at 1720 cm^{-1} is very low. Above 1% concentration, the former flattens and the latter increases. This behavior indicates that at 1% γ-MPS concentration, all surface hydroxyl groups have reacted with the coupling agent and the excess forms nonhydrogen bonded γ-MPS surface layers. Thus, using PA FT-IR spectroscopy, it is possible to detect and quantitatively analyze bonding between the substrate moiety and the oligomer, in this case, the γ-MPS coupling agent and γ-Al_2O_3.

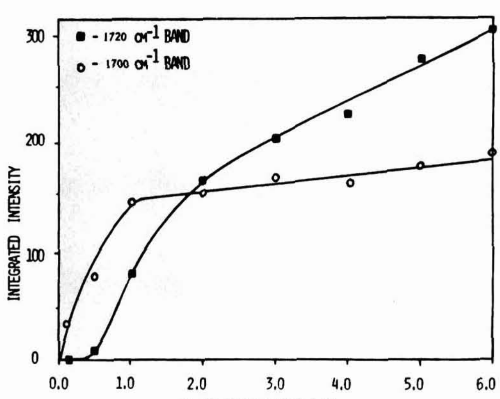

Figure 7—Integrated intensity of the carbonyl band as a function of the γ-MPS coupling agent. [Reproduced by permission from reference (21)]

ORIENTATION OF THE SURFACE SPECIES

Recently, another useful application of PA FT-IR spectroscopy to predict the orientation of surface species was found. As stated earlier, the photoacoustic experiment requires a coupling gas that transmits the heat generated from the surface to a microphone. Urban and Koenig[22] have shown that by using highly polarizable inert gas in the photoacoustic cell, such as xenon, and comparing the spectra with a nonpolarizable helium, it is possible to determine orientation of the surface species. *Figure* 8 illustrates a distortion of the electron cloud responsible for the dipole moment changes of the surface species upon interaction with the inert gases. A highly polarizable gas, xenon, enhances those surface modes which are preferentially oriented parallel to the surface and suppresses the intensity of the perpendicular modes. This method was successfully applied to study orientation of the surface functional groups on SiO_2, Kevlar® and PBT fibers.[22-24] Using the above approach the orientation of the silanes as a function of the surface coverage on silica was established.[25] This is schematically shown in *Figure* 9. With the increasing surface coverage, the oligomers are preferentially perpendicular to the surface and further concentration increase leads to multilayer structure that favors parallel orientation.

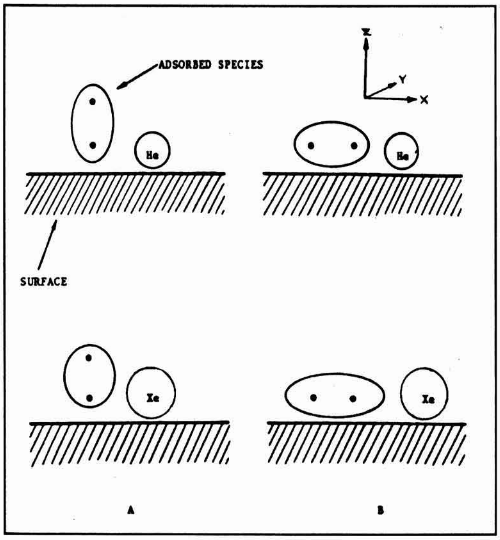

Figure 8—Model enhancement of the surface modes with the use of inert gases. [Reproduced by permission from reference (22)]

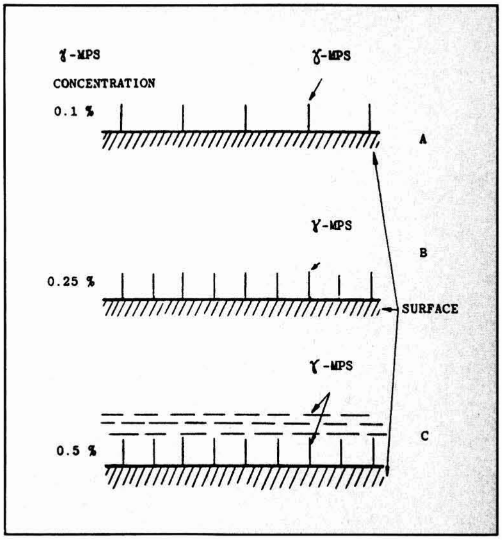

Figure 9—Orientation of the γ-MPS coupling agent on the silica with the increasing γ-MPS surface coverage. [Reproduced by permission from reference (25)]

POTENTIAL OF PA FT-IR SPECTROSCOPY

PA FT-IR can be applied to study the surface protection of polymeric materials, wood, paper, fibers, and composite materials. The versatility of this technique in answering a broad spectrum of questions such as coating composition at various depths, surface functionality of substrates, and coating-substrate bonding mechanisms is still in an initial stage. This is because no more than a few years ago the technique was in development stage. Relatively low signal-to-noise ratio made application of this technique rather impractical. Today, with additional improvements, we are in a position that photoacoustic infrared spectrum can be obtained in a few minutes. Thus, PA FT-IR creates great opportunity for coatings industry to answer a number of important questions and offers advantages summarized below:

(1) The studied sample is in its native state (no sample preparation).

(2) It allows the performance of surface depth profiling studies.

(3) It is possible to monitor the orientation of the surface.

(4) It has relatively good sensitivity (few monolayers coverage).

With these advantages, it can be applied to *in-situ* studies of weathering and degradation processes of coatings, corrosion, kinetics of UV cured coatings, and as an early detection method in detrimental effects of sunlight. Until the development of photoacoustic spectroscopy, many natural or synthetic materials could not be studied by conventional spectroscopic techniques. Usually these materials occur in the form of gels, oils, suspensions or fibers, textiles, or paints, coatings, and so on. With photoacoustic spectroscopy, optical absorption spectra of virtually any material can be obtained. Although the formative stages of photoacoustics have passed, its potential both as a research and as an analytical tool appears unexplored. This is particularly true in the field of coatings where there is a need for such a technique.

An intent of this article was to outline the applicability of photoacoustic FT-IR spectroscopy to the study of coated surfaces. Although this technique has not been fully exploited, its potential in the coatings field is extremely promising.

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Fractal-Based Description of the Roughness of Blasted Steel Panels

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National Bureau of Standards*

Shot-, grit-, and sand-blasted Keane-Tator comparator leaves were thermographically imaged and their fractal dimension computed. It was found that imaging a heated roughened surface with a thermographic camera provides a good delineation of the peak-to-valley heights of the structures on the surface and that, in general, the computed fractal dimension increased with an increase in profile depth and an increase in the concentration of the crater-like structures. It was also shown that fractals adequately describe an abraded surface in that the computed fractal dimension can be used as input into a simulation model from which most of the perceptually relevant shape structures on the originally imaged surface can be reconstructed.

INTRODUCTION

Blast cleaning is one of the fastest and most economical means of removing mill scale, rust, old paint, and other material from the surface of new or maintained steel. It is also one of the most critical steps in the application of a coating, in that poor surface preparation is thought to be the primary cause of premature coating system failures.[1-3] Poor surface preparation usually means a rough surface or the presence of contaminants. In this paper, we are only interested in characterizing surface roughness.

Surface roughness is the natural outcome of the abrasive cleaning process, in which crater-like impressions are impacted into the surface of the steel. At present, the effect of surface roughness on the service life of a coating system is not well understood. On the one hand, a rough surface may improve the service life of a coating system by increasing the surface area for adhesion.[4] On the other hand, a rough surface may be detrimental in that it may affect the electrochemical behavior of the surface[5] and make it more difficult to protect the steel from corrosion, since a very rough surface requires special care to insure that the peaks of the abraded surface are covered by an adequate coating thickness.[6] To isolate the effect of surface roughness on service life, the roughness must be quantified. At present, quantitative measures of surface roughness are seldom made, since roughness is difficult to define and measurements, which intuitively constitute surface roughness, are difficult and time consuming to make. The objective of the present paper, therefore, is to present a procedure, based on thermographic imaging and fractal analysis techniques, for measuring and quantifying the perceived roughness of a remotely imaged blasted steel surface.

SURFACE ROUGHNESS CHARACTERIZATION

The roughness of a surface can be characterized either by depth mapping or by a visual perception measure. In depth mapping, physical measurements of the peak-to-valley heights are made at various locations on a roughened surface using a depth micrometer or stylus. These measurements are then summarized using such statistical descriptions as the average or the maximum peak-to-valley height. From these statistics, one can obtain information on the localized patterns and on the profiles of the crater-like structures. The precision and accuracy of these measurements, however, is not always satisfactory.[1]

In a perceptual measure of surface roughness, the three dimensional crater-like structures of an abraded surface are cognitively assessed with respect to their structural regularities and the scale of these regularities. That is, each abrasive type gives a distinct surface texture, the structural regularities, and the depth or scale of these regularities depends on such factors as air pressure, geometric shape of the abrasive particles, and angle of impact. One of the most popular, but qualitative, perceptual measures of roughness is obtained using a profile comparator, e.g., the Keane-Tator profile comparator.* A Keane-Tator comparator contains three

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*Identification is made solely to define an experimental material and not to endorse a particular product.

discs, each comprised of five leaves. Each disc has been abraded with a different abrasive type (sand, grit, or shot) and each leaf has been abraded to a different profile depth, such as, 2.0, 2.5, 3.0, 4.0, and 5.5 mils (50, 65, 75, 100, and 140 μm). A comparator is used for assigning a profile depth to a blasted surface. This assignment is made by first selecting the disc which was abraded with the same abrasive as that used in cleaning the substrate of interest, comparing and selecting the leaf that most closely approximates the roughness of the blasted substrate, and then assigning the depth of this leaf to the substrate. The advantages of using a comparator are that the measurements are fast; they are made without contacting the substrate surface; and the shape structures on a comparator leaf look like those of the blasted surface. The disadvantage of using comparator discs is that the selection of a leaf is subjective, in that it is greatly influenced by the bias of the evaluator.[7] What is needed, therefore, is to eliminate this subjectiveness and replace it with a quantitative measure of surface roughness which succinctly and adequately describes the shape structures on the surface. To adequately describe the surface requires that the perceptual measure can be derived and quantified from the information obtained when a surface is remotely imaged; and once computed, this quantitative measure can be inserted into an appropriate mathematical model from which most of the perceptually relevant shape structures on the originally imaged surface can be reconstructed. This ability to reconstruct structural regularities from an empirically derived parameter is a distinguishing feature of perceptual roughness measures, since depth mapping statistics do not provide sufficient information.[8]

FRACTAL-BASED DESCRIPTIONS

Fractal models are good representations of a wide range of natural images including clouds,[9,10] coastlines,[9] absorbents,[11,12] and textured surfaces.[8] The concept of a fractal dimension was introduced by Mandelbrot[9] who suggested that the structure of a rough surface can be described by adding a fractional quantity to its classical dimension, which in the case of a surface is two. Hence, a smooth surface has a fractal dimension of approximately two while an extremely rough surface has a fractal dimension close to three. A naturally occurring surface is one whose shape has been randomly modified by some local action,[8] in our case, by abrasive particles randomly impacting a steel surface.

For a naturally occurring surface to fit a fractal model,[8,13] it must be self-similar over some scaling range; that is, the new detail, which appears when an abraded surface is magnified, looks like that of the original, unmagnified surface. For this to occur, the ratios of the large to medium and small surface features must remain constant over a range of magnifications; therefore, the measured surface area of a fractal surface is highly dependent on the measurement scale, ϵ, which is used in measuring it. That is, as the measurement scale decreases, the surface area increases, since smaller and smaller features are included in the measurement. For a fractal surface, Mandelbrot[9] expressed this dependency of surface area on measurement scale by

$$A(\epsilon) = F\epsilon^{2-D} \qquad (1)$$

where

$A(\epsilon)$ is the measured surface area for measurement scale ϵ

F is the estimated surface area for a measurement scale of unit length, ϵ = 1 pixel length, and

D is the fractal dimension of the surface and has a value between 2 and 3.

In equation (1), the surface area data, $A(\epsilon)$, at different pixel scales, ϵ, must be determined. This is accomplished by analyzing the digitized visual or thermographic image of a blasted surface using an algorithm such as that presented in Peleg, et al.[13] (A digital image is comprised of a rectangular grid of equally spaced picture elements (pixels). Each pixel is assigned a greyscale level corresponding to the number of photons detected at that location. Since the pixels are evenly spaced, the distance between two adjoining pixels has length one; thus, the distance between pixels is used as a ruler. The measurement scale, ϵ, therefore, is any combination of unit pixel lengths). In Peleg's algorithm, upper and lower bounding surfaces are computed on the greyscale intensity surface at each pixel scale, ϵ = 1, 2, . . . ,20. From these bounding surfaces, the surface area, $A(\epsilon)$, at each pixel scale, ϵ, is determined. Knowing $A(\epsilon)$ for all ϵ, the fractal dimension, D, is estimated by plotting the common logarithm of the surface area, $\log(A(\epsilon))$, against the common logarithm of the measurement scale, $\log(\epsilon)$. From equation (1), the slope of this line is 2-D.

EXPERIMENTAL

The Keane-Tator profile comparator discs were selected for computing fractal dimensions for four reasons: they are commercially available; they have been abraded with the three major abrasive types (sand, grit, and shot);* each disc provides a gradation of surface roughness; and the comparator discs are manufactured within strict tolerances. The Keane-Tator comparators, therefore, can be used for determining the effect of changes in the type of abrasive and the profile depth on fractal dimension.

The comparator leaves were imaged using both a video and a thermographic camera. The video camera imaged light reflections from the surface of the substrate. In our experiments, we varied the position of the light source relative to the surface between 0 and 90°. Thermographic images were produced by uniformly heating the back of a comparator leaf to temperatures ranging from 10 to 30°C above ambient, then imaging the surface with an AGA 780† thermographic camera which was outfitted with a 20° field of view and measures radiation in the 1-5 μm infrared spectral region. The resolution of the thermographic camera is 230 by 140 pixels. For this study, the imaged surface area was 8.5 mm × 8.5 mm (.34 in. × .34 in.), and the distance between pixels is .11 mm (.0042 in.) in the x-direction and .18 mm (.0071 in.) in the y-direction.

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*The original comparator leaves were blasted with the three abrasive types. The commercially available comparator discs are electro-formed copies of the master.

†Identification is made solely to define an experimental material and not to endorse a particular product.

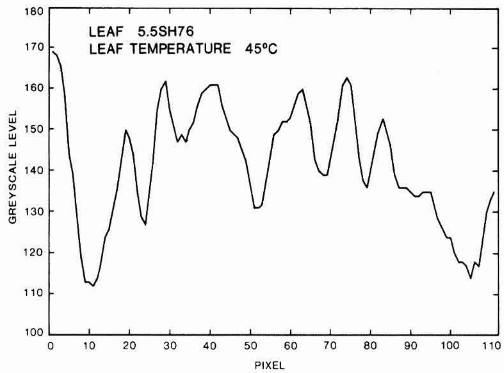

Figure 1—Greyscale level vs pixel number along one row of a thermographic image of the 5.5 mil shot-blasted comparator leaf heated to 45°C

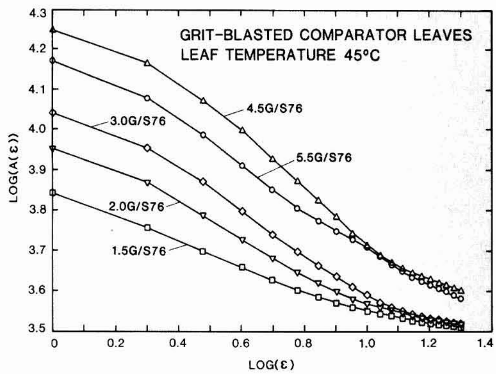

Figure 3—Logarithm of surface area vs logarithm pixel scale for the grit-blasted comparator leaves heated to 45°C

The number of photons detected at each pixel location on a thermographic image is greatly influenced by noise fluctuations in the random photon emissions from the heated surface. To reduce this noise, eight consecutive thermographic images were averaged. Processing of the thermographic images and fractal dimension computations were performed on a computer image processing system developed at our laboratory.[14,15]

Besides determining the fractal dimension of each of the comparator leaves, experiments were conducted to determine the sensitivity of the calculated fractal dimension to changes in temperature and viewing angle. These effects were determined by heating the same leaf to different temperatures (31, 35, 40, 45, and 50°C) and by changing the viewing angle of the camera (70, 80, and 90°), where 90° is the angle normal to the surface.

RESULTS AND DISCUSSION

Experimentally, thermographic imaging of a blasted surface was easier than visual imaging. In visual imaging, it was difficult to distinguish between surface discolorations and shadows cast on the abraded surface as a result of the position of the light source. It was also difficult to obtain a good delineation between the peaks and valleys of the crater-like surface, since the greyscale level of the peaks was only slightly higher than that of the valleys. A good delineation is necessary for computing the fractal dimension of a surface. These problems were not encountered in thermographic imaging; instead the major experimental problems were maintaining a uniform panel temperature and keeping the panel in intimate contact with the heating pad. These problems were overcome by clamping each comparator disc to a uniformly heating electrical resistance pad. The requirement of a uniform heat source may hinder the transfer of this technology to the field. Due to the experimental problems associated with visual imaging, only the results from thermographic imaging are presented.

In thermographic imaging, a panel is uniformly heated from the backside, producing a thermal gradient through its thickness. If the panel is homogeneous, then the temperature in the valley of a crater-like structure is slightly higher than the temperature of its peak, since a valley is

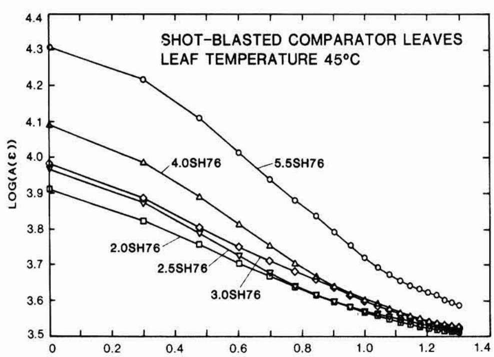

Figure 2—Logarithm of surface area vs logarithm pixel scale for the shot-blasted comparator leaves heated to 45°C

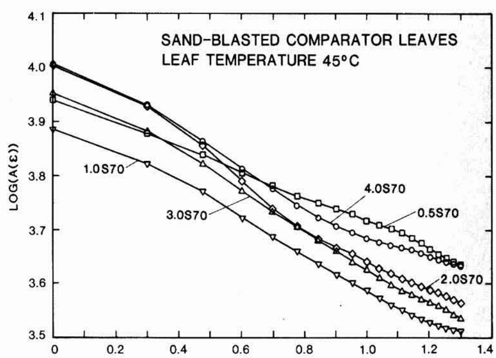

Figure 4—Logarithm of surface area vs logarithm pixel scale for the sand-blasted comparator leaves heated to 45°C

Table 1—Computed Fractal Dimension and Surface Areas for Each of the Keane-Tator Comparator Leaves. (The Temperature at Which the Computations Were Made Was 45°C)

Leaf Ident-ification	Start Pixel Scale	End Pixel Scale	Corr. Coef. r	Frac. Dim. D	Surface Area, A(ϵ), at Measurement Scale ϵ A(1)	A(2)	A(3)
1. Shot-blasted leaves							
2.0SH76[a]	2	5	.999	2.39	8800	6720	4700
2.5SH76	2	7	.999	2.48	10450	7490	4830
3.0SH76	2	5	.999	2.44	10530	7760	5190
4.0SH76	2	7	.999	2.58	14740	9860	5800
5.5SH76	2	5	.999	2.69	27100	16800	8930
2. Grit-blasted leaves							
1.5G/S76	2	6	.999	2.32	7160	5740	4278
2.0G/S76	2	10	.998	2.43	9830	7300	4920
3.0G/S76	2	6	.999	2.54	13240	9110	5550
4.5G/S76	2	6	.997	2.61	22860	15000	8560
5.5G/S76	2	6	.999	2.57	18020	12140	7200
3. Sand-blasted leaves							
0.5S70	2	6	.999	2.24	8980	7600	6100
1.0S70	2	5	.996	2.33	8460	6730	4980
2.0S70	2	6	.998	2.47	11830	8540	5550
3.0S70	2	5	.999	2.37	9940	7690	5480
4.0S70	2	7	.999	2.38	11120	8550	6030

(a) First number in comparator leaf code is the profile depth. The letter designation following this number indicates the abrasive type.

closer to the back of the panel. (The emissions may also be higher in a valley; especially if a valley acts as a cavity radiator.) Since the temperature and perhaps the emissions from the valleys are slightly higher than the peaks, the valleys emit more radiation. These surface emissions are detected by the thermographic camera, which transforms them into a greyscale intensity image. This image is composed of a matrix of pixels, each of which can be mapped onto a corresponding geometric location on the roughened surface. The greyscale value (between 0 and 255) assigned to each pixel depends on the intensity of the photon emissions from the corresponding location on the abraded surface. Since the valleys emit more radiation than the peaks, the valleys are assigned a higher greyscale value. This is shown in *Figure* 1 for one row of pixels of a thermographically imaged shot-blasted surface. In this figure, the high greyscale values correspond to valleys whereas the low values correspond to peaks. (We are currently conducting research to transform this greyscale intensity surface into its equivalent geometrical surface).

Using the algorithm of Peleg, et al.[13] and the greyscale intensity surfaces, the logarithm of the surface area, log(A(ϵ)), vs the logarithm pixel scale, log(ϵ), diagrams were determined for each of the shot-, grit-, and sand-blasted leaves. Peleg's algorithm proved to be computationally fast, in that the collection and analysis of the data for one image was completed in a matter of seconds. From *Figures* 2-4, the log(A(ϵ)) vs log(ϵ) plots are shaped like elongated S's; that is, the slope at each end is less than the slope in the middle. This elongated S-shape seems to be typical for a wide variety of surfaces.[16-18] At the low pixel scales, the slight change in slope may be due to noise in the infrared images or to a real change in the fractal dimension of the surface at low pixel scales. At the highest pixel scales, the change in slope is presumably the result of having reached a critical pixel scale beyond which no change in the computed surface area occurs. Since the abraded surfaces are fractal over the middle measurement scales, the center linear portion of these plots is the region in which the fractal dimension, D, is calculated. A procedure was needed, therefore, for selecting starting and stopping pixel scales. Since no standardized procedure could be found; we devised the procedure described in the *Appendix*. Once the end points were selected, the remaining data were analyzed using equation (1) and standard linear regression techniques (see *Table* 1). The correlation coefficient in *Table* 1 gives an indication of the linearity of this regression line. In general, the imaged surfaces were found to be fractal over a scale of 0.2 to 0.6 mm. All of the computed surface areas in *Table* 1 are reported in relative area units, because there is no easy way of experimentally verifying our computed surface areas.

Effect of Abrasive Type and Depth on Fractal Dimension

The fractal dimensions and computed surface areas (*Table* 1) are greatest for the shot-blasted leaves (D between 2.39 and 2.69) and least for the sand-blasted leaves (D between 2.24 and 2.47). For the shot- and grit-blasted leaves, the fractal dimensions and the computed surface areas tend to increase with increasing profile depth, except for the 4.5 mil (4.5G/S76) and the 5.5 mil (5.5G/S76) grit-blasted leaves, for which a reversal in the ordering is observed. This reversal is interesting in that it indicates what factors influence the fractal dimension computation. For the 5.5 mil leaf, the crater-like structures are deeper, but the concentration per unit area of these structures is lower than for the 4.5 mil leaf, implying that both the depth and the concentration of crater-like structures contribute to the fractal dimension computation.

For the sand-blasted leaves, the ordering is not as definitive as it is for the shot- and grit-blasted leaves. This is especially true for the 2 mil sand-blasted leaf (2.0S70). Unlike the grit- and shot-blasted leaves, the crater-like structures on the sand-blasted leaves are small and shallow, while their concentration is very high, giving an almost smooth texture to the sand-blasted leaves.

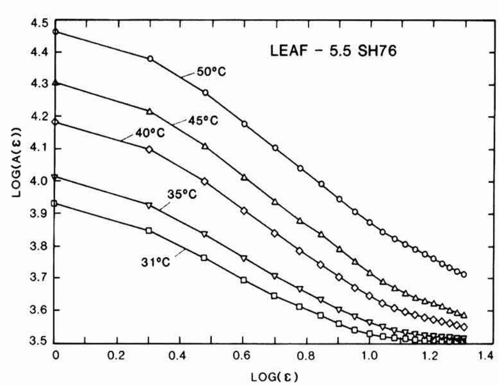

Figure 5—Logarithm of surface area vs logarithm pixel scale for the 5.5 mil shot-blasted leaf heated at different temperatures

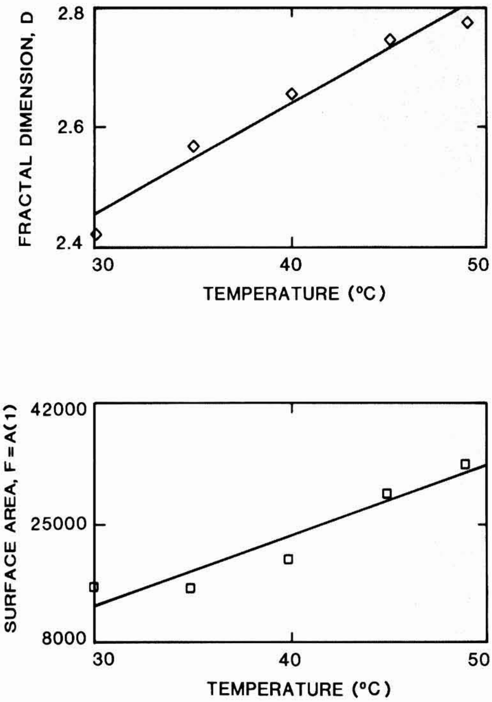

Figure 6—Effect of leaf temperature on (a) fractal dimension and (b) surface area at pixel scale 1 for specimen 5.5SH76

This smooth texture explains the low fractal dimensions of the sand-blasted leaves. It does not explain, however, the high fractal dimension and surface area of the 2.0 mil leaf. This may be due to the atypical shape of the log(A(ε)) vs log(ε) plot for this leaf (*Figure* 4), in that the upper part of the S-shaped plot covers a greater range of pixel scales than the other sand-blasted leaves. When the pixel scale range procedure outlined in the *Appendix* is used, the second and sixth pixel scales were identified as the starting and stopping points. A better selection for this leaf might have been the eighth and the twentieth pixel scales, since the plot is more linear over this range. The fractal dimension for this new pixel scale range is 2.26 and the computed area for the unit measurement scale is 7860.

Effect of Temperature on Fractal Dimension

The effect of temperature on the fractal dimension and surface area is shown in *Figure* 5. As the temperature is increased, the number of photons emitted per unit surface area in a given period of time increases. As a result, the thermographic camera detects finer structures on the abraded surface, which make the thermographic image appear rougher. With an increase in roughness, both the fractal dimension and the surface area increase. For the experimental temperature range used in this experiment, the increase in fractal dimension and surface area appears

Table 2—Effect of Viewing Angle on the Fractal Dimension and Surface Area Computations for the 5.5 mil Shot-Blasted Leaf Heated to 45°C

Viewing Angle	Start Pixel Scale	Stop Pixel Scale	Fractal Dimension D	Surface Area at Unit Meas. Scale A(1)
70°	2	9	2.66	23580
80°	2	6	2.73	28680
90°	2	7	2.75	32350

to be linear with temperature (*Figures* 6a and 6b). In actuality, the total number of photons emitted from a non-black body varies with the third power of the absolute temperature.

Effect of Viewing Angle on Fractal Dimension

The effect of a change in viewing angle on the fractal dimension and surface area is shown in *Figure* 7 and *Table* 2. With the limited number of data points, it appears that both D and F decrease with a decrease in the viewing angle from 90° to 70°.

Computer Rendering of a Blasted Surface

A fractal description of a blasted surface is both quantitative and succinct, but the real test of its usefulness is whether the computed fractal dimension can be used in generating a simulated surface having most of the relevant structural features of the original surface. To test this, three fractal surfaces (D = 2.2, 2.5, and 2.8) were generated on a computer (*Figure* 8) using the stochastic triangular-subdivision model published by Fournier, et al.[19] A photograph of the leaf having a fractal dimension closest to each computer generated surface is positioned next to the generated surface. They are the 5 mil shot-blasted leaf (D = 2.69), the 2.5 mil shot-blasted leaf (D = 2.48), and the .5 mil sand-blasted leaf (D = 2.24).

The only input into the simulation model were the fractal dimension, a scaling factor, and the number of subdivisions. The scaling factor (we used 2.0) regulates

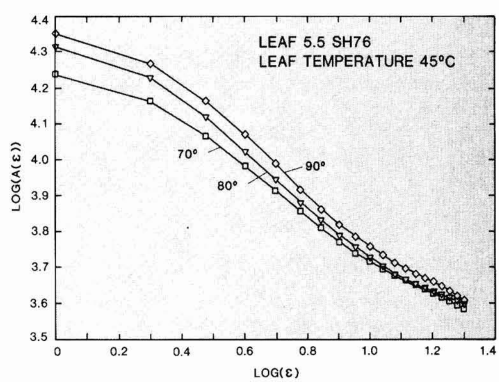

Figure 7—Logarithm surface area vs logarithm of pixel scale for the 5.5 mil shot-blasted leaf heated at 45°C and viewed at three viewing angles

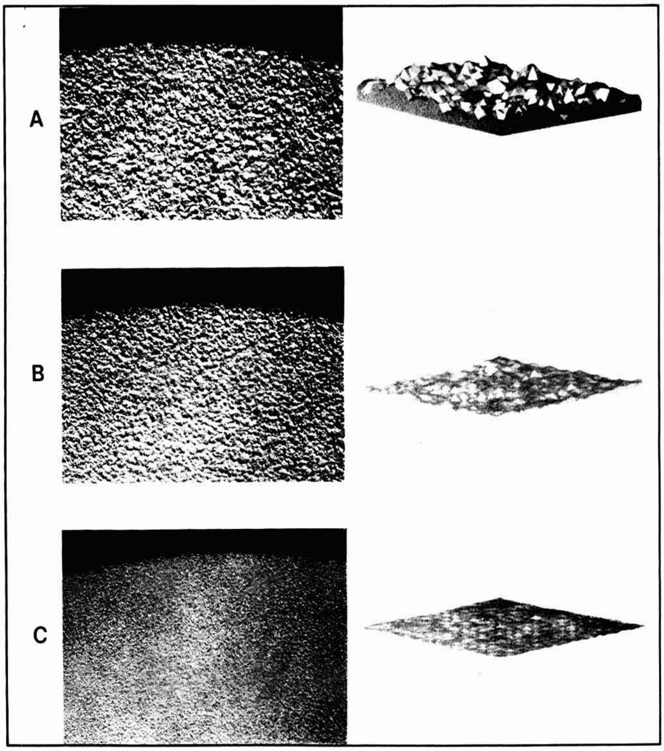

Figure 8—Leaf photographs and computer generated surfaces of increasing fractal dimension: a) photograph D = 2.69, computer D = 2.80; b) photograph D = 2.48, computer D = 2.50, and; c) photograph D = 2.24, computer D = 2.20

the amplitude of the computer generated surface features; it does not correspond to the F-value in equation (1). The number of subdivisions controls the fineness of the generated surfaces and also the amount of computer time needed to generate the surface (computer rendering of the surfaces in *Figure* 8 took 3 h of computer time on a Vax Model 11/750 computer). As the number of subdivisions increase, the surface appears finer. Five subdivisions yield an image consisting of a 33 × 33 matrix of pyramidal structures with triangular facets. As can be seen from *Figure* 8, five subdivisions are not adequate to obscure the triangular building blocks used in constructing the surface.

In general, the authors felt that the computer generated surfaces compare quite favorably in roughness to the perceived roughness of the actual blasted surfaces, in so far as the perceived roughness decreases with decreasing fractal dimension and the roughness of the computer generated surface corresponds to its paired photographed surface.

SUMMARY AND CONCLUSIONS

Poor surface preparation is thought to be the primary cause of premature coating system failures. One of the factors associated with poor surface preparation is the roughness of a substrate. The effect of surface roughness on the service life of a coating system is not well understood, since, historically, surface roughness has been difficult to measure and quantify. In this paper, a computationally fast procedure is presented, based on fractal analysis techniques, for remotely measuring and quantifying the perceived roughness of thermographically imaged, blasted steel panels.

Shot-, grit-, and sand-blasted Keane-Tator comparator leaves were thermographically imaged. Keane-Tator comparator leaves were selected because they are abraded with the three most commonly used blasting materials and they are abraded to different profile depths. The leaves were thermographically imaged, because thermographic imaging is an easy experiment to perform and thermographic images provide a good delineation between the peak-and-valley heights, which is necessary for the fractal dimension computation.

The fractal dimension of each leaf was computed from the thermographic greyscale intensity surface. (For the Keane-Tator comparator discs, the fractal dimensions ranged between 2.2 and 2.7.) In general, the fractal dimension of a surface increases with increasing profile depth and concentration of the crater-like structures. Finally, it is shown that fractals are a good representation of an abraded surface; that is, the fractal dimension can be used as input into a simulation model from which most of the perceptually relevant shape structures on the originally imaged surface can be reconstructed.

ACKNOWLEDGMENTS

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APPENDIX A:
Selection of the Pixel Scale Range For Fractal Dimension Computation

To determine the fractal dimension of a comparator leaf, it is necessary to decide the pixel scale range over which a leaf exhibits fractal behavior. In looking at the S-shaped curves in *Figures* 2-4, this range corresponds to the middle linear portion of each curve. Since no standardized procedure was found, the following strategy was adopted.

The lower value of the pixel scale range was selected to be 2 by observing the sharp bend in the area curves at this value. This visual observation was used due to the limited amount of information available at this end of the curve. To determine the upper extent of the pixel range, the signature of the leaf in question was computed,[12] where the signature is defined as the fractal dimension of every sequence of three pixels (e.g., (1,2,3), (2,3,4), etc.). Thus, in a sense, the signature is the first derivative of the log(A(ϵ)) vs log(ϵ) plot. As can be seen in *Figure* A-1, the signature typically increases to some maximum value and then decreases, approaching a value of 2 at large pixel scales. A leaf is fractal, therefore, over the range through which the signature is relatively constant. To determine the upper extent of this range, the derivative of this signature was computed once again using every three points in sequence (see *Figure* A-1) and the upper pixel scale value was selected as the first minimum to occur in this curve. Thus, for leaf 3.0G/S76, this minimum occurs at the sixth pixel so that the fractal dimension is calculated for the pixel range of 2-6. The pixel scale ranges for all fifteen leaves are tabulated in *Table* 1.

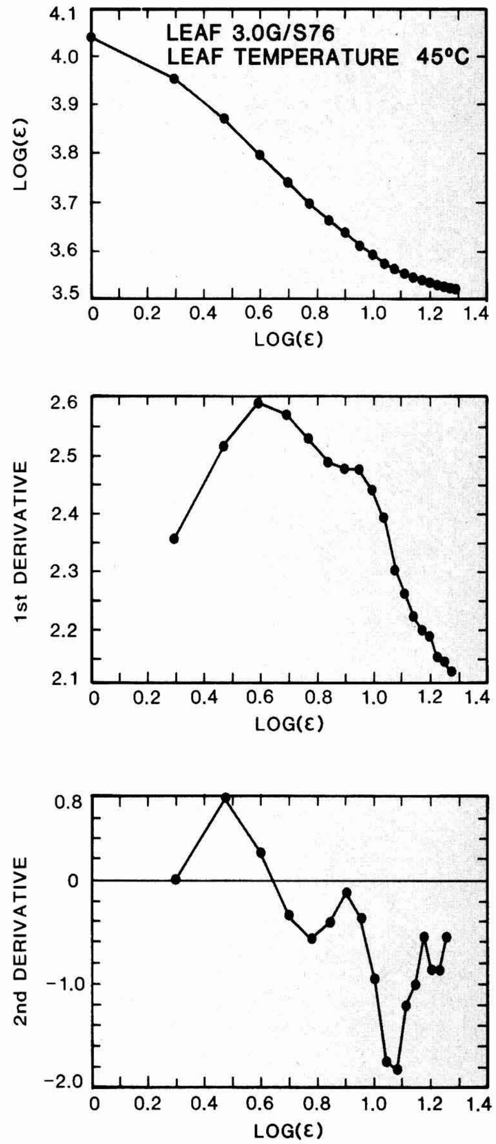

Figure A-1—Curves used for selection of starting and stopping pixel scales: (a) logarithm surface area vs logarithm pixel scale plot for the 3.0 mil grit-blasted leaf heated to 45°C; (b) first derivative plotted against log(ϵ); and (c) second derivative plotted against log(ϵ)

Behavior of Pigments in Underwater Anticorrosive Paints with Cathodic Protection

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Protective coatings are used mostly in conjunction with cathodic protection for the preservation of ship hulls against corrosion. The coating plays a significant role in deciding the cost of protection. This paper describes work related to the behavior of pigments in coatings under cathodic protection. Formulations prepared using individual pigments in a chlorinated rubber resin were examined.

Aluminum, zinc chromate, and zinc phosphate-based coatings required low current densities for maintaining a potential of −850 mV(SCE). Adhesion of these coatings to the steel was good and did not exhibit any blistering during the test period. The aluminum pigment, along with extender pigment, demonstrated unsatisfactory behavior. Red lead, barium chromate, and basic lead silico chromate did not behave satisfactorily and required higher protective current densities.

INTRODUCTION

Corrosion protection of ship hulls and other structures in seawater is achieved by a combination of an anticorrosive paint system and cathodic protection. Protective current demand, i.e., economics of cathodic protection, is closely related to the nature and quality of the coating. Laque[1] has reported that a ship at rest with an intact satisfactory paint system can be protected at a current density of approximately 1 mA/m^2. The current density requirement increases to 30 mA/m^2 depending upon the behavior of the paint system.

It has been established that it is not only the binder materials but also the pigments incorporated in the compositions that control the performance of coatings in seawater. Anderton[2] observed that a vinyl composition with aluminum pigment showed superior performance as compared to a vinyl red lead formulation. The current required to maintain protective potential of steel coated with vinyl aluminum paint system was also much lower than vinyl red lead composition.

This paper reports the behavior of pigments in a chlorinated rubber binder under cathodic protection conditions. Chlorinated rubber-based paints are being widely used, particularly in developing countries, in view of their excellent chemical resistance as well as greater tolerance to surface and climatic conditions. The results will provide guidelines for the selection of pigment(s) for underwater coatings for long-term protection of ship hulls installed with a cathodic protection system.

MATERIALS AND METHODS

Chlorinated rubber anticorrosive paints containing six pigments[3] were used for the present experiments. Important features of these paint compositions are given in *Table* 1, along with their performance in seawater.

Preparation of Test Panels

Test panels (150 × 100 mm) were prepared from cold-rolled sheet steel conforming to type D of Indian Standard specification, IS:513-1963. The panels were cleaned by abrasive blasting using chilled cast iron grits to a surface finish of quality Sa 2½ of Swedish Specification SIS 05.5900. After abrading with zero grade emery paper and

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Table 1—Important Features of Chlorinated Rubber Resin Anticorrosive Paint and Their Performance in Seawater

Pigment	PVC %	Total PVC %	Performance in Seawater Immersion Test[a]	
			Blistering	Corrosion
Aluminum	18	21	10	10
	24	27	10	10
	30	33	10	9
	18	35	8	5
Zinc chromate	10	35	9	10
Basic lead silico chromate	10	35	8	10
Barium chromate	10	35	7	10
Zinc phosphate	20	35	5	6
Red lead	20	35	10	10
Zinc phosphate/ red lead	10+10	35	10	10

(a) Performances of aluminum pigmented compositions in seawater have been shown for a period of eight weeks and other compositions for two weeks. Blistering and corrosion have been quantified on a scale of 10 to 0, where 10 represents completely intact film and 0 indicates 100% blistering or corrosion.

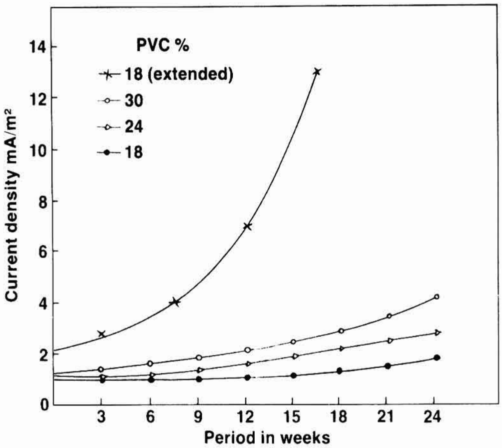

Figure 2—Current requirements of chlorinated rubber compositions incorporating aluminum pigment

degreasing with solvents, a self-adhesive spot 16 mm in diameter was fixed in the center on one side of test coupon. Both sides of the panel were painted by brushing to build up an average dry film thickness of about 100 microns. The adhesive tape was removed after seven days of drying of the coating under laboratory conditions. Exposed bare metal represented the holiday defect in coatings encountered in service. Before panels were immersed in seawater tanks, their edges were sealed with epoxy resin to a depth of 5 mm to eliminate edge effects.

Experimental Set-up

The procedure adopted for the study of paint behavior with cathodic protection was based on the guidelines suggested in a CREO report.[4] The required amount of current was impressed using an inert platinum anode to maintain the painted panel at a potential of −850 mV(SCE). The seawater was changed at weekly intervals. Experiments were carried out at ambient temperature. The schematic experimental set-up is shown in *Figure* 1. The protective current required for test coupons over a 24-week period was recorded.

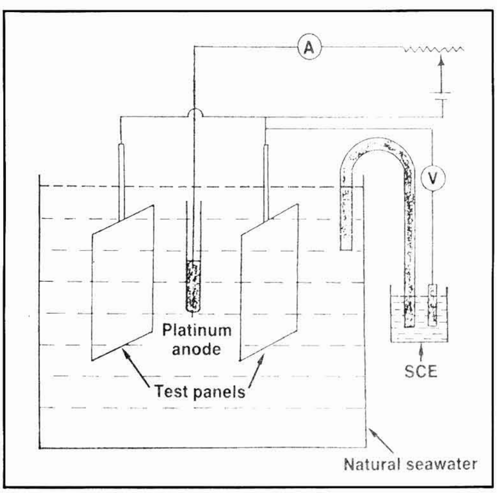

Figure 1—Experimental set-up for cathodic protection

RESULTS AND DISCUSSION

Protective current density-time curves, as well as the behavior of chlorinated rubber-based anticorrosive coatings, are shown in *Figures* 2-6. It is seen from *Figures* 2, 4, and 6 that the protective current requirement of a coating is influenced by the nature of the pigment used in the composition. The compositions pigmented with aluminum (without any extender), zinc chromate, and zinc phosphate show adequate tolerance to the alkaline conditions generated at the coating-substrate interface under cathodic protection. These compositions required current densities varying between 0.3 to 4 mA/m^2 over a period of 24 weeks without any sign of adhesion loss. However, compositions containing aluminum along with an extender pigment, barium chromate, basic lead silico chromate, red lead, and a combination of red lead and zinc phosphate required higher current densities during the same period.

Aluminum Pigmented Compositions

Of the four compositions investigated, three contained aluminum at pigment volume concentration (PVC) of 18, 24, and 30% without any extender pigment. The extended composition was comprised of 18% aluminum and 14% barytes by volume.

Aluminum pigmented compositions without extender were found to maintain excellent adhesion during the test period under cathodic protection. The coatings were also found to be free from blistering. Some discoloration,

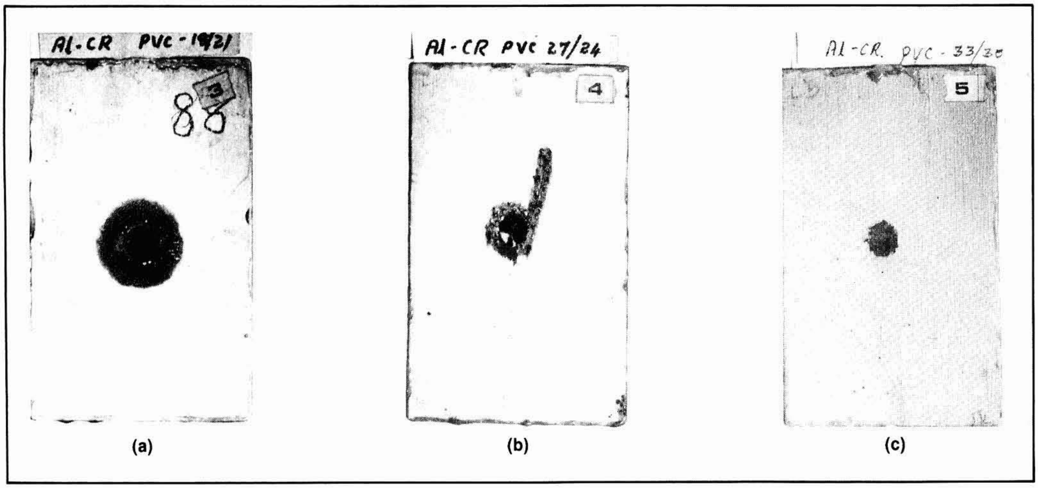

Figure 3 —Test panels with aluminum pigmented compositions, aluminum % PVC (a) 18; (b) 24; and (c) 30, after 24 weeks of immersion

however, was noticed around the holiday. The extent of this discoloration decreased with increase in aluminum pigment concentration (*Figure* 3). Similar discoloration was observed by Anderton[5] with vinyl aluminum primer. He attributed this phenomenon to the transmission of alkali formed at the metal interface towards seawater through the paint film.

Aluminum pigmented compositions showed identical initial current requirement for maintaining a protective potential (−850 mV), which increased with time as well as with pigment volume concentration. The current required for compositions having 18, 24, and 30% PVC of aluminum was 1 mA/m^2 initially and rose to 2, 2.8, and 3.1 mA/m^2, respectively, at the end of 24 weeks (*Figure* 2). The current demand for the composition having 18% PVC was found to be the lowest. The good behavior of an aluminum pigment in anticorrosive paints is probably due to the lamellar shape of the pigment particles which restricts the permeation of corrosion-inducing species, namely water and oxygen, to the substrate.[6,7]

Anderton[8] considers that aluminum pigment acts as an oxygen scavenger. According to him, the alkali formed as a result of the cathodic reaction dissolves the oxide coating of the pigment particles, rendering the exposed metallic aluminum very reactive to diffusing oxygen. This results in reducing the access of oxygen to the substrate and eventually in the production of hydroxyl ions at the metal surface. The hydroxyl ions which are produced are transmitted towards the seawater through the water layer enveloping the pigment particles.

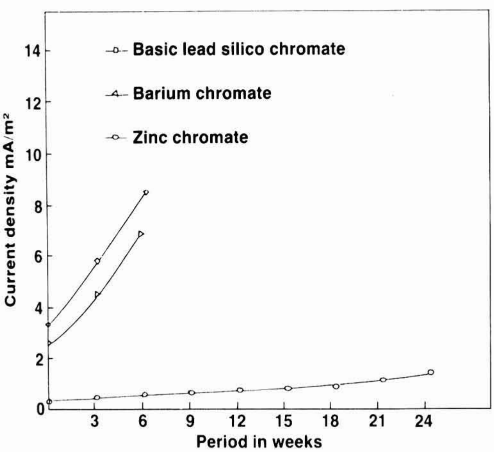

Figure 4—Current requirements of chlorinated rubber composition incorporating chromate pigments

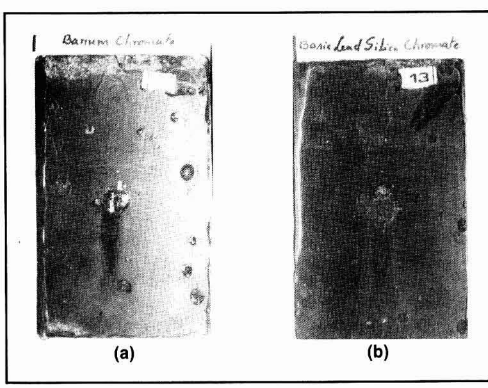

Figure 5—Compositions containing (a) barium chromate; (b) basic lead silico chromate, after six weeks of immersion

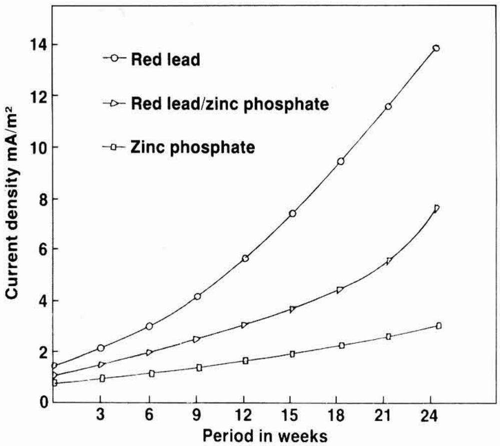

Figure 6—Current requirement of chlorinated rubber composition incorporating red lead and zinc phosphate pigments

The behavior of the aluminum composition containing an extender pigment was found to be far from satisfactory. The current density demand of this composition was observed to be of the order of 2 mA/m^2 initially, increasing steeply to 14 mA/m^2 at the end of 16 weeks. Blistering of the coating commenced a few days after the exposure in seawater. The spherical shape of the extender pigment particles probably disturbs the packing of the lamellar aluminum particles and this results in the inferior performance of the extended aluminum paint.

Chromate Pigmented Compositions

Zinc chromate, barium chromate, and basic lead silico chromate were used at a PVC level of 10% each and extended with barytes and red iron oxide to a total PVC of 35%. The current density curves shown in *Figure* 4 indicate that zinc chromate is a more effective anticorrosive pigment compared to the other two pigments. The composition containing zinc chromate required 0.45 mA/m^2 at the end of 24-week period. There was no loss of adhesion or formation of blisters on panels. However, compositions with barium chromate and basic lead silico chromate behaved poorly, requiring higher currents at the beginning as well as at the end of six weeks of experiments. The specimens painted with these two compositions were withdrawn because of early formation of blisters (*Figure* 5), several of which grew to 6-8 mm diameter size. Blisters ruptured and exposed more bare area. This explained the higher current required at the end of experiments.

The difference in the behavior of these three chromate pigments in chlorinated rubber compositions can be explained on the basis of their solubility in water. The relatively higher solubility of zinc chromate (1.1 gm of CrO_3 per liter in water) ensures more effectiveness in inhibiting anodic reactions, compared to other chromate pigments used in the study.

Red Lead Pigmented Composition

Red lead has been one of the most versatile pigments used in oil-based anticorrosive primers. The first attempt to use this material in underwater formulations dates back to 1944.[9] Chlorinated rubber red lead anticorrosive paint not only showed a steadily increasing current requirement (*Figure* 6), but also showed appreciable blistering (*Figure* 7a). The current demand increased from 1.75 to 14 mA/m^2 in a period of 24 weeks. Red lead pigment helps in the formation of a compact paint film with a low water permeability[10] and shall show good behavior in underwater corrosion protection. It is not, however, clear why the red lead pigmented coating required a higher current density for cathodic protection and at the same time resulted in pronounced blistering.

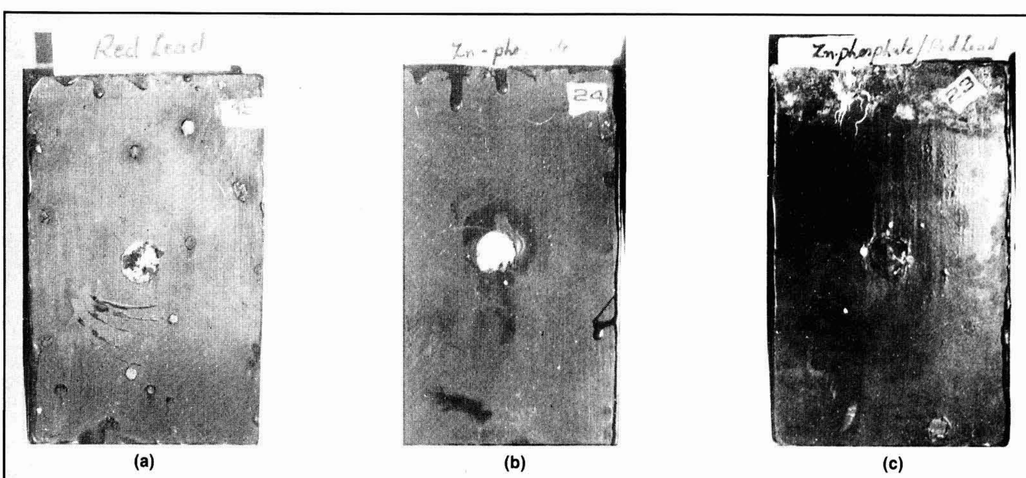

Figure 7—Compositions containing (a) red lead; (b) zinc phosphate; (c) red lead/zinc phosphate, after 24 weeks of immersion

Zinc Phosphate Pigmented Composition

Zinc phosphate is a relatively new anticorrosive pigment of low toxicity, and has been the subject of a number of investigations in recent years. The coating, when subjected to a potential of −850 mV, did not show any blistering or loss of adhesion from the panel (*Figure* 7b). The different behavior of the composition pertaining to blistering observed in seawater immersion test (*Table* 1) and the present study apparently seems to be due to the higher coating thickness. This, however, requires further investigations.

The current demand of the paint composition containing zinc phosphate pigment was much lower than the red lead-based paint (*Figure* 6). According to Clay and Cox,[11] zinc phosphate, by virtue of its slight solubility, acts by polarizing both anodic and cathodic areas. The pigment also appears to pack in the film in a manner that acts as a barrier to water molecules and salts. A combination of electrochemical suppression of corrosion cells along with a moisture barrier effect possibly explains the diminished current requirement for cathodic protection of steel coated with zinc phosphate pigmented paint composition.

Composition containing a mixture of equal parts of red lead and zinc phosphate has shown a behavior intermediate between red lead and zinc phosphate formulations. Its current density requirement was found to be 1.2 mA/m^2 initially, increasing to 7.8 mA/m^2 in a period of 24 weeks (*Figure* 6). The paint film did not show any blistering or loss of adhesion (*Figure* 7c).

CONCLUSIONS

Pigments in anticorrosive paints are found to have a pronounced effect on the performance of coatings, as well as the current requirement for cathodic protection. Aluminum and zinc chromate exhibit exceptionally good behavior in coatings with cathodic protection. Protective current requirement for compositions having these pigments is substantially low. Zinc phosphate pigment also behaves well.

Red lead, barium chromate, and basic lead silico chromate in coatings need very high current densities for maintaining the steel at protective potential. The coatings based on these pigments are also susceptible to blister formation.

ACKNOWLEDGMENT

The authors wish to thank Dr. R. Krishnan, Director, Naval Chemical and Metallurgical Laboratory for his keen interest in the work.

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Coatings Progress in the Mid 1980's

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The large number of articles on coatings progress published during the past two years is indicative of improvements in technology in this field. Paint history, which dates back to the Cro-Magnum period, is over 20,000 years old, but most of the advances in coatings technology have been made during the last half century. The efforts toward reducing VOC emissions in this $9 billion industry have been catalyzed by environmental regulations which started with Rule 66 in 1965. These efforts have resulted in the development of superior water-borne and higher solids coatings, new pigments, new curing techniques, new characterization tools, and many new applications.

HISTORY

As pointed out by Dr. Raymond Myers, the use of coatings extends further into the past than any other facet of polymer science.[1] The 20,000 year old Cro-Magnum cave paintings and most pre-17th century coatings were primarily decorative. But, after lead paints became available in the 17th century, paint was widely used as a preservative for wooden structures.

The versatility of the early artisans was demonstrated by the use of sap from the lac tree, *Rhus Verncifera*, over 4,000 years ago.[2] This vesicatory urush or lacquer was actually cured by exposure to the atmosphere. Linseed oil, which was used in paints in the 11th century, also cured or crosslinked when exposed to oxygen in the air. The use of this oleoresinous coating continued and was used to coat the horseless carriage of the early 1900's. The use of a crude paint stone mill in Boston in 1692 is recorded for its historical value as the so-called "black art" of paint manufacture progressed from the curing of tung oil to group transfer polymerization.[3]

In keeping with the recognition of the importance of history, information has been provided on the following: early history,[4] history of decorative church paintings,[5] developments during the past 75 years,[6] the past 50 years,[7] and during the 20th century.[8] Other historical accounts include: history of the UK paint industry,[9] 30 years of powder coatings,[10] history of pigments,[11] history of water-borne coatings,[12] developments in Germany and abroad,[13] a coatings update,[14] and progress in coatings in 1984.[15]

CHANGES IN THE COATINGS INDUSTRY

In spite of competition from paint-free materials, the American paint industry continues to grow. Over 980,000 gallons of paint, including over 320,000 gallons of architectural paints, were produced in the U.S. in 1985. However, because of the requirement for improved technology, the number of American paint producers has decreased from over 1,500 in 1967 to less than 1,000 in 1986. Twenty firms produce 60% of America's paint at a selling price of $6 billion. Four firms account for more than one-half of this volume or 30% of all paint sold in the U.S.

Among the many changes and acquisitions are: the purchase of Dutch Boy Paints by Sherwin Williams, the purchase of Du Pont's acrylic coatings by Clorox, the acquisition of Mobil's entire product coating line by Valspar, the purchase of Inmont by BASF, and the acquisition of Carboline by Sun.[16] Du Pont has purchased the painting facility at Mt. Clemons, MI, from Ford, and DeSoto, which has been dependent on Sears for most of its sales, has diversified.[17]

According to the Paint Makers Association of Great Britain, the relative cost of materials, production, and sales of paint accounts for 56%, 13%, and 13%, respectively, of the selling price of a can of paint. Some saving is made possible by the use of rust-free plastic containers, particularly for water-borne coatings.[18] The "do it yourself" applicator uses a brush, roller, or spray gun to paint

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exterior and interior surfaces. The paint roll coater was developed in Finland in the 1930's.[19] All application techniques have been improved and automated for industrial applications.[20-22]

WATER-BORNE COATINGS

In recognition of the trend away from low solids coatings, the University of Southern Mississippi and the Southern Society for Coatings Technology inaugurated annual conferences on water-borne and higher-solids coatings at New Orleans, LA, in the mid 1970's. The plenary address at the 12th annual conference was presented in February, 1985, by Dr. J.L. Gardon, Director of Research for Sherwin Williams.[23]

According to C.H. Kline and Company, annual latex sales in the U.S. exceed $2 billion and the paint industry is the major consumer of this product. Frost and Sullivan report that over 400,000 tons of vinyl and acrylic latices are used annually in western Europe and that this volume will exceed 500,000 tons in 1990. Italy, which had been the leading consumer of latex, has been displaced by West Germany.

According to Business Communications Co., over 200,000 tons of water-soluble polymers are used annually in the U.S. C.H. Kline reports that the annual sales of industrial thickeners are in excess of $500 million and that this volume should be greater than $600 million by 1988. Cellulosics account for 85% of the thickening agents used in water-borne coatings,[24,25] but polyurethanes[26] and other thickeners are also used in relatively large quantities.[27] Both hydrophilic and hydrophobic agents are used as thickeners.[28]

Chao has described a two-part water-borne acrylic coating system[29] and Sethi has supplied a list of resins used in emulsion coatings.[30] Other recently published information includes a statistical model for emulsion paints above the critical PVC,[31] the rheological performance of polyvinyl acetate emulsions,[32] the drying of latex paints,[33] aqueous dispersions of crosslinked polyurethanes,[34] and information on emulsion polymerization for formulators.[35]

Polyvinyl acetate emulsions are being produced without seeding the latex.[36] Water reducible alkyds containing barium metaborate have low VOC emissions.[37] An acrylic resin, which crosslinks with epoxy resins, is being used in emulsions.[38] Du Pont has developed a high solids "next generation" paint by the use of group transfer polymerization.[39]

Other information published on water-borne paint is as follows: high gloss acrylics,[40] alkyd primers,[41] furniture coatings,[42] water soluble ammonium acrylates,[43] anticorrosive metal coatings,[44] carboxylated acrylics,[45] trimellitic anhydride coatings,[46] water thinnable epoxy-alkyd oligomers,[47] ABS,[48] nonionic acetylenic glycol surfactants,[49] latex components,[50] branched polyether-ester oligomers,[51] and the hydrolytic stability of oligoesters.[52] Other reports have been published on the choice of emulsifiers for epoxy resins,[53] the characteristics of emulsified alkyds,[54] kinetics of reactions of amines and polyvinylbenzoyl chloride,[55] a review of water-borne coatings,[56] and factors affecting applications and marketability of industrial water-borne enamels.[57]

ELECTRODEPOSITION

New information is available on the effect of voltage on the cationic electrodeposition of primers over zinc-coated steel,[58] the effect of surfactants on the electrodeposition of organic solvent dispersed PVC coatings,[59] and on the cathodic deposition of coatings on appliances,[60] the electrodeposition of alkyd primer coatings,[61] blending of polymers for electrodeposition,[62] and the effect of polystyrene on electrodeposited carboxylated coatings.[63]

HIGH SOLIDS COATINGS

The solid content of organic coatings has been increased from less than 5% in the early oleoresinous automobile coating, to Du Pont's higher solid Duco lacquer in the 1920's, to today's very high solids coatings with much lower VOC emission values.[64] Improved high solids coatings, based on hydroxylated polymers,[65] hydroxyl functional mercaptan chain transfer agents,[66] hexamethylolmelamine,[67,68] polyesters,[69] and chlorinated polyethylene[70] are available. Block copolymers have been used as dispersants.[71] The effect of fine particles on optical properties of latex coatings[72] and the effect of carboxylic acid substitutes on the viscosity of acrylic oligomers have been reported.[73]

POWDER COATINGS

According to Frost and Sullivan, epoxy anhydride resins, such as epoxy-polyester blends, account for 32% and 40% of the 40,000 tons of powder coatings used annually. These coatings are widely used for furniture and small parts.[74] New reports have been published on advances in powder coating technology,[75,76] trouble shooting,[77] and reviews.[78-81] Other published reports on powder coatings are as follows: future outlook,[82] new applications,[83] window frame applications,[84] new advances,[85] surface preparations,[86] appliance coatings,[87] new applications,[88,89] powder production,[90] and electrostatically applied powder coatings.[91] Rissman has described a new laboratory for polyester powder coatings.[92]

The use of the following resins in powder coatings has been described: polyesters,[93] polyether-amides, block copolymers,[94] radiation modified polyamides,[95] and epoxy resins.[96] Powder coatings are being used by the American automobile industry for coating steering wheels, window trim, luggage racks, coil suspension springs, and brake housings.[97]

ACRYLIC AND POLYESTER RESINS

The production of acrylic coatings has been reviewed.[98,99] High solids acrylics have been used for appliance coatings.[100] The use of emulsion polymerization techniques for the production of acrylic copolymers,[101] and the molecular weight distribution in high solids acrylics has been determined.[102]

New information is available on the rheological properties of alkyds as a function of concentration[103] and the solubility parameter of the solvent.[104] Alkyds modified with other polymers[105] and acid catalyzed alkyd/melamine resins have been used as coatings.[106] Alkyds have been produced from pentaerythritol and trimethylolpropane.[107] Propylene glycol mono t-butyl ether has been used as a cosolvent in water-reducible alkyds.[108]

OTHER RESINS

Recent investigations have shown that low oil absorption pigments should be used in concentrations that are 5% below CPVC in PVC.[109] New reports are available on epoxy resins,[110] coal tar-epoxy resin systems,[111] epoxy-polyamine systems,[112] polyphenylene sulfide,[113] peroxidized melamine-formaldehyde oligomers,[114] rubber modified epoxy resin systems,[115] polyurethane coatings,[116,117] modified polystyrene,[118] and higher solids phenolic primers.[119]

APPLICATION TECHNIQUES

About 70 tons of plastics are being metal coated annually.[120] Small plastic articles are being coated at Battelle by molding the plastic in a die that has a temporary metal lining.[121] A metal alloy coating (Elamet) is being used to protect plastic parts against electromagnetic interference (EMI).[122] Metallized polypropylene film is more resistant to gaseous permeation than uncoated film.[123] Metal powder suspensions are being deposited by an electrocoating deposition process.[124]

A new automated flow-coat spraying application process,[125] automated powder coating techniques,[126] robot coating production lines,[127-129] automated painting systems,[130] and plasma processes for the application of polymeric films[131] are available. Rotary film evaporation has been used to reduce the volatile content of coatings.[132]

CURING OF COATINGS

Japanese lacquer made from the sap of the *Rhus Verncifera* tree consists primarily of urishiol which crosslinks when exposed to oxygen in the atmosphere. A similar curing process occurs with unsaturated drying oils which were introduced in the 11th century and this reaction is catalyzed by heavy metal salts of organic acids, called driers. Varnishes were produced by blending phenolic resins and unsaturated oils in the early 1900's. Later, alkyds were modified by heating with these "drying oils."[133,134]

The curing step was eliminated in modern thermoplastic coatings, based on cellulose nitrate, polymethyl methacrylate, and polyvinyl chloride. Nevertheless, melamine, alkyd, and phenolic resins are added to some thermoplastics to produce crosslinked coatings.

Coatings containing multifunctional acrylates, such as trimethylolpropane triacrylate, N-vinylpyrrolidone and N-vinylcaprolactam may be cured by exposure to ultraviolet light radiation.[135-136] Mercury, electroless lamps, pulsed xenon lamps, as well as pulsed lasers, may be used as UV sources.[137] Sulfonium and iodonium photo-initiators may also be used for curing coatings. Abrasion and chemical resistant UV cured coatings are being used to protect optical grade acrylic and polycarbonate surfaces.[138] New information on photochemistry and photophysics of polymers is available.[139]

Electron beams are used to a lesser extent for radiation curing of coatings. Polymethyl methacrylate is degraded by electron beams to provide non-specific curing of films.[140] Infrared has also been used to cure films but this method has been displaced by UV and electron beam curing. The latter is preferred for highly pigmented films.[141] The Ford Motor Co. started using electron beam curing in 1969 but has discontinued this technique in favor of conventional lacquers.[142] Mixtures of polyol liquid resins and liquid isocyanate functional resins have been cured rapidly by exposure to gaseous tertiary amines.[143]

PIGMENTS

Since the original coatings were used primarily for artistic decoration, pigments played an important role in the ancient cave murals and these colorants continue to make important contributions to modern coatings.[144] Titanium dioxide which is produced at an annual rate of over 800,000 tons is the principal white pigment.[145] About one half of this volume is used for coatings.

The worldwide capacity for the production of titanium dioxide is 2.6 million tons[146] and the total demand is expected to reach 3.5 million tons by the year 2000.[147,148] New information has been provided on the hiding power of titanium dioxide pigments,[149] on the characterization of pigment surfaces in terms of index of refraction and solubility parameters,[150] and on the stabil-

RAYMOND B. SEYMOUR has been associated with the paint and coatings industry for over half a century. He developed and patented protective coatings for the Goodyear Tire and Rubber Company in 1937 and commercialized a line of vinyl coatings for Atlas Minerals and Chemical Company in 1939. While serving as a Group Leader in polymer research and development at Monsanto (1941-45), he developed water-borne and silica-filled coatings. When he returned to Atlas as President in 1949, he pioneered coatings based on polyurethane and epoxy resins. He developed phenolic coatings while serving as President of Loven Chemical of California (1955-60). After returning to university research, at the University of Houston (1964-76), he directed fundamental research for the Paint Research Institute. He has published annual reviews on progress in polymer science since 1950 and has since continued this activity at the University of Southern Mississippi where he is a Distinguished Professor of Polymer Science. He has been awarded 45 patents by the U.S. Patent Office, is the author of more than 1,500 publications in scientific books and journals, and is the author or co-author of over 30 books on polymer science.

ity of aqueous metallic oxide pigment dispersions.[151] Alumina-modified titanium dioxide is recommended for use in water-borne coating systems.[152]

The reactors used to produce titanium dioxide are protected by a temperature resistant silicone coating.[153] Acrylic polymers have been used as decolorizing flocculating agents for titanyl sulfate solutions.[154] International standards on titanium dioxide have been reviewed.[155]

Calcined china clay,[156] zinc sulfide,[157] calcium carbonate,[158] and silica[159] have been used as white pigment extenders. Other reports have been published on the dispersion of magnetic pigments,[160] the use of zinc oxide in primers,[161] amorphous silica gels,[162] and diatomite.[163]

Worldwide demand for iron oxide pigments is 570,000 tons.[164] Micaceous lamellar iron oxide,[165] calcined mixtures of iron and other metallic oxide,[166] oxidized ferrous oxide,[167] and yellow iron oxide[168] are available. Other reports are available on the properties of iron oxide pigmented paints,[169] heavy metal based pigments,[170] yellow cadmium pigments,[171] bronze powder,[172] anti-corrosive paints,[173] green organic pigments,[174] universal tinting systems,[175] greenish-blue phthaloxyamine pigments,[176] heterocyclic yellow pigments,[177] azo-based pigments,[178-179] organoclay extenders,[180] carbon black,[181] and N-ϵ -lauryl glycine surface treatment.[182] The Environmental Protection Agency (EPA) has questioned the use of tributyltin in marine paints.[183] The use of germanium oxide has been suggested for this end use.[184]

SOLVENTS

A high incident rate of neurological disorders in painters has been observed in Scandinavia and American paint makers are reducing the VOC emissions of their coatings[185] and installing solvent recovery systems.[186] EPA believes that glycol ethers pose an unreasonable risk to health.[187] That glycol ethers affect reproduction and are toxic was announced by the *Wall Street Journal* and the national NBC nightly news show.

The number of incinerators for waste disposal are too few[188] but landfill-compatible and marketable wastes have been obtained by the steam distillation of still bottoms.[189,190] New information has been supplied on VOC emissions and ozone problems[191] and suggestions have been made for the reformulation of paint recipes.[192] Equations have been developed for calculating the solubility parameters of homologous solvent series.[193]

CHARACTERIZATION AND TESTING

Attempts have been made to predict the service life of steel coatings.[194] Laser interferometry has been used to measure the internal stress of coatings[195] and scanning laser acoustic microscopy has been used to characterize latex paint films.[196]

Nitrogen oxide decay kinetics have been used to predict the surface life of coatings[197] and protective properties of paints have been evaluated by accelerated tests,[198] electrochemical methods,[199] and impedance tests.[200] A mechanism for corrosion and delamination of coatings on phosphated steel has been proposed.[201]

The anticorrosive performance of coatings systems containing zinc phosphate has been improved by the addition of zinc chromate[202] or aluminum phosphate.[203] Salt deposits from pigmented coatings exposed to sulfur dioxide and ammonia have been evaluated.[204]

Other studies include the effect of crosslink density and polarity on permeation,[205] water permeation,[206] accelerated weathering tests,[207] and testing of powder coatings.[208] New information has been published on baking of primers,[209] reaction mechanisms in printing ink applications,[210] monitoring the curing of coatings,[211] chromatographic characterization of epoxy resins,[212] and the curing of polyester coatings.[213] New information on characterization of color[214] and identification of pigments[215] is available.

APPLICATIONS

Water-borne coatings are being cured by the addition of zirconium compounds.[216] Polymeric coatings are being used for the protection of optical fibers,[217] as can coatings,[218] as intumescent paints,[219] as fire resistant coatings,[220] as protection for ship hulls against barnacle growth,[221] as hot melts,[222] for use in runways,[223] and for coating fabrics.[224]

Silicone coated fabric structures will be used for the gymnastic and fencing stadia at the Olympic Games in South Korea in 1988. The hazards of broken glass have been reduced by the application of polyurethane coatings to bottles.[225]

Coatings played an important part in the renovation of the century-old Statue of Liberty. Water-borne zinc dust in aqueous potassium silicate was used as a protective primer for the iron frame. Two component water-borne epoxy-polyamide and polytetrafluorethylene tape were also used in this reconstruction.[226] The USA's last switch engine has been restored by the application of a polyurethane coating.[227] The Fort Pitt block house, the oldest monument to British colonization of the 18th century, has been restored by the application of wood preservatives.[228]

SUMMARY

In his remarks on barriers to innovation in the coatings industry, Glaser stated that better management practices were needed to optimize research and development effectiveness.[229] In his plenary talk at the 1986 Water-Borne and Higher-Solids Coatings Conference in New Orleans, Dr. T.J. Miranda emphasized the need for renewed innovation, support of fundamental research, and the development of new and evolving technology. He maintained that there are too many people trained in "mortuary" science who impede progress and are anxious to bury new ideas. He quoted Masterlink's verse, "for every creative spirit, there are a thousand souls who will rise up and defend the past." He used Iacocca's resurrection of the Chrysler Corp. as an example for those in the coatings industry.[230] It is evident from this review that some coatings firms are attempting to follow Iacocca's example. However, in summary, one must admit that the 500 paint firms which went out of business during the last two decades must have been disciples of Masterlink rather than of Iacocca.

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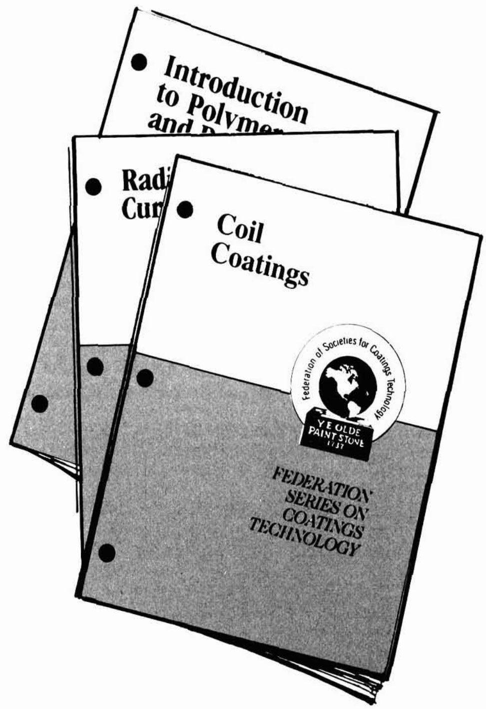
by Zeno W. Wicks, Jr.



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Society Meetings

DALLAS .... NOV.

"Calcium Carbonate Extender Size"

Federation President Carlos E. Dorris, of Jones-Blair Co., was in attendance at the meeting. He spoke briefly about the 1986 Annual Meeting and Paint Show in Atlanta, mentioning that attendance was the second largest ever. He invited members to attend this year's meeting to be held in Dallas in October.

Technical Committee Chairman Richard G. Gohman, of Jones-Blair Co., announced that the Society continues to work on a paper for presentation at the 1987 Annual Meeting in October.

The evening's technical presentation was given by Kenneth Haagenson, of Thompson, Weinman & Co., Cartersville, GA. The Southern Society member spoke on "The Effect of Calcium Carbonate Extender Size on the Hiding Properties of Interior Paints."

Mr. Haagenson reviewed briefly the four general roles that calcium carbonates play in interior flat wall paints. They are, as follows: (1) To optimize spacing for TiO_2; (2) To provide dry hide; (3) To increase total solids; and (4) To reduce low angle sheens.

It was evident, from photos and contrast ratio measurements, that opacity dropped as particle size increased. Mr. Haagenson used several graphs to illustrate the effect particle size has on opacity.

Concluding his presentation, Mr. Haagenson noted that for optimum hiding power, the following is needed: For high PVC's, an extender with a particle size less than 6.25 microns; For low PVC's, a flatting agent will probably be required. In addition, the vehicle must be chosen carefully and the effects of dispersants, surfactants, other additives, and varying orders of addition must be determined.

Q. Would precipitated calcium carbonate act the same?

A. An earlier study showed that they may be better in hide, but natural ground calcium carbonates will cost you less in the end.

Q. What is the particle size of TiO_2 vs extenders?

A. TiO_2 runs between .24 and .30 microns. If you could obtain an extender that small, you'd have optimum hide. You can't get extenders that small, though.

Bruce W. Alvin, *Secretary*

GOLDEN GATE .... NOV.

"Chemistry of Silicones"

Society President Patricia Shaw, of Davlin Coatings Inc., reported on the Federation's Annual Meeting in Atlanta.

Robert T. Miller, of Frank W. Dunne Co., 1985-86 Society President, announced that the Society had won the Material Marketing Association Award at the Federation's Annual Meeting. The award was given for the Manufacturing Committee Conference on VOC presented in June 1986. The conference was chaired by Louis F. Sanguinetti, of Jasco Chemical Corp.

A. Gordon Rook, of Nuodex, Inc., reported that the George Baugh Heckel Award was presented to Society member, Neil Estrada. The award is presented to an individual whose contributions to the general advancement of the Federation's interest and prestige have been outstanding.

Wolfgang Zinnert, of Byk-Chemie USA, presented the evening's technical talk. He spoke on the "New Insight into Chemistry of Silicones for the Coatings Industry."

He reviewed the types of silicone additives used in coatings and the influence of their molecular structure on coatings properties.

Mr. Zinnert stated that it is the chemical structure of the silicone additives that gives good or bad results.

Silicone additives, according to Mr. Zinnert, are used to correct surface defects, such as orange peel, crawling, craters, foaming, fisheyes, and floating. They are also used for slip, mar resistance, and reducing surface tension.

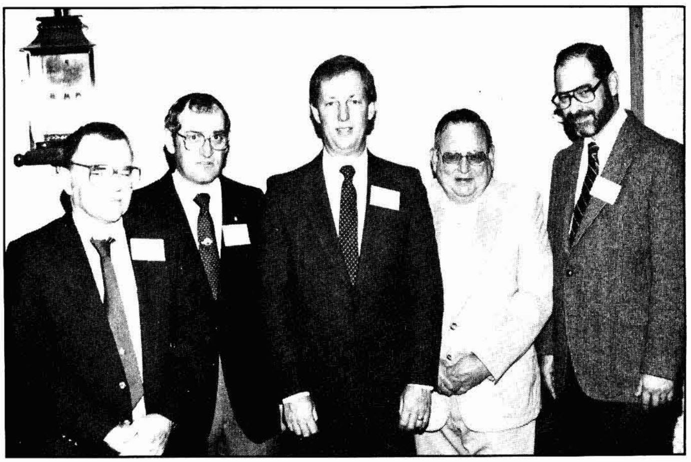
The oldest silicone additives used in the coating industry are the dimethylpolysiloxanes. Because of their volatility and the fact that they pose a health hazard, they are very selective and of limited use.

Replacing the methyl group with a phenyl group forms phelylpolysiloxanes. They give a wider range of application for surface flow and tension reduction and better compatibility but are not as good for slip and mar resistance.

The speaker went on to say that polyether modified dimethylpolysiloxanes exceed all other types of silicone additives used in the coatings industry today. This class of silicones is not dependent on molecular weight for performance.

The hydrolytic stability of polyether modified dimethylpolysiloxanes depends on the Si-R or Si-OR linkage. The Si-R linkage is resistant to hydrolysis. The Si-OR is prone to hydrolyze with the polyether group splitting off, forming Si-O-Si, and resulting in incompatibility.

The polyether modified methylalkylpolysiloxanes silicone additives act like surfactants. They are stable up to 300°F.



OFFICERS OF THE PACIFIC NORTHWEST SOCIETY are (from left to right): Secretary—John Daller; Vice-President—Yvon Poitras; President—Dennis Hatfield; Society Representative—Carlton R. Huntington; and Treasurer—Emil Iraola

SOUTHERN SOCIETY OFFICERS: (from left to right): Society Representative—Berger G. Justen; Treasurer—Kenneth W. Espeut; President—Ronald R. Brown; Vice-President—C. Lewis Davis; and Secretary—R. Scott McKenzie

KANSAS CITY OFFICERS (from left to right): Treasurer--Nick Dispensa; President—Steve Johnson; Vice President Jerry Hefling; Secretary—Roger Haines; and Society Representative—Norman Hon

OFFICERS OF THE LOUISVILLE SOCIETY are (from left to right): Vice-President—Kenneth Hyde; President—Howard Ramsay; Treasurer—Larry Pitchford; Past-President—Joyce S. St. Clair; Secretary—Louis Holzknecht; and Society Representative—James A. Hoeck

In conclusion, Mr. Zinnert touched on the newest silicone additives on the market today, polyester modified dimethylpolysiloxanes. They do not behave like surfactants and are thermally stable up to 500°F.

Q. A customer is applying epoxy coil coating to a primer and the intercoat adhesion is failing. What is the problem?

A. Find out if the customer is using a silicone in his coating. It could be a silicone problem. Determine surface tension of the topcoat. The topcoat may have too high a surface tension and is not wetting the primer for good adhesion.

Q. What is your recommendation for testing a silicone additive for hydrolytic stability?

A. Ask your supplier if the silicone additive is hydrolytic stable. A simple test would be to add a few drops of the silicone additive to the clear vehicle and then add a little PTSA and water and place in a 120°F oven for two days. If it is hydrolytic unstable, it will become hazy.

ERNEST J. SOLDAVINI, *Secretary*

HOUSTON .... OCT.

Past-President's Pin Presented

Society President James W. Judlin, of Devoe & Raynolds Co., Inc., presented a Past-President's pin to Arthur R. McDermott, of Nalco Chemical Co.

Willy C.P. Busch, of PPG Industries, Inc. was nominated by the Board for honorary membership in the Houston Society.

JAMES E. TUSING, *Secretary*

NORTHWESTERN .... NOV.

"Black Pigment Manufacturing"

Society Representative Richard L. Fricker, of Valspar Corp., reported on the Federation's Convention in Atlanta.

The Symposium Committee report was given by Susan Oebser, of H.B. Fuller Co. The Society-sponsored conference, scheduled for March 3 at the Bloomington Marriott, will focus on "VOC Regulations and Alternatives."

Achmad Elbrechter, of the Degussa Corp., was one of the evening's guest speakers. He covered the manufacturing processes for the different types of black pigments.

The speaker said that the furnace process is the most modern, clean, and efficient process of manufacturing black pigments. The old methods were inefficient and dirty.

According to Mr. Elbrechter, small particle size produces jetness. Large surface area yields high tinting strength and hiding power is dependent upon structure.

The oxidation of carbon black produces better wetting and therefore better gloss. Carbon black is available in either powder form or beads.

The tinting strength of carbon black is ten times higher than iron oxide black because there are so many more particles per weight unit.

Q. Can you make a high-gloss black out of a large particle size black pigment?

A. Yes, but it will not be jet.

Q. Can you grind in dispersant only in water systems?

A. No, you need some vehicle.

RICHARD KARLSTAD, *Secretary*

Society Representative Jan P. Van Zelm, of Byk-Chemie U.S.A., addressed the Los Angeles Society at its November meeting

PHILADELPHIA .... NOV.

"Statistical Process Control"

Jack R. McCall, of Valspar Corp., presented a paper on "Statistical Process Control."

The speaker began his presentation saying that the object of Statistical Process Control is to take out variation to insure product quality. The emphasis of SPC is to change from detection of errors to prevention of errors. SPC provides evidence of how a system is performing.

Statistical Process Control involves quality and frequency distribution of measurements and control charts using average and range data. Data is in two types; variable data is numerical numbers and attribute data involves counting each incident. Variable data is used to plot range data.

Mr. McCall then proceeded to give the mathematical formulation for standard deviation and used charts to show how it applies to various production events. He indicated that a process is in control when the plotted data shows 68% of the data is plus or minus one standard deviation from the norm and 95% of the data is plus or minus two standard deviations. Approximately 100% of the data should be within three standard deviations.

Statistical Process Control is a tool for improvement. An SPC program should be implemented at the top of an organization. Senior management should be involved, employees should receive formal training, an overall coordinator should be appointed, and if possible, the data should be computerized to simplify and speed up the evaluation of the data.

OFFICERS AND COMMITTEE CHAIRMEN OF THE WINNIPEG SECTION of the Northwestern Society for 1986-87. From left to right: Liaison—Robert Tinsley; Secretary—Neil Webb; Program—Alex Anstruther; President—Stephen Schultz; Membership—Andrew W. Lejczak; and Social—Kjell Talgoy

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's Market Square, Towson, MD). HELEN KEEGAN, Valspar Corp., 1401 Severn St., Baltimore, MD 21230. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). D.M. HEATH, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ England.

CHICAGO (First Monday—meetings alternate between Como Inn in Chicago and Sharko's West in Villa Park). EVANS ANGELOS, Kraft Chemical Co., 1975 N. Hawthorne Ave., Melrose Park, IL 60160.

CDIC (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; and Nov., Feb. in Dayton). CAROLYN TULLY, Sun Chemical Corp., 4526 Chickering Ave., Cincinnati, OH 45232.

CLEVELAND (Third Tuesday—meeting sites vary). R. EDWARD BISH, Jamestown Paint & Varnish Co., 108 Main St., Jamestown, PA 16134.

DALLAS (Thursday following second Wednesday—Executive Inn. Near Love-field Airport). BRUCE ALVIN, DeSoto, Inc., P.O. Box 461268, Garland, TX 75046.

DETROIT (Fourth Tuesday—meeting sites vary). JOANNE CEDERNA, BASF Inmont Corp., 26701 Telegraph Rd., Southfield, MI 48086.

GOLDEN GATE (Monday before third Wednesday—Alternate between Francesco's in Oakland, CA and Leaning Tower Restaurant in S. San Francisco). ERNEST SOLDAVINI, Nuodex Huls, 5555 Sunol Blvd., Pleasanton, CA 94566.

HOUSTON (Second Wednesday—Look's Sir-Loin Inn, Houston, TX). JAMES TUSING, PPG Industries, Inc., P.O. Box 1329, Houston, TX 77251.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). ROGER HAINES, Tnemec Co., Inc., P.O. 1749, Kansas City, MO 64141.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). PARKER PACE, Behr Process Corp., P.O. Box 1287, Santa Ana, CA 92702.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). LOUIS HOLZKNECHT, Devoe Marine Coatings, 1437 Portland Ave., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary).

MONTREAL (First Wednesday—Bill Wong's Restaurant). R. FERRIS, Canbro Ltd., 29 E. Park St., Valleyfield, Que., Canada J6S 1P8.

NEW ENGLAND (Third Thursday—LeChateau Restaurant, Waltham, MA). ROGER WOODHULL, California Products Corp., P.O. Box 569, Cambridge, MA 02139.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). DAVID PENICHTER, D.H. Litter Co., Inc., 116 E. 16th St., New York, NY 10003.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). RICHARD KARLSTAD, Ceramic Industrial Coatings, 325 Hwy. #52-South, Osseo, MN 55396. WINNIPEG SECTION (Third Tuesday, Marigold Restaurant)—NEIL WEBB, Phillips Paint Products Ltd., 95 Paquin Rd., Winnipeg, MB, Canada R2J 3V9.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). JOHN DALLER, McCloskey Corp., 4155 N.W. Yeon, Portland, OR 97210.

PHILADELPHIA (Second Thursday—Williamson's, GSB Bldg., Philadelphia, PA). LAWRENCE J. KELLY, Peltz-Rowley Chemicals, 5700 Tacony St., Philadelphia, PA 19135.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood Exit of I-85, High Point, NC). BARRY YORK, Reliance Universal, Inc., P.O. Box 2124, High Point, NC 27261.

PITTSBURGH (First Monday—Montemurro's, Sharpsburg, PA). RICHARD G. MARCI, Royston Laboratories, 128 First St., Pittsburgh, PA 15238.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's Arvada, CO). JEFFREY B. JOHNSON, Sashco, Inc., 1395 S. Acoma, Denver, CO 80223.

ST. LOUIS (Third Tuesday—Salad Bowl). ROBERT L. WAGNON, Mozel Chemical Products Co., 4003 Park Ave., St. Louis, MO 63110.

SOUTHERN (Gulf Coast Section—Third Thursday; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section bi-monthly on Second Tuesday; Miami Section—Tuesday prior to Central Florida Section—R. SCOTT MCKENZIE, Southern Coatings & Chemicals, P.O. Box 2688, Sumter, SC 29150.

TORONTO (Second Monday—Cambridge Motor Hotel). LARRY HAM, Stochem Inc., 5200 Dixie Rd., Suite 201, Mississauga, Ont., Canada L4W 1E4.

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

In conclusion, Mr. McCall summarized by stating that SPC is the only way the United States is going to once again compete in the world market with companies from Japan and the Near East. The chief competitors of the U.S. use the SPC process and have been able to significantly improve their production quality.

LAWRENCE J. KELLY, *Secretary*

PITTSBURGH .... NOV.

"Titanium Chelates"

Mark Troutman, of Bradley Paint Co., Society Secretary for 1985-86 was named co-winner of the Federation's Trigg Award.

The Environmental Controls Committee is in need of a Chairperson and is still seeking volunteers. Diane Kdicus gave a report on what industry should be doing to comply with OSHA and RCRA requirements.

John E. Hall, of Tioxide of Canada Ltd., gave the evening's technical talk entitled "TITANIUM CHELATES—A NOVEL APPROACH TO RHEOLOGICAL CONTROL IN LATEX PAINTS." Mr. Hall is a member of the Montreal Society.

RICHARD MARCI, *Secretary*

WESTERN NEW YORK .... OCT.

"Current Environmental Scene"

Education Committee Chairman James Price, of Pratt & Lambert, Inc., announced that two students were awarded \$400 scholarships for the 1986-87 scholastic year.

Secretary Mark Markoff, retired, reported that member companies Pratt & Lambert, Inc., ChemCentral/Buffalo, NL Chemicals, Inc., Dar-Tech, Inc., and L.V. Lomas Chemical Co., had donated a total of \$250 to the Special Education Fund.

Gerald F. Ivancie, of Pratt & Lambert, Inc., was appointed temporary Environmental Committee Chairperson.

The speaker of the evening was Hugh M. Smith who presented a talk on the current environmental scene and how recent developments would likely impact on the coatings industry. Dr. Smith said that the transportation of hazardous chemicals, regulations at the work place, and toxic substances in the laboratory are a few of the recent developments affecting the coatings industry.

He indicated that OSHA laws were expanding this year to cover laboratories, industries other than the coatings industry, and labeling to conform with their European counterparts.

MARKO K. MARKOFF, *Secretary*

Elections

CLEVELAND

Active

DOWNEY, GERALD F.—Sherwin-Williams Co., Cleveland, OH.
GRIBBLE, PETER R.—Glidden Co., Strongsville, OH.
KONCHAR, RICHARD J.—Loctite Corp., Cleveland.
MEEK, JOHN D.—Sherwin-Williams Co., Cleveland.
REUTER, JAMES M.—Sherwin-Williams Co., Cleveland.
SMITH, JAN ERIC—Jamestown Paint & Varnish, Jamestown, PA.
TUCKERMAN, RICHARD—Glidden Co., Strongsville.
USCHEEK, DAVE P.—Sheffield Bronze Inc., Cleveland.
WOODS, BRIAN M.—Jamestown Paint & Varnish, Jamestown.

Retired

SCOTT, H.A.—Rocky River, OH.

DALLAS

Active

MARTINEZ, MARIO A.—Roach Paint Co., Inc., Dallas, TX.
STEPHEN, MATHEW—Lilly Ind. Ctgs. Inc., Dallas.
TENNANT, MARCUS—Jones-Blair Co., Dallas.

Associate

GOMES, ANTHONY J.—Polyvinyl Chemicals, Spring, TX.
JENNINGS, MATTHEW J.—Monsanto Co., Dallas, TX.
NICCOL, ROBERT L.—Degussa Corp., Plano, TX.
RIBELIN, BRAD A.—Ribelin Sales, Garland, TX.
RILEY, JOEL T.—Ribelin Sales, Garland.
RUMFORD, ROBERT H.—Valley Solvents, Fort Worth, TX.
YOUNG, RONALD P.—Rohm and Haas Co., Dallas.

HOUSTON

Associate

CRANFORD, DANNY J.—Delta Distributors, Houston, TX.
FLOYD, G. LEE—Accron Chemical Dist., Houston.
NELSON, CRAIG—Cabot Corp., Richardson, TX.
SEITER, LOUIS H. JR.—Columbian Chemicals, Houston.
TRCKA, MICHAEL P.—Dow Chemical Co., Houston.

KANSAS CITY

Active

BEYER, BRUCE G.—Hallmark Cards Inc., Leavenworth, KS.

Associate

FRISK, JOHN M.—Contrast Equipment, Kansas City, MO.
GOMES, ANTHONY J.—Polyvinyl Chem. Ind., Spring, TX.
HILTON, THOMAS W.—F.R. Hall Co., N. Kansas City, MO.
PURCELL, THOMAS E.—Rohm and Haas Co., Dallas, TX.

LOS ANGELES

Active

FATHOLLAHI, ZAHRA—U.S. Microtek, Sun Valley, CA.
GILBERT, DAN—Surface Protection Industries, Inc., Los Angeles, CA.
GODAT, ROBERT J.—Hiebert Inc., Carson, CA.

Associate

FINCH, KAREN G.—A.J. Lynch, Los Angeles, CA.
PODELL, CRAIG M.—Harshaw/Filtrol Partnership, Sepulveda, CA.
RICE, COLLEEN R.—AC Products Inc., Placentia, CA.
SEYMOUR, JAMES—Washtech Systems, Inc., Riverside, CA.
TAIPALE, WAINO A.—Steelcase Inc., Tustin, CA.

NEW YORK

Active

HAWKES, MARIAN E.—R.T. Vanderbilt Co., Norwalk, CT.
KAYE, JEFFREY C.—MacArthur Petroleum, Newark, NJ.

Associate

ASCHNER, ELI M.—EM Industries, Inc., Hawthorne, NJ.
BATTAGLIA, FRANK J.—Nuodex Inc., Piscataway, NJ.
FLAMING, MEL—Henley & Co., Montvale, NJ.
KUSHINS, ALLAN M.—Lonza Inc., Fair Lawn, NJ.
PATEL, RASHMI J.—Absolute Coatings Inc., New York, NY.
STIFF, WENDY L.—Color Corp. of America, Sicklerville, NJ.
TEANEY, SIGRID—EM Industries Inc., Hawthorne.

Retired

KAYE, MELVIN S.—Short Hills, NJ.

NORTHWESTERN

Active

GROTH, ROGER C.—Diversified Specialties, Minneapolis, MN.
HALM, LEO W.—Valspar Corp., Minneapolis.
HEDDEN, RANDY J.—Diamond Vogel Paint, Minneapolis.
LUNDAHL, STEPHEN L.—Frost Paint & Oil Co., Minneapolis.
ZIEGEWEID, JOSEPH E.—Brooklyn Park, MN.

Associate

EVANOFF, KRISTOPHER P.—Kraft Chemical Co., Franklin, WI.
GROUT, JOHN E.—Nuodex Hüls, Chicago, IL.
HANSON, TERRY M.—Unocal Chemical Div., St. Paul, MN.
NECHKASH, DANIEL O.—Possis Corp., Edina, MN.
PIETRANTONIO, JOHN J.—DuPont Co., Plymouth, MN.
TRUHLER, GREG T.—Diamond Shamrock, Vadnais Hts., MN.
ZAPP, ROBERT S.—Cyprus Ind. Minerals, Arlington Hts., IL.

Educator/Student

EXSTED, BERT JON—North Dakota State University, Fargo, ND.
LUNDBERG, DAVID—North Dakota State University, Fargo.

PACIFIC NORTHWEST

Active

BAUSH, JACK M.—Georgia Pacific Resins, Tacoma, WA.
GEIGER, CHARLES W.—McCloskey Corp., Portland, OR.
GETZIN, DANIEL—Reliance Universal Inc., Salem, OR.
GIESEKE, DAVID S.—Wiltech Corp., Longview, WA.
PARLAN, ANGEL J.—Pleko Products Inc., Tacoma.

Associate

HALPIN, JOHN—Van Waters & Rogers Inc., Kent, WA.
KIEFEL, DANIEL T.—J.F. Shelton Co., Portland, OR.
MCTAVISH, DENNIS—Henley Chemicals Ltd., Langley, B.C.

Sanderson, Malcolm—Nacan Products Ltd., Surrey, B.C.
Wolstenholme, Brian K.—Charles Tennant & Co. Ltd., Vancouver, B.C.

PHILADELPHIA

Active

Caskie, John A.—Classic Paint Co., Penns Grove, NJ.
Jenkins, William G.—Silberline Mfg. Co., Inc., Tamaqua, PA.
Kubert, Joseph P.—Silberline Mfg. Co., Inc., Tamaqua.

Associate

Hammez, Mel—Fein Container, Cockeysville, MD.
Hubley, Dan—Fein Container, Pennsauken, NJ.
Merges, John C.—Saturn Chemicals Inc., Philadelphia, PA.
Ortman, Paul E.—Monsanto Chemical Co., Kenilworth, NJ.
Sheehan, Patrick M.—Durr Marketing Assoc., Pittsburgh, PA.

PIEDMONT

Active

Davis, Michael S.—Sadolin-Paint Prod., Walkertown, NC.
Hubicki, Peter M.—Ridgeway Chemicals, Charlotte, NC.

Associate

Bosse, D.G.—Maginet Projects, Ayden, NC.
Coppock, Wesley A.—Milton Roy Co., Charlotte, NC.
Dupont, Steven M.—Ashland Chemical Co., Charlotte.
Hall, William M.—Growth International, Advance, NC.
McQuillan, John J.—ChemCentral Jamestown, NC.
Mixon, Daniel L.—Baychem Inc., High Point, NC.
Sammons, Kurt L.—Diamond Shamrock, Matthews, NC.
Vespa, Robert A.—Tate Chemical Sales Co., Greensboro, NC.

Retired

Mayfield, Howard—Raleigh, NC.

PITTSBURGH

Active

Anna, Leo A.—Clanabar Inc., Pittsburgh, PA.
DiPierro, Michael J.—PPG Industries, Inc., Allison Park, PA.
Foster, Keith A.—Mobay Corp., Pittsburgh.
Marciniak, Richard F.—PPG Industries, Inc., Springdale, PA.
Ross, Alan S.—Koppers Co., Inc., Monroeville, PA.
Schaaf, Victoria R.—Mobay Corp., Pittsburgh.
Tranquill, John—National Polymers, Bethel Park, PA.
Ward, Hans A.—Koppers Co., Monroeville.

Associate

Asche, Dan—Dar-Tech Inc., Pittsburgh, PA.
Hill, Don—Thomas L. Sullivan Inc., Cleveland, OH.
McNamara, Donald M.—Tara Chemical Co., Pittsburgh.
Pikus, Michael F.—C.P. Hall Co., Twinsburg, OH.

WESTERN NEW YORK

Active

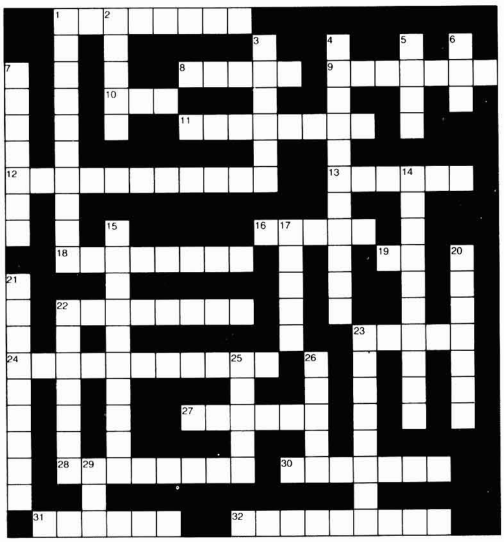
Gniecko, James Z.—NL Chemicals, Buffalo, NY.
Landon, Thomas E.—Corning Glass Works, Corning, NY.
Naples, Gerald—NL Chemicals, Buffalo.
Walker, Edward L.—Pratt & Lambert, Inc., Buffalo.

Associate

Packer, Wesley L.—Cyprus Industrial Minerals, Munroe Falls, OH.

CrOSSLinkS

by Earl Hill



Solution to be published in March issue.

No. 16

ACROSS

1. Paint thinner
8. Asphalt base enamel, black
9. Coating composition
10. Insoluble colloidal state of matter
11. _____ of grind
12. Water absorbing
13. Transparent dye, blue
16. Derived from pine oleoresin
18. Hardness test
19. Viscosity unit (Abr.)
22. Liquid system, two-phase
23. Test method for unsaturation
24. Modern curing method
27. Flame spray process
28. Gets thicker (Rheol.)
30. Absence of coating
31. Metallic pigment
32. To expand with heat

DOWN

1. Diatomaceous silica pigment
2. Red
3. Dibasic acid for alkyds
4. Makes polymers flexible
5. Water-base
6. Common ketone (Abr.)
7. Type of pigment (process derived)
14. Spectral power distribution source
15. Having to do with sound
17. Fatty acid
20. Stretchable; recoverable
21. Form of viscosity, K_____
22. Green
23. Natural iron oxide
25. To combine with
26. Naturally derived drying oil, L_____
29. Prefix (Org. chem.)

Future Society Meetings

Birmingham

(Mar. 5)—"Determination of Short and Long Term Protection Offered by Chromate-Free Anti-Corrosion Paints"—Mr. Nitsche, BASF Stuttgart.

(Apr. 2)—Memorial Lecture for E.A. Bevan "Amino Resin Development"—R. Barrett, B.I.P. Chemicals Ltd.

Chicago

(Mar. 2)—"How Close Is Close Enough"—Terry Downes, Applied Color Systems, Inc. "Effective Filtration of Industrial Coatings"—Carney Likens, Commercial Filters.

(Apr. 6)—"New Insights into the Chemistry of Silicones for the Coatings Industry"—speaker from Byk Chemie USA. "High Solids Urethane Coatings"—Bernard Taub, Spencer Kellogg Products, NL Chemicals/NL Industries, Inc.

CDIC

(Mar. 9)—"Environmental Update"—Hugh Smith, Sun Chemical Corp.

Golden Gate

(Mar. 16)—"New Developments in High Solids Coatings"—Richard Johnson, Cargill, Inc.

(Apr. 13)—"Vinyl Rheology Modified Systems"—Rick Caudwell, Reichhold Chemicals, Inc.

(May 18)—"Advantages of Predispersed Polyethylenes and Waxes in High Performance Coatings"—Elio Cohen, Daniel Products Co.

Los Angeles

(Mar. 11)—"New Developments in High Solids Coatings"—Richard Johnson, Cargill, Inc.

(Apr. 8)—"Vinyl Rheology Modified Systems"—Rick Caudwell, Reichhold Chemicals, Inc.

(May 13)—"Advantages of Predispersed Polyethylenes and Waxes in High Performance Coatings"—Elio Cohen, Daniel Products Co.

New England

(Feb. 19)—"Waterborne Rheological Additives"—Speaker from Rohm and Haas Co.

(Mar. 19)—"Investigative Techniques Using Paint"—Speaker from Federal Bureau of Investigation.

(Apr. 16)—"Health Aspects of Isocyanates"—Paul Ziegler, Mobay Chemical Corp.

New York

(Feb. 26)—Joint Meeting with NYPCA. "Legislative Update."

(Mar. 10)—"Hardeners for Epoxy Coatings"—John Sinclair, Pacific Anchor Chemical.

(Apr. 7)—"Update on Powder Coatings"—Sid Harris, Consultant.

(May 12)—Past-Presidents' Night. PaVac Awards Presentation.

Pacific Northwest Portland, Seattle, and Vancouver Sections

(Mar. 17-19)—"New Developments in High Solids Coatings"—Richard Johnson, Cargill, Inc.

(Apr. 14-16)—"Vinyl Rheology Modified Systems"—Rick Caudwell, Reichhold Chemicals, Inc.

(May 19-21)—"Advantages of Predispersed Polyethylenes and Waxes in High Performance Coatings"—Elio Cohen, Daniel Products Co.

Philadelphia

(Mar. 12)—Educators' Night. "Employment Opportunities in the Coatings Industry"—Speakers to be announced.

Piedmont

(Mar. 18)—Federation Night.

(Apr. 15)—"Career Enhancement"—Richard Fayssoux, Jr., Eastman Chemical Products, Inc.

(May 20)—"Current Dispersion Milling Method"—Armin Szatmary, Premier Mill Corp.

(June 17)—"An Introduction to Appearance Analysis"—Richard W. Harold, Hunter Associates Laboratory, Inc.

Rocky Mountain

(Mar. 9)—"New Developments in High Solids Coatings"—Richard Johnson, Cargill, Inc.

(Apr. 6)—"Vinyl Rheology Modified Systems"—Rick Caudwell, Reichhold Chemicals, Inc.

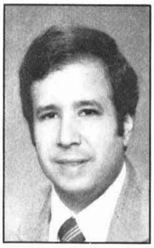
(May 11)—"Advantages of Predispersed Polyethylenes and Waxes in High Performance Coatings"—Elio Cohen, Daniel Products Co.

CLASSIFIED ADVERTISING

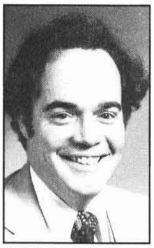
People

Joseph D. Giusto received the 1986 Herman H. Shuger Memorial Award of the Baltimore Coatings Industry Awards Council on November 20, 1986. He was President of the Baltimore Society in 1984 and has been Society Representative on the Federation Board of Directors since 1985. Mr. Giusto is Vice-President of Operations for Lenmar, Inc., in Baltimore.

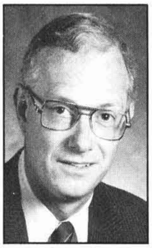
Recipients of the 1986 Merit Awards were: **F. Gerhardt,** of Bruning Paint Co.; **T. Hopper,** of Valspar Corp.; **R. Jortland,** of Tate Chemical Sales Co.; **J. McCormick,** of LCI, Inc.; **S. Ridgely,** of Lasting Paints, Inc.; and **C. Tatman,** of SCM Pigments.



J.D. Giusto



R.R. Nelson



R.A. Winstanley

W.L. Stiff

Kelco Div. of Merck and Co., Inc., San Diego, CA, has appointed **Frank R. Bagshaw** Director, Industrial & Oil Field Marketing. He will be responsible for worldwide oil field and domestic industrial marketing/sales activities.

In addition, Kelco Div. announced the promotion of **Ronald R. Nelson** to Senior Sales Representative, Industrial Division. He will be responsible for all sales activities in the northeastern U.S. Mr. Nelson is a member of the Southern Society.

Battelle Memorial Institute, Columbus, OH, announced two key appointments naming **William J. Madia** Director of the Columbus Div. and **Richard A. Nathan** General Manager of the Project Management Division.

In his new position, Dr. Madia will head a staff of 3,100 scientists, engineers, and supporting specialists at the research center in Columbus. He has been a member of the Battelle staff since 1975.

Dr. Nathan succeeds Dr. Madia and is responsible for over 500 staff members in the demonstration and development research programs division. He has been with Battelle for 17 years.

Rheometrics, Inc., Piscataway, NJ, has named **Peter J. Longarzo** Vice-President with responsibilities in sales, application engineering, and service. Mr. Longarzo's prior work experience includes developing business and marketing strategies and building successful sales organizations.

In addition, Rheometrics announced two appointments to their technical staff. **Im K. Park** was named Director of Applications Development and **Ting-An Huang** was named Senior Applications Engineer.

Richard A. Winstanley has joined the A.E. Staley Mfg. Co., Decatur, IL, as Sales Manager, Surfactants, in the firm's Horizon Chemical Division. Prior to joining the firm, Mr. Winstanley was Territory Manager for Surfactants with the Vista Chemical Co.

Jerome A. Seiner, Director of Advanced Research at the research and development center of PPG Industries' Coatings & Resins Group, Allison Park, PA, has been elected to the PPG Technical Collegium. He is the 11th Distinguished Colleague named to the collegium since its inception in 1983.

Mr. Seiner holds 65 patents and has made many contributions to the coatings field.

In another move at PPG, the Coatings & Resins Group announced the appointment of **Michael M. Chau** as Senior Research Associate. Dr. Chau will work at the R&D Center, Springdale, PA.

Johnson Wax, S.C. Johnson & Son, Inc., Racine, WI, has appointed **Richard A. Barry** Senior Marketing Manager—Coating Polymers. Prior to joining Johnson Wax, Mr. Barry held a variety of sales management positions with the Henkel Corp.

The company also announced that **James P. Sperelakis** has been named Associate Market Manager—Coating Polymers. Mr. Sperelakis will assist new product and market development programs. He will report to Mr. Barry.

S.P. Morell & Co., Inc., Scarsdale, NY, announced the appointment of **Craig R. Kenworthy** as Technical Representative in the mid-Atlantic territory. Mr. Kenworthy is a member of the Philadelphia Society.

Wendy L. Stiff has been appointed Eastern Regional Sales Manager for Color Corp. of America, a division of The Valspar Corp., Minneapolis, MN. Ms. Stiff will be responsible for manufacturers representatives as well as direct sales in 17 states. She is a member of the New York and Philadelphia Societies.

Macbeth, a division of Kollmorgen Corp., Newburgh, NY, announced that **K.H. Lam** has been appointed Manager of China trade. Mr. Lam brings more than 14 years of experience in the color control of textiles and plastics to his new position. He will be based in Hong Kong to support sales to customers in the Peoples' Republic of China and Southeast Asia.

The company announced the addition of **James M. Tracy** as Representative in the midwest U.S. for color measurement and control products and **Robert T. Marcus** as Director of the Munsell Color Products Group Laboratory.

As a result of management reorganization and growth, the following appointments were announced by Akzo Coatings America Inc., Troy, MI: **Joseph L. Wenzler**—Executive Vice-President; **George M. Findling**—Executive Vice-President; and **Bal K. Dubey**—Manager, Commercial Development, Coil Coatings.

Charles S. Rigby has been promoted to National Sales Manager, Specialty Chemicals, Velsicol Chemical Corp., Rosemont, IL. Mr. Rigby will be based in the Atlanta sales office and guide the sales activities of territory sales managers, in addition to managing national account sales.

B. James McCarthy has formed a new distributor company located in the Chicago area. A to Z Sales services the ink, paint, and plastic industries in northern Illinois, southern Wisconsin, and northwestern Indiana. Mr. McCarthy formerly served as Director of Marketing for The Glidden Co. and as Vice-President and General Manager for the colorant divisions of Bee Chemical.

Kevin LeStarge has been appointed Technical Director of the Mautz Paint Co., Madison, WI. In this new position, he will direct all phases of research and development in the laboratory.

Working with Mr. LeStarge in research and product development will be **Bill Entwistle.** He was recently appointed Senior Research Associate for the firm.

CEM Corp., Indian Trail, NC, has appointed **Lee B. Gilman** Marketing Manager. Dr. Gilman will be responsible for developing and implementing marketing strategy, coordinating advertising and promotion, and managing technical support for the company's instrumentation.

Garth W. Thorpe has joined CEM Corp., Indian Trail, NC, as a Sales Representative. He will be responsible for the Mid-Atlantic territory including Virginia, West Virginia, Kentucky, Tennessee, and North Carolina.

Mark Pucci has been appointed Research and Development Manager for extrudable resins by Morton Chemical Div., Morton Thiokol, Inc., Chicago, IL. Dr. Pucci will be responsible for research, development, and start-up functions for extrudable specialty products.

Paul M. Bryant has been named National Marketing Manager for FRP Coatings, Coatings Div., Ferro Corp., Cleveland, OH. He previously served as Regional Operations Manager and Los Angeles District Sales Manager.

In another move, Ferro announced that **H. James Luke** has been appointed Technical Manager for the Plymouth, IN, FRP Coatings operations. Mr. Luke will be responsible for the management of quality control and technical service activities, and have the responsibility of statistical process control coordinator.

SCM Pigments, SCM Corp., Baltimore, MD, has named **Robert Dennis** Sales Representative. In his new position, Mr. Dennis will be responsible for sales and service support in Wisconsin, Minnesota, and upper Michigan. He is a member of the Northwestern Society.

Casey L. Cordon has been appointed Technical Sales Representative for Coatings & Additives at Hercules Incorporated, Wilmington, DE. Mr. Cordon will be headquartered at the midwest regional office in Naperville, IL.

Atlantic Industries, Nutley, NJ, has promoted **Johnny E. Raines** to the position of Assistant Technical Director of their southern operation in Greenville, SC. Mr. Raines will be responsible for supervising exhaust dyeing and paper technical services.

Steven W. Schaefer has been named Executive Vice-President—Plastics & Polymers for Occidental Chemical Corp., Darien, CT. Mr. Schaefer joined Occidental in 1983 and most recently served as Senior Vice-President—PVC Products.

Doug Melton has joined the headquarters staff of Myers Engineering, Bell, CA, as a Sales Engineer. Prior to joining the firm, he was an Applications Engineer with Morehouse Industries.

Freeman Chemical Corp., Port Washington, WI, announced that **Philip J. Zaluska** has joined the Marketing Department as a Coatings Specialist. He brings over 15 years' diversified experience in the chemical industry to Freeman. Mr. Zaluska's new duties will include defining and determining new markets for Freeman products.

Michael G. Sloan has been promoted to Vice-President—West for Devoe Marine Coatings Co. and Devoe Napko Protective Coatings, divisions of Grow Group, Inc., New York, NY. He will be responsible for all marketing, sales, and technical services in the western U.S., including Alaska and Hawaii.

In addition, Devoe has promoted **William H. Rembold** to Manager of Operations for Devoe Marine Coatings Co. Mr. Rembold will be responsible for all operations of the Riverside, CA, and Pennsauken, NJ plants.

Union Carbide Corp., Danbury, CT, announced the appointment of two new Vice-Presidents in their Solvents and Coatings Materials Division. **Karl J. Hutchinson** has been named Vice-President and General Manager of the Emulsion Systems Dept. and **Paul J. Johnston** Vice-President and General Manager for the Coatings Resins Dept.

Charles Glen Shugart was appointed Assistant Technical Director for the Corrosion Control Group of Southern Coatings & Chemical Co., Sumter, SC. His responsibilities will include technical duties as well as R&D liaison activity with sales engineers and clients. Mr. Shugart is a member of the Southern Society.

Furane Products Co., Los Angeles, CA, named **Jensheng Chen** Senior Research Chemist for Electronic Materials. In this new position, Mr. Chen will be developing adhesives, coatings, and other high technology materials required for the automated production of electronic systems.

Don Morgan, of NL Chemicals/NL Industries (Atlanta PCA) and **Barry Adler**, of Royell, Inc., Menlo Park, CA, (Golden Gate PCA) were awarded Industry Achievement Awards by the National Paint and Coatings Association for their outstanding management of "Picture It Painted" community service projects on behalf of their local associations.

Mr. Morgan directed two projects, including the donation of paint and association manpower for the construction of low-income homes and the enhancement of a downtown Atlanta mass transit station with a colorful mural.

Mr. Adler, the newly appointed coordinator of the "Picture It Painted" campaign, negotiated the final details to provide paint as the finishing touch on the renovation of San Francisco's Coit Tower. Mr. Adler is a member of Golden Gate Society.

Obituary

Miriam Lauren, wife of Sid Lauren, who served as Executive Director of Coatings Research Group, Inc. in Cleveland from early 1972 to mid-1985, died on November 9.

Mrs. Lauren was well known by many paint industry executives, chemists, and their wives representing the 30 companies in five countries that are associated with CRGI, as well as many members of the Federation, which her husband has served in various capacities.

She received her M.S. degree from Cornell Univ. Medical School and most recently worked at the Case Western Reserve University School of Medicine in Cleveland. In addition to her husband, she is survived by a daughter, Barbara; a son, David; and a sister.

Western Coatings Societies Announce Speakers For Biennial Symposium, Feb. 23-25, in Monterey

The speakers have been announced for the Western Coatings Societies' 18th Biennial Symposium and Show in Monterey, CA, February 23-25, 1987. This year's theme is "Technical Excellence and Innovations for '87."

Speakers and their topics are as follows:

"Extender Pigments: Do They Make a Difference?"—Jay Austin, Halox Pigments

"Pathways to Innovation"—Abel Banov, *American Paint & Coatings Journal*

"Multi-Metallic Complexes—The Next Generation of Driers"—Samuel J. Belletiere, Nuodex, Inc.

"Substrate-Initiated Fungal Growth on Coatings: Origin and Control"—Michael C. McLaurin, Buckman Laboratories

"Weather Resistant Coatings Based on Solvent Soluble Fluoro Polymer Resins"—Marvin L. Caine, I.C.I. Americas

"Compliant Coatings Based on Cyclo Aliphatic Epoxides and Tone Polyols"—Robert Eaton, Union Carbide Corp.

"The Use of Small Polymeric Miocrovoids in Formulating High PVC Paints"—David M. Fasano, Rohm and Haas Co.

"Controllable Variations in Pigment Dispersion Manufacture"—Martin Feldman, Nuodex, Inc.

"New Epoxy Resins Technology for Ambient Temperature Curing High Solids and Solvents Coatings"—Marcel M. Gaschke, CIBA-GEIGY Corp.

"Vinyl Modified Epoxy Coatings"—Thomas Ginsberg, Union Carbide Corp.

"The Effect of Resin Formulation on Performance Properties of High Solids Polyurethane Business Machine Coatings"—Cheryl Blomquist, CAS Chemical

"Urethane Associative Thickeners and Non-Pigmentary Hiding Polymer"—Frederick Marschall, DPI Quality Paints

"Effective Utilization of Titanium Dioxide in Coatings"—James E. McNutt, DuPont Co.

"Mercaptans—An Added Dimension for Epoxy Coatings"—Stuart Hartman, Diamond Shamrock

"Challenges in Developing an Acrylic Polyol for VOC Compliant Urethane Coatings"—Douglas B. Rahrig, S.C. Johnson & Son, Inc.

"The New Super Dispersible Organo Clays: Fact or Fiction"—Steve Roth, United Catalyst, Inc.

"Rheological Measurements as a Guide to Additive Performance"—Marvin J. Schnall, Troy Chemical Corp.

"Stabilization of Maintenance Coatings"—Peter Schirmann, CIBA-GEIGY Corp.

"High Solids Urethane Coatings"—Bernard Taub, Spencer Kellogg/N.L. Industries

"Hydrocarbon Solvents in High Solids Coatings"—B.W. Taylor, Chevron Research

"Use of the Correlation Coefficient Matrix in the Design of Experiments"—George A. Coney, Jr. and Richard Verseput, S. Matrix

"Water-borne Epoxy Baked Resins for Coatings Application Over Marginally Treated Surfaces"—Speaker to be announced.

For additional information, contact General Chairman, Ted Favata, T.L.T., Inc., 318 Pendleton Way, Oakland, CA 94621.

DePaul Univ. Hosting Coatings Course

DePaul University's Lincoln Park Campus is hosting "A Course in Coatings Technology." The course, being sponsored by the Joint Education Committee of the Chicago Society for Coatings Technology and Chicago Paint and Coatings Association, introduces both technical and non-technical personnel to the fundamentals of the coatings industry.

The series of 16-weekly meetings began on January 14 and features guest lecturers who are acknowledged professionals in their fields. The speakers, experts from both industry and academia, include John Gordon, John Graham, and Fred Steig. Guest lecturers are provided by Cargill, Inc., CIBA-GEIGY Corp., Rohm and Haas Co., and Union Carbide Corp.

Two texts, as well as handouts provided by the speakers, accompany the lectures.

The course introduces the important concepts of coating technology for chemists, technicians, sales people, and those seeking a basic understanding of coatings. Formulating techniques, raw materials, quality assurance, application methods, problem solving, and environmental considerations are covered in the course.

Topics yet to be presented are:

February 18—Water-borne Paints: Trades Sales and Industrial

February 25—Dispersion of Pigments; Rheology and Viscosity Measurement

March 4—Adhesion Theory; Rheology Modifiers and Thickeners

March 11—Use and Abuse of Additives, Mildewcides, and Preservatives

March 18—Surfactants, Dispersants, and Defoamers

April 1—Oils, Alkyds, and Varnishes; Driers, Antioxidants, and Antiskins

April 8—Emulsion Polymers

April 15—Industrial Polymers: Polyurethanes; Epoxies and Aminoplasts

April 22—Coatings Applications: Industrial and Tradesales

April 29—Quality Assurance and Test Methods

May 6—Emerging Technologies; Environmental Considerations and Governmental Regulations

A banquet on May 13 concludes the lecture series.

For more information, contact Gregory E. McWright, U.S.G. Corp., 700 N. Rte. 45, Libertyville, IL 60048, or Dave Kuehner, DeSoto, Inc., 1700 S. Mt. Prospect Rd., Des Plaines, IL 60018.

Automotive Color Design Is Focus of Symposium To Be Held May 28 in Ontario

The Canadian Society for Color and the Detroit Colour Council have announced a joint symposium on Automotive Color Design, to be held on May 28 at Cleary Auditorium, Windsor, Ontario (just across the river from Detroit).

The program will feature as speakers, representatives from automotive firms, as well as from the coatings and pigment industries, who will describe the complexities of developing automotive color programs. Comparisons between American, European, and Japanese approaches will be highlighted.

For complete program and registration information, contact William V. Longley, Ford Motor Company, Design Center, 21175 Oakwood Boulevard, P. O. Box 2110, Dearborn, MI 48123 (313) 337-5234.

"Science and Technology in Surface Coatings" To Be Theme of OCCA Conference in Eastbourne

The Biennial Conference of the Oil and Colour Chemists' Association will be held at the Grand Hotel, Eastbourne, England, from June 17-20, 1987. The theme of the program sessions will be "Advances and Application of Science and Technology in Surface Coatings."

The Conference will be arranged in four technical sessions with lecturers from the U.S., the U.K., Belgium, Finland, France, Norway, and Switzerland. The papers scheduled are:

- Keynote Address by Arja Saloranta, President of the Federation of Scandinavian Paint and Varnish Technologists.
- "Preparation of Ionomers for Coatings from Water Soluble Polymers" — Dr. A. Wilson and Dr. J.W. Nicholson, of the Laboratory of the Government Chemist.
- "Novel Polyamide Type Epoxy Curing Agents" — R.H.E. Munn, of Cray Valley Products.
- "Alkyd Emulsions, Properties and Applications" — Thor Fjeldberg, of Dyno Industrier AS Norway.
- "Recent Advances in Crosslinking and Curing Applications to Surface Coatings" — Dr. H. Warson of Solihull Chemical Services.
- "A Novel Water Based Coating System for Wet Areas" — Ilkka Sarvimaki, of Tikkurila OY. (Presented on behalf of the Scandinavian Federation).
- "New Propylene Glycol Ethers for Water Borne Coatings" — J. Spauwen, of Dow Chemical Co. Ltd.
- "High Binders in Decorative Emulsion Paints" — D.S.W. Dargan and J. Hemmings, of Kirklees Chemicals.
- "The Reliability of Durability Testing" — L. Cutrone and D.V. Moulton, of Tioxide Ltd.
- "Improving Dispersion of Pigments with Hyperdispersants" — A.C.D. Cowley, of ICI Organics Div.
- "Development of Novel Driers for Paint" — N. Usman, of the Paint Research Association.
- Keynote Address by G. Phillips, of Ault & Wiborg plc.
- "Advances in Ink Jet Printing and Ink Jet Inks" — Dr. W.G. Erskine, of Domino Printing Inks.
- "Advances in Environmentally Acceptable Polyurethanes" — Paul C. Stievater, of NL Chemicals, Spencer Kellogg Products. (Presented on behalf of the FSCT)
- "Rapid Electrodeposition Systems for Metallic Coatings" — Prof. Mengies, of Loughborough University.
- "Advances and Changes of Ink Technology in Cold Seal Packages" — P. Fallon, of Johnson and Bloy Ltd.
- "Durability of Anti-Carbonation Coatings" — Dr. H. Robinson, of Taylor Woodrow Engineering.
- "Production of Zinc and Zinc Alloyed Dusts by Fine Atomization" — M. Leclercq, of Societie des Mines et Fonderies de Zinc de la Vielle Montagne.
- "Advances in Science and Technology in Pigments" — Dr. B.L. Kaul, of Sandoz Huningue SA.
- "Membrane Separation for the Production of Nitrogen Enriched Inert Gas" — Dr. N. Henwood, of Dow Chemical Co. Ltd.
- "Technical Progress of New Ecologically Safe Paint Systems and Application Technologies" — I. Tonini, of Walter Maeder AG. (Presented on behalf of FATIPEC).

For a copy of the Conference Brochure, write to: Robert H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF England. Phone: 01-908-1086.

Macbeth Seminar to Focus on "Fundamentals of Color"

The 1987 schedule for "The Fundamentals of Color" seminar, conducted by Macbeth, a division of Kollmorgen Corp., has been announced.

The two-day meeting is structured to provide a clear understanding of the problems and solutions associated with the measurement, specification, and control of color. Presentations are aimed at those involved in the design, production, or quality control of products for which color is important.

Lectures and practical demonstrations are scheduled for the first day of the seminar, which costs $150. The fee covers reference material, workbook, and lunch. There is no charge for the second day.

Locations and dates for the seminars are: January 15-16, Toledo, OH; January 22-23, Bloomington, MN; February 2-3, Chicago, IL; February 26-27, Dallas, TX; March 9-10, Los Angeles, CA; April 6-7, Grand Rapids, MI; and April 9-10, Neenah, WI. The remainder of the schedule will be released at a later date.

Additional information and applications can be obtained from Jeanne Dolan or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382.

Literature

Expanded Sample Kit

A sample kit containing up to 17 silicone additives has been introduced in literature. The kit is designed for laboratory bench-top use. Sample containers hold four or five ounces of product. The additives are available both in the kit and as single samples by writing Dow Corning, P.O. Box 1592, Midland, MI 48640.

Spray Booth Additive

Information is now available on a new chemical additive designed to reduce time and manpower for cleaning and maintaining paint spray booths. The additive, which forms a barrier between overspray paint and booth walls and grates, allows paint overspray to be removed with water. For additional information on DG-1095, contact Betz Laboratories, Inc., Somerton Rd., Trevose, PA 19047.

Adhesion Resins

A data sheet describing two adhesion resins that are designed to improve initial, long-term, and interlayer adhesion of paints to metallic, mineral, and certain plastic surfaces is available. Included are recommendations on compatibility and availability, properties and applications, and processing and storage. For more information on adhesion resins LTH and LTS, contact Nuodex, Inc., a Hüls Company, P.O. Box 365, Piscataway, NJ 08854.

Partnership Program

New families of resins and dispersants and a "partnership program" have been introduced in recently released literature. The new resins represent an addition to existing solid acrylic bead resin lines. The dispersants were developed for the automotive finishes market. The "partnership program," in custom-designed polymers and polymer manufacture, allows technical experts to work directly with the industry's technical personnel when developing or manufacturing resins. More information can be obtained by writing the Du Pont Co., External Affairs Dept., Wilmington, DE 19898.

Mini Pumps

A recently released product bulletin describes mini progressive cavity pumps. The mini pumps meter a wide range of materials and pump low volumes of shear sensitive, high viscosity, high solids content materials. The pumps are available in three sizes with output capacities of 0-10, 0-5, and 0-2.5 liters per minute, depending upon size and pump speed. For details on NE Series Nemo® pumps, contact Netzsch Inc., 119 Pickering Way, Exton, PA 19341-1393.

Coatings Instrument

A two-color, 28-page brochure details a comprehensive line of coatings inspection instruments. The brochure contains a complete description and photograph of each instrument, a listing of technical books and training manuals, and a "helpful hints" section on the proper use of the various instruments. For a copy of the instrument brochure, contact William D. Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275.

Flame Retardant

A water-based flame retardant designed to minimize the chance of corrosion on production equipment during usage has been introduced in literature. These flame retardants can be used as replacements for halogen/antimony oxide and other halogen/phosphorus systems. Further information on Fyarestor® 330B can be obtained from Pearsall Products, Witco Corp., P.O. Box 42817, Houston, TX 77242-2817.

Filter Cartridge

An eight-page, four-color brochure describes in detail a disposable cartridge filter line. The brochure also provides data on chemical compatibility, cartridge sealing options, and a detailed checklist to assist in specifying the optimum wound fiber filter for an application. The cartridge is available in a choice of 13 different fibers, 16 different removal ratings, 17 different lengths, and five different center core materials. For details on the "DFT Classic Filter Cartridge" brochure, contact Filterite, 2033 Greenspring Dr., Timonium, MD 21093.

Toxicology Information

Bulletins updating toxicology information on EO- and PO-based glycol ethers and acetates have been published. The literature offers comprehensive data on the latest developments in glycol ether research and health and safety information on PO-based glycol ethers and acetates. Also included are updates on the EPA's recent referrals to OSHA and an advanced notice of proposed rulemaking for testing tri-EO-based ethers. Copies of the literature are available from the Marketing Communications Department, ARCO Chemical Co., 1500 Market St., Philadelphia, PA 19102.

Fourier Transform Techniques

A new booklet on basic experimental techniques used in Fourier Transform NMR is being offered. The booklet illustrates NMR experiments commonly used in the laboratory and covers one- and two-dimensional techniques. A copy of "FTNMR Techniques for Organic Chemists" is available by writing IBM Instruments, Inc., Magnetics Marketing, P.O. Box 3332, Danbury, CT 06813.

Paint Matching System

A computerized paint matching system is described in a technical bulletin. The system is designed to match a sample shade to a standard color in the desired paint system or calculate a new matching recipe. More information is available on the P.O.P.-Eye™ Paint Matching System from Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382.

Preservative

A water-soluble preservative capable of protecting a wide range of aqueous products from microbial attack and spoilage is highlighted in a four-color brochure. Applications include emulsion resins, latex paints, adhesives, dispersed colors and pigment slurries, liquid polishes and waxes, ready-mix joint cement, printing inks, petroleum drilling muds, paper coatings, sealants, and caulks. For additional information on Cosan 145, contact Cosan Chemical Corp., 400 14th St., Carlstadt, NJ 07072.

Pigment Preservative

Literature describes a preservative for pigment and filler slurries. The preservative contains a 50% aqueous solution of glutaraldehyde and is used in controlling bacterial growth in aqueous pigment and filler slurries. Further information on UCARCIDE® Antimicrobial 750 can be obtained from Union Carbide Corp., Specialty Chemicals Div., Dept. L-3493, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Asphalt Thickener

Information is available on an asphalt thickener that helps formulators produce non-asbestos asphalt coatings with a buttery consistency. It also contributes liquid separation resistance and shelf stability while producing formulations equivalent to those containing asbestos. For more details on Attagel® 36, write Engelhard Corp., Performance Minerals Group, Specialty Chemicals Div., 33 Wood Ave. South, Menlo Park, CN-28, Edison, NJ 08818.

Side Striping Guide

Literature is available on a ten-page booklet that gives welded can production line designers information on the side striping process. The brochure discusses production line equipment options, mechanical variables which affect stripe application, and common production problems and solutions. Further information or a free copy of "DeSoto Side Stripe Applications Guidelines" can be obtained from Donna Johnson, Marketing Communications Manager, DeSoto, Inc., 1700 S. Mt. Prospect Rd., Des Plaines, IL 60017.

Friction Tester

Literature is available on a fully automated instrument for testing the slip and friction characteristics of paper, film, rubber, plastic, and other similar materials. The instrument calculates and displays both static and average kinetic coefficients of friction in one test run. For details on the Monitor/Slip and Friction, write Testing Machines Inc., 400 Bayview Ave., Amityville, NY 11701.

Microprocessor Instrument

A microprocessor instrument that gives a digital readout of the temperature, relative humidity, and dew point is the subject of a recently released product bulletin. The hand-held unit can be used in any location and offers relative humidity readings from 0-97% and dew point calculation. For more information on the Elcometer 217, write Elcometer Inc., 1180 E. Big Beaver, Troy, MI 48083.

Software Brochure

A recently released brochure describes an updated Material Safety Data Sheet software program. The MSDS program complies with OSHA's Hazard Communication Standard. The program automatically looks up hazardous ingredients and will determine weight percent, boiling range, specific gravity, flash point, and more. The "BatchMaster PLUS+" brochure is available from Pacific Micro Software Engineering, 6511 Salt Lake Ave., Bell, CA 90201.

Porosimeter

A recently released eight-page brochure details a porosimeter designed to determine total pore volume and pore volume distribution versus pore size, total pore area and pore area distribution, and bulk and apparent densities. For more information, contact Micromeritics, One Micromeritics Dr., Norcross, GA 30093-1877.

Attapulgite Products

A pocket-size guide describes a diverse line of specialty kaolin- and attapulgite-based products. The "Handy Guide to Typical Properties of Engelhard Products" is available through the Performance Mineral Group, Engelhard Corp., 33 Wood Ave. South, Menlo Park, CN-28, Edison, NJ 08818.

Ammonium Polyphosphate Flame Retardants

Recently released information details ammonium polyphosphate flame retardants for paints and coatings. For further information and data sheets on Exolit flame retardants, contact Hoechst Industrial Chemicals, American Hoechst Corp., Somerville, NJ 08876.

Liquid Nonionic Surfactant

Recently released literature describes a new liquid nonionic surfactant that is soluble in water, n-hexane, and dimethylformamide. The nonionic surface active agent may be used in combination with high-foaming anionic surface active agents and is stable to acids, bases, heat, and freezing. More information on "Merpol" 100 is available from the Du Pont Co., External Affairs Dept., Wilmington, DE 19898.

Electrophoresis

A free quarterly newsletter addressing electrophoresis technology is being offered. The eight-page publication focuses on products, applications, instrument design, and time-saving and problem-solving ideas. To obtain a copy of "Ephortechniques," write Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001.

EPA Approval On Biocide Use

The Environmental Protection Agency has given approval to a chemical manufacturer for expanded uses of biocides. The biocides may now be utilized in a broader range of applications in products formulated with emulsions. The EPA clearances allow biocide use as a preservative for water-soluble and water-dispersed adhesives, water-based coatings and paints, building materials, and as a preservative added in the manufacture or use of alkaline, acid, and emulsion-based metal cleaning fluids. Complete information on Kathon® LX can be obtained from Rohm and Haas Co., Attn. Joan Macey, Independence Mall West, Philadelphia, PA 19105.

Color Order Bibliography

Recently released is a new edition of a bibliography on color order systems. The 90-page booklet contains the full original report of over 400 entries, updated to November, 1986. Among the color order systems covered are Munsell, Natural Color, OSA-VCS, Ostwald, DIN, and Coloroid systems. For more information on how to obtain a copy of "Annotated Bibliography on Color Order Systems," contact Mimeoform Services, Inc., Rear, 4805 Prince George's Ave., Beltsville, MD 20705.

Automated Color System

A recently published product bulletin introduces an automated system designed to monitor color on continuous finishing lines. The system enables users to isolate the optical sensor from adverse on-line operating environments which can interfere with accurate color measurements. For more information on the Eagle-Eye™ Color Surveillance System, contact Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 230, Newburgh, NY 12250-0382.

Coming Events

FEDERATION MEETINGS

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

1987

(March)—Seminar on Statistical Process Control. Sponsored by FSCT Professional Development Committee. Scheduled by region: March 2-3—Marriott Hotel, Chicago O'Hare Airport, Chicago, IL; March 9-10—Radisson Hotel, Atlanta, GA; March 16-17—Marriott, Philadelphia Airport, Philadelphia, PA; and March 30-31—Marriott, Torrance, CA.

(Apr. 29-May 2)—Combined Federation Spring Week and Pacific Northwest Society Symposium. The Westin Hotel, Seattle, WA. FSCT Society Officers Meeting on April 29; FSCT Board of Directors Meeting on April 30; Seminar on May 1-2. Concludes with a dinner dance on May 2.

(Oct. 5-7)—65th Annual Meeting and 52nd Paint Industries' Show. Convention Center, Dallas, TX.

1988

(Oct. 19-21)—66th Annual Meeting and 53rd Paint Industries' Show. McCormick Place, Chicago, IL.

SPECIAL SOCIETY MEETINGS

1987

(Jan. 14-May 13)—Coating Technology course sponsored by the Chicago Society and The Chicago Paint and Coatings Association, Chicago, IL. (Greg McWright, USG Corp., 700 N. Highway 45, Libertyville, IL 60048).

(Feb. 23-25)—Southern Society 14th Annual Water-Borne and Higher-Solids Coatings Symposium. New Orleans, LA. (Dr. Gordon L. Nelson, Chairman, Department of Polymer Science, University of Southern Mississippi, Southern Station Box 10076, Hattiesburg, MS 39406-0076).

(Feb. 25-27)—Western Coatings Societies' Symposium and Show, Monterey Convention Center, Monterey, CA. (Barry Adler, Royell, Inc., 1150 Hamilton Ct., Menlo Park, CA 94025).

(Apr. 1-3)—Southern Society. Annual Meeting. Dutch Inn, Lake Buena Vista, FL. (C. Lewis Davis, 802 Black Duck Dr., Port Orange, FL 32019).

(Apr. 7)—Detroit Society. 12th Annual Focus Conference, Management Education Center, Troy, MI. (Bohdan Melnyk, 26727 Newport, Warren, MI 48089).

(Apr. 7-8)—Chicago Society's Symco '87 "Risky Business: Technology of Our Times." Knickers, Des Plaines, IL. (William Fotis, The Enterprise Cos., 1191 S. Wheeling Rd., Wheeling, IL 60090).

(Apr. 29-May 2)—Combined Federation Spring Week and Pacific Northwest Society Symposium. The Westin Hotel, Seattle, WA. April 29—FSCT Society Officers Meeting; April 30—FSCT Board of Directors Meeting; PNW Golf; PNW Evening Activities; May 1—Seminar; May 2—Seminar continued; PNW Sports Competition; Dinner Dance.

(May 26-27)—30th Annual Advances in Coatings Technology Conference. NASA's Lewis Research Center, Cleveland, OH. Sponsored by the Cleveland Society. (Stephen J. Damko, Coatings Research Group, Inc., 2340 Hamilton Ave., Cleveland, OH 44114).

(June 12-13)—Joint meeting of St. Louis and Kansas City Societies. Holiday Inn, Lake of Ozarks. (A.E. Zanardi, Thermal Science, Inc., 2200 Cassens Dr., Fenton, MO 63026).

1988

(Apr. 13-15)—Southern Society. Annual Meeting. Charleston, SC. (Scott McKenzie, Southern Coatings Co., P.O. Box 160, Sumter, SC 29150).

(Apr. 28-30)—Pacific Northwest Society. Annual Symposium. Vancouver, B.C., Canada. (Yvon Poitras, General Paint Corp., 950 Raymur Ave., Vancouver, B.C., Canada V6A 3L5).

1989

(Mar. 13-15)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA. (Andy Ellis, NL Industries, Inc., 200 N. Berry St., Brea, CA 92621).

OTHER ORGANIZATIONS

1987

(Feb. 13-15)—Southern Decorating Products Show. Atlanta Apparel Mart, Atlanta, GA. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Feb. 17-19)—"Coatings Failure Analysis" course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Feb. 18-20)—"Radiation Curing" course sponsored by the Center for Professional Advancement, East Brunswick, NJ. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Feb. 21-27)—"Adhesion—Fundamentals and Practice" course and 10th Annual Meeting of the Adhesion Society, Williamsburg, VA. (Prof. Lawrence T. Drzal, Composite Materials & Structures Center, Michigan St. Univ., East Lansing, MI 48824-1226).

(Feb. 23-27)—"Water Based Polymers: Chemistry and Application Technology" course sponsored by The Center for Professional Advancement, East Brunswick, NJ. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Feb. 24-26)—"Process Hazards Management" seminar sponsored by the Du Pont Co., Wilmington, DE. (Du Pont Safety Services, Barley Mill Plaza, P19-1104, Wilmington, DE 19898).

(Feb. 26-27)—"The Fundamentals of Color" seminar sponsored by Macbeth, a division of Kollmorgen, Corp. Dalas, TX. (Jeanne Dolon or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382).

(Mar. 3-5)—"Coating Inspection of Industrial Facilities" course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 4-6)—"Radiation Curing" course sponsored by The Center for Professional Advancement, Chicago, IL. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 7-8)—Canadian Decorating Products Show. Constellation Hotel, Toronto, Ont. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Mar. 9-10)—"The Fundamentals of Color" seminar sponsored by Macbeth, a division of Kollmorgen, Corp. Los Angeles, CA. (Jeanne Dolon or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382).

(Mar. 9-13)—CORROSION/87. National Association of Corrosion Engineers. Moscone Center, San Francisco, CA. (NACE, P.O. Box 218340, Houston, TX 77218).

(Mar. 16-18)—"Adhesion Science and Technology" course sponsored by The Center for Professional Advancement, East Brunswick, NJ. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 17-19)—Powder Coatings '87. G-MEX Exhibition Center, Manchester, England. (Mervyn W.K. Little, Specialist Exhibitions Ltd., Grantleigh House, 14-32 High St., Croydon, Surrey CRO 1YA, England).

(Mar. 20-25)—The International Paint Industry & Anti-Corrosion Technology Exhibition, Beijing, People's Republic of China. (Sino Trade Promotions, 15A Wing Cheong Commercial Bldg., 19-25 Jervois St., Central, Hong Kong).

(Mar. 21-22)—Western Decorating Products Show. Long Beach Convention Center, Long Beach, CA. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Mar. 25-27)—"Radiation Curing" course sponsored by The Center for Professional Advancement, San Francisco, CA. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 26-29)—Colour 87—the International Exhibition for Painting Techniques and Colour Application. Cologne, Germany. (Koln Messe, Postbox 210760, D-5000 Cologne 21, Germany).

(Mar. 30-Apr. 1)—Annual Meeting of the Zinc Institute and the Lead Industries Association, Fairmont Hotel, San Francisco, CA. (Annual Meeting, ZI/LIA, 292 Madison Ave., New York, NY 10017).

(Mar. 30-Apr. 1)—"Adhesion Science and Technology" course sponsored by The Center for Professional Advancement, Chicago, IL. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 31-Apr. 2)—PaintCon '87. Sponsored by *Industrial Finishing* magazine. O'Hare Expo Center, Rosemont, IL. (PaintCon '87, 2400 E. Devon Ave., Suite 205, Des Plaines, IL 60018).

(Apr. 4-5)—Eastern Decorating Products Show. World Trade Center, Boston, MA. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Apr. 5-7)—Inter-Society Colour Council. Annual Meeting. "Industrial Problems in Color Science." Barclay Hotel, Philadelphia, PA. (Dr. A. Rodrigues, Du Pont Co., 945 Stephenson Hwy., Troy, MI 48084).

(Apr. 5-10)—ACS, Div. of Polymeric Materials: Science & Engineering, Anaheim, CA. (T. Davidson, Ethican, Inc., Route 22, Somersville, NJ 08876).

(Apr. 6-7)—27th Annual Symposium of the Washington Paint Technical Group. Sponsored by the National Paint & Coatings Association. Marriott Twin Bridges Hotel, Washington, DC. (Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

(Apr. 6-7)—"The Fundamentals of Color" seminar sponsored by Macbeth, a division of Kollmorgen, Corp. Grand Rapids, MI. (Jeanne Dolon or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382).

(Apr. 7-9)—"Bridge and Highway Structures Coatings Inspection" course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

Advertisers Index

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'Humbug' from Hillman

The immediate Past-President of the Southern Society and my dear friend, Sal Sanfilippo, recently retired, and has turned to literature search in a misguided decision to bring the industry "back to basics."

His technical research turned up a book by Dr. Winfield G. Scott (who passed away in 1919), "Formulas and Processes for Manufacturing Paints, Oils and Chemicals," republished in 1928 by The Trade Review Co. The first and second paragraphs of the preface in the republished version are worth quoting, in case you don't remember—

"Dr. Winfield G. Scott was an expert chemist with thorough technical training combined with an artistic temperment and a splendid faculty of being able to apply his technical knowledge in a practical manner. As an artist, some of his paintings were awarded a diploma at the World's Columbian Exposition in 1892. As an author and speaker, he was called upon to contribute articles on chemical subjects to the leading technical journals of this and foreign countries and to address numerous meetings of technical men and trade bodies.

"He was the author of 'White Paints and Painting Materials,' the largest and most valuable work on the subject ever published in this country and, although out of print for a number of years, it is still a recognized authority on the subject."

Sal's richly scientific mind was particularly aroused by the following two formulas.

First Coat, Ship Bottom Varnish No. 22122

99½ lb.	Singapore Damar
*14⅛ lb.	Para Rubber Scrap
4⅛ gal.	Heavy Benzol Naphtha
30 gal.	Naphtha (Benzene)

**Note:* The inner tubing of bicycles and automobiles is nearly pure rubber and can be used in place of para rubber scrap, besides old inner tubes are cheaper.

Hard Transparent Gold Lacquer

(a)	8	oz.	Powdered Tumeric
	2	oz.	Dragon's Blood
	32	fl. oz.	V.M. Denatured Alcohol
(b)	1½	lb.	Seed Lac
	96	fl. oz.	V.M. Denatured Alcohol

Any comment from "Humbug" would be presumptuous except to admit that — "Those were the good old formulas." If you, too, are impressed by the rebirth of these technical possibilities, there are detailed directions available. Write Sal, if you can find him.

A letter to Humbug from old friend, Walter Maass—

"Accidentally, I received a copy of the *New Yorker's* first issue, dated February 21, 1925 [*talk about slow mail, Ed.*]. At that date Calvin Coolidge was President, J.P. Morgan was still around, and a movie, 'The Lost World,' was a big hit.—Not too much seems to have changed since those days."

"It may also interest your readers that the Institute of Corrosion Science and Technology in England has a peculiar award for deserving recipients. They are handed an engraved stainless steel sword, symbol of the fight against corrosion. I think they would be better off with a ball point pen, considering that the pen is mightier than the sword, anyway."

One of the clips sent in by Walter from the issue:

From the Opinions of a New Yorker

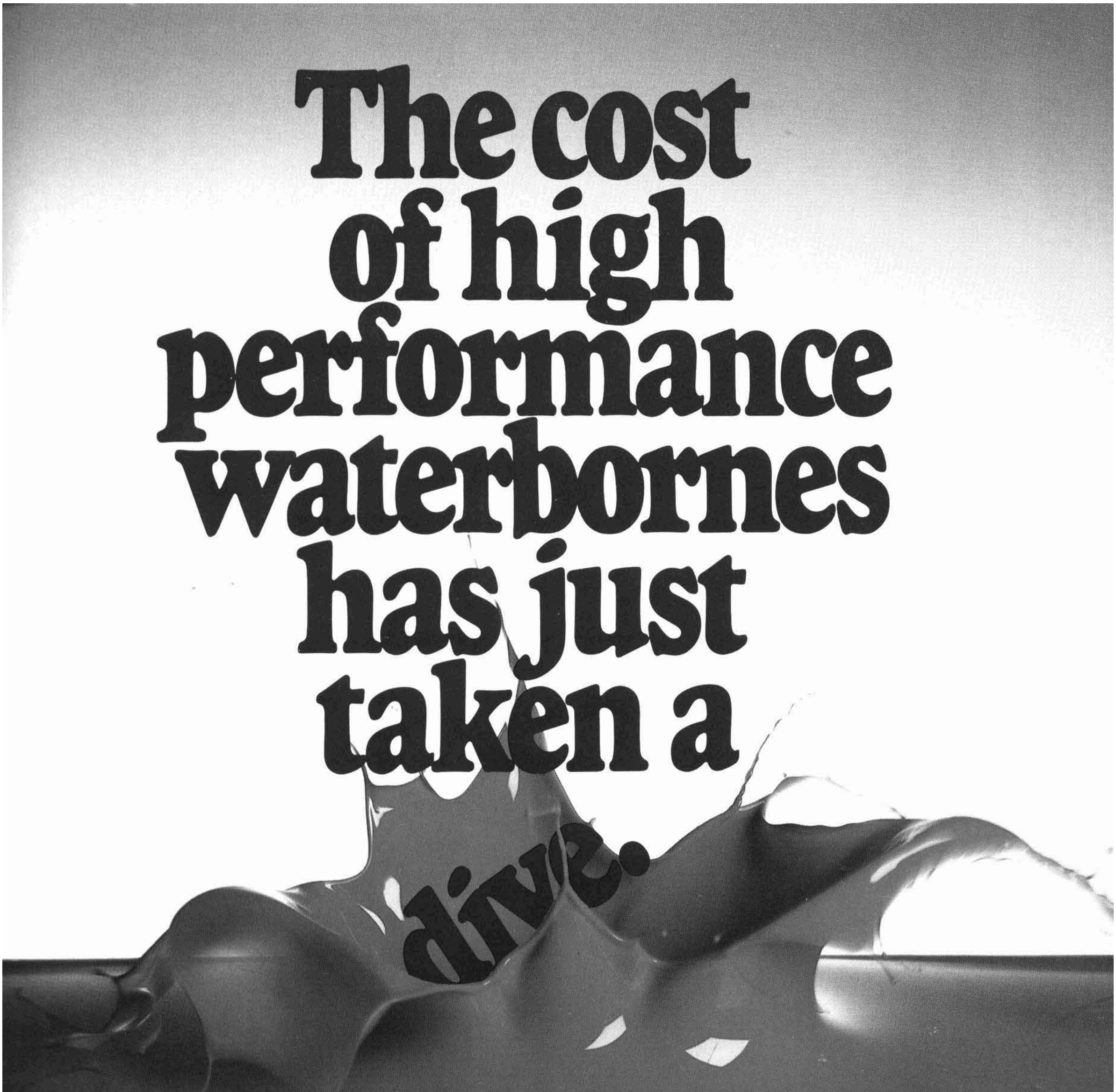
New York is noisy.
New York is overcrowded.
New York is ugly.
New York is unhealthy.
New York is outrageously expensive.
New York is bitterly cold in winter.
New York is steaming hot in summer.
I wouldn't live outside New York for anything in the world.

—C.G.S.

- Prevention of problems is more valuable than curing them, but it pays less.
- Only one in 500 tigers eats people, but if you're eaten, one is enough.
- You'll never guess what we found in your old desk.

—Bob Ahlf

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


The cost of high performance waterbornes has just taken a dive.

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Shamrock

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Where you want one of these desired PERFORMANCE CHARACTERISTICS...

Select from these **PRODUCTS...**

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Material	PE	PE	PE	PE (Water)	Modified PE	Modified PE	Melt Blend	Carnauba Wax	Liquid PE (Solvent)	Liquid PE (Water)	PTFE	PP
COATING SYSTEMS												
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Coil and Metal Deco – *Solvent*	☘	☘	☘		☘	☘	☘	☘	☘		☘	☘
Air Dry	☘	☘	☘	☘	☘	☘	☘	☘	☘			☘
Wood Lacquers		☘	☘		☘	☘	☘	☘	☘		☘	
Powder Coatings	☘				☘						☘	☘
Flexible Packaging		☘			☘		☘	☘	☘	☘	☘	
Automotive Topcoats					☘		☘	☘	☘	☘		
U.V. Clears			☘					☘	☘	☘		
Rigid Packaging		☘	☘			☘	☘	☘	☘	☘	☘	
Architectural Paint					☘					☘		
PERFORMANCE CHARACTERISTICS												
Block Resistance		☘	☘	☘			☘	☘	☘	☘	☘	
Slip*	☘			☘	☘	☘	☘	☘	☘	☘		
Mar Resistance	☘	☘		☘	☘	☘	☘	☘	☘	☘	☘	
Abrasion** Resistance			☘					☘			☘	
Flow Control									☘	☘		
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