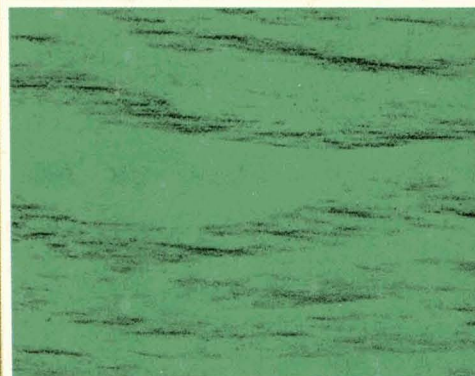
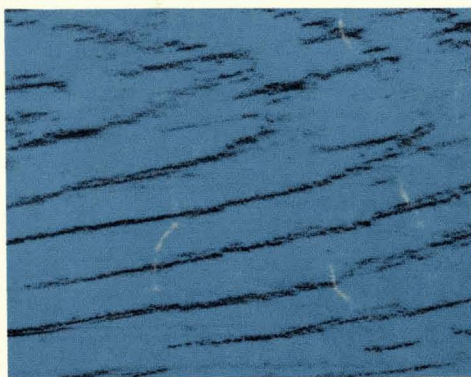
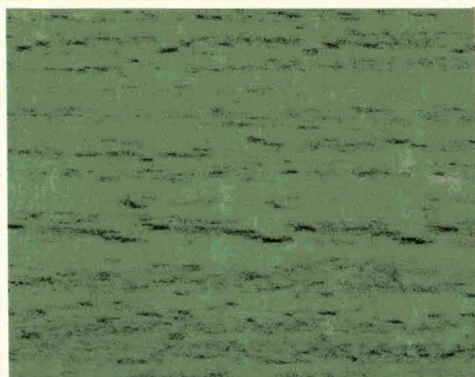
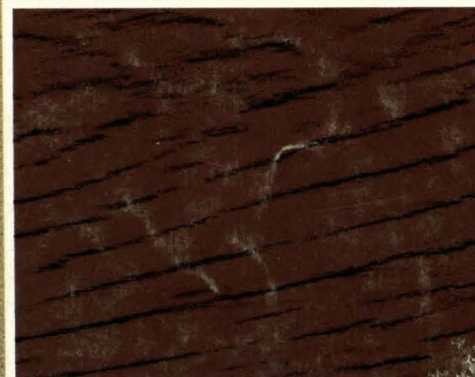


ict JOURNAL OF COATINGS TECHNOLOGY



Performance Comparison of Exterior Flat Finishes on Hardboard Siding



CHICAGO '84
Annual Meeting and Paint Show
CONRAD HILTON HOTEL
OCTOBER 24, 25, 26



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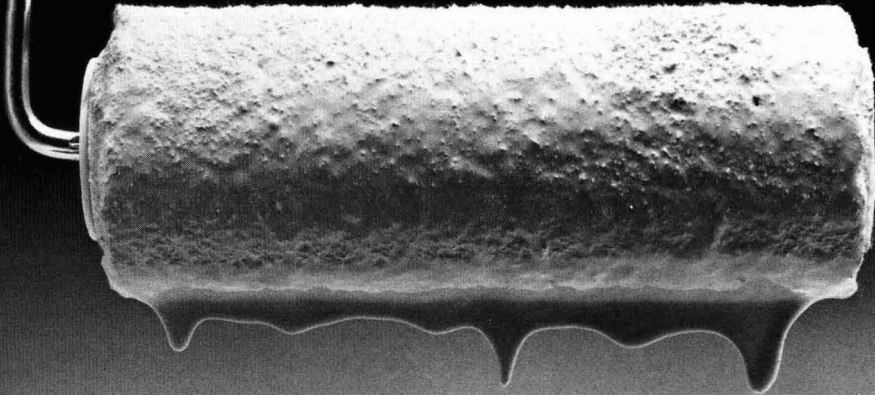
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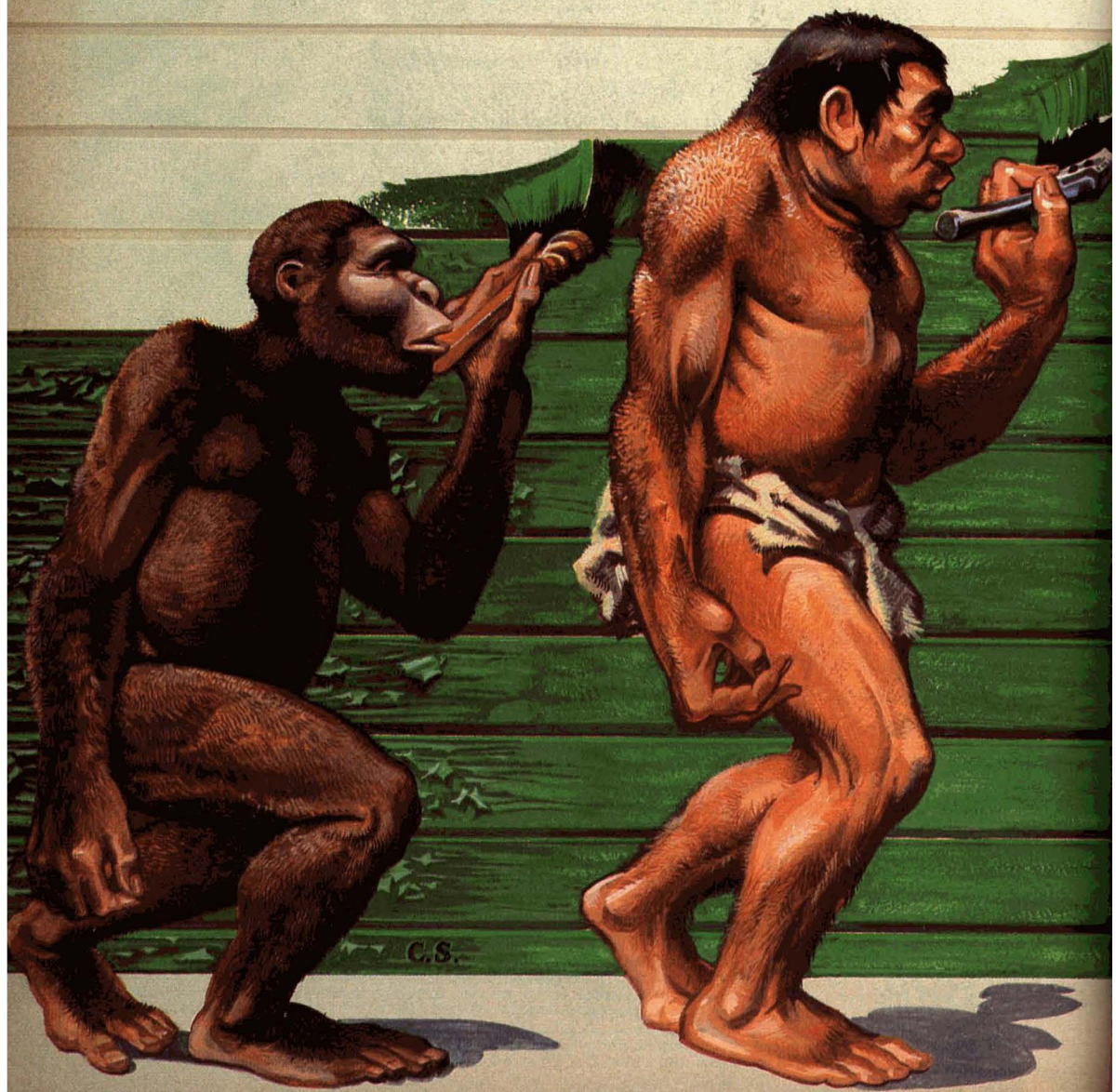
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Journal of Coatings Technology

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

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

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

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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.

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Valuable Update on Paint Production

Continuing the fulfillment of one of its constitutional objectives—to provide scientific, engineering, and technical data, facts, etc.—the Federation this year devotes its spring seminar to a segment of our industry claimed by many to have been neglected—Manufacturing.

Roy Brown, the Federation's Technical Advisor, has arranged an excellent program for the seminar, "Producing Paint Efficiently, Safely, and Economically," at the Convention Center in Louisville, May 15-16.

Beginning with the Keynote Address—"The Importance of the Manufacturing Function"—by J. Robert Pickering, President of Lilly Industrial Coatings, attendees will hear well-known coatings industry personnel speak on practical, down-to-earth elements of paint manufacturing. For example—Production Planning and Scheduling . . . Pigment Dispersion . . . Storage and Distribution of Liquid Raw Materials . . . Warehousing and Shipping . . . Instrumental Production Color Control . . . Automatic Container Filling . . . Waste Management . . . Employee Safety . . . Motivating Your Employees.

Anyone actively engaged in paint manufacturing—particularly management and supervisory production & technical personnel—will learn much from the experts who will discuss the above subjects for a day and a half.

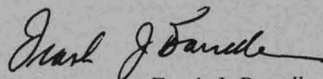
The registration fees are: \$125 for Federation members; \$155 for non-members; and \$165 for everyone after May 1. Brochures have been mailed to all members.

This year, the Federation introduces a new concept, "Spring Week," which it plans to make an annual event.

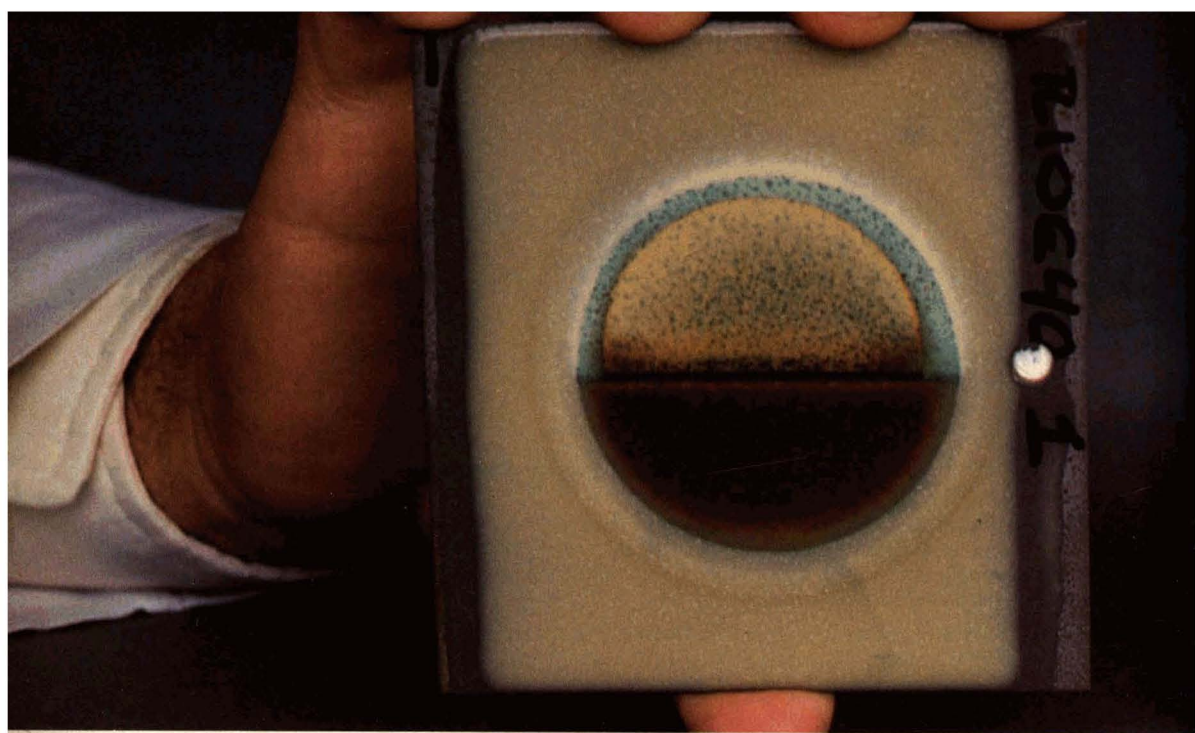
The Seminar is on Tuesday and Wednesday; the orientation meeting for Society Officers on Thursday; and the Board of Directors meeting on Friday.

Where better to initiate "Spring Week" than in the City of Louisville where there is a thriving paint industry, a very active and successful Society for Coatings Technology, and the most friendly and hospitable people you'll find anywhere.

In the "Blue Grass Country," they are readying the "Red Carpet" for the Federation.



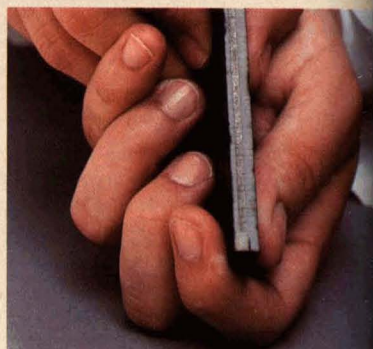
Frank J. Borrelle
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CIBA-GEIGY epoxy hardeners vs. the toughest applications around.

You can now formulate practical, durable coatings for such difficult applications as pollution control equipment.

Conditions are so hostile inside a coal-burning utility's flue gas desulfurization unit that, until today, no completely satisfactory coating has existed. Traditional coatings for carbon steel have been too



Encapsulated in our XU 252 and XU 264 system, this strip of steel was immersed in a 50% sulfuric acid bath for two hours at room temperature then, without rinsing, put into a 350° oven for 30 minutes. This was followed by quenching in sulfuric acid. After 10 such cycles, there was slight surface charring — but no penetration.

brittle. And exotic alloys have been too costly.

Now, however, there is an answer. An answer that, for the first time, allows you to formulate an organic coating with the characteristics you need to meet the demands of this particularly difficult application.





In 14 days of continuous exposure in an Atlas Cell, refluxing 50% sulfuric acid had virtually no effect on the combination of our XU 252 epoxy resin and XU 264 epoxy hardener. After only four days, however, a conventional system was completely destroyed.

Start with a high performance resin.

Our system begins with XU 252, a high performance epoxy resin that has already proven its worth against chlorinated solvents, ethanol, methanol, aromatic amines, acids, caustic and ammonia—and proved it under a wide range of service temperatures. But you require more than a high performance resin to formulate a superior coating. You also need a high technology hardener that can produce the desired physical properties in the cured system.

Combine with a high technology hardener.

Today, CIBA-GEIGY offers highly versatile hardeners that you can combine with XU 252 to formulate coating systems with the high level of resistance and durability you require.

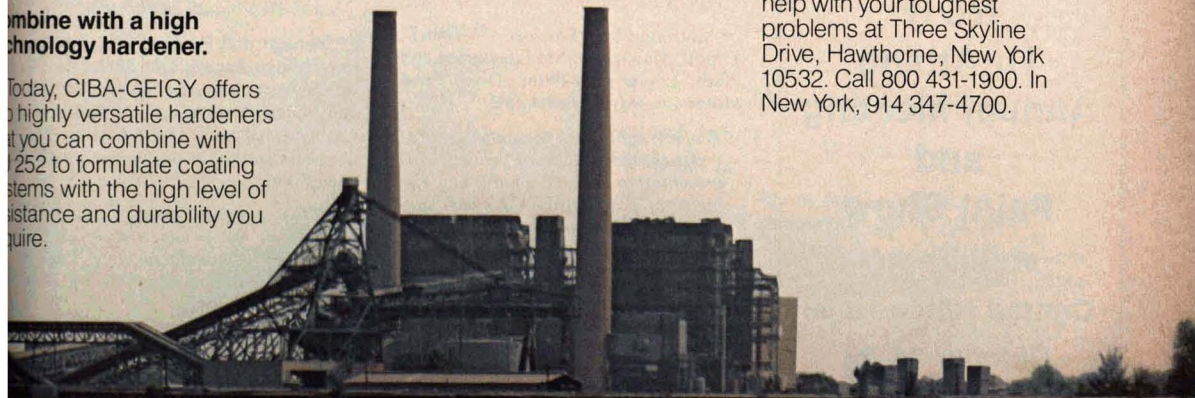
The first, XU 264, is a toughened aromatic amine-based epoxy hardener that is particularly suitable for high temperature service. It provides good flexibility, superior toughness, and excellent resistance to sulfuric acid—properties that make it the ideal hardener for use in high performance coatings for the scrubbers, ducts and stacks in flue gas desulfurization units.

The second of these new products, XU 265, is a liquid hardener that cures epoxy resins into coatings that are highly resistant to acid, alkali,

solvents and chemicals. In combination with XU 252, it produces a coating system that is widely used, for example, in tanks, processing plants and transmission pipes.

Add in responsive service.

So when you are faced with the toughest applications, and need to formulate the toughest coating systems, we believe the choice of a supplier is clear. The CIBA-GEIGY Resins Department—the one source that combines high technology specialty resins and hardeners. We are ready to help with your toughest problems at Three Skyline Drive, Hawthorne, New York 10532. Call 800 431-1900. In New York, 914 347-4700.



CIBA-GEIGY

Program Announced for FSCT Seminar On Paint Manufacturing Practices, May 15-16

Focusing on the topic, "Producing Paint Efficiently, Safely, and Economically," the technical program of the Federation's 1½ day Manufacturing Seminar will present in-depth information on all aspects of paint production.

The seminar, to be held at the Commonwealth Convention Center, Louisville, Kentucky, May 15-16, will feature presentations by well-known coatings industry personnel who will offer practical, down-to-earth information on various elements of paint manufacture, ranging from Raw Materials Inventory Management, and Production Planning and Scheduling, to Pigment Dispersion, Color Matching, Warehousing and Shipping, Waste Management, Health and Safety, and Employee Motivation.

Manufacturing executives, plant managers, production superintendents, foremen, warehouse and shipping personnel, as well as top company management, can benefit from participating in this update on paint production.

Each of the three program sessions will conclude with an open forum period, when registrants will have an opportunity to question the panel of speakers.

**Start Planning
NOW
To Attend
Annual Meeting
and
Paint Show
at Chicago's
Conrad Hilton Hotel
October 24-26**



Program

The program is scheduled to include the following:

Tuesday, May 15

Keynote Address: "The Importance of the Manufacturing Function"—J. Robert Pickering, President, Lilly Industrial Coatings, Inc., Indianapolis, IN.

The role of the manufacturing operation is viewed from the perspective of a company president, who discusses the relationship of Manufacturing to Sales, Technical, and the overall operation of the company.

"Motivating Your Employees"—John F. Tripoli, Manager of Manufacturing and Plant Engineering—Paint Div., Ford Motor Co., Mt. Clemens, MI.

Properly motivated personnel are critical to the manufacturing process. This presentation focuses on the key elements of Ford Motor Co.'s very successful employee involvement motivation program.

"Resins and Polymers"—Dr. Herman J. Lanson, President, Lanchem Corp., E. St. Louis, IL.

Today's paint producer makes use of a wide variety of resins and polymers. This presentation discusses the manu-

facture, handling, and use of these materials and the properties they impart to modern coatings.

"Production Planning and Scheduling"—Chester Yates, Manager of Manufacturing, Porter Paint Co., Louisville, KY.

An efficient manufacturing operation requires careful planning and scheduling. The factors involved in achieving such a program are described.

"Pigment Dispersion"—Earl E. Baumhart, President, Coatings Engineering and Systems Co., Kansas City, MO.

The dispersion of pigments is an important, energy-intensive function of paint manufacture. This presentation discusses various pigment dispersion methods, along with equipment efficiency.

Open Forum: Speakers will assemble as a panel for discussion period.

Wednesday, May 16

"Storage and Distribution of Liquid Raw Materials"—Michael Kenes, President, Straubing, Rubin and Kenes, Inc., Orland Park, IL.

The handling of all types of liquid materials at the plant or tank farm is discussed, along with future trends in automated liquids distribution.

"Instrumental Production Color Control—How to Keep It Out of the Red"—Nelson Auge, Manager of Manufacturing and Manufacturing Services, and James Cave, Manager of Color Control Systems, Reliance Universal, Inc., Louisville, KY.

Matching colors quickly and accurately in the production process is essential to manufacturing efficiency. This presentation describes one company's approach.

"Automatic Container Filling"—Robert W. Zimmerman, Vice President—Engineering, The Enterprise Companies, Wheeling, IL.

Discussed are the principles of automatic container filling in a large trade sales paint manufacturing plant.

"Warehousing and Shipping"—James Skaggs, Manager of Materials Scheduling, Rust-Oleum Corp., Vernon Hills, IL.

Described is a highly automated system, which includes order entry and order picking using scanning devices on conveyor systems. Materials handling in warehouse operations is also discussed.

Open Forum: Speakers will assemble as a panel for discussion period.

"Managing Employee Safety and Loss Control Programs"—W. Horton Russell, Vice President-Manufacturing, Safety, Health and Environment, Grow Group, Inc., Louisville, KY.

All manufacturing plants should have programs to protect the health and safety of employees. This presentation discusses how to establish and manage such programs.

"Waste Management"—Lawrence N. Streff, Manager of Environmental Engineering and Control, PPG Industries, Inc., Allison Park, PA.

Stringent government regulations, as well as economic considerations, dictate that paint manufacturers efficiently manage their wastes, to maintain profitability and meet compliance standards.

Open Forum: Speakers will assemble as a panel for discussion period. Also present will be Richard E. Max, President, Synkote Paint Co., Elmwood Park, NJ and A.L. Marino, Supervisor—Oxygenated Solvents, Arco Chemical Co., Newtown Square, PA.

Registration

To register, fill out accompanying form and return with payment to Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, PA 19107.

Registration fee is \$125 for FSCT members, \$155 for non-members; After May 1, registration fee is \$165 for everyone. (Payment must be in U.S. funds, payable in U.S. banks.)

Included in the registration fee is continental breakfast, luncheon, coffee breaks, and copies of talks, as well as bus transportation to airport at completion of seminar. *Please note reference to bus on registration form, and check appropriate box.*

Housing

Headquarters hotel for the seminar is the Galt House, which is within walking distance from the Convention Center.

FEDERATION MANUFACTURING SEMINAR

REGISTRATION FORM

Registration fees: \$125 (FSCT members);
\$155 (non-members)
\$165 for everyone after May 1.

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Note: Reservations must be made no later than April 30.

Abstracts of Papers in This Issue

PERFORMANCE COMPARISON OF EXTERIOR FLAT FINISHES ON HARDBOARD SIDING—Kansas City Society for Coatings Technology

Journal of Coatings Technology, 56, No. 711, 19 (Apr. 1984)

Exposure studies on the comparative performance of several flat exterior finishes on a variety of hardboard siding substrates have demonstrated a significant improvement in both substrate protection and coating performance with two-coat systems versus a single topcoat application. Ten different hardboard siding products were included as substrates for this evaluation. These boards were shown to have a wide range of densities, impact resistance, and moisture content. Substrate tests were also run to identify the edge swell and moisture absorption tendency of each board.

Best overall performance was achieved with a latex emulsion top-coat over either an alkyd/oil undercoat or acrylic latex primer.

A SIMPLE MODEL FOR THE NUMERICAL SIMULATION OF REFLECTANCE OF BLACK CHROME COATING SYSTEMS—S.T. Wu and L.W. Masters

Journal of Coatings Technology, 56, No. 711, 29 (Apr. 1984)

Black chrome has been used extensively as an absorptive coating in solar collector systems because of its high absorbance/emittance ratio as well as its general stable characteristics under various environmental conditions. This paper presents a numerical simulation on the optical properties of black chrome coating systems. A simple model is developed for black chrome composite by considering the coating to be composed of three "pseudo" layers. Rouard's method is used for computing the reflectance spectra of the system. The model can be used to serve the engineering needs for correlating the optical performance of the material. A numerical example is provided to illustrate the approach.

AUTOOXIDATIVE CROSSLINKING OF VEGETABLE OILS AND ALKYD EMULSIONS—J.W. Gooch, G.C. Wildman, and B.G. Bufkin

Journal of Coatings Technology, 56, No. 711, 33 (Apr. 1984)

Autooxidative crosslinking of vegetable oils and vegetable oil-derived alkyds prior to application of the coating is a new and novel method of economically preparing water emulsions of these materials for commercial coatings uses. Air and oxygen were utilized to autooxidize the emulsified particles to an optimal crosslink density for a balance between rapid dry times and good film properties. The process variables of oxygen concentration, tempera-

ture, agitation rate, and catalysis were studied to optimize the conditions of the reaction to produce the best possible films. Alkyds were synthesized with varying oil lengths to determine the effect of oil length on autooxidation reaction rate. Also, alkyds were synthesized from vegetable oils containing varying percentages of conjugation to study the reaction rate as a function of percent conjugation. The films prepared from the emulsions were evaluated in terms of tensile strength, elongation, hardness, and dry time.

DEGRADATION CHEMISTRY OF PRIMARY CROSSLINKS IN HIGH SOLIDS ENAMEL FINISHES: SOLAR ASSISTED HYDROLYSIS—A.D. English and H.J. Spinelli

Journal of Coatings Technology, 56, No. 711, 43 (Apr. 1984)

Diffuse reflectance infrared spectroscopy and solid state ^{13}C NMR spectroscopy have been used to study the crosslinking and degradation chemistry of a melamine formaldehyde cured acrylic copolymer coating. The bulk composition of the cured unweathered coating has been semi-quantitatively analyzed by solid state ^{13}C NMR spectroscopy, and a depth profile of weathering chemistry has been obtained using diffuse reflectance infrared spectroscopy. These data allow us to identify the extent of crosslinking, the molecular composition after curing, and to obtain mechanistic insight into degradation chemistry taking place under realistic exposure conditions. The insight obtained infers methods of inhibiting degradation.

DISPLACEMENT OF WATER FROM A STEEL SURFACE—C.R. Hegedus

Journal of Coatings Technology, 56, No. 711, 51 (Apr. 1984)

A quantitative test to evaluate organic coatings for their ability to displace water droplets from a steel surface has been developed. The test method consists of the placement of water droplets onto an inclined steel surface, followed by the application of a test coating. The coating flows down the surface, contacting the water droplets. The water may either remain on the specimen or be displaced. The specimen is then immersed in methanol which absorbs residual water on the specimen. The methanol is then analyzed for water content, yielding a quantitative result for water displacement.

Five materials have been evaluated for water displacing ability. Two silicone alkyd coatings were found to be good water displacers. A third silicone alkyd material was found to be a poor water displacer at low specimen angles but effective at higher angles. An acrylic and an epoxy coating were found to be poor water displacers. These results are discussed in reference to a proposed mechanism for water displacement.

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**with
improved
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features.**

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- Good color acceptance
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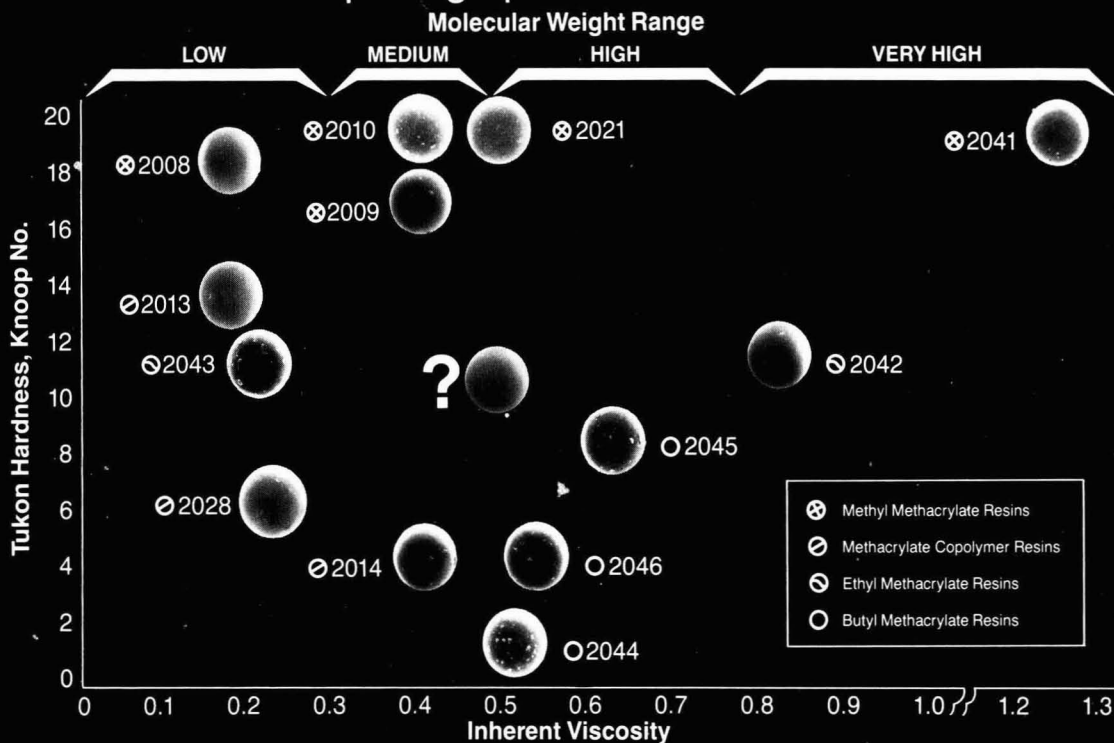
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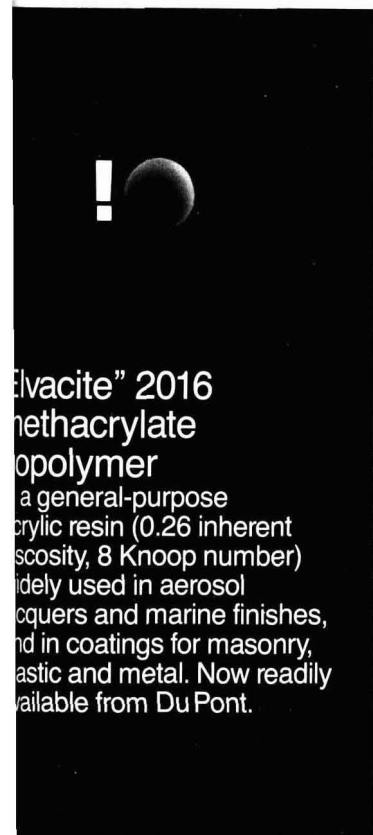
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Government and Industry

NPCA Intervenes in Suit Challenging OSHA Hazard Rule

The National Paint and Coatings Association has moved to intervene on behalf of the Occupational Safety and Health Administration in a major lawsuit that would challenge the Hazard Communication Final Standard issued by OSHA in November.

Petitions requesting court review of the rule were filed by the United Steelworkers of America and Public Citizen, Inc., an environmental lobbying group, in the United States Court of Appeals for the Third Circuit. The steelworkers union and Public Citizen sought to modify or set aside the rule on the basis of several of its provisions, including Federal preemption of conflicting state and local standards, a provision strongly endorsed by the paint industry.

The NPCA motion to intervene cited the industry's long-standing commitment to hazard communication programs, specifically NPCA's labeling guides, its

guide for completion of Material Safety Data Sheets for communicating hazard information to workers, and its Hazardous Materials Identification System (HMIS).

The motion also states that the association and its members would be adversely affected if the OSHA standard were enjoined, set aside, or substantially changed as a result of the suit.

NPCA commented that since no other member of industry has yet moved to intervene, or filed an independent petition for review, this appeal is needed to present an industry perspective.

While recognizing that costs to the industry of complying with the OSHA standard will be considerable, NPCA noted, they are far less than the costs that might be incurred if NPCA members were required to comply with various state and local laws in addition to the Federal standard.

New Standards for Artist Paints And Materials Available from ASTM

ASTM Subcommittee D01.57 on Artist Paints and Related Materials has developed two new standards and revised a third standard.

Specification for Artist Oil and Acrylic Emulsion Paints (D 4302) lists pigments that are suitable for use in first-quality artist paints. The standard provides important labeling information for artist paint manufacturers and consumers.

Test Methods for Light Fastness of Pigments Used in Artist Paints (D 4303) presents the test methods which were used to determine the list of pigments designated in D 4302. Artist paint manufacturers and consumers can use this standard to add to this pigment list.

In addition, revisions to D 4326, Standard Practice for Labeling Art Materials for Chronic Health Hazards, have been made. The standard, approved March 25, 1983, is used to label art materials such as paints, solvents, thinners, glazes, and clays for chronic health hazards. The revised version of the standard, while making no changes in the labeling requirements, has been rewritten in a more clear and consistent manner.

ASTM standards are available from ASTM Sales Services Dept., 1916 Race St., Philadelphia, PA 19103.

For more information on these standards and any work of Subcommittee

D01.57, contact Joy Turner Luke, Studio 231, Box 18, Route 1, Sperryville, VA 22740.

Additional information on any activities of Committee D-1 may be obtained from Brent Backus, ASTM Standards Development Div., in Philadelphia.

Applied Color Systems Opens New Headquarters

Applied Color Systems, Inc., a subsidiary of Armstrong World Industries, has opened its new 40,000 square foot headquarters complex in Lawrenceville, NJ. Situated on a 10-acre site adjacent to US Route 295 in the Princeton Pike Industrial Park, the facility houses all of Applied Color's New Jersey operations, including research, product development, customer training, manufacturing, and system assembly.

According to ACS President Donald R. Hall, "The new complex enables us to continue serving our customers efficiently and will accommodate future growth."

ACS, founded in 1970, has offices and technical centers in Charlotte, NC, Chicago, IL, and Western Europe. The company's major markets are in the textile, paint, plastics, and ink and printing industries.

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Cook Paint Sells Decorative Powder Business

Cook Paint and Varnish Co., Kansas City, MO, manufacturer of industrial and commercial coatings, has sold its decorative industrial powder business to Pratt & Lambert, Inc., Buffalo, NY.

The transaction involved approximately 3.5% of Cook's current sales volume and is in keeping with the firm's strategic plan to concentrate the marketing of its powder coatings in other directions.

Cook, a supplier of internal and external pipeline coatings, will intensify its thrust into the pipeline market as well as providing powder coatings for corrosion protection on reinforcing steel members used extensively in highways and bridge construction.

Mobil Acquires Du Pont's Can Coating Business

Mobil Chemical Co., New York, NY, a worldwide supplier of packaging coatings, has purchased Du Pont's domestic can coatings assets.

The acquisition includes patents, a license for the trademark Corlar[®] for can coatings use, product formulations, and manufacturing equipment. The technology will be integrated into the existing packaging coatings business of Mobil's Chemical Products Division.

Parr Paint Div. Acquired By Man-Gill Chemical

Man-Gill Chemical Co. announced the purchase of the Parr Paint Div. of Parr Inc., a wholly-owned subsidiary of Koppers Corp. The Division will be combined with another recent acquisition, Body Bros., Inc., to form the Man-Gill Chemical Co. Paint Group. The Paint Group will retain all sales and research/technical personnel from Parr Paint and Body Bros.

Sales and marketing functions for the Paint Group will be headed by Michael J. Clark, Vice President of Sales & Marketing. All other functions, including purchasing, production and research, will be under the direction of Joseph J. Potoczak, Vice President and General Manager, Paint Group.

Since 1953, Man-Gill Chemical Co. has developed products for metal forming, acid inhibitors, cleaning and metal finishing, and industrial coatings, and are used extensively in the steel, automotive and appliance industries.

Further applications of the company's extensive powder technology are being developed for rigid containers, and for heavy duty corrosion-resistant products for the chemical, oil, sewage, and structural steel markets, and coil coating applications.

LanChem Purchased by Akzo N.V.

Akzo N.V., a \$6 billion multinational chemical enterprise based in Arnhem, The Netherlands, has agreed to purchase LanChem Corp., East St. Louis, IL, effective as of January.

LanChem will continue to operate under the direction of its founder and chief executive officer, Dr. Herman J. Lanson, and vice-president, Elliott W. Lanson, as a subsidiary of Akzo Coatings America, Inc.

Dr. Hans Remijnse, managing director of Kunsttharsfabriek Synthese b.v., a subsidiary of Akzo Coatings, and manufacturer of specialty resins, said that LanChem will serve as the U.S. base for specialty coating resins and printing ink resins manufacturing and marketing. The acquisition of LanChem will enable the company to fully realize the U.S. market potential for its printing ink resin products, he said.

Dr. Lanson said the affiliation with Synthese will enable his company to combine the coating resin research efforts of LanChem with the polymer research resources of Synthese.

The LanChem plant facility began operation in September 1979.

Reichhold Purchases Florida Resin Plant

Reichhold Chemicals, Inc., White Plains, NY, has completed the acquisition of Textron Incorporated's Spencer Kellogg resin plant in Pensacola, FL.

Along with the plant, Reichhold also acquired Spencer Kellogg's Arochem rosin-based hard resin product line which is used in printing inks, coatings, and chewing gum. Both the plant and product line have been consolidated into Reichhold's Resins & Binders Div., which is headquartered in Pensacola, adjacent to the plant.

Reichhold said the acquisition will strengthen its resin marketing position in the Southeast, and provide additional process technology used in the manufacture of coating resins.

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Performance Comparison Of Exterior Flat Finishes On Hardboard Siding

R. Becker, S. Bussjaeger, Roger Haines,
J. Laurent, R. McFadden, and T. Sotta
Kansas City Society for Coatings Technology
Technical Committee

Exposure studies on the comparative performance of several flat exterior finishes on a variety of hardboard siding substrates have demonstrated a significant improvement in both substrate protection and coating performance with two-coat systems versus a single topcoat application. Ten different hardboard siding products were included as substrates for this evaluation. These boards were shown to have a wide range of densities, impact resistance, and moisture content. Substrate tests were also run to identify the edge swell and moisture absorption tendency of each board.

Best overall performance was achieved with a latex emulsion top-coat over either an alkyd/oil undercoat or acrylic latex primer. A single coat of oil/alkyd house paint was given the worst overall rating. Coating performance was generally better on smooth hardboard than on the textured products.

taken many of the markets previously held by plywood and lumber.

Of particular interest to the paint industry is the fact that hardboard siding comprises 25% to 30% of the total market for exterior wall covering. A full 60% of all hardboard manufactured is used directly in residential construction¹.

Exterior hardboard siding generally is sold in panel form or as narrow sheets for use as lap siding. All hardboard siding can be placed in one of the three following categories:

- (1) Factory-primed, smooth siding. No texture on the face of the board (*Figure 1*).
- (2) Factory-primed, embossed, or textured siding. Material is embossed or scored during the pressing operation to simulate various wood grains and surface finishes (*Figure 2*).
- (3) Unprimed, textured siding; sold without a factory-applied pre-primer (*Figure 3*).

A wide variety of finishes are applied to these siding products, offering various degrees of protection against weathering, but relatively little information is available concerning finish system performance on this substrate.

The primary objective of this study was to obtain comparative data on the weathering performance of selected exterior flat finishing systems on several currently available hardboard siding materials. An attempt was made to evaluate the substrate itself in order to demonstrate significant differences in the hardboard material and the effect of these differences on coating performance. The results of this two year study will serve as a basis for additional long-term evaluations of the finishing systems represented.

INTRODUCTION

Hardboard is a generic term for a panel manufactured from lignocellulosic fibers consolidated under heat and pressure to a density of 32 lb/ft³ or more¹. It is used for exterior siding, interior wall paneling, furniture, and other industrial and commercial uses. Hardboard has

¹Presented by Mr. Haines at the 61st Annual Meeting of the Federation of Societies for Coatings Technology in Montreal, Que., Canada, October 12, 1983.

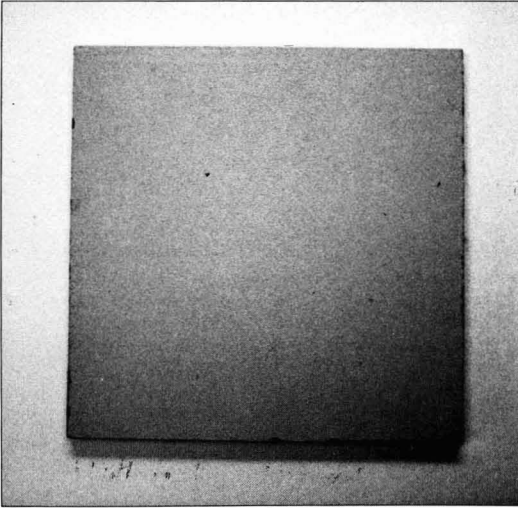


Figure 1—Pre-primed, smooth hardboard siding



Figure 3—Unprimed, textured hardboard

MATERIALS AND METHODS

Substrates

The hardboard panels used in this study were supplied by the various manufacturers in 1 ft × 2 ft sections. (Two of the five manufacturers contacted declined to supply boards; therefore, these boards were purchased at a local lumberyard in 4 ft × 8 ft panels and cut to the specified size.) The manufacturers were asked to supply products classified as medium-density, pre-primed, smooth lap siding; pre-primed textured; and unprimed textured siding. (Not all manufacturers produce a board in all three categories.)

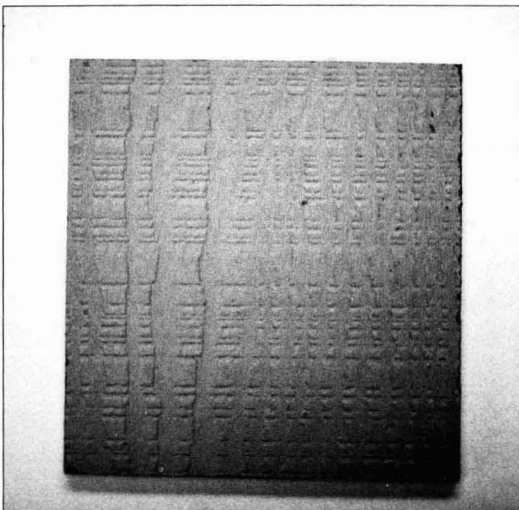


Figure 2—Pre-primed, textured hardboard

Any boards showing fractures, frayed edges, or other damage were discarded, and specific exposure panels were randomly selected from the remaining boards. A total of 120 boards were used in the exposure study.

Each of the five manufacturers was arbitrarily assigned an alphabetical code, A through E, and each board type was identified numerically as follows: 1 = Pre-primed, smooth lap siding; 2 = Unprimed textured siding; and 3 = Pre-primed, textured siding.

The boards were identified *only* by this alphabetical code and numerical classification throughout the evaluation (i.e., A-1, B-2, E-3, etc.).

FINISHING SYSTEMS

Primers

Formulation constants for the base coats used in this study are listed in *Table 1*. These primers were chosen to avoid the use of brand names or proprietary formulations.

Each panel was primed as shown in *Figure 4*. The top 4 in. of the panel were coated with a TT-P-25-type primer. The bottom 4 in. received a coat of latex primer. No base coat was applied to the 4 in. stripe in the center of the panel. Both primers were spray-applied at a coverage rate of 400 to 450 ft²/gal (3 to 4 mil wet).

Dry film thicknesses were measured at 1.5 mil for the TT-P-25 wood undercoat and 1.0 mil for the latex primer. Board D-2, because of its porosity, required two coats of the oil/alkyd primer to achieve equivalent dry film thickness. The panels were cleaned with a damp cloth before priming.

Top Coats

Table 2 provides a summary of the generic type and formulation constants of the finish coats included in this

Table 1—Priming Systems

	TT-P-25E ² Wood Undercoat	Acrylic House Paint Primer ² Rohm and Haas EXPR-35-4
Wt/gal	10.35 lb	9.50 lb
Viscosity	85 k.u.	85 k.u.
% Weight solids	64.0	37.3
% Volume solids	42.5	28.50
PVC	38.0%	13.50%

study. A representative range of vehicle systems and PVCs for exterior flat finishes was chosen for this performance evaluation.

All top coats were applied to the hardboard substrates with a brush at a spreading rate of 400 to 450 ft²/gal (3 to 5 mil wet). No special surface preparation was used. The edges and backs of the panels were left uncoated to simulate actual exposure and accelerate any failures related to moisture absorption.

Actual dry film thicknesses of the top coats were not recorded. Variations in finished dry film thickness would be expected, depending on the top coat choice of the consumer, application method, and substrate texture. Therefore, practical coverage rate and total number of coats were given priority over equivalent film thicknesses in this study.

Figure 5 shows a completed board. The panels were divided in half (one-foot square sections). Both halves were coated with the same vehicle system at identical PVCs, the left half in a medium green, the right half in a darker, deep brown color. These colors were chosen to enhance any discoloration and to simplify the evaluation of top coat failures versus top coat/primer defects.

All panels were allowed to dry for nine days in the laboratory before installation on the test fence.

Exposure

The hardboard substrates were fastened to galvanized metal A-frames at a 45° angle with a southern exposure. The panels were grouped according to manufacturer in 10 horizontal rows.

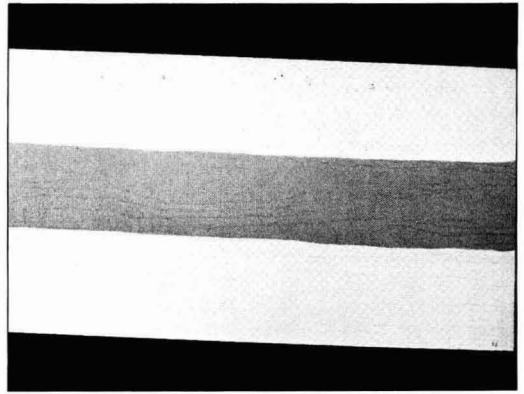
All boards were visually inspected every three months. ASTM performance ratings were taken only after 26 months of exposure.

Substrate Analysis

Of the 23 tests outlined in ASTM D 1037-72A (Evaluating the Properties of Wood Base Fiber and Particle Panel Materials),⁴ five were performed on the uncoated hardboard. These five tests are outlined in Table 3.

The objective of these tests was to determine whether hardboard, like natural wood siding, varies in many respects, and how some of these differences (i.e., water absorption, swell, texture, etc.) may affect the paint holding properties of the board.

All tests were run according to ASTM standards. Three specimens from each board were evaluated, and all ratings represent an average of these multiple tests.

**Figure 4—Preprimed, textured board with test primers applied**

Weights were accurate to within 0.01 g and measurements to 0.001 in.

Exposure Performance Ratings

Each finishing system was evaluated for six different criteria and assigned a numerical rating as specified in the ASTM methods listed in Table 4.⁵ An overall performance rating was given to each system, based on the average performance scores on all substances. (General Performance Rating, G.P.R.)

RESULTS AND DISCUSSION

Substrate Analysis

Densities of the boards tested varied from a low of 41.16 lb/ft³ (0.659 g/cm³) up to 54.65 lb/ft³ (0.876 g/cm³). In all cases, if a manufacturer submitted both smooth and textured products, the smooth lap, pre-primed siding had a lower density than boards with a textured finish (see

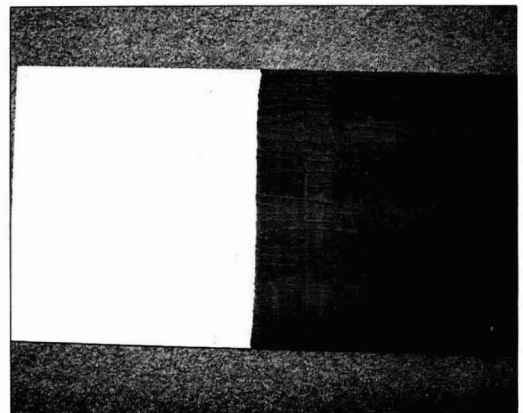
**Figure 5—Completed preprimed, textured panel before exposure**

Table 2—Finishing Systems

Code No.	Generic Type	PVC (%)	WT/Gal (lb)	% Solids Volume	% Solids Weight	PVC/CPVC
01-35	Oil/alkyd	35	9.55	40.85	59.12	0.672
01-43	Oil/alkyd	43	9.40	33.55	53.75	0.826
01-50	Oil/alkyd	50	9.30	29.12	50.14	0.960
02-35	Acrylic	35	10.78	39.15	52.45	0.672
02-43	Acrylic	43	10.70	31.85	46.40	0.826
02-50	Acrylic	50	10.65	27.40	42.75	0.960
03-35	Acrylic terpolymer	35	10.90	39.15	53.00	0.672
03-43	Acrylic terpolymer	43	10.76	31.85	46.85	0.826
03-50	Acrylic terpolymer	50	10.71	27.40	43.05	0.960
04-35	Vinyl-acrylic	35	10.88	39.15	52.92	0.672
04-43	Vinyl-acrylic	43	10.78	31.85	46.80	0.826
04-50	Vinyl-acrylic	50	10.70	27.40	43.00	0.960

Figure 6). Boards from Manufacturer "A" showed relatively high densities compared to most of the other boards evaluated, some measuring higher than the density range specified by the American Hardboard Association for medium density boards.⁶

Moisture content of the boards ranged from 4.30% by weight to 6.99% with an average of 5.71% moisture.

The test for water absorption, as measured by the percent increase in the weight of the boards after immersion in water for a 24-hour period, resulted in a wide range of values. The textured, *unprimed* boards showed a 4.0% increase in water absorption over the textured and smooth *primed* boards.

Table 3—Substrate Tests

Board Characteristic	ASTM D 1037-72a Reference
Size and appearance	Sections 7 through 10
Impact resistance	Sections 91 through 95
Water absorption and percent swell	Sections 100 through 106
Moisture content	Sections 124 and 125
Density	Sections 124 and 125

Table 4—Criteria for Evaluating Test Coatings

Performance Criteria	ASTM Designation
Erosion	D-662-44 "Evaluating Degree of Erosion of Exterior Paints"
Checking	D-660-44 "Evaluating Degree of Checking of Exterior Paints"
Cracking	D-661-44 "Evaluating Degree of Cracking of Exterior Paints"
Flaking (adhesion loss)	D-772-47 "Evaluating Degree of Flaking (scaling) of Exterior Paints"
Discoloration	All surface contamination was numerically rated based on FSPT standards for dirt and mold accumulation.

As demonstrated in Figure 7, boards A2-B and D-2 showed dramatic increases in weight (24.1% and 57.3%, respectively). Board D-2 has shown some unique problems with severe warping and board degradation (see Figure 9). This substrate deterioration is evident only on areas of the board where a single coat of latex paint was applied and is much more pronounced in the 43% and 50% PVC vinyl-acrylic and acrylic terpolymer formulations.

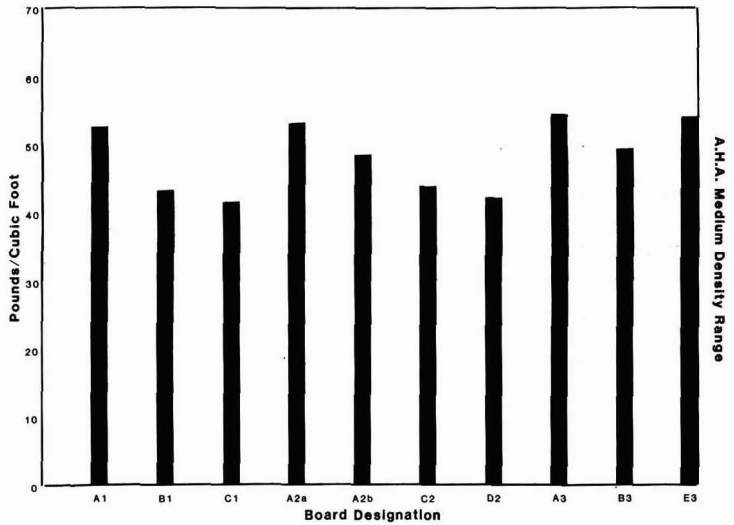
The impact resistance of the boards is shown in Figure 8. It is difficult to relate the impact resistance of the substrate to the performance of the coatings applied to that substrate. This test is more likely a measure of the hardboard's resistance to structural damage due to mishandling during construction or hail.

A simple test was performed to measure the board's tendency to swell when subjected to a high moisture environment. The board's thickness was measured after stabilizing for two days in the laboratory (50% R.H. \pm 2% and 70° F \pm 2°) and again after being immersed in water for a 24-hour period. The difference between the dry thickness and wet thickness was used to determine the percent board swell. These values are shown on the graph in Figure 7. The pre-primed boards generally showed less swell than the unprimed boards. The primer apparently offers some protection to the board against moisture penetration. The boards from Manufacturer "B" showed a slightly higher tendency to swell than identical board types from the other manufacturers.

Exposure Ratings

OIL/ALKYD TOP COATS (01 SERIES): All oil/alkyd top coats demonstrated consistently poorer performance over both priming systems than their latex counterparts. Within the oil/alkyd group, ratings for erosion are much lower on the latex-primed areas of the boards than on either the unprimed or oil-primed sections. The single-coat, oil/alkyd finish was given the lowest overall rating, showing poor results for adhesion, checking, and discoloration in all PVC ranges (Table 5).

Figure 6—Density of hardboard [ASTM D 1037 (124-125)]



Loss of adhesion at this point is evident only on two of the three pre-primed, textured boards (A-3 and B-3), and is limited to the unprimed sections of the panels. Adhesion loss is more pronounced in the 35% PVC formulation (01-35) than in the higher PVC finishes.

ALL ACRYLIC TOP COATS (02 SERIES): The acrylic finishes are performing well on the majority of the boards, as are the rest of the latex formulations. It should be noted that on the unprimed areas of board D-2, where most of the latex systems have allowed the board to degrade substantially, the all-acrylic coatings have offered significantly better protection (Table 6).

There are few differences between the performance of the 35% PVC formulation and the 50% PVC product within the acrylic test group. The lower PVC coating has

shown better resistance to discoloration and checking than the 50% PVC finish.

ACRYLIC TERPOLYMER TOP COATS (03 SERIES): The terpolymer finishes also performed well in this exposure study; however, some differences were noted between these paints and the all-acrylic systems on the unprimed sections of the boards.

The protection offered to board D-2 with a single coat of the acrylic terpolymer formulations was noticeably less than the all-acrylic top coats, and resistance to cracking was less in the high PVC (50%) terpolymer formulation than with the equivalent all-acrylic product. Protection against discoloration was rated higher for all PVC ranges in the 03 Series than in the 02 Series test group (Table 7).

No differences were noted in the performance of the

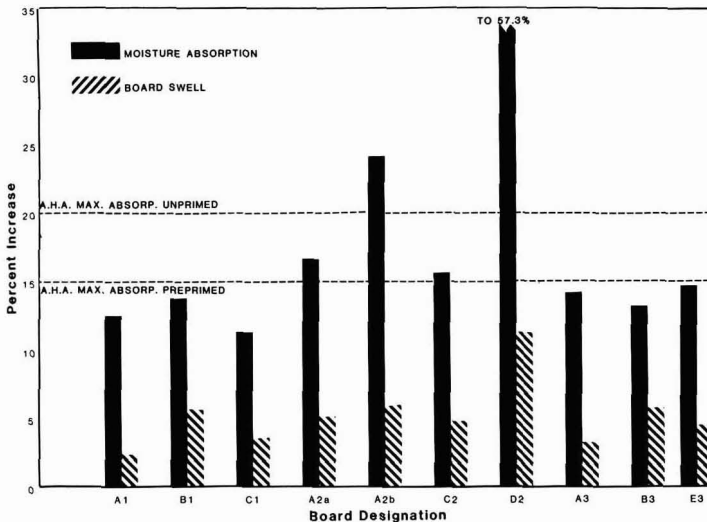


Figure 7—Percent moisture absorption and percent board swell [ASTM D 1037 (100-106)]

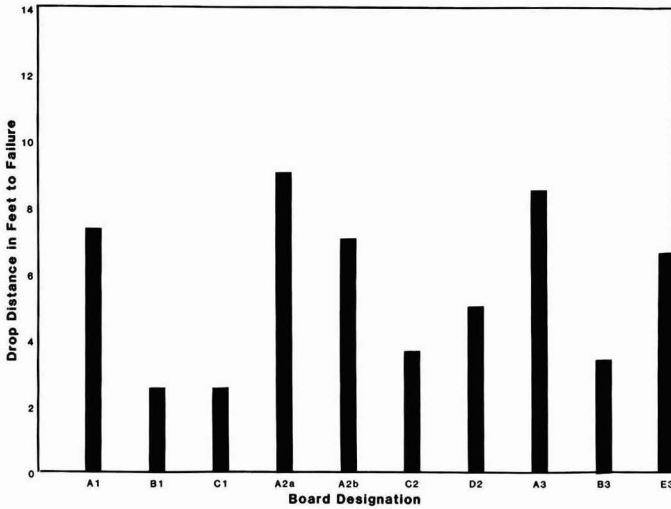


Figure 8—Impact resistance [ASTM D 1037 (91-95)]

acrylic terpolymer formulations and the all-acrylic top coats on the primed areas of the boards.

VINYL-ACRYLIC TOP COATS (04 SERIES): After 26 months of exposure, the overall individual ratings for the vinyl-acrylic systems are very close to those of the Series 03 and 02 top coats. The 50% PVC formulation exhibited some film erosion over the latex primed section of board A-2, and the resistance to checking with a single coat of vinyl-acrylic was somewhat less in the higher PVC formulations (43% and 50%) than in the other latex top coats (Table 8).

The vinyl-acrylic finishes were also rated lower for color retention (fade) than the 03 and 02 Series paints.

SUMMARY

This exposure study illustrates the enhanced protection and weatherability of two-coat paint systems on the hardboard substrates tested. The two-coat, all-latex systems and oil-primed, latex top coat systems exhibited significantly better performance than equivalent coats of all oil/alkyd products or the latex-primed, oil/alkyd topcoat systems. Generally, the highest rate of failure was found with a single coat of an oil/alkyd paint on textured hardboard substrates.

The factory-primed boards showed more resistance to water absorption and swelling than their unprimed counterparts; however, there was no conclusive evidence correlating the low absorption and swelling properties of these boards to increased paint holding characteristics. In fact, there was no statistical evidence to support any correlation between test results on the uncoated boards and the performance of the boards as paint substrates. At this point, it can only be stated that the paint systems tested have shown a lower rate of failure on the smooth pre-primed boards than on the textured products (pre-primed or unprimed).

From the results of this study, it appears that a minimum of two coats of finish is necessary for satisfactory performance on exterior hardboard siding (pre-primed or unprimed). Latex top coats are preferred, but there is no evidence at this time to suggest better service life from an all-acrylic paint compared to an acrylic terpolymer or vinyl-acrylic product (except for the improvement in color retention noted for the 03 and 02 Series top coats versus the vinyl-acrylic formulations). Poor results can be expected from one coat of a flat, oil/alkyd finish, or a two-coat, latex-primed, oil/alkyd top coat system.



Figure 9—Unprimed, textured board "D-2" after 26 months' exposure. Note panel degradation on center, single-coated, section of board

Table 5—Oil/Alkyd Topcoat Systems

	01-35 PVC			01-43 PVC			01-50 PVC		
	O.P. ^b	U.P. ^b	L.P. ^b	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.
Erosion	9.5	10.0	7.1	9.6	10.0	8.3	9.5	9.9	8.1
Checking	9.4	7.9	9.5	9.8	7.8	9.7	9.5	7.2	9.4
Cracking	9.9	8.1	10.0	9.8	8.3	10.0	9.9	8.6	9.9
Flaking	9.8	8.7	9.9	9.9	8.7	10.0	10.0	8.9	10.0
Discoloration	9.9	9.2	9.9	9.7	8.0	9.9	9.7	7.9	9.8
Fade	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
G.P.R. ^a	8.58	7.97	8.70	8.80	7.80	8.65	8.77	7.75	8.53

(a) General Performance Rating.

(b) O.P. = Oil primed; U.P. = Unprimed; L.P. = Latex primed.

Table 6—All Acrylic Topcoat Systems

	02-35 PVC			02-43 PVC			02-50 PVC		
	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.
Erosion	10.0	10.0	10.0	10.0	9.9	10.0	10.0	9.0	10.0
Checking	10.0	9.8	10.0	10.0	9.9	10.0	10.0	9.7	10.0
Cracking	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.8	10.0
Flaking	10.0	10.0	10.0	10.0	9.9	10.0	10.0	9.9	10.0
Discoloration	10.0	9.8	10.0	10.0	9.5	10.0	10.0	9.5	10.0
Fade	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
G.P.R.	9.83	9.76	9.83	9.83	9.70	9.83	9.83	9.63	9.83

See Table 5 for abbreviation designations.

Table 7—Acrylic Terpolymer Topcoat Systems

	03-35 PVC			03-43 PVC			03-50 PVC		
	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.
Erosion	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Checking	10.0	9.9	10.0	10.0	9.9	10.0	10.0	9.8	10.0
Cracking	10.0	9.8	10.0	10.0	9.6	10.0	10.0	9.6	10.0
Flaking	10.0	9.9	10.0	10.0	9.9	10.0	10.0	9.9	10.0
Discoloration	10.0	10.0	10.0	10.0	9.7	10.0	10.0	9.9	10.0
Fade	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
G.P.R.	9.83	9.77	9.83	9.83	9.68	9.83	9.83	9.70	9.83

See Table 5 for abbreviation designations.

Table 8—Vinyl Acrylic Topcoat Systems

	04-35 PVC			04-43 PVC			04-50 PVC		
	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.	O.P.	U.P.	L.P.
Erosion	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	9.9
Checking	10.0	9.9	10.0	10.0	9.6	10.0	10.0	9.6	9.9
Cracking	10.0	9.8	10.0	10.0	9.6	10.0	10.0	9.6	10.0
Flaking	10.0	9.9	10.0	10.0	9.8	10.0	10.0	9.8	10.0
Discoloration	10.0	9.9	10.0	10.0	9.5	10.0	10.0	9.5	10.0
Fade	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
G.P.R.	9.50	9.40	9.50	9.50	9.25	9.50	9.50	9.25	9.46

See Table 5 for abbreviation designations.

Kansas City Society Technical Committee

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ACKNOWLEDGMENT

We wish to thank Farmland Industries, Inc., and Davis Paint Co. for their valuable assistance in the presentation of this work. Additional thanks to the Kansas City Society for Coatings Technology and the members of the Technical Committee for their input and support.

Acknowledgment is also due the American Hardboard Association and its member companies for contributing both materials and information critical to the successful completion of this study.

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Vehicle	Medium Oil Alkyd	Epoxy-Polyamide	Long Oil Alkyd	Acrylic or Styrenated Acrylic
Pigments	HALOX CW-221	HALOX BW-111	HALOX CW-2230	HALOX BW-191
HALOX composition, lb/gal	1.0-1.5	1.0	3.5	0.75-1.50
Expected salt fog performance, hr.	350	1000-1500	3000-4000	1000-1500
Expected field service life, yr	1-3	10-12	8-12	7-10



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A Simple Model For the Numerical Simulation Of Reflectance of Black Chrome Coating Systems

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Black chrome has been used extensively as an absorptive coating in solar collector systems because of its high absorptance/emittance ratio as well as its general stable characteristics under various environmental conditions. This paper presents a numerical simulation on the optical properties of black chrome coating systems. A simple model is developed for black chrome composite by considering the coating to be composed of three "pseudo" layers. Rouard's method is used for computing the reflectance spectra of the system. The model can be used to serve the engineering needs for correlating the optical performance of the material. A numerical example is provided to illustrate the approach.

INTRODUCTION

Black chrome has been used extensively as an absorptive coating in solar collector systems because of its high absorptance-to-emittance ratio as well as its stability under many of the exposure conditions encountered in solar collectors.¹⁻³ Recent research has demonstrated that the ability of black chrome to withstand long-term exposures to elevated temperatures may depend upon the composition of the material.^{2,4} The experimentally observed degradation in absorptance of black chrome

during oven aging tests up to 250°C led to the development, by the authors, of a model for estimating the effect of exposure to elevated temperatures.⁵ Based on the model, the permanent changes in the spectral reflectance of black chrome resulting from thermal aging can be predicted. To use the model, it is necessary to obtain first the baseline spectral reflectance at a reference temperature. The baseline spectra reflectance may be determined using analytical instrumentation. But because of the cost of the instrumentation and its maintenance, it is not readily available to industrial and manufacturing firms.

Reported here is a simplified process for determining the baseline reflectance of black chrome coatings so that the previously developed model⁵ can be used more in the industry. Specifically, a simple model is developed for numerically computing the reflectance curve using known parameters of the coating system.

BACKGROUND

Black chrome is a complex composite. It is composed of metallic chromium (Cr) and chromic oxide (Cr₂O₃). Even though analytical and experimental studies have been pursued,⁶⁻⁸ the microstructure is not fully characterized. For this reason, the reflectance of the system cannot be computed satisfactorily based on the microstructural composition of the coating. Assumptions on the composition have been made to utilize multilayer modeling in the numerical simulation of the reflectance of the coating system.⁹ Because the reflectance of a system is very sensitive to the composition of the material, the multilayer approach

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Nomenclature

F	= effective Fresnel coefficient
R	= the term defined in equation 2 (reflectance)
d	= thickness of a layer
f	= volume fractions of the components in a composite
k	= absorption coefficient
n	= reflectance index
δ	= a term defined in equation 3
λ	= wavelength
ρ	= reflectance of the system

Subscripts

i, j = an index denotes the number of the layer d

Symbols

\sim	= denotes the variable as a complex number
*	= denotes the variable as a conjugate of a number

based on the assumed composition is unlikely to provide quantitative information on the optical characteristics of the coating system. Furthermore, the surface of black chrome is not smooth at the microstructural level, especially after exposure to elevated temperature conditions. Such roughness on the surface can be seen in *Figures 1 and 2*. *Figure 1* shows an unexposed black chrome specimen; *Figure 2* shows a specimen after it was exposed at 250°C even aging for 22 days. The surface conditions raise further problems in utilizing a layered model for the numerical simulation of the coating system. Because of these concerns, the approach used in this study has focused on the development of a simple structural model. The effects due to the surface roughness, such as diffusing, are not included in the present model.

DEVELOPMENT OF THE MODEL

Description of the Model

The major criteria used are: (1) the model must be simple; (2) the model must be capable of reflecting the known properties of black chrome; (3) the model must

depend on physically realistic parameters of the coating, e.g., the thickness of the coating.

The black chrome coating is visualized as three pseudo-layers, shown schematically in *Figure 3*. The outer layer is assumed to be a layer of chromic oxide (Cr_2O_3); the middle layer is assumed to be composed of metallic chromium and chromic oxide ($\text{Cr}/\text{Cr}_2\text{O}_3$); and the inner layer is assumed to be composed entirely of metallic chromium. The distribution of chromic oxide in these layers is based on the assumption that oxidation will be more prevalent near the top surface. In reality, the major portion of the coating should be composed of a mixture of Cr and Cr_2O_3 . Therefore, the thickness of the middle layer should be much more than that of the other layers.

In the example given below, it is assumed that the inner and outer layers comprise five percent each and the middle layer the remaining 90% of the total coating thickness. The optical properties of the inner and the outer layers should be based on the real properties of the materials, i.e., Cr or Cr_2O_3 , respectively. But the properties of the second layer should be determined based on its relation to the reflectance of the system as follows. It should be noted that the properties of the second layer obtained in this approach are the pseudo properties of the assumed layer.

Reflectance of a Layered Coating System

For a layered coating system with given material constants, the reflectance can be computed directly with Maxwell equations. In this paper, an equivalent approach, Rouard's method,¹⁰ is utilized for evaluating the reflectance of the system. A complex refractive index, \tilde{n} , is used to represent the properties of the system.¹⁰ The real part of the index, \bar{n} , n , represents the ratio of the wave velocity in vacuum to that in the medium. The imaginary part of \tilde{n} represents the energy absorption, k . It is worth pointing out that, in practice, the complex refractive index \tilde{n} has been used in the absorptive medium to replace the function of n in a transparent medium.¹⁰⁻¹² Hence, the effective Fresnel coefficient, \bar{F} , used in Rouard's method

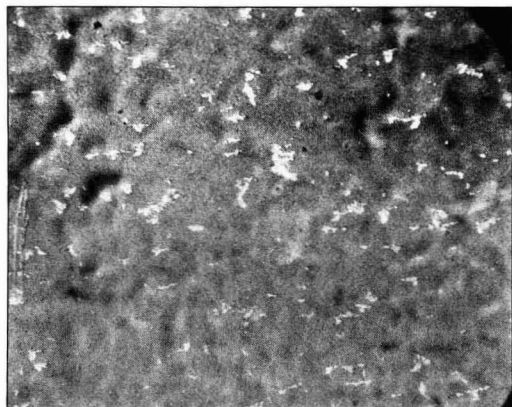


Figure 1—Micrograph of the surface of an unexposed black chrome specimen (at 80 × magnification)

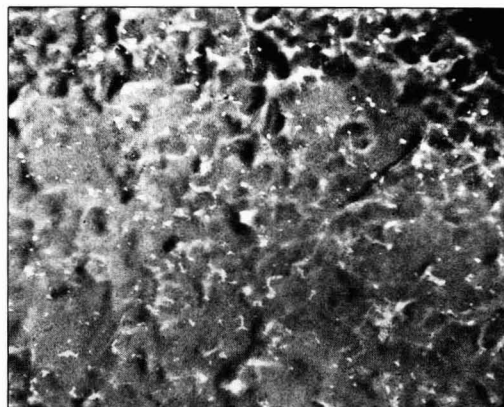


Figure 2—Micrograph of the surface of a specimen after it was exposed to 250° C oven aging for 22 days (at 80 × magnification)

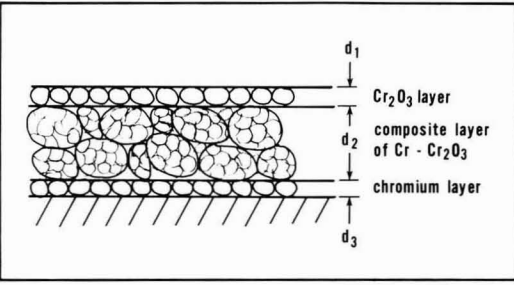


Figure 3—Sketch of the structural model for the black chrome coating

is a complex number. For the specific layer, i , of a system, F_{i-1} may be expressed as:

$$\tilde{F}_i = \frac{\tilde{R}_i + \tilde{R}_{i+1} \exp(-2i\delta_i)}{1 + \tilde{R}_i \tilde{R}_{i+1} \exp(-2i\delta_i)} \quad (1)$$

where

$$\tilde{R}_i = \frac{\tilde{n}_{i+1} - \tilde{n}_i}{\tilde{n}_{i+1} + \tilde{n}_i} \quad (2)$$

with

$$j = i, i + 1 \quad (2a)$$

and

$$\delta_i = 2\pi d_i \tilde{n}_i / \lambda \quad (3)$$

in which d_i is the thickness of the i th layer. The effective Fresnel coefficient, F_{i-1} , for the $(i-1)$ layer can be written as:

$$\tilde{F}_{i-1} = \frac{R_{i+1} + F_i \exp(-2i\delta_{i+1})}{1 + \tilde{R}_{i+1} \tilde{F}_i \exp(-2i\delta_{i+1})} \quad (4)$$

and the reflectance, ρ , of the system is:

$$\rho = \tilde{F}_1 \cdot \tilde{F}_1^* \quad (5)$$

where \tilde{F}_1^* is the conjugate of \tilde{F}_1 . For the present model, the total number of layers is fixed as three.

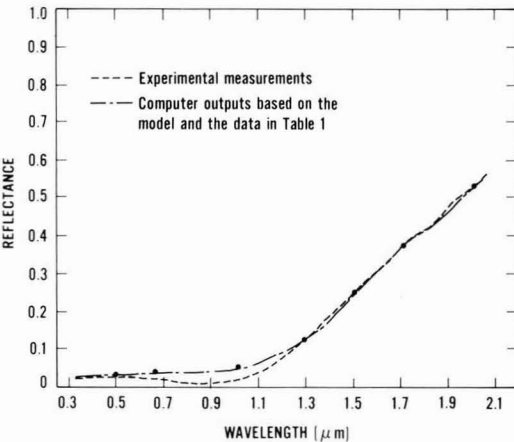


Figure 4—Computed reflectance using the model

Table 1—Values of n and k as the Effective Properties Of the Second Layer in the Model for the Illustrated Example

Wavelength (in μm)	n	k
2.0	5.89	3.10
1.7	4.03	2.02
1.5	3.57	1.74
1.3	2.45	1.17
1.0	2.27	1.19
0.67	2.68	1.33
0.5	2.77	1.67

EXAMPLE AND DISCUSSION

An example is given to illustrate how the model may be used to evaluate the reflectance of the system. Assume a black chrome coating specimen with measured spectral reflectance, as shown in Figure 4, is to be simulated numerically by the model described above. The specimen is a black chrome coating over a nickel flashing on a steel substrate.⁵ The average total thickness of black chrome was measured to be $0.75 \mu\text{m}$. As noted earlier, the first layer and the third layer are assumed to be five percent each of the total thickness. The optical properties of the first and third layers used in the evaluation are shown in Figures 5 and 6.¹³ The volume fraction of Cr, f_1 , is equal to 0.0 for the first layer and equal to 1.0 for the third layer. With the trial and error method, n and k values for the second layer are obtained using equations (1) through (5);

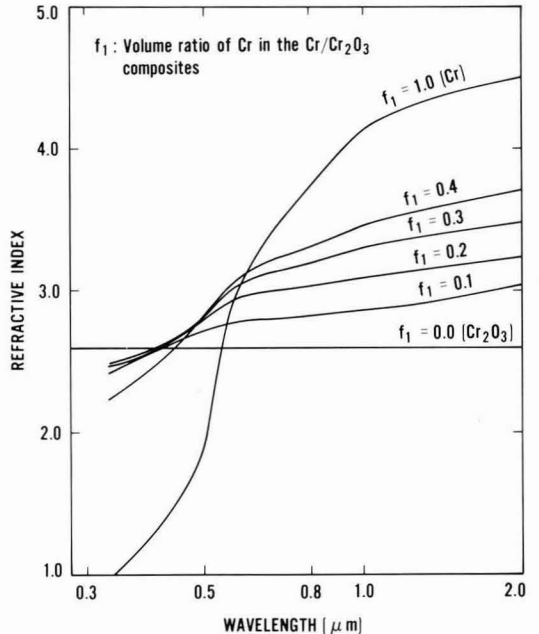


Figure 5—Refractive index vs wavelength. The index was computed based on the mean field theory

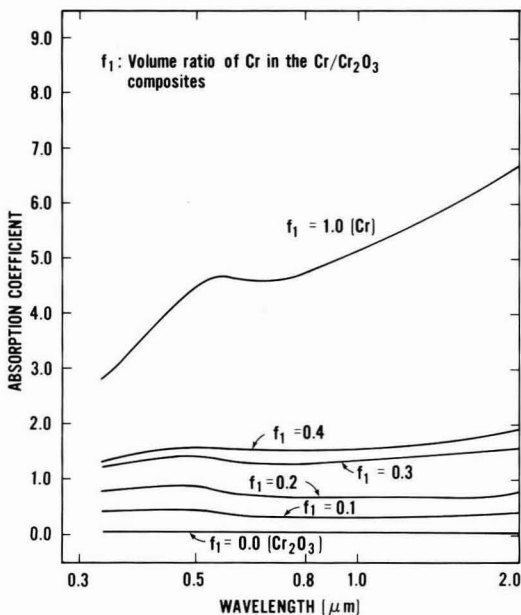


Figure 6—Absorption coefficient vs wavelength. The coefficient was computed based on the mean field theory

these values are listed in Table 1. The values shown are not the optimized solutions but they are in the realistic range of Cr/Cr₂O₃ values. The computed reflectance spectra of the system based on these data can give satisfactory results as shown in Figure 4. An interesting fact found in the numerical study was that the k values obtained in the example for each wavelength, as listed in Table 1, are quite close to the values found using mean field theory¹⁴ for the volume fraction of Cr equal to 0.4. The n and k values for various values of f , including 0.4, are plotted in Figures 5 and 6. The mean field theory was discussed in depth in reference 14.

SUMMARY

A simplified three-layer model was developed to simulate numerically the black chrome coating system. It was shown how the parameters of the layers in the model could be determined based on Rouard's method. With these model parameters obtained, the reflectance of the coating system could be calculated. The model was satisfactory for numerically simulating the baseline spectral reflectance for the black chrome coatings. It was found in the illustrated example that the imaginary part

of \tilde{n} values of the second layer were close to a condition with a specific f ($f=0.4$ for the selected example). It seems that the model developed not only can serve the purpose of computing the baseline spectral reflectance but also may be used to estimate the composition of the system.

ACKNOWLEDGMENTS

The authors are grateful to Drs. J. Ings and D.E. Newbury, of the National Bureau of Standards, for their assistance in the experimental work, and to Dr. Kent Reed, of the National Bureau of Standards, for his assistance as well as valuable discussions in the preparation of this paper. The authors also express their thanks to Drs. R.N. Pettit and J.N. Sweet, of Sandia National Laboratories, for their helpful discussions on the subject, and to the U.S. Department of Energy for its support of the research.

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Autooxidative Crosslinking Of Vegetable Oils and Alkyd Emulsions

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Autooxidative crosslinking of vegetable oils and vegetable oil-derived alkyds prior to application of the coating is a new and novel method of economically preparing water emulsions of these materials for commercial coatings uses. Air and oxygen were utilized to autooxidize the emulsified particles to an optimal crosslink density for a balance between rapid dry times and good film properties. The process variables of oxygen concentration, temperature, agitation rate, and catalysis were studied to optimize the conditions of the reaction to produce the best possible films. Alkyds were synthesized with varying oil lengths to determine the effect of oil length on autooxidation reaction rate. Also, alkyds were synthesized from vegetable oils containing varying percentages of conjugation to study the reaction rate as a function of percent conjugation. The films prepared from the emulsions were evaluated in terms of tensile strength, elongation, hardness, and dry time.

INTRODUCTION

The primary goal of this research is the utilization of renewable raw materials such as soybean oil in waterborne emulsion-type surface coatings. Emulsified alkyds and oils have been autooxidatively crosslinked to a near-gel or gelled state within the emulsified polymer particles. The emulsifier type was carefully selected such that the emulsion remained stable during the crosslinking process. Before crosslinking, the emulsion particle size was reduced to less than 1.0 micron and maintained at this size during the autooxidative process. The autooxidative

process was continued until the maximum crosslink density that would still allow adequate flow for coalescence was achieved as observed by scanning electron microscopy (SEM). During film formation and particle coalescence, the particles continue to autooxidize on exposure with atmospheric oxygen and form a dense uniform film as observed by SEM.

This research has produced vegetable oil-based emulsions which will dry to touch rapidly and allow water clean-up equivalent to acrylic and vinyl latex coatings. However, the hardness is 40% less than the base alkyd.

THEORY

Emulsification of Alkyds and Oils

The emulsification of vegetable oils and vegetable oil-derived alkyd polymers requires suitable emulsifying agents. The selection of an emulsifier for stabilization of vegetable oil material will not necessarily be the most favorable emulsifier for a vegetable oil-derived alkyd. Emulsification experiments must be conducted after determining the compatibility of the emulsifier in the aqueous and polymer phases such that the hydrophilic-lipophile balance, which is related to the solubility parameter,¹ may be obtained. Emulsifiers were selected on the basis of the characteristics that were necessary for emulsification of vegetable oils and vegetable oil-derived alkyds. "McCUTCHEON'S Detergents and Emulsifiers"² was reviewed for this general purpose. *Figure 1* illustrates the geometrical configuration of the particle in relation to the emulsifier layer which presents a barrier to oxygen diffusion. It can be seen that the lipophile segment of the emulsifier is soluble in the alkyd particle phase and the hydrophilic segment is soluble in the aqueous phase. As indicated in *Figure 1*, the oxygen must diffuse³ from the aqueous phase through the emulsifier region and into the alkyd particle to initiate autooxidation. A discussion of mechanisms may be found in the texts of Lenz⁴ and Odian.⁵

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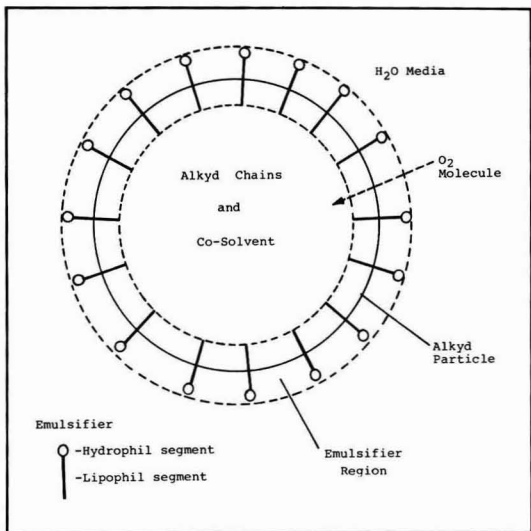


Figure 1—Emulsified alkyd particle and oxygen diffusion

Autooxidation of Emulsified Alkyds and Oils

Vegetable oils are obtained and refined from several plant sources. They are largely comprised of the triglyceride esters of fatty acids. Three particularly important oils are soya, linseed, and tung oil since these oils contain fatty acids with wide variation in olefinic groups and conjugation. For example, soya oil contains oleic, linoleic, linolenic, stearic, and palmitic fatty acids; linseed oil contains the same fatty acids, but in different proportions; and tung oil contains a major proportion of eleosteric fatty acid.

Stearic fatty acid is saturated, oleic contains one olefin group at the carbon (9) position, linoleic fatty acid contains two olefin groups at the carbons (9) and (12) positions. Linolenic fatty acid contains three olefin groups at the carbons (9), (12), and (15) positions. Eleosteric acid contains olefin groups at carbons (9), (11), and (13) and the double bonds are conjugated. In addition, a mixture of isomers exists within the structure of these materials. Also, erythro- and threo-conformations are present in these same structures, but of undetermined proportions.

Historically, two fundamental theories of autooxidation are dominant. First, there is allylic abstraction of a hydrogen atom and second, direct addition of oxygen to the double band. One of the most important consequences of free radical theory of olefin autooxidation is that the unpaired electron in the initially formed allylic type hydrocarbon radical is delocalized being more or less equally distributed between the "1" and "3" carbon atoms in alkylated ethylenes. This leads to two consequences: The first is that more than one hydroperoxide may be formed; the ratios of the various hydroperoxides depend on the electron densities on the carbon atoms involved. The second is that the more delocalized an unpaired electron the greater the rate of formation of hydro-

Table 1—Materials

Number	Material Description
I	Soya oil, alkali refined
II	Short oil soya alkyd
III	Medium soya oil alkyd
IV	Long soya oil alkyd
V	Extra-long oil soya alkyd
VI	Urethane soya alkyd

peroxide. The investigations of Farmer, et al.⁶ on polyenes showed the existence of both of these phenomena.

Autooxidative crosslinking of the above materials results in the formation of a three-dimensional polymer network containing ester and ether crosslinks. The degree of crosslinking is controlled by several factors including oxygen concentration, concentration of unsaturated and conjugated groups, and temperature. In a reactor, the oxygen concentration can be controlled by the oxygen partial pressure as described by Henry's Law.

Bufkin and Grawe⁷ discussed most of the principal concepts which have been employed over the last 10 years to develop thermosetting or crosslinking emulsions based upon many different chemistries including a discussion of drying oils and alkyd resins in emulsions. This six-part review was designed to serve as an introduction to a series of publications from these laboratories describing research and development of crosslinking emulsions which are new and novel, of which this report is a portion.

Control of Autooxidative Crosslinking With the Swelling Ratio

An excellent technique for studying the network structure in crosslinked polymers involves the swelling of a polymer in solvent to measure its "swelling ratio."⁸ The swelling ratio is the volume of the solvent swollen polymer to the volume of the dry polymer. If a crosslinked polymer is added to a solvent for the uncrosslinked polymer, then the crosslinked polymer will swell, but it will not dissolve, and the total volume will increase. If any uncrosslinked polymer is present it will dissolve and diffuse out of the swollen polymer. The uncrosslinked material is the sol fraction of the total polymer sample. The crosslinked material will swell in the three-dimensional polymer gel phase until the solution osmotic forces are balanced by the forces due to the stretched segments of polymer chains. These elastic retractive forces are inversely proportional to the molecular weight of polymer between crosslinks. A highly crosslinked polymer will not swell as much as a lightly crosslinked polymer.⁹

Table 2—Formulation for Conjugation Study

Component	Percent (W/W)
Trimethylol propane	31.90
Fatty acid oil, vegetable	41.12
Phthalic anhydride	33.10
Less water	6.12

Table 3—Formulation of Soya Oil Emulsion

Component	Percent (W/W)
Soya oil	50.0
Distilled water	49.0
Dodecyl sodium sulfate	1.0

EXPERIMENTAL

Materials

The materials used in this study are listed in *Table 1*. The alkyds were prepared by esterification of vegetable oils with phthalic anhydride and multifunctional alcohols to obtain the desired oil length.¹⁰ The raw soya oil had been alkali refined to remove free fatty acids. Conjugated oils were used for varying the percent conjugation of alkyds for autooxidizable emulsions which were synthesized by the formulation described in *Table 2*.

Emulsification Procedure

The oils and alkyd materials were emulsified by the following procedures:

- (1) The emulsifying agent was dissolved in distilled water at 25.0°C.
- (2) The oil or alkyd was mixed with the emulsifier solution while simultaneously being dispersed with a Braunsonic Ultrasonic Vibrator at 100 watts of power, forming a pre-emulsion.
- (3) The pre-emulsion was stable enough to remain intact during transfer to a Gaulin Submicron Disperser and Homogenizer. The emulsion was recycled until the desired particle size reduction was achieved. The Gaulin Homogenizer was operated at 3,500 pounds per square inch of shear force.

Table 3 lists the components of the formulation that were found to be suitable for the emulsification of alkali refined soya oil emulsion. *Table 4* lists the components for the formulation of the alkyd emulsions.

Particle Size Determination

A Coulter-Counter Model T411 was used with the M3 Data Converter¹¹ and 15 micron aperture to measure the emulsion particle diameter. The limiting particle diameter for this instrument was 0.20 microns. The emulsion samples were diluted with 2.0% NaCl electrolyte before

Table 4—Formulation of Alkyd Emulsion

Component	Percent (W/W)
Alkyd, vegetable oil	50.0
Distilled water	48.0
Emulsifier	2.0
75% Nonylphenoxypoly (ethyleneoxy) alcohol	
25% Dodecyl sodium sulfate	

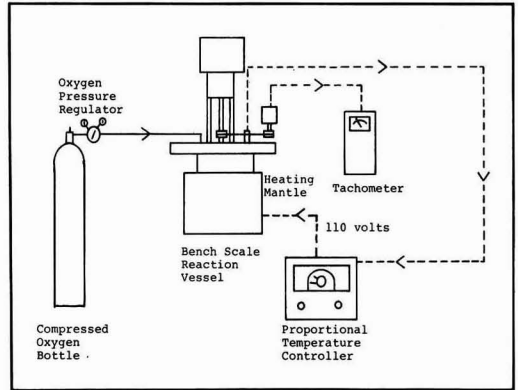


Figure 2—Emulsion autooxidation reaction apparatus

the measurement. The data are reported in particle diameter distribution by volume and population.

The volumetric particle diameter was indicated by the relative volume occupied by particles in a given volume of emulsion. The population of particles of a given diameter was indicative of the number of particles of that diameter within a volume. As a particle decreases in diameter, it also decreases in volume and increases with surface to mass ratio. Therefore, the term which best expresses the average particle diameter is volume geometric mean, microns. The explanation for this difference is related to the different statistical methods for calculation of these mean values. "Volume geometric mean" is calculated from percent particle size by volume and "population geometric mean" is calculated from the number of particles of each diameter.

Processing of Alkyd and Oil Emulsions

The autooxidation of oil and alkyd emulsions was conducted in a Bench Scale pressure vessel illustrated in *Figure 2*. The reactor was equipped for control of the air/oxygen pressure, temperature, and agitation rate. The turbine agitator, monitored by a tachometer, thoroughly circulated the emulsion within the vessel. The temperature sensor was in the liquid adjacent to the turbine

Table 5—Oxygen Pressure, Induction Time, Crosslinking Period, and Total Reaction Time for Alkyd III To Reach a Swelling Ratio of 3.7

Oxygen Pressure, psig/atm	Induction Period, Hours	Crosslinking Period, Hours	Total Reaction Time, Hours
80.0/5.44	4	5	9
70.0/4.76	7	5	12
60.0/4.08	12	4	16
50.0/3.40	16	5	21
40.0/2.72	19	5	24
30.0/2.04	24	7	31
20.0/1.36	29	16	42
10.0/0.68	36	22	58

Table 6—Comparison of Autooxidized Emulsion To Alkyd-Solvent System

System	Tensile Strength, Kg/cm ²	Film Dry Time, Hours
Solvent-borne		
Alkyd III	14.3	7.0
Alkyd VI	25.9	5.0
Autooxidized emulsion^a		
Alkyd III	10.7	0.5
Alkyd VI	21.5	1.0

(a) Alkyd emulsion, reacted for 9.0 hours at 80.0 psi oxygen pressure.

agitator and produced a continuous signal to the proportional temperature controller. The proportional temperature controller pulses heat to the vessel proportional to the difference between the desired temperature setting and the actual vessel temperature. The oxygen (or air) pressure was controlled by a pressure regulator connected to a delivery tube which entered beneath the surface of the emulsion. Periodic samples for analysis were taken from the interior of the vessel beneath the surface of the liquid through a sample valve.

Determination of the Swelling Ratio

The "swelling ratio" of the emulsified particles was determined at frequent intervals to monitor the auto-oxidative reaction.^{8,9} In each determination, a 0.2 gram sample of emulsified solids was added to a deciliter of reagent grade acetone to swell the crosslinked particles. Density, viscosity, and percent solids measurements were made for each sample. Then, "swollen and unswollen volume fractions" were determined as by Gooch.¹²

Film Characterization

The films were prepared by drawing down a two milliliter sample of the emulsion on a smooth glass panel with a doctor blade with 3.0 and 6.0 mil openings. The

Table 7—Comparison of Films from Commercial And Autooxidized Emulsions

Emulsion	Tensile Strength, Kg/cm ²	Percent Elongation	Dry Time, Hours	Relative Work to Break ^c Kg/cm ²
Rhoplex® Ac-64 ^a ...	35.5	475.0	0.5	84
Amsco® 3077 ^b	24.6	707.0	0.7	87
Autooxidized Emulsions:				
Alkyd III ^d	10.7	95.0	0.5	5.1
Alkyd VI ^e	21.5	51.2	1.0	5.5

(a) Rohm and Haas Co.

(b) Union Oil Co.

(c) Estimated as $\frac{TS \times \%E}{200}$

(d and e) No driers were used for curing these films.

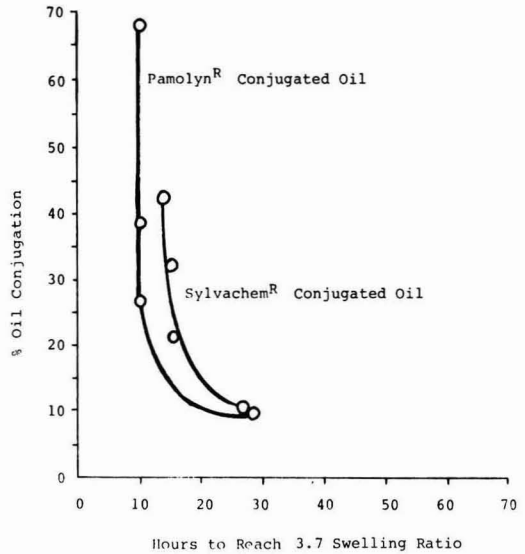


Figure 3—Oil conjugation vs reaction time

thickness of the dried film was measured with a micrometer after the film was removed from the glass panel.

The hardness of the film was determined with a Sward Hardness Rocker Tester, Model C, using the procedure described in the *Paint Testing Manual* edited by G. C. Sward.

The tensile strength and percent elongation of the free films were determined with an Instron 1130 Tensile Tester. The test specimens had a width of 1.0 cm, a thickness of 1.0 to 3.0 mils, and a gauge length of 2.0 cm. The crosshead speed was 2.0 cm per minute.

The SEM samples were prepared by adhering thin samples of dried film to the aluminum sample pedestal with double-stick tape. A layer of carbon was deposited on the samples and they were shadowed with gold-palladium alloy in a vacuum evaporator. The micrographs were taken directly from these samples with an AMR scanning electron microscope at a magnification of fifty to fifty thousand times.

Dry time was measured as "tack-free" time as specified in ASTM D 1640.

Table 8—Characterization of Films From Alkyd Emulsions with Varying Percent Oil

Alkyd	Percent Oil	Tensile Strength, Kg/cm ²	Percent Elongation	Dry Time, Hours
II	30	5.2	43.4	1.0
III	52	10.7	95.0	0.5
IV	60	3.6	117.5	1.1
V	80	—	—	—
VI	62	21.5	51.2	1.0

Table 9—Reaction Time and Film Hardness

Reaction Time, Hours	Sward Hardness Test	
	Cobalt ^a	No-Cobalt
Solvent-alkyd ^b	10	—
0	0	0
5	0	0
15	2	2
25	4	4
35	4	4
45	6	6

(a) Cobalt drier, 0.04% w/w alkyd IV added after processing.
 (b) Alkyd IV in mineral spirits (50/50%, w/w and 0.04% cobalt naphthenate).

RESULTS AND CONCLUSIONS

Autooxidative Crosslinking of Soya Oil

Stable emulsions may be prepared from soya oil. The autooxidative crosslinking of the emulsified soya oil was slow and produced slow drying films of poor tensile strength. These results showed feasibility of the approach and were encouraging. The maximum intrinsic viscosity¹³ achieved with the autooxidized soya oil was 0.046. Neither catalysis nor increasing the temperature of reaction for processing of the emulsion increased the intrinsic viscosity further or improved the film integrity from soya oil emulsion. This was not unexpected since soya oil is a semidrying oil; but it did show that an intrinsic viscosity greater than 0.046 would be required to achieve reasonable film properties.

Autooxidative Crosslinking of Soya Alkyds

After emulsifying an alkyd resin, processing conditions were studied for autooxidation at atmospheric pressure utilizing air and pure oxygen. Air autooxidation produced significant gas voids within the film which reduced film tensile strength, but did not impair drying of the films. Measurement of intrinsic viscosity demonstrated that the autooxidation reaction crosslinked the alkyd beyond the maximum intrinsic viscosity obtained with soya oil. The crosslinked alkyd produced an alkyd particle that possessed a small swelling ratio, less than 5.0, which indicates that the material is densely crosslinked. Conducting the autooxidation of the alkyd emulsion under oxygen developed crosslinks faster than air and the emulsion formed films of improved tensile strength and

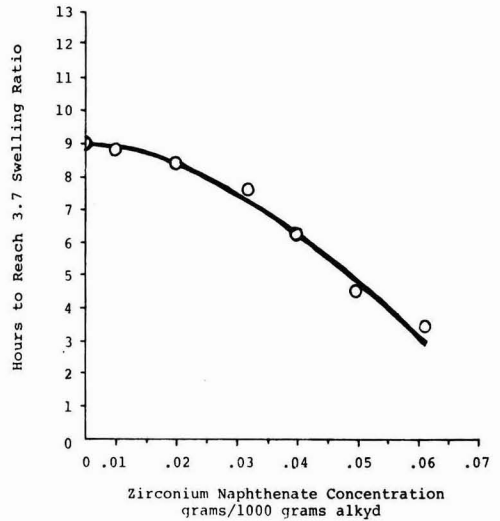


Figure 4—Zirconium naphthenate concentration vs reaction rate

elongation. Increased oxygen pressure further increased the reaction rate by reducing the induction period as shown in *Table 5*. By following the swelling ratio, the degree of crosslinking could be monitored and a combination of drying time and crosslink density could be compromised for maximum tensile strength. *Table 6* compares the optimized autooxidized emulsion films from alkyds III and VI to the base solvent-borne systems. It can be seen that the emulsion film from alkyd III possesses 25.2% less tensile strength, but a 1,300% reduction in dry time compared to the base alkyd which was cured with 0.04% cobalt drier. For alkyd VI, the tensile strength of the emulsion was 17% lower and the dry time

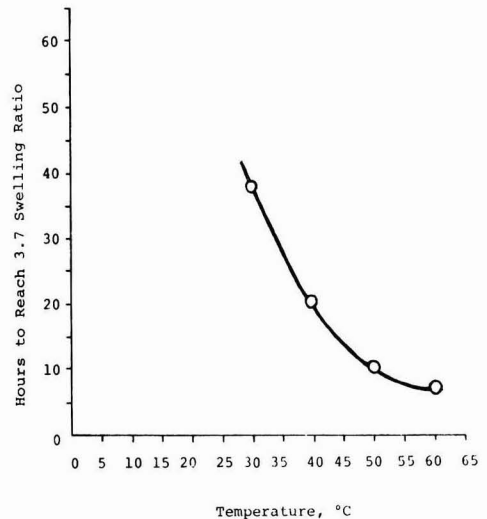


Figure 5—Reaction temperature vs reaction time

Table 10—Reaction Time and Physical Properties for Alkyd III

Swelling Ratio	Dry Time, Hours	Tensile Strength, Kg/cm ²	Percent Elongation
4.9	2.0	—	—
4.0	1.0	4.6	67
3.7	0.5	10.7	95
3.0	0.4	8.4	55
2.3	0.3	8.5	50
2.0	0.3	8.4	57

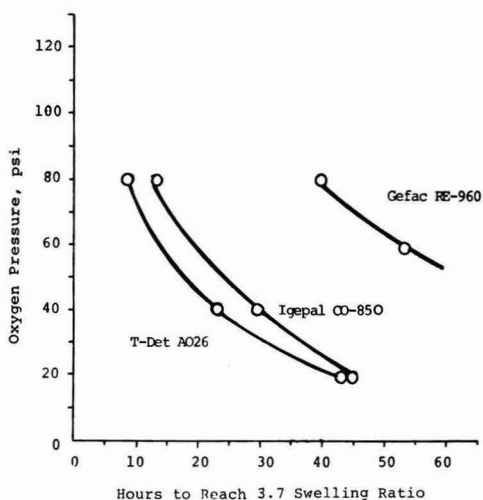


Figure 6—Effect of emulsifier structure on reaction rate for alkyd III

improved from five hours to one hour. Table 7 compares two commercial acrylic emulsions with the vegetable oil alkyd films prepared in these laboratories. It can be seen that the commercial emulsions possess higher tensile strength, but the alkyd emulsion had a comparable dry time. The soya urethane emulsion has a tensile strength closer to that of the commercial products, but its elongation is lower.

The reaction rate increases with percent conjugation to about 20% conjugation and then, other parameters appear to be rate determining as shown in Figure 3. From Table 8, increasing oil length of alkyds decreases the tensile strength of the films, except for the urethane alkyd with 62% soya oil length. The urethane alkyd structure is responsible for the tensile strength property of the dried film since the base alkyd is also superior.

The Sward hardness of the base alkyd IV and films formed from autooxidatively crosslinked emulsions are listed in Table 9. It can be seen that the base alkyd IV possesses 40% greater hardness than any of the autooxidatively crosslinked emulsion films. Also, addition of 0.04% cobalt drier did not increase the hardness of the emulsion films.

A comparison of swelling ratio, dry time, tensile strength, and percent elongation of films formed from alkyd III emulsion is presented in Table 10. It can be seen that the optimal film properties occur at a swelling ratio of 3.7. However, the dry time continues to decrease with

Table 11—Particle Size and Homogenization Cycles

Homogenization Cycles	Volume Geometric Mean, microns
1	1.128
2	1.334
3	1.190
4	1.217

Table 12—Particle Size Distribution Of Autooxidized Emulsion, after One Day

Particle Size, microns	Cumulative	Differential
0.16	100.0	48.8
0.18	51.2	24.0
1.01	27.2	13.0
1.02	14.2	7.0
1.06	7.2	3.2
1.20	4.0	1.8
1.25	2.2	1.4
1.34	0.8	0.7
1.40	0.1	0.1

Volume Geometric Mean, microns = 0.41

decreasing swelling ratio. A swelling ratio of 3.7 was selected as the optimal degree of autooxidative processing, and it is utilized in the following studies.

The effect of catalysis was studied at an oxygen pressure of 80.0 p.s.i.g. (6.13×10^{-3} moles of O_2 per liter of H_2O). The catalysts selected for this study were those that are successful for catalyzing alkyds in solvent-borne systems. Cobalt naphthenate in concentrations of 0.04% (wt/wt alkyd) produced instability within the alkyd III emulsion; therefore, this catalyst was not used singularly, but in combination with zirconium naphthenate, which does not degrade the stability of the emulsion. The catalysts were dispersed in the alkyd phase prior to emulsification. Catalysis of the emulsion by 0.02% cobalt naphthenate and 0.02% zirconium naphthenate (wt/wt alkyd) reduced the reaction time required to crosslink the emulsion particles to a swelling ratio of 3.7 by about two hours below the non-catalyzed autooxidation.

To further reduce the autooxidation time required to crosslink the alkyd polymer particles, systems were tried with increased catalyst concentration. At an oxygen pressure of 80 p.s.i.g., uncontrollable autooxidative crosslinking was caused from increasing the concentration of zirconium naphthenate to 0.05% and cobalt naphthenate to 0.05%. Figure 4 illustrates the effect on reaction time with increasing zirconium naphthenate concentration. At and above 0.05% zirconium naphthenate (wt/wt) in alkyd III, instability within the emulsion occurs.

Table 13—Particle Size Distribution Of Autooxidized Emulsion after One Year

Particle Size, microns	Cumulative	Differential
0.40	100.0	19.0
0.50	81.0	18.6
0.63	62.4	14.4
0.79	48.0	16.8
1.00	31.2	12.4
1.26	18.8	8.5
1.59	10.4	4.7
2.00	5.7	3.2
2.52	2.4	1.5
3.18	0.9	0.9

Volume Geometric Mean, microns = 0.814

The effect of temperature on the autooxidation reaction was studied at 80.0 p.s.i.g. of oxygen in an uncatalyzed system. The study was designed to include an alkyd III emulsion autooxidized at 20°C, 30°C, 40°C, 50°C, and 60°C at 80.0 p.s.i.g. oxygen pressure. Each reaction was considered complete at a swelling ratio of 3.7. *Figure 5* represents the decreasing reaction times to reach a swelling ratio of 3.7 with increasing temperature. The data for *Figure 5* were collected using alkyd III, 80.0 p.s.i.g. of oxygen, 300 rpm agitation, and two percent w/w emulsifier consisting of a 50/50 mixture of reagent grade dodecyl sodium sulfate and T-Det A026. The rate of autooxidation increases exponentially with increasing temperature. However, the emulsion was unstable above 55° C.

As indicated in *Figure 1*, the oxygen must diffuse from the aqueous phase through the emulsifier region and into the alkyd particle phase in order to initiate autooxidation. If the emulsifier is capable of retarding the diffusion of oxygen or the reaction by radical stabilization or other effects, then the crosslinking reaction by autooxidation is slowed. A total explanation of how emulsifiers retard the reaction is not within the scope of this research, but demonstration that the factor exists is clearly made here.

Many emulsifier variations have been used during the course of this research effort. The effect of emulsifiers has been observed on numerous properties of the emulsions generated. A study was initiated to determine the effect of emulsifier structure on the rate of autooxidation. *Figure 6* represents the time required to reach a swelling ratio of 3.7 at selected oxygen pressures as a function of three different surfactants. The Gafac RE-960 system is dramatically slower relative to the rate of autooxidation when T-Det A026 and Igepal CO-850 surfactants are employed.

Gafac RE-960 contains a phosphoric acid group together with an aryl group. Both of these groups are capable of stabilizing a radical electron through resonance. The Igepal CO-850 structure contains an aryl group. The T-Det A026 does not contain any substituent or groups capable of stabilizing a radical electron. Since the diffusion of oxygen through the emulsifier region surrounding the polymer particle is necessary if autooxidation with the polymer particles is to occur, the emulsifying agent should not characteristically possess an ability to retard oxygen diffusion or to stabilize free radicals. If it does, the crosslinking reaction will proceed at a slower rate than expected as evidenced in *Figure 6*.

Emulsification and Particle Size

Homogenization of alkyd III was accomplished after one cycle, as indicated by insignificant particle diameter change in *Table 11*. Continued shearing of this emulsion at a constant 3,500 pounds per square inch of shear force did not decrease the average particle diameter. Therefore, the shear force must be increased to further decrease average particle diameter.

The average particle diameter, computed as volume geometric mean, of autooxidized emulsions of alkyd VI increased from 0.41 microns to 0.814 microns over a period of one year. The emulsion remained stable and no

coagulum was observed. Referring to *Tables 12* and *13*, the particle diameters below 0.40 are significantly different. The particle diameters of 0.16 to 1.01 in *Table 12* agglomerated over 12 months to increase the average particle size observed in *Table 13*. The greatest particle diameter distribution in the one year sample is 0.40 microns to 1.00 microns compared to 0.16 microns to 1.01 microns in the one day sample. However, shelf stability of one year or less can be expected from these emulsions.

SUMMARY

Emulsified vegetable oil alkyds were autooxidatively crosslinked while in the emulsion form. The resultant emulsion produced films with acceptable tensile strengths and drying times comparable to commercial emulsion products. The majority of the petroleum solvents were eliminated from these emulsions, thus demonstrating the potential for significantly reducing petroleum products in these coatings. Further research and development are required to produce marketable products from these emulsions.

ACKNOWLEDGMENT

This research was made possible by a grant from the Cargill Corp. of Minneapolis, MN. We gratefully acknowledge their assistance.

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Degradation Chemistry Of Primary Crosslinks In High Solids Enamel Finishes

Solar Assisted Hydrolysis

Alan D. English and Harry J. Spinelli
E.I. DuPont de Nemours & Company, Incorporated*

Diffuse reflectance infrared spectroscopy and solid state ^{13}C NMR spectroscopy have been used to study the crosslinking and degradation chemistry of a melamine formaldehyde cured acrylic copolymer coating. The bulk composition of the cured unweathered coating has been semi-quantitatively analyzed by solid state ^{13}C NMR spectroscopy, and a depth profile of weathering chemistry has been semi-quantitatively analyzed by solid state ^{13}C NMR spectroscopy, and depth profile of weathering chemistry has been obtained using diffuse reflectance infrared spectroscopy. These data allow us to identify the extent of crosslinking, the molecular composition after curing, and to obtain mechanistic insight into degradation chemistry taking place under realistic exposure conditions. The insight obtained infers methods of inhibiting degradation.

INTRODUCTION

The crosslinking and degradation chemistry of melamine formaldehyde acrylic copolymer coatings has been a field of renewed interest recently.¹⁻⁴ The intractability of these highly crosslinked systems makes them difficult to study with conventional physical techniques. We illustrate here that modern physical methods can give substantially more information as to both the reaction and degradation chemistry of highly crosslinked systems.

We have used diffuse reflectance infrared spectroscopy and solid state ^{13}C NMR spectroscopy to study the crosslinking and degradation chemistry of a melamine formaldehyde cured acrylic copolymer coating. The bulk

composition of the cured unweathered coating has been semi-quantitatively analyzed by solid state ^{13}C NMR spectroscopy, and a depth profile of weathering chemistry has been obtained using diffuse reflectance infrared spectroscopy. These data allow us to identify the extent of crosslinking, the molecular composition after curing, and to obtain mechanistic insight into degradation chemistry taking place under realistic exposure conditions. The insight obtained infers methods of inhibiting degradation.

EXPERIMENTAL

Coating Preparation

Coatings were prepared by mixing the acrylic resin with Resimene® 747 (nominally hexamethoxymethylmelamine) at a 70/30 weight ratio in methyl ethyl ketone and adding 0.30% p-toluenesulfonic acid (PTSA) as a catalyst. The pigmentation (4% of binder) in the coating contained aluminum flake, titanium dioxide, carbon black, phthalocyanine blue, fumed silica, and Monastral® Red pigment. The coatings were baked for 30 min at 120°C. The cured thicknesses were 50 ± 5 microns.

Coatings were exposed in Florida on a black box rack for a total of 24 months. The panels faced south and were inclined at an elevation of 5° above horizontal. After exposure, the panels were washed with a mild soap solution, rinsed, and dried before being analyzed.

Coating Depth Profiling

Depth profiling of coatings that had been applied to steel panels was accomplished by abraiding the panel with 600-A Tufbak® Durite T44 cloth (14 μ silicon car-

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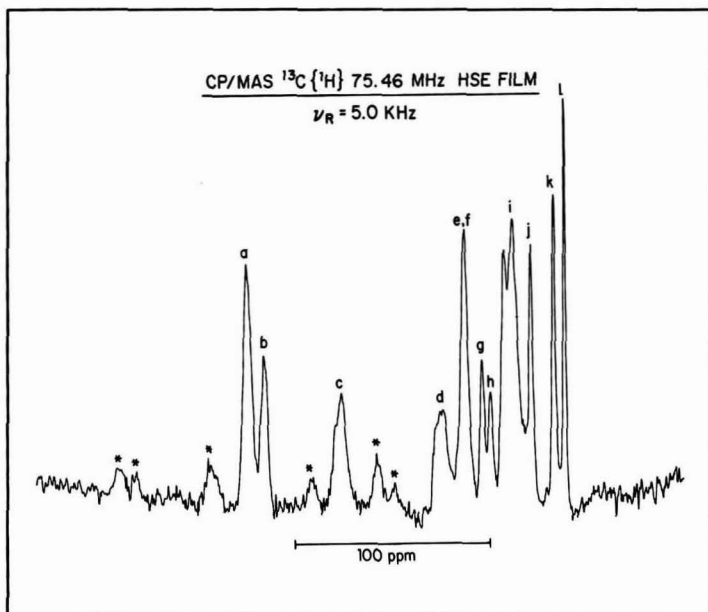


Figure 1—Solid state ^{13}C NMR spectrum of a melamine formaldehyde crosslinked acrylic copolymer coating. The static magnetic field is 7.0 T and the spinning rate is 5.0 KHz. Chemical shifts and assignments are given in Table 1 and features marked with an asterisk are resolved spinning side bands

bide particle size) in a water medium. After a short period of abrasion (ca. 30 sec), the material removed was collected, filtered, and dried in a vacuum oven at 55–65°C for 24–48 hours to remove residual water. This procedure was repeated 10–30 times on each panel until the primer was barely visible. The material collected in each sample was then cryogenically milled and dried in a vacuum oven at 55–65°C for 24–48 hours. This procedure produces particle sizes prior to cryomilling of 1 μ size which then agglomerate upon drying. The cryomilling procedure is necessary to produce infrared spectra that are particle size independent.

Infrared

All infrared spectra were obtained with a Nicolet 7199 FT-IR spectrometer operating in a diffuse reflectance configuration. The design of the diffuse reflectance bench was similar to that of Fuller and Griffiths.⁵ Two hundred fifty-six interferograms were averaged, apodized with a polynomial function F_3 ,⁶ and transformed to give two cm^{-1} resolution spectra.

NMR

NMR spectra were recorded on a Bruker CXP300 NMR spectrometer. Solid state ^{13}C NMR spectra were obtained using cross polarization, dipolar decoupling, and spin temperature alternation techniques⁷ using a radio frequency field strength $\gamma H_1 = 64$ KHz with a cross polarization time of 5 msec to minimize intensity distortion in spin counting due to varying strength of carbon-proton dipolar interactions among individual carbon nuclei. Samples were contained in rotors of the Beams,⁸ Andrew⁹ geometry fabricated from perdeuterated poly-

(methylmethacrylate). Sample spinning speeds were chosen to minimize spinning side band overlap and a 5.0 KHz spinning rate appeared to be optimum at this field strength and rotor size.

RESULTS

Recent investigations into curing chemistry of intracurable polymer systems have demonstrated that solid state ^{13}C NMR spectra may be used to examine curing chemistry in thermally polymerized polyimides¹⁰ and expressed hope¹¹ that these techniques may be used in conjunction with infrared spectroscopy to give further mechanistic insight. We have used both solid state ^{13}C NMR and diffuse reflectance infrared spectroscopies to characterize the curing and degradation chemistry of melamine formaldehyde crosslinked acrylic copolymer coatings.

NMR

Solid state ^{13}C NMR spectra are of particular use in characterizing the curing chemistry of this system because non-carbonaceous pigments and other fillers used in the formulation of these coatings are transparent. Extraction of quantitative chemical compositions from cross polarization magic angle spinning ^{13}C NMR spectra is complicated by spin polarization dynamics and the distribution of significant signal intensity into spinning sidebands for many of the magnetically distinct carbon nuclei at the magnetic field strength and spinning speeds we employ. The question of the relationship between spin polarization dynamics and spectral populations has been dealt with previously,^{12–14} in this case, where proton spin diffusion is able to produce a

homogeneous spin bath that is characterized by a singly exponential $T_{1\rho}$ (H), we have used long cross polarization times (5msec) and large spin locking fields ($\gamma H_1 = 64$ KHz) to obtain representative spectral populations even for those carbon nuclei with small proton-carbon dipolar interaction.

Figure 1 illustrates a ^{13}C NMR solid state NMR spectrum of an unpigmented melamine formaldehyde acrylic copolymer coating prepared from methyl methacrylate, butyl acrylate, styrene and hydroxyethyl acrylate (MMA/BA/S/HEA) and crosslinked with Resimene 747 (see above). Chemical shifts and spectral assignments are given in Table I. This spectrum illustrates that all carbon nuclei which are distinct on the most elementary level (not comparable to solution NMR) may be assigned in the spectrum. In Table I we have also tabulated integrated intensities measured from this spectrum which have been corrected for estimated spinning side-band contributions and additionally, intensities calculated from the known initial composition of the film assuming complete primary crosslinking and no side reactions (see below). The experimental and calculated results are in reasonable qualitative agreement and support the infrared spectroscopic results (see below) that the primary crosslinking goes to completion under the cure conditions used and the extent of competing side reactions is minimal.

We have also obtained solid state ^{13}C NMR spectra of a few selected pigmented coatings and these results are similar to those found for the unpigmented system. At this time the NMR results are of use only to corroborate the infrared results.

Infrared

Diffuse reflectance infrared spectroscopy has been used to characterize both the curing and degradation chemistry of melamine formaldehyde crosslinked acrylic copolymer coatings. This technique is useful for not only clear coats, but most appropriately for coatings that contain pigment, aluminum flake, and other fillers that are by their very nature intended to be efficient scatterers and thus cannot usually be examined with transmission infrared techniques. Figure 2 illustrates both a conventional transmission and a diffuse reflectance infrared spectrum of a clear coating (MMA/BA/S/HEA and Resimene 747). The infrared bands of interests may be integrated and the relative integrals of the bands in each spectrum are with $\pm 3\%$ of each other when peak absorbance values of less than 2.0 and peak Kubelka-Munk values less than 20 are used. The regions of the infrared spectrum of interest are 816 cm^{-1} (melamine triazine ring deformation), 913 and 870 cm^{-1} (methoxymethyl deformation), 3570 cm^{-1} (ROH stretch), $\sim 3350\text{ cm}^{-1}$ (N-H stretch). Resolution of any methanol contribution to the infrared spectrum requires deconvolution of the observed band shape using the unreacted polymer as a model for the OH band and the unreacted melamine, which contains 0.6 amine sites per triazine ring, as a model for the NH band. In all cases, the ratio of the integrated intensity of the band of interest to the integrated intensity of the melamine triazine ring deformation has been used to

Table 1—Composition of MMA/BA/S/HEA Crosslinked with Resimene 747

Structure	δ^a	Concentration	
		Experimental	Calculated
a Acrylic carboxyl	175.2	2.6	2.3
b Triazine ring	166.5	1.7	1.1
c Styrene aromatic	127.8	3.3	2.8
d NCH_2O	76.6	1.5	2.1
e,f $\text{OCH}_2\text{CH}_2\text{O} + \text{OCH}_2$ (NBA)	64.5	2.3	2.7
g NCH_2OCH_3	55.5	0.8	1.3
h $-\text{OCH}_3$ (MMA)	51.6	0.6	0.5
i Acrylic backbone	44.4, 40.4	3.9	5.5
j CH_2 (NBA)	31.1	1.1	1
k αCH_3 (MMA) + CH_2 (NBA)	19.3	1.1	1.5
l CH_3 (NBA)	13.9	≈ 1	≈ 1

(a) δ in ppm from TMS; referenced to glycine at $\delta = 176.1$.

measure normalized intensity. The melamine concentration, as measured from the intensity of the triazine ring deformation mode, is independent of depth in all samples with random fluctuation of $\pm 10\%$ for a given formulation. Additionally, depth profiling of unexposed clear film demonstrates that the extent and type of cure is independent of depth. As reference compounds 2-chloro-4,6-bis(propylamino)-s-triazine and Resimene 747 (see Experimental Section) have been used as primary standards for $>\text{N-H}$ and $>\text{NCH}_2\text{OCH}_3$, respectively.

Infrared analysis of both clear and pigmented coatings, prepared as described in the Experimental Section, show complete consumption of all hydroxy functionality on the acrylic copolymer within $\pm 2\%$ when cured at 120°C for 30 minutes. Additionally, there is no detectable generation of free amine and the loss of methoxymethyl functionality on the melamine is equivalent on a molar basis to consumption of hydroxyl on the acrylic copolymer within the accuracy ($\pm 5\%$) of the measurement of methoxymethyl functionality. These observations are in agreement with previous work^{2,16} that demethylation (reaction 2, Figure 3), deformylation (reaction 3), and melamine self-condensation (reaction 4) do not occur to a significant extent, and that transesterification (reaction 1) goes essentially to completion under these curing conditions with a fully methylated melamine. Figure 3 outlines the most elementary scheme of melamine formaldehyde crosslinking and hydrolytic degradation reactions that must be considered. These results for the bulk curing of the coatings indicate that only reaction (1) is of significance during the curing step with the conditions we have used and thus, the initial chemical state of the coating to be exposed is known.

Pigmented coatings that had been exposed in Florida for two years were depth profiled, via the abrasion procedure described in the Experimental Section. One part of the coating was exposed to sunlight and the second part was protected from sunlight but exposed to all other elements. Seventeen and 12 samples were collected for the exposed and covered portions of the coating respec-

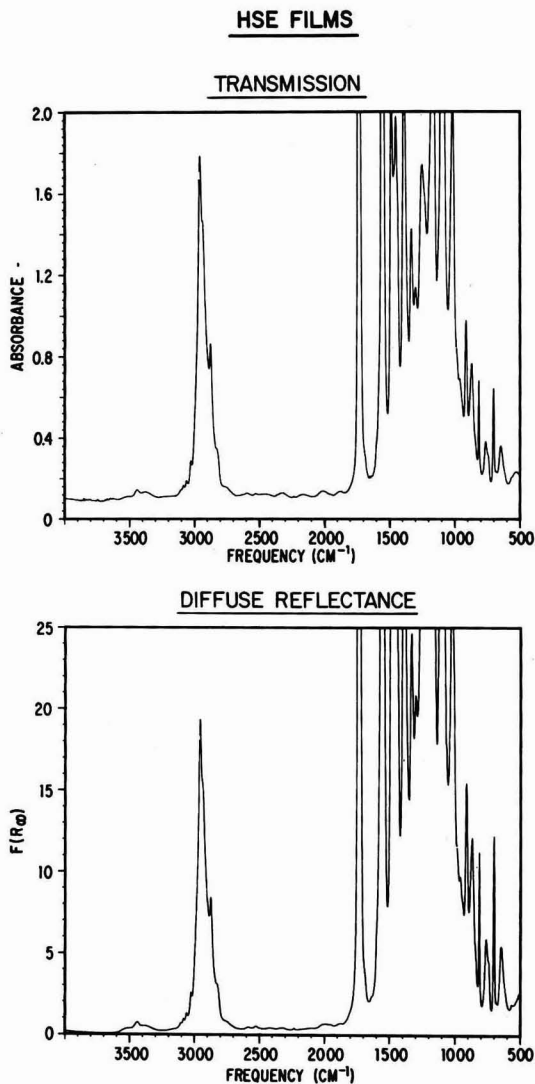


Figure 2—Transmission and diffuse reflectance infrared spectra of a clear melamine formaldehyde crosslinked acrylic copolymer coating

tively and analyzed by diffuse reflectance infrared analysis for ROH, $>NH$, $>NCH_2OCH_3$, and melamine concentration as a function of depth. There was no alcohol functionality detectable ($\pm 2\%$) in any of the samples. The remainder of the data obtained from the sample exposed to sunlight are shown in *Figure 4* and illustrate the following: (1) $>NH$ concentration is highest at the surface and decreases monotonically as the depth of the sample increases, approaching the value (rhs graph) calculated from the starting material with the knowledge that only reaction (1) is significant and goes to completion; (2) $>NCH_2OCH_3$ concentration is near zero at the

surface and becomes nonzero near the middle of the film and once again approaches the value (rhs graph) calculated from the starting material and known reaction chemistry; (3) X is essentially independent of depth and is very close to that calculated (rhs graph) from the starting material and known reaction chemistry except at the surface where it is 30% smaller. X equals $(6 - [>NH] - [>NCH_2OCH_3])$ and is a measure of the sum of primary crosslinks (reaction 1) and melamine self condensation (reaction 4) (see Discussion). As noted, each graph in *Figure 4* indicates the amount of each species that is expected to be present in the absence of weathering based upon our observations of the curing chemistry of each film. It is clear that there has been significant production of $>NH$, loss of $>NCH_2OCH_3$, and X is invariant to weathering except at the surface to a depth of $\sim 5\text{--}10\mu$. This observation is not at variance with the traditional method of characterizing film degradation: gloss loss. The gloss of this coating decreased from 60 to 30 during the two years of Florida weathering.

Data for the covered (protected from sunlight) coating are shown in *Figure 5* and illustrate that the degradation chemistry is much different than in the presence of sunlight (*Figure 4*). *Figure 5* illustrates that weathering in the absence of sunlight may be characterized by: (1) $>NH$ concentration is independent of depth and is essentially the same as that seen in an unweathered coating; (2) $>NCH_2OCH_3$ concentration is lower near the surface than at the middle of the coating and approaches the concentration of an unweathered coating near the primer; (3) X is largest near the surface, decreases monotonically with depth, and is much larger near the surface (~ 4.8) than is observed in an unweathered coating ($X \sim 3.4$).

DISCUSSION

The structure and degradation chemistry of melamine formaldehyde crosslinked acrylic copolymer coatings that we have discussed is limited only to considerations of reactions at or near the primary crosslink site involving the melamine with the acrylic copolymer hydroxyl site or with another melamine. There exists copious evidence in the literature that physical appearance degradation occurs in pure acrylic coatings and similar degradative pathways involving only acrylic backbone degradation are expected to exist in the system we have examined as well. Nevertheless, we have chosen to confine ourselves to an examination of the reactions and degradation chemistry at the primary crosslinking site because this is the major difference between the two systems.

Figure 3 illustrates that the number of species that must be identified and followed in the most simplistic examination of primary crosslink chemistry followed is six ($>NCH_2OCH_3$, $>NCH_2OR$, $>NCH_2OH$, $>NH$, $>NCH_2N$, melamine triazine ring) if we wish to completely characterize even this elementary scheme. We can reduce this number with the following conditions:

(1) Reaction (3) has been shown⁴ to be facile in fully alkylated systems and we do not observe methylol groups in the infrared spectra.

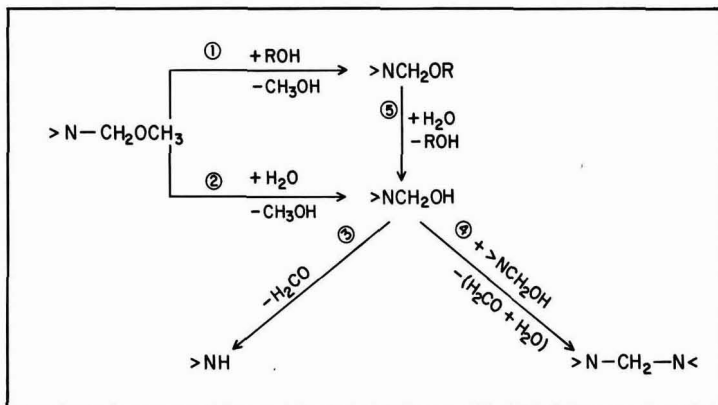


Figure 3—Elementary crosslinking and hydrolytic degradation reactions involved in melamine formaldehyde ($>NCH_2OCH_3$) crosslinking reactions with hydroxy functionalized acrylic copolymers (ROH)

(2) The relative concentrations of $>NCH_2OCH_3$, $>NH$, ROH, and melamine can be measured quantitatively by infrared methods.

(3) The consumption of ROH during cure is assumed to be accomplished by only reaction (1).

With these conditions it is possible to measure $>NH$ and $>NCH_2OCH_3$ relative to melamine concentration and also to calculate from mass balance a crosslink parameter (X) which is the sum of $>NCH_2OR$ and $>N-CH_2-N<$ (or other condensed species) relative to melamine. The calculated value (X) may then be compared to the expected concentration of NCH_2OR obtained from ROH consumption to evaluate the likelihood of any melamine condensation products (reaction (4)). An examination of Figure 4 shows that the value of X obtained throughout the coating except at the very surface is quite close to that calculated from ROH consumption. Additionally, we find no infrared spectroscopic evidence for the presence of $>NCH_2N<$ ¹⁵ or free ROH at any point in the coating profile. These observations when taken as a whole lead to the following description of the primary crosslink reaction and degradation chemistry that takes place in the presence of sunlight.¹⁷

(1) The primary crosslinking reaction (reaction (1)) goes to completion and no other reaction takes place to a significant extent when the cure is 30 minutes at 120°C.

(2) Degradation under realistic exposure conditions is facilitated near the surface with all degradation below the surface 2-5 μ layer in the coating that remains after exposure attributable to reactions (2) and (3).

(3) Primary crosslink degradation is observed only at the very surface where X is decreased by ~30% and there is no evidence for either ROH or $>NCH_2OH$ in this layer.

(4) There is no evidence for any significant amount of melamine-melamine self condensation at any time during cure or exposure.

The degradation chemistry in the absence of sunlight is quite different than is observed in the presence of sunlight:

(1) Loss of unreacted $>NCH_2OCH_3$ is observed, but not to the extent observed in the presence of sunlight, and the concomitant production of $>NH$ expected via reactions (2) and (3) is not observed.

(2) The crosslink concentration is much higher at the surface than is found in the unexposed coatings and decreases with depth.

This description of both dark and light degradation chemistry enables us to propose a pathway of primary crosslink degradation in this system.

(1) The initially hydrophobic surface of the coating is oxidized photolytically which increases the concentration and/or mobility of water and increases the mobility of the residual acid.

(2) Acid catalyzed hydrolysis of $>NCH_2OCH_3$ to form free amine is favored due to production of volatile products which may escape to the atmosphere.



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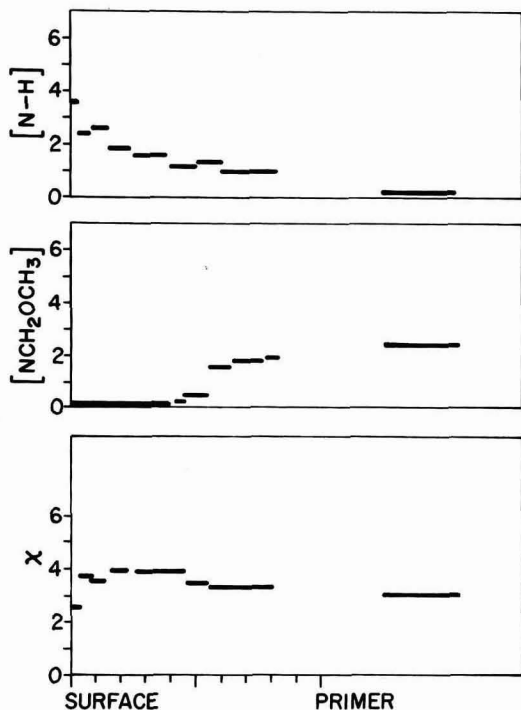


Figure 4—Depth profile of free amine, methoxymethyl, and primary crosslink density of a 50 μ thick blue pigmented melamine formaldehyde crosslinked acrylic copolymer coating that was exposed for two years in Florida. Bars on rhs of graph indicate concentrations expected in the absence of degradation

(3) Acid catalyzed hydrolysis of primary crosslinks is reversible and therefore unobserved except where the hydrolysis products undergo further reaction to prevent back reaction. At the very surface of the coating, where there is insufficient pigment to provide an effective solar screen, ROH and $>NCH_2OH$ in reaction (5) are consumed presumably by photo-oxidation and reaction (3), respectively.

(4) Further melamine crosslinking, reaction (4), does not occur to a significant extent in the presence of sunlight or is unstable.

(5) Unreacted melamine can form additional stable crosslinks when sunlight is absent.

The proposed pathway requires the presence of light, residual acid, and atmospheric water to promote degradation. This implies that removal of any of these three components should retard degradation. This pathway also suggests that accelerated weathering studies which employ a higher light flux for a shorter period of time may well give an unrepresentatively large amount of primary crosslink degradation due to photo-oxidation of transient ROH produced in reaction (5).

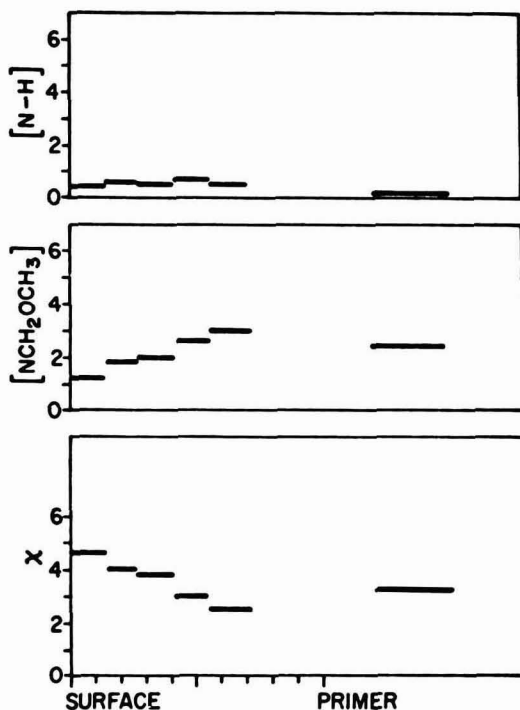


Figure 5—Depth profile of free amine, methoxymethyl, and primary crosslink density of a 50 μ thick blue pigmented melamine formaldehyde crosslinked acrylic copolymer coating that was exposed for two years in Florida but protected from sunlight. Bars on rhs graph indicate concentrations expected in the absence of degradation

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Displacement of Water From a Steel Surface

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A quantitative test to evaluate organic coatings for their ability to displace water droplets from a steel surface has been developed. The test method consists of the placement of water droplets onto an inclined steel surface, followed by the application of a test coating. The coating flows down the surface, contacting the water droplets. The water may either remain on the specimen or be displaced. The specimen is then immersed in methanol which absorbs residual water on the specimen. The methanol is then analyzed for water content, yielding a quantitative result for water displacement.

Five materials have been evaluated for water displacing ability. Two silicone alkyd coatings were found to be good water displacers. A third silicone alkyd material was found to be a poor water displacer at low specimen angles but effective at higher angles. An acrylic and an epoxy coating were found to be poor water displacers. These results are discussed in reference to a proposed mechanism for water displacement.

INTRODUCTION

Water displacement is defined as the removal of macroscopic quantities of water from a metal surface by the application of a liquid compound. The objective of this displacement is to reduce the risk of corrosion.

Early investigations of water displacement were performed to develop cleaning and preservation materials for salvaged naval equipment.¹⁻⁹ In this effort, removal of continuous layers or puddles of water was a significant problem, and many materials were evaluated for their ability to displace water.⁴

A mechanism for the displacement of a continuous water layer from a surface by organic compounds has been described.^{1,9,10} The displacing agent is dropped onto the water layer. Upon impact, a two-dimensional spreading pressure is formed at the agent-water interface. This pressure causes the lateral transportation of water from the impact site and allows penetration of the agent into the water phase. Being slightly soluble in water (usually between two and 25 weight percent), the agent diffuses to the metal surface. By preferential adsorption, the agent adheres to the surface and displaces the water layer from the metal substrate. *Figure 1* illustrates this mechanism.

The phenomenon discussed here is the displacement of a discontinuous water phase, water droplets, from a metal surface. This is encountered when painting metal surfaces in a marine environment, and corrosion control procedures must insure removal of this water. A mechanism has been proposed for displacing a discontinuous water phase from a metal surface using water displacing compounds.¹¹ This mechanism requires the displacing agent to:

- (1) Spread over the metal surface upon application, wetting the substrate and contacting the water drops.
- (2) Be immiscible with water to ensure no water entrapment in the displacing agent.
- (3) Display a higher affinity for the substrate than water does in order for the agent to diffuse under the droplets and thus displace them from the surface.

There are several tests which have been designed to determine the ability of a material to displace water.^{1,4,12-15} *Table 1* lists the tests and a brief description of the methods. Most of these methods are qualitative, with the results obtained from an estimated extent of substrate corrosion caused by water remaining on the metal surface. The more extensive the corrosion, the less efficient the material as a water displacer. These tests do not

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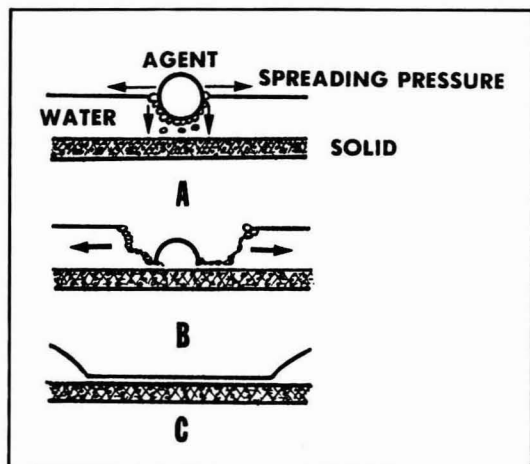


Figure 1—Water displacement mechanism. A—Displacing agent applied to water surface, spreading pressure and mixture with water begins; B—Agent reaches the surface while pushing water aside; C—Preferential adsorption of the agent over water allows water to be displaced from the surface

Table 1—Water Displacement Tests

Test	Method
(1) Continuous water layer ^{1,4}	A thin continuous layer of water is placed onto a steel specimen. A droplet of test agent is dropped onto the water and the circumference of the resulting impression in the water layer which the agent makes upon contact is estimated. Reproducibility of this test is claimed to be $\pm 10\%$.
(2) Static water drop ¹²	A drop of water is introduced onto a flat steel specimen containing a conical depression. The test agent is applied. The specimen is then periodically examined for corrosion products in the depression.
(3) Partial water immersion ¹³	A steel specimen is immersed in the displacing agent and then immersed in water. The specimen is periodically examined for corrosion.
(4) Water spray test ¹²	A steel specimen is immersed in the agent for one hour and then suspended in a humidity cabinet. The specimen is periodically examined for corrosion.
(5) Oil test ¹⁴	A steel specimen is immersed in a constantly stirred mixture of 10% water in oil. The specimen is periodically examined for corrosion.
(6) Water droplets ¹⁵	Water droplets are introduced onto a steel specimen after which a test agent is applied and allowed to flow over the specimen. The specimen is then placed in a 100% relative humidity chamber. The specimen is periodically examined for corrosion.

lend themselves to quantitative evaluation of the water displacing phenomenon. Only one of these tests is quantitative^{1,4} and it is designed to test the displacement of a continuous water layer. It is not applicable to evaluation of discontinuous water layers.

The objective of this effort has been to devise and validate a quantitative test for the displacement of a discontinuous phase of water on a steel surface. The test was designed as a means of evaluating materials for their water displacing ability and as a research tool to assist future investigation of water displacement. Also, several compounds were tested and the results will be discussed in light of the proposed displacement mechanism.

EXPERIMENTAL

AISI 1010 cold rolled steel specimens of dimensions $5.1 \times 10.2 \times 0.32$ cm were used for the metallic substrate. Reagent grade methanol and distilled water were used throughout the method. Mineral spirits used conformed to Federal Specification TT-T-291.

The surface of each steel specimen was ground to a roughness of 0.432 ± 0.127 root mean square micrometers, and then immersed in boiling mineral spirits for 10 minutes. The specimens were then immersed in a second container of boiling mineral spirits, followed by immersion in boiling 90% methanol, 10% water solution, and finally immersed in boiling methanol. Specimens were stored in a desiccator at room temperature until testing.

A specimen holder was fabricated to hold specimens at angles ranging from 5° to $85^\circ \pm 30'$ of arc, in increments of 5° . The test procedures and equipment are illustrated in Figure 2. A specimen was placed at the desired angle in the specimen holder, and the holder was then inclined such that the appropriate surface of the specimen was horizontal and facing upward. A microsyringe was used to apply the water droplets, which had an average weight of 25.07 ± 0.16 mg (Figure 2, part a). Six drops of water were applied to each specimen. After application, the specimen holder was lowered until the specimen was at the desired angle (Figure 2, part b).

Table 2 lists the test agents evaluated for water displacing ability, which in this study were all organic coatings. It was determined that one milliliter of test agent would be adequate to cover the entire specimen without excess agent. With the drops in place and specimen at the correct angle, the test agent was applied along the upper edge of the specimen using a standard 50 μ L syringe (Figure 2, part c). Minimal pressure was applied to the plunger of the syringe to minimize momentum of the agent flowing down the specimen. In this manner, the agent flowed down the panel, contacting and displacing the droplets. Displaced droplets would often gather at the bottom edge of the specimen; a cotton swab was guided along this edge to adsorb and remove any displaced water which may have gathered (Figure 2, part d).

The specimen was then removed from the holder and placed in an air tight jar containing 350 mL of methanol such that the specimen was completely immersed. The methanol was tested for water content before specimen immersion and 24 hours after specimen immersion using

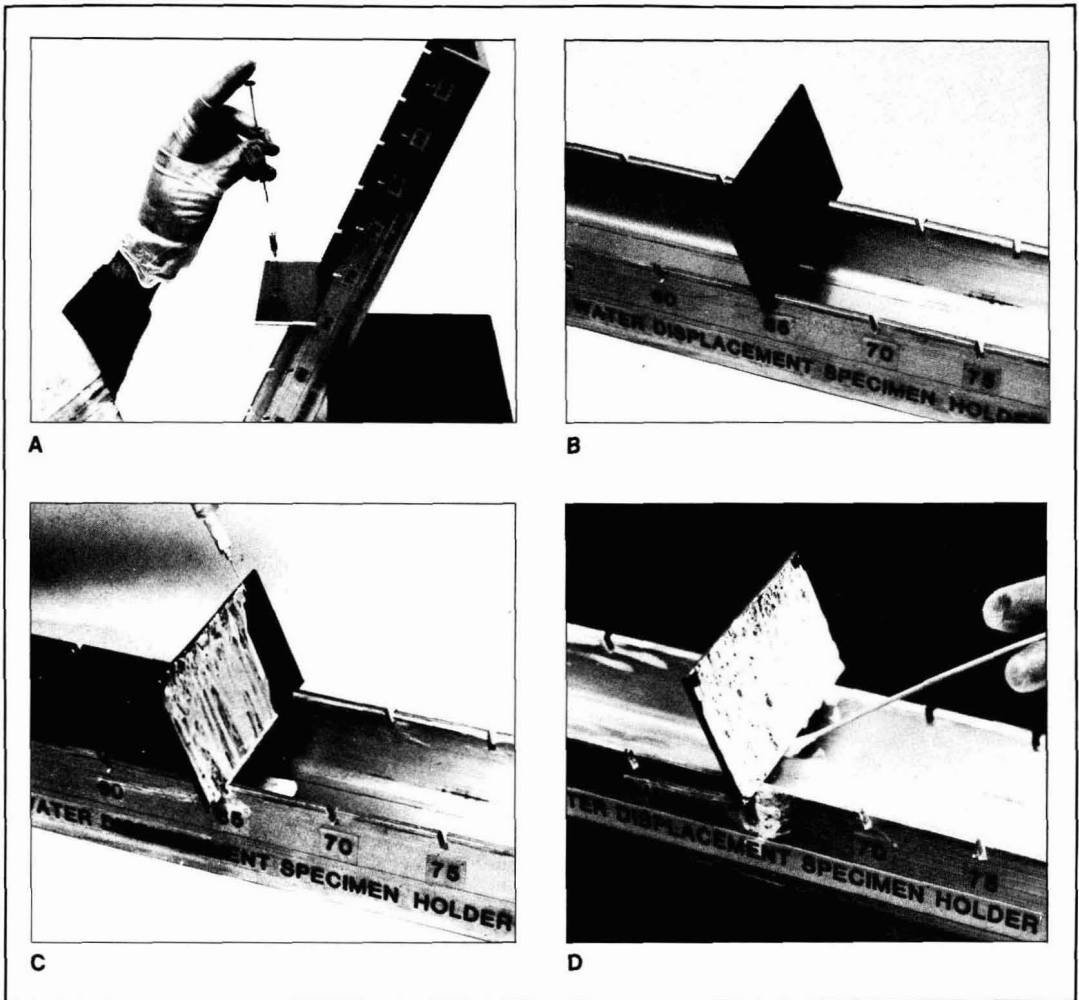


Figure 2—Water displacement test procedure. A—Application of water droplets; B—Specimen holder lowered to place specimen at appropriate angle (65°); C—Test agent applied to upper edge of specimen; and D—Absorb displaced water using cotton swab

the Karl Fisher method (ASTM D-890) using an Aquatest IV instrument (Photovolt Corp.). Water remaining on the specimen following agent application, X_t , could then be determined by:

$$X_t = X_{(n,\theta)} - X_i$$

where: $X_{(n,\theta)}$ = Water content of the methanol following agent application for trial n at angle θ

X_i = Initial water content of the methanol

The results can also be expressed in terms of the percentage of water initially on a specimen which a test agent has displaced, signifying water displacing efficiency (WDE):

$$WDE = \frac{W_i - W_t}{W_i} \times 100\%$$

where: W_i = amount of water initially on a specimen prior to agent application (water sorbed on the steel specimen plus water introduced onto the specimen).

W_t = amount of water remaining on the specimen after agent application.

Controls of the blank specimen immersed in methanol were performed to determine initial water content, W_i . The test agents themselves made no significant contribution to water content.

RESULTS

The test agent displacement data are presented in Figure 3. It was found that the steel specimen contributed 21.3 mg of water to the methanol. The water introduced onto the specimen was 150.0 mg; thus, W_i is equal to 171.3 mg. This value is indicated by the solid horizontal line at the top of Figure 3, and corresponds to

Table 2—Composition of Agents

	Percent (Weight)
Composition of SA-1^a	
Isopropanol	4.6
Aromatic hydrocarbon ^b	21.2
Trichlorotrifluoroethane	28.6
Ethyl cellulose ^c	0.4
Barium sulfonate ^d	4.0
Alkyl ammonium organic phosphate ^e	1.0
Silicone varnish ^f	5.1
Silicone resin ^g	5.1
Silicone alkyd resin ^h	30.0
	100.0
Composition of SA-2	
Silicone alkyd resin ⁱ	39.1
Ethyl acetate	19.4
Mineral spirits ^j	11.7
1,1,1 Trichlorotrifluoroethane	7.7
Sodium petroleum sulfonate ^k	2.1
Rutile; titanium dioxide ^l	11.5
Zinc molybdate ^m	6.4
Isopropyl, Tri(N-ethylamino-ethylamino) titanate ⁿ (4.5% in isopropyl alcohol)	2.1
	100.0
Composition of SA-3	
Silicone alkyd resin ⁱ	39.9
Ethyl acetate	19.8
Mineral spirits ^j	11.9
1,1,1 Trichlorotrifluoroethane	7.9
Rutile; titanium dioxide ^l	11.7
Zinc molybdate ^m	6.5
Isopropyl, Tri(N-ethylamino-ethylamino) titanate ⁿ (4.5% in ethyl alcohol)	2.3
	100.0
Composition of AC-1^o	
Acrylic resin ^p	43.6
Acrylic resin ^q	32.8
Titanium dioxide	18.4
Cellosolve acetate	3.8
Plasticizer ^r	1.4
	100.0
Composition of EE-1	
Epoxy ester resin ^s	80.0
Xylene	20.0
	100.0

(a) This material is marketed commercially as Amlguard. It conforms with Military Specification Mil-C-85054.

(b) Amso Solvent G (American Mineral Spirits Co.)

(c) T-200 (Hercules Powder)

(d) NaSul BSN (R.T. Vanderbilt Co.)

(e) R.P. No. 2 (E. I. DuPont)

(f) DF-88 (General Electric)

(g) SR-82 (General Electric)

(h) Varkyd 385-50R (McCloskey Varnish Co.)

(i) Varkyd 385-50E (McCloskey Varnish Co.)

(j) Amso Solvent G (Union Oil of California)

(k) Alox 904 (Alox Corp.)

(l) R-960 (E. I. DuPont)

(m) Moly-White 101 (Sherwin Williams Chemicals)

(n) KR-44S (Kenrich Chemicals)

(o) This material conforms with Military Specification Mil-C-81352.

(p) Acryloid A-21 (Rohm and Haas Co.)

(q) Acryloid B-44 (Rohm and Haas Co.)

(r) Santicizer 160 (Monsanto Co.)

(s) Varkyd 13-50x (McCloskey Varnish Co.)

0% water displacing efficiency, the scale located on the right side of Figure 3.

Figure 4 is an example of the actual test data for SA-3, falling within the 95% confidence interval. This interval was determined by:¹⁶

$$X_{(n,\theta)} \pm 2.571(S/\sqrt{N})$$

where S is the standard deviation at point $X_{(n,\theta)}$, 2.571 is the Student's t distribution value for 95% confidence with 5 degrees of freedom, and N is equal to the number of replicates, six.

Figure 3 compares agents SA-1, SA-2, AC-1, and EE-1. SA-1 is a good water displacer over the entire range of angles studied. SA-2 is only a fair water displacer at an angle of 5°, but between 10° and 85°, SA-2 is a good water displacer. AC-1 is a poor water displacer at angles less than 45°, but a good displacer at higher angles. EE-1 is a poor water displacer, never obtaining better than 74% WDE. Figure 4 shows that SA-3 is a poor water displacer at angles less than 20°. At angles from 20° to 85°, SA-3 is a good displacer with a WDE of 86%.

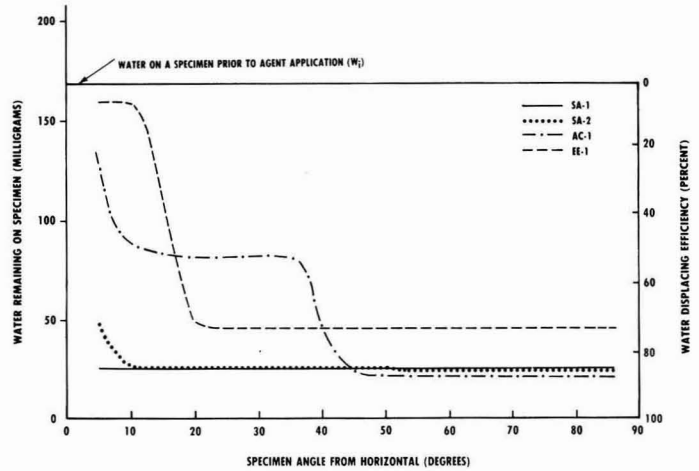
Figure 3 clearly illustrates a difference in water displacing efficiency of SA-2 and SA-3 at angles less than 20°, where SA-2 is significantly more effective than SA-3. This suggests that the high affinity requirement of the proposed mechanism is correct; compounds with high affinities for the solid surface will perform better than those with less affinity for the surface.

The test results also indicate that poor water displacers are not effective at low specimen angles. One can infer two effects occurring during the test—an adsorption effect and a gravity effect. The adsorption effect is observed at low angles with efficient water displacers. The agent preferentially adsorbs onto the solid surface; it can then diffuse between the water phase and the solid phase. At this point, the contact angle on the water drop rapidly decreases and the water spreads over the displacing agent, eventually flowing off of the specimen. This is not observed with poor water displacers which will not absorb as strongly and cannot diffuse under the droplets. Although this adsorption effect is best observed at low angles, it is not dependent upon angle.

The gravity effect is observed at higher angles with the poor water displacers. The agent will flow down the specimen and contact a water drop. The impact, in conjunction with the force of gravity (due to high specimen angle), will cause the water drop to flow down and off of the specimen. Although this is best observed with poor water displacers, gravity obviously assists all compounds in their ability to displace water. The gravity

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Figure 3—Comparison of SA-1, SA-2, AC-1, and EE-1—Water displacement efficiency



effect is dependent upon the angle in that the force of gravity affecting the water drops' ability to remain on the specimen is controlled by the trigonometric sine of the specimen angle.

DISCUSSION

The prime objective of this effort has been to devise and validate a quantitative test for the displacement of a discontinuous phase of water on a steel surface. The test method which has been presented has yielded results which agree with previous investigations^{11,15,17} and preliminary studies using the water drop test.¹⁵ SA-1 and SA-2 have been confirmed to be good water displacers while the displacing ability of AC-1, EE-1, and SA-3 is dependent upon substrate angle and as such, these compounds are considered to be poor water displacers.

Unlike previous test methods, the current method yields data which is quantitative, providing a more precise

means of evaluating compounds and allowing a better understanding of their displacing ability.

A second objective of this effort was to use the test results to discuss the proposed mechanism for displacing a discontinuous water phase. For example, one requirement of the proposed mechanism is that an agent have a high affinity for the substrate. This is accomplished by a large adsorption force of the agent onto the solid surface. Agent adsorption was designed as a factor in this study by addition of petroleum sulfonate to a test agent. SA-2 is similar to SA-3 except for the addition of petroleum sulfonate to SA-2. Petroleum sulfonates have heats of adsorption on steel of approximately 10 kcal/mole.¹⁸ This is high relative to most compounds. For example, alcohols have heats of adsorption on steel ranging from 3.7 kcal/mole for methanol to 4.8 kcal/mole for octadecanol. Fatty acids have heats of adsorption on steel ranging from 2.1 kcal/mole for acetic acid to 5.3 kcal/mole for stearic acid.¹⁹ Castor oil, which contains

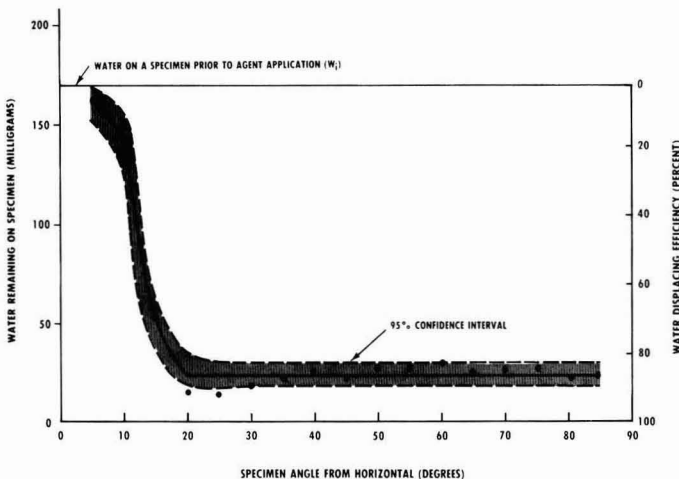


Figure 4—Water displacement test data for SA-3

an ester group, has a heat of adsorption onto steel of 2.3 kcal/mole.

CONCLUSIONS

A quantitative water displacement test method has been devised to evaluate organic coatings for their ability to displace water droplets. This method can be used to compare the water displacing efficiency of compounds, and to further investigate the phenomenon and theories of water displacement. Water displacement appears to be controlled by preferential adsorption of the water displacing agent at low angles, but at high angles water displacement is controlled by the force of gravity. Compounds with high heats of adsorption on steel assist in the displacement of water from a steel surface.

ACKNOWLEDGMENTS

The author wishes to thank Dr. John J. De Luccia, of the Naval Air Development Center, for his enlightening discussions throughout this effort. A special note of gratitude is extended for his continued encouragement, without which this work would not have been performed.

The author also wishes to thank his co-workers at the Naval Air Development Center, especially Mr. Paul Prale, for their support throughout this effort.

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Lawyer Vis-A-Vis Chemist In Paint Product Liability Situations

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The vast expansion in the number of product liability claims and the most common type claims and lawsuits found in the paint industry are discussed. This is followed by the author's view of how to handle such claims and the use of chemical experts in legal process. Finally, there is a short lesson on the do's and don'ts of appearing as a witness and giving testimony at various forms of legal proceedings.

Introduction

First, let me define the area we are discussing. "Product liability" has come to mean the liability of a manufacturer, processor, or other seller for injury to the person or property of a buyer, user, or even a non-purchasing third party which has been caused by a product which has been sold, used, or consumed. This area of the law has developed in response to the increased complexity of consumer products and the increased opportunities for mishaps in their design, manufacturing, marketing, or use. Such "mishaps"

have led to a substantial increase in both the incidence and the amounts of unintended harm occurring in the course of, or as a consequence of, the use of products. The doctrine of product liability, as it has evolved over the course of English and American jurisprudence, is merely a reflection of changes which have occurred and will continue to occur in our philosophy as to the sharing of the burden of loss and damage as between users and consumers on the one hand and manufacturers and vendors on the other. The assumption underlying today's shifts of that responsibility to manufacturers and vendors is that they are better able to spread the amount of any loss as a cost of production and sale and, thus, ultimately share it among the entire class of consumers.

The law of product liability is complicated and confusing—to lawyers as well as laymen—for several reasons:

(1) The law varies from state to state and often varies between jurisdictions within the same state;

(2) The law often varies from product to product, with, for example, manufacturers of certain products such as drugs, food, or explosives being held to a higher standard of care than manufacturers of some other products such as paint;

(3) The laws may vary also depending on the circumstances of the particular transaction (i.e., the knowledge of the parties, their prior course of dealings, the terms of an agreement of sale) or on the

particular plaintiff involved (e.g., the recovery in a wrongful death action brought by the parents of a child burned to death as a result of exploding paint fumes is likely to be large in amount).

In general, there are three legal theories upon which liability has been permitted: (1) negligence, (2) warranty, and (3) strict liability. These theories overlap to a considerable extent, and it is not uncommon to find one lawsuit alleging all three as a basis for recovery. Initially, however, it is important to remember that no matter which of these theories a plaintiff may rely on, he must always show that the injury to his person or property was caused by the product in question or by some conduct of the manufacturer. This may seem rather obvious, but plaintiffs often fail to win because they do not prove that their injury was causally related to the defendant's conduct or product.

Negligence

Negligence, in a legal sense, is a violation of a duty to use that degree of care a reasonable person would have used under the same or similar circumstances. In the case of a manufacturer, he is held to the standard of care which a reasonably prudent manufacturer in the same business would use.

In order to win a suit premised on negligence, a plaintiff usually must show a defect or dangerous condition not known to him and resulting from the defendant's failure to act reasonably; that

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This paper was presented at the Symposium on Forensic Chemistry of Coatings at the American Chemical Society's Annual Meeting on August 31, 1983 in Washington, DC.

the defendant foresaw or should have foreseen the danger to a consumer using the product for its intended purpose; that the plaintiff was in fact injured and that the product was the proximate cause of the injury.

In addition, reasonable care requires that manufacturers make such inspections and tests in the course of the manufacturing process as are reasonably necessary to ensure the production of a safe product.

A manufacturer must also exercise reasonable care in warning purchasers or other contemplated users of any dangerous characteristics or inherent limitations of his product. The duty to warn is based on the manufacturer's presumed ability to foresee the danger to the consumer. The most prevalent location for such warnings in the paint business is the label on the can.

Warranty

The warranty theory of product liability is based upon the breach of a promise or representation which the manufacturer or seller has made to the purchaser or user with regard to the character or quality of the product. To recover under this theory, it is typically necessary to show (1) that a warranty exists, (2) that the warranty has been breached, and (3) that the defect which constituted the breach was the proximate cause of the injury.

Warranty can mean more than a fine print, multi-clause, embossed contract containing express and carefully described warranties as is done in chemical coatings. This is an express warranty and can be found in ads, sales literature, or labels. The law recognizes a second type of warranty—the implied warranty.

An implied warranty is an assurance that the law deems the seller to have made. The implied assurances of every sale are that the product (a) is of merchantable quality and (b) is fit for the general purpose for which it is sold. If the buyer makes known the specific purpose for which he is buying the product, the implied warranty is extended to cover the fitness of the product for that particular purpose. The Uniform Commercial Code which is now the law in 49 states (every state except Louisiana) recognizes all of these warranties.

Strict Liability

One of the most striking recent developments in the field of product liability has been the doctrine of strict liability. Strict liability is the imposition of liability without any proof of negligence or breach of warranty. It subjects the manufacturer

or seller to liability even though he may have exercised all possible care in the preparation and sale of the product, if the product is defective and in its defective state it causes injury. In such circumstances, recovery will be allowed regardless of the degree of care exercised by the manufacturers in the formulation, manufacture, and inspection of his product.

The doctrine of strict liability is the logical extreme of the philosophy that it is both just and expedient for the enterprise which sets the product in the stream of commerce and thereby "causes" the loss, to lift the burden of loss from the individual victim and distribute the burden widely, and thus less severely, among all customers of that enterprise. Not everyone may agree with this social concept, but it is one that has achieved recognition in almost every state of the union.

Here are some of the important features of the doctrine of strict liability:

(1) Proof of negligence is not essential and lack of it is immaterial. Liability may be imposed even though there is nothing to show that every reasonable precaution was not taken.

(2) Any person engaged in the business of selling may be held liable, including suppliers of raw materials or component parts, distributors, and retailers.

(3) Liability may extend to any person whose possible harm from a defective product is reasonably foreseeable. This includes the buyer's family, household members, and guests. It may include employees and even mere bystanders.

(4) Recovery may be made for both personal injuries and property damages.

(5) Available legal defenses in strict liability cases are limited, such as willful or unreasonable misuse of the product or assumption of risk where the person harmed used the product despite knowledge of the defect.

Note, however, that as a general rule strict liability does not yet mean absolute liability. Proof of lack of a defect in the product is in most cases a good defense.

PRODUCT DEFECT: What constitutes a defect may, however, be a difficult question. Courts usually say that a product is defective only if it is not reasonably fit for the ordinary purpose for which such products are sold and used, or that a defect is a condition not contemplated by the ultimate consumer which will be unreasonably dangerous to him. For example, pits are not normally considered a defect in olives, but a District of Columbia Court has held that a martini drinker might recover for a broken tooth if he had reason to believe that he had been served an unpitted olive in his vodka

martini. *Hochberg v. O'Donnell's Restaurant, Inc.*, 272 A.2d 846 (D.C. Cir. 1971). In other words, the martini was "defective".

These types of claims and lawsuits against manufacturers have not really changed in substance—change has been in the number of such lawsuits and the dollar value attached to them. In both categories—the number of suits and the monetary demands—the increase has been staggering. Think for just a moment of the number of lawsuits that have resulted and will continue to result from the Tylenol tragedy. In addition to the known deaths which occurred to the victims of Chicago, there will be multitudinous other claims related to the fact that Tylenol packages were not properly sealed. Johns Manville, a known and respected name in the building profession, has resorted to bankruptcy in an attempt to ward off the thousands upon thousands of cases claiming injury which resulted from the use of asbestos. Lest you believe that the paint business is or has been free of these type of claims, I would remind you that several cases have been brought in recent years where individuals or groups of individuals have claimed that exposure to chemical fumes, including paint fumes, have resulted in various forms of physical disability.

USE OF EXPERT WITNESSES: In any of these cases from the relatively small and simple claim of defective coating on an individual residence to the class action type with multiple plaintiffs and multiple defendants, there is a need for technical expertise. It is needed quickly and intensely. It must be given honestly and in the type of language that is readily understood by all involved. The assistance should be direct and should be pointed. The investigators and/or the lawyers seeking to determine the possible causes do not need proof of expertise by a recitation of everything the expert knows. Restrain your view to the case at hand.

It is essential that a paint company faced with a defective product claim has available to it the needed technical ability to cope with such claims.

Reduction of Liability

I would now like to turn to some things a manufacturer may do to reduce or shift his liability.

Clearly, the best protection against product liability is to produce a good product. With the increasing acceptance of the strict liability theory, the exercise of reasonable care will no longer be a

thorough substitute for manufacturing a product free from defects. A good inspection and quality control system is essential. Moreover, the system must be documented so that months or years after a product leaves the production line, it can be shown that testing and sampling programs conducted at the time showed an absence of defects.

However, even if a product is formulated as safely as possible and is manufactured free of defects, it may have certain dangerous properties that are inherent or impossible to avoid. In such cases, the product manufacturer should include clear and prominent warnings to alert consumers of such dangers, as well as clear and complete instructions aimed at avoiding them.

A manufacturer may shift the burden of liability caused by a defect in his product by purchasing appropriate product liability insurance. The difficulty with product liability is its cost. Like malpractice for doctors and other professionals, recent increases in product liability claims and awards have caused premiums to rise drastically.

Another way of shifting liability is to negotiate indemnity or contribution agreements with other parties such as raw material suppliers, toll manufacturers, or formula licensors who may be equally responsible for a product defect. The choice among indemnity, insurance, or a combination of the foregoing will vary from manufacturer to manufacturer depending on the price and cost tradeoffs involved in each individual case.

Disclaimer or warranty limitations may also be helpful. However, in practically no instance can a manufacturer now shift to a retail consumer liability for personal injuries caused solely by a defect in his product for which he is responsible. Such disclaimers are being held to be intrinsically unfair by a growing number of courts.

Another way to reduce your product liability is to ensure the prompt investigation of claims after any injury has occurred. Often, evidence of the plaintiff's improper use of the product quickly disappears soon after the injury.

A final area where a manufacturer can shift or prevent a great deal of product liability exposure is in advertising and labelling. As noted before, liability based on express warranty has been predicated on advertising claims. Such written material should obviously be carefully checked by technically competent personnel to insure its accuracy and completeness.

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You as an Expert Witness

A few words about giving testimony. You may be called upon either as part of your personal activities or your job to give sworn testimony at any one of a variety of proceedings. The most visible, of course, is either the criminal or civil trial. There are in addition, however, depositions, which call for sworn testimony before the trial. There are administrative hearings such as those before the Federal Trade Commission, Environmental Protection Agency, zoning boards, etc. There are arbitration proceedings before one or more arbitrators who act as judges and jurors, and there are legislative committee hearings before city, state, or federal government bodies.

For the most part, instructions on how to testify will be the same for all such proceedings with the one exception being the deposition. Testimony given at a deposition is normally given only before the opposing counsel. It is basically an investigative tool—a means by which attorneys for either side will attempt to learn the facts of the case. It can be used as written testimony at a trial if the witness is unavailable on the trial date. It can also be used to impeach a witness at a trial; that is, if it can be shown that the witness is testifying differently at the trial than he had testified earlier at the deposition. In these proceedings, it is particularly important for the witness to answer only the question which is asked. The witness should attempt to avoid opening other areas of interrogation by giving names of parties or the identity of documents unless he is absolutely required to do so. Each name given in a deposition is merely giving the opposing side the name of an additional witness to call at some future deposition before trial. Accordingly, try to be precise in your answers and answer only the question that is asked. If your attorney wants you to amplify, he can ask you additional questions on cross-examination.

A very important difference between a

deposition and a trial is that the only outcome of a deposition is a typewritten record. There is no judge or jury present who can detect signs of anger, nervousness, blushing, and whatever other physical signs people might give in verbal testimony. Deposition also presents a witness with a good rehearsal for a trial. It may be his only opportunity to become accustomed to testifying before he is required to testify at the trial. It also gives the witness an opportunity to get acquainted with the style or manner of questioning used by the attorney for the opposing side.

Other than depositions, the remaining forms of testimony are pretty much the same. Only the identity of the person or persons hearing the testimony changes from one type of hearing to another. As a general rule, and like so many other things, your testimony will be only as good as the amount of pre-trial preparation that is devoted to such testimony. You should be extensively rehearsed by the attorney for your side. He or she should give you an overview of the entire case and exactly where your testimony and your documents fit into the overall plan. He should give you some feel for the nature of the opposing attorney and the judge that will hear the case. This preparation and your rehearsal of your testimony is perfectly proper. If you take the stand and are asked whether or not your attorney and you have worked on your testimony, you should admit it freely.

Once the trial date arrives, there are several do's and don'ts on the manner of giving testimony. Almost all are common sense which any of us would think of if we sat down for a half an hour and tried to draw up a list of instructions for a prospective witness.

First of all in the matter of appearance—be yourself. Do not dress to either extreme—too conservative or too wild. For one reason or another, a man in a business suit or a well groomed woman is more believable than a middle-aged hip-

pic with dungarees, sneakers, and a sweatshirt. When giving your oral testimony, be as natural as you can and attempt to be consistent; that is, answer in the same manner when you are responding to direct examination as you do when responding to cross-examination. One very obvious point which is made by your oath is that you should tell the truth. Lying invariably will get you tangled up and presents the opportunity to destroy the entire position which you may be advocating. It is recommended that you speak as if you were dictating a business letter. When describing yourself at the outset of your testimony, remember that you are now creating the first impression with the judge and the jurors. Try to lean toward the humble side rather than being too pompous.

A few other matters at random—avoid too quick a response to the questions. Pause for a moment before responding and give yourself time to think. This also gives your attorney time to object if he desires to do so. Be sure that you wait to answer until you are sure the question has been completed. On the other side of the coin, however, don't pause too long or you give the judge and jury the impression that you are uncertain of what you are going to say.

A few don'ts—don't overreact while on the witness stand and don't try to outwit the other side's attorney. Remember that you are playing his ballgame in his ballpark and it is to be expected that he is

to be better at the game than you. Don't try to memorize your answers word by word. Don't be embarrassed to admit a loss of memory. Perhaps the most popular answer in any kind of legal proceeding is "I don't recall."

During the course of your testimony your attorney may well stop the questioning with objections. Don't think that you can at that point relax and let the attorney argue with the judge. Objections may well be made for the purpose of giving you a break or a breather or making you think again about the answer you are going to give. So listen very closely to the objections and to the arguments in favor of the objections.

It is quite easy to get into a sing-song tempo when answering questions from your opponent's attorney. He can, on cross-examination, generally ask you leading questions and can reach the point where each question he asks is said at the same tempo and your response can follow that tempo. You may well find yourself responding in a manner contrary to your actual knowledge merely because you have sung his song at his tempo. Not only try to think of your response, but think of what the opposing attorney is trying to elicit from you.

At times you are allowed to refresh your recollection either with notes of your own which must be made available to the other attorney or with documents, letters, or reports which had been written by you or to you from someone else. In

these situations, read all of the document or the portion which your attorney directs you to read before testifying. Your attorney should ask for a recess periodically during lengthy testimony. It is most dangerous for a witness to become fatigued while testifying. Usually an hour to an hour and a half is considered long enough for one stretch. If your attorney misses the boat on this matter, you as a witness can ask the judge for a few minutes for a break. During these breaks, speak only to your attorney. Joviality or friendliness with anyone on the other side may well be misunderstood by a juror.

In conclusion, some of you because of the nature of your job may be called as expert witnesses, i.e. one who due to his or her educational background and/or occupational experience is recognized as having particular expertise in a specific discipline. The only additional point in that regard is that an expert witness is allowed to give opinion testimony where other witnesses are not. Generally, these opinions will be asked for in response to a hypothetical question; that is, one which simulates the facts which have been brought out at the trial. Responding to such questions is not different than others. Follow the suggestions set forth above and there should be no difficulty.

With this brief rundown, you should be prepared to act in sterling fashion as a witness, expert witness, and a stout advocate of your position in any form of product liability situation.

Open Forum is an experiment in communications designed to give readers the opportunity to share creative concepts in all aspects of coatings. Suggested topics include color, formulation and manufacture, testing, and selection of raw materials. These "tricks of the trade" need not be prepared formally such as research papers, but should, however, be thorough in their preparation and presentation. Submissions should be sent to "Open Forum" Editor, Journal of Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107.

These subcommittee reports are for the use of the membership of ASTM Committee D-1 in continuing its work and for the interest of readers in the activities of ASTM Committee D-1. The reports are not official actions of ASTM and may not be quoted as representing any action or policy of the American Society for Testing and Materials.

December 1983 Subcommittee Reports of ASTM Committee D-1

The December meeting of ASTM Committee D-1 on Paint and Related Coatings and Materials was held on December 11-14, 1983 at the Sheraton Hotel, Bal Harbour, FL. In the three and one-half days preceding the final report session and general meeting of Committee D-1, 152 members and guests met in 146 scheduled meetings of D-1 subcommittees and working task groups. The present membership of Committee D-1 is 494.

A *Memorial Resolution* was presented on the passing of George G. Sward.

The Provisional Subcommittee on Masonry Treatments was given permanent status as Subcommittee D01.47, with Robert S. Shane as its Chairman.

Officer appointments were made as follows: Sub. D01.13 on Consumer Affairs—R. S. Shane to replace S. B. Levinson as Chairman; Sub. D01.46 on Industrial Protective Painting—K. A. Trimmer to replace D. M. Berger as Chairman; and Sub. D01.52 on Factory-Coated Wood Products—S. B. Schroeder to replace R. C. Marck as Chairman.

R. J. Connor was appointed to the Executive Subcommittee to replace E. E. Haney, who resigned.

D-1 Officers for the years 1984-85 are: Chairman—J. C. Weaver; First Vice-Chairman—J. M. Behrle; Second Vice-Chairman—S. LeSota; Third Vice-Chairman—H. Fujimoto; Recording Secretary—Harold M. Werner, and Membership Secretary/Treasurer—C. K. Schoff.

Highlights

The following projects of major interest to the coatings industry warrant special emphasis:

VOC Determinations—Sub. D01.21.56 will run a round-robin on water content of high water content coatings using a new titrant in an effort to improve precision for calculating VOC (D 3960 and in EPA Method 24).

Flocculation—Sub. D01.23 invites suggestions on and seeks participants in the development of a practice for identification of flocculation and determination of the degree in coatings.

Masonry Treatments—Sub. D01.47 is the new permanent number for this committee. It will not meet in Montreal, but may have a separate meeting in the Fall in the U.S.

Swelling in Hardboard Siding—Sub. D01.52"B" continued discussions on the problem of wetting and swelling of

hardboard siding by surfactants in water-borne house paints. Decided to work with AHA's Field Finishing task group to increase precision of one of their test methods.

Coil Coated Metal—Sub. D01.53 is in great need of more members, especially paint producers.

Paint Brushes and Rollers—Sub. D01.61 is developing a round-robin for testing paint brushes and rollers. Seven cooperators agreed to participate.

Future Meetings

*May 20-23, 1984—Montreal, Canada (Queen Elizabeth Hotel)

January 20-24, 1985—Orlando, FL (Marriott)

June 23-26, 1985—San Diego, CA (Town & Country Hotel)

*January 12-17, 1986—New Orleans, LA (Sheraton New Orleans)

June 15-20, 1986—Philadelphia, PA (Franklin Plaza Hotel)

*—Committee Weeks

New Standards

New standards since the January, 1983, meetings of D-1 approved by the ASTM Committee on Standards in the months: (subcommittee jurisdiction)

March, 1983

D 4145-83 Test Method for Coating Flexibility of Prepainted Sheets (Sub .53)

D 4236-83, Practice for Labeling Art Materials for Chronic Health Hazards (Sub .57)

August, 1983

D 4213-83, Test Method for Wet Abrasion Resistant of Interior Paint by Weight Loss (Sub .42)

D 4277-83, Practice for Testing Amino Resins (Sub .33)

October, 1983

D 4146-83, Test Method for Formability of Zinc-Rich Primer/Chromate Complex Coatings on Steel (Sub .53)

D 4287-83, Test Method for Determination of Viscosity of Paints and Varnishes at a High Rate of Shear by the ICI Cone/Plate Viscometer (Sub .24)

D 4288-83, Specification for Calcium Borosilicate Pigments (Sub .31)

November, 1983

D 4302-83, Specification for Artists Oil and Acrylic Emulsion Paints (Sub .57)

D 4303-83, Test Methods for Relative Light-Fastness of Pigments Used in Artists Paints (Sub .57)

New Standards since January 1983 in D-1 Related Committees, approved by ASTM Committee on Standards in the months:

D-33, Committee on Protective Coating and Lining Work for Power Generating Facilities

April, 1983

D 4082-83, Test of the Effects of Radiation on Coatings Used in Light-Water Nuclear Power Plants (Sub .02)

D 4227-83, Practice for Qualification of Journeymen Painters for Application of Coatings to Concrete Surfaces of Safety Related Areas in Nuclear Facilities (Sub .04)

D 4228-83, Practice for Qualification of Journeymen Painters for Application of Coatings to Steel Surfaces of Safety Related Areas in Nuclear Facilities (Sub .04)

June, 1983

D 4256-83, Test Method for Determination of the Decontaminability for Coatings Used in Light-Water Nuclear Power Plants (Sub .02)

D 4258-83, Practice for Surface Cleaning Concrete for Coating (Sub .05)

D 4259-83, Practice for Abrading Concrete (Sub .05)

D 4260-83, Practice for Acid Etching Concrete (Sub .05)

August, 1983

D 4261-83, Practice for Surface Cleaning Concrete Unit Masonry for Coating (Sub .05)

D 4262-83, Method for Testing pH of Chemically Cleaned or Etched Concrete Surfaces (Sub .05)

D 4263-83, Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method (Sub .05)

September, 1983

D 4285-83, Test Method for Indicating Oil or Water in Compressed Air

October, 1983

D 4257-83, Practice for Design and Use of Safety Alert System for Hazardous Work Locations in the Coatings and Lining Industry (Sub .03)

G03 Committee on Durability of Non-metallic Materials

May, 1983

G 80-83, Test Method for Specific Cathodic Disbonding of Pipeline Coatings (Sub .06)

The above listed standards will appear in the 1984 ASTM Book of Standards.

Standard which await COS Approval

Committee D-1

D 4301-83, Test Method for Total Chlorine in Epoxy Resins and Compounds

Committee D-33

D 4286-83, Practice for Determining Contractor Qualification for Nuclear Powered Electric Generation Facilities

DIVISION 1 ADMINISTRATIVE

AD HOC COMMITTEE ON INDEXING

S. LeSota, Chairman

There was a general discussion and consensus that the ASTM D-1 index was a mess. It was agreed to make corrections, modifications, and additions on 3" x 5" index cards so that they could later be arranged in alphabetical order. It was also agreed that this ambitious program would take a long time and it was recommended to the Executive Subcommittee that this ad hoc committee be given permanent status as a part of the D01.18 Editorial Subcommittee. The Executive Subcommittee agreed that it will be a task group under Sub. D01.18. The future designation will be Sub. D01.18.02.

SUBCOMMITTEE D01.07 GOVERNMENT CONTACTS

A. A. Chasan, Chairman

It was reported that, in its continued reorganization, The Federal Supply Service of the General Services Administration moved the standardization functions (specification writing activities) of the FSC class 8010 (paints) to Auburn, WA, and classes 8030 (coatings) and 8040 (adhesives) to Kansas City, MO.

Federal Standard 141, which reverted to the Army at Fort Belvoir, VA some time ago, is going to be revised again. At the present time technical comments are being solicited to help in the rewrite. It is anticipated that a preliminary document will be circulated by the end of calendar year 1984.

In a general statement affecting the entire Federal government, the GSA has been charged with the responsibility to implement the use of metric designations

(SI units) dually with the inch-pound system. No deadline has been set as yet.

In a surprise move the FSS of the GSA announced that effective immediately it would procure paints (FSC 8010) only that conform to air pollution regulations.

Federal Standard 595, Colors, is being reprinted, previous supplies having been exhausted. A contract, administered by the Government Printing Office, and supervised by the FSS, has been let for providing full sets, individual color cards, fan decks, and the addition of new colors. While metamerism is being controlled through the use of several illuminants, color matching will rely on visual examinations, and not on spectrophotometric measurements as has been done in the past. Moves to have the standard administered through private sources (e.g., ASTM E 12) have been ignored.

SUBCOMMITTEE D01.15 LECTURES & SYMPOSIA

H. A. Wray, Chairman

It was reported that H. E. Ashton will present a talk on Canadian/United States Standards Relationships at the May 1984

meeting in Montreal. A symposium on Computers in the Paint Industry was suggested for the January 1985 meeting. E. A. Praschan and J. J. Brezinski were named as Cochairmen of this symposium. C. K. Schoff and S. LeSota were named to the committee. It was agreed to recommend to the Executive Subcommittee that the symposium be held on Monday afternoon and Tuesday morning of the D-1 session, with possibly a special affair Monday night.

SUBCOMMITTEE D01.16 DEFINITIONS

S. LeSota, Chairman

The following definitions were submitted for subcommittee letter ballot: for deletion—industrial talc, nonasbestos type; for revision—filler and plasticizer; new additions—ball indent adhesion, inorganic zinc coating, natural spreading rate, organic zinc-rich primer, pigment, storage stability, yellowing, flash rusting, and volatile organic compounds (VOC).

DIVISION 20 RESEARCH AND GENERAL METHODS

SUBCOMMITTEE D01.20 SAMPLING, STATISTICS, ETC.

H. E. Ashton, Chairman

The chairman reported that D 3980 had been reviewed editorially, but the galley proof had apparently been lost in the mails so the final version could not be checked. Consequently, the Practice had not been sent to Committee E-11 for comment. It was suggested that E-11 would not be in a position to assist in setting up a computer program. C. J. Sherman volunteered to look into the possibility of revising the E 180 program or developing a D 3980 program for analysis of interlaboratory test results.

In connection with extending the D 3925 Sampling Practice, the chairman reported that he only had been able to review the ISO method, as the result of a ballot, and the Bureau de normalisation du Quebec method, which is based on three ISO methods and one French standard. Sampling procedures from E-15 and D-2 and one in U. S. Federal Test Method Standard 141 will be evaluated.

The subcommittee requests that headquarters send a circular to D-1 subcommittee chairmen requesting incorporation of D 3924 and D 3925 where applicable, and pointing out that D 3980 has been completed and should be used by the subcommittees for analyzing test results. (D 3924 is environment conditioning. D 3925 is sampling practice.)

SUBCOMMITTEE D01.21 CHEMICAL ANALYSIS OF PAINTS AND PAINT MATERIALS

R. W. Scott, Chairman

D01.21.13, Coordination of VOC Standards and Information, J. C. Weaver, Chairman, reported that volatile organic content (VOC) of water-borne coatings as determined by Federal Method 24 (Fed. Register, Oct. 3, 1980) is thought to be less precise on water-borne coatings than on solvent base coatings. This EPA method is based on, and cites, four ASTM methods on liquid coatings for density (D 1475), total volatile (D 2369), and water contents by either GC (D 3792) or Karl Fischer (D 4017), is less precise at higher water contents up to 50 or 60% water.

EPA will issue in early 1984, from its Research Triangle facility in North Carolina, its detailed interpretation of its own extensive analytical data upon samples of practical solvent and water-borne coatings submitted by eight or more producers in response to a July, 1982 general request by EPA. This interpretation may influence revisions of EPA's Method 24 for better precision.

D 4017, "Water Content Determination by Karl Fischer Titration," was discussed as being the most possible cause of poor precision in Method 24. Water contents of large magnitude may be the principal, but not sole, suspect variable in the "Confidence Limit Calculations" of Method 24. Volume solids content may be another, especially on zinc dust primers and other coatings with high pigment contents. New displacement methods are sought.

Precision or confidence limits calculations are at variance between: (1) EPA Method 24; (2) ASTM's general practice, E 180; and (3) D-1's own D 3980 practice on interlaboratory testing. Cooperation is needed between Subs. D01.21.56, D01.20 and, hopefully, EPA, to find an optimum treatment of such large magnitudes of variables.

EPA's "VOC DATA SHEET—Determination of Apparent VOC Content" was criticized as being: (1) too complex; (2) not in paint jargon; (3) with unnecessary revelation of confidential formulations; and (4) inferior to that of improved Method 24 or D 3960.

D 2369, on total volatile content, seems precise enough for many conventional solvent coatings, but not for inks which contain high boiling volatile mineral oils. The Sub. D01.56.11, task group on volatiles in inks, has completed one round-robin and is starting another to study the variables of sample film thickness in the oven for one or several hours, always at 110°C, and 95 mm, as well as, 58 mm pans.

Exempt solvents, such as halohydrocarbons, are not provided for in Method 24 as yet. Sub. D01.21.55 has completed further round-robins and another draft of their GC method for this purpose, which will need consideration in revisions of Method 24 and D 3960.

D01.21.22, Analysis of Electrocoat (E/C) Bath Samples, W. Van Der Linde, Chairman, received negatives and comments on all four items on a recent concurrent ballot. Since revisions are extensive as a result of this, all four methods will be resubmitted for ballot.

Two proposed new methods were distributed for review: (1) "Weight percent Determination of Solvents and/or Amines in Electrocoat Baths and Permeates by GC," prepared by P.D. Soucek, of DeSoto, and (2) "Test for Determination of Cation Contaminants in Electrocoat Samples," prepared by H. D. Swafford, of Glidden. These methods will be discussed at the May meeting. Four cooperators have agreed to participate in any proposed round-robin to evaluate these methods.

D01.21.26, Revision of D 2697, Volume Nonvolatile (VNV), M. E. Sites, Chairperson. In the absence of Chairperson Sites, H. Fujimoto chaired the meeting. The present status of the revised method for determining VNV was reported. Editorial comments received from a task group ballot have been incorporated. There was a question on the E 180 based statistical handling of the data. Following a review by H. E. Ashton, the revised D 2697 will be submitted for concurrent Sub. D01.21 and Committee D-1 ballot.

Mr. Fujimoto stated that a new quick and clean method to determine the density of the dried paint film is under investigation and its feasibility for a round-robin will be reported at the next meeting. In place of the stainless steel discs used in D 2697 and the weighing in air and in water, the film density is determined with Quantachrome's gas pycnometer which measures the volume of helium displaced by a known weight of paint film.

D01.21.27, Low Temperature Furnace Ashing, W. V. Moseley, Jr., Chairman, reported that the method for "Pigment Content of Paint by Low Temperature Furnace Ashing (450°C)" has been sub-

mitted for the next D-1 letter ballot. The method has been revised since the last ballot of Sub. D01.21 to reflect all technical and editorial comments. A precision statement has been added based on the statistical evaluation data furnished by PPG. Comments were made on the use of aluminum dishes for this method and also for D 3723, "Pigment Content of Water Emulsion Paint by Low Temperature Ashing." This method uses porcelain dishes, but D 3723 uses aluminum dishes, which lose weight when heated to 450°C. The chairman will investigate the aluminum dish problem. G. Cunningham observed that some of the new thinner gauge aluminum dishes lost solvent by permeation. Sub. D01.33.26 will be advised of the weight loss problem with the aluminum dishes.

D01.21.42, AAS Analysis of Pigments, W. V. Moseley, Jr., Chairman, reported the results of the ballots on "Standard Method of Test for the Atomic Absorption Analysis of Titanium Dioxide Content in Pigments Recovered from Whole Paint." A negative from H. E. Ashton was found persuasive. His recommended changes and comments from other persons will be incorporated, where applicable. The corrected and revised method is now ready for Society ballot.

D01.21.48, Analysis of Zinc Hydroxy Phosphite Pigments, L. Dicarolo, Chairman, reported that a round-robin had been conducted since the last meeting for the determination of zinc oxide and phosphorus acid in zinc hydroxy phosphite pigment. Two samples, which represented two levels of ZnO, were tested by five collaborators. The zinc content was determined by EDTA titration and calculated as zinc oxide. The phosphorus content was determined colorimetrically and calculated as phosphorus acid. The results appeared encouraging. A statistical review and precision statement will be generated by Mr. Cunningham, of PPG. The first draft will include a "Bias Statement" to conform to ASTM Style and Format. After submission to the editorial subcommittee it will be submitted to Sub. D01.21 ballot.

D01.21.53, Trace Levels of Monomers in Paints, J. Benga, Chairman, discussed the proposed method for determining free monomers. It was stated that the urgency of the regulation on controlling free monomers in paints has been relaxed, but the need for a method still exists. This is especially true since the method could be used for in-house quality control. It was agreed to conduct another round-robin. Particular care will be taken to ensure sample integrity.

The work on a capillary method for free monomers will be suspended temporarily.

A solicitation was made for a tentative method for determining free isocyanates.

D01.21.55, Halohydrocarbons in Coatings, C. Niemi, Chairperson, revised the proposed method for determining halohydrocarbons in coatings to fit ASTM form and style. The round-robin data was submitted to a member of ASTM's Committee E-11 for statistical analysis. The rewritten method was then sent to Mr. Ashton for review and comment. He revised the method to fit other GLC methods such as D 3362 and D 3892. In addition, he objected to the manner in which the data was statistically interpreted. He recommended using D-1's modification of E 180. This has been done. The corrected method with an added "Bias Statement" and placement of SI units in a primary position with U. S. units in parentheses will now be submitted to Sub. D01.21 ballot.

D01.21.56, Revision of D 3960, Calculating VOC in Paints, M. E. Sites, Chairperson. Mr. Fujimoto chaired the meeting. Results of the second round-robin, which included two water-reducible coatings, indicated both water determination methods used, i.e., D 3792 (GC method) and D 4017 (Karl Fischer method), showed poor precision, which in turn, affected the VOC calculations. D 4017 gave repeatability of 28.72% relative and a reproducibility of 71.21% relative. VOC obtained using D 3792 developed repeatability statements of 31.91% relative and reproducibility of 87.45% relative. Mr. Cunningham reran the data using E 180, but kept the % water values constant. He reported an improvement in repeatability (single analyst) to 20.74% relative and a reproducibility (multilaboratory) of 25.26%. However, these reported values were less precise than the 2.65% relative repeatability and 5.92% relative reproducibility obtained for solvent-reducible coatings. It appears poorer precision for VOC are obtained with water-reducible systems.

K. Leavell brought to the attention of the group a new method to determine water content of coatings his laboratory found to be better than the GC or Karl Fischer methods. This method uses the titrant, "Hydranal," which does not use pyridene. The reagent is supplied by Crescent Chemical Co. Relative errors of around 8% for water below 1%, 0.8% error in the 1 to 10% range and 0.7% above 10% are claimed for this method. The task group voted to initiate another round-robin on water-reducible paint systems using this titrant. In addition, the collaborators will be asked to determine the VOC of the test coatings. Three samples with high water content to be tested are: (1) an electrodeposition primer,

(2) household paint and (3) a water-reducible can coating.

D01.21.72, Metals in Air Particulate Samples, L. Dicarolo, Chairman, reported that the seventh draft of "Determination of Lead and Chromium in Air Particulates by Atomic Absorption Spectroscopy" passed the D-1 ballot with no negatives. It will be submitted for Society ballot.

D01.21.80, Exploratory Analytical Research, K. Leavell, Chairman, discussed the new method for improving the current method for determining water content by the Karl Fischer titration method using the new titrant, "Hydranal," as reported under Sub. D01.21.56.

Quantitative Fourier Transform Infrared (FTIR) was suggested as one area for committee action. R. W. Scott agreed to write up a general method for FTIR usage which could be applied towards a current ASTM approved method, such as hydroxyl numbers. The method will not be specific, but a general practice.

Current SEC methods for coating vehicles are considered out-of-date. Mr. Cunningham agreed to look into this area to see what might be done to update existing methods or generate a method using the latest and best available technology.

SUBCOMMITTEE D01.22 HEALTH AND SAFETY

H. A. Wray, Chairman

Six standards have gone through D-1 ballot since the June meeting. Negatives have been resolved and, where appropriate, comments will be included in the standard. Of the six, five will now be submitted for Society ballot. Only D 1310, "Flash Point and Fire Points of Liquids by Tag Open Cup Apparatus," will need additional drafting, specifically to show new information on calibrating liquids and to clarify the correction factor equation.

A new task group has been established for determining precautionary statements to be used in ASTM D-1 standards. J. J. Brezinski will be the chairman. The establishment of this task group is considered necessary because of the action of Committee D-2 on Petroleum, the proliferation of various precautionary statements in D-1 and the anticipated OSHA regulations on hazard information on approximately 600 materials. It is expected that the information coming from this new task group will provide recommendations for ASTM policy regarding precautionary statements.

The chairman of the Coordinating Committee on Flash Points (CCFP)

reported that a comprehensive manual relating to flash point methods and the history of flash point testing has been drafted and is now being edited by a committee chaired by Dr. David Lewis, of Great Britain, in cooperation with Mary Williams, of the U.S. Coast Guard. This manual will serve as a useful tool for both Industry and Governmental Regulating Agencies.

SUBCOMMITTEE D01.23 PHYSICAL PROPERTIES OF APPLIED PAINT FILMS

M. P. Morse, Chairman

D01.23.10, Adhesion, H. E. Ashton, Chairman, reported that work is continuing on determining if the tape pull-off adhesion test can be used on thick films. Difficulty has been encountered in obtaining good cross-hatch cuts in thick films. Attempts will be made to devise a satisfactory cutting tool. Evaluation of a tensile pull-off method is continuing. D 2197, "Adhesion of Organic Coatings" is being revised to eliminate the method for measurements by the Arco Micro-Knife. The revision will be submitted for D-1 ballot.

D01.23.11, Wet Film Thickness, H. A. Ball, Chairman, has revised the new practice for measuring wet film thickness with notch gauges to include the numerous suggested changes received from the D-1 letter ballot. The revised version will be submitted to concurrent Sub. D01.23 and Committee D-1 letter ballot.

D01.23.12, Dry Film Thickness, K. A. Timber, Chairman, has revised D 1005, "Measurement of Film Thickness with Micrometer," to include measurements on free films and films on substrates using stationary mounted and hand-held micrometers. A round-robin has been completed to determine the precision of the method. The data obtained will be analyzed and a precision statement will be formulated. The method will then be submitted to concurrent ballot.

D01.23.14, Hardness and Abrasion Resistance, will revise D 1474, "Indentation Hardness," by eliminating the method for using the spherical indenter. This revision will be submitted to D-1 letter ballot. The draft of a new method for determining hardness by pendulum damping was submitted to D-1 letter ballot. The several suggested editorial changes received have been incorporated in the method. The revised draft will be submitted to Society ballot.

D01.23.15, Slip Resistance, reported that a method for measuring the static coefficient of friction of coating surfaces has been approved by subcommittee ballot. The suggested changes received on the ballot have been incorporated and the new draft will be submitted to D-1 ballot. A round-robin is planned to determine the precision of measurements by this method.

D01.23.16, Water Permeability of Paint Films, was activated to determine if method D 1653 should be retained or should be withdrawn in favor of using method E 96. It was decided that D 1653 should be retained in a revised form that will include the desirable features of E 96. A revised draft will be submitted to the task group members in the near future.

SUBCOMMITTEE D01.24 PHYSICAL PROPERTIES OF LIQUID PAINTS & PAINT MATERIALS

C. K. Schoff, Chairman

Current D01.24 activities of interest include: (1) Completion and publication (by the end of 1983) of D 4287, "Viscosity of High Rate of Shear by ICI Cone/Plate Viscometer"; (2) Development of a series of precision statements for the three methods contained in D 2196, "Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer"; and (3) Working on a major revision of D 4212, "Viscosity by Dip-Type Viscosity Cups." Due to considerable differences between Zahn and Shell cups, including cup standardization, or lack of it, precision, and possibility of checking and calibration, this test method is being split into separate Zahn and Shell cup sections.

New projects include writing methods for: (1) Direct current volume resistivity for liquid coatings and related materials (including solvents) based on the Ransburg tester (Task Group on Electrical Properties of Liquid Coatings), and (2) Low shear viscosity (Task Group on Rotational Viscometers).

A planned project for which suggestions and participants are invited is a practice for the identification of flocculation and determination of the degree of flocculation of coatings. Such a practice could include viscosity measurements, microscopy and optical techniques. The first meeting regarding this project will occur at the May 1984 meeting in Montreal.

SUBCOMMITTEE D01.26 OPTICAL PROPERTIES

C. J. Sherman, Chairman

D01.26.02, Color Measurement, C. S. McCamy, Chairman, reported that a revision of D 3134, "Selecting and Defining Color and Gloss Tolerances of Opaque Surfaces and Evaluating Conformance," that includes the comments from the latest ballot will be submitted to Sub. D01.26 ballot.

D 1535, "Specification of Color by the Munsell System," received a negative and several comments on the ballot. The negative was found persuasive. A revision will be submitted for concurrent Sub. D01.26 and Committee D-1 ballot.

D 2244, "Instrumental Evaluation of Color Difference of Opaque Materials," will be revised to simplify for coatings and be balloted by Sub. D01.26.

A draft of a proposed standard practice of defining, selecting, and maintaining color standards will be balloted by the subcommittee.

D01.26.06, Hiding Power, L. Schaeffer, Chairman, reported that D 344, "Relative Hiding Power of Paints by Visual Evaluation of Brushouts," received two negatives and several comments on the latest ballot. One negative was withdrawn. The negative by J. DeWilde was found to be not persuasive. The comments will be incorporated in the method and it will be submitted for Society ballot.

D 2805, "Hiding Power of Paints," will be reviewed and submitted for ballot.

D01.26.11, Gloss and Goniophotometry, R. S. Hunter, Chairman, will incorporate comments from the latest ballot into the proposed Method for Visual Evaluation of Gloss of Similar Appearance and submit it for Society ballot.

A version of D 523, "Test for Specular Gloss," to bring it closer to the ISO method will be balloted by the subcommittee. A proposed method for Distinctness of Reflected Image test will be drafted and submitted for Sub. D01.26 ballot.

D01.26.23, Retroreflectance of Horizontal Coatings, N. L. Johnson, Chairman, reported that the title of D 4061 has been changed to "Retroreflectance of Horizontal Coatings" and a revision of the method that references E 808 and E 809, which are general methods of retroreflection, will be balloted by Sub. D01.26.

New Business—D 332, "Tinting Strength of White Pigments," D 2745, "Instrumental Tinting Strength of White Pigments," and D 3964, "Selection of Coating Specimens and their Preparation for Appearance Measurement," will be reviewed for reapproval.

Attention is called to the E-12 Symposium on Appearance to be held on Wednesday, May 23, 1984, in Montreal.

SUBCOMMITTEE D01.27 ACCELERATED TESTS FOR PROTECTIVE COATINGS

E. A. Praschan, Chairman

A negative by Harry Ashton on the D01 ballot (83-04) for D-2454, "Standard Practice for Determining the Effect of Overbaking on Organic Coatings," was withdrawn when the subcommittee agreed to the editorial changes recommended. This practice with the editorial changes will be sent on to Society ballot.

Editorial changes of two other standards which were on the D01 (83-4) ballot (D-1654, "Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments," and D-2485, "Coatings Designed to be Resistant to Elevated Temperatures During Their Service Life") were made in accordance with comments by Mr. Ashton. These will also be submitted to Society ballot.

D01.27.02 Water Tests, G. Grossman, Chairman, reported that a recent round-robin to compare various water tests gave unsatisfactory results because of a lack of blistering on the panels used. A new round-robin will be held using panels having a different coating system which, based on screening tests, should produce blistering.

D01.27.04 Light and Water Exposure Apparatus, S. Totty, Chairman, reported that a new draft of the proposed standard practice for the use of fluorescent UV/condensation apparatus has been written containing changes recommended in replies to a previous subcommittee ballot. This will be placed on the next D01 ballot.

D01.27.09 Corrosion, R. Williamson, Chairman, distributed and discussed a paper on cyclic testing which compared a number of cycle tests used worldwide. While test work is not completed it appears that specific cycles might duplicate the type of corrosion failure observed in actual practice. The chairman and a couple of other group members will meet to decide details of the "best" cycle tests for a task group round-robin.

D01.27.10 Accelerated Outdoor Weathering, M. Morse, Chairman, distributed data showing that gloss loss and color change values obtained after 8 months on the new EMMA (night time wetting) cycle at DSET Laboratories compared favorably with values obtained after 24 months Florida 5°S open rack exposure. The comparison of these EMMA n.t.w. values to previously ob-

tained Florida 5°S black box values was not quite as good. It is planned to make further comparisons of a modified EMMA n.t.w. cycle (slightly higher panel temperatures) to Florida 5°S (open rack and black box) with a series of automotive coatings.

Plans are underway to determine if the exposure of coil coatings on plywood-backed racks will provide a useful method of accelerating their degradation.

D01.27.11 Revision of D-2485, J. Robins, Chairman, reported that D-2485, "Coatings Designed to be Resistant to Elevated Temperatures During Their Service Life," has been approved on D1 ballot. Several editorial changes based on comments by Mr. Ashton have been made and it has been passed on for Society ballot. This task group will become inactive.

D01.27.14 Filiform Corrosion, R. De-Graaf, Chairman. This group meeting was chaired by Frank Lutze in the absence of the chairman. A round-robin will be conducted with several paint systems to determine if the formation of filiform corrosion can be accelerated by increasing the temperatures specified in the current method (D-2803) up to 140°F. Results of this evaluation should be available for the next meeting.

D01.27.17 Evaluation of Weathering Effects, A. Allen, Chairman, intends to update the methods for evaluating the degree of weathering effects (D-660, D-661, D-662 and D-772). The chairman brought a rough draft of a revision of D-660 (checking) for discussion. Several changes were suggested in the sections covered in the meeting and the chairman will revise the draft for further discussion at the next meeting.

SUBCOMMITTEE D01.28 BIODETERIORATION

D. L. Campbell, Chairman

D01.28.01 Package Stability, W. B. Woods, Chairman, reported that paint samples and cultures of the bacteria species *P. aeruginosa* have been sent to laboratories participating in a round-robin to evaluate the Presumptive Challenge Test Method for determining the capacity of preservatives to prevent microbial spoilage of paint.

D01.28.02 Rapid Determination of Enzyme Presence, A. J. Desmarais, Chairman. A round-robin test will be initiated to evaluate a method using a low substitution carboxymethylcellulose and Cellulase 1000 (enzyme).

D01.28.04 Resistance of Paint to Algae Attack, W. B. Woods, Chairman. A tentative procedure for testing algae resistance was discussed. Preconditioned acrylic paint films on birch tongue depressors and fresh cultures of the algae *Oscillatoria* will be supplied to laboratories participating in the round-robin testing.

D01.28.05 Recoating Mildewed Surfaces, D. L. Campbell, Chairman, reported the results of the D-1 letter ballot on the "New Standard Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings." Several good suggestions were made for revision. These will be incorporated into a new draft and submitted for concurrent Sub. D01.28 and Committee D-1 letter ballot.

SUBCOMMITTEE D01.29 SUBSTRATE PREPARATION FOR COATING TESTING

S. D. Ozenich, Chairman

Final details for the proposed round-robin on sandblasted panels were discussed. It was agreed that: (A) Panels should be blasted on the edges; (B) Panels should be precleaned before blasting; (C) Only virgin sand should be used for the test; and (D) All sides and edges should be coated.

It was further agreed that enough details had been agreed upon and that the chairman should send a letter and details of the proposed testing to all Sub. D01.29 members and the members of Subs. D01.23 and D01.27 to obtain comments and to secure at least four cooperators.

The chairman agreed to submit the details within the month to allow enough time to investigate comments and suggestions before the May meeting. After all comments have been received the subcommittee will begin drafting the recommended practice for preparation of sandblasted panels for testing.

DIVISION 30 PAINT MATERIALS

SUBCOMMITTEE D01.31 PIGMENT SPECIFICATIONS

C. W. Fuller, Chairman

Items for rebalot were discussed. As a result, nine standards were prepared in proper format and given to Dorothy

Savini immediately following the meeting. They were D 83, D 211, D 520, D 475, D 480, D 476, D 2218, D 3619 and D XXX, "Zinc Hydroxy Phosphite Pigment."

D 964, "Copper Powder for Use in Antifouling Paints," will be reviewed by D. C. Kinder and submitted for the February ballot.

D 603, "Aluminum Silicate Pigments (Hydrous)," will be reviewed and rebaloted in 1984.

There were comments and a negative on D 83, D 211, and D 2218 by Mr. Ashton. His comments were accepted with the exception of changing % PbCrO₄ content in Table I of D 211. The committee ruled that raising this % to the higher level was not allowed since the lower level is being produced. Mr. Ashton later withdrew the negative.

Task Group Chairman W. Hart reported on the E-34 meeting with respect to E 848. There were three areas of concern. E-34 recommended: (a) Delete requirement for engineering controls, (b) Change PEL to 0.05 mg Cr. (current OSHA level), and (c) Labeling. Sub. D01.31 will request ASTM headquarters to supply copies of E 848 to the Sub. D01.31 members on hazards of insoluble chromates.

Comments by Mr. Ashton on the revision of D 153, "Specific Gravity of Pigments," were reviewed and accepted. D. C. Kinder will revise D 153 and submit it for rebalotting.

Sub. D01.31 received a draft proposal from the Department of the Navy for revision of D 79, "Specification for Zinc Oxide," so that requirements of MIL-Z-15486A would be covered. Mr. Kinder will revise D 79, incorporating these suggestions and submit it for Sub. D01.31 ballot.

Doug Ruddick, of New Jersey Zinc, accepted appointment as Vice-Chairman of Sub. D01.31.

SUBCOMMITTEE D01.33 VARNISH & RESINS, INCLUDING SHELLAC

A. C. Abbott, Chairman

The subcommittee chairman will send a questionnaire to resin producers regarding the current methods used to determine color. This is in response to questions raised on color standards by two major resin producers at the Sub. D01.33 meeting.

Task group chairman are needed for the urethane, alkyd and emulsion groups.

D01.33.01, Varnish, H. A. Ball, Chairman, reported that a second draft of a major revision of D 154, "Guide to Testing Varnishes," will be submitted for concurrent ballot of Sub. D01.33 and Committee D-1.

D01.33.24, Nitrogen Resins, J. Smith, Chairperson, reported that D 4277, "Standard Guide for Testing Amino Resins," has completed Society balloting. The first draft of a test method for determination of free formaldehyde in amino resins was discussed. Preliminary screening of the method in PPG's laboratories will be conducted prior to round-robin testing. Cooperators for a round-robin on the analysis of melamine formaldehyde resins by C-13 NMR are being sought.

D01.33.25, Polyvinyl Chloride and Polyvinyl Butyral, J. J. Brezinski, Chairman, will devise a questionnaire for distribution to determine the need to expand the scope of this group to include water-soluble resins.

SUBCOMMITTEE D01.35 SOLVENTS, PLASTICIZERS AND CHEMICAL INTERMEDIATES

L. R. Thurman, Chairman

D01.35.01, Hydrocarbon Solvents, S. A. Yuhas, Jr., Chairman, reviewed the proposed restructuring of Sub. D01.35 into four task groups. It was reported that D 891 still remains active under Committee E-15's jurisdiction. Either D 891 or D 1298 is permissible as a method for determining apparent specific gravity. D. L. Ahlberg suggested that D 4052 be considered as a specific gravity test. This is based on the Mettler-Parr electronic instrument.

The passing of Carlye Lochboehler, of the U. S. Army ARRADCOM, was noted with deep regret. She was an active member of the task group and Sub. D01.35 and championed the cause for referencing Federal Standard PPP-2020 in ASTM solvent spec's.

D01.35.02, Oxygenated Solvents, T. H. Golson, Chairman, held a discussion on guidelines for a general safety caveat that would be used in standard specifications.

D01.35.03, Chemical Intermediates, J. R. Morrison, Chairman, reviewed the proposed standard for 2-ethylhexanol with the decision to develop two sets of

properties, one for a "regular" grade and one for a "monomer" grade. It was also pointed out that E-15 is developing a capillary GC method which should be available for discussion at the May meeting.

Old Business—The current safety caveat is to be used only in test methods or in a specification which contains detailed test procedures. A safety caveat to be used in specifications was discussed for proposed inclusion in the blue book. Its wording is as follows: "The material specified in this standard is hazardous if improperly handled. This standard does not purport to address all of the safety problems associated with the use of this material. It is the responsibility of whoever uses the material to consult and establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use (see section ____)." It is suggested that this caveat appear in the scope of specifications, where necessary.

J. J. Brezinski was concerned over the safety statements presented in the specification for formaldehyde and 2-methoxyethanol. After considerable discussion, the following statement was arrived at for formaldehyde (to be used in addition to the above caveat in the scope): "Formaldehyde and formaldehyde solutions are toxic and exposure to them should be minimized to avoid acute effects and possible sensitization. Consult your supplier's safety data sheet for specific hazard information." For 2-methoxyethanol the following statement was established: "2-Methoxyethanol is hazardous. Avoid skin and eye contact and inhalation of its vapors to prevent possible adverse health effects. Consult your supplier's safety data sheet."

The proposed standard specification for 2-ethylhexanol will contain properties for two grades.

Either D 891 or D 1298 is permissible for determining apparent specific gravity.

New Business—A proposal for reorganizing the task groups within the subcommittee was discussed. The proposed four groups would be: Solvents, Reactive Monomers, Chemical Intermediates, and Plasticizers. Additional information will be sent to Sub. D01.35 members.

Two new standards were proposed, one for the consolidation of all n-butyl acetate specifications and the other for all the ethyl acetate specifications.

DIVISION 40 PAINT PRODUCTS APPLIED ON SITE

SUBCOMMITTEE D01.41 CRITERIA FOR THE PURCHASE OF COMMERCIAL PAINTS AND COATINGS

R. A. Brown, Chairman

The chairman stated that the objective of the subcommittee is to develop a method for the purchase of commercial paints and coatings. He said there is sufficient evidence from past meetings that such a method is needed. State and local government agencies say they do not have the funds to maintain laboratories staffed with chemists who can write specifications and test paint performance. Even the Federal government has closed many paint testing laboratories and have eliminated many jobs formerly held by paint chemists. Institutional purchasers of paint are also faced with making buying decisions without any technical back-up.

The Office of Management and Budget (OMB) is telling Federal government agencies that they must buy commercial products whenever such products meet their needs—rather than writing specifications to cover the procurement of special products.

W. V. Moseley, Jr., of the State of Virginia, prepared a modified version of the method his state uses to purchase commercial paints. This "Guide for Purchasing Architectural Paints" was submitted to Sub. D01.41 ballot following the June 1983 meeting of the subcommittee. Results of the ballot were: 13 affirmative, 6 negative, and 9 abstaining. Comments which accompanied the negative ballots showed a great deal of thought and consideration. The negative ballots were discussed in detail. Although there were other basic differences of opinion which could not be resolved, some of the suggestions could be incorporated into the document.

The subcommittee encouraged Mr. Moseley to modify and rewrite his document and again submit it for Sub. D01.41 ballot. A group of Federal government agency representatives volunteered to write a proposed standard for Latex Wall Paint and submit it to Sub. D01.41 before the May 1984 meeting. These were Irving Bloom, of Naval Facilities Engineering Command; Mary McKnight, of National Bureau of Standards, and Jesse Neal, of U.S. Air Force.

The chairman urged any interested institutional or government purchasing

groups to submit an outline of the help they need in purchasing paint products.

Basic differences of opinion among Sub. D01.41 members still exist, which has made it impossible, to date, to come up with a method for purchasing commercial architectural paint products, which is satisfactory to both paint manufacturers and paint purchasers.

SUBCOMMITTEE D01.42 ARCHITECTURAL PAINTS

R. H. Rowland, Chairman

D01.42.02, Practical Soil and Stain Removal, C. Tatman, Chairman. In the absence of the chairman, W. Dean chaired the meeting. The results of the Fall 1983 Sub. D01.42 and Committee D-1 ballot Item 71 were discussed. The two negatives received from Mr. Ashton and J. DeWilde were found to be persuasive. These changes along with three editorial comments will be incorporated into the revised method and be rebaloted.

D01.42.04, Wet Adhesion, F. Winkelman, Chairman, did not meet since the planned round-robin had not gotten underway. The method and the materials will be distributed to the 10 cooperators shortly.

D01.42.06, Standard Practice for Testing Latex Semi-Gloss and Gloss Paints, S. LeSota, Chairman, reviewed the third draft of Recommended Practices for Testing Interior Latex Semi-Gloss and Gloss Paints. Minor editorial changes were made and Mr. Ashton's critique is being awaited prior to submitting it for Sub. D01.42 ballot.

D01.42.16, Opacity (Practical Method), R. Armstrong, Chairman, reported that as a result of the last round-robin, several comments and suggestions were made in order to improve the method. It was suggested that three-inch rollers, made from standard nine-inch rollers, be used to reduce the size of the test panel required. Such rollers, as supplied by EZ Paint, will be used for the upcoming round-robin. A suggestion to use a new roller for each test sample was considered. Conditioning of the rollers with the test paint prior to the application of the paint will be specified in the procedure. The procedure will also specify placing the panel in a vertical position during the application. For the upcoming round-robin, paints will continue to be applied at a specified spreading rate. Future round-robin work will attempt to rank various paints for practical hiding when applied at the so-called natural spreading rate.

D01.42.17, Roller Spatter, J. Price, Chairman, heard a summary of the work to date and then saw a comparison of the results obtained using the old notched spool versus the new notched spool, which has four times as many points for the generation of spatter. The new notched spool will be used in the upcoming round-robin which should be completed prior to the Montreal meeting.

D01.42.18, Block Resistance, U. Jackson, Chairman. This is a new task group and will meet for the first time in Montreal. Anyone interested in working up a method for block resistance is urged to attend.

SUBCOMMITTEE D01.44 TRAFFIC COATINGS

R. L. Davidson, Chairman

D01.44.01, Thermoplastics, J. O'Brien, Chairman, announced that samples for the present round-robin have been distributed. The tests will include bond strength, abrasion resistance, directional reflectance, and effects of freeze-thaw. Results should be available for the May meeting.

D01.44.02, Traffic Paint, J. Atkins, Chairman, reviewed all Sub. D01.44 standards and set a deadline of May 1984 for updating all of them for full compliance. D 2205, "Standard Practices for the Testing of Traffic Paint," will be submitted for concurrent Sub. D01.44 and Committee D-1 ballot. D 913, "Evaluating Degree of Wear of Traffic Paint," will be the subject of a round-robin to generate data for a precision statement.

D01.33.03, Night Visibility, discussed the "Mrs. Casey" letter sent to GSA concerning the use of glass beads for night visibility on airport runways. Discussions are underway with GSA and this matter is reaching a satisfactory conclusion. The statistical results on the tests run on gradations and rounds have not been received. Both of these tests are being reevaluated and may necessitate another round-robin. This data should be available by the January 1985 meeting.

A discussion on retroreflectometers was held to bring everyone up to date. It was decided to have a test guideline written for retroreflectometer use. This will be done by J. Ritter for discussion at the next meeting. The test panels which will be used for horizontal testing will be available for testing.

SUBCOMMITTEE D01.45 MARINE COATINGS

L. S. Birnbaum, Chairman

D01.45.05, Algae Control, C. D. Stevens, Chairman, reviewed in detail a draft of a proposed Standard Method of Test for the Evaluation of Antifouling Algal Fouling Control Efficacy. Of special significance was the subcommittee consensus that separate performance rating values be assigned for macro-algal fouling (slime). Chairman Stevens agreed to prepare a revised draft incorporating comments for circulation to Sub. D01.45 members.

D01.45.07, Antifouling Rating, C. Perez, Chairman, was advised that there was no additional data received from Pearl Harbor. Panels exposed at Miami for 20 months were made available for inspection at the Miami Marine test site at 5:00 p.m. as well as photographs of panels exposed at the Battelle site.

D01.45.06, Dynamic Testing, D. Laster, Chairman, discussed sections of the draft of a Standard Test Method for Marine Antifouling Systems under Hydrodynamic Flow which had not been reviewed at the June meeting. Changes will be incorporated into a new draft and distributed by mail for comment.

D01.45 Business—A subcommittee ballot to determine new areas and priorities of interest for seven proposed projects for activation was reviewed. An arbitrary rating scheme based on interest and desired priorities showed prime support for performance specifications for marine coatings (score of 20) and inspection of ships for performance of underwater hull systems (score of 18) followed by ablation rates of bioactive materials (score of 8 each). The chairman advised attendees of action initiated by F-25.02 on the first two items. After some discussion, it was agreed that F-25.02 should take the lead in managing these two projects, but that Sub. D01.45 members be kept advised of progress so they could comment on documents prepared. It was suggested that Sub. D01.45 members submit applications for membership in F-25.02 so they may receive documentation for comments and voting. Chairman Birnbaum agreed to serve as liaison and to keep Sub. D01.45 members informed.

A motion was passed to activate a project on the rate of release of biocides from antifouling paints. The chairman agreed to circulate drafts of proposed methods received as a result of a November 15, 1983 request to Sub. D01.45 members and to look for a group chairman.

It was the consensus that action on activation of a method on ablation rate be

deferred in view of overlap with Hydrodynamic Flow Test.

The chairman distributed copies of a proposed performance type Military Specification for Antifouling Paint, dated November 9, 1983, which was forwarded to industry by the Navy for comments and recommendations, for response by the end of December 1983. Several of the attendees expressed a desire to review the document and felt there was insufficient time for possible preparation of comments to meet the Navy deadline. Accordingly, the chairman agreed to prepare a letter to the Navy requesting an extension of 30 days for receipt of comments from attendees and coordination of comments by the chairman for transmittal to the Navy Sea Systems Command.

SUBCOMMITTEE D01.46 INDUSTRIAL PROTECTIVE PAINTING

K. A. Trimber, Chairman

D01.46.02 "Surface Preparation", K. A. Trimber, Chairman. The results of the concurrent sub and main committee ballot of "Standard Method for Field Measurement of Surface Profile of Blast Cleaned Steel" were presented. The negative (submitted by Mr. Ashton) was discussed and found to be persuasive. The standard will be rewritten to handle the negative (and comments by E. R. Lewis) and re-submitted for ballot in the Spring.

In other business, it was noted that D 2200, "Pictorial Surface Preparation Standards for Painting Steel Surfaces," is due for review in 1984. John Keane reported that SSPC has some comments on D 2200 that they would like to have ASTM consider. The comments will be sent to Mr. Trimber for subcommittee review. It is expected that the standard will be ready for the 1984 Fall ballot.

During the June 1983 meeting, the committee discussed the need for a standard for determining abrasive cleanliness (chlorides, sulfates, grease, etc.). No action has been taken on this subject, as SSPC has developed a committee for evaluating abrasives. The SSPC has investigated the work of others in evaluating abrasives, and plans to have a guide published within two years. Rather than independently generate the same information, the subcommittee has agreed to assist SSPC in their efforts.

D01.46.03 "Repainting", D. Noxon, Chairman. A. Schwartz chaired the task group for D. Noxon, who was unable to attend the meeting. The task group has prepared a "Standard Method for Field

Identification of Coatings." This method defines the use of procedures and portable apparatus for determining the generic type of previously applied coating films in the field. The coating examined can either be weathered from exposure or freshly applied. The latest draft of the proposed method was circulated to task group members prior to the meeting and 13 written comments were received. Several comments questioned the technical accuracy of some of the statements which will be investigated. R. Wakefield also proposed that additional methods of determination be added to the procedures. The addition of these methods and resolution of the comments will result in a rewrite of the draft in January 1984. The proposed standard will then be submitted for subcommittee ballot.

A broad precautionary statement (per ASTM Form & Style of Methods, A13.4) will be added to the text to warn the field operator of potential noxious fumes and aggressive reactions, etc.

D01.46.04 "Pull-Off Adhesion Test", A. Cunningham, Chairman, reviewed the status of the on-going round-robin using the Elcometer Adhesion Tester. It was reported that the main problem encountered with some of the systems submitted to participants last Spring was that they had pull-off strengths which exceeded the range of the instruments used. Therefore, numerical data was not obtained for all systems. An additional set of panels submitted to the participants after the June 1983 meeting which was expected to be within the range of the instruments was again unfortunately off scale. At this meeting, it was agreed that two to three additional systems would be chosen which would unquestionably have pull-off strengths below the 1000 psi capacity of the instruments and submitted to participants. J. Lanning, R. Wakefield, and A. Cunningham agreed to prepare and distribute the required panels. It was also decided that a new adhesion testing instrument on the market, the FINS Company System 2000 would be included in the round-robin. R. Fisher, of Fisher Instruments and Navigational Services, will provide the task group chairman with a list of participants.

M. McKnight reviewed data for several coating systems which compared the Instron, Elcometer, and a pneumatic prototype portable pull-off adhesion apparatus developed at NBS (similar to the FINS instrument). The data showed that the Elcometer gave results approximately 50% lower than the other apparatus. It was thought that this resulted from the deformability of the panels during testing. This data highlighted the importance of

including the pneumatic type testers (FINS 2000) in the round-robin so that side-by-side comparisons with the Elcometer can be made.

Draft 5 of the "Method for Portable Pull-Off Adhesion for Coatings" had been submitted to concurrent main and subcommittee ballot. Comments were received from three voters. The negatives were discussed and for the most part centered on the fact that the standard was written specifically around the Elcometer instrument, although other types of portable apparatus are available for testing adhesion. The negatives were found to be persuasive and the method returned to subcommittee for rewrite. Mr. Fisher agreed to assist Mr. Cunningham in the redrafting of the method. Draft 6 will be prepared and rebalotted (concurrent sub and main committee) in Spring 1984.

D01.46.07 "Inspection", R. Martell, Chairman. Consistent with the decisions made during the June 1983 meeting, Draft A of ASTM D 3276, "Standard Guide for Painting Inspectors," was prepared and distributed to task group members. The draft separated the "educational" information from the "how to" punch list of inspection items. The task group developed a comprehensive inspection check list explained by a few concise phrases that will ensure that none of the items essential in the proper application of a coating system will be overlooked. Draft 5 incorporating these changes will be prepared and circulated to the task group for comment. The comments will be discussed at Montreal in May in an attempt to have a document ready for ballot in Fall 1984. It was pointed out that this standard is due for reapproval in 1984.

General D01.46 Business. At the main committee meeting, future work for D01.46 was discussed. Because some of the standards that have been developed during the last few years are close to completion, the committee is actively seeking other work. Suggestions included:

(1) A standard for determining the cleanliness of steel after blast cleaning. This would include field methods for evaluating the presence of rust, mill scale, and so forth.

(2) Standard method for test patch application of coatings to assure compatibility in maintenance work. It was pointed out that ISO may have done some work along these lines which could be used by ASTM.

(3) Standard for proper application of coatings. This would include techniques for proper use of conventional and airless spray equipment.

(4) Standard for the painting of bridges and elevated structures. This would in-

clude the categorization of systems that could be used, methods of preparation and application, and so forth. This suggestion generated a great deal of interest and it is expected that many highway departments would be anxious to participate in the development of such a standard. Mr. Schwartz agreed to draft a scope for this work to be presented at the May 1984 meeting. At that time, a separate task group may be organized to undertake this activity.

(5) Other—Sub. D01.46 welcomes suggestions on standard test methods or recommended practices that others in the industry feel are needed.

SUBCOMMITTEE D01.47 MASONRY TREATMENTS

R. S. Shane, Chairman

The chairman delivered a state of the art presentation on the consolidation and preservation of masonry. Presentations were also made by representatives of the U. S. National Park Service, the National Bureau of Standards, the National Research Council of Canada, and other interested parties.

Meeting places were discussed and it was brought out that federal employees would have great difficulty in attending meetings held outside the United States. This precluded a meeting of the subcommittee in Montreal in May 1984.

Since this subcommittee has just been given permanent status, a committee was appointed to develop a scope for Sub. D01.47. It consists of R. S. Armstrong (Chairman), H. C. Miller, A. Schwartz, M. E. McKnight, and H. M. Werner (ex-officio).

SUBCOMMITTEE D01.48 ZINC RICH COATINGS

D. C. Kinder, Chairman

D01.48.02, Determination of Cure, J. Lanning, Chairman, reported on a D-33 round-robin on determination of film hardness and cure by six different methods. Four coatings used were not identified generically. It was commented that the test was one more for hardness than for cure. The chairman distributed test guidelines for a Sub. D01.48 round-robin to include the Oeschle Gauge, MEK Rub and pencil hardness tests. Zinc-rich coatings would include inorganic and organic types.

D01.48.03, Lab Tests, R. Wakefield, Chairman, presented Draft #2, dated July 8, 1983, of a proposed test method for the

so-called "bullet hole" test and the V stripe test along with comments received on Draft #1. It was voted to submit Draft #2 to Sub. D01.48 ballot. A round-robin was planned with a total of five coatings involved.

Sub. D01.48 Business—R. S. Shane reported that NACE had withdrawn NACE 6B173 for rework. When the document is revised and resubmitted in final form, he feels it can be written up in ASTM format.

Report on SSPC Guide 12.00, "Selecting Zinc-Rich Painting Systems"—G. McLeod was unable to attend the SSPC meeting. A. Cunningham reported that work has started on putting the guide into ASTM format.

Report on System 2000—Adhesion Tester—Chairman Kinder reported data received from D. Ballard, of Micro Source, and circulated SEM photos showing micro topographic details of one pull test area. Mr. Cunningham reported Sub. D01.46 is working on a pull-off test for adhesion that will include instruments such as the "System 2000".

Determination of Total Volume Solids content of Inorganic Zinc Coatings Using Mercury Displacement—D. Kinder circulated a procedure in ASTM format developed from NACE Technical Report T-6A-36. It was decided not to pursue this method further because of the use of mercury as the suspending medium and the use of tungsten panels.

New Business—Chairman Kinder reported that a 10-year summary report of NACE Committee T-6H-15 Panel Exposure Tests was given at the "International Corrosion Forum" in Anaheim, April 1983. Eight surface preparations and five coating systems were studied. The authors concluded, under "Coating System Performance—Overall Evaluation" that top-coated zinc-rich coatings systems were superior to the organic systems in performance over all surface preparations at all exposure sites. This summary report can be obtained from NACE Publications Department, P.O. Box 218340, Houston, TX 77218.

DIVISION 50 PAINTS FOR FACTORY APPLICATION

SUBCOMMITTEE D01.52 FACTORY-COATED WOOD PRODUCTS

R. C. Marck, Chairman

D01.52^B, Hardboard, S. B. Schroeder, Chairman, continued from last meeting the discussion on the problem of wetting and swelling of hardboard siding by surfactants in conventional water-borne housepaints. A recent American Hardboard Association test method was cited. Difficulties with reproducibility were reported, so it was decided to work with the AHA Field Finishing Task Group. A modified adhesion test for use on hardboard siding and proposed by AHA was also discussed.

D01.52.12, Textured Wood Products, R. C. Marck, Chairman, has worked for over five years in the development of definitive test methods for use on textured wood products. Little or no success was achieved, so this task group was terminated.

D01.52.13, Prefinished Hardboard Siding, K. V. Kruse, Chairman, is a new task group formed to evaluate test methods for prefinished hardboard siding. A scope for this task group will be developed and presented at the May 1984 meeting.

D01.52/55, Formaldehyde Emissions, R. C. Marck, Chairman, had previously agreed that formaldehyde emissions from wood products logically fell within the scope of Committee D-7 on Wood. It has, therefore, transferred its duties to Sub. D07.14, M. Efland, Chairman.

SUBCOMMITTEE D01.53 COIL COATED METAL

R. A. Cassel, Chairman

D01.53.01, Formability, W. H. Gunn, Chairman, will replace the existing document precision statement with a new one generated by Mr. Ashton as soon as balloting procedures allow. The task group will then revert to inactive status.

D01.53.02, Cure, R. A. Cassel, Chairman, plans no work until a new task group chairman is found.

Sub. D01.53 General—The lack of any progress in task groups is a reflection of the sad state of the active participation in

the subcommittee. Within the past three months two more working chairmen have had to resign regretfully due to job changes. Unfortunately, both of these were representatives of the paint industry. J. C. Weaver has agreed to help set up a meeting with the technical section Vice-President of the National Coil Coaters Association to seek more support of Sub. D01.53.

SUBCOMMITTEE D01.55 FACTORY-APPLIED COATINGS ON PREFORMED PRODUCTS

F. Zurlo, Chairman

D01.55.01, Coatings For Wood Products, M. Mull, Chairman, will add a description of panel substrate specifications to D 1211, along with significance and use statements, prior to submitting it to Sub. D01.55 ballot. D 3170 will be circulated to PPG Industries and Ford Motor Co. for review.

Mr. Ashton will be contacted concerning an invitation to a Canadian Government National Research Council representative to attend the Sub. D01.55.01 meeting in May 1984 in Montreal to present an overview of Canadian Furniture Finishing Test Methods.

R. Wint will contact the Southern Furniture Manufacturers Association to request a survey of their members on what test methods are used to determine the quality of the finishes on their furniture. It is believed that many of these could be made ASTM methods.

Since a crock test question was assigned to this committee, F. Zurlo will contact the inquirer for details.

D01.55.07, Industrial Water-Reducible Coatings, F. Zurlo, Acting Chairman, reported that the proposed practice (guide) for testing water-reducible industrial coatings which had been balloted by Sub. D01.55 has been modified to include all constructive comments made. It will appear on the next ballot.

SUBCOMMITTEE D01.56 PRINTING INK

J. M. Fetsko, Chairman

D01.56.02, Lightfastness, J. Benson, Chairman, reported that, on the basis of instrumental measurements on exposed lithol rubine prints, three-filter densitometry cannot replace spectrophotometry for evaluating degree of fade in the

presence of color shifts. A new round-robin is planned in which solid and halftone prints prepared by a single source will be distributed for exposure in various types of fadeometers, under laboratory light and under glass facing south.

D01.56.06, Ink Tack, C. Shepard, Chairman, reported that the D-1 ballot of the proposed new standard "Apparent Tack of Printing Inks by the Inkometer" elicited no negative votes. After suggested editorial changes are made, the method will be ready for society ballot.

D01.56.09, Tinting Strength, W. Riedel, Chairman, reported that 12 laboratories participated in a round-robin conducted on a series of lithol rubine flushes. Although statistical analysis has not been conducted as yet, there did not appear to be significant differences in test results between ZnO and TiO₂ bases, nor among visual, densitometric and spectrophotometric parameters. For the next round-robin, yellow flushes will be distributed along with blue and white bases.

D01.56.10, Water Uptake, G. Bien, Chairman, distributed a brief report which concluded, on the basis of two round-robins, that water uptake measurements by themselves did not predict lithographic printing performance. A more detailed research report is to be prepared. Because of the widespread use of the Duke Tester, its precision and accuracy will be determined by means of a round-robin.

D01.56.11, Non-Volatile Matter in Heat-set Inks, B. Blom, Chairman, reported that, in a round-robin conducted at the film thickness specified in D-1644 and D-2369, test results were generally too high compared to the theoretical NVM to be useful. A new round-robin will be conducted at a lower film thickness.

D01.56.12, Fineness of Grind, J. Cichon, Chairman, reported on the preparation of the required precision statement for D 1316, "Fineness of Grind of Printing Inks by the Production Grindometer." Results of a round-robin suggest that the report section of the method be modified to require that scratch readings from four paths (two drawdowns on a double path gauge) be averaged. A new round-robin will be conducted to check out the new instructions and to compare scratch vs. gloss readings on Grindometer drawdowns.

D01.56.13 Ink Mileage, B. Blom, Chairman, reported that two sets of process inks varying in mileage on a production press are now in-hand. Because the quantity of paper supplied precludes a round-robin, the samples will be tested in one lab in order to evaluate agreement between production and bench presses.

D01.56.14, Setting of Heat-set Inks. A. Urdea was appointed Chairman of a new task force which will attempt to standardize the operation of ovens used for drying heat-set inks.

SUBCOMMITTEE D01.57 ARTISTS' PAINTS AND RELATED MATERIALS

J. T. Luke, Chairman

D01.57.01, Preparation of Samples for Colorimetric Determination. H. W. Levison, Chairman. Reports previously submitted by H. Levison were discussed. Test data has indicated that a hand draw-down procedure proposed by Levison seems accurate enough for oil colors, but not accurate enough for acrylics. It was agreed to conduct a round-robin working with acrylics using a 10 mil clearance draw-down blade. Test data will be analyzed for accuracy.

D01.57.02, Lightfastness of Pigments. H. W. Levison, Chairman. Revision of D 4303, "Test Methods for Relative Lightfastness of Pigments Used in Artists' Paints," has been balloted with no negatives at the subcommittee and committee levels. Some editorial changes and affirmative comments were received from Mr. Ashton and N. Hale. Editorial changes were accepted. Affirmative comments were discussed as follows:

(Mr. Ashton) Section 10.2—change "A minimum of two exposures" to "an exposure to a minimum of two sources." The subcommittee voted not to make the change.

(Mr. Hale) Section 10.1—Add additional sentence to be sure that a visual check is made of exposed and unexposed specimens to verify that visual and instrumental agreement exists. The subcommittee voted not to make this change.

The subcommittee agreed to add in the notes section. "Two sun exposures in distinct locations will be considered two different tests."

D01.57.03, Tinting Strength of Pigments. I. Shack and T. Pamer, Co-Chairmen. After much discussion on the area of tinting strength, it was decided to proceed with a round-robin on tinting strength. Two samples of acrylic phthalocyanine blue along with a white were

distributed to participants. The method of Ruth Johnston-Feller will be used. Results will be sent to T. Pamer for compiling.

D01.57.04, Artists' Paint Specifications. A. Spizzo, Chairman. Revision of D 4302, "Standard Specification For Artists' Oil and Acrylic Emulsion Paints," has been balloted with no negatives at the subcommittee and committee levels. Some editorial changes and affirmative comments were received from Mr. Ashton. Editorial changes were accepted. The affirmative comment by Mr. Ashton was concerning whether the subcommittee has the right to assign lightfastness categories to pigments based upon testing. After much discussion and in an effort to keep consistency in the assignment of lightfastness ratings, the subcommittee unanimously passed the following motion: "Due to the uncertainties inherent in lightfastness testing, the subcommittee reserves the right of reviewing the results of exposure tests and deciding, based on all available information, which is the most suitable lightfastness category to use for the pigment in Table 1 of D 4302."

Statement of Conformance (Section 5.6) was then discussed. Companies have requested that variation be allowed in the statement of conformance given in Section 5.6 of D 4302. They also would like to be able to combine it with other conformance statements into one general conformance statement. Wording is to be developed by J. Luke to accomplish this and will be submitted for subcommittee ballot with other revisions to D 4302.

The subcommittee was asked to assign a description to Lightfastness III pigments. Pigments in "Lightfastness III" will be described as having "Fair" lightfastness.

D01.57.07, Physical Tests. H. W. Levison, Chairman, circulated a report, "The Adhesion and Cohesion of Artists' Acrylic Emulsion and Oil Tube Paints" prepared by H. Levison. This report describes testing done using a "System 2000" pneumatic adhesion tester made by Semicro Division M. E. Taylor Engineering. The force needed to check the inner coat adhesion or cohesion between various paint films is presented in the report.

D01.57.08, Chronic Toxicity. W. Stopford, M.D., Chairman. D 4236, "Standard Practice For Labeling Art Materials For Chronic Adverse Health Effects,"

will be available in the 1984 Book of ASTM Standards, Section 6.01. The subcommittee is trying to find ways to publicize this standard.

D01.57 Business—The first order of business was an ASTM "Certificate of Award" presentation to Henry W. Levison. The presentation was made by S. B. Levinson, D-1 Committee Chairman, with many D-1 officers present. The award was made to H. Levison for his untiring work on Subcommittee D01.57.

All items requiring voting and recommendations as discussed in Task Groups were brought to the subcommittee for voting. Approval was received on all matters.

DIVISION 60 PAINT APPLICATION

SUBCOMMITTEE D01.61 MANUAL PAINT APPLICATORS

F. B. Burns, Chairman

D01.61.01, Paint Brushes. W. V. Moseley, Jr., Chairman, reviewed responses from government agencies, including Canada and five U. S. states. Three had formalized purchasing procedures and three did not. In further discussion it became evident no objective painting performance testing was included. Four EZ Paint'r in-house test methods were presented for discussion. It was concluded that while all of these would be good candidates for round-robin testing, it would be practical to select only one or two as a start. Seven persons agreed to be cooperators when the program is finalized.

D01.61.02, Paint Rollers. J. F. Price, Chairman, continued the discussion on matters related to paint rollers. It was concluded that governmental agencies address rollers similarly to brushes. Two EZ Paint'r in-house test methods for characterizing paint rollers were presented for discussion. The same cooperators as for the brush testing agreed to include roller testing. At least one of these methods will be put into the round-robin testing.

Society Meetings

BALTIMORE..... JAN.

"The Sensible Way To Paint and Profit"

A 25-Year Pin was presented to Harry Schwartz, of Sherwin-Williams Co.

Cal Tatman announced that applications were available for the \$750 scholarships for students entering their freshman year this September.

"THE SENSIBLE WAY TO PAINT AND PROFIT" was presented by Dennis Lakomy, of Bee Chemicals.

Mr. Lakomy discussed the advantages of purchased universal dispersions over composite grinding of special in-house dispersions. These advantages include: (1) less inventory to finance and store; (2) less wash solvent required; (3) lower capital investment; and (4) reduced labor costs.

An example paint company was presented. It has 500,000 gallons sales \times \$14/gallon.

I. Assuming 11 lines of special dispersion \times 24 colors = 264 dispersions = approximately 4,000 gallons of inventory. The cost of financing 4,000 gallons of inventory = \$7,000/yr. The cost of storing 4,000 gallons of inventory = \$1,800/yr. Total = \$8,800/yr.

If, however, you purchased a line of universal dispersions \times 24 colors = approximately 720 gallons of inventory. To finance and store this smaller inventory would cost approximately \$2,500/yr. This would be a savings of \$6,300/yr, explained Mr. Lakomy.

II. Wash solvent from premix tanks, etc., cost \$25-\$40/drum to dispose of because of EPA requirements. Assuming 30 gallons of wash solvent/color/piece of equipment (re-used a maximum of three times) = 1,025 gallons of wash solvent/week \times \$1.50/gallon = \$79,000 wash solvent cost/yr.

Through the use of purchased dispersions, wash solvents reduced to 560 gallons/week = \$42,000/yr. According to Mr. Lakomy, this is a savings of \$35,000/yr for wash solvent.

III. Purchased dispersions would reduce capital equipment needs from \$367,000 to \$185,000, explained Mr. Lakomy. This is a savings of \$21,000/yr in financing.

IV. Mr. Lakomy demonstrated reduced labor costs by giving as an example, a light brown gloss enamel.



Attending the Cleveland Society's January Joint Meeting and Manufacturing Symposium were (left to right): Society President—Harry A. Scott; Keynote Speaker—Irving Foote, of SCM Corp.; and CPCA President—Paul Beaudry

Composite Grind	Purchased Dispersions
Raw materials \$721	\$755
Tint, mix, etc. <u>86</u>	—
\$807	\$755

This presents a savings of \$52.

Using purchased dispersions, the example paint company, with an average batch size of 200 gallons, would save \$218,000 and increase its profit 104%, said Mr. Lakomy.

In addition to these savings, a company would realize indirect savings in: (1) improved laboratory utilization; (2) quicker transfer of formulas from lab to plant; (3) easier OSHA and EPA compliance—reduced wash solvent—less dust; and (4) faster order response, which satisfies customers, which brings in more business.

Mr. Lakomy concluded that purchased universal dispersions can improve the efficiency of an operation and increase its profits.

FRANK H. GERHARDT, *Secretary*

BIRMINGHAM..... JAN.

"The Technical Department"

Honored guests included Bristol OCCA Chairman, Roger Saunders, and eight members of his section.

Dr. P.P.W. Weiss, of Croda Paints (Birmingham) Ltd., spoke on "THE TECH-

NICAL DEPARTMENT: A DRAIN ON RESOURCES OR AN AID TO PROFITABILITY."

Dr. Weiss expressed his belief that paint laboratories should be part of the marketing department, or at least should respond directly to market forces.

The variations in cost, sales, and profits were discussed. Dr. Weiss noted that the numbers employed in the paint industry had been slightly less affected by the recession than the manufacturing industry as a whole. Laboratories had been less affected in terms of employment than any other sector.

Dr. Weiss said that cost had risen overall by 11.1%, while laboratory costs had risen by 38.9%. Profit of the average UK paint company was 3.2% net, while the laboratory cost 3.7% of turnover. Dr. Weiss proposed a plan for maximizing the benefits of the laboratory to the company.

D.H. CLEMENT, *Secretary*

CLEVELAND..... JAN.

"Joint Meeting and Symposium"

One hundred sixty-eight persons attended the Joint CSCT/CPCA Meeting and the symposium and table top exhibit.

Frank Passen, Chairman of the Manufacturing Committee, and Dick Shannon, CPCA Chairman of the Chemical Coatings Committee, were commended for organizing the joint meeting, symposium, and table top display.



Attending the January meeting of the Los Angeles Society were: (Seated, left to right): President—Lloyd Haanstra; Treasurer—Michael Gildon; and Meeting Chairman—John Zywoienski. (Standing, left to right): Vice-President—Earl Smith; Speaker—Patrick MacDonald, of Reichhold Chemicals, Inc.; and Secretary—Henry Kirsch

Irving Foote, of SCM Corp., presented the keynote address for the symposium entitled, "Tools for Tomorrow: Increase Profitability through Innovative Manufacturing Concepts."

Mr. Foote described the planning, construction, start-up, and shake-down of the newer facilities of the Glidden Division of SCM Corp.

To take advantage of the newest technologies for materials handling, manufacturing, and quality control, designing required innovative thinking. Mr. Foote noted that automated and computerized processes were utilized wherever practicable. Employee training and retraining programs were improved to provide fully trained personnel.

Mr. Foote explained that as new equipment and new procedures were activated, production standards and industrial engineering standards were developed. As productivity increased, standards were revised to provide an accurate basis for figuring costs.

The new facilities showed approximately 40% improved productivity as compared to the older plants. Mr. Foote emphasized that innovative people are a very valuable asset.

Twenty-eight suppliers to the coatings industry provided table top exhibits. Technical advice and product literature were available.

Byk-Mallinckrodt USA, Inc. was awarded for its outstanding table top exhibit which featured laboratory and control test equipment.

SCOTT E. RICKERT, *Secretary*

HOUSTON JAN.

"Composite vs Single Dispersants In Colorants and Coatings"

Nominating Committee Chairman K.D. Jacobson presented the slate of officers for 1984-85. As proposed by the Committee, they are: President—Richard Batchelor; Vice-President—Arthur R. McDermott; Secretary—Rudy Buri; and Treasurer—David Satzger. Mr. Jacobson pointed out that nominations from the floor would be accepted at the Election Meeting.

Willy C.P. Busch, Society Representative, reported on the nomination of J.C. Leslie for Federation Honorary Membership. Mr. Busch reviewed Mr. Leslie's qualifications which included his term as Federation President (1974-75) and President of both the Kansas City Society (1957-58) and the KCPA (1965-66). He asked the Society's support of this nomination.

"COMPOSITE VS SINGLE DISPERSANTS IN COLORANTS AND COATINGS" was discussed by Elio Cohen, of Daniel Products Co.

Mr. Cohen explained that the use of pigment dispersants can enhance pigment loading in mill bases, reduce energy requirements, speed-up dispersion, and improve stability and rheology of finished products.

Mr. Cohen pointed out that proper dispersant choice affords the user the benefits of improved manufacturing processes, improved product stability, and easier use of end products.

Based on data collected on a water-reducible acrylic pigmented with yellow oxide, Mr. Cohen said that it can be concluded that SCD are most effective in increasing production rates.

Data was then presented on a long oil alkyd pigmented with carbon black. Mr. Cohen explained that the data concluded, again, that the SCD are most effective in improving product stability.

Using data based on water-reducible acrylic pigmented with phthalo green, Mr. Cohen said that the same SCD promote easier use of end products.

ARTHUR R. McDERMOTT, *Secretary*

KANSAS CITY JAN.

"Architectural and Maintenance Coatings"

Due to the departure of Secretary Dennis Mathes, of Olympic Stain Co., Treasurer, Steve Bussjaeger, of Davis Paint Co., assumed the Secretary's duties. Jerry Hefling, of Locite Auto & Consumers, was nominated and elected Treasurer.

"APPROACH TO FORMULATION OF ARCHITECTURAL AND MAINTENANCE COATINGS" was discussed by John Ballard, of Kurfees Coatings.

STEVE BUSSJAEGER, *Secretary*

LOS ANGELES JAN.

"A Practical Approach To Understanding Emulsions"

A moment of silence was observed for Dr. C.C. Meyers, Justin Meyers, Thomas J. Rogers, of PPG Industries, Inc., and George Hartter, of the Rocky Mountain Society, who recently died.

James Hall, Educational Committee Chairman, discussed registration for the 1984 Paint Course. He also noted that application forms are available for the LASCT scholarship.

President Lloyd Haanstra announced the theme of "Automating Your Business a Little at a Time," for the Manufacturing Seminar to be held April 11.

Patrick J. MacDonald, of Reichhold Chemicals, Inc., discussed "A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS."

Three water-borne vehicle systems were discussed by Mr. MacDonald. These included water-reducible systems; colloidal dispersion; and aqueous dispersion.

According to Mr. MacDonald, ingredients in emulsion polymerizations include:

water, monomer, surfactants, initiator or catalyst, protective colloid, and pH buffers.

HENRY J. KIRSCH, *Secretary*

LOUISVILLE JAN.

"Product Liability"

Jim Hoeck, Educational Committee Chairman, reported that 16 students are enrolled in the spring semester course, "Surface Coatings Technology I."

Technical Committee Chairman, Don Collier, reported that the committee was participating in the cooperative Mildew Study work under the direction of the Mildew Consortium. Also, a project description for the committee's corrosion study was being prepared.

Don Darby, a Louisville attorney, discussed "PRODUCT LIABILITY CASES."

Several items such as a football helmet, a sweater, and a can of alkyd enamel were distributed to the audience. These items had been found at fault in product liability cases.

Mr. Darby indicated that companies should do all they can to protect themselves by providing the consumer with directions for using their products safely. He warned, however, that even having done so, the company may easily be found liable in a jury hearing.

Q. Could you relate the story behind the can of alkyd enamel?

A. A consumer had filed suit against the manufacturer when he was burned in a fire while using the product near a space heater. The jury ruled that the manufacturer was at fault because their label warning of "combustible" was too complex for the average consumer to understand.

M. JOYCE SPECHT, *Secretary*

NEW ENGLAND JAN.

"Joint Meeting with NEPCA"

The meeting was held jointly with the New England Paint and Coatings Association.

A moment of silence was observed for Jan Early, who recently died.

Bruce Okco, of The Truesdale Co., gave a short slide presentation outlining the participation of local societies and associations in the "Picture It Painted" campaign.

"WHAT'S IN STORE FOR '84—AN ECONOMIC OUTLOOK" was presented by Nick Perna, of General Electric Co.

Mr. Perna presented his entire economic forecast. He noted that the best economic news is that the GNP is 5%, coupled with an inflation rate of approximately 5%. The inflation rate is only about one third of what it had been in 1981-82. He stressed that interest rates alone tell the story. The prime is only 11%, compared with 16% of just two years ago. Mr. Perna explained that mortgage rates seem to be comparably flat, holding at about 13%.

MAUREEN LEIN, *Secretary*

PIEDMONT JAN.

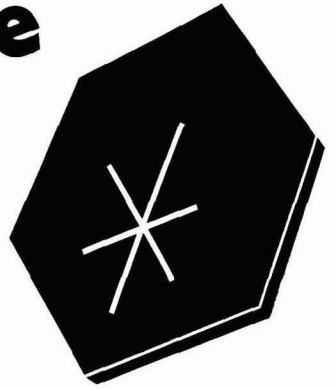
"Laboratory Calculation Technique And the Paint Chemist"

Environmental Committee Chairman Ed West announced that an EPA cassette entitled, "Record Keeping and Reporting Requirements," is available for member viewing.

A \$350 check was presented to Robert Nipp, past Chairman of the Educational Committee, as winner of the MMA Awards competition. The Committee was recognized for sponsoring and funding a credited academic polymer course at UNC.

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James T. DeGroff, of Applied Color Systems, Inc., spoke on "LABORATORY CALCULATION TECHNIQUE AND THE PAINT CHEMIST."

Mr. DeGroff addressed the basic problem of using computers to assist in paint formulation. He noted that computers will not remove the human element, but they will accelerate number processing and data storage so that the paint chemist can spend valuable time in formulating and evaluating.

MICHAEL S. DAVIS, *Secretary*

PITTSBURGH FEB.

"Joint Meeting with NACE"

The meeting was held jointly with the Pittsburgh Section of the National Association of Corrosion Engineers (NACE).

"URETHANE PERFORMANCE PROPERTY DIFFERENCES—ACRYLIC VERSUS POLYESTER" was discussed by Richard Hergenrother, of Mobay Chemical Corp.

Mr. Hergenrother discussed several interesting statistics concerning the amount that was and will be spent for corrosion protection, the heavy duty maintenance, new construction, and marine and off shore drilling areas. In 1980, it was estimated that 18 million dollars were spent in these combined areas, and by 1985, the estimate will probably reach 35 million dollars. In each specific segment, the use of urethanes has been increasing by a very elaborate evaluation sequence which Mobay has developed. They feel various combinations of inorganic zinc, epoxy, and urethane coatings can provide the best and most economical means of protection.

Wallace E. Cathcart, of Tank Lining Corp., spoke on "TODAY'S SELECTION AND USE OF COATINGS AS LININGS".

In the way of preventing product contamination in the chemical and food industry, seven basic types of coatings are used. They are, said Mr. Cathcart: (1) A high bake thermosetting phenolic, which affords outstanding performance, but has a tendency to be somewhat brittle; (2) A high bake modified thermosetting phenolic, usually modified with an epoxy, to provide some flexibility, but is less acid resistant; (3) A low baked epoxy of the catalyzed type; (4) A polyester or vinyl-ester coating, in the 30-60 mil range; (5) Latex neoprene; (6) Inorganic zinc; and (7) Vinylns.

These seven primary coatings used in tank linings can each do an outstanding job, when properly applied, and put into those service areas for which they are best suited.

JOSEPH L. MASCIA, *Secretary*



Several members of the Montreal Host Committee for the recent Annual Meeting, gathered at the January monthly meeting to accept tokens of appreciation from the Federation. They are (left to right): W. Kolonitch, R. Snyder, E. Templeton, C. Crait, J. Fiocco, R. Frayser, S. Valente, and B.J. Sharma

ROCKY MOUNTAIN JAN.

"A Practical Approach To Understanding Emulsions"

Edward G. Trousil, of Komac Paint Inc., discussed starting a committee to study environmental laws.

President Don Shillingburg explained how the Society should promote new people into the coatings industry. He also suggested the idea of presenting an award to the individual asking the best technical question. An award would be presented at each meeting, and the speaker would be the judge of the winner.

"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS" was presented by Patrick J. McDonald, of Reichhold Chemicals, Inc.

CARWIN BEARDALL, *Secretary*



At the January meeting of the Montreal Society, Mr. A. Afzal, of the National Defence Headquarters, discussed the role of coatings in national defense

ST. LOUIS JAN.

"Dispersion Pilot Plant"

Twenty-five Year Pins were awarded to E.W. Meyer, retired, and Francis J. Wagner, of Mozel Chemical Prod. Co.

Susan Bailey, Educational Committee Chairperson, announced that a \$100 contribution was made to the ACS for high school science day.

President Robert Giery reported that J.C. Leslie has been nominated for Honorary Federation Membership.

Howard Jerome announced that the ad hoc committee on paint history is looking for volunteers.

The Ralph Gatti Award, which recognizes outstanding technical achievement in the coatings industry in the St. Louis area, was discussed and plans to assist in the presentation were established.

Dr. Marty-Feldman, of Nuodex Color Lab, discussed "THE DISPERSION PILOT PLANT—THE SHORTEST DISTANCE BETWEEN THE LAB AND PRODUCTION."

The need for and the utility of a pilot plant for pigment dispersions were discussed. Dr. Feldman described controllable variables and detailed examples showing some of the difficulties which could be prevented during scale up from lab to production.

Q. How do you scale up?

A. You compare pilot batches of current materials with production batches to get a relationship.

Q. Do you use horizontal mills?

A. We are in the process of evaluating them.

CHARLES GRUBBS, *Secretary*

Future Society Meetings

Baltimore

(May 17)—ANNUAL BUSINESS MEETING AND ELECTION OF OFFICERS.
(June)—JOINT OUTING WITH BPCA.

Birmingham

(May 3)—“Trends in Automotive Finishes”—R. Hurn, Ford Motor Co. Ltd.

Cleveland

(May 21)—Annual Meeting/Spouses' Night. “PAINT EXAMINATION TECHNIQUES UTILIZED IN THE FBI LABORATORY”—James E. Corby, Federal Bureau of Investigation.

Detroit

(May 15)—Joint Meeting with DPCA.

Golden Gate

(May 16)—“THE PROPER SOFTWARE FOR YOU”—L.S. Feldman, Sinclair Paint Co.

Houston

(May 9)—“CONTROL FOR THE MODERN PAINT PLANT”—James T. DeGroff, Applied Color Systems, Inc.

Kansas City

(June 8-9)—Joint Meeting of the Kansas City and St. Louis Societies.

Los Angeles

(May 9)—AWARDS NIGHT. “THE PROPER SOFTWARE FOR YOU”—L.S. Feldman, Sinclair Paint Co.

(June 13)—ANNUAL MEETING/ELECTION OF OFFICERS. TECHNICAL COMMITTEE PROGRAM.

Montreal

(May 2)—MANUFACTURING COMMITTEE'S PRESENTATION.

New York

(May 8)—PAVAC NIGHT.

Pacific Northwest

(May 17)—“THE PROPER SOFTWARE FOR YOU”—L.S. Feldman, Sinclair Paint Co.

Philadelphia

(May 10)—Speaker from Cargill, Inc.

Piedmont

(May 16)—“INERTING FOR SAFETY IN COATINGS PLANTS”—Kevin Donahue, Neutronics, Inc.

(June 20)—“COMPOSITE VS. SINGLE DISPERSANT IN COLORANTS AND COATINGS”—Elio Cohen, Daniel Products Co.

Pittsburgh

(May 7)—“INS AND OUTS OF TiO₂”—Richard Ensminger, NL Industries.

Rocky Mountain

(May 9)—“THE PROPER SOFTWARE FOR YOU”—L.S. Feldman, Sinclair Paint Co.

St. Louis

(May 15)—MANUFACTURING NIGHT.

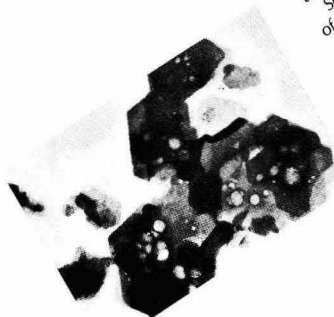
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BALTIMORE

Active

GRACIE, JAMES W.—J.M. Huber Corp., Havre de Grace, MD.
MILLS, CHARLES E.—Sherwin Williams Co., Baltimore, MD.
WRENN, FRANCIS J.—Lenmar, Inc., Baltimore.

Associate

HUTCHINS, DONNA L.—McWhorter, Inc., Baltimore, MD.
SLACK, JR., J. WARREN—SCM Pigments, Baltimore.

BIRMINGHAM

Active

KILVINGTON, H.J.—Cray Valley Products Ltd., Cardiff South Glam, England.

CHICAGO

Active

DAVIS, GLENN R.—Fuller-O'Brien Corp., South Bend, IN.
DONOVAN, MARCELLA G.—General Paint & Chemical Co., Cary, IL.
DRAHOS, SANDY—Ashland Chemical Co., Willow Springs, IL.
ESSIGMANN, MARTIN L.—Sherwin-Williams Co., Chicago, IL.
FOGARTY, PATRICK J.—Midland Div., Dexter Corp., Waukegan, IL.
FREEMAN, RICHARD A.—James B. Day and Co., Carpentersville, IL.
HAYDEN, CARL—CR Industries, Elgin, IL.
HOLZERICHTER, NORMAN—Rust-Oleum Corp., Evanston, IL.
LOPEZ, JUDY ANN—Rust-Oleum Corp., Evanston.
MAIN, DAVID—Rust-Oleum Corp., Evanston.
MAREK, MANNY—General Paint & Chemical Co., Cary.
PATEL, SANKABHAI D.—Rust-Oleum Corp., Evanston.
PAWELA, MICHAEL A.—Federated Paint Mfg. Co., Chicago.
SENN, ROGER—Freeman Chemical Co., Port Washington, WI.
STEINBECK, JOHN A.—Ashland Chemical Co., Willow Springs.
ZENTNER, MARK R.—DeSoto, Inc., Des Plaines, IL.

Associate

BROWN, TOM—Betz Laboratories, Griffith, IN.
DEMPSEY, DENNIS—Harshaw/Filtrol, Batavia, IL.
HISLOP, ROBERT P.—McWhorter, Inc., Carpentersville, IL.

JANNETTO, PHILIP J.—Applied Color Systems, Westmont, IL.
MEYER, G. WALLACE—McWhorter, Inc., Carpentersville.
ROECKER, ROBERT J.—Certified Equipment, Cherry Valley, IL.
ROWE, RICHARD—McWhorter, Inc., Carpentersville.
SMALL, RICHARD W.—M&T Chemicals Inc., Northbrook, IL.

HOUSTON

Active

LARUE, NANCY—Valspar Corp., Houston, TX.
WALLACE, HAZEL—Valspar Corp., Houston.
WORLEY, RICK G.—Valspar Corp., Houston.

Associate

WENDLING, MICHAEL D.—Accrow Chemical Dist., Houston, TX.

LOS ANGELES

Active

ANGENENT, CONRAD H.—Western Specialty Coatings, Los Angeles, CA.
CRESSY, KENNETH D.—Furane Products Co., Los Angeles.
FIFER, VERN—Paints for Industry, Santa Fe Springs, CA.
FLINT, DONALD R.—Ferro Corp., Los Angeles.
GEORGE, DONALD J.—Applied Plastics Co., El Segundo, CA.
MARUYAMA, ROBERT T.—Avecor Inc., San Fernando, CA.
OLSON, KAREN M.—Pacific Dispersions Co., Inc., Cudahy, CA.
OSEN, LAMBERT—Thorson Chemical Corp., Garden Grove, CA.
PARK, JA IN—Applied Products Co., El Segundo.
POULOS, FRED—Allied Industrial Inc., Los Angeles.
SHIMOYAMA, ISAO—D.F.C. Co., Los Angeles.
SOLAR, ROBERT C.—Western Specialty Coatings, Los Angeles.
THEODORY, EMILE—Chemstop Corp., Bellflower, CA.
VELASQUEZ, ANTONIO A.—Western Specialty Coatings, Los Angeles.
YOUNG, THOMAS J.—PPG Industries, Inc., Torrance, CA.

Associate

BOEHEIM, JOHN—Western Star Color & Chem., Santa Ana, CA.
DUNKLEY, DON—Chevron U.S.A., Inc., La Habra, CA.
MOREHOUSE, DALE H.—Morehouse Industries, Inc., Fullerton, CA.

PECKMAN, RAY—Bennett Industries, San Fernando, CA.
RENFRO, BOB R.—TCR Industries, Inc., Carson, CA.
RISSMILLER, RALPH W.—Cargill, Inc., Lynwood, CA.
RITTER, BRIAN—Wilson & Geo Meyer, Santa Fe Springs, CA.
ROGERI, JR., JOHN H.—Neville Chemical Co., Anaheim, CA.

Educator/Student

PENPRASE, CATHERINE J.—City of Commerce Public Library, Commerce, CA.
RAWOLLE, FRANKLIN M.—Cal Polly Pomona, Alhambra, CA.

NEW ENGLAND

Active

FINE, HARRY M.—FCM Co., Manchester, CT.
MARTIN, JOHN F.—Arthur D. Little, Cambridge, MA.

Associate

FLATHERS, NEIL T.—Omya, Inc., Sudbury, MA.
HALEY, JR., ROBERT A.—Finnaren & Haley Inc., Conshohocken, PA.

NEW YORK

Active

DEFUSCO, ANDREW J.—Diamond Shamrock Chemical Co., Morristown, NJ.
DE SESA, MICHAEL A.—NL Chemicals, Hightstown, NJ.
FISH, THOMAS C.—Gentape Co., Bloomfield, NJ.
SILVAIN, ALBERT W.—Colloids, Inc., Newark, NJ.
STRASSER, JOHN F.—Con Edison, New York, NY.

Associate

COLLINS, JACK—Nuodex Inc., Piscataway, NJ.
FREEDMAN, HAROLD—Corbet Chemicals Inc., Livingston, NJ.
KUSHINS, ALLAN M.—Glyco Inc., Greenwich, CT.
LADDHA, SUDHIR—Essex Chemical Corp., Clifton, NJ.
MUELLER, NICOLE M.—Degussa Corp., Teterboro, NJ.
PAGE, PAUL L.—Hercules Incorporated, Wilmington, DE.
SMITH, RICHARD A.—Burgess Pigment Co., Ridgefield Park, NJ.
WELLER, SANDRA—Monsanto Polymer Prod., Kenilworth, NJ.

PACIFIC NORTHWEST

Active

- HARRIS, MIKE L.—Farwest Paint Mfg. Co., Tukwila, WA.
HOFSTEDE, ROB—Nero Acrylic Paint, Lethbridge, Alberta, Can.
WARD, STUART J.—Webesen Pacific Corp., Seattle, WA.

PHILADELPHIA

Active

- JUNKER, L. JOSEPH—Sermatech International, Limerick, PA.

Associate

- BOGATIN, JR., ROBERT S.—Peltz-Rowley Chemicals, Philadelphia, PA.
ERRICO, WALTER—MD-Both Industries, Stockton, NJ.
LARSON, DOROTHY A.—Mid Atlantic Container, Somerset, NJ.
STANZIOLA, RALPH—Applied Color Systems, Princeton, NJ.

PITTSBURGH

Active

- KOLESKE, JOSEPH V.—Union Carbide Corp., S. Charleston, WV.
LORE, JAMES E.—Watson Standard Co., Pittsburgh, PA.

Associate

- HUDAC, DAVID A.—FBC Corp., Mars, PA.
WATSON, C.B.—Mobay Chemical Corp., Pittsburgh, PA.

ST. LOUIS

Associate

- MILLER, DENNY—Thompson-Hayward Chem. Co., St. Louis, MO.

WESTERN NEW YORK

Active

- KIELMA, ROBERT F.—Pratt & Lambert, Inc., Buffalo, NY.
LOATS, RICHARD K.—Spencer Kellogg Div., Textron, Inc., Buffalo.
MARGEVICH, MARTIN—Pierce & Stevens Chemical Corp., Buffalo, NY.
MEKA, THOMAS—Pierce & Stevens Chemical Corp., Buffalo.
ROGEMOSER, DAVID R.—Spencer Kellogg Div., Textron, Inc., Buffalo.
SEADOR, CAROL—Pratt & Lambert, Inc., Buffalo.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD; FRANK GERHARDT, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224; Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA).

BIRMINGHAM (First Thursday—Westbourne Suite, Botanical Gardens, Birmingham) D. H. CLEMENT, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ England.

CHICAGO (First Monday—meeting sites in various suburban locations). MARTIN F. BALOW, United Coatings, Inc., 3050 N. Rockwell Ave., Chicago, IL 60618.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). BILL M. HOLLIFIELD, Perry & Derrick Co., Inc., P.O. Box 12049, Cincinnati, OH 45212.

CLEVELAND (Third Tuesday—meeting sites vary). SCOTT E. RICKERT, Case Western Reserve University, Cleveland, OH 44106.

DALLAS (Thursday following second Wednesday—Executive Inn, near Lovefield Airport), VAN G. FALCONE, Koppers Co., 801 E. Lee St., Irving, TX 75060.

DETROIT (Fourth Tuesday—meeting sites vary). AL MOY, Glasurit America, Inc., P.O. Box 38009—Fenkell Station, Detroit, MI 48238.

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabella's Restaurant on Fisherman's Wharf and Francesco's, Oakland, CA). SANDRA LUND, The O'Brien Corp., 450 E. Grand Ave., S. San Francisco, CA 94080.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX) ARTHUR McDERMOTT, Nalco Chemical Co. P.O. Box 87, Sugarland, TX 77478.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). H. DENNIS MATHES, Olympic Stain Co., 1141 N.W. 50th, Seattle, WA 98107.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). HENRY J. KIRSCH, Trans Western Chemicals, 7240 Crider Ave., Pico Rivera, CA 90660.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). JOYCE SPECHT, Porter Paint Co., 400 S. 13th St., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary). GEORGE CARRINGTON, Nuodex Mexicana, S.A., Av. de las Granjas 536, 02020 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). JEAN BRUNET, Van Waters & Rogers Ltd., 2700 Jean Baptist Deschamps, Lachine, Que., Can., H8T 1E1.

NEW ENGLAND (Third Thursday—Hillcrest Function Facilities, Waltham). MAUREEN M. LEIN, Raffi & Swanson, Inc., 100 Eames St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). RAYMOND P. GANGI, International Paints, P.O. Box 386, Union, NJ 07083.

NORTHWESTERN (Tuesday after first Monday—Tax Cafe, Minneapolis, MN). ALFRED F. YOKUBONIS, Celanese Specialty Resins, 5008 W. 99th St., Bloomington, MN 55437.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). GERALD McKNIGHT, Rodda Paint Co., 6932 S.W. Macadam Ave., Portland, OR 97219.

PHILADELPHIA (Second Thursday—Dugan's Restaurant). ROBERT L. TOZER, Delkote, Div. of Lilly Ind. Coatings, Inc., 76 S. Virginia Ave., Penns Grove, NJ 08069.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood exit of I-85, High Point, NC.) MICHAEL DAVIS, Paint Products Co., Inc., P.O. Box 648, Walkertown, NC 27051.

PITTSBURGH (First Monday—Skibo Hall, Carnegie Mellon Univ.). JOSEPH MASCIA, Campbell Chemical Co., P.O. Box 11182, Pittsburgh, PA 15237.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). CARWIN BEARDALL, Howells, Inc., 4285 S. State St., Salt Lake City, UT 84107.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). CHARLES L. GRUBBS, U.S. Paint Div., Grow Group, Inc., 831 S. 21st St., St. Louis, MO 63103.

SOUTHERN (Gulf Coast Section—Third Thursday; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—bi-monthly, Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). S.G. SANFILIPPO, Reichhold Chemicals, Inc., Technical Services Lab., P.O. Box 1610, Tuscaloosa, LA 35401.

TORONTO (Second Monday—Cambridge Motor Hotel). GORDON MAJOR, 46 Dearbourne Blvd., Unit 61, Bramalea, Ont., Can., L6T 1J7.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). CHARLES C. TABBI, Spencer-Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 14225.

Dispersion Course Scheduled at KSU, May 7-11

A short course entitled, "Dispersion of Pigments and Resins in Fluid Media," will be presented May 7-11, by the Rheology and Coatings Div. of Kent State University's Chemistry Dept., Kent, OH.

Featuring industry and academic experts knowledgeable on the subject of dispersion, the course will concentrate on the fundamentals of surface chemistry and physics related to dispersion of latexes, pigments, and resins in water and classic solvent systems. The session will also focus on lectures pertaining to the mechanics of dispersion and the selection of the proper dispersion equipment for specific materials.

The course is designed for personnel involved in research, development, and production of coatings, adhesives, polymers, inks, and related materials.

The following presentations are scheduled for the program:

Monday, May 7

"Fundamentals of Surface and Colloid Chemistry I"—Richard J. Ruch, KSU.

"Dispersant Selection Based on Pigment Functionality"—Robert F. Conley, Mineral & Resource Technology.

Spray Finishing Workshop To Be Held May 14-18

A Spray Finishing Technology Workshop will be held by Bowling Green State University and the DeVilbiss Co. on May 14-18. Workshop sessions will be held at the University campus and in the Technical Center of the DeVilbiss Co., World Headquarters, Toledo, OH.

Featured will be sessions on equipment and material selection, spray finishing techniques associated with automotive refinishing, furniture, and industrial spraying. Additionally, topics associated with the latest technology—powder coating, automatic spraying, and plural components—will be included. Each participant will have an opportunity for "hands-on" practice.

The workshop is under the direction of Dr. Richard A. Kruppa, University Professor of Manufacturing Technology, School of Technology.

Additional information can be obtained from Judy Jennings, Bowling Green State University, Bowling Green, OH 43403.

"Fundamentals of Surface and Colloid Chemistry II"—Richard J. Ruch.

"Aqueous Dispersant Selection Based on Product/Process Operation"—Robert F. Conley.

Tuesday, May 8

"Dispersion of Pigments in Liquid Media—A Review of Principles and Practice"—Geoffrey D. Parfitt, Carnegie-Mellon University.

"Interactions at the Pigment/Vehicle Interface and their Relevance to Pigment Dispersion"—Geoffrey D. Parfitt.

"Dispersion of Carbon Black and Other Pigments in Fluid Vehicles for Printing Inks"—John W. Vanderhoff, National Printing Ink Research Institute, Lehigh University.

"Measurement of Degree of Dispersion of Water-Based Flexographic Inks by Capillary Chromatography and Color Strength"—John Vanderhoff.

Wednesday, May 9

"Selection of Industrial Surfactants"—John C. Graham, Eastern Michigan University.

"Particle Size Analysis of Coatings Systems"—Theodore Provder, Glidden Coatings & Resins Div., SCM Corp.

"Dispersion in Oil-Soluble Coatings Systems: The Inseparable Roles of Art and Science"—George R. Pilcher, Hanna Chemical Coatings Corp.

"Attritor Grinding and Dispersing

Equipment"—Arno Segvari, Union Process, Inc.

"High Shear—High Intensity Mixing"—B.L. Aarons and Richard Gash, Silver-son Machine, Ltd.

Thursday, May 10

"Small Media Milling and Dispersion Technology"—Leo Dombrowski, Chicago Boiler Co.

"Characterization of Grinding and Dispersion Media"—Walter W. Perkins, Norton Co.

"Principles of Ball and Pebble Milling"—John M. Rahter, Paul O Abbe, Inc.

"Theory and Application of Mixers in Blending and Dispersion"—James Y. Oldshue, Mixing Technology, Mixing Equipment Co.

"High Viscosity Dispersion"—James W. White, White Chemical Equipment Co., Inc.

Friday, May 11

"Assessment of Dispersion Stability: Rheological and Sedimentation Techniques"—Mel Croucher, Xerox Research Centre of Canada.

"Current Processing Techniques for Magnetic Media Dispersions"—Gregory R. Liebert, Netzsch, Inc.

For additional information, contact Carl J. Knauss, Chemistry Dept., KSU, Kent, OH 44242.

Special Discount Fares Available from United Airlines To Annual Meeting in Chicago

Special arrangements have been made with United Airlines to offer a \$15.00 discount off Supersaver fares within the U.S. to/from Chicago for the October 24-26 Annual Meeting and Paint Show at the Conrad Hilton Hotel. The seven-day minimum stay requirement is waived. These special fares are available only when you call the unlisted toll-free number (800-521-4041) of United's Convention Desk. You must give the FSCT Convention number which is:

4405

NDSU to Offer Coatings Courses in June

Three short courses in coatings: "Basics of Coatings," "Water-Borne Coatings," and "High Solids Coatings," will be offered by North Dakota State University, Fargo, ND, in June.

"Basics of Coatings," a condensed version of the well-known coatings course developed by Dr. Zeno W. Wicks, now retired Professor Emeritus, is scheduled for June 4-15. Updated and refined annually by Dr. Wicks, the two-week course is designed for the chemist who is relatively new to the coatings field, or for the experienced chemist who wants to gain a better general understanding of coatings and their underlying principles.

The one-week courses in "Water-Borne Coatings" and "High Solids Coatings," to be held June 11-15 and June 25-29,

respectively, are designed for the experienced person involved in research or working specifically in either of these two areas. Recent developments in both fields will be considered, and both sessions include considerable material applicable to other types of coatings.

Special guest lecturers for the "Water-Borne Coatings" course will include the following well-known industrial scientists: Dr. Gordon Bierwagen, of Sherwin-Williams Co.; and Drs. Theodore Provder and Robert Serdewand, of Glidden Coatings and Resins Div., SCM Corp.

All three courses will be taught by Dr. Wicks; Dr. Frank N. Jones, Chairman of the Department of Polymers and Coatings at NDSU; Dr. S. Peter Pappas, NDSU Professor of Chemistry and Polymers and Coatings; Dr. Loren W. Hill, adjunct Professor of Polymers and Coatings and a science fellow with Monsanto Plastics and Resins; and Dr. J. Edward Glass, NDSU Professor of Polymers and Coatings.

Additional information may be obtained by contacting Dr. Frank N. Jones, Polymers and Coatings Dept., NDSU, Fargo, ND 58105.

Theme Selected for OCCA 1985 Conference

The Technical Committee of the Oil & Colour Chemists' Association has chosen the theme, "New Substrates, New Materials, New Problems?", for its biennial conference to be held June 26-29, 1985, in Edinburgh, Scotland.

The committee selected this theme since it felt that "the time is opportune for a review of the impact of new technology, since the traditional coatings industry has now so diversified that it encompasses industries such as the automotive, building, electrical, aerospace, plastics, packaging, adhesives, and other industries." The conference, therefore, will explore the problems in both novel and traditional substrates by the introduction of new materials and methods of application and the problems arising therefrom.

For further information on the 1985 conference, contact Director & Secretary R. H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF.

UMR to Sponsor Symposium On Vinylidene Chloride

The University of Missouri-Rolla, Rolla, MO, will present a symposium on "Vinylidene Chloride: A Monomer for the '80's," May 2-4 at the Breckenridge Concourse Hotel, St. Louis, MO.

The symposium, a coatings continuity education activity of the UMR College of Arts and Sciences' chemistry department, is designed to give participants an opportunity to update their knowledge of vinylidene chloride as an economical and versatile comonomer for surface coatings resins. Discussion sessions are included in the program.

For further information, contact Cindy Sonewald, Chemistry Dept., UMR, Rolla, MO 65401.

Coming Next Month . . .

. . . the JCT will feature the topic of **Problems and Control of Defacement of Coatings by Mildew and Bacteria**. Highlighting the issue will be two Roon-Award winning articles dealing with the subject:

"Presence and Effects of Anaerobic Bacteria in Water-Based Paints," by R.A. Opperman and M. Goll, of Cosan Chemical Corp.

"Protection of Mildewcides and Fungicides from Ultraviolet Light Induced Photo-oxidation," by P. Gabriele and R. Iannucci, of CIBA-GEIGY Corp.

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3-B

People

The Southern California Paint & Coatings Association presented **Clyde L. Smith**, a co-founder of Ameritone Paint Corp., with a 50-Year Pin for his continued service to the industry.

Mr. Smith helped to establish Vi-Cly Industries, Inc. (which later became Ameritone Paint Corp.) in 1949. He served as President and maintained that position when the company was acquired by Grow Group, Inc. in 1965. Mr. Smith was appointed Chairman of the company in 1982, a position he held until March 1983. Presently, he is a consultant to Ameritone.

Mr. Smith is a Past-President of the Federation of Societies for Coatings Technology, the Los Angeles Society for Coatings Technology, and the SCPCA. He is a recently retired Vice-President of the Western Region of the NPCA.

Dr. George E.F. Brewer, coatings consultant and pioneer of the electrocoating process, spoke at the March meetings of the Paint Research Institute, near London, and the Institute of Metal Finishing, in Birmingham, England.

Dr. Brewer's address, "The Seven Stages of an Invention," analyzed the successive steps in the development of innovations, focusing on the development of the electrocoating process, which is used to coat over 85% of all automobiles worldwide.

Hilton-Davis Chemical Co., Cincinnati, OH, has named **Robert R. Sill** to the position of Midwest Regional Sales Representative.

Joseph G. O'Grady, Vice-President of Public Service Electric and Gas Research Corp., Maplewood, NJ, was appointed Executive Vice-President of the American Society for Testing and Materials (ASTM). He replaces **Henry J. Stremba**, who has retired after 30 years of service to ASTM.

Mr. O'Grady is responsible for coordinating ASTM's managerial staff and overseeing the progress of ASTM's 140 standards writing committees.

A longtime active member of ASTM, Mr. O'Grady is a past chairman of the board of directors and is past chairman of both the Finance Committee and the Standing Board Committee on Technical Committee Activities. Currently, Mr. O'Grady is active on ASTM Committees D-2 on Petroleum Products, D-22 on Sampling and Analysis of Atmospheres, and E-36 on Laboratory Accreditation.



C.L. Smith



G.E.F. Brewer



W.D. Kinsell, Jr.



K.A. McGrath

William D. Kinsell, Jr., President of Glidden Coatings & Resins, Div. of SCM Corp., Cleveland, OH, received a national decoration from the Republic of Panama. His Excellency Aquilino Boyd, Ambassador of the Republic of Panama to the United States, presented the National Decoration of the Order of Vasco Numex de Balboa to Mr. Kinsell. The medal and decree, which are the second highest honor given to an individual, were in recognition of the economic investment that Glidden paint and resins operations have made in Panama. Glidden opened a paint plant in the Republic in 1976 and a resins facility in 1982.

Effective February 1, Mr. Kinsell has retired from Glidden after 28 years. He had been President of SCM's largest division for seven years.

Mr. Kinsell began his career with Glidden as Sales Promotion Manager of the Paint Division. In 1960, he became General Manager—Trade Sales and six years later was appointed Vice-President—Marketing. In 1969, he was named Vice-President of the Coatings and Resins Group.

Mr. Kinsell is the immediate Past President of the National Paint and Coatings Association and is a member of its Board of Directors and the Executive Committee.

The Midland Div., Dexter Corp., Waukegan, IL, has announced the following appointments. **John Gibb** has joined the firm as a Research Associate. Appointed as Senior Research Chemist in the general laboratory was **Gerry Steele**. **Dr. K.G. Srinivasan** was named Research Associate in the polymer laboratory.

Ronald F. Phillips was appointed Manager, National Accounts, for Arizona Chemical Co., a joint venture of American Cyanamid Co. and International Paper Co.

Kathy A. McGrath has been named Polymer District Accounts Manager, U.S. Specialty Chemicals, for S.C. Johnson & Son, Inc., Racine, WI. Prior to her appointment, Ms. McGrath was associated with Texas Instruments.

Promoted to Senior Market Manager—Industrial Coatings, Specialty Chemicals Group, for Johnson Wax, Racine, is **Bruce H. Todd**. He most recently served the Group as Commercial Development Manager—Polymers.

Carl Lechner, Inc., Northbrook, IL, has announced the appointment of **Jack Weisman** as Chairman of the Board. Mr. Weisman was previously President of Donald R. Fitzgerald Co., and has been associated with the paint and coatings industry for 36 years. He is a member of the Chicago Society.

Silberline Manufacturing Co., Inc., Lansford, PA, has announced the following promotions. **William R. Whildin** has been named Superintendent of the firm's plant, responsible for all buildings and property. He will assist in the planning, layout, and construction of additional manufacturing facilities, productivity improvements, and pilot plant operation. **Thomas R. Sterba** was promoted to Lansford Plant Manager. He most recently served as Assistant to the Executive Vice-President with duties in process engineering, administration, and safety and regulatory affairs.

Dennis L. Dalton has been appointed Manager—Coatings and Plastics Chemical Div. of Buckman Laboratories, Inc., Memphis, TN. Formerly Development Specialist and Assistant Marketing Manager at the Buckman-Ghent, Belgium company, Mr. Dalton has also served as Technical Service Manager at the Memphis company.

NL Chemicals/NL Industries, Inc., Hightstown, NJ, has appointed **Robert Van Doren** as Manager, Product Strategy. Prior to his promotion, Mr. Van Doren was Marketing Manager, Rheological Additives and Specialty Chemicals Products in the U.S. Mr. Van Doren is a member of the New York Society.

Dean R. Thacker has been appointed President of Pfizer Inc.'s minerals, pigments, and metals (MPM) operations. Mr. Thacker, a 33-year veteran of Pfizer, has headed the Quigley Co., Inc., a unit of MPM division specializing in products and services for the steel-making industry.

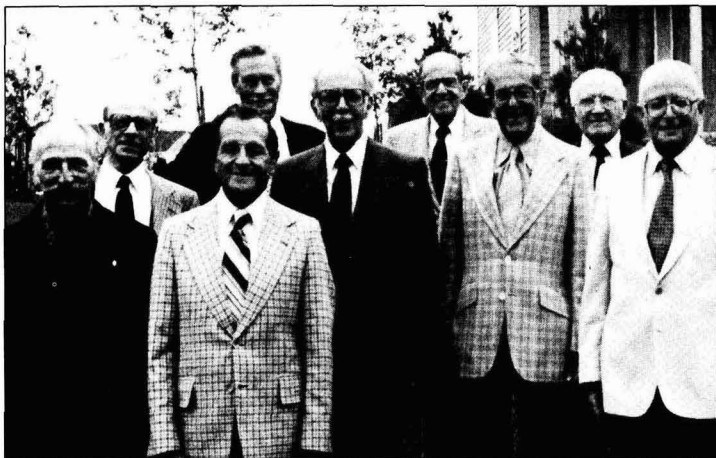
James C. O'Donoghue, President of Quigley Europe since 1974, succeeds Mr. Thacker as President in New York.

W.R. Grace & Co., Lexington, MA, has appointed **Peter I. Kuziuk** as National Sales Manager for nitroparaffins. Mr. Kuziuk, who joined Grace in 1978, most recently served as Western regional Sales Manager for the Specialty Chemicals Unit of the Division.

The appointment of **Sam K. Mitchell** as a Technical Sales Representative was announced by Sandoz Colors & Chemicals, Charlotte, NC. Mr. Mitchell will specialize in the sales and service of the firm's colorants and specialty chemicals to the coatings, plastic, leather, cosmetic, and household products industries on the west coast. Prior to his appointment, Mr. Mitchell was associated with Mobay Chemical Corp. He is a member of the Los Angeles Society.

Catherine Enright and **Thomas Mastandrea** have been named Sales Representatives by the Chemical Coatings Div. of The Sherwin-Williams Co., Chicago, IL. Ms. Enright is assigned to the Cleveland, OH area, while Mr. Mastandrea will focus on the Houston, TX region.

The following appointments have been made by the Organic Chemicals Div. of W.R. Grace & Co. for its Specialty Chemicals Unit. **William F. Scheufele, Jr.** has been named Product Group Manager for the division's emulsion polymer product lines. Mr. Scheufele, a Grace employee since 1955, most recently served as Product Manager for polyvinyl acetate emulsions. He is a member of the New England Society. Appointed Product Group Manager for the division's Hampshire® and naphthalene DAXAD® product lines was **George J. Power**. As a 22-year employee of Grace, Mr. Power has held a number of research and product management positions.



AFTER 50 YEARS—Back in the 1930's, ten graduate chemists worked for what was probably the first consulting laboratory in the paint industry. Now, in 1984, nine reunited to celebrate their 50th anniversary. Back row (left to right): **Alfred Driscoll**; **Norman Haber**; and **Joseph Cataldo**. Middle (left to right): **Sidney B. Levinson**; **Joseph Cantor**; **Elias Singer**; and **Benjamin Farber**. Front (left to right): **Monroe Rapaport**; and **Herman J. Singer**

Paint Chemists Celebrate 50th Anniversary

Ten graduate chemists, who were employed in the 1930's by the same paint consulting laboratory located in Brooklyn, NY, have remained active in the Paint and Coatings Industry. During the past 50 years, five of the men became presidents of their companies, two became Presidents of the New York Society for Coatings Technology, one became president of the NYPCA, and one became National Chairman of the paint and coatings committee of the American Society for Testing and Materials.

Over the years, the men remained good friends and met about every other month, a total of 250 times, to discuss technical subjects of mutual interest.

The men include:

Joseph Cantor is President of Josad Consultants, Inc., Queens, NY, and was formerly Technical Director of Fyn Paint & Lacquer Co., Brooklyn, NY. He is a 40-year member of the New York Society.

Formerly, Technical Director of Standard Tex Co., Brooklyn, **Joseph R. Cataldo** has retired. He is a 40-year member of the New York Society.

Alfred Driscoll, Consultant, has been associated with the New York Society for 40 years.

The Flecto Co., Inc., Oakland, CA, and Flecto Coatings, Ltd., Richmond, B.C., Canada, has appointed **Frederick J. Connelly** as Technical Director for both companies. Mr. Connelly was previously associated with DAP, Inc. He is a member of the C-D-I-C Society.

Formerly, President of Farnow Inc., Kearny, NJ, **Benjamin Farber** has retired after 45 years of service to the industry.

Alexander C. Haber, formerly Technical Director of Arnesto Paint, Co., New York, NY, died October 1980. He was associated with the New York Society for over 35 years.

Norman Haber is a retired Account Supervisor for AMSCO Div. of Union Oil of California. He is a 40-year New York Society member.

Sidney B. Levinson, retired Chairman and CEO of D/L Laboratories, New York, NY, is a consultant. He is a 45-year member of the New York Society and has served as its President.

Monroe Rapaport is President of Pyrolac Corp., Hawthorne, NJ and has worked in the industry for 50 years.

Elias Singer is Chairman Emeritus of Troy Chemical Corp., Newark, NJ with 50 years of service to the paint and coatings industry. He is a member of the New York Society.

Herman J. Singer, a 40-year member of the New York Society, and formerly President of Lehman Brothers, Jersey City, NJ, is a consultant.

Craig A. Cornett was named Regional Purchasing Manager for Glidden Coatings and Resins Div., SCM Corp., based in Carrollton, TX. Mr. Cornett was previously associated with the Southwest Div. of O'Brien Corp. He is a Houston Society member.

Wood Finishes

A new publication, "Economical Cellulose Acetate Butyrate (CAB) High-Viscosity Wood Sealer and Lacquer," is now available. The four-page bulletin presents formulations for two wood finishes prepared from CAB-531-1, lacquer BW-11-53 and sealer BW-11-54. For a copy of publication No. E-238, write Eastman Chemical Products, Inc., Chemicals Div., P.O. Box 431, Kingsport, TN 37662.

Short Oil Alkyd

A short oil alkyd resin for use by coating manufacturers in formulating finishes with 2.5 or lower VOC is described in a new bulletin. The literature cites low viscosity at high solids and good amino resin compatibility as the important features of Beckoso[®] 98-210 short oil alkyd. It also notes such performance features as good coating stability and excellent application properties. The bulletin is available from Reichhold Chemicals, Inc., 525 N. Broadway, White Plains, NY 10603.

Surfactant Product Guide

A comprehensive product guide to hundreds of surface active agents for many functional purposes in 12 major application areas is now available. The 32-page brochure simplifies product references by organizing pertinent descriptive and application data into charts for industrial, paint, aerosol formulation, food and food processing, and emulsion polymerization surfactants. Copies of the "Surfactant Product Guide" may be obtained from the Organics Div., Witco Chemical Corp., 520 Madison Ave., New York, NY 10022.

Rheology Modifier

A rheology modifier for maintenance, industrial, and architectural latex paints has been introduced in new literature. Rheological properties, application uses, and advantages of this nonionic, water-soluble synthetic polymer supplied in solution are listed. Further information is available from Union Carbide Corp., Specialty Chemicals Div., Dept. K3444, Danbury, CT 06817.

Storage Tanks

Information is available on cone bottom, vertical liquid storage tanks designed to withstand maximum loads and stresses. Construction of the tanks are discussed as are their interior and exterior surfaces. Literature is available from Certified Equipment & Manufacturing Co., P.O. Box 298, Springfield, IL 62705.

Anticorrosive Pigment

A new 40-page brochure that details an anticorrosive pigment for both solvents and aqueous systems is now available. Included is information on typical properties, formulations, and toxicological data of NALZIN[™]2. For a copy of "NALZIN[™]2, Non-Toxic High Performance Protections," contact NL Chemicals/NL Industries, Inc., P.O. Box 700, Hightstown, NJ 08520.

Color QC System

Literature is available announcing a color QC system, which features the IBM personal computer, the ACS Spectro-Sensor[®] II spectrophotometer, and Color-Calc[™], and ACS developed program package. The color QC system, which was designed to provide extensive color quality control capabilities, is discussed, as are its operational capabilities and its wide range of options. For information, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08540.

Color Measurement

On-line color measurement that helps identify and correct color problems before they prove costly and disrupt continuous production has been successfully adapted to the coil coating industry and is discussed in recent literature. Featured is an On-Line Color-Eye[®] Measurement System designed to analyze and process color data by computer to provide complete color variance information in a coil coating operation. Discussed is how the on-line system monitors color on a wide variety of coil-coated surfaces including wood grain finishes. Advantages listed include increased color accuracy and consistency, throughout, and quality control. For additional information, write Macbeth Color Systems, P.O. Box 950, Newburgh, NY 12550.

Laboratory Instruments

A 76-page brochure has been published featuring 25 laboratory instruments and items. Described are the new dip type Ford viscosity cup; the new pocket clip timer; plastic wet film thickness gauges; digital, computer/printer coating thickness gauges; the new Zahn viscosity cup kit; and mixer and humidity/temperature meters. Included are prices, operations, specification references, and ordering information for each item. A copy of the brochure is available from Paul N. Gardner Co., Inc., 218-D Commercial Blvd., Suite 205, Lauderdale By-The-Sea, FL 33308.

Amino Resins

Applications and features of amino resins for water and solvent systems are covered in a recently issued brochure. The eight-page publication covers melamine, urea, and benzoguanamine resins used to harden and impart water and chemical resistance to baking finishes. Basic differences between the three classes of resins are discussed and charted to help the reader decide which group to consider for a given problem. A table of relative properties is also included. The literature is available from Reichhold Chemicals, Inc., 525 N. Broadway, White Plains, NY 10603.

Hydroquinone

A new publication, "Solubility to Tecquinol[®] Hydroquinone and Derivatives," is available. The hydroquinone and derivatives covered include Tecquinol hydroquinone (HQ), toluhydroquinone (THQ), para-benzoquinone (p-BQ), mono-tertiary-butylhydroquinone (MTBHQ), 2,5-di-tertiary-butylhydroquinone (DTBHQ), and hydroquinone mono-methylether (HQMME). They are used as intermediates for manufacturing a variety of products and as polymerization inhibitors for vinyl monomers and unsaturated polyester resins. The literature lists their approximate solubility in various glycol ether and ether ester solvents, ester solvents, alcohols, ketones, and glycols. A copy of No. D-163, may be obtained by contacting Eastman Chemical Products, Inc., Chemicals Div., Building 280, Kingsport, TN 37662.

Coming Events

FEDERATION MEETINGS

(May 15-18)—Federation "Spring Week." Manufacturing Seminar on 15th and 16th; Society Officers on 17th; and Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

(Oct. 24-26)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1985

(May 14-17)—Federation "Spring Week." Seminar on 14th and 15th; Society Officers on 16th; and Board of Directors on 17th. Hilton Hotel, Baltimore, MD. (FSCT, 1315 Walnut St., Philadelphia, PA. 19107).

(Oct. 7-9)—63rd Annual Meeting and 50th Paint Industries' Show. Convention Center, St. Louis, MO. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

(May 3-5)—Pacific Northwest Society for Coatings Technology Symposium. Holiday Inn Crowne Plaza, Seattle, WA. (Robert Hogg, Preservative Paint Co., 5410 Airport Way S., Seattle, WA 98108).

(May 14)—Philadelphia Society for Coatings Technology's Seminar on "Anti-Corrosive Coatings." Airport Hilton Hotel, Philadelphia, PA.

(May 15-16)—Cleveland Society for Coatings Technology 27th Annual Technical Conference, "Advances in Coatings Technology." (Richard Eley, Glidden Coatings & Resins Div. SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(May 16-17)—"Coatings Tech Expo '84." 3rd Biennial Convention & Exposition sponsored by New England Society for Coatings Technology. Sheraton Inn & Conference Center, Boxborough, MA. (Chairman Bruce Ocko, The Truesdale Co., Brighton, MA 02135).

(June 8-9)—Joint Meeting of St. Louis and Kansas City Societies for Coatings Technology. Kansas City, MO.

(June 18)—Golden Gate Society for Coatings Technology's Manufacturing Committee Symposium on "Safety and Robotics." Sabella's, San Francisco, CA. (Louie Sanguinetti, Jasco Chemical Co., P.O. Drawer J. Mountain View, CA 94042).

1985

(Feb. 26-Mar. 1)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA.

(Apr. 25-27)—Pacific Northwest Society for Coatings Technology Symposium. Empress Hotel, Victoria, B.C. (Ottwin Schmidt, Helzer Canada Ltd., 8531 Cullen Crescent, Richmond, B.C., V6Y 2W9 Canada).

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OTHER ORGANIZATIONS

(Apr. 29-May 2)—"Opportunities in the Automotive Market" meeting sponsored by the National Coil Coaters Association. Rancho Las Palmas, Rancho Mirage, CA. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Apr. 29-May 3)—75th Annual Meeting of the American Oil Chemists' Society, Fairmont Hotel, Dallas, TX. (AOCS, 508 S. Sixth St., Champaign, IL 61820).

(May)—Robotics and Computer Controlled Automation. Owen Graduate School of Management, Vanderbilt University, Nashville, TN. (Ms. Mary Kelly, Program Director, Vanderbilt Univ., Nashville, TN 37203).

(May 1-3)—Oil & Colour Chemists' Association's 35th Annual Exhibition. London, England. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(May 1-4)—Painting and Decorating Contractors of America. 100th Anniversary Meeting. New York, NY.

(May 2-4)—"Vinylidene Chloride: A Monomer for the '80's" Symposium. Breckenridge Concourse Hotel, St. Louis, MO. (Cindy Sonewald, Chemistry Dept., University of Missouri-Rolla, Rolla, MO 65401).

(May 7-11)—Short Course on "Dispersion of Pigments and Resins in Fluid Media." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 7-11)—Spray Painting Seminar. Binks Manufacturing Co., Franklin Park, IL. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(May 14-18)—"Spray Finishing Technology Workshop" sponsored by Bowling Green State University and the DeVilbiss Co. (Judy Jennings, Bowling Green State University, Bowling Green, OH 43403).

(May 14-18)—"Basic Microcomputer Programming for Coatings" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(May 16-18)—"Appearance Science Workshop." HunterLab, Reston, VA. (Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090).

(May 20-23)—ASTM Annual Meeting. Queen Elizabeth Hotel, Montreal, Que., Canada. (ASTM, 1916 Race St., Philadelphia, PA. 19103)

(May 20-23)—ASTM Committee D-1 on Paint and Related Coatings & Materials. Montreal, Que., Canada. (ASTM, 1916 Race St., Philadelphia, PA 19103).

(May 21-25)—Short Course on "Adhesion Principles and Practice for Coatings and Polymer Scientists." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 21-25)—Short Course on "Corrosion and Its Control by Protective Coatings." Lehigh University, Bethlehem, PA. (Prof. Henry Leidheiser, Jr., Sinclair Laboratory #7, Lehigh University, Bethlehem, PA 18015).

(May 22-24)—Chemical Coaters Association. "Surface Coating '84." Bloomington, MN. (Matt Huertz, Chemical Coaters Assn., Box 241, Wheaton, IL 60187).

(May 23)—ASTM Symposium on "Review and Evaluation of Appearance: Methods and Techniques" sponsored by Committee E-12. Queen Elizabeth Hotel, Montreal, Canada. (Symposium Chairman, J.J. Rennilson, Retro-Tech, P.O. Box 3103, La Mesa, CA 92041).

(June 4-8)—Short Course on "Advances in Emulsion Polymerization and Latex Technology." Lehigh University, Bethlehem, PA. (Dr. M.S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

(June 4-8)—Short Course on "Thermal and Rheological Characterization of Coatings and Polymers." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(June 4-15)—"Basic Course in Coatings." North Dakota State University, Fargo, ND. (Dr. Frank N. Jones, Polymers & Coatings Dept., NDSU, Fargo, ND 58105).

(June 6-7)—"Color Technology for Management" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 10-13)—"58th Colloid and Surface Science Symposium." Carnegie-Mellon University, Pittsburgh, PA. (G.D. Parfitt, Chemical Engineering Dept., Carnegie-Mellon University, Pittsburgh, PA 15213).

(June 11-15)—"Principles of Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 11-15)—"Water-Borne Coatings" Short Course. North Dakota State University, Fargo, ND. (Dr. Frank N. Jones, Polymers & Coatings Dept., NDSU, Fargo, ND 58105).

(June 17-20)—Dry Color Manufacturers' Association's Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (P.J. Lehr, DCMA, Suite 202, 206 N. Washington St., Alexandria, VA 22314).

(June 18-22)—"Principles of Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 25-29)—"Advances in Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

PARTNER SOUGHT

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(June 25-29)—"High Solids Coatings" Short Course. North Dakota State University, Fargo, ND. (Dr. Frank N. Jones, Polymers & Coatings Dept., NDSU, Fargo, ND 58105).

(July 9-13)—10th International Conference on "Organic Coatings Science & Technology." Athens, Greece. (Prof. Angelos V. Patsis, Director, Materials Research Lab., CSB 209, State University of New York, New Paltz, NY 12561).

(July 31-Aug. 2)—"International Symposium on the Analysis and Identification of Polymers." Forensic Science Research and Training Center, Quantico, VA. (K.W. Nimmich, Symposium Coordinator, Forensic Science Research and Training Center, Bldg. 12, Rm. 212, FBI Academy, Quantico, VA 22135).

(Aug. 13-17)—Short Course on "Physics and Chemistry of Printing Inks." Davos, Switzerland. (Dr. M.S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

(Aug. 20-24)—Short Course on "Advances in Emulsion Polymerization and Latex Technology." Davos, Switzerland. (Dr. Gary Poehlein, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332).

(Sept.)—"Maintenance Painting of Industrial Plants" Symposium sponsored by the Steel Structures Painting Council. Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Sept. 10-14)—"The Basic Composition of Coatings" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(Sept. 13-15)—Oil and Colour Chemists Association Australia. 26th Convention. Mandurah, Western Australia. (Grant McManus, P.O. Box 490, Cloverdale, Western Australia 6015).

(Sept. 17-21)—"Physical Testing of Paints & Coatings" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(Sept. 22-25)—Canadian Paint and Coatings Association. Annual Convention. Westin Hotel, Winnipeg, Man., Canada. (CPCA, 515 St. Catherine St. W., Montreal, Que. H3B 1B4, Canada).

(Sept. 23-26)—American Oil Chemists' Society Short Course on Fatty Acids. Kings Island, OH. (AOCS, 508 S. Sixth St., Champaign, IL 61820).

(Sept. 23-28)—XVIIth Congress of FATIPEC (Federation of Associations of Technicians in the Paint, Varnish, Lacquer and Printing Ink Industries of Continental Europe). Lugano, Switzerland. (C. Bourger, Secretary General, FATIPEC, Maison de la Chimie, 28 Rue St.-Dominque, 75 Paris (7), France).

(Oct. 8-12)—"Advanced Industrial Paint Formulation" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(Oct. 8-12)—Spray Painting Seminar. Binks Manufacturing Co., Atlanta, GA. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(Oct. 21-26)—Interfinish '84. Jerusalem, Israel. (Interfinish '84 Secretariat, P.O. Box 29313, 61292 Tel Aviv, Israel).

(Oct. 22-24)—National Paint & Coatings Association 97th Annual Meeting. Palmer House, Chicago, IL. (Karen Bradley, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

(Oct. 23-26)—Fall Technical Meeting of the National Oil Coaters Association. Hyatt Regency O'Hare Hotel, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Nov. 7-8)—4th World Congress on "Coatings Systems for Bridges and Steel Structures." Breckenridge Concourse Hotel, St. Louis, MO. (Cindy Sonewald, University of Missouri-Rolla, Dept. of Chemistry, Rolla, MO 65401).

(Nov. 16-17)—37th National Decorating Products Show. McCormick Place, Chicago, IL. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Nov. 26-27)—"Job Estimating Workshop for Painting Contractors" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(Nov. 28-30)—FINSTRAT '84, Conference and Exposition on Finishing Strategies for the 80's. Marriott Hotel and Anaheim Convention Center, Anaheim, CA. (Association for Finishing

Processes of SME, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Nov. 28-30)—"Maintenance Painting" Short Course. University of Missouri-Rolla, Rolla, MO. (Cindy Sonewald, Dept. of Chemistry, UMR, Rolla, MO 65401).

(Dec. 3-7)—Spray Painting Seminar. Binks Manufacturing Co., Franklin Park, IL. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(Dec. 16-21)—1984 International Chemical Congress of Pacific Basin Societies. Honolulu, Hawaii. (PAC CHEM '84, Meetings and Divisional Activities, American Chemical Society, 1155 Sixteenth St., N.W., Washington, DC 20036).

1985

(Mar. 25-27)—"Electrochemical Techniques for Corrosion" Symposium to be held during CORROSION/85, sponsored by the National Association of Corrosion Engineers. Boston, MA. (Symposium Chairman, Robert Baboian, Texas Instruments, Inc., Mail Station 10-13, Attleboro, MA 02703).

(June 26-29)—Oil & Colour Chemists' Association's Biennial Conference. Edinburgh, Scotland. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HA0 2SF).

(Sept. 2-4)—Federation of Scandinavian Paint and Varnish Technologists. 11th Congress. SAS Hotel Scandinavia, Oslo, Norway. (Paal Ivan, Nodest Industrier A/S, Boks 500, N-3001 Drammen, Norway).

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'Humbug' from Hillman

When Maureen Lein sent in the following hints on how to know you're growing older, I found most of them strangely familiar. I guess you young kids find them strange rather than familiar. In any event here they are, in case any of our readers find them funny rather than usual.

• • •

Aged Wisdom

Everything hurts and what doesn't hurt, doesn't work. The gleam in your eyes is from the sun hitting your bifocals.

You feel like the night before and you haven't been anywhere.

You get winded playing chess.

Your children begin to look middle aged.

You finally reached the top of the ladder, and find it against the wrong wall.

Your mind makes contracts your body can't meet.

A dripping faucet causes an uncontrollable bladder urge.

You know all the answers, but nobody asks you any questions.

You look forward to a dull evening.

Your favorite part in the newspaper is "25 Years Ago Today".

You sit in a rocking chair and can't make it go.

Your knees buckle and your belt won't.

You regret all those mistakes resisting temptation.

Your pacemaker makes the garage door go up when you watch a pretty girl go by.

The little gray haired lady you help across the street is your wife.

You sink your teeth into a steak and they stay there.

So—What's So Funny!!!

From time to time Frank Borrelle reads stuff without pictures. Recently, during one of those expeditions into erudition, he came upon the following gems to help guide you on your way through life.

Nothing makes it easier for a driver to obey the 55 miles per hour speed limit than a proper understanding of the reasons for the law, a sound set of personal values, and a state trooper in the rear view mirror.

The trouble with being a good sport is you have to lose to prove it.

Our neighborhood teenager claims that all his rich uncle left him was a rich aunt.

Strength is the capacity to break a chocolate bar into four pieces with your bare hands—and eat only one piece.

It is only after you lose your membership in it that the younger generation looks pretty bad.

Frustration is when you tell your teenage son to get a haircut and he says he just did.

Some Citations, Referring to the Paint Industry Quoted by Walter B. Maass

Re: Technical Committee.

A learned fool is more foolish than an ignorant one.
(J.B. Moliere)

Re: Technical Writing.

A man will turn over half a library to write one book.
(Samuel Johnson)

Re: Note of Technical Director to Sales Department.

Against stupidity the very gods themselves contend in vain.
(Friedrich Schiller)

Re: Note of Sales Manager to Research Department.

Throw physic to the dogs!
I'll none of it.
(William Shakespeare, Macbeth)

Re: Austerity program for Research Department.

Mere parsimony is not economy.
(Edmund Burke)

Re: Water Pollution.

The river Rhine, it is well known
Doth wash your city of Cologne.
But tell me, nymphs, what power divine
Shall henceforth wash the river Rhine?
(S.T. Coleridge)

Re: Specification for Marine Paint.

That packet of assorted miseries which we call a ship.
(Rudyard Kipling)

Re: OSHA inspector calls.

The Hun is at the gate!
(Rudyard Kipling)

Re: Paint Convention.

Shall I crack any of those old jokes at which the audience never fails to laugh?
(Aristophanes)

Re: Latex paint versus Wallpaper.

Either that wallpaper goes, or I do.
(Oscar Wilde)

Re: Corrosion:

There being many things wherein we have very imperfect notions. . .
(John Locke)

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

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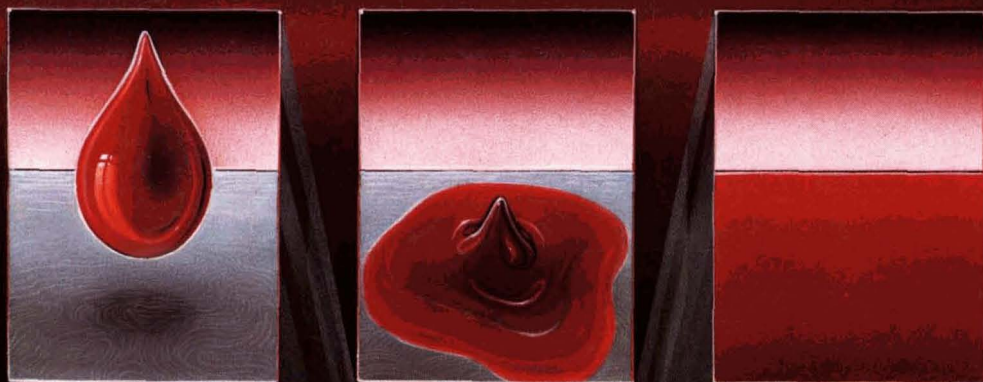
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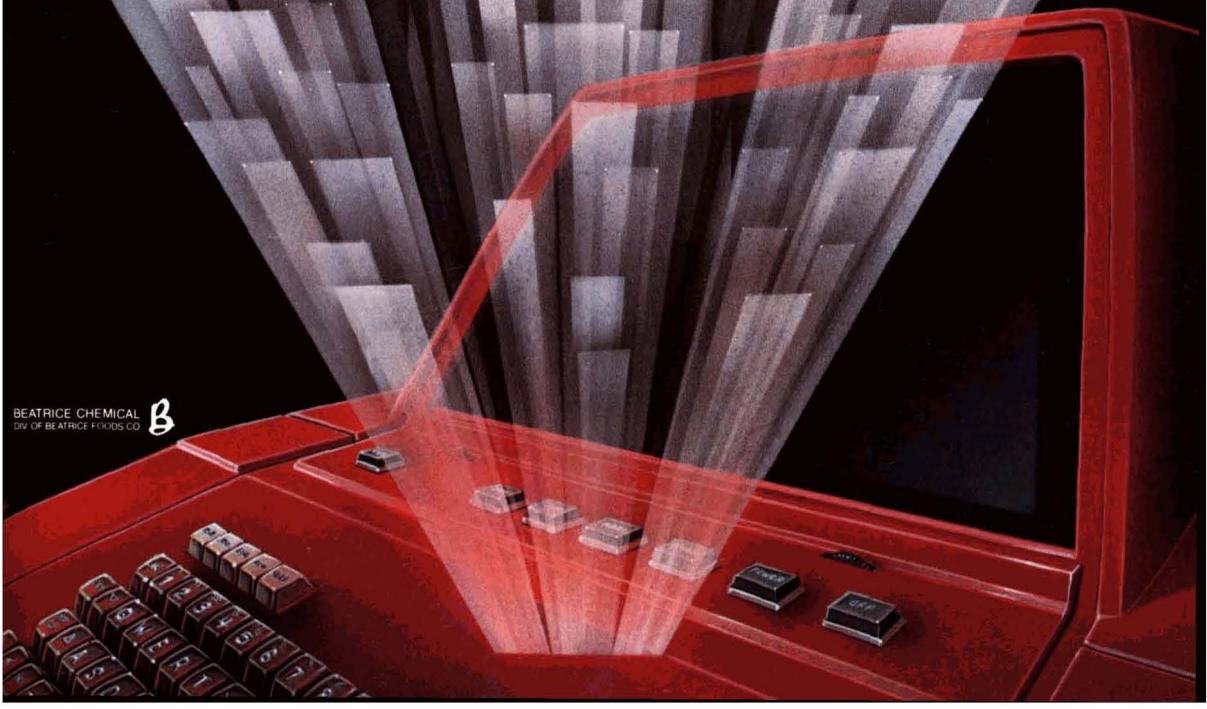
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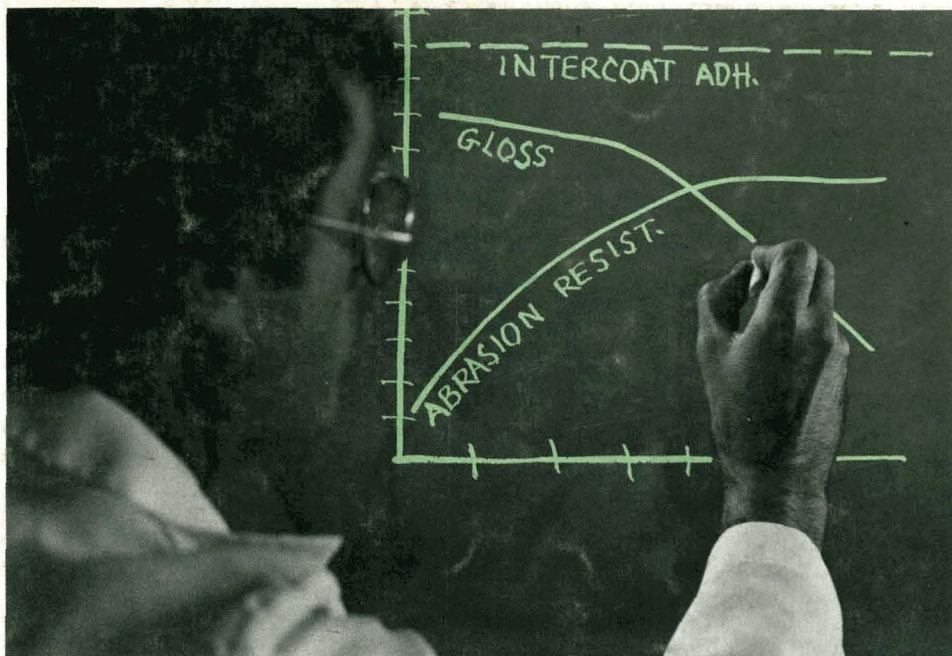
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