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OCTOBER 89—This special Annual Meeting and Paint Show Issue, which is distributed at the show in addition to our regular circulation, contains Abstracts of Papers to be presented; the Program of Technical Sessions; floor plan of show exhibitors; a list of exhibitors and their booth numbers, classified by product/service; an alphabetical list of exhibitors and their booth numbers; and general show information.

JANUARY 90—This Annual Meeting and Paint Show Wrap-up Issue features information on all exhibitors, with emphasis on products and special booth features; photo displays of award-winning booths; as well as a complete review of important Annual Meeting and Paint Show happenings.

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

Annual dues for Active and Associate Members of the Federation of Societies for Coatings Technology is \$20.00. Of this amount, \$13.50 is allocated to a membership subscription to this publication. Membership in the Federation is obtained through prior affiliation with, and payment of dues to, one of its 26 Constituent Societies. Non-member subscription rates are:

	U.S. and Canada	Europe (Air Mail)	Other Countries
1 Year	\$27.00	\$ 55.00	\$ 40.00
2 Years	\$51.00	\$107.00	\$ 77.00
3 Years	\$73.00	\$157.00	\$112.00

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

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

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

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Continuing a Tradition of Innovation

Through the years, the Federation has been shaped by leaders who have brought constructive, creative responses to the challenges facing the industry, and who have made significant contributions to the ever-changing world of coatings technology.

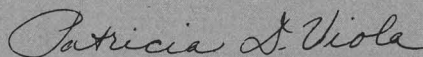
One of its earliest pioneers was Joseph J. Mattiello, whose dedication and vision was an inspiration to his contemporaries.

Joseph Mattiello joined Hilo Varnish Co. as a Chemist in 1925. That year also marked the beginning of his association with the New York Paint and Varnish Production Club. After he served the organization in many capacities, he was named its President in 1939. His endeavors expanded to the national level and, in 1943, he was elected President of the Federation of Paint and Varnish Production Clubs. Dr. Mattiello's contributions were further recognized when the French government made him a member of its Legion of Honor while he was in Paris representing the Federation.

In memory of his untiring efforts and spirit of innovation, the Federation instituted the Joseph J. Mattiello Memorial Lecture in 1949. The name of the organization—now the Federation of Societies for Coatings Technology—has changed, but its charge has remained the same: annually to sponsor a presentation to be given by a "person who has made outstanding contributions to science" on "a phase of chemistry, engineering, human relationship, or other science fundamental to paint, varnish, lacquer, or related protective and decorative coatings."

Forty years since its inception, the tradition continues. On November 10, Dr. Marco Wismer will present the 1989 Mattiello Lecture at the Federation's 67th Annual Meeting in New Orleans. Once again, a man of vision will address the industry on matters pertinent to its continued success. Formerly the Vice President of Research and Development at PPG, Dr. Wismer has focused attention on the need to raise awareness of the benefits of coatings and to gain the added recognition and respect for an industry worthy of them—goals recognized by Joseph Mattiello nearly half a century ago.

(For information on housing and registration at the Annual Meeting and Paint Industries' Show, see pages 21-30 of this issue.)



Patricia D. Viola,
Editor



Here's how consistent global support can be.

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away," says Jim, a senior technology manager at Dow. "Every resin in every plant is checked by computer 86,400 times a day during production. Then every few weeks we take samples from each plant and test those against a master checklist in America. The result: a resin produced in one plant is the same as a resin produced in another." (There are seven plants on five continents, which helps explain why Jim and his staff give new meaning to

the words "frequent flyer.")

The result is a world of countries that's as easy to produce in as a network of states.

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Abstracts of Papers in This Issue

CONTINUOUS WET VS CYCLIC WET-DRY SALT IMMERSION RESULTS FOR SCRIBED COATED STEEL PANELS—J.W. Martin, et al.

Journal of Coatings Technology, 61, No. 772, 39 (May 1989)

Most accelerated aging tests for coatings subject coated panels to either a continuous wet or a cyclic wet-dry exposure. Proponents of cyclic exposures have long argued that cyclic exposures provide more realistic results, in that they better simulate outdoor weathering conditions and produce failure modes which closely resemble those observed outdoors. To test out this premise, two sets of nominally identical oil-alkyd coated steel panels containing a prominent defect were exposed to either continuous wet or cyclic wet-dry immersion in a 5% NaCl solution. It was concluded that, for the experimental coating system, continuous wet immersion was a more severe exposure than cyclic wet-dry immersion and that the failure mechanisms underlying degradation in both exposures appeared to be identical.

CALCULATING TECHNIQUE FOR FORMULATING HYDROXYL TERMINATED POLYESTERS BASED ON BLENDS OF POLYOLS AND POLYACIDS—T.A. Misev

Journal of Coatings Technology, 61, No. 772, 49 (May 1989)

A formulating technique is presented for the general case of saturated polyester resins terminated with hydroxyl groups, based on blends of polyols with a functionality of 2, 3, or 4 and polyacids with a functionality of 2 or 3.

The derived expressions make it possible to calculate resin compositions as a function of number average molecular mass, the desired acid value at the end of the esterification, the percentage of free hydroxyl groups available for further crosslinking reactions, and the mole ratio between the branching components.

The equations are very suitable for combining in a computer program with those based on the work of Flory, Stockmayer, Gordon, and Miller and Macosco, and by which a prediction of the gel point can be made. Using a

simple iteration technique, the gel point distance can be given initially as an independent variable, thus making this method an efficient tool for the resin chemist in experimental work.

EFFECTS OF SILICON INCORPORATION ON THE PERFORMANCE OF EPOXY DERIVED POWDER COATINGS—S.F. Thames and N. Patel

Journal of Coatings Technology, 61, No. 772, 53 (May 1989)

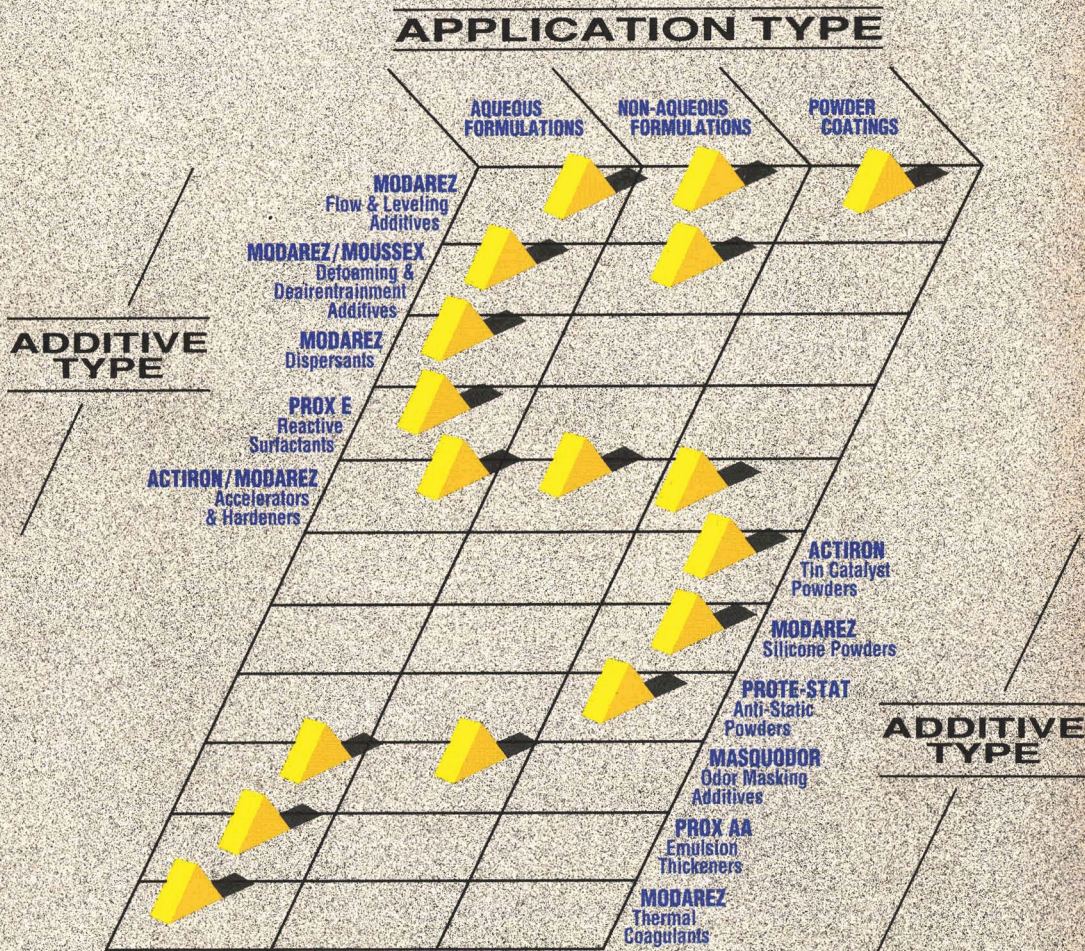
The silicon atom has been incorporated into several epoxy derived polymers via use of silicon-containing curing agents possessing a stable Si-C bond. Novel silicon-containing crosslinking agents of di-, tri-, and tetracarboxylic acids, acid anhydrides, and dianhydride constitute the preferred method of silicon incorporation. A number of silicon-containing, epoxy-based powder coatings have been formulated. The effect of the silicon, incorporated via a nonhydrolyzable silicon-carbon bond, on polymer properties was investigated through evaluation of electrical and corrosion resistance, gloss and gloss retention, and chalking resistance.

POLY(EPOXY-URETHANE-ACRYLIC) INTERPENETRATING POLYMER NETWORKS (IPNs) FOR PRIMER APPLICATIONS—Detroit Society for Coatings Technology

Journal of Coatings Technology, 61, No. 772, 61 (May 1989)

IPN coatings were synthesized from a urethane triol acrylic macromonomer, crosslinked by free radical polymerization of the pendant double bonds, and an amine-terminated epoxy resin crosslinked through a blocked isocyanate curing agent. These systems exhibited good corrosion resistance and higher tensile strength and adhesive strength than the individual components. The morphologies of these coatings were determined by differential scanning calorimetry and scanning electron microscopy.

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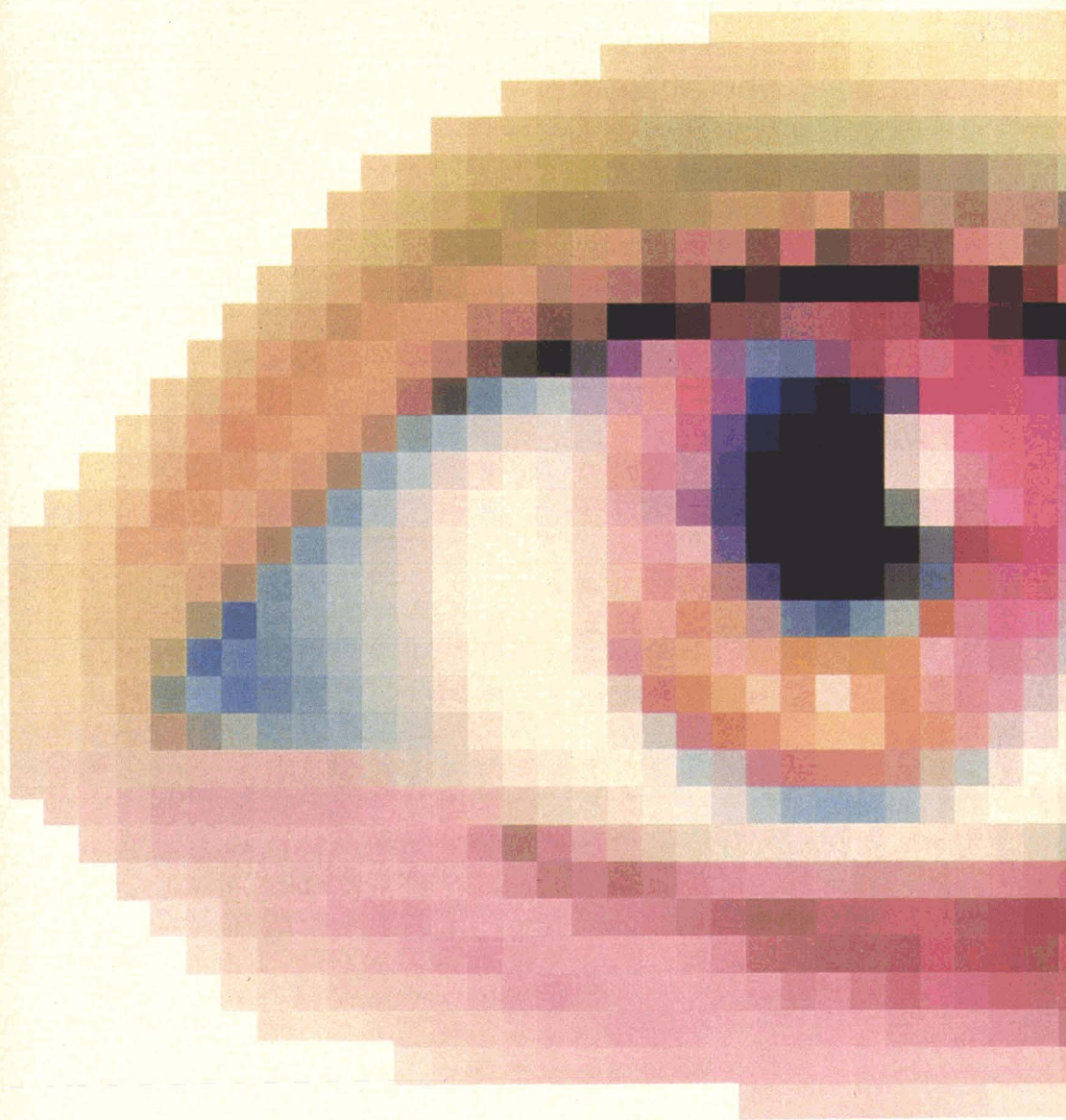
anti-foams are especially suitable for many aqueous and non-aqueous coating formulations. For non-aqueous applications in particular, Synthron's MODAREZ MFP-F is a high quality, more cost-effective alternative to most competitive flow modifiers, while our line of MASQUODOR odor masking agents is suitable for both aqueous and non-aqueous formulations. Finally, our PROX E series of reactive surfactants utilizes a specific chemistry truly unique to the field, and is designed exclusively for water reducible epoxy systems.

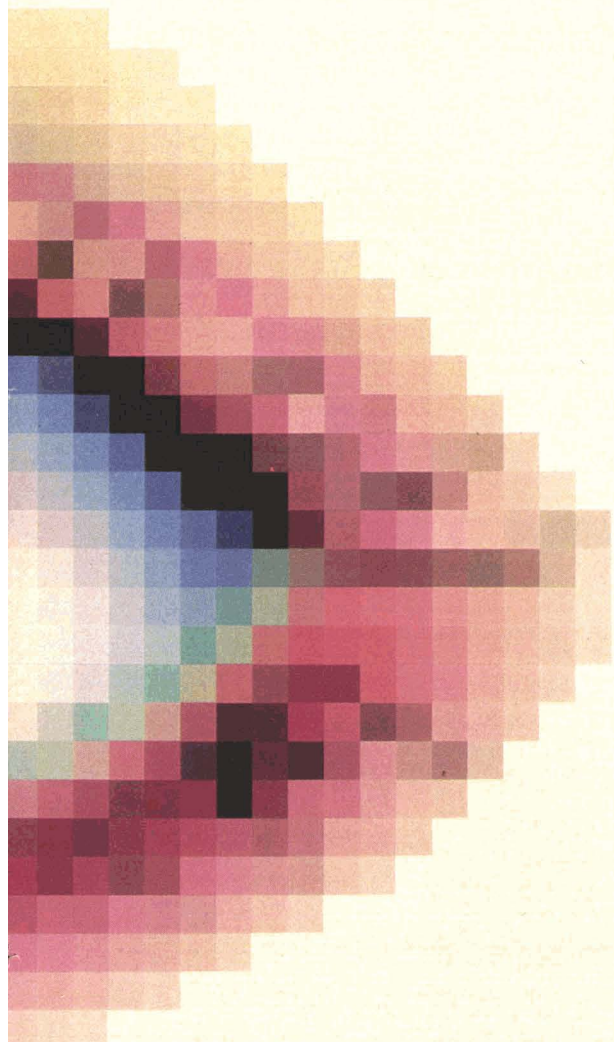
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1988 PIPP Contractor Contest Winners Honored by NPCA and PDCA

Thirteen painting contractors have received national recognition as winners in the 1988 "Picture It Painted Professionally" (PIPP) contractor contest, sponsored by the National Paint & Coatings Association and the Painting and Decorating Contractors of America.

This annual contest is designed to pay tribute to PDCA members for their creative and skillful use of paint and to showcase their winning work to the industry and consumers.

Contestants competed in five categories—interior residential, exterior residential, interior commercial, exterior commercial, and industry. The projects were rated by an independent panel of judges on the basis of: the use of color as a primary design element; the use of special techniques and unusual treatments; creativity; and overall execution.

Winners of PIPP, honored at PDCA's recent annual convention include:

INTERIOR RESIDENTIAL—

First Place: Washington Street Residence, by Magic Brush, Inc., San Francisco, CA.

Second Place: Green Street Residence, by Magic Brush, Inc.

Third Place: Rogers Residence, Towne Painting Co., Newton Square, PA.

EXTERIOR RESIDENCE—

First Place: Fulton Street Residence, by Local Color, Mill Valley, CA.

Second Place: Beaver Street Residence, by Magic Brush, Inc.

Honorable Mention: Gauthier Residence, by Joseph Kuhn Painting & Decorating, Inc., Lexington, MA.

Honorable Mention: Joseph Hall Cottage, by Charles Bernard Coatings, Cape May, NJ.

Henkel Acquires Emery Div.

Henkel Corp., the U.S. subsidiary of Henkel Group of West Germany, has signed a definitive agreement with Quantum Chemical Corp. to purchase the Emery Division.

Headquartered in Cincinnati, Emery produces organic acids, surfactants, plasticizers, synthetic lubricants, glycerine, and products intended for the textile, personal care, paints, and coatings industries. The firm, which employs over 1300 people at its headquarters and five plants in the U.S. and Canada, had annual sales of approximately \$330 million in 1988.

Honorable Mention: Pacific Avenue Residence, by Magic Brush, Inc.

INTERIOR COMMERCIAL—

First Place: St. Paul's Episcopal Cathedral, by Ingersoll Painting & Construction, Inc., Alden, NY.

Second Place: Milwaukee Athletic Club, by Brite 'N' All, Cedar Grove, WI.

Third Place: St. John's Roman Catholic Church, by Theodore Hooven Sons, Inc., Havertown, PA.

Honorable Mention: Minnehaha County Courthouse Museum Law Library, by Olson Painting Service, Sioux Falls, SD.

EXTERIOR COMMERCIAL—

First Place: Ruschke Clockshop, by Bob Swanson Painting, Cary, IL.

Second Place: Sherith Israel Temple, by Traditional Painting & Decorating, Ltd., San Francisco, CA.

INDUSTRIAL—

First Place: Stow & Davis Furniture Manufacturing Facility, by De Maat Bros. Painting Contractors, Inc., Grand Rapids, MI.

Second Place: Enid, Oklahoma Waste Water Treatment Plant, by Zeigler Painting and Sandblasting, Inc., Nauvoo, IL.

Organizational Restructuring at Battelle Features Development of 11 Business Groups

Battelle, Columbus, OH has established 11 business groups in an organizational restructuring designed to further focus its technology department, commercialization, and management services.

The new groups, their respective Group Vice Presidents and General Managers, and the primary technology market areas they serve are:

Advanced Materials—Thomas G. Byrer—materials performance and reliability, polymer science and technology, metals and ceramics, organic and polymer chemistry, ordnance programs, process simulation programs, advanced casting technologies, the Metals and Ceramics Information Center, and the Center for Materials Fabrication, operated by Battelle for the Electric Power Research Institute.

Battelle Europe—Helmut Rabenhorst—a range of services to clients from technology centers in Frankfurt, West Germany, and Geneva, Switzerland.

Decontamination and Decommissioning Operations—Joseph W. Ray—regulatory compliance, radiological characterization of facilities, decontamination methods and technology, decommissioning planning, and radiological health and safety training.

Defense Systems and Technology—Mert R. VanderLind—defense systems analysis, operations analysis and planning, ordnance systems and technology, and related defense programs.

Design and Manufacturing Engineering—Donald P. McConnell—manufacturing technology; product, machine, and equipment development; process engineer-

ing and systems; structures and mechanics; thermal systems; dynamics; separations technology; oceanics; and natural gas transmission systems and programs.

Electronic Systems—Leonard W. Braverman—electro-optic systems, including laser technology and effects, photonic products, and guided-wave optics; and electronic systems and technology, including electronic products and electromagnetics.

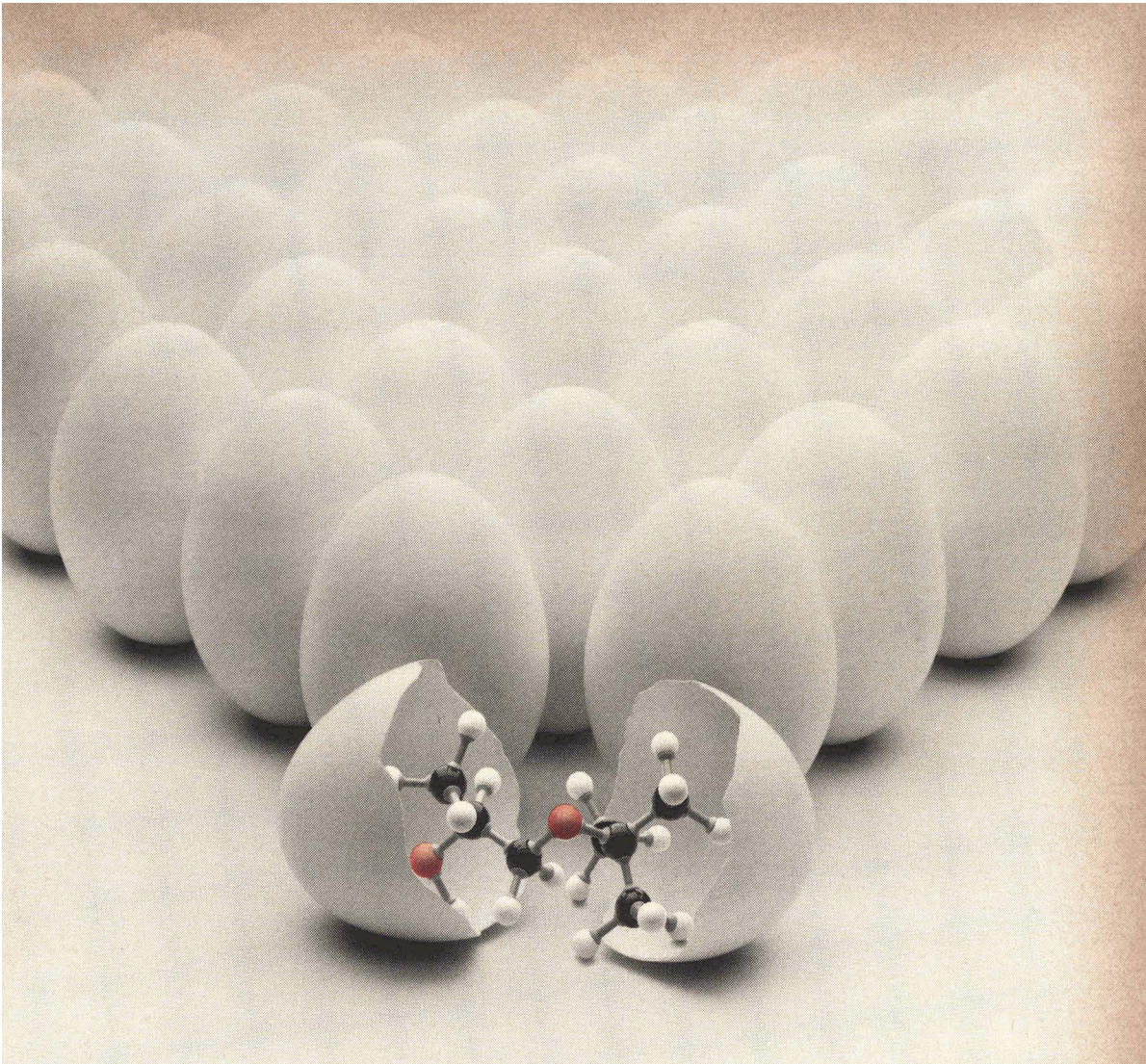
Health and Environment—Anna D. Barker—health and environmental chemistry, effects, and programs; chemical registration services, health products registration services; and air and water toxics' technology.

Information Systems—Gabor J. Kovacs—design, development, and implementation of information systems; systems integration; data base management; expert systems; and intelligent user interfaces.

Manufacturing Systems—John B. Fried—computer-integrated manufacturing, computer-aided design and manufacturing, manufacturing modernization, manufacturing systems implementation, and manufacturing software products.

Nuclear Systems—Richard A. Nathan—management, technical, and systems support services to worldwide public and private nuclear markets.

Technical Services—H. Ronald Hamilton—systems safety and security, utility and regional planning, statistics and data analysis systems, information systems security, and business and technology integration.



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Recent testing and field experience show that Exxate alkyl acetate solvents provide important advantages over methoxypropyl acetate (PM acetate) when used as the active tail solvent and thinner in two-component polyurethane enamels. These advantages result from a unique combination of properties: slow evaporation, low surface tension, and water immiscibility.

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Low evaporation rate and low surface tension combine to minimize dry-spray problems and to improve wetting and flowout for better gloss and appearance. Although Exxate solvents evaporate slowly, the level of solvent retained in the film after curing is less than with PM acetate. Less solvent retained means better coating adhesion and long-term performance.

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Tests show that there is an inverse relationship between solubility of water in a solvent and the blister resistance of the applied coating. Hydrophilic solvents like PM acetate absorb water, facilitating and accelerating blister formation. Hydrophobic Exxate solvents, however, resist water dilution and retard blister formation significantly.

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Amine-cured epoxy maintenance coatings also exhibit improved properties—ease of application and higher blister resistance—when Exxate solvents are used.

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Exxate solvents have been approved for use as thinners in coatings for aircraft and other military equipment (MIL-T-81772B).

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Exxate solvents are less dense than PM acetate, so volatile organic compounds are lower for equivalent formulations. Also, Exxate solvents have a low order of acute and subchronic toxicity. Tetralogical and ecological testing demonstrates minimum risk to human health and the environment.

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Complete information on tests and comparative properties of Exxate solvents and PM acetate are yours for the asking. Call your Exxon Chemical sales representative or contact Jackie Reynolds at Exxon Chemical Company, P.O. Box 3272, Houston, Texas 77253-3272. Phone: 713/870-6377.





Federation of Societies for Coatings Technology

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Regulatory UPDATE

MAY 1989

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by Roy F. Weston, Inc., Washington, D.C.

Clean Air Legislation Status—Several pieces of Clean Air Act legislation have been introduced in both the House and Senate (See March and April issues of FSCT *Regulatory Update*). Rep. Henry Waxman, chairman of the Health and Environment Subcommittee of the House Energy and Commerce Committee, has also reintroduced legislation to regulate air toxics with provisions to prevent accidental releases of these pollutants. His subcommittee was scheduled to introduce ozone and carbon monoxide non-attainment legislation in mid-April. The bill is basically the same as HR 3054 of the 100th Congress. The legislation is aimed at reducing health threats from ozone using the best available technology (BAT).

EPA Denies Petition to Delete Cyclohexane from Community Right-to-Know List—EPA has denied a petition from the Chemical Manufacturers Association (CMA) to delete cyclohexane from the list of toxic chemicals under Section 313 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). See 54 Federal Register 10668 (March 15, 1989). EPA has concluded that cyclohexane is a high volume volatile organic compound that contributes to the formation of tropospheric ozone and other hazardous air pollutants such as formaldehyde.

For further information, contact Robert Israel, Acting Petition Coordinator, Mailstop OS-120, Emergency Planning and Community Right-to-Know Hotline, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460, (800) 535-0202, or in Washington, D.C. and Alaska (202) 479-2449.

Underground Storage Tank (UST) Training Programs—EPA's Office of Underground Storage Tanks (OUST) is interested in providing information on UST training programs organized by state, local, and private parties. In particular, they are interested in programs dealing with regulatory and clean-up issues. OUST will compile a list of programs available to be distributed to interested parties. Information should be sent to: Steve Vineski, Training Coordinator, Office of Underground Storage Tanks (OS 420-D), Environmental Protection Agency, Washington, D.C. 20460. For further information contact, Steve Vineski, EPA/OUST at the above address or call (202) 475-9723. See 54 Federal Register 12954 (March 29, 1989).

Deadlines for Financial Assurance Requirements for UST Owners—EPA's final rule for establishing financial responsibility requirements for underground storage tank (UST) owner/operators has a number of deadlines owner/operators must meet. See 53 Federal Register 43322 (October 26, 1988).

There are two categories of owner/operators that must comply with the requirements:

- owners of petroleum USTs engaged in petroleum production, refining, or marketing, and all owners that have an average throughput of more than 10,000 gallons of petroleum need to prove financial assurance for at least \$1 million per occurrence.
- owners or operators of facilities that are *not* involved in production, refining, or marketing, and have a throughput of 10,000 gallons or less need to prove financial assurance for at least \$500,000 per occurrence.

The following deadlines are in place for complying with these requirements for non-petroleum marketing companies and are based on their tangible net worth:

- net worth of \$20 million or more must meet the financial assurance requirements by January 20, 1989.
- net worth of less than \$20 million must meet the financial assurance requirements by October 26, 1990.

Owner/operators must keep a record of their designated financial assurance mechanism on-site or at their company headquarters.

For more information, contact: the RCRA/Superfund Hotline at (800) 424-9364 or (202) 382-3000 in Washington, D.C.

Bill Proposed to Reduce Hazardous Waste Production—Rep. Howard Wolpe (D-MI) will introduce legislation requiring EPA to expand its activities regarding waste minimization. The bill would amend RCRA to fund a number of programs. Specifically, it would require EPA to establish a hazardous-waste repository and data base aimed at providing information on waste reduction efforts currently available and those that have been implemented. It would also require EPA to provide grants to states to help them give technical assistance to businesses trying to reduce hazardous waste production. This bill is similar to HR 1457 of the 100th Congress. There are currently no hearings scheduled.

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

New Jersey Rule Limits VOC Content in Coatings—A final rule issued by New Jersey Department of Environmental Protection places limits on the VOC content on 14 architectural coatings effective January 1, 1990. The regulation was prompted by a federal court order to bring New Jersey into compliance with national ambient air quality standards (NAAQS) for ozone. Some of the coatings covered in the final rule are: industrial maintenance coatings, sealer primer, undercoater, traffic coatings, and wood preservatives. An example of some of the limits are: industrial maintenance coatings—3.8 pounds per gallon, for undercoater—2.9 pounds per gallon. A proposed rule covering limits for 15 other architectural coatings was to be published May 1, 1989, with a 30 to 60 day comment period. For further information, contact: Beth Ready or Sandra Chen, Department of Environmental Protection, Division of Environmental Quality, Mail Code: CN027, 401 E. State Street, Trenton, NJ 08625, (609) 633-1123.

South Coast District Sets Air-Quality Standards—New measures have been proposed to meet federal air-quality standards in Southern California. The new measures will be implemented by the South Coast Air Quality Management District in its new 20 year attainment plan. These new measures will be introduced on a three-tiered approach. Tier 1 provisions will be applied using currently available technologies. Under this tier, solvents and coatings will need to comply with stringent limits on VOC content. Tier 2 provisions, to be implemented by the year 2000, will be applied using technologies that have been demonstrated but are not yet typically used. Under this tier, solvents and coatings emissions will be reduced by 50% below Tier 1 limits. Tier 3 provisions are aimed at eliminating emissions altogether from coatings and solvents and assume new breakthroughs in technology in order to be implemented.

For further information, contact: South Coast Air Quality Management District, 9150 Flair Drive, El Monte, CA 91731, (818) 572-6200.

Toxicology Program Reviews Three Solvents—In a new procedure, the National Toxicology Program (NTP) Peer Review Panel has reviewed short-term studies of three solvents: acetone, n-hexane, and hexachloro-1,3-butadiene.

In the past, the NTP has not conducted peer reviews of short-term studies. Acetone is a widely used solvent; n-hexane is used in paints, glues, and gasoline; and hexachloro-1,3-butadiene is used in rubber compounds. The solvents were tested for toxicity and carcinogenicity and found to have toxicity ranges from minimal to mildly toxic in laboratory mice.

For further information, contact: National Toxicology Program, P.O. Box 12233, Research Triangle Park, NC 27709, (919) 541-3991.

Final Rule for Significant New Use Rule (SNUR)—EPA, under the Toxic Substances Control Act (TSCA), is establishing a significant new use rule (SNUR) for any use of the following substances: *benzenamine, 4-chloro-2-methyl-* (CAS No. 95-69-2-69); *benzenamine, 4-chloro-2-methyl-, hydrochloride* (CAS No. 3165-93-3); and *benzenamine, 2-chloro-6-methyl-* (CAS No. 87-63-8).

This rule becomes effective on May 10, 1989. For further information, contact Michael M. Stahl, Director, TSCA Assistance Office (TS-799), Office of Toxic Substances, U.S. EPA, RM. EB-44, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-1404. See 54 Federal Register 12445 (March 27, 1989).

EPA Deletes Melamine from Community Right-to-Know List—EPA has deleted melamine from the list of toxic chemicals under Section 313 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). See 54 Federal Register 12912 (March 29, 1989). EPA has concluded that there is no evidence of adverse human health or environmental effects from melamine (CAS No. 108-78-1). For further information, contact Robert Israel, Acting Petition Coordinator, Mailstop OS-120, Emergency Planning and Community Right-to-Know Hotline, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460, (800) 535-0202, or in Washington, D.C. and Alaska (202) 479-2449.

Food and Drug Administration Approves Use of Polyethylene Glycol Succinates in Paper and Paperboard Products—The Food and Drug Administration (FDA) has changed its regulations to allow for the safe use of a mixture of: *mono- and di-(2-alkenyl) succinyl esters of polyethylene glycol* in the manufacture of paper and paperboard products for use in contact with food. See 54 Federal Register 10627 (March 15, 1989).

The action was in response to a petition filed by the Chevron Chemical Co. The amendment is effective March 15, 1989. Written objections and requests for hearings were due by April 14, 1989 to: Dockets Management Branch (HFA-305), Food and Drug Administration, Rm 4-62, 5600 Fishers Lane, Rockville, MD 20857. For further information contact Julius Smith, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

FDA Approves Use of Polyvinylcyclohexane—The FDA has changed its regulations to allow for the safe use of: *polyvinylcyclohexane* as a clarifying agent for polypropylene and propylene containing olefin copolymers intended for use in contact with food. See 54 Federal Register 12432, (March 27, 1989).

The action was in response to a petition filed by Sumitomo Chemical Co., Ltd. The amendment is effective March 27, 1989. Written objections and requests for hearings were due by April 26, 1989 to: Dockets Management Branch (HFA-305), Food and Drug Administration, Rm 4-62, 5600 Fishers Lane, Rockville, MD 20857. For further information contact Vir Anand, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

FDA Approves Use of Olefin Polymers as an Indirect Food Additive—The FDA has changed its regulations to allow for the safe use of: *polyoxyethylene-grafted and polydimethylsiloxane* as an extrusion aid in the production of the olefin polymers for use in contact with food. See 54 Federal Register 10630 (March 15, 1989).

The action was in response to a petition filed by Union Carbide Corp. The amendment is effective March 15, 1989. Written objections and requests for hearings were due by April 14, 1989 to: Dockets Management Branch (HFA-305), Food and Drug Administration, Rm 4-62, 5600 Fishers Lane, Rockville, MD 20857. For further information, contact Hortense S. Macon, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

FDA Approves Use of Several Polymers—The FDA has changed its regulations to allow for the safe use of a polymer prepared from: *urea, ethanedial, formaldehyde, and propionaldehyde* for use as a starch and protein reactant in coatings for paper and paperboard intended for use in contact with dry food. See 54 Federal Register 13880 (April 6, 1989).

The action was in response to a petition filed by the Sun Chemical Corp. The amendment was effective April 6, 1989. Written objections and requests for hearings are due by May 8, 1989 to: Dockets Management Branch (HFA-305), Food and Drug Administration, Rm 4-62, 5600 Fishers Lane, Rockville, MD 20857. For further information, contact Andrew D. Laumbach, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

Agency for Toxic Substances and Disease Registry (ATSDR) Announces Availability of Toxicological Profiles—ATSDR has announced the availability of final versions of several toxicological profiles it previously issued in draft form. These profiles were prepared in compliance with the Superfund Amendments and Reauthorization Act of 1986 (SARA) which required the ATSDR to prepare toxicological profiles for each substance included on the priority list of 100 chemicals most commonly found in facilities on the CERCLA National Priorities List. The toxicological

profiles may be used later to develop new regulations or amend existing regulations. See 54 Federal Register 14037 (April 6, 1989).

Substance	CAS Number
Beryllium	7440-41-7
Chloroform	67-66-3
1,4-Dichlorobenzene	106-46-7
Nickel	7740-02-0
N-Nitrosodiphenylamine	86-30-6

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

FDA Approves Use of Olefin Copolymers—The FDA has changed its regulations to allow for the safe use of: *2,4-di-tert-butylphenyl-3,5,-di-tert-butyl-4-hydroxybenzoate* as a light stabilizer for olefin copolymers for use in contact with food. See 54 Federal Register 13877 (April 6, 1989).

The action was in response to a petition filed by the Ferro Corp. The amendment was effective April 6, 1989. Written objections and requests for hearings are due by May 8, 1989 to: Dockets Management Branch (HFA-305), Food and Drug Administration, Rm 4-62, 5600 Fishers Lane, Rockville, MD 20857. For further information, contact Julius Smith, Center for Food Safety and Applied Nutrition (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

SUMMARY CALENDAR OF REGULATORY ACTIONS

March 29, 1989	Effective date of EPA deletion of melamine from the Community Right-to-Know list. (See this issue.)
April 14, 1989	Comments due on FDA approval of use of polyethylene glycol succinates in paper and paperboard products. (See this issue.) Also, comments due on FDA approval of polyoxyethylene-grafted and polydimethyl-siloxane as an extrusion aid in the production of olefin polymers for use in contact with food. (See this issue.)
April 26, 1989	Comments due on EPA's new Waste Minimization Policy (Pollution Prevention Policy). (See March issue.) Also comments due on FDA approval of use of polyvinylcyclohexane. (See this issue.)
May 1, 1989	New Jersey scheduled to publish proposed amendments to Subchapter 23, proposing new VOC limits on 15 architectural coatings. (See this issue.)
May 8, 1989	Comments due on FDA approval of 2,4-di-tert-butylphenyl-3,5,-di-tert-butyl-4-hydroxybenzoate as a light stabilizer for olefin copolymers for use in contact with food. (See this issue.) Also, FDA approval of use of polymers prepared from urea, ethanedial, formaldehyde, and propionaldehyde for use as a starch and protein reactant in coatings for paper and paperboard intended for use in contact with dry food. (See this issue.)
May 10, 1989	Significant new use rule becomes effective. (See this issue.)
July 1, 1989	Mandatory use of new EPA manifest form and OMB Burden Disclosure Statement required. (See April issue.)
January 1, 1990	New Jersey limits on VOC content on architectural coatings effective. (See this issue.)
October 26, 1990	UST financial assurance requirements deadline for non-petroleum marketing companies with a net worth of less than \$20 million. (See this issue.)

Federation of Societies for Coatings Technology

67th Annual Meeting ★ 54th Annual Paint Industries' Show

Housing and Advance Registration Forms



The New Orleans Hilton ★ The Rivergate

Wednesday, Thursday, Friday ★ November 8, 9, 10, 1989

New Orleans, Louisiana

**67th Annual Meeting
54th Paint Industries' Show
November 8, 9, 10, 1989
The New Orleans Hilton and
The Rivergate
New Orleans, Louisiana**

**TO OUR MEMBERS AND FRIENDS
OF THE FEDERATION EVERYWHERE:**

It is a pleasure for me to invite all those associated with the coatings manufacturing industry to attend the Federation's 67th Annual Meeting and 54th Paint Industries' Show in "The Crescent City," New Orleans, November 8-10.

This year marks the initial visit of these popular Federation events to New Orleans. The Paint Industries' Show, coming off a record year in 1988, will be even bigger, with almost 74,000 net square feet of exhibit space at the New Orleans Hilton Exhibition Hall and at the adjacent Rivergate Exhibition Center.

Running concurrently with the Paint Show will be the technical Program Sessions with the theme – "Coatings Worldwide: Meeting the Needs of the Nineties." Presentations will focus on the increasingly international aspects



of the coatings industry and the technology required for future progress.

The locals call it "The Big Easy"; everyone else calls it "Fun." To the Coatings Industry in 1989, New Orleans means the largest and finest exhibition of materials, equipment, and services in the world – and – programming to help you to better prepare for the future.

James E. Geiger
James E. Geiger
President, FSCT



Rivergate Exhibition Center

**FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
1989 ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
THE NEW ORLEANS HILTON AND THE RIVERGATE
WEDNESDAY, THURSDAY, AND FRIDAY, NOVEMBER 8, 9, 10, 1989**

The combined Annual Meeting and Paint Industries' Show is a major educational activity of the Federation. This international coatings manufacturing industry event consists of three days of technical program sessions and exhibits, running concurrently. Registration is required for admission.

"COATINGS WORLDWIDE: MEETING THE NEEDS OF THE NINETIES"

The theme of the 1989 Annual Meeting underscores the coatings industry's heightened awareness that it is part of a global marketplace, and that all areas of interest and endeavor are being viewed from an increasingly international perspective. Programming will focus on such areas pertinent to the "Decade of the Nineties" as raw material availability, uses of computers, environmental regulations, new approaches for corrosion control, manufacturing for excellence, and advanced topics on the "cutting edge" of the industry.

Also on the program will be the Mattiello Memorial Lecture, Roon Award Papers, Society Papers, and Seminars. Speakers will come from throughout the world of coatings science and manufacture.

ANOTHER RECORD PAINT SHOW WILL FEATURE LATEST PRODUCTS/SERVICES OF MORE THAN 220 EXHIBITORS

The Paint Industries' Show — the largest and best international exhibit of its kind in the world — will feature attractive exhibitor displays devoted to a wide variety of raw materials, production equipment, containers, laboratory apparatus, testing devices, and services furnished to the coatings manufacturing industry.

The purpose of the Show is to provide attendees with an opportunity to learn of the latest developments in these products and services. Key personnel from the top technical and sales staffs of exhibitors will be on hand. More than 220 exhibitors from the U.S., Canada, and Europe, will utilize almost 74,000 net square feet of exhibit space at the Show. Exhibit hours will be 11:00 - 5:30 on Wednesday; 9:00 - 5:30 on Thursday; and 9:00 - 3:00 on Friday.

The Paint Show will be held at both the New Orleans Hilton's Exhibition Hall and at the adjacent Rivergate Exhibition Center.

HOTELS/RESERVATIONS: MARRIOTT AND SHERATON CO-HEADQUARTERS

Nine hotels in New Orleans have reserved blocks of rooms for the Annual Meeting and Paint Show. The Marriott and Sheraton will be the co-headquarters hotels.

The other cooperating hotels are: Meridien, Monteleone, Omni Royal Orleans, Westin Canal Place, Doubletree, Holiday Inn Crowne Plaza, and the Hilton. The Monteleone and Omni Royal Orleans are located in the French Quarter.

Rooms are subject to an 11% occupancy tax plus a \$2.00 per room night city ordinance tax. All hotel reservations will be processed by the FSCT Housing Bureau. Phone reservations will not be accepted. You will receive an acknowledgment of your reservation from the Housing Bureau. This is not the hotel confirmation; that will be sent to you directly from the hotel to which you have been assigned.

Reservations for the Hilton will be accepted for arrival beginning Wednesday, November 8, only. Any reservations requesting the Hilton for arrival prior to November 8 will be assigned to another hotel.

Requests for accommodations at either the Marriott or Sheraton will be limited to ten rooms per company. A parlor counts as one room. All hotels require deposits. Please mail your deposit directly to the hotel. Additions, changes, and cancellations must be submitted in writing directly to the hotel in which you have been confirmed. (All hotels are in New Orleans, LA — zip codes in parens.)

Marriott Canal & Chartres Sts. (70140)	Westin Canal Place 100 Rue Iberville (70130)
Sheraton 500 Canal St. (70130)	Doubletree 300 Canal St. (70140)
Meridien 614 Canal St. (70130)	Holiday Inn Crowne Plaza 333 Poydras St. (70130)
Monteleone 214 Rue Royale (70140)	Hilton Poydras at the Mississippi River (70140)
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So if you're ready to make the leap to P-series, try the practical approach with new DOWANOL PnB and DPnB. And don't monkey around with anything else.

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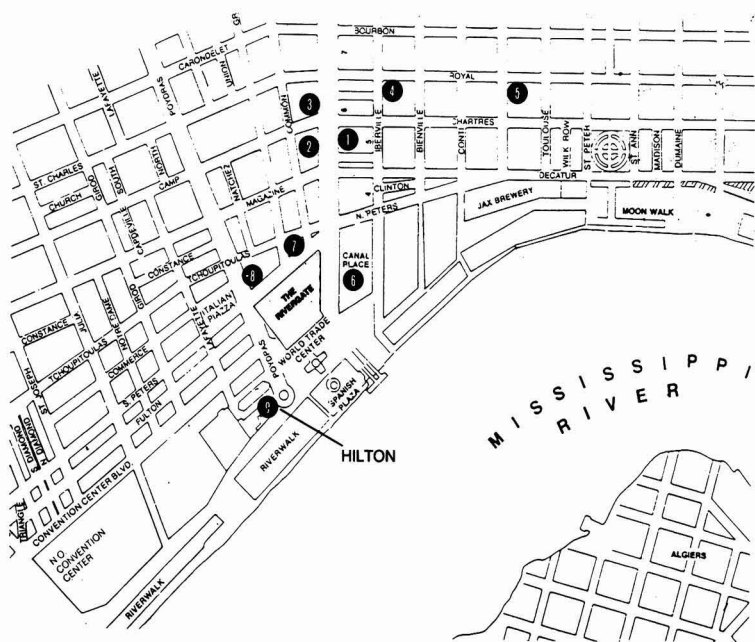
HOTEL ROOM AND SUITE RATES

Map No.	Hotel	Suites			
		Singles	Doubles/Twins	1 BR	2 BR
1	Marriott	\$112	\$128	\$360-400	\$488-528
2	Sheraton	115	130	183-310-480	310-705
	Towers	135	170	480-600	705
3	Meridien	95	105	275 & up	500 & up
4	Monteleone	92	104	215-425	325-550
5	Omni Royal Orleans	99,140,165	160,185	310,350	475,515
6	Westin Canal Place	115	130	350-425	525-600
7	Doubletree	85	95	160-200	300-400
8	Holiday Inn	95	110	226-446	349-592
	Crowne Plaza				
9*	New Orleans Hilton	115	135	290-950	375-1125
	Towers	165	185	575-950	725-1100

Note: Rates subject to 11% occupancy tax plus a \$2.00 per room night city ordinance tax.
All hotels require a first-night room deposit. Please send directly to hotel.

*Reservations at the Hilton will be accepted for arrival beginning Wednesday, November 8, only.

- | | | |
|---|---|---|
| (1) Marriott
Canal & Chartres Sts. (70140) | (4) Monteleone
214 Rue Royale (70140) | (7) Doubletree
300 Canal St. (70140) |
| (2) Sheraton
500 Canal St. (70130) | (5) Omni Royal Orleans
621 St. Louis St. (70140) | (8) Holiday Inn Crowne Plaza
333 Poydras St. (70130) |
| (3) Meridien
614 Canal St. (70130) | (6) Westin Canal Place
100 Rue Iberville (70130) | (9) New Orleans Hilton
Poydras at the Mississippi
River (70140) |



**1989 FSCT ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
 NEW ORLEANS HILTON AND RIVERGATE, NEW ORLEANS, LA
 WEDNESDAY, THURSDAY, AND FRIDAY, NOVEMBER 8, 9, 10**



APPLICATION FOR HOTEL ACCOMMODATIONS

**Mail to: FSCT Housing Bureau
 1520 Sugar Bowl Dr.
 By 10/5/89 New Orleans, LA 70112**

Please indicate below the type of accommodations desired and the choice of hotels. (Refer to the hotel map and rates on opposite page.) All reservations will be processed by the FSCT Housing Bureau. Hotel assignments will be made in accordance with the prevailing availability. You will receive an acknowledgment of your reservation from the Housing Bureau. This is not the hotel confirmation. That will come to you directly from the hotel to which you have been assigned. Changes/additions/cancellations must be submitted in writing to the hotel.

TYPE OF ACCOMMODATION	NUMBER	RATE REQUESTED	CHOICE OF HOTELS
Single (1 person)			1ST
Double (2 persons)			2ND
Twin (2 persons)			3RD
Suite (parlor and 1 bedroom)			4TH
Suite (parlor and 2 bedrooms)			

NAMES OF ROOM OCCUPANTS AND DATES OF ARRIVAL/DEPARTURE

Type of Room	Name	Arrive	Dates Depart

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

SEND CONFIRMATION FOR ALL RESERVATIONS TO:

Name _____ Telephone _____

Company _____ FAX _____

Address _____

City, State, Zip _____

Country _____

Name of Credit Card _____ Signature _____

Credit Card Number _____ Exp. Date _____

- Note:** (1) Requests for accommodations at either the Marriott or the Sheraton will be limited to 10 rooms per company.
 (2) Reservations for the Hilton will be accepted for arrival beginning Wednesday, November 8, only.

SPECIAL FARES AVAILABLE FROM DELTA AIR LINES

Delta Air Lines, in cooperation with the FSCT, is offering a special discount fare which affords passengers a 40% minimum savings off their round trip, undiscounted day coach fares for travel to the FSCT Annual Meeting and Paint Industries' Show on the airlines' domestic systems. The discount from Canada is 35%.

To take advantage of this discount, you must: (1) Travel between November 4-14, 1989; (2) Purchase tickets at least seven days in advance; (3) Phone 1-800-241-6760 for reservations. Immediately reference the FSCT file number: U0235. The special fares are available only through this number.

Discounts are good for both direct and connecting flights to New Orleans. If you use a travel agent, have your reservations placed through the toll-free number to obtain the same fare advantages. Delta has a variety of other promotional fares, some of which may represent even greater savings. When you phone for reservations, ask for the best discount applicable to your itinerary.

FEDERATION BOARD OF DIRECTORS TO MEET ON TUESDAY AT MARRIOTT

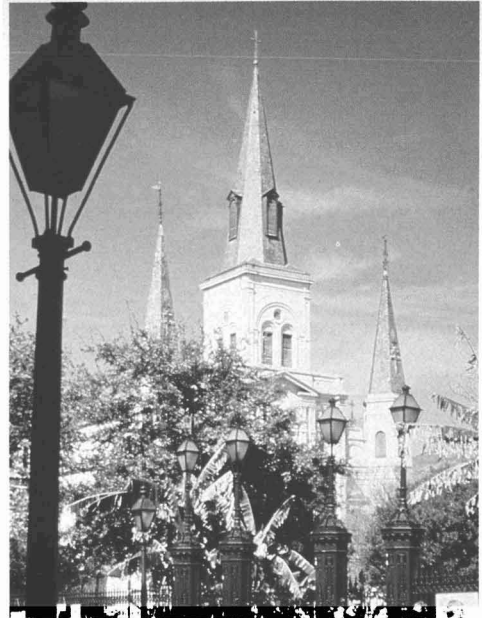
The Board of Directors of the Federation will meet on Tuesday, November 7, at 9:00 a.m. in the Marriott.

HILTON EXHIBITS – SITE OF DELTA FIRST-CLASS TICKETS DRAWING

The Federation will offer a special door prize during the Paint Show: a pair of Delta Air Lines first-class, round-trip tickets for any destination in the continental United States. Entries must be made at a special location at the Hilton Exhibition Hall. The drawing will be held at the Hilton Exhibition Hall at 11:00 a.m., Friday, November 10. Winner need not be present, however, the announcement of the winning entry will be made at the Federation's Annual Luncheon.



Hilton Riverside and Towers Hotel



St. Louis Cathedral, Jackson Square

FEDERATION ANNUAL LUNCHEON WILL BE HELD ON FRIDAY

The annual Federation Luncheon will be held on Friday, November 10, at the New Orleans Hilton.

SPOUSES PROGRAM INCLUDES TOUR OF FRENCH QUARTER

The Spouses Program will open on Wednesday with a get-acquainted wine and cheese social in the Mardi Gras Ballroom of the Marriott Hotel. On Thursday, there will be a deluxe motor coach tour of the city, featuring the French Quarter, the elegant Garden District, the shores of Lake Pontchartrain, the unique St. Louis III Cemetery, and a visit to Germaine Wells' Mardi Gras Museum. Lunch will be served during the tour at the famous Arnaud's Restaurant in the French Quarter. Also included in the spouses' registration is Continental Breakfast served at the Marriott on Thursday and Friday mornings.

NPCA TO MEET SAME WEEK AT NEW ORLEANS HILTON

The National Paint and Coatings Association will hold its annual meeting on November 6-8, 1989, at the New Orleans Hilton Riverside and Towers. Persons wearing NPCA badges (who sign up at a special registration desk at the Hilton) will be admitted to the Paint Show on Wednesday only, with the compliments of the Federation.

1989 Advance Registration

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
1315 Walnut St., Philadelphia, PA 19107

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U	Date Received _____
V	Amount \$ _____
	Check No. _____

Please fill out this form and mail with a check in the correct amount (made payable to the FSCT) **to the Federation address shown above.** All checks must be payable in U.S. Funds. Any that are not will be returned. **DEADLINE DATE FOR ADVANCE REGISTRATION IS OCTOBER 13. NONE WILL BE ACCEPTED AFTER THAT DATE.**

A \$10.00 charge will be made for cancellations received prior to October 13. No refunds will be made after that date.

INDUSTRY REGISTRATION FEES: INFORMATION FOR REGISTRATION BADGE:

A **MEMBER** **\$50.00**

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

Federation Constituent Society

B **NON-MEMBER** **\$75.00**

G **SPECIAL FEE FOR RETIRED MEMBERS** **\$25.00**

Federation Constituent Society

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BB Manufacturers of Raw Materials

CC Manufacturers of Equipment and Containers

DD Sales Agent for Raw Materials + Equipment

EE Government Agency

FF Research/Testing/Consulting

GG Educational Institution Library

HH Paint Consumer

JJ Other

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LL Manufacturing and Engineering

MM Quality Control

NN Research and Development

PP Technical Sales Service

QQ Sales and Marketing

RR Consultant

SS Educator/Student/Librarian

TT Other

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Z **NUMBER REQUIRED:** _____ **\$25.00 EACH.**

<p>A CHECK IN THE AMOUNT OF: \$ _____ IS ENCLOSED</p>

1989 Paint Industries' Show

Current List of Exhibitors

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Advanced Coatings Technologies
Advanced Software Designs
Air Products & Chemicals, Inc.
Alcan-Toyo America, Inc.
Ambrose Co./Pioneer Packaging
American Cyanamid Co.
Amoco Chemical Co.
Angus Chemical Co.
Applied Color Systems, Inc.
Aqualon Co.
Arco Chemical Co.
Ashland Chemical Co., IC&S Div.
Atlas Electric Devices Co.
- B&P Environmental Resources
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BASF Corp., Chemicals Div.
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University of Detroit
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Dow Chemical USA, Latex Prods. Div.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
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Sun Chemical Corp.
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- R.T. Vanderbilt Co., Inc.
Van Waters & Rogers
Velsicol Chem. Corp., Chattanooga Prods.
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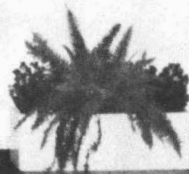
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The JOURNAL OF COATINGS TECHNOLOGY has first right to the publication of papers presented at the Annual Meeting of the Federation and at local or regional meetings or symposia of the Constituent Societies. *Papers in which proprietary products or processes are promoted for commercial purposes are specifically non-acceptable for publication.*

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If a submitted paper consists of the text of a presentation made previously to a monthly or special meeting of a Society for Coatings Technology, or to another technical group, the name of the organization and the date of the presentation should be given. If someone other than the author of the paper made the presentation, this information, too, should be noted. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY.

Papers originally composed for oral presentation may have to be revised or rewritten by the author to conform to the style suitable for written publication.

Open Forum: Three complete copies should be sent to the Open Forum Editor, at the address listed above.

The same general rules as given for technical papers should be followed in the preparation of an Open Forum manuscript. However, the subject may be informally approached. Topics may be nontechnical in nature, dealing with any aspect of the coatings industry.

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

. . . by Constituent Societies For Annual Meeting Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to the Editor at the address listed above.

. . . for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1989 Roon Awards Committee, Richard Eley, The Glidden Co., 16651 Sprague Rd., Strongsville, OH 44136. (For complete details, see "Roon Awards" section of the JOURNAL for January 1989.)

MANUSCRIPT PREPARATION

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

Manuscripts should be typed with double spacing on one side of 8½ × 11 inch (22 × 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

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

Authors' Biographies and Photographs

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

Abstracts

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

Text

The headings and sub-headings in this Guide illustrate their use to divide the text into sections to improve readability for comprehension, and to break up typographical monotony; they may be used as a model for preparation of the text of a manuscript for publication. The text should *not* be presented as an alphanumeric outline.

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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

Graphs should be on good quality white or non-photographic blue-lined 8½ × 11 inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a *copy* of the original graph. Graph captions and legends should also be typed on a separate sheet for typesetting.

Graphs should not be used if they merely duplicate the data given in tables, or vice versa.

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Photographs

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

Color prints and slides are unacceptable.

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

Nomenclature

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

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

Nomenclature of chemical compounds should conform to the style of *Chemical Abstracts* and the IUPAC rules.

Equations

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

Summary

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

Acknowledgment

If used, it should follow the summary.

References

These should be listed in the numerical order in which they are cited in the text, and should be placed at the end of the manuscript. Names of authors may or may not be shown in the text with reference numbers. If possible, include titles of articles referenced in the literature. The following are examples of acceptable reference citations for periodicals^{1,2,3}, books⁴ and patents.⁵

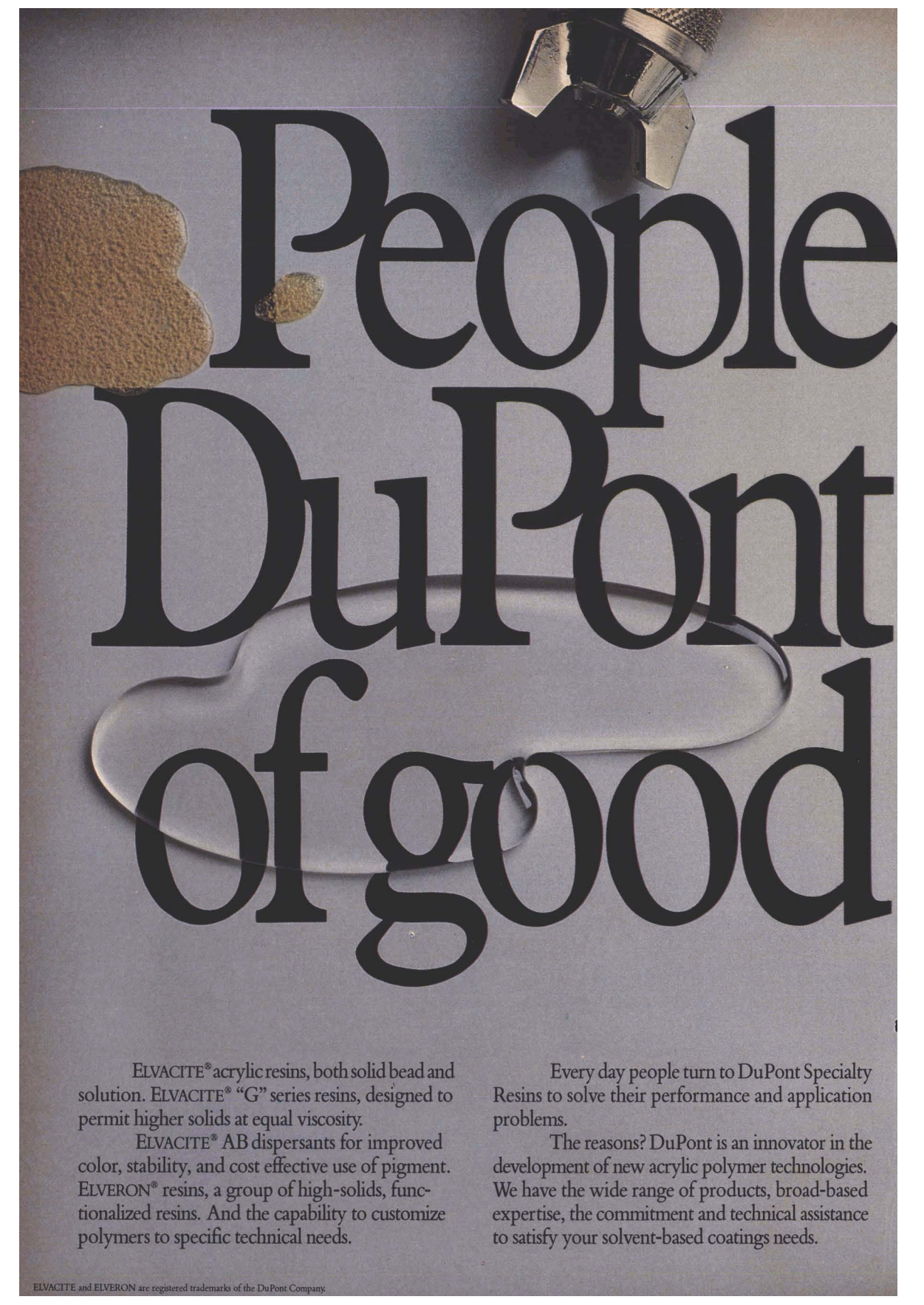
- (1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official Digest*, 36, No. 475 (Part 1), 839 (1964).
- (2) Davidson, H.R., "Use and Misuse of Computers in Color Control," *JOURNAL OF COATINGS TECHNOLOGY*, 54, No. 691, 55 (1982).
- (3) Stephen H.G., "Hydrogen Bonding—Key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

OTHER INFORMATION

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

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Continuous Wet vs Cyclic Wet-Dry Salt Immersion Results for Scribed Coated Steel Panels

Jonathan W. Martin, Mary E. McKnight, Tinh Nguyen, and Edward Embree
National Institute of Standards and Technology*

Most accelerated aging tests for coatings subject coated panels to either a continuous wet or a cyclic wet-dry exposure. Proponents of cyclic exposures have long argued that cyclic exposures provide more realistic results, in that they better simulate outdoor weathering conditions and produce failure modes which closely resemble those observed outdoors. To test out this premise, two sets of nominally identical oil-alkyd coated steel panels containing a prominent defect were exposed to either continuous wet or cyclic wet-dry immersion in a 5% NaCl solution. It was concluded that, for the experimental coating system, continuous wet immersion was a more severe exposure than cyclic wet-dry immersion and that the failure mechanisms underlying degradation in both exposures appeared to be identical.

INTRODUCTION

Most accelerated aging tests for coatings subject coated panels to either a continuous wet (e.g., the salt fog test) or a cyclic wet-dry environment. Proponents of cyclic exposures have long argued that cyclic exposures provide more realistic results, since they more closely simulate outdoor weathering conditions and they give rise to failure modes similar to those observed outdoors (see, for example, Timmins¹ and Smith²). Implicit in their arguments is that a relationship does not exist between continuous wet and cyclic exposure results. If this assumption is true, it should greatly affect the design and

selection of accelerated aging tests and place into question performance criteria based solely on continuous wet exposure conditions.

The objectives of this research, therefore, were to quantitatively determine for one candidate coating system (1) the extent, rate, and mode of failure for identical sets of coated panels containing a scribe mark exposed to continuous wet or cyclic wet-dry conditions, (2) the relative severity of the two exposures, and (3) if the results from one exposure can be transformed for predicting the results from the other exposure.

EXPERIMENTAL

Panel Preparation

Forty six matte-finished, SAE 1010, low carbon, cold-rolled steel panels were selected for this study, each having dimensions of approximately $100 \times 150 \times 0.8$ mm and surface roughnesses ranging from 0.9 to 1.3 μm . Although the manufacturer vapor degreased the panels in a volatile solvent at 70°C and packed them in a rust inhibiting paper prior to shipment, we instituted an additional cleaning step to insure an acceptable level of cleanliness and uniformity among the panels. This extra cleaning step involved repeatedly dipping the panels into successive acetone and ethanol baths (reagent grades) after which the panels were allowed to dry at laboratory conditions (22°C and 45% relative humidity) for less than 24 hr prior to the application of the primer. Both the acetone and ethanol were replaced with fresh solutions midway through the cleaning process.

A medium-oil alkyd primer, containing zinc hydroxy phosphite and iron oxide pigments, was applied over the cleaned panels using a draw down blade, after which the

This paper is based upon a presentation given before the American Chemical Society in Toronto, Canada, on June 6, 1988.

*U.S. Department of Commerce, Gaithersburg, MD 20899.

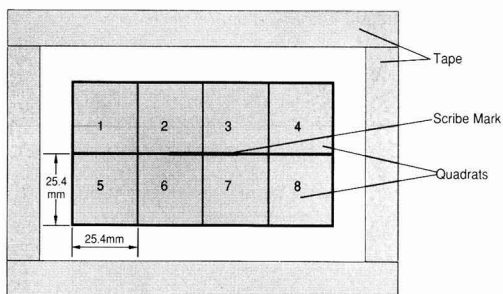


Figure 1—Schematic of the sampling area depicting the location of the scribe mark and the position of the sampling quadrats

panels were cured at laboratory conditions for 2 hr, heated in an air circulating oven at 70°C for 24 hr, and allowed to cool. The thickness of the primer was measured at 15 regularly spaced locations over the surface of each panel using an eddy current thickness gauge; the average thickness of the primer on the 46 panels was 76 μm with a standard deviation of 13 μm .

Two coats of a medium-oil alkyd topcoat, containing titanium dioxide pigments and conforming to SSPC Paint 104, were applied over the primer using a draw down blade. The coated panels were cured after each application of the topcoat using the same curing procedure used for the primer. After the second application, the topcoat was cured and the thickness of the fully coated panel was measured at the same 15 locations used for measuring primer thickness. The average total coating thickness for the 46 panels was 143 μm with a standard deviation of 20 μm . By subtraction, the average thickness of the topcoat was 67 μm with a standard deviation of 16 μm .

The fully cured panels were then scribed by positioning each panel in a jig and moving it under a fixed, weighted, diamond tipped scribe making a scribe mark of length 25.4 mm and width 0.2 mm. The scribe was centered and oriented parallel to the length of the panel (see *Figure 1*). All scribe marks were visually inspected to insure cleanliness and consistency.

After the panels were scribed, they were randomly assigned to either the continuous wet or cyclic wet-dry exposure experiments (23 were assigned to the continuous wet exposure test while the other 23 were assigned to the cyclic exposure test). Prior to exposure, all of the panels were taped on the back and edges to protect these areas from corrosion.

Apparatus

The exposure apparatus consisted of two 130-liter exposure tanks sharing a common 150-liter reservoir (see *Figure 2*). The reservoir was equipped with voltage-regulated immersion heaters, thermocouples, an aerator, a pump to circulate the electrolyte from the reservoir to the two exposure tanks, and a 15 μm particle filter to remove corrosion products from the electrolyte. Over the duration of the experiment, the following properties of the electrolyte in the reservoir were monitored approximately three

times per week: temperature (the average temperature was 30°C with a standard deviation of less than 1°C), NaCl concentration (the average NaCl concentration was 5.0% with a standard deviation of 0.3%), pH (the average pH was 6.8 with a standard deviation of 0.1), and oxygen concentration (the average oxygen concentration was 5 ppm with a standard deviation of 0.1 ppm). Oxygen concentration was measured with an Orion 942 meter* connected to an oxygen probe while the pH was measured using the same meter connected to a pH probe. Reagent-grade NaCl and laboratory tap water were used in preparing the electrolyte.

The two exposure tanks were identical in construction, except as detailed in the following discussion, and were continually stirred by pumping electrolyte from the reservoir into the bottom of the exposure tanks. The cyclic exposure tank was equipped with an electric timer connected to servo-motors for raising and lowering all 23 panels out of the electrolyte at once while at the same time actuating electrical fans for drying the panels. The panels were completely immersed in the electrolyte in both experiments.

Exposure Cycle and Panel Evaluation

The coated panels were exposed to either a continuous wet or cyclic wet-dry exposure. In the continuous wet exposure, the panels remained in the 5% NaCl electrolyte for the duration of the experiment, except when individual panels were removed for evaluation (approximate time for evaluating a panel was five min). The cyclic exposure consisted of 12 hr of immersion followed by 12 hr of drying at laboratory conditions. The cyclic wet-dry exposure panels were evaluated during the immersion part of the cycle to insure conformity with the evaluation procedure used for the continuous wet immersed panels.

At preselected times, panels were individually removed from the exposure tanks and visually evaluated for

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

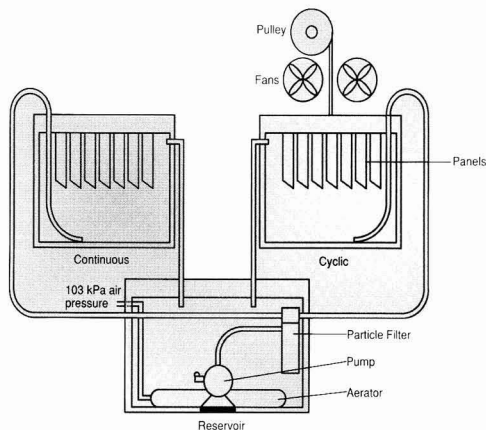


Figure 2—Schematic of the experimental apparatus

degradation by superimposing a transparent sheet of plastic containing eight embossed, equal-sized 25.4 × 25.4 mm quadrats over each panel (see Figure 1) and counting the number and measuring the size of all defects (e.g., blistering and corrosion) within each quadrat.^{3,4} The transparent sheet was designed so that the same area of a panel was overlaid at each inspection and only defects in a quadrat were recorded. The continuous wet and cyclic wet-dry exposures were terminated when a majority of the panels had failed; that is, when the entire sampling area of a panel had degraded either due to blistering or corrosion. For continuous wet immersion, the experiment was terminated after 2020 hr, while for cyclic immersion, the experiment was terminated after 4261 hr or approximately 2130 hr of immersion.

RESULTS AND DISCUSSION

Mechanisms and Modes of Failure

CONTINUOUS WET IMMERSION: Plots of the percent area degraded vs time are presented in Figure 3 for the 23 continuous wet immersed panels, all of which failed by delamination. The delaminated area tended to monotonically increase with time for all of the panels except one, in which an error in data recording was known to have occurred at 1500 hr (panel 17 in Table 1). Within a short time after immersion (approximately 24 hr), the scribe became capped by corrosion products along its entire length. Blisters first appeared at approximately 500 hr on some of the panels adjacent to and along the perimeter of the scribe. These blisters coalesced and grew in size until the amassed blister covered the entire sampling area of a panel (see Figure 4a).

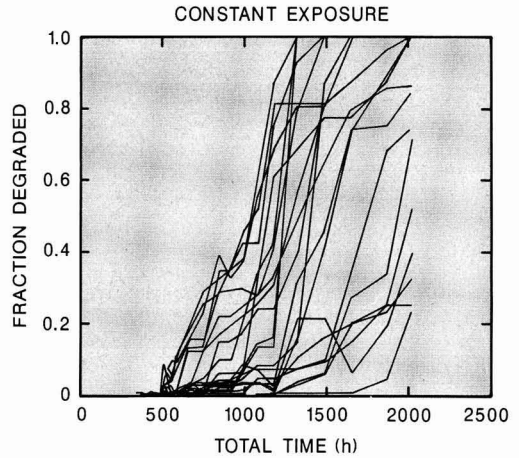


Figure 3—Plot of the delaminated fraction of the sampling area vs time for the 23 continuous wet immersed panels. Each line in the graph corresponds to delamination of a panel

The induction times, t_0 , the time at which a panel began to delaminate (see Figure 5), and the rates of delamination among the panels exhibited great variability. For example, induction times for the 23 panels ranged from 450 hr to 1200 hr. At the time that the continuous wet immersion experiment was terminated (2020 hr), 12 of the panels had completely degraded and 10 had partially degraded. One panel had been removed from the experiment for microprobe analysis; these results will be reported elsewhere.

Table 1—Coefficients and the Squared Correlation Coefficient, r^2 , for the 23 Panels Which Were Continuously Immersed in Electrolyte and Fitted to Equation (1)

Also Tabulated Are the Maximum Exposure Time and Corresponding Degradation Fraction Used in Computing the Coefficients for Equation (1)

Panel #	a	b	k	r^2	Max. Exp. Time	Max. Degr.
1	-3.284	0.00270	-0.000150	0.93	1180	0.75
2	-3.201	0.00220	-0.000170	0.97	1324	0.57
3	-3.473	0.00288	-0.000085	0.91	1084	0.63
4	-4.065	0.00248	0.000038	0.84	1324	0.49
5	-3.152	0.00232	0.000033	0.94	1324	0.81
6	-4.834	0.00347	-0.000012	0.96	1324	0.79
7	-17.846	0.01180	-0.000040	0.99	1493	0.87
8	-6.855	0.00398	-0.000026	0.98	1660	0.72
9	-5.160	0.00334	-0.000017	0.97	1493	0.84
10	-4.348	0.00324	-0.000124	0.98	1180	0.42
11	-10.567	0.00855	0.000008	0.98	1180	0.61
12	-12.187	0.00560	0.000047	0.99	2020	0.52
13	-13.736	0.01036	0.000006	0.99	1324	1.00
14	-3.383	0.00282	0.000127	0.97	1180	0.81
15	-5.401	0.00314	-0.000042	0.97	1660	0.74
16	-2.888	0.00122	-0.000176	0.87	2020	0.25
17	-5.902	0.00238	0.000009	0.77	2020	0.39
18	-14.003	0.01056	0.000011	0.99	1324	1.00
19	-20.847	0.00958	0.000002	0.99	2020	0.23
20	-2.359	0.00139	-0.000372	0.97	2020	0.74
21	-7.152	0.00417	-0.000023	0.98	1660	0.74
22	-7.399	0.00350	-0.000015	0.97	2020	0.71
23	-4.021	0.00155	-0.000040	0.96	2020	0.32

Degradation curves for individual continuous wet immersed panels were fitted to the model having the form (see *Figure 5*)

$$D(t) = \exp(a + bt) + kt \quad (1)$$

where

$D(t)$ is the fraction of the total sampling area which delaminated by time t and

a , b , and k are coefficients.

The coefficients of equation (1) are tabulated in *Table 1*, along with the squared correlation coefficient for each panel, which is a measure of the portion of total variation in the response variable, $D(t)$, explained by the fitted model. Equation (1) is a compromise between two distinctly different failure models; i.e., for most of the continuous wet immersed panels, delamination appeared to increase exponentially with time, while for a few panels, a linear model was a better fit to the data. The combined linear and exponential model, equation (1), fit the delamination data better than did either the linear or exponential model (see *Figure 5*).

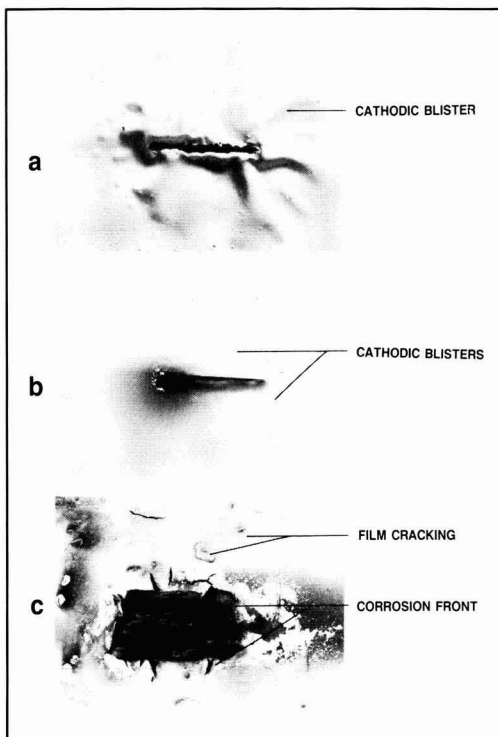


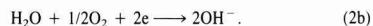
Figure 4—Failure mode for (a) a continuous wet immersed panel exhibiting cathodic delamination, (b) a cyclic wet-dry immersed panel exhibiting failure mode I, and (c) a cyclic wet-dry immersed panel exhibiting failure modes I and II (cathodic blisters are not apparent, since the photograph was taken after the panel had dried)

Coefficients of equation (1) were computed from the delamination data for exposure times up to the time that the first quadrat in the sampling area had completely delaminated rather than from all of the available data. This was done to remove any bias in computing the model coefficients resulting from edge effects.⁵ Edge effects become important when the delamination front exceeds the boundaries of quadrats 2,3,6, and 7 in the vertical direction prior to complete delamination of quadrats 1,4,5, and 8 (see *Figure 1*). The maximum exposure time to which equation (1) was fit along with the fraction of the sampling area which had delaminated at this time (termed maximum degradation in *Table 1*) are tabulated in *Table 1*.

Delamination of the continuous wet immersed panels is consistent with a cathodic delamination failure mechanism, which has been well elucidated by Leidheiser, Wang, and Igetoft,⁶ Leidheiser, Igetoft, Wang, and Weber,⁷ Dickie, Hammond, and Holubka,⁸ Ritter and Rodriguez,⁹ Funke,¹⁰ and Leidheiser.¹¹ For cathodic delamination to occur, water, ions, and oxygen must be present at the steel surface by either permeating through the bulk coating system or through the coating/substrate interface via a defect. Then an electrochemical corrosion cell can be created in which iron dissolves at the anode



and oxygen is reduced at the cathode



The cathodic reaction produces hydroxyl anions which locally increase the pH of the electrolyte in the cathodic region to a value of approximately 14,¹²⁻¹⁵ causing delamination of the coating from the substrate.^{11,16-24} In order for reaction (2b) to proceed, however, cations must be transported to the cathodic region to neutralize the electric charge of the hydroxyl anions produced by the cathodic reaction. Cations can be transported to the cathode either through the bulk coating or through the coating/substrate interface. When a potential gradient is not applied, it is generally accepted that the primary mode of transport for cations is through pathways along the coating/substrate interface.²⁵ Pathways are formed by the displacement of the polar bonds between the coating and substrate with water^{6,10,26-28}; in the absence of an applied electrical potential, formation of these pathways and the transport of cations is believed to be the rate limiting step in cathodic delamination.^{21,25} As the number of monolayers of water increases, the wet-adhesive strength of the coating to the steel decreases and the rate of cation transport increases,^{19,29} thereby increasing the rate of delamination.^{19,29,30} In our case, delamination increased exponentially with time, that is, it obeyed equation (1) (see also Watts and Castle³¹); whereas, under an applied electrical potential, delamination often appears to increase linearly with time after an observed delay time.^{7,11,32-34}

CYCLIC IMMERSION: Plots of the percent area degraded vs time are presented in *Figure 6* for the 23 panels subjected to cyclic wet-dry immersion. Two different and apparently independent age onset failure modes were observed in these panels. The first, early age onset failure

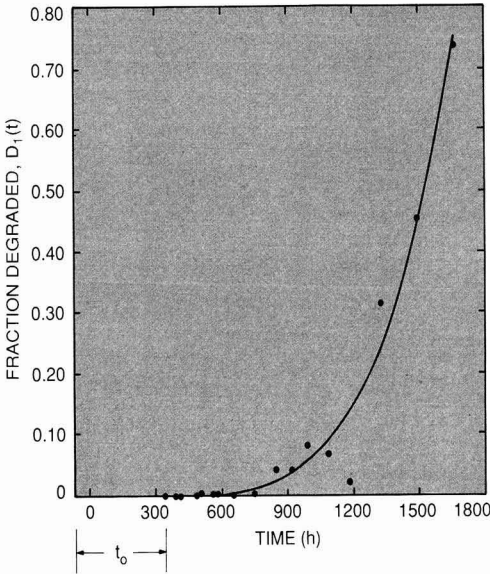


Figure 5—Fit of equation (1) to the delamination of a continuous wet immersed panel (panel 15 in Table 1). Induction time, t_0 , is also shown

mode (mode I) centered around and emanated from the scribe and was marked by corrosion creep, also called scab corrosion, underrusting, and rust creepage^{2,12} (see Figure 4b). The second, late onset failure mode (mode II) was a rapid, catastrophic failure mode (possibly caused by film hydrolysis³⁵) and was marked by film embrittlement, cracking, and corrosion initiation occurring at random locations over the surface of the film and at distances far removed from the scribe (see Figure 4c).

For individual cyclic wet-dry immersed panels, degradation increased linearly with time for both failure modes; i.e., degradation could be adequately modeled by

$$D(t) = \begin{cases} a_1 + b_1t & \text{for } T < t_{int} \\ a_2 + b_2t & \text{for } T > t_{int} \end{cases} \quad (3)$$

where

$D(t)$ is the fraction of the total sampling area which degraded by time t ;

t_{int} is the time intersection for failure modes I and II; and a_1 and b_1 are coefficients.

A typical fit of equation (3) to panel delamination is shown in Figure 7. Coefficients of the two models along with their squared correlation coefficients are tabulated in Table 2 for all 23 panels.

The degradation sequence for the cyclic immersed panels was as follows. For failure mode I, small cathodic blisters first appeared adjacent to and along the perimeter of the scribe at approximately 500 hr. Unlike the continuous wet immersed panels, however, these blisters did not significantly grow in size, presumably because an aqueous layer of sufficient thickness to transport cations was not formed at the coating/substrate interface, due to the shortness of the immersion time. Also, unlike the con-

tinuous wet immersed panels, a corrosion cap was not formed over the scribe. Instead, a scab-like, amorphous growth of corrosion products exuded from the scribe having morphological characteristics which would occur if the bulk electrolyte always had direct access to the coating/substrate interface.

During the drying period, the cathodic blisters disappeared and either reappeared or became occupied by corrosion products when the panels were reimmersed. It is postulated that corrosion occurs as a result of a mechanism similar to that proposed by Whitely, et al.,¹⁷ Gay,³⁵ Wiggle, et al,¹² and Funke¹⁰ in which the neutral, bulk electrolyte gains access to the formerly blistered area. This may occur as a result of high shear stresses^{36,37} which are known to occur next to a film discontinuity when a coating film is dried. Once neutral electrolyte gains access to formerly blistered areas, these areas begin to corrode. With the formation of corrosion products, the cathode is relocated to a position adjacent to the leading edge of the corrosion front where oxygen is more plentiful. With continued cyclic wet-dry immersion, new cathodic blisters form at these cathodic sites and as before, these blistered areas eventually become corroded.

The second, late onset failure mode (mode II) initially appeared at approximately 2000 hr. This mode of failure was quite different from failure mode I in that degradation occurred at random locations over the surface of the film and was marked by film embrittlement, film cracking, and corrosion initiation. Failure mode II was also a highly linear degradation process having a rate which was much greater than that observed for failure mode I (compare b_1 and b_2 in Table 2); thus, once the onset of failure mode II occurred, it dominated degradation. The time of onset of failure mode II was highly variable (the intercept points in Table 2) and, by analysis of variance, was weakly sensitive to changes in the thickness of the primer (i.e., the thinner the primer, the earlier the onset), but not the topcoat.

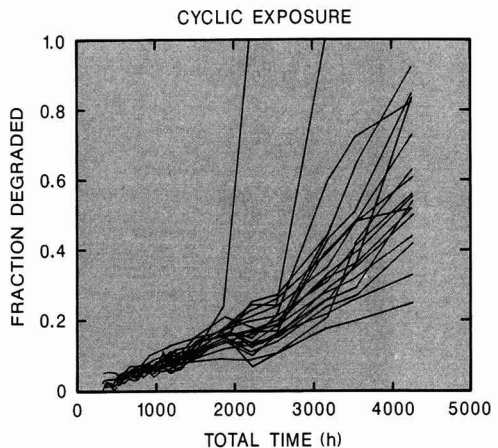
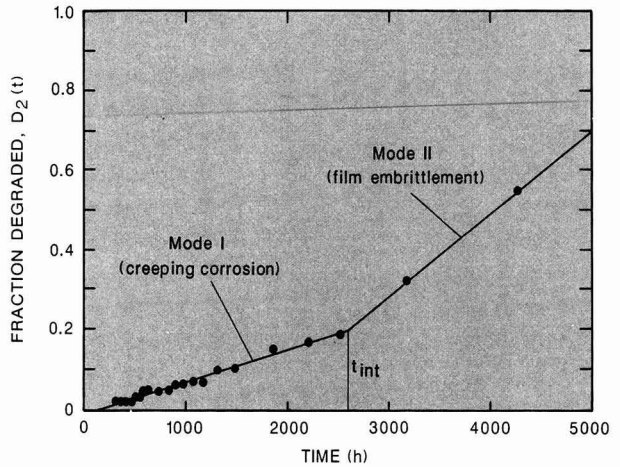


Figure 6—Plot of fraction degraded vs time for the 23 cyclic wet-dry immersed panels. Each line in the graph corresponds to the degradation of a panel

Figure 7—Typical fit of mode I and II linear degradation models to a cyclic wet-dry immersed panel (panel 12 in Table 2). The intersection time, t_{int} , of the two failure modes is shown



Severity of Continuous Wet and Cyclic Wet-Dry Immersion Results

From Figures 3 and 5, it is obvious that great within-treatment variability exists in the degradation of individual panels for both the continuous wet and cyclic wet-dry immersed exposures. Due to this high variability, the severity of the two exposures can not be assessed by examining the performance of individual panels, but must be assessed by comparing the time-to-failure distributions for the two exposures. Since the time-to-failure distributions are seldom normally distributed, specialized com-

parison procedures which do not depend on the normal assumption were used. These analysis procedures are detailed in Appendix A and summarized here.

The analysis begins by defining a critical performance level, δ_c , beyond which a panel is said to have failed. Once defined, the time-to-failure for each panel is computed for both continuous wet and cyclic wet-dry immersed panels using equations (1) and (2), respectively. These computed times-to-failure form a sample time-to-failure distribution to which a theoretical time-to-failure distribution $F_k(t)$ (where $k = 1$ for continuous wet immersion or $k = 2$ for cyclic wet-dry immersion), is fit. Here,

Table 2—Coefficients and Squared Correlation Coefficient, r^2 , for the 23 Panels Which Were Subjected to Cyclic Wet-Dry Immersion and Fitted to the Two Linear Models in Equation (3)

Panel #	a_1	b_1	r^2	a_2	b_2	r^2	t_{int}
1	-0.0068	0.00008	0.96	-0.940	0.0035	1.00 ^a	3420
2	-0.0077	0.00008	0.93	-3.850	0.0022	1.00 ^a	1830
3	0.0062	0.00005	0.71	-0.964	0.0004	0.96	2925
4	-0.0174	0.00009	0.98	-0.413	0.0002	1.00 ^a	2950
5	-0.0109	0.00008	0.98	-0.358	0.0002	0.99	2625
6	-0.0229	0.00008	0.98	-0.932	0.0004	0.99	2560
7	-0.0079	0.00007	0.94	-0.825	0.0004	0.87	2715
8	-0.0496	0.00012	0.92	-1.539	0.0007	0.94	2570
9	-0.0190	0.00010	0.99	-0.372	0.0002	0.96	2750
10	-0.0342	0.00011	0.98	-2.725	0.0012	1.00 ^a	2550
11	-0.0268	0.00009	0.93	na ^b	na	na	na
12	0.0062	0.00006	0.88	-0.347	0.0002	1.00	2560
13	0.0155	0.00006	0.87	-0.597	0.0004	0.89	2140
14	-0.0276	0.00010	0.97	na	na	na	na
15	-0.0256	0.00009	0.96	-0.302	0.0002	0.97	2800
16	-0.0172	0.00008	0.97	-0.864	0.0004	0.98	2660
17	-0.0152	0.00007	0.91	-1.590	0.0006	0.97	3190
18	-0.0097	0.00007	0.94	na	na	na	na
19	-0.0002	0.00005	0.95	na	na	na	na
20	-0.0257	0.00009	0.93	na	na	na	na
21	-0.0052	0.00009	0.87	0.074	0.0001	0.88	2000
22	-0.0133	0.00010	0.99	-0.647	0.0003	1.00	2900
23	-0.0229	0.00008	0.98	na	na	na	na

(a) Only two data points available for fitting the regression line.
 (b) Failure mode II not observed.

we assume that the times-to-failure were Weibull distributed [see equation (8) in Appendix A]. In general, the Weibull distribution fit the time-to-failure data rather well (see Figure 8) except for the continuous wet immersed panels at the high critical performance levels, $\delta_c = 0.2, 0.3,$ and $0.4,$ where it fit the time-to-failure data rather conservatively, i.e., the Weibull distribution predicts a higher probability of failure than is actually observed for the early times-to-failure.

The severity of one exposure relative to that of another can be assessed by comparing the time-to-failure distributions of the two exposures at any given critical performance level, $\delta_c,$ where exposure condition j is said to be more severe than exposure conditions $i,$ if and only if, for all $t > 0$

$$F_i(t) < F_j(t) \tag{4}$$

In other words, for any time $t,$ exposure condition j is said to be more severe than exposure condition $i,$ if the probability of failure from exposure j is always greater than that from exposure condition $i.$

In this experiment, the relative severity of the two exposures was analyzed and compared at four critical performance levels $\delta_c = 0.1, 0.2, 0.3,$ and $0.4,$ where δ_c is the fraction of the sampling area that has degraded. The parameters of the Weibull time-to-failure distributions are tabulated in Table 3 and are plotted in Figure 8. In all cases, the time-to-failure distribution for panels exposed to continuous wet immersion fell to the left of the time-to-failure distribution for cyclic immersion, indicating that for the two conditions studied, continuous wet immersion is the more severe exposure. These results are consistent with those reported by other researchers.^{2,38,39}

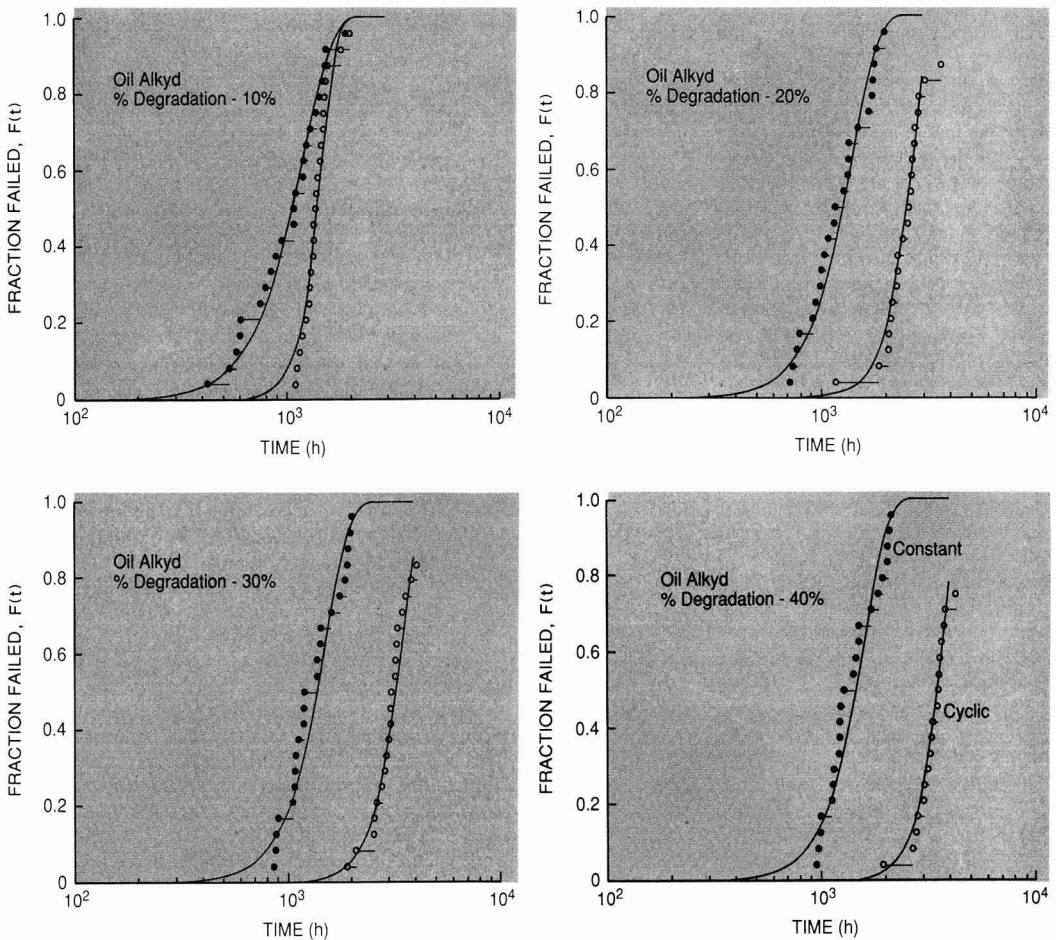


Figure 8—Comparison of time-to-failure distributions for continuous wet [symbol ●] and cyclic wet-dry immersed panels [symbol ○] at four critical performance levels, $\delta_c = 10, 20, 30,$ and 40%

Table 3—Weibull Time-to-Failure Parameters^a for Both the Continuous Wet and Cyclic Wet-Dry Exposures

Exposure Condition	Critical Perf. Lev. δ_c	#Panels on Test n	#Observed Failures r	Weibull Scale β	Weibull Shape α
continuous	0.1	23	23	1205.0	3.07
	0.2	23	23	1403.8	3.60
	0.3	23	23	1522.5	3.82
	0.4	23	23	1609.1	3.92
cyclic	0.1	23	23	1505.1	6.22
	0.2	23	21	2678.1	5.48
	0.3	23	20	3523.2	5.08
	0.4	23	18	3730.0	5.88

(a) See equation (8).

Discussion of Continuous Wet and Cyclic Wet-Dry Immersion Results

From the sequence of events expressed in the previous sections of this paper, it may be deduced that, even though the apparent modes of failure for continuous wet and cyclic wet-dry exposures are quite different, the underlying failure mechanism (cathodic delamination) controlling the rate of degradation in both exposures is the same. The reasoning behind this deduction follows.

Both the continuous wet and cyclic wet-dry immersed panels were exposed to identical experimental conditions except for their respective exposure cycles. At least initially, the panels appeared to degrade in the same way, i.e., corrosion at the scribe followed by the formation of small cathodic blisters adjacent to and along the scribe. With increased exposure, however, blisters on the continuous wet immersed panels tended to coalesce and grow in size until they covered the entire sampling area; whereas, blisters on the cyclic wet-dry immersed panels did not grow. Thus, for the experimental conditions studied, blister formation was always the precursor of corrosion.

From these observations and prior to the onset of film embrittlement and film cracking (which occurred at exposure times greater than 2000 hr in the cyclic wet-dry immersion experiment), we conclude that (1) continuous immersion can be viewed as a special case of cyclic wet-dry immersion in which the wet period is of infinite duration; (2) the formation and progressive advance of corrosion oxides during the cyclic wet-dry immersion does not greatly affect the rate of degradation of the cyclic wet-dry panels, since the rate of degradation is controlled by the rate of cathodic delamination; and (3) it should be possible to create a wide range of failure modes and rates of degradation by varying the length of the wet and dry periods in which the most severe exposure would be continuous wet immersion and the least severe exposure would be continuous dry.

This scenario is somewhat complicated by the advent of film embrittlement, however, which has been identified as the precursor of failure mode II. Film embrittlement was not only observed on panels exposed to cyclic wet-dry immersion, but also on panels exposed to continuous wet immersion. The continuous wet immersed

panels did not degrade by failure mode II, however, either because the panels failed by delamination prior to the onset of failure mode II or a drying period was needed to produce internal stresses of sufficient magnitude to cause film cracking. Aging by film embrittlement complicates our ability to transform the continuous immersion results to cyclic wet-dry immersion, because it seems possible to design a cyclic wet-dry experiment (and for that matter, identify an analogous outdoor exposure environment) in which failure mode II is the only observed failure mode. Conceptually, such an exposure environment would involve a cycle in which the wet period is of very short duration and the dry period is of long duration, thus preventing the formation of an aqueous layer at the coating/substrate interface, yet allowing film embrittlement processes to continue. Compared to continuous wet immersion, however, degradation from this wet-dry cycle should be very slow.

SUMMARY AND CONCLUSION

Two identical sets of oil-alkyd coated panels, all containing scribe marks, were exposed to either continuous wet immersion or a cyclic wet-dry immersion in a 5% NaCl solution in which the oxygen concentration, salt concentration, electrolyte temperature and pH were frequently monitored and controlled. From our results, we conclude that for the experimental oil-alkyd coating system:

(1) Prior to the onset of film embrittlement, continuous wet immersion is a more severe exposure than a wet-dry immersion cycle in which the half cycle for the wet and dry exposures is of 12 hr duration.

(2) Although panels exposed to the two exposure conditions appeared to fail by different failure modes, the underlying failure mechanisms are believed to be identical—cathodic delamination. For this reason, continuous wet immersion appears to be a limiting case of cyclic wet-dry immersion.

(3) The apparent mode of failure in the cyclic wet-dry immersed specimens was by corrosion creep. However, the progressive advance of corrosion does not appear to greatly affect the rate of cathodic delamination. Hence, the production of corrosion oxides does not appear to control the rate of degradation of the cyclic immersed panels.

(4) For the cyclic wet-dry immersed panels, a second failure mode (failure mode II) was observed after about 2000 hr of wet-dry immersion. This failure mode was marked by film embrittlement, cracking, and corrosion initiation at large distances from the scribe (that is, failure mode II appeared to be independent of failure mode I). Once failure mode II began, it dominated the rate of degradation of the cyclic wet-dry panels.

ACKNOWLEDGMENTS

Funding for this project was provided by the Naval Civil Engineering Laboratory, NCEL, at Port Hueneme, CA. The authors would like to thank Dan Zarrate of

NCEL for his help and support throughout this research. The authors would also like to thank Jack Lee and John Winpiger for their technical support and Larry Kaetzel for computer graphical support.

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Appendix A: Determination of the Relative Severity of Two Treatments

The failure of a coating system is seldom a well-defined catastrophic event; instead, the coating system progressively degrades over time until it reaches a critical performance level, δ_c , beyond which it is said to have failed. This critical limit is user defined; for example, a typical failure criterion for corrosion based on current practice is an ASTM D610 visual grade of 7.

Once the critical performance level, δ_c , has been defined, the random time-to-failure, T'_{jk} for a panel exposed to either the continuous wet or cyclic wet-dry immersion can be computed by solving for t'_{jk} in

$$t'_{jk} = D_{jk}^{-1}(\delta_c) \quad (5)$$

where

$D_{jk}(t)$ is the fraction of the total sampling area of panel $j = 1, 2, \dots, n$, which has degraded for panels subjected to exposure condition k .

For continuous wet immersed panels, $k=1$ and $D_{jk}(t)$ is given by equation (5), while for the cyclic wet-dry panels, $k=2$ and $D_{jk}(t)$ is given by equation (6). Computation of the time-to-failure for a panel from equation (5) involves solving for its positive root using, for example, a Newton numerical analysis procedure.⁴⁰ Computation of the time-to-failure for a panel from equation (6) is straightforward.

These random times-to-failure are then ranked in ascending order such that

$$\tau_1 \leq \tau_2 \leq \dots \leq \tau_r \quad \text{for } r \leq n \quad (6)$$

where τ_i is the i -th ordered time-to-failure, r is the number of observed failures, n is the total number of panels placed on test (for both exposures, $n=23$), and when $r \leq n$ the sample is said

to be censored. From these ordered times-to-failure, a time-to-failure distribution, $F_k(t)$, is created such that

$$F_k(t) = P(T < t) \quad (7)$$

where

$P(\cdot)$ is the probability of the event within the parentheses and $F_k(t)$ is the time-to-failure distribution for exposure condition k and is assumed to have a Weibull distribution; that is,

$$F_k(t) = 1 - \exp(-(t/\beta_k)^{\alpha_k}) \quad (8)$$

where

α_k and β_k are the Weibull shape and scale parameters, respectively, and subscript k indicates exposure condition.

Justification for the selection of the Weibull distribution is given by Cohen.⁴¹ Estimates for α_k and β_k can be obtained for both complete and censored samples using maximum likelihood estimation techniques.⁴²

The relative severity of the two exposure conditions can be assessed in several ways. Here, we compare the time-to-failure distributions for the two exposures. (Other inferences for comparing the relative severity of two treatments are outlined in Lawless,⁴³ Chap. 4). Exposure condition j is said to be more severe than exposure i if and only if for all $t > 0$

$$F_i(t) < F_j(t) \quad (9)$$

where

$i = 1$ or 2 and j is not equal to i .

For example, if continuous wet immersion ($k=1$) is more severe than cyclic wet-dry immersion ($k=2$), then $F_2(t) < F_1(t)$ for all $t > 0$.

Calculating Technique for Formulating Hydroxyl Terminated Polyesters Based on Blends of Polyols and Polyacids

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A formulating technique is presented for the general case of saturated polyester resins terminated with hydroxyl groups, based on blends of polyols with a functionality of 2, 3, or 4 and polyacids with a functionality of 2 or 3.

The derived expressions make it possible to calculate resin compositions as a function of number average molecular mass, the desired acid value at the end of the esterification, the percentage of free hydroxyl groups available for further crosslinking reactions, and the mole ratio between the branching components.

The equations are very suitable for combining in a computer program with those based on the work of Flory, Stockmayer, Gordon, and Miller and Macosco, and by which a prediction of the gel point can be made. Using a simple iteration technique, the gel point distance can be given initially as an independent variable, thus making this method an efficient tool for the resin chemist in experimental work.

INTRODUCTION

The calculation of a formulation is the first step in the process of creating a new polyester resin. In the case of linear polymerization, it is not necessary to have a special calculating technique to begin the experimental work. When the used materials together have a functionality higher than two and certain functional groups (mostly carboxyl and hydroxyl) have to be introduced in the polyester, the situation is more complicated and a good meth-

od for calculating the right batch composition is of real importance.

Nonlinear polymerization has been a matter of interest for more than 50 years. Carothers published his theory of gelation in 1936,¹ at a time when there was no common distinction between different molecular mass averages. Although his theory suffers from serious errors (of course, one has to take into consideration the state of the polymer science in that very early period), it was the basis for the method most used to calculate formulations of alkyd resins.² From the late 1940s until the beginning of the 1960s, many different methods of formulating alkyd resins were published.²⁻¹¹

Flory and Stockmayer^{12,13} derived the basic relations between the extent of the reaction and the resulting structure of the nonlinear polymer with considerable agreement between the theoretical predictions and experimental results. Later, Jonaston extended Flory's theory to include the alkyd resins having phthalic anhydride as dibasic acid and taking into account the difference in reactivity between both carboxyl groups.¹⁴

Gordon,^{15,16} using a theory of stochastic branching processes with cascade substitution which involves abstract mathematics often unfamiliar to the polymer chemist, has derived expressions which can predict both pre- and postgel structures depending on the monomer ratio at the beginning. An extension of this method to a three-stage process of network formation was recently published.¹⁷ Finally, Macosco and Miller, starting with elementary probability and utilizing the recursive nature of network formation, developed simpler equations for predicting M_n and M_w .¹⁸

The problem the resin chemist faces in practice can be expressed with formal mathematical language, as follows:

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Resin Composition = f (Final Coating Properties)

Of course, this is not likely to be realized in the near future. Therefore, resin chemists are quite satisfied with expressions giving correlations between typical resin parameters and the resin composition which, in a case of alkyds and polyesters, leads to:

$$\text{Resin Composition} = f(L, M_n, M_w, AV, HV, P_g)$$

where the abbreviations correspond to oil length, number average molecular mass, mass average molecular mass, acid value, hydroxyl value, and the extent of the reaction at the gel point, respectively.

Unfortunately, the expressions derived by Flory, Stockmayer, Jonaston, Gordon, and Macosco and Miller deal with the prediction of the gel point, number average, and mass average molecular mass for the already given resin composition. In other words, the relations between resin parameters and resin composition are not given explicitly. For this reason, resin chemists have developed practical methods for calculating resin formulations. Although, in many cases, these methods are not published and do not leave the authors' laboratories, there are also a considerable number of published articles and monographs concerning this matter.^{2-11, 19-25}

The calculation technique presented in this article refers to the general case of saturated polyesters terminated with hydroxyl groups based on blends of polyols with a functionality of 2, 3, or 4, and polyacids with a functionality of 2 or 3. Resin parameters as independent variables are the number average molecular mass, the percentage of free hydroxyl groups, the acid value at the end of the esterification, and the ratio between the branching monomers.

DERIVATION OF THE METHOD

The method begins with a resin composition of N_{p2} , N_{p3} and N_{p4} moles of diol, triol, and tetraol, and N_{a2} and N_{a3} moles of diacid and triacid. The polyacids can be also in the form of anhydrides. The sum of moles of polyacids is indicated with x and their molar ratio with y :

$$N_{a2} + N_{a3} = x \tag{1}$$

$$N_{a3}/N_{a2} = y \tag{2}$$

This results in:

$$N_{a2} = x/(1+y) \tag{3}$$

$$N_{a3} = xy/(1+y) \tag{4}$$

It can be shown that the most suitable composition of molecular mass distribution is to be expected when the moles of the starting materials in the resin formulation fulfill the following condition:

$$\sum N_{pi} = N_{a2} + 2N_{a3} + 1 \tag{5}$$

On the other hand:

$$\sum N_{pi} = N_{p2} + N_{p3} + N_{p4} \tag{6}$$

The substitution of equations (3) and (4) in equations (5) and (6) gives:

$$\sum N_{pi} = xb + 1 \tag{7}$$

where:

$$b = (1+2y)/(1+y) \tag{8}$$

Three new terms which represent the molar ratios between the branching components can be defined:

$$Z_3 = N_{p3}/N_{p2} \tag{9}$$

$$Z_4 = N_{p4}/N_{p2} \tag{10}$$

$$Z = N_{p4}/N_{p3} \tag{11}$$

The combination with equation (7) gives:

$$N_{p2} = (xb + 1)/(1 + Z_3 + Z_4) \tag{12}$$

$$N_{p3} = Z_3(xb + 1)/(1 + Z_3 + Z_4) \tag{13}$$

$$N_{p4} = Z_4(xb + 1)/(1 + Z_3 + Z_4) \tag{14}$$

Knowing the values for x , y , Z_3 , and Z_4 , equations (3), (4), and (12)-(14) can be used for calculating the number of moles of the constituents in the resin formulation.

If one assumes an esterification reaction during the buildup of the polyester without ring formation, M_n can be calculated, keeping in mind that the number of molecules at a certain time after starting the esterification is the original number less the number of the new bonds formed, which means:

$$\text{No. molecules} = \sum N_{pi} + \sum N_{ai} - Pa(2N_{a2} + 3N_{a3}) \tag{15}$$

On the other hand, the total weight of the polyester at any stage of the reaction can be calculated, subtracting the amount of esterification water from the weight of the materials at the beginning of the reaction:

$$\text{Total weight} = \sum N_{pi}M_{pi} + \sum N_{ai}M_{ai} - Pa(a_2N_{a2} + a_3N_{a3}) \tag{16}$$

where Pa is the extent of the reaction expressed via the carboxyl groups. The constants a_2 and a_3 represent the amount of water which comes as a result of esterification of one mole of diacid (or anhydride of diacid) and triacid (or anhydride of triacid), respectively. Therefore, $a_2 = 36$ and $a_3 = 54$ when the used polyacids are in acid form, or $a_2 = 18$ and $a_3 = 36$ when they are in the form of anhydrides.

Consequently, the number average molecular mass can be calculated according to the following equation:

$$M_n = \frac{\sum N_{pi}M_{pi} + \sum N_{ai}M_{ai} - Pa(a_2N_{a2} + a_3N_{a3})}{\sum N_{pi} + \sum N_{ai} - Pa(2N_{a2} + 3N_{a3})} \tag{17}$$

The amount of free hydroxyl groups available for crosslinking during the curing of the coating where the polyester is used as binder usually is expressed through the hydroxyl value of the polyester or through the percentage of free hydroxyl groups. The mutual dependence between these two terms comes as a result of the definition of the hydroxyl number and can be described by the following expression:

$$HV = \frac{56100 \cdot H}{17 \cdot 100} = 33 \cdot H \tag{18}$$

where:

HV = hydroxyl number of the polyester (in mg KOH/g)
H = percentage of free hydroxyl groups in the polyester

It is easy to calculate the percentage of free hydroxyl groups at given extent of the reaction Pa , and therefore, because of practical reasons, this term will be used in the equations which follow.

The weight of the free hydroxyl groups (molecular weight 17) for given extent of the reaction can be expressed as:

$$\text{OH weight} = 17 \cdot (\sum iN_{pi} - Pa \sum iN_{ai}) \tag{19}$$

Knowing the total weight of the resin [equation (16)], the percentage of free hydroxyl groups can be calculated according to equation (20):

$$H = \frac{1700(\sum iN_{pi} - Pa\sum iN_{ai})}{\sum N_{pi}M_{pi} + \sum N_{ai}M_{ai} - Pa(a_2N_{a2} + a_3N_{a3})} \quad (20)$$

As during the resin preparation, the determination of the acid value is the most commonly used method to follow the reaction (as it is also a rule to use acid value in the resin specification), it will be more convenient from a practical point of view to have the acid value in the derived expression instead of Pa. Equation (21), which permits calculation of the acid value (A) of the resin for a given extent of the reaction Pa, comes from the definition of the acid value as milligrams KOH necessary for neutralization of one gram of resin containing carboxyl groups:

$$A = \frac{56100(1 - Pa)\sum iN_{ai}}{\sum N_{pi}M_{pi} + \sum N_{ai}M_{ai} - Pa(a_2N_{a2} + a_3N_{a3})} \quad (21)$$

or after appropriate substitutions for N_{p2} , N_{p3} , N_{p4} , N_{a2} , N_{a3} , and solution for Pa:

$$Pa = \frac{A[Q(1+y)(xb+1) + sx(M_{a2} + yM_{a3})] - 56100xs(2+3y)}{xs[A(a_2 + y_{a3}) - 56100(2+3y)]} \quad (22)$$

The value of Pa can be substituted in equations (17) and (20), giving:

$$x = \frac{(1+y)[Q(1-AV) - sM_n]}{SD - bQ(1+y)(1-AV)} \quad (23)$$

and:

$$x = \frac{(1+y)[1700t - Q(H+RA)]}{b(1+y)[Q(H+RA) - 1700t] + SE} \quad (24)$$

where:

$$Q = M_{p2} + Z_3M_{p3} + Z_4M_{p4} \quad (25)$$

$$S = 1 + Z_3 + Z_4 \quad (26)$$

$$t = 2 + 3Z_3 + 4Z_4 \quad (27)$$

$$V = \frac{a_2 + y_{a3} - M_n(2+3y)}{A(a_2 + y_{a3}) - 56100(2+3y)} \quad (28)$$

$$R = \frac{1700(2+3y) - H(a_2 + y_{a3})}{A(a_2 + y_{a3}) - 56100(2+3y)} \quad (29)$$

$$D = (M_{a2} + yM_{a3})(AV - 1) - 56100(2+3y) + M_n(1+y)(1+b) \quad (30)$$

$$E = R[A(M_{a2} + yM_{a3}) - 56100(2+3y)] + H(M_{a2} + yM_{a3}) \quad (31)$$

The comparison of equations (23) and (24) eliminates x and gives the following solution for Z_3 :

$$Z_3 = \frac{M_nE - 2L1 - LM_{p2}}{L(M_{p3} + ZM_{p4}) + L1(3+4Z) - M_nE(1+Z)} \quad (32)$$

where:

$$L = E(1 - AV) - (H + RA)[M_n(1 + 2y) - D] \quad (33)$$

$$L1 = 1700[M_n(1 + 2y) - D] \quad (34)$$

Equation (32) can be used to determine the interval of possible values of M_n for given values of H and vice versa. In order to have a real physical meaning, Z_3 must be a positive number. This condition can be fulfilled in the following cases:

$$M_nE - 2L1 - LM_2 > 0 \quad (35)$$

$$L(M_3 + ZM_4) + L1(3 + 4Z) - M_nE(1 + Z) > 0 \quad (36)$$

or:

$$M_nE - 2L1 - LM_2 < 0 \quad (37)$$

$$L(M_3 + ZM_4) + L1(3 + 4Z) - M_nE(1 + Z) < 0 \quad (38)$$

The solution of this system of inequalities for the case when $Pa = 1$ has been published elsewhere.²⁰ In the case when $Pa < 1$, it is very difficult to find the solution of this system. Therefore, a numerical approach using a computer program is much better.

Once the interval of possible number average molecular masses for a given value of H has been determined (or the interval of possible values of H for given M_n), and the value of M_n has been chosen, Z_3 can be calculated from equation (32) and the substitution in (23) or (24) gives the value of x. Thus, all the elements for calculating the resin formulation for given values of M_n , H, A, Z, and y are available.

The free choice of Z and y enables one to calculate formulations with the same number average molecular masses, hydroxyl numbers, and acid numbers and a different degree of branching, thus adjusting the distance of the resin from the gel point, and at the same time the necessary degree of additional crosslinking during the curing of the coating in order to obtain network formation. This can be done by combining these expressions with those derived by Flory, Stockmayer, Gordon, or Macosco and Miller, according to which a prediction of the gelation of the system can be made. Equation (39) of Stockmayer¹³ which gives the relations between the extent of the reaction at the gel point and the composition of the coating, is very convenient for this purpose.

$$(PaPp)_{gel} = \frac{1}{(fe - 1)(ge - 1)} \quad (39)$$

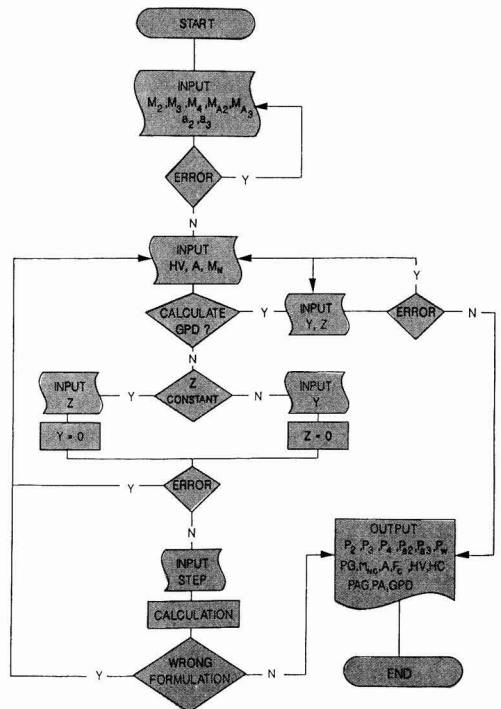


Figure 1—Computer program in flow chart form to carry out the gel point distance

where:

$$f_e = \frac{\sum i^2 N_{ai}}{\sum i N_{ai}} \quad (40)$$

$$g_e = \frac{\sum i^2 N_{pi}}{\sum i N_{pi}} \quad (41)$$

On the other hand, the relation between Pa and Pp is as follows:

$$P_p = \frac{Pa \sum i N_{ai}}{\sum i N_{pi}} \quad (42)$$

Substitution of equation (42) in equation (39) gives:

$$(Pa)_{gel} = \left[\frac{\sum i N_{pi}}{(f_e - 1)(g_e - 1) \sum i N_{ai}} \right]^{0.5} \quad (43)$$

The value of Pa at the given acid value can be calculated from equation (22). The ratio of Pa to (Pa)gel can be a measurement for the distance of the system from the gel point (GPD):

$$GPD = 1 - Pa/(Pa)_{gel} \quad (44)$$

When Pa = (Pa)gel then GPD = 0, which means that the resin will probably gel during cooking.

It is well known that predictions which are made according to the Stockmayer theory are rather pessimistic.²⁵ Practice shows that there is a discrepancy between the calculated and the experimental values for Pa at gelation of up to 20%.²⁶⁻²⁸ From a practical point of view, it is better to write equation (44) as follows:

$$GPD = K - Pa/(Pa)_{gel} \quad (45)$$

where the value of K has to be determined experimentally for the specific system. Once this has been done, it will be very convenient to use the set of equations presented in this paper for the calculation of formulations of saturated polyesters together with a prediction of the possibilities for gelation. Using a simple iteration technique, the gel point distance can be given at the beginning as an independent variable, thus making this method an efficient tool for the resin chemist to prepare experimental work. A simple computer program (Figure 1) is given in flow chart form to carry out these calculations very quickly.

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Effects of Silicon Incorporation on the Performance of Epoxy Derived Powder Coatings

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The silicon atom has been incorporated into several epoxy derived polymers via use of silicon-containing curing agents possessing a stable Si-C bond. Novel silicon-containing crosslinking agents of di-, tri-, and tetracarboxylic acids, acid anhydrides, and dianhydride constitute the preferred method of silicon incorporation. A number of silicon-containing, epoxy-based powder coatings have been formulated. The effect of the silicon, incorporated via a nonhydrolyzable silicon-carbon bond, on polymer properties was investigated through evaluation of electrical and corrosion resistance, gloss and gloss retention, and chalking resistance.

INTRODUCTION

The ever-increasing demand for low volatile organic compounds (VOC) coating compositions of long-term durability has prompted our investigation of silicon-containing powder coatings. The current state of the art regarding powder coating technology^{1,2} and its attendant advantages³⁻⁹ has been published and, accordingly, the future of powder coatings appears assured. Epoxy and epoxy-polyester powders currently account for 32% and 40%, respectively, of the annual powder coatings consumption. Their primary applications are for appliances, furniture, electrical equipment, and automotive parts.^{10,11} However, the deficiencies of epoxy powder coatings when used for outdoor applications include their

tendency to chalk and yellow and to exhibit poor color and gloss retention as well as weather resistance.

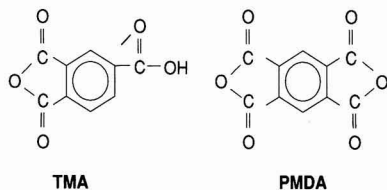
Traditionally, silicon-containing polymers have been recognized as offering outstanding properties including electrical,¹² corrosion, and weather resistance.¹³ However, incorporation of silicon into polymer compositions has more often than not involved the use of silicones and thus the incorporation of one or more Si-O bonds. Therefore, it was of interest to determine the influence of the silicon atom without the presence of the Si-O bond. The more hydrolytically stable and less studied Si-C bond was chosen as the method for silicon incorporation in this investigation and represents our continuing interest in silicon-carbon chemistry which began in 1971.^{14,15} This early work had as its thesis a means by which aqueous stable organosilicon-containing emulsions could be prepared. In the current study, we have extended our interest into powder coatings where novel silicon-containing crosslinking agents of diacid, acid anhydride, and dianhydride functionalities are being employed. A comparison of unique epoxy powder coatings with silicon-carbon bonds with conventional thermoplastic polyester and thermoset epoxy powder coatings has been effected. Particular attention has been given to flow and leveling, adhesion, electrical resistance, corrosion resistance, chalking resistance, gloss, gloss retention, and weather resistance.

Experimental Materials

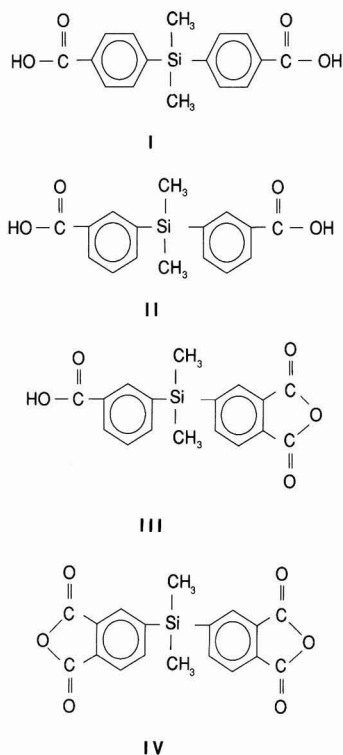
All resins, reagents, and additives—with the exception of the silicon-containing crosslinking agents—were used as received. The epoxy resin Epon® 2002 was obtained from Shell Chemical Co. The conventional crosslinking

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agents, trimellitic anhydride (TMA), pyromellitic dianhydride (PMDA), and terephthalic acid were purchased from Aldrich Chemical Co., Moda Flow®, Troykd defoamer® 262, and triphenyl phosphine were obtained from Monsanto, Troy Chemical, and Eastman Chemical Co., respectively. Titanium dioxide, Ti-Pure® CR-800, was obtained from the Du Pont Co.



The novel silicon-containing crosslinking agents, Bis-(p-carboxyphenyl)dimethylsilane (I), Bis-(m-carboxyphenyl)dimethylsilane (II) and Bis-(3,4-dicarboxyphenyl)dimethylsilane dianhydride (IV) were prepared in these laboratories.^{16,17} A silicon monomer somewhat similar to trimellitic anhydride, i.e., m-carboxyphenyl-3,4-anhydridephenyldimethylsilane (III) was prepared according to Scheme 1.



Preparation of m-Carboxyphenyl-3,4-anhydridephenyldimethylsilane (III)

One hundred grams of m-bromotoluene and 250 mL of anhydrous ether were charged into a one-liter, three neck flask equipped with a Tru-Bore stirrer, dropping funnel,

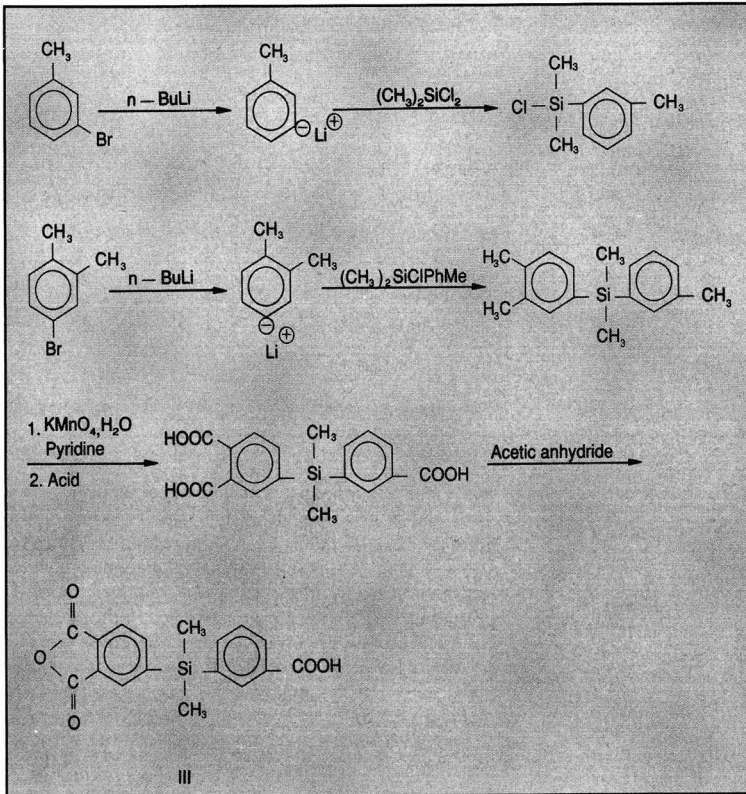
Table 1—Typical Powder Formulation

Resin selection:	Epon-2002
Crosslinking agent selections:	a: silicon-containing crosslinking agents
	b: conventional crosslinking agents
Pigment; Titanium dioxide:	20 phr
Moda Flow:	0.4 phr
Defoamer Troykd 262:	0.3 phr
Triphenyl Phosphine:	1.0 phr
Stoichiometry: crosslinker/epoxy resin ratio = 1.25	

ice bath, and nitrogen inlet. The solution was cooled to 0°C and n-butyllithium (315.80 mL; 0.60 mole) was added slowly. The mixture was subsequently stirred for three hours, at which time dimethyldichlorosilane (84.08 g) was added dropwise. The mixture was stirred for one hour at room temperature at which time the precipitated lithium chloride was removed by filtration, the ether was removed *in vacuo* and the residue distilled at 125-127°C/40mm Hg giving a 58% yield of m-tolyldimethylchlorosilane. In a similar manner, a metal halogen interconversion reaction was conducted with 4-bromo-o-xylene (92.54 g) and n-butyllithium (273.68 mL, 0.52 mole) at 0°C using 250 mL of anhydrous ether as the solvent. The mixture was stirred for five hours at which time m-tolyldimethylchlorosilane (96.10 g) was added dropwise. The resultant mixture was stirred over night at room temperature. The lithium chloride was then removed by filtration and the ether was removed *in vacuo*. Fractional distillation of the residue produced m-tolyl-3,4-dimethylphenyldimethylsilane which boiled at 140°C/0.35 mm Hg (58% yield). The oxidation reaction of m-tolyl-3,4-dimethylphenyldimethylsilane (25.44 g) with potassium permanganate (142.50 g) was carried out in 500 mL of refluxing aqueous pyridine. After five hours reaction time, the manganese dioxide was removed by filtration, the pyridine removed by evaporation, and the aqueous medium was neutralized with dilute hydrochloric acid. Recrystallization from acetic acid and hexane provided a 55% yield of m-carboxyphenyl-3,4-dicarboxyphenyldimethylsilane, melting at 160-170°C. Finally, the anhydride was formed by the reaction of m-carboxyphenyl-3,4-dicarboxyphenyldimethylsilane (10 g) in toluene with acetic anhydride (40 mL) for two hours at 100°C. The reaction mixture was

Table 2—General Test Methods

Substance	Test	ASTM Ref. No.
Spray Powders:	Gel time	D 3451
	Storage stability	Modified D 3451
Cured Coating:	Degree of cure	Shell Chemical test
	Flexibility	D 522
	Impact resistance	D 2794
	Adhesion	D 3359
	Hardness	D 2134
	Electrical resistance	D 149
	Corrosion (salt-fog)	B 117
	Solvent resistance	Immersion test
	Gloss	D 523
	Gloss retention	D 1006
	Chalking resistance	D 659 44



Scheme 1

filtered and the filtrate concentrated *in vacuo*. After crystallization of the residue from benzene and hexane, *m*-carboxy phenyl-3,4-anhydridephenyldimethylsilane (mp, 158-160°C) was obtained in 42% yield.

Powder Formulation

Powder coatings were formulated with epoxy resin Epon 2002, equivalent weight of 800, utilizing both conventional and silicon-containing crosslinking agents. A ratio of crosslinker to epoxy equivalents of 1.25 was maintained for all formulated coatings. Likewise, other formulating parameters were kept constant throughout the formulation of all powder coatings, thereby allowing the evaluation of the efficacy of silicon as an Si-C bond (Table 1). It is important to note that no antioxidants and/or UV absorbers were incorporated into any of the formulations studied.

Coatings Preparations

Individual powder batches were prepared by a melt compounding process using a two-roll mill. The cooled chips were pulverized in a fluid energy mill and sieved through 115, 200, and 325-mesh screens. The powder coatings were applied by electrostatic spray application onto 3 in. × 5 in. × 24 gauge Bonderite™ 37 (Parker Chemical Co.) cold rolled steel panels. The coated panels

were cured at 450°F for 30 minutes. Coating thickness ranged between 2.2 and 2.6 mills.

Performance Evaluation

The test methods for evaluation of the coatings are listed in Table 2. The storage stability was measured by gel time as determined after six months of storage at room temperature. The flow characteristics of the powders were observed during the cure process. The degree of cure was determined by the MEK double rub test. Salt spray evaluations were performed according to ASTM B-117 method for a period of 1000 hours. The substantial effects of silicon incorporation on gel time, flow, cure, flexibility, impact, electrical, and corrosion resistance, gloss and gloss retention, chalking, and weather resistance were noteworthy and are reported in Tables 3-10 and described by photomicrographs 1 and 2 (Figure 1).

RESULT AND DISCUSSION

Novel silicon-containing crosslinking agents, **I**, **II**, **III**, and **IV** were synthesized and incorporated into standard powder coating formulation(s), No. 2, 3, 5, 6, and 8. The resultant coatings were compared to those prepared from conventional curing agents such as TMA, PMDA, and terephthalic acid; powders No. 1, 4, and 7. Powders No. 9 and 10 were control formulations of the epoxide and polyester types, respectively.

Table 3—Gel Time, Storage Stability, Film Flow, and Appearance

Powder Coating No.	Crosslinking Agents	Gel Time (sec) at 232°C		Film Flow	Coatings Appearance ^a
		Initial	After Six Months		
1	Terephthalic acid	16	12	good	fair
2	I ^b p-si-diacid	18	16	excellent	uniform
3	II ^b m-si-diacid	18	17	excellent	uniform
4	TMA	15	5	fair	fair
5	III ^b si-acid/Anhy	10	8	excellent	uniform
6	IV ^b si-diAnhy	5	4	good	good
7	TMA/PMDA	5	2	fair	fair
8	TMA/IV ^b si-diAnhy	7	6	good	good
9 ^c	—	25	20	excellent	uniform
10 ^c	—	—	—	good	good

(a) fair = some orange peel; good = little orange peel; and uniform = no orange peel.

(b) Silicon-containing crosslinking agents.

(c) Powders #9 and 10 are Shell Epoxy and Eastman polyester, respectively.

Properties

Gel time, storage stability, film flow, and coating appearance are summarized in *Table 3*. Gel time was affected primarily by: (1) the crosslinking density and (2) the nature of the crosslinking agents. Powder coatings No. 4, 5, 6, 7, and 8 were formulated with curing agents of high crosslink density potential and possess shorter gel times compared to those of lower crosslink density coatings No. 1, 2, and 3. When the silicon-containing powder coating (No. 5) of anhydride functionality is compared with its nonsilicon-containing counterpart (No. 4), it is clear that the silicon-containing powder is significantly more reactive. This correlation does not hold, however, with formulations No. 1 and 2 containing acid functionalities.

It was also noted that the commercial epoxy powder formulation No. 9 had the longest gel time. Furthermore, the gel times for the silicon powders, No. 2, 3, 5, 6, and 8 are more consistent after storage than are the nonsilicon powders. This may be due to the characteristic moisture resistance¹⁸ engendered by silicon.

The formation of a uniform, orange peel-free coating is an important performance criteria and the silicon-containing powders are superior in this regard. For the conventional powders (*Table 3*), longer gel times (No. 9) represent superior flow properties and coating appearance

when compared to those with shorter gel times, i.e., No. 1, 4, and 7. However, when comparisons of coatings of shorter gel times are made, those containing silicon (No. 5 and 8) possess superior flow, leveling, and appearance when compared to the nonsilicon-containing powders (No. 4 and 7). These data strongly support the thesis that the presence of silicon-containing molecules provides better surface active properties,¹⁸ reduces surface tension and melt viscosity and, to some extent, assists in the displacement of air and/or vapor from between the powder particles.

Degree of Cure Study

Cure studies have confirmed (*Table 4*) that 232°C for less than 30 minutes is insufficient to build an optimum molecular weight or crosslink density. However, increasing the curing time to 30 minutes optimizes solvent resistance as measured by MEK double rubs. Comparison of the MEK double rubs of powders No. 4 and 5 cured at 232°C for 5 and 15 minutes confirms the superior solvent resistance of silicon-containing powder coatings. For instance, at no time after the first five minutes of cure is the conventional coating (No. 4) equal in solvent resistance to that containing silicon (No. 5).

Table 4—Degree of Cure Study

Cure Time/Temperature (°C)	MEK Double Rub Test				
	Powder Coating No.				
	4	2 ^a	3 ^a	5 ^a	6 ^a
5 min/178	10	—	—	—	—
15 min/178	17	—	—	—	—
30 min/178	25	—	—	—	—
2 min/206	20	—	—	—	—
5 min/206	42	30	—	—	—
2 min/232	28	20	—	—	—
5 min/232	56	42	58	65	68
15 min/232	80	64	85	100	85
30 min/232	100	100	>100	>100	>100

(a) Denotes silicon-containing powder coatings.

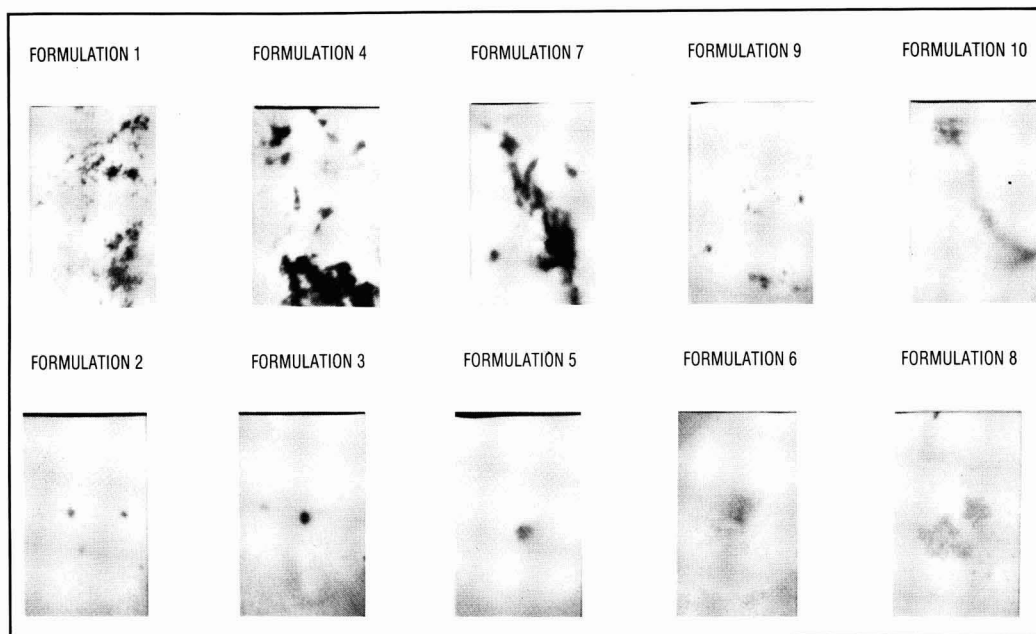


Figure 1—Photomicrographs showing effects of silicon incorporation on performance properties

Flexibility and Impact Resistance

The silicon-containing powder coating No. 5 Acid/Anhy and commercially available epoxy powder coating No. 9 possess superior flexibility and impact resistance. It is of interest to note, however, that the epoxy powder No. 6, derived from a tetrafunctional silicon-containing crosslinking agent, showed flexibility superior to the commercial polyester product, No. 10 (Table 5). Powder coatings No. 2 and 3, with difunctional silicon-containing crosslinking agents I and II, exhibited reduced flexibility and impact resistance when compared to coating No. 5.

The TMA-containing powders No. 7 and 8 serve as excellent examples for the influence of silicon incorporation on physical properties. The two powders are quite similar in that both are highly crosslinked and contain dianhydride functionality combined with equal amounts of TMA. However, powder coating No. 8 contains silicon and, although it has a higher aromatic content than pow-

der No. 7, it is superior in flexibility and direct and reverse impact.

In the case of polycarboxylic acid anhydride curing agents such as PMDA and bis(3,4-dicarboxy-phenyl)dimethylsilanedianhydride (IV), complex addition and crosslinking reactions occur. It has been reported that these reactions are¹⁹; (1) the opening of the anhydride rings by hydroxy groups of epoxy resins giving half esters and (2) the addition of the carboxyl groups of the half esters to epoxide functionalities to form diesters. Further etherification between epoxy and hydroxy groups occurs during curing. The relative rates of these reactions depend upon the catalyst present, the acid content of the anhydride, and to some extent on the cure time and temperature.²⁰ As a result, a tightly crosslinked, three-dimensional structure provides for reduced flexibility and impact resistance. This tenet is supported by the substitution of 40% of the dianhydride crosslinking agent IV of

Table 5—Flexibility and Impact Resistance

Powder Coating No.	Flexibility	Direct Impact in/lbs	Reverse Impact in/lbs
1.....	¼" Pass 180°	160	132
2.....	½" Pass 110°	120	38
3.....	½" Pass 110°	112	36
4.....	¼" Pass 180°	140	108
5.....	¼" Pass 180°	>160	160
6.....	½" Pass 130°	48	>10
7.....	¾" Pass 90°	80	>10
8.....	¼" Pass 180°	160	140
9.....	¼" Pass 180°	>160	160
10.....	1" Pass 60°	72	>10

Table 6—Adhesion and Hardness of Powder Coatings

Powder Coating No.	Percent Adhesion	Sward Rocker Hardness
1	100	24
2	100	42
3	95	43
4	99	16
5	100	34
6	100	20
7	100	24
8	100	40
9	100	48
10	100	40

Table 7—Solvent Resistance of Epoxy Powder Coatings

Powder Coating No.	Xylene	Mineral Spirit	10% NAOH	10% HCl	10%NH ₄ OH	Hot Water	Chloroform	MEK	MIBK
1	c	b	c	c	h	b	b	k	d
2	a	a	a	a	a	a	b	i	f,i
3	b	a	a	a	a	a	a	f,g	c
4	c	b	c	c	h	i	f,g	e	e
5	a	a	b	a	b	a	f	f,i	c
6	b	a	c	b	c	b	c	f,g	c
7	c	c	c	c	j	i	f,g	e	e
8	b	b	c	b	c	c	c	d,c	c
9	b	a	a	a	b	b	b	f,k	c
10	b	a	b	a	b	b	b	d,k*	d,k*

a = excellent
b = very good
c = good
d = fair

e = poor
f = softing
g = crazing
h = slight yellow color development

i = slight blisters
j = loss of gloss
k = slight loss of adhesion
k* = loss of adhesion in 72 hr.

formulation No. 6 by one of less functionality, i.e., TMA (No. 8). The result is a significant improvement in flexibility and impact resistance (Table 5). Furthermore, our work has shown that the use of a trifunctional silicon-containing curing agent (No. 8) has resulted in additional increases in flexibility and impact resistance over similarly formulated powders using only carbon-containing curing agents (No. 7).

Adhesion and Hardness

Adhesion testing results of Table 6 indicate acceptable adhesion for all powder formulations tested. However, hardness comparisons of powders cured with difunctional agents, i.e., No. 1, 2, and 3, are revealing. The silicon-containing powders, No. 2 and 3, show hardness superior to formulation No. 1 which utilized terephthalic acid as the crosslinker. This is likely the result of improved flow of the silicon-containing powders.

Solvent Resistance

Solvent resistance tests were conducted by the immersion of coated test specimens for four weeks. The panels were evaluated upon removal, and the results are included in Table 7. These data show that all powders tested have good to excellent resistance to xylene, mineral spirits, 10% sodium hydroxide, and 10% hydrochloric acid. Deionized water affected the all-carbon powders No. 4

and 7 and ammonium hydroxide solution resulted in yellowing (No. 1 and 4) and loss of gloss (No. 7). Similarly chloroform has less overall effect upon the silicon-containing powders as do MEK and MIBK.

Electrical and Corrosion Resistance

The effect of silicon on electrical and corrosion resistance is illustrated in Table 8. Silicon-containing coatings No. 2, 3, 5, 6, and 8 possess electrical resistance superior to similar carbon containing powders, No. 1, 4, and 7. Comparison of the electrical resistance of No. 7 and 8 is instructive in that the substitution of the silicon crosslinker IV for a similar and well-known carbon compound, PMDA, results in a decided increase in electrical resistance for the silicon-containing powders. This improved electrical resistance is accompanied by improvements in corrosion resistance. The silicon-containing coatings No. 2, 3, 5, 6, and to a lesser extent No. 8 are significant improvements over their carbon counterparts No. 1, 4, and 7.

Weather Resistance

The effect of silicon-containing molecules I, II, III, and IV on gloss and gloss retention of epoxy powder coatings is noted in Table 9. The silicon-containing epoxy powder coatings No. 2 and 3 possessed superior initial gloss and retained a level comparable to the commercial polyester after 18 months exposure. Although silicon-containing epoxy coatings No. 5 and 6 possess somewhat lower initial gloss than the diacids, they too retain a relatively high percentage of their gloss over an 18 months exposure period.

The chalking resistance of epoxy and polyester powder coatings are reported in Table 10. Although the silicon-containing powders have higher levels of aromaticity, they are superior to the nonsilicon epoxides in initial gloss and gloss retention.

The weather resistance of the coatings was studied by scanning electron microscopy (SEM) examination after 18 months, 45° southern exposure in Hattiesburg, MS. The silicon-derived powder coatings No. 2, 3, and 5

Table 8—Electrical and Corrosion Resistance

Powder Coating No.	Electrical Resistance volts/mil	Corrosion Resistance (0-10 scale)
1	1500	7
2	2500	9
3	3000	9
4	840	6
5	2575	9
6	2250	8
7	800	6
8	2042	7
9	2136	7
10	1428	7

Table 9—Gloss and Gloss Retention

Powder Coating No.	60° Gloss Readings Exposure Time ^a				
	Initial	1 month	6 months	12 months	18 months
1	45	33	22	10	5
2	100	85	68	38	32
3	100	95	65	54	45
4	52	42	26	10	8
5	65	52	38	31	25
6	68	60	32	25	18
7	30	28	15	11	8
8	52	50	31	22	10
9	90	85	62	33	12
10	95	85	74	60	45

(a) 45° south in Hattiesburg, MS.

prepared with the silicon crosslinking monomers I, II, and III, respectively, showed less deterioration and greater weather resistance than did formulations No. 1, 4, 7, and 9 which utilized the nonsilicon-containing curing agents.

SUMMARY

The literature consistently teaches improvements in durability and weatherability with the use of silicone polymers. However, there is a paucity of information with regard to the influence of silicon's presence as the Si-C bond.

In an effort to determine the efficacy of the Si-C presence, we are reporting the use of several novel acid and/or anhydrides curing agents synthesized to include the silicon-carbon functionality. It should be emphasized that although the silicon-containing curing agents are structurally quite different from the conventional carbon based acid and anhydrides, their increased aromaticity is not manifested in physical property and exterior weatherability characteristics to the extent that one might otherwise surmise. For instance, increases in aromatic content would normally result in increased chalking and hardness

with a concomitant reduction in flexibility. However, the data reported herein clearly confirms the property-enhancing influence of the silicon atom although its presence is accompanied by increased aromaticity and the unconventional Si-C functionality.

These data argue for the presence of the silicon atom as the overriding factor in performance enhancements of the silicon-containing epoxy powder coatings. It matters not whether silicon is incorporated as the Si-O or as the Si-C functionality and coatings scientists are thus afforded an additional principle of design for enhanced polymer performance.

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Table 10—Chalking Resistance

Powder Coating No.	Chalking Resistance (0-10 scale) Exposure Time ^a			
	1 month	6 months	12 months	18 months
1	7.0	6.5	6.5	6.0
2	9.0	8.0	7.5	7.0
3	9.0	8.0	7.5	7.0
4	7.0	6.5	6.0	5.0
5	8.5	7.5	7.0	6.5
6	8.0	7.5	7.0	6.5
7	6.5	6.0	5.5	5.5
8	8.0	7.5	7.0	6.5
9	8.0	7.0	6.5	6.0
10	8.5	7.5	7.5	7.0

(a) 45° south in Hattiesburg, MS.

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Poly(Epoxy-Urethane-Acrylic) Interpenetrating Polymer Networks (IPNs) for Primer Applications

J. Shah, R.A. Ryntz, V.E. Gunn, H.X. Xiao, K.C. Frisch, A. Feldpausch, and P.I. Kordomenos
Detroit Society for Coatings Technology Technical Committee

IPN coatings were synthesized from a urethane triol acrylic macromonomer, crosslinked by free radical polymerization of the pendant double bonds, and an amine-terminated epoxy resin crosslinked through a blocked isocyanate curing agent. These systems exhibited good corrosion resistance and higher tensile strength and adhesive strength than the individual components. The morphologies of these coatings were determined by differential scanning calorimetry and scanning electron microscopy.

INTRODUCTION

The first known interpenetrating polymer network (IPN), a natural rubber/phenol formaldehyde mixture, was synthesized in 1914, but it was not until the early 1960s that IPN morphology was understood.¹ An IPN is most commonly described as a blend of two polymeric networks in which at least one of the networks has been synthesized and/or crosslinked in the intimate presence of the other.²

Several types of IPNs exist, each influenced by the method in which the multicomponent alloy is synthesized.³ IPNs can be prepared by the "sequential" technique; this is, by swelling a crosslinked polymer in monomer and the crosslinking agent of its corresponding polymer, and then polymerizing the monomer in the swollen polymer matrix.⁴ Another method of synthesizing IPNs is by the "simultaneous" or "SIN" technique which consists of blending the linear polymers, prepolymers, or monomers in some liquid form (latex, solution, or bulk) together with the respective crosslinking agents,

evaporating the liquifying vehicle if present, and curing the component polymers simultaneously.⁵⁻⁸ If only one polymer of the combined polymers is crosslinked, the material is referred to as a semi-IPN.⁹ Although classical IPN systems involve thermosetting polymers, it has recently been shown that thermoplastics can also form IPN structures.¹⁰ The mobility of the thermoplastic materials is impaired by entanglement of the physical crosslinks within the polymer network. Subsequent heating of the network reduces the physical entanglements and the polymers flow as thermoplastics.¹⁰ In the classical sense, the process is reversible. Physical crosslinks can also be formed in the crystalline portions as well as the amorphous portions of a semicrystalline polymer, the glassy or rubbery portions of a block copolymer, or the ionic and nonionic portions of an ionomer.¹⁰ The synthetic methods which can be utilized in IPN formation are bulk,^{11,12} solution,¹³ or emulsion polymerization.¹⁴

IPNs synthesized to date exhibit varying degrees of phase separation depending primarily upon the compatibility or miscibility of the component polymers. The phase separation of IPNs, however, is limited in comparison to polymer blends. Polymer blends generally have low interface strength because they lack chemical bonds between them. Only thermoplastics can be used in polymer blends since mixing or blending occurs after polymerization has been completed. The phase separation in IPNs, on the other hand, can be regulated by the number of permanent entanglements formed as well as the network formation time. Since mixing starts at the beginning of the polymerization of each constituent, thermosetting systems can be used.

The combinations of chemically dissimilar crosslinking polymers which do not interact chemically, yet which are crosslinkable by different mechanisms under the pro-

Presented at the 66th Annual Meeting of the Federation of Societies for Coatings Technology, in Chicago, IL, on October 20, 1988.

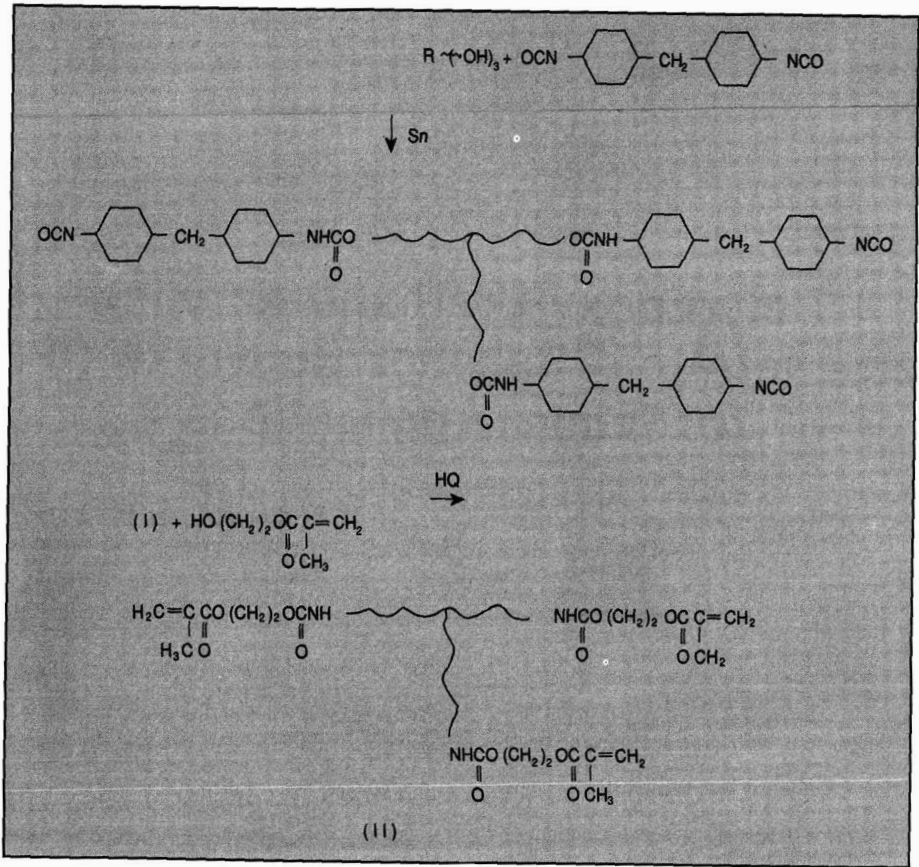
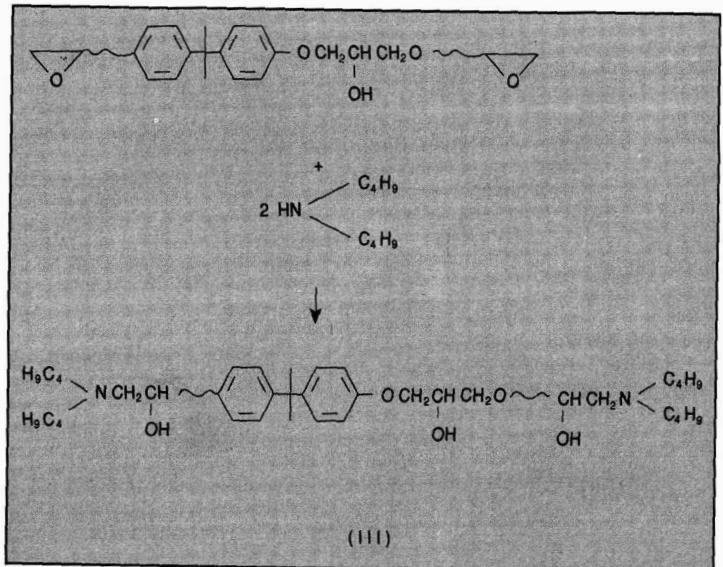


Figure 1—Synthesis of poly(urethane-acrylic)

Figure 2—Synthesis of end-capped epoxy



cess conditions employed, frequently result in controlled morphologies and synergistic behavior. Synergistic properties such as enhanced tensile and impact strengths, improved adhesion, and, in some cases, significantly greater sound and shock absorption can be achieved in an IPN as compared to a polyblend. Further proof of the existence of a single IPN rather than a completely phase-separated polyblend is provided by the fact that the IPNs exhibit a single glass transition temperature (T_g), intermediate in temperature to the T_g 's of the constituent components.¹⁵

The size and shape of the phase domains in several IPNs and their effect on physical properties have been studied over the past several years.¹⁶⁻¹⁸ The application of these types of entangled networks in formulated coatings to date, however, has been limited in scope.¹⁹⁻²²

This paper describes the novel synthesis of poly(epoxy-urethane-acrylic) IPNs for coating applications. These systems were prepared by the simultaneous or SIN technique of solution polymerization. A schematic representation of the synthesis of the IPN is shown in Figures 1-4.

EXPERIMENTAL

Raw Materials

The raw materials used in this study are listed in Table 1. Solvesso 100 and methylamyl ketone were dried over anhydrous magnesium sulfate, filtered, and distilled at atmospheric pressure into a nitrogen purged flask. The Tone 0301 caprolactone polyol was degassed for 48 hr and stored under nitrogen. All other materials were used as received.

Synthesis of Urethane-Modified Polyol Acrylate (II) (Figure 1)

Into a reaction kettle equipped with a nitrogen inlet, an air powered mechanical stirrer, a heating mantle, a reflux condenser, and an addition funnel were placed 200 parts Tone 0301 polyol dissolved in 1000 parts MAK and 524.8 parts Desmodur W and the mixture was heated to 40°C. To the mixture was added 0.14 parts dibutyltin dilaurate (T-12 catalyst) and the reaction exothermed to 70°C. The heating mantle was replaced with an ice bath and the temperature was maintained at 60°-70°C for approximately 10 minutes until the percent free isocyanate (as measured by titration) was lowered to 9. Hydroxyethyl methacrylate (HEMA), 260.3 parts, was then added and the reaction mixture heated at 60°-70°C until no

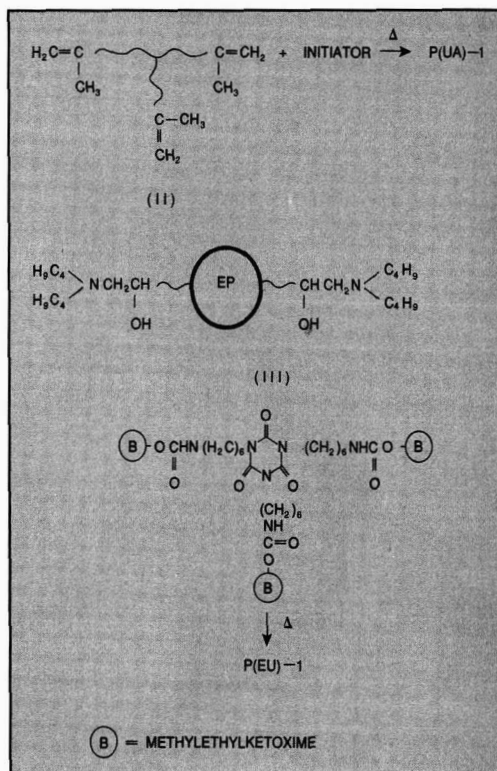


Figure 3—Synthesis of simultaneous IPN

free isocyanate was detected by infrared spectroscopy (2260-2250 cm^{-1}). One hundred ppm hydroquinone (HQ) was added prior to storage. The oligomer had a viscosity of 32 cps at 49.6% solids content. The number average molecular weight (as measured by gel permeation chromatography (GPC) with polystyrene standards) was 960 g/mole.

Synthesis of Amine End-Capped Epoxy (III) (Figure 2)

Into a reaction kettle equipped with a nitrogen inlet, an air-powered mechanical stirrer, a heating mantle, and an addition funnel were added 35.2 parts Epon 2002 dissolved in 41.4 parts of a 60/40 mixture (w/w) of MAK/Solvesso 100 and 6.2 parts dibutyl amine (DBA) and the mixture was heated to 70°C for two hours or until the amine content (as measured by ASTM 2074-66) was constant over a one-hour period. The oligomer had a viscosity of 65 cps at 50% solids content. The number average molecular weight (as measured by GPC with polystyrene standards) was 1645 g/mole. The hydroxyl equivalent weight (as measured by titration) was 213.9.

Preparation of P(UA)-1 Coatings (Figure 3)

Into the 49.6% solids content of urethane modified acrylate, II, solutions were added 0.1% by weight of Tego Flow ZFS 460 and 0.3% by weight di-*t*-butyl perox-

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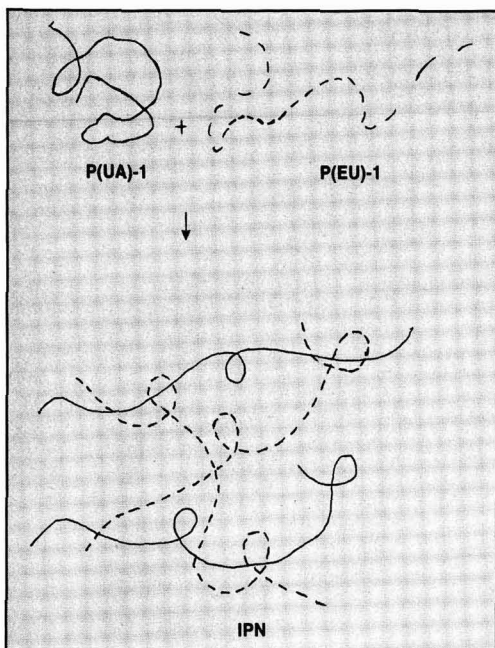


Figure 4—Schematic representation of IPN coatings

ide. The clear films were drawn down on glass and steel (Bonderite® 40) panels and cured at 150°C for 30 min.

Preparation of P(EU)-1 Coatings (Figure 3)

Into one hydroxyl equivalent weight of the amine end-capped epoxy oligomer, III, (50% solids content) was added 0.5% by weight of cellulose acetate butyrate solution (CAB, 20% solids content), 0.2% by weight of T-12 catalyst, and 1 equivalent of the isocyanurate trimer of hexamethylene diisocyanate blocked with methylethyl ketoxime (BL-3175). The films of the P(EU)-1 system were prepared and cured using the same conditions as described for the P(UA)-1 system.

Preparation of IPN Coatings (Figure 4)

Varying mixtures of P(UA)-1 and P(EU)-1 were prepared (Table 2) and films were cast on glass and steel panels. The cure schedule for these films was the same as that used for the P(UA)-1 and P(EU)-1 system.

Testing of IPN Coatings

The tensile strength was measured on an Instron Tensile Tester at a crosshead speed of 2 in./min. The cutting adhesion, gauge hardness, scratch pencil hardness, and Knoop (Tukon) hardness were measured on films 0.6-1.0 mils thick. The Gardner impact resistance was run according to ASTM D2794-69.

The gravelometer results were performed according to SAE-J400. The lap shear strength in tension was mea-

sured on an Instron Tester with 3 × 0.5 in. steel plates lapped 0.5 in. from their edges. The salt spray resistance was determined according to ASTM B117.

The glass transition temperatures were determined on a Du Pont 9900 Differential Scanning Calorimeter over the temperature range of -100-200°C with a heating rate of 10°C/min.

To determine the morphology of the coatings, samples were prepared by freeze-fracturing in liquid nitrogen and then applying a gold coating of approximately 200 Angstroms. The micrographs were obtained using a Philips Scanning Electron Microscope Model SEM 505.

Preparation of IPN Primer Coatings

The P(UA)-1 and P(EU)-1 clear, unpigmented primer coatings were formulated as previously described. The IPN coatings IPN-3, IPN-5, and IPN-7 (Table 2) were also prepared.

The coatings were applied by siphon gun over both cold-rolled steel and electrodeposition primed* Bonderite steel panels. The panels were flashed at room temperature for five minutes prior to baking. Average cured film thickness was 0.6-1.0 mils after baking at 150°C for 30 min.

RESULTS AND DISCUSSION

Mechanical Properties of IPN Coatings

The IPN coatings had low tensile strengths and exhibited some anomalous changes in tensile strength as the composition was varied from P(EU)-1 to P(UA)-1, shown

*Cathodic high build electrodeposition coated (HBEC) primer, commercially available from Mt. Clemens Coatings, Inc.

Table 1—Raw Materials

Designation	Description	Supplier
Epon® 2002	Glycidyl epoxy resin	Shell Chemical
DBA	Dibutylamine	Eastman Kodak
BL-3175	Blocked isocyanate (isocyanurate trimer of hexamethylene diisocyanate blocked with methylethyl ketoxime)	Mobay
Tone™ -0301	Caprolactone extended trimethylolpropane	Union Carbide
Desmodur™ W	H ₁₂ MDI	Mobay
HEMA	2-Hydroxyethyl methacrylate	Rohm & Haas
Solvesso® 100	Aromatic solvent blend	Exxon Chemical
MAK	Methylamyl ketone	Eastman Chemical
T-12	Dibutyltin dilaurate	Air Products
CAB	Cellulose acetate butyrate EAB 381-0.1	Eastman Chemical
Tego Flow™ ZFS460	Acrylic flow and leveling agent	Goldschmidt
di- <i>t</i> -BPO	di- <i>tert</i> -butyl peroxide	Lucidol Corp.
HQ	Hydroquinone	Aldrich Chemical Co.

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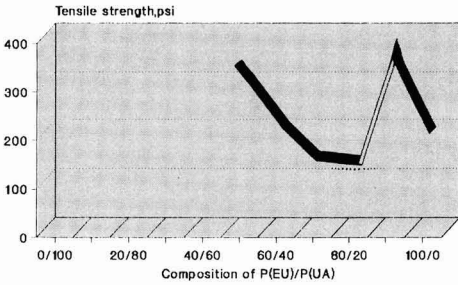


Figure 5—Effect of composition of IPN primers on the tensile strength

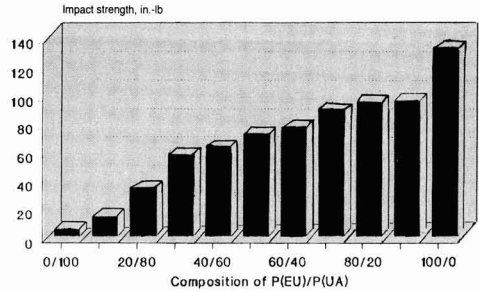


Figure 6—Effect of composition of IPN primers on the impact strength

Table 2—Composition of Poly(Epoxy-Urethane-Acrylic) IPNs

Material	Description	Composition
P(EU)-1	Poly(DBA end-capped Epon 2002) reacted with BL-3175	100%
IPN-1	P(EU)-1/P(UA)-1	90/10
IPN-2	P(EU)-1/P(UA)-1	80/20
IPN-3	P(EU)-1/P(UA)-1	70/30
IPN-4	P(EU)-1/P(UA)-1	60/40
IPN-5	P(EU)-1/P(UA)-1	50/50
IPN-6	P(EU)-1/P(UA)-1	40/60
IPN-7	P(EU)-1/P(UA)-1	30/70
IPN-8	P(EU)-1/P(UA)-1	20/80
IPN-9	P(EU)-1/P(UA)-1	10/90
P(UA)-1	(Tone-0301/Desmodur W/HEMA) Crosslinked Polymer	100%

Table 3—Mechanical Properties of IPN Coatings

Composition	Tensile (psi)	Gardner Impact Direct (in.-lbs)	Gardner Impact Indirect (in.-lbs)	Pencil Hardness	Tukon Hardness (Knoops)
P(EU)-1	199.2	>120	20	B	>16
IPN-1	355.0	96	16	F	>16
IPN-2	121.0	84	9.6	H	>16
IPN-3	140.0	80	4.0	H	>16
IPN-4	211.2	66	2.0	H	>16
IPN-5	313.9	62	<1	H	>16
IPN-6	Brittle	56	<1	H	>16
IPN-7	Brittle	50	<1	2H	>16
IPN-8	Brittle	24	<1	2H	>16
IPN-9	Brittle	14	<1	2H	>16
P(UA)-1	Brittle	6	1	3H	>16

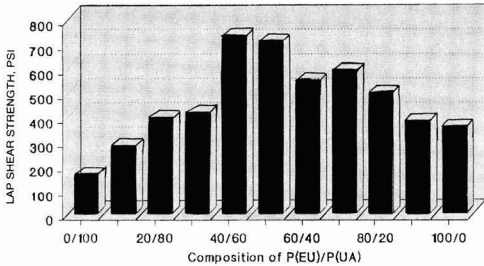


Figure 7—Effect of composition of IPN primers on the lap shear strength

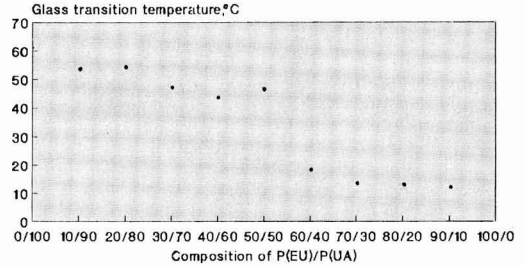


Figure 8—Effect of composition of IPN primers on the glass transition temperature

Table 4—Adhesive Strength of IPN Coatings to Steel Panels

Composition	Lap Shear (psi)	Failure	Cutting Adhesion
P(EU)-1	301	Cohesive	5B
IPN-1	319	Cohesive	5B
IPN-2	437	Cohesive	5B
IPN-3	518	Cohesive	5B
IPN-4	496	Cohesive	5B
IPN-5	666	Cohesive	4B
IPN-6	691	Coh./adh.	4B
IPN-7	380	Coh./adh.	3B
IPN-8	369	Coh./adh.	3B
IPN-9	231	Adhesive	2B
P(UA)-1	138	Adhesive	1B

Table 5—Properties of IPN Primer Compositions

Composition	MEK Resistance ^a	20° Gloss	Gravelometer Phos.	E-Coat	Salt Spray (500 hr)
P(EU)-1	P	93.2	2B	2B	<1mm
IPN-3	P	91.0	2B	2B	<1mm
IPN-5	P	92.2	2B	2C	<1mm
IPN-7	P	89.8	2C	2C	<1.5mm
P(UA)-1	P	91.3	2C	2C	<1.5mm
Control	F	4.4	2C	2C	<2.0mm

(a) ≥200 double rubs = P, <200 double rubs = F.

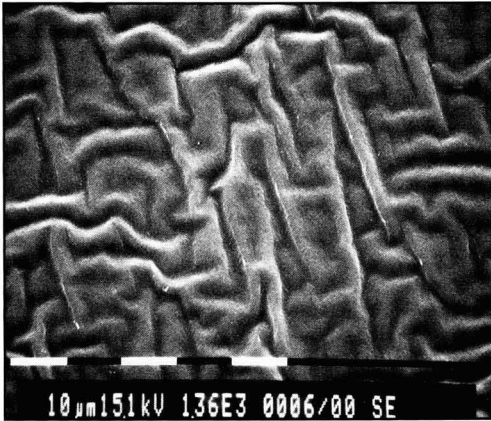


Figure 9—Micrograph of P(EU)-1



Figure 10—Micrograph of P(UA)-1



Figure 11—Micrograph of IPN-1 coating [90/10 P(EU)-1/P(UA)-1]

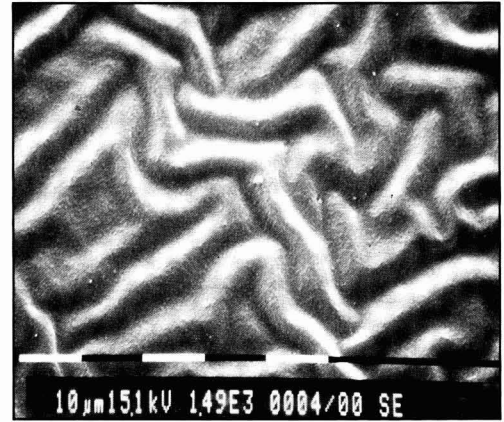


Figure 12—Micrograph of IPN-2 coating [80/20 P(EU)-1/P(UA)-1]

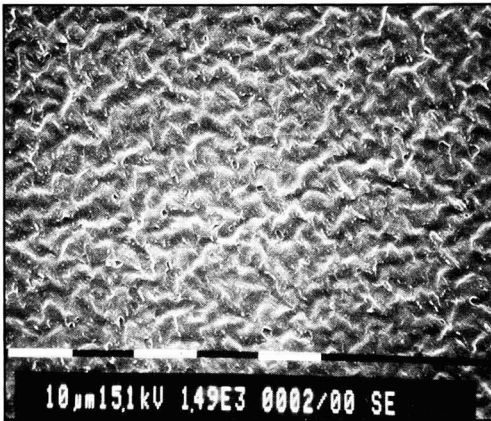


Figure 13—Micrograph of IPN-3 coating [70/30 P(EU)-1/P(UA)-1]

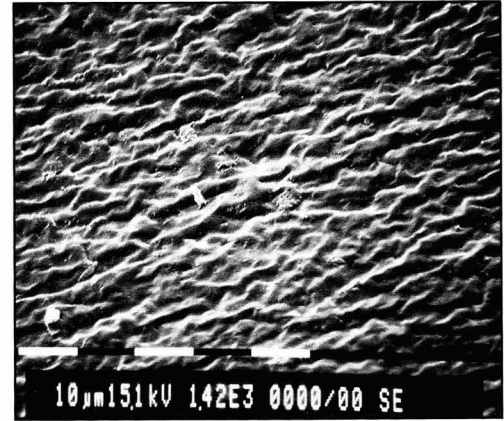


Figure 14—Micrograph of IPN-4 coating [60/40 P(EU)-1/P(UA)-1]

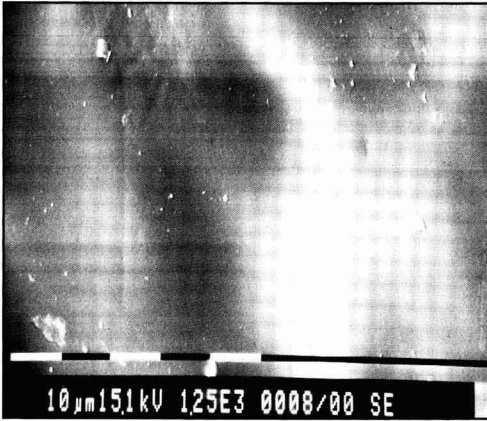


Figure 15—Micrograph of IPN-5 [50/50 P(EU)-1/P(UA)-1]

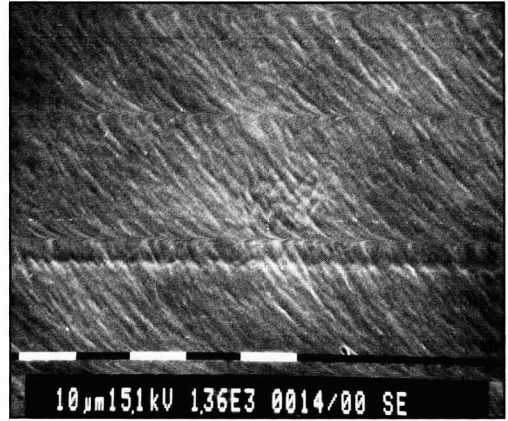


Figure 17—Micrograph of IPN-7 [30/70 P(EU)-1/P(UA)-1]

in Table 3 and Figure 5. The 90/10 P(EU)-1/P(UA)-1 composition, denoted as IPN-1, demonstrated a higher tensile strength (355 psi) than that of its original components, presumably as a result of maximized penetration of the entangled polymer chains. The tensile strength for the 80/20 P(EU)-1/P(UA)-1 composition, denoted as IPN-2, however, fell off dramatically to a value of 121 psi. This could be due to a phase inversion from the leathery epoxy-urethane continuous phase to a brittle acrylic continuous phase. The tensile strengths of the remaining IPNs follow a trend of increasing values to a maximum of 313.9 psi for the 50/50 P(EU)-1/P(UA)-1 composition. Again, this could be the result of maximized penetration of the polymers with the acrylic polymer being the continuous phase (as opposed to the case in the IPN-1 composition where the urethane-epoxy is the continuous phase). Above a 50% weight percentage of acrylic polymer in the IPN, the networks were too brittle to measure meaningful values for the tensile strengths.

The Gardner impact resistance, both direct and indirect, as well as the pencil and Tukon hardness of the IPN coatings paralleled the behavior of the measured tensile

strengths. The tough, leathery epoxy-urethane polymer exhibited better flexibility and corresponding softness than the brittle, hard acrylic polymer. The IPN compositions high in epoxy-urethane polymer content were therefore more pliable and soft than those high in acrylic polymer content (Figure 6).

The adhesive strength of the IPN coatings to steel panels was related to the hydrogen bonding capabilities of the corresponding network compositions (Table 4). Those coatings high in epoxy-urethane content exhibited better cohesive strength than the high acrylic content coatings. The urethane structure compounded with the flexibility of the epoxy backbone contributed to the ability of the IPNs high in epoxy-urethane content to bond to the steel panels. The high acrylic content IPNs, on the other hand, failed adhesively due to their brittle nature and lack of cohesive energy density.

The lap shear strength of the IPN coatings went through a maximum value of 691 psi at a 60/40 P(UA)-1/P(EU)-1 composition (Table 4 and Figure 7). The fact that a maximized value higher than that of its original

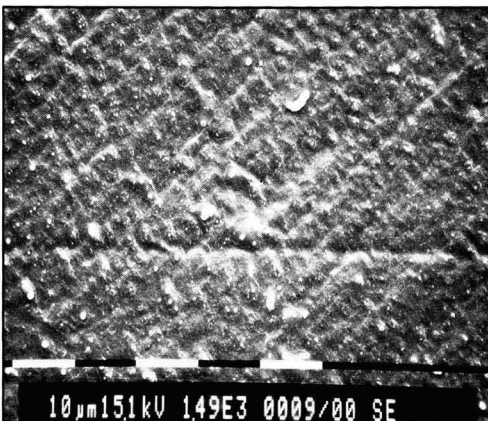


Figure 16—Micrograph of IPN-6 [40/60 P(EU)-1/P(UA)-1]

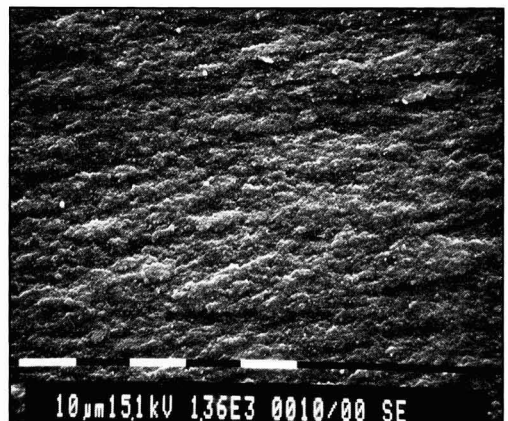


Figure 18—Micrograph of IPN-8 [20/80 P(EU)-1/P(UA)-1]



Figure 19—Micrograph of IPN-9 [10/90 P(EU)-1/P(UA)-1]

components was attained is indicative of good interpenetration of the polymer chains in the IPN.

The solvent resistance of the IPN films to methylethyl ketone (MEK) was excellent (Table 5). When compared to a high solids epoxy ester/melamine crosslinked control primer, all IPN compositions fared well. The control epoxy ester/melamine primer was softened considerably by the solvent after only 20 double rubs. The IPN primers, on the other hand, withstood 200 double rubs without softening.

Chip resistance of the IPN primers was measured over both phosphated steel and electrodeposition primer (one pint gravel at room temperature). The films higher in epoxy-urethane content had slightly better chipping resistance, as measured by the size of the chip, than those high in acrylic content. All fared equally in the distribution of chips throughout the panels regardless of substrate treatment.

MORPHOLOGY OF IPN COATINGS

Glass Transition Temperature by DSC

The IPN coatings of varying P(EU)-1/P(UA)-1 compositions each exhibited only one T_g (Table 6 and Figure 8). The values of T_g increased progressively from a low value of 7.8°C for the rubbery, tough epoxy-ure-

Table 6—Glass Transition Temperature of IPN Coatings (by DSC)

Composition	T_g (°C)
P(EU)-1	7.8
IPN-1	11.9
IPN-2	13.2
IPN-3	13.3
IPN-4	18.0
IPN-5	46.9
IPN-6	43.7
IPN-7	46.9
IPN-8	53.9
IPN-9	53.5
P(UA)-1	61.0

thane to a maximum of 61.0°C for the hard, brittle acrylic. The fact that each IPN composition exhibited only one T_g implies that interpenetrating polymer networks between P(EU)-1 and P(UA)-1 were formed by segmental mixing.

Micrographs by SEM

As shown in Figures 9-19, both starting components, P(UA)-1 and P(EU)-1, and the varying IPN compositions exhibited only one phase at a magnification of roughly 1500x. The presence of only one phase is indicative of good molecular mixing due to interpenetration between the networks.

CONCLUSIONS

Primer compositions based on the novel IPN systems prepared from P(EU)-1, an amine end-capped epoxy prepolymer crosslinked through an isocyanate curing agent, and P(UA)-1, a urethane modified acrylic macromonomer crosslinked by the free radical polymerization of pendant double bonds, exhibited good corrosion resistance over phosphated steel panels for up to 500 hours in salt spray. The good corrosion resistance of the IPN primer compositions was attained without the addition of corrosion inhibitive pigments.

The IPN coating compositions exhibited good adhesive strength, excellent hardness, and excellent solvent resistance. Morphologies of the coatings, as determined by SEM and DSC, indicated that molecular mixing in these IPNs was due to interpenetration between the respective networks.

ACKNOWLEDGMENTS

The authors wish to express their thanks to Carmel Harkins, Department of Biology, Wayne State University, for his contributions for the SEM micrographs, and to Mt. Clemens Coatings, Inc. for use of the facility testing equipment without which this paper would not be possible.

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1989/90 Schedule of Special Paint Show Issues

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SEPTEMBER—Featured are the Preliminary Program of Technical Sessions, floor plan of show exhibitors, registration forms, housing forms and hotel information, as well as general show information.

OCTOBER—This special Annual Meeting and Paint Show Issue, which is distributed at the show in addition to our regular circulation, contains Abstracts of Papers to be presented; the Program of Technical Sessions; floor plan of show exhibitors; a list of exhibitors and their booth numbers, classified by product/service; an alphabetical list of exhibitors and their booth numbers; and general show information.

JANUARY—This Annual Meeting and Paint Show Wrap-up Issue features articles on all exhibitors, with emphasis on products and special booth features; photo displays of award-winning booths; as well as a complete review of important Annual Meeting and Paint Show happenings.

PICTORIAL STANDARDS OF COATINGS DEFECTS

Revised and updated edition of this manual (previously titled "Exposure Standards Manual") has been compiled in conjunction with the American Society for Testing and Materials, and includes definition, description, and photographic standards for each of the following defects: Adhesion; Blistering; Chalking; Checking; Cracking; Erosion; Filiform Corrosion; Flaking; Mildew; Print; Rust; Traffic Paint Abrasion and Chipping.

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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.

January 1989 Subcommittee Reports of ASTM Committee D-1

The January meeting of ASTM Committee D-1 on Paint and Related Coatings and Materials was held on January 15-18, 1989 at the Embassy Suites Hotel in Ft. Lauderdale, FL. In the three and one-half days preceding the final session and general meeting of Committee D-1, 228 members and guests met in 172 scheduled meetings of D-1 subcommittees and working task groups. The present membership of Committee D-1 is 542.

Special Highlights of the meeting included talks by H.E. Ashton on "Measuring Coating Adhesion: 35 Years of Frustration"; Professor Gordon Nelson of the University of Southern Mississippi on "Testing of Coating Adhesion on Plastic Substrates"; and Dr. Michael J. Napolitano of Hercules, Inc. on "The Constrained Blister Test For Adhesion."

Awards presented included: Henry A. Gardner Award to L.R. Thurman, and Certificates of Appreciation to L. Burmeister, D.F. Savini, T.J. Sliva, and A.L. Spizzo.

A *Memorial Resolution* was presented and a moment of silence observed for the passing of H.W. Levison.

Highlights

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

Sub. D01.08—Reports on current federal activities relating to lead analysis and abatement, as well as VOC measurement in reactive marine coatings, VOC content of radiation-cured coatings, and formaldehyde content of water-borne coating vehicles.

Sub. D01.41—Decided to remain active until the Society negative on D 4717, "New Standard Specification for Flat Interior Latex Paint," is resolved.

Sub. D01.46.04—This group is evaluating four different adhesion testers vs D 3359.

Sub. D01.47—Has agreed to initiate several round-robins relative to masonry surfaces and coatings.

Sub. D01.52.15—Has planned round-robins on measuring film thickness of furniture coatings, as well as on smooth and textured hardboard coatings using D 2691, Standard Method for "Microscopical Measurements of Dry Film Thickness of Coatings on Wood Products."

Sub. D01.53—Is seeking comments, suggestions, and recommendations on the subject of "cure determination."

Sub. D01.56.10—New test method, "Water Pickup of Lithographic Printing Inks and Vehicles in a Laboratory Mixer," passed the D-1 ballot and has been assigned the number D 4942.

Sub. D01.56—Announced the establishment of two new task groups, Sub. D01.56.25 on Radiation Curing and Sub. D01.56.26 on Chemical Resistance.

Sub. D01.57.08—Discusses the language in the new federal law on toxicity labeling.

Future Meetings

June 25-28, 1989—St. Louis, MO, Sheraton Hotel (Committee Week).

January 21-25, 1990—Ft. Lauderdale, FL, Embassy Suites Hotel.

June 17-20, 1990—San Francisco, CA (Committee Week).

January, 1991—Ft. Lauderdale, FL, Embassy Suites Hotel.

June, 1991—Ottawa, Canada.

New Standards

New D-1 standards since the June 1988 meetings of D-1 approved by the ASTM Committee on Standards in the months shown: (subcommittee jurisdiction).

APPROVED JUNE 1988

D 4835-88, Specification for Propylene Glycol Monomethyl Ether Acetate (Sub D01.35)

D 4836-88, Test for Purity of Propylene Glycol Monomethyl Ether, Dipropylene Glycol Monomethyl Ether and Propylene Glycol Monomethyl Ether Acetate (Sub D01.35)

D 4837-88, Specification for Propylene Glycol Monomethyl Ether (Sub. D01.35)

APPROVED OCTOBER 1988

D 4797-88, Test Methods for Chemical and Gravimetric Analysis of White and Yellow Thermoplastic Traffic Marking Containing Lead Chromate and Titanium Dioxide (Sub. D01.21)

D 4794-88, Test Method for the Determination of Ethoxyl Substitution in Cellulose Ether Products by Gas Chromatography (Sub. D01.36)

D 4795-88, Test Method for Nitrogen Content of Soluble Nitrocellulose-Alternative Method (Sub. D01.36)

D 4796-88, Test Method for Bond Strength for Thermoplastic Traffic Marking Materials (Sub. D01.44)

D 4838-88, Test Method for Determining the Relative Tinting Strength of Chromatic Paints (Sub. D01.57)

DIVISION 1 ADMINISTRATIVE

SUBCOMMITTEE D01.07 GOVERNMENT STANDARDS

M.E. McKnight, Chairman

The chairman summarized recent government actions on paint specifications and documents in Federal Stock Class (FSC) 8010. Generally, the trend appears to be to reduce the number of military paint specifications by cancelling those for materials with high volatile organic content or those with limited use but to seek adoption of industry standards and specifications. Several Steel Structures Painting Council documents and three American Water Works Association specifications were recently adopted for military use.

H. Ammlung presented his review of Fed. Std. 141C test methods with priorities for conversion to ASTM standard methods as high, medium, and low. In a quick review of the table of contents of Fed. Std. 141C, it seemed to the committee that there are ASTM methods for many of the methods listed in Fed. Std. 141C. M.T. Burgess reported that the Department of Defense (DoD) has adopted about 120 standards for which D-1 has responsibility. Except for limited circumstances, DoD preparing activities are required either to use only those standards in their documents that have been DoD adopted or to initiate adoption proceedings for other standards they wish to use. The General Services Administration, the other major Federal Government paint-specification preparing activity, also uses DoD adoption as a guideline for use of ASTM standards.

Finally, procedures for handling special government requirements in ASTM standards were discussed. DoD policy in this regard is contained in the manual *Defense Standardization and Specification Program Policies, Procedures and Instructions*, DoD 4120.3-M, Section 3-701.6. It states that "DoD participants should avoid militarizing nongovernment standards by having military-unique requirements included in such a way that they would be-

come the norm rather than the exception. . . . A good way to handle DoD needs is to request that they be included in a 'when specified . . .' paragraph, or in an appendix as an additional or provisional requirement . . ." The chairman plans to have further discussion of this topic at the next meeting of Sub. D01.07.

SUBCOMMITTEE D01.08 ENVIRONMENTAL CONCERNS

J.J. Brezinski, Chairman

Testing needs related to the following issues were discussed: lead content in and on painted surfaces; VOC content of marine (reactive) coatings; VOC content of radiation-cured coatings; and formaldehyde content of water-borne vehicles. Also included are highlights of the January 23rd meeting of the ASTM Coordinating Committee for Environmental Activities.

Lead Issues—Among the current federal activities relating to lead analysis and abatement, as outlined by M.E. McKnight, are as follows:

- Preparation by the National Institute for Building Standards of a manual about currently known testing methods and lead abatement procedures.

- A planned lead abatement demonstration project under HUD involving about 200 houses in selected cities—to define the extent of lead removal and the efficiency of the clean-up and disposal processes.

- A study, headed by McKnight, of techniques used to measure total lead in paint films, including the use of X-ray fluorescence (to be conducted under Sub. D01.21).

Concern was expressed by J.C. Weaver that the recommended lead abatement procedures do not emphasize the significant lead removal that may be possible using surface washing and of the need to identify the chemical compounds present on the surfaces of the old dwellings, from which the lead source could be determined.

(A new task group was formed, in Sub. D01.21, headed by H.D. Swafford, to investigate procedures for determining the identity of the lead compounds that could be present in and on old painted surfaces.)

VOC Measurement—Reactive Marine Coatings—As one approach to meeting the reducing VOC limits in new California air control regulations, higher solids marine coatings are being formulated with lower molecular weight, reactive binder components. When tested with method D 2369, these coatings yield higher apparent VOC content than that which occurs in use. Studies to identify the magnitude of the difference and investigation of a viable approach to VOC determination for such coatings are planned by a group of the SSPC, the latter study to be conducted as a task group of Sub. D01.21.

Modification of D 2369—Suggested statements to replace Sections 1.3 and 1.4 of the Scope of D 2369, "Volatile Content of Coatings," will be submitted to letter ballot by Sub D01.21. The proposed changes are intended to clarify the applicability of the method. The present wording provides an erroneous impression that the method is generally not applicable to multi-package coatings; earlier round-robin studies included such systems. The revisions proposed are as follows:

Section 1.3—This test method can be used with multi-package heat-cured coatings that are applied, and can be tested, as single mixed compositions.

Section 1.4—This method may not be applicable to all types of coatings, e.g., some printing inks, radiation-cured coatings, and inks, for which other procedures may be substituted upon mutual agreement of the producer and user.

Radiation-Cure Coatings—The organizational meeting held in Sub. D01.55.10 on VOC in radiation-cured coatings concluded that though the vast majority of available coatings have low VOC content, definition of the need for and development of a viable method for VOC determination of such coatings should be explored further at the June meeting.

VOC Manual—The ASTM Manual (#4) on "Determination of Volatile Organic Compounds in Paints, Inks and Related Coating Products" is expected to publish this Spring.

ASTM Coordinating Committee for Environmental Activities (CCEA)—At the January 23rd meeting, it was agreed that a

proper function of CCEA is to recommend policies related to ASTM environmental activities for adoption by the Society. The initial draft policy to be submitted to COTCO in April, is directed at those environmental interests related to air and water quality and solid waste covered by Committees D-18, D-19, D-22, D-34, and E-47. Included in the draft policy are: involvement of EPA in the validation of ASTM consensus procedures and of those methods needed by EPA for implementing environmental laws and regulations; creation of an ASTM data base of all environmental measurements standards; and mandated joint meeting, at least annually, of the ASTM environmental committees.

Formaldehyde in Water-Borne Vehicles—Methods to define free formaldehyde in polymer latexes and other water-borne coating binders are being assembled by Sub. D01.33.26 in preparation for a possible task group investigation/development of an ASTM procedure.

DIVISION 20 RESEARCH AND GENERAL METHODS

SUBCOMMITTEE D01.20 QUALITY ASSURANCE AND STATISTICS

G.Y. Moore III, Chairman

G.Y. Moore was introduced as the new chairman of Sub. D01.20. He reviewed the name change from "Statistics and Sampling" to "Quality Assurance and Statistics" and read the revised scope which had been approved at the Executive Committee meeting in October 1988.

To initiate attempts to define quality assurance standards, H.M. Werner agreed to supply some general guidelines and G.R. Peterson to provide copies of two military specifications and a Statistical Quality Control (SQC) training manual used by Dow Chemical. These are to be sent to G.Y. Moore who will make copies and distribute them to the subcommittee membership for study before the June meeting in St. Louis.

The three standards under jurisdiction of Sub. D01.20 were reviewed. D 3924, "Specification for Standard Environment for Conditioning and Testing Paint, Varnish, and Lacquer," is due for review in 1989. R.M. Olszewski agreed to do so and have it ready for Sub. D01.20 ballot in June. D 3925, "Practice for Sampling Liquid Paints and Related Pigmented Coatings," is also due for review in 1989. G.Y.

Moore will do this and have it ready for Sub. D01.20 ballot in June. D 3980, "Practice for Interlaboratory Testing of Paint and Related Materials," is not due for review until 1992, but J.C. Weaver expressed a concern that we establish a liaison with E-11 to insure that D 3980 conforms to ASTM standards. After considerable discussion, this matter was deferred to the June meeting.

We then reviewed a request from Weaver to hold a workshop on quality assurance practices at the June meeting in St. Louis. Moore reported that he had an agreement with the Quality Assurance Manager of the Aqualon Company to be one of the speakers. R.A. Orr agreed that Dow Chemical would provide a speaker. The subcommittee indicated a desire to have someone from the automotive industry speak on the future direction of quality assurance efforts in that industry. Moore will coordinate with D.R. Bradley to see if this can be arranged. E.A. Praschan of General Motors was suggested as a possibility.

As a final item, it was agreed that Moore will coordinate with Bradley to send out a notice to the D-1 membership advising of the workshop in June and to publicize the existence of Sub. D01.20.

SUBCOMMITTEE D01.22 HEALTH AND SAFETY

J.J. Brezinski, Chairman

D 3278, "Flash Point of Liquids by Setaflash Closed Cup Apparatus"—Consideration was given to a negative and comments received on the Sub. D01.21/D-1 ballot on this method.

The negative by A. Richardson was ruled persuasive. The wording in Section 4.1 will be changed to bring the instructions in line with the procedure described in Section 10.

Several comments by E.R. Lewis were ruled persuasive, among which were: clarification of the meaning of Section A 4.1.2 on loading the sample into the syringe with a spoon; replacement of the term "sampling port" in Section A 4.1.3 with "filling orifice" and clarifying changes in this section, and improved wording in Section 10.4.

Comments received from H.A. Wray and E.M. Nesvig dealt with the identification in Footnote 6 of commercial sources for the test apparatus. The sources listed will be limited to the two manufacturers as inclusion of only one or two of many distributors was judged inconsistent with ASTM policy.

Other editorial changes suggested by H.A. Wray, E.R. Lewis, B.R. Jenkin, M. Sherrott, and A. Richardson were accepted and will be incorporated.

The revised method will be submitted to an additional Sub. D01.22/D-1 ballot.

Revision of D 4206, "Sustained Burning of Liquid Mixtures by the Setaflash Tester (Open Cup)"—Two additional editorial changes suggested in the D-1 ballot were discussed and approved. These include a revision of the wording in Section 4.1 and a change in Footnote 3 to limit the listed commercial sources for the apparatus to two manufacturers in line with a similar change approved in D 3278. The method is now ready for Society ballot.

D 3630, "Determining Constituents Classified As Hazardous Contained in Protective Coatings"—Changes suggested in an earlier Sub. D01.22 ballot by H.E. Ashton were discussed and will be incorporated. Several other changes were made to identify the present limited scope. The revised draft will be submitted to a Sub. D01.22/D-1 ballot. Though limited, the Standard has value and is being retained until a satisfactory substitute is available.

New Standard Method for Determination of the Upper Layer Separated from a Viscous Liquid—Three outstanding negatives received in a D-1 ballot were withdrawn. The method will be submitted to Society ballot.

SUBCOMMITTEE D01.23 PHYSICAL PROPERTIES OF APPLIED PAINT FILMS

M.P. Morse, Chairman

D01.23.10, *Adhesion*, H.E. Ashton, Chairman, discussed the efforts being made to establish the present adhesion strength of pressure-sensitive tape Permacel #99, cited as being satisfactory for use in D 3359, "Measurement of Adhesion by the Tape Test." A letter was sent by the chairman to the vice-chairman of Committee D-10 inquiring of the status of the interlaboratory study to evaluate this tape. No reply had been received. Also, the chairman has contacted the Technical Director of the Permacel Co. requesting their in-house specifications for this tape.

The attempts that have been made to extend the upper film thickness limit of the cross-cut procedure were reviewed. The multi-cutter with outriders and the template with gap widths to prevent utility knife blades from bending were described. The multi-cutter with increasing spacing, developed by Maynard Euvavarad, was shown and discussed. K. Trimmer will circulate two of these cutters in the round-robin being conducted by Sub. D01.46.10. Thick films differing in adhesion will be prepared for inclusion in that round-robin test.

Prof. G. Nelson of Southern Mississippi University described the work undertaken

on determining the adhesion of radio interference-reducing coatings to plastics. Initial tests performed with the tape test (D 3359) gave poor precision so he has concentrated on using vertical pull-off tests using a tensile tester. A head has been devised to prevent the plastic substrates from bending and producing low adhesion values. Prof. Nelson stated that he had found cyanoacrylate adhesive to be suitable for attaching the tester fixture to the coatings. The chairman remarked that, in tests he had performed, this adhesive had attacked some coatings as evidenced by extremely low adhesion values obtained.

The chairman is seeking collaborators for conducting a round-robin test to evaluate a vertical pull-off adhesion test.

D01.23.14, Hardness, Abrasion, and Mar Resistance. D.J. Wilverding, Chairman, reported that a round-robin test is in progress to determine the applicability and precision of instrumental methods for measuring the mar resistance of applied coatings. Three laboratories have reported results obtained on a series of coated panels using the Balanced Beam tester. In addition, they reported ratings for these panels obtained by coin and pencil mar, and erasure rub tests. Analysis of these results is awaiting receipt of results from additional collaborators. Additional sets of coated panels are being distributed to all collaborators with instructions to repeat coin and pencil tests at a specified angle.

D01.23.15, Slip Resistance. H.A. Ball, Chairman, reported that sleds with embossed steel and neoprene surfaces had been distributed to the collaborators in a round-robin test to establish the reliability and precision of static friction measurements of coated surfaces using the inclined procedure given in Method A of D 4518, "Measurement of Static Friction of Coatings." It was hoped that embossing the surfaces would minimize the problem of sled adhesion to wet surfaces that has produced friction values higher than expected. However, W.C. Golton of Du Pont reported test results with the embossed neoprene sled surface wherein the values obtained for water-wet coating surfaces were no lower than those obtained for the dry coating surfaces. Golton suggested that the high values for wet surfaces may be due to insufficient wetting of the surfaces and proposed that the use of a wetting agent in the applied water solution should be investigated. He agreed to do this.

A discussion was held regarding the usefulness of static friction measurements in evaluating coated surfaces for resistance to slipping of footwear. It was pointed out that the test procedures of D 4518 do not include all the directional forces involved in the walking process. The Significance and Use section of D 4518 acknowledges this and states that levels of slip resistance,

as determined by these test procedures, may not predict a person's resistance to slipping when walking on various surfaces. It was suggested that a combination of static and dynamic friction measurements may provide useful information regarding the resistance of coated surfaces to slipping of footwear during the walking process. This will be investigated in a proposed round-robin test for measuring both static and dynamic friction values for coated panels using types of horizontal-pull testers described in Method B of D 4518.

D01.23.16, Water Vapor Permeability. T.J. Sliva, Chairman, is conducting round-robin tests to determine the precision of D 1653, "Water Vapor Permeability of Organic Coating Films." An initial round-robin test was conducted in which two types of flat latex paints and one semi-gloss alkyd-based paint were evaluated. The results obtained showed the reproducibility of water transmission values to be about 20% for both dry and wet cup procedures. This was considered to be unsatisfactory and Sliva introduced some revisions in the test procedures to provide better reproducibility and a second round-robin test is underway using these procedures to evaluate the water vapor transmission of two vapor barrier (low permeability) latex coating films. Two of the collaborators have reported results that indicate improved precision. The other collaborators have agreed to complete their testing of these paints. All collaborators have been requested to perform repetitive tests to provide estimates of repeatability.

To further improve reproducibility of the test procedures, the chairman has compiled a list of proposed changes and distributed it to the task group members for their comments and additions to the list. It is planned to include the suggested changes in a draft revision of D 1653.

D01.23.18, Flexibility. M.P. Morse, Chairman, has completed plans for conducting a round-robin test to determine the precision of the conical mandrel and cylindrical mandrel test procedures in D 522, "Mandrel Bend Tests of Attached Organic Coatings." Panels coated with appliance and automotive coatings will be subjected to a bend of 135° in five seconds.

SUBCOMMITTEE D01.24 ON PHYSICAL PROPERTIES OF LIQUID PAINTS

C.K. Schoff, Chairman

D01.24.19, Viscosity by Efflux Cups, met with Sub. D01.56.12 Liquid Inks to discuss the interlaboratory testing that had been done to generate data for a better precision statement for D 1212, "Viscosity by Dip-Type Viscosity Cups." There were

difficulties with some of the test materials, but useful information was gained. The method will go forward to Society ballot with the current precision statement, but the ink viscosity task group will carry out additional interlaboratory testing with inks to determine if precision is different for inks as compared to paints.

D01.24.21, Density, met to discuss D 1475, "Density of Paint, Varnish, Lacquer, and Related Products" and to decide whether we should attempt to incorporate D 1963, "Specific Gravity of Drying Oils, Varnishes, Resins, and Related Material," (from Sub. D01.32) into D 1475. After considerable discussion, it was decided that the methods were too different to put together and that each should be left as a separate method. We will revise D 1475 so that it defines specific gravity as well as density and cross references D 1963. There also will be an explanation of how to handle highly bodied materials by diluting them and including the dilution in the calculations.

D01.24.26, Electrical Properties of Liquid Paints, discussed the recent interlaboratory testing with solvents to test the proposed standard test method for "Determination of the Electrical Resistivity of Liquid Paint and Related Materials," and generate data for a precision statement. The testing was successful with six laboratories testing the electrical resistance of four solvents. Four laboratories used the Ransburg tester, one the Byk tester, and one lab used both testers. Repeatability was good (12%), but, not surprisingly, reproducibility was not good (70%). The value for reproducibility fit well with results seen in the field for solvents and coatings. A precision statement will be written based on the precision data and the method will be submitted for subcommittee ballot.

D01.24.30, Calculation of VOC, Volume Solids and Other Formula Physical Constants, G. Praschan, Chairman, discussed the results of the recent subcommittee ballot on the proposed practice for "Calculating Formulation Physical Constants of Paints and Coatings." Two negatives and six comments had been received. Most of the comments were editorial and were accepted. The casters of the negatives objected to the way VOC was calculated, in the practice but were voted nonpersuasive since VOC was defined by EPA, not by us, and the method must reflect standard definitions and equations. After the editorial changes have been incorporated, the revised draft will be submitted to simultaneous subcommittee and D-1 ballots.

D01.24.32, Viscosity by Concentric Cylinder Viscometers, met to determine whether there was sufficient interest in developing a new viscosity method or standard practice for concentric cylinder vis-

cometers. Requests had come from outside D-1 (from viscometer manufacturers) to have such a method. The attendees were luke-warm about working on the method and suggested that the membership of D-1 be polled to determine the extent of use of such devices and the degree of interest in developing a method. This will be done.

D01.24.33, Odor Evaluation, had an organizational meeting to see whether there was a need for and interest in developing a standard practice for odor evaluation of paints and related materials. A. Rutkiewicz pointed out that E-18 on Sensory Evaluation already had methods and practices for evaluating odor. He also pointed out the need for specialized methodology, facilities, and apparatus in doing such work. He said that he and E-18 would be glad to help if we decided either to work toward a method or just wanted to put on a mini symposium or information session on odor. It was decided to poll the members of D-1 as to the needs and interests regarding odor evaluations, whether a standard practice was needed, the support for a mini symposium or information session, etc. This will be done before the June meeting.

D01.24.31, Viscosity by ISO Cups, did not meet, but its business was handled by the subcommittee. The proposed method on viscosity by ISO cups being developed by H. Wray was discussed along with the recent subcommittee ballot. There was one negative on the ballot. The objection was to the lack of a caveat pointing out that the method should not be used to determine paint application viscosity. The negative was voted not persuasive. Certain editorial changes will be made in the method and then it will be submitted for D-1 ballot.

Dr. Noh Park and Prof. Thomas Irvine were then introduced and Dr. Park gave a presentation on the Irvine-Park falling needle viscometer manufactured by the J&L Instruments Corporation. Sub. D01.24 has had requests from a number of users of the instrument that an ASTM method be written for the viscometer. We would like to see some of these people become active in Sub. D01.24 and particularly need one of them to lead a task group on the instrument if a method is to be written. The falling needle viscometer is an interesting device that appears to have promise for use with resins and coatings.

SUBCOMMITTEE D01.26 OPTICAL PROPERTIES

C.J. Sherman, Chairman

D01.26.02, Color Measurement, R.T. Marcus, Chairman, reported that C.S. McCamy's schedule is preventing him from completing the revision of D 1535,

"Standard Method of Specifying Color by the Munsell System," and D 1729, "Standard Practice for Visual Evaluation of Color Differences of Opaque Materials." He will send copies of the current draft and his notes on the problems with them to R.T. Marcus for completion. By defining Horizon light to be at a color temperature of 2200 Kelvin, D 1729 should be ready to be advanced to D-1 ballot. Macbeth Division of Kollmorgen Instruments Corporation is currently in the process of verifying the color temperature of Horizon light, so a note might be included in the draft about verification. The note can be removed by editorial action once the value is confirmed and/or a new value determined.

W.N. Hale, Jr. discussed the changes that he made to D 3134, "Standard Recommended Practice for Selecting and Defining Color and Gloss Tolerances of Opaque Materials and for Evaluating Conformance." C.S. McCamy suggested that Section 7.2.3 be expanded to discuss why hue, value, and chroma tolerances are useful and to include some examples. Both C.S. McCamy and R.L. Connelly have some write-ups and information that Hale might find helpful, which they will send to him. Hale will attempt to modify the method for concurrent Sub. D01.26/D-1 ballot in time for the March 3, 1989 submission deadline.

C.J. Sherman will write a letter to the chairman of D-1 about transferring D 4086, "Standard Practice for Visual Evaluation of Metamerism," to Committee E-12 on Appearance.

D 2244, "Standard Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates," contains an error in the CIELAB equations. The same error appears in E 308, "Standard Method for Computing the Colors of Objects by Using the CIE System." F.W. Billmeyer, Jr. is writing a letter to S.L. Kauffman, ASTM Staff Manager for E-12 to help expedite correction of this error. Billmeyer agreed to copy D. Bradley, ASTM Staff Manager for D-1, on his letter to Kauffman and to prepare a similar letter on D 2244 to be sent directly to Bradley with a copy to Kauffman. (Note: Further investigation of the equations by Billmeyer following this meeting found the equations to be correct but inconsistent with those listed in CIE Publication 15.2, Colorimetry. Since the CIE publication is the original source reference for the equations, it is important for ASTM to remain consistent with that reference. Efforts will continue to ensure both correctness and consistency).

D 3964, "Practice for Selection of Coating Specimens for Appearance Measurements," had been balloted at the committee level for reapproval. C.J. Sherman reported that the standard was reapproved with no comments received. It will now be advanced to Society ballot.

The future direction of the task group was discussed. W.N. Hale, Jr. provided a historical perspective on how general appearance standards were originally developed in D-1, but now have been originating in E-12 as E-12 has grown and become more active. W.H. Venable, Jr. suggested that D01.26.02 may want to make a method for measuring metallics (being worked on by Sub. E-12.03 on Geometry) into a method specific to paint and coatings. R.T. Marcus urged the task group members to contact him with any additional suggestions for the future direction of Sub. D01.26.02.

D01.26.02 will next meet in conjunction with E-12 during May 14-16, 1989 in Gaithersburg, MD.

D01.26.06, Hiding Power, L. Schaeffer, Chairman, reported on the reapproval of Method D 344, "Relative Hiding Power of Paints By Visual Evaluation of Brushouts," and approval of a revision of D 2805, "Hiding Power of Paints by Reflectometry," the latter omitting all tables and depending on calculations done entirely on the use of a programmed computer.

The previously proposed concept of a visual hiding power test based on the use of a multi-groove applicator was discussed, and it was decided to temporarily set this idea aside.

Draft #2 of the proposed "Hiding Power Method for Industrial Finishes" was discussed with regard to the question of using color-difference as the end point rather than contrast ratio. Problems with both end points were pointed out, and it was decided to stay with contrast ratio.

For further simplification, it was decided to separate Draft #2 into individual methods for liquid and powder coatings. The method for liquid coatings will be based on spray application rather than wire-wound rods, although provision would be made for the use of wire-wound rods as a non-mandatory alternative. A round-robin with liquid industrial coatings will be planned on that basis.

D01.26.11, Gloss and Goniophotometry, M. Morse, Chairman, announced that the recent revision of method D 523, "Specular Gloss," had been approved by D-1 ballot and the method had been submitted for Society ballot. The most important revision was to insert an addition to the Significance and Use Section cautioning users that when specimens differing widely in perceived gloss and/or color are compared, nonlinearity may be encountered in the relationship between visual gloss difference ratings and instrumental gloss readings.

A questionnaire was circulated to D-1 members asking if method D 449, "Visual Evaluation of Gloss Difference Between Surfaces of Similar Appearances," should be revised to include an alternate procedure

that used reflected images of an illuminated bare filament bulb. Twenty-nine persons responded with 24 affirmative and five negative votes.

The task group members agreed that the method should be revised to include the use of the bare filament bulb. The chairman will prepare a draft of a revision and submit it promptly to the task group members for their comments after receipt of a description of the bulb and surrounding used by Francis O'Donnell in his research at RPI.

A questionnaire was submitted to the D-1 membership asking if a method should be developed specifically to measure the distinctness of image (DOI) of coatings. Twenty-eight persons responded with 21 affirmative and seven negative votes. After considerable discussion, the task group members decided that the best approach to the measurement of DOI of coatings would be to modify the present E 430, "Measurement of Gloss of High-Gloss Surfaces by Goniophotometry," method to accommodate instruments with geometric measuring conditions differing from those specified in E 430, providing that their usefulness in measuring DOI of high gloss coatings is demonstrated.

Attempts will be made to assemble a series of high gloss coated panels differing in visual DOI. These panels will be submitted to collaborators for measurements by the DOI instruments they have available.

D01.26.23, Retroflectance of Horizontal Coatings. N. Johnson, Chairman, reported that D 4061, "Retroflectance of Horizontal Coatings," with editorial revisions was passed to C. Sherman for submission for Society ballot. Data from the preliminary round-robin done by R. Davidson was presented to the committee. It included eight panels circulated to four laboratories. In addition, readings on portable instruments were included. It was agreed to continue with these panels, but to include replicate readings so that a new precision and accuracy statement could be generated for D 4061. This work is expected to be continued in E-12.10 on retroreflection. Some geometric considerations were presented by N. Johnson regarding apertures for portable instruments. The work of this committee has been agreed to be transferred to E-12.10 including the development of a practice for portable instruments. The transfer of D 4061 will be addressed at the Sub. D01.26 meeting.

D01.26.24, Tinting Strength. C.J. Sherman, Chairman, reported that D 3022, "Test Method for Color and Strength of Color Pigments by Use of a Miniature Sandmill," passed D-1 ballot and is ready for the Society ballot. D 2745, "Test Method for Instrumental Tinting Strength of White Pigments," latest revision will be submitted for concurrent Sub. D01.26/D-1 ballot.

A draft of a proposed "Method of Test for Evaluating the Tint Undertone of Titanium Dioxide Pigments," that was proposed by R. Morrison was reviewed. Several changes will be made and a second draft of the proposed method will be submitted for Sub. D01.26 ballot.

D01.26—The recommendation by task group D01.26.23, Retroflectance of Horizontal Coatings, to transfer the jurisdiction of D 4061 to Committee E-12 was discussed. It was voted five affirmative, zero negative and one abstention to recommend to D-1 to transfer this method to E-12.

In the revision of the Optical Properties section of STP500, H.K. Hammond, III is considering updating the Light and Color chapter, R. Morrison the chapter on Gloss, and A. Plyler the chapter on Hiding.

SUBCOMMITTEE D01.27 ACCELERATED TESTS FOR PROTECTIVE COATINGS

B.L. Williamson, Chairman

D01.27.04, Light and Water Exposure Apparatus. L.E. Thieben, Chairman, and W. Ketola discussed the negative votes received on Sub. D01.27 balloting of D 822-80, "Practice for Testing Paints, Varnishes, Lacquers and Related Products using Filtered Open Flame Carbon Arc Light and Water Exposure Apparatus," and a new standard, "Practice for Testing Paints, Varnishes, Lacquers and Related Products using the Enclosed Carbon-Arc Light and Water Exposure Apparatus." As a result of the discussions, all negative votes were withdrawn and a new draft will be rebalotted for concurrent Sub. D01.27/D-1 ballot.

A revised draft of the new Practice for Xenon-Arc accelerated weathering was not balloted because of problems encountered in writing the text. Discussions were held on whether tables or graphs of Representative Spectral Power Distribution were most useful and will rewrite some of text. This revised draft will be sent to the Task Force Committee prior to the June meeting, so that a final draft should be ready for balloting in August to Sub. D01.27.

D01.27.10, Accelerated Outdoor Weathering. M.P. Morse, Chairman, has been evaluating the durability results obtained for coated panels exposed on the three types of racks described in practice D 4141. Presently, the group is evaluating the suitability of an exposure cycle on the EMMA-QUA weathering apparatus at DSET Laboratories in Arizona for producing accelerated gloss loss and color change in the automotive coatings that correlate satisfactorily with Florida 5° S. black box exposure results.

The EMMA-QUA-NTW cycle in which the coated panels are sprayed with water for 30 sec every 5 min during the period of

8 p.m. to 4 a.m. has provided encouraging results. In this cycle the panels are backed in the winter months to evaluate panel temperatures. A series of 12 automotive coatings differing in color and vehicle composition have been exposed on this new cycle in July 1988 and in October 1988. The gloss loss results produced by the July-initiated exposures have produced good correlation with mean Florida black box exposure results when comparisons are made within the same color. These two EMMA-QUA-NTW exposures are to be continued until the mean gloss produced is equivalent to the mean gloss loss produced by 24 months Florida exposure. It was agreed that a set of the 12 automotive coated panels would be exposed on a weathering machine at the South Florida Testing Service exposure site in Arizona. The same cycle conditions used for the EMMA-QUA-NTW exposures will be used at this South Florida site in order to obtain an estimate of producibility for results produced by this new cycle.

It was agreed that this task group should establish standardized procedures for weathering coated panels by periodic wetting during exposure on panel racks. The chairman will solicit descriptions of the test procedures now in use by exposure stations and compile them for discussion at the next task group meeting. The chairman is preparing detailed reference reports of the results obtained in the two extensive round-robin tests conducted by the task groups.

D01.27.12, Detergent Testing. F. Lutze, Chairman, reported D 2248, "Practice for Detergent Resistance of Organic Finishes," had passed concurrent Sub. D01.27/D1 balloting and would be submitted for printing. This group will be kept on the inactive list until work is required in this area.

D01.27.17, Evaluation of Weathering Effects. J. Robbins Jr., Chairman, reviewed the results of the round-robin tests between DSET Laboratories Inc., South Florida Test Services, Inc., Sub-Tropical Test Service Inc., Everglades Testing Laboratory, and SCM. The round-robin was an evaluation of exposed (outdoor weathered) panels for flaking (D 722-86) using draft revision of this standard practice.

The new draft of D 722 incorporates some of the terminology and pictorial standards from ISO 4628/5 (flaking) and the TNO method. A letter enclosing a copy of the ISO 4628/5 Pictorial Standard on flaking was received from the ISO Central Secretariat to use in the revision of the standard. In the next round-robin, a new cooperative has been added. South Florida Test Services (Desert Site) has agreed to cooperate, thanks to their representative, E.J. Walmsley.

D01.27.29, Substrates. B. Williamson, Chairman, reported the revision of D 609,

“Standard Method for Preparation of Steel Test Panels for Testing Paint, Varnish, Lacquer, Conversion Coatings and Related Products,” and D 3891, “Glass Test Panels,” passed Sub. D01.27 ballot with no negatives, and will be sent on to D-1 ballot with minor editorial changes.

The revision of D 2201, “Method for Preparation of Galvanized Steel Panels for Testing Paint,” will be revised further and submitted for discussion at the next meeting. D 1734, “Masonry Test Panels,” will be sent to concurrent Sub. D01.27/D-1 ballot for withdrawal. The method has serious technical problems and no one in Sub. D01.27 uses the method or has the expertise to rewrite it.

D01.27.30, Corrosion Tests—Automotive, F. Lutze, Chairman, discussed the status of the joint American Iron & Steel Institute, Society of Automotive Engineers, and ASTM Program. Thirty cycles have been completed on the four AISI experimental laboratory corrosion tests. Initial results and panels are being reviewed in Detroit today to determine when the test should be terminated. Many of the SAE tests, i.e., those currently in use in the industry, are completed and reports are being prepared.

Panels have been distributed for the ASTM outdoor corrosion exposures in the U.S., Canada, and Europe. Data should be available for the June 1989 meeting.

D01.27.31, Corrosion Tests—Non-Automotive, D. Wallace, Chairman, began the first meeting of this group with the introduction of Bob Schmitt of PPG Canada, who presented the PPG Cyclic Test Method for Corrosion Testing and several sets of panel documentation showing better correlation with Daytona Beach seacoast exposure than with ASTM B 117.

L. Perez explained his company’s “Intermittent Salt Spray Method,” a field test run on Miami Bay. B. Appleman advised of the survey of corrosion test methods recently completed by the SSPC for the U.S. Navy with which he was directly involved. Discussion followed as to the scope of the mission in the task group.

To summarize: The mission will be to survey existing cyclic corrosion test methods to choose the most useful one to implement as a new ASTM standard, with the intent of providing a better method than ASTM B 117 to serve the needs of the metal building products markets.

To accomplish this, the group will:

1. Establish a practical and appropriate set of systems to test by each proposed method as well as at controlled exposure sites representing marine and industrial environments. A task group committee composed of D. Ball, R. Schmitt, B. Appleman, R. Eritano and H.G. Rommal will meet before June to determine the specific systems that will be used. (It is hoped for a

series of 12 or less.) Results will be presented at the next meeting.

2. Assemble all of the proposed test methods to consider. Several attendees indicated they would submit methods. These must be sent to Appleman at SSPC as soon as possible. D. Wallace will meet with him to review all methods received prior to the next D01.27.31 meeting. Proposed methods will be discussed by the full committee and agreed upon in June.

3. Decide on the outdoor exposure sites to be used to correlate with. D. Wallace will consult with the NCCA accelerated weathering committee for input. Attendees should come prepared to recommend appropriate test sites in June. These should be known aggressive marine or industrial locations with current exposure capabilities. An attempt will be made to settle on the sites at the June meeting, or alternately to set a limit on the number of sites and get a task group committee to decide while the test panels are assembled.

4. Set up a committee to implement the actual tests and see that they are properly run and documented. Three or four very committed participants will be needed to carry out this important task and advise the task group of progress during the test program. Let the chairman know if you are interested.

SUBCOMMITTEE D01.28 BIODETERIORATION

M.C. McLaurin, Chairman

D01.28.01, Package Stability, W.B. Woods, Chairman, was led by M.C. McLaurin in the absence of W.B. Woods. Test methods currently used by various companies for evaluating the resistance of coatings in the container to bacterial attack were distributed and discussed. Agreement was reached on a proposed new method which will be written up and distributed to the group by M.C. McLaurin. Test paints will be supplied to those agreeing to participate in a round-robin evaluation of the method by M.C. McLaurin; inoculum will be supplied by R.A. Oppermann. Results from the round-robin should be available for discussion at the next meeting.

It was suggested that there is a need for a method for determining whether or not various coatings raw materials are contaminated with microorganisms. The method should be simple and straight forward. A proposed method will be prepared and distributed to the group prior to the next meeting by M.C. McLaurin.

D01.28.02, Rapid Method for Detection of Enzymes, L.A. Burmeister, Chairman, distributed methods for the testing of redox and enzyme contamination as submitted by individual laboratories and they were discussed by the group. The objective is to

expand the scope of our current method to take into account the possibility of redox contamination. The new chairman, D.R. Hess, will prepare a revised method based on member input along with suggestions for a round-robin prior to the June 1989 meeting.

D01.28.04, Resistance of Paint Films to Algae Attack, W.B. Woods, Chairman, was led by M.C. McLaurin in the absence of W.B. Woods. The group discussed the problem of algal growth on paints and in general methods for testing algal resistance. R.A. Oppermann will write a proposed test method and distribute within the group. A few cooperative laboratories will perform the test and report back next meeting.

Sub. D01.28—There are no reapprovals of standards due until 1990. The editorial changes required on D 3274-82, “Standard Method of Evaluating Degree of Surface Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation,” did not get submitted before the standard was put on D-1 ballot. These will be submitted. Other areas for future microbiological test method development were discussed.

DIVISION 30 PAINT MATERIALS

SUBCOMMITTEE D01.31 PIGMENT SPECIFICATIONS

D.H. Ruddick, Chairman

One negative vote from the 88-3 ballot was received, Item 28, D 3360-80, intent to withdraw “Test Method for Particle Size Distribution of the Common White Extender Pigments by Hydrometer.” It was voted 6-0 to ballot for reapproval as is.

A task group will be formed to write a standard for micaceous iron oxide compatible with the ISO standard being developed.

A task group will be formed to write a standard for zinc phosphate.

The DCMA requested a letter from Sub. D01.31 Organic Pigments Task Group requesting DCMA’s input on the organic pigments specification being developed.

SUBCOMMITTEE D01.32 DRYING OILS

P.C. Stievater, Chairman

A negative on the 88-3 ballot from D. Zinkel on D 1983, “Standard Test Method

for Fatty Acid Composition by Gas-Liquid Chromatography of Methyl Esters," was found to be persuasive and the item was removed from ballot for further revision and will be rebalotted at D-1 level once the revision is completed.

The following methods are scheduled for review in 1989 and will be placed on the next D-1 ballot for reapproval: D 1955, "Test Method for Gel Time of Drying Oils"; D 1959, "Test Method for Iodine Value of Drying Oils and Fatty Acids"; D 1962, "Test Method for Saponification Value of Drying Oils, Fatty Acids and Polymerized Fatty Acids"; D 1963, "Test Method for Specific Gravity of Drying Oils, Varnishes, Resins and Related Materials at 25/25C"; D 1964, "Test Method for Tung Oil Quality"; and D 1982; "Test Method for Titer of Fatty Acids."

Several years ago a recommendation was made to revise D 1475, "Test Method for Density of Paint, Varnish, Lacquer and Related Products" to include D 1963 in one method. It was agreed by Sub. D01.32 to do this, and a draft of the revised method was sent to Sub. D01.24 which has the jurisdiction for D 1475. At the January meeting, Sub. D01.24 decided not to continue with this combination of methods, so D 1963 is being balloted for reapproval.

Some suggested changes to D 3169, "Standard Specification for Once-Refined Sunflower Oil, Technical Grade," were considered by the Editorial Review Board to be technical in nature so it will be balloted at D-1 level with these changes.

SUBCOMMITTEE D01.33 POLYMERS & RESINS

R.A. Orr, Chairman

D01.33.14, Alkyds, R.E. Lowrance, Chairman, will revise the recently balloted test methods incorporating the appropriate suggested comments. T. Rendl will review the revisions prior to submitting them for rebalotting to incorporate technical changes.

D 1725, "Test Method for Viscosity of Resin Solutions," was balloted for reapproval, passing without comments or negatives.

In June, a discussion was held concerning the updating of Federal Specification TT-E-490e to incorporate an ASTM method for determining silicon dioxide content. P.C. Stievater and the chairman met with C. Hollis (Specification Manager at GSA) who agreed to have the chemists in the San Francisco GSA Laboratory run tests on silicone alkyds by three methods: wet ash, dry ash, and atomic absorption.

C. Hollis will be contacted to coordinate a meeting between the chemists in GSA, San Francisco and interested parties from the D01.33.14 group to discuss an appro-

priate silicon dioxide test method. A report will be made at the next D-1 meeting at St. Louis in June.

D01.33.23, Epoxy Resins, G. Peterson, Chairman, reviewed the fourth draft of D 1652, "Test Method for Epoxy Content of Epoxy Resins," and D 1726, "Test Method for Hydrolyzable Chlorine Content of Liquid Epoxy Resins," including the new precision statement.

These two methods will be balloted concurrently by Sub. D01.33 and D-1 with a copy of all round-robin data and precision calculations going to all Sub. D01.33 members.

D 1544, D 1545, and D 4142 received no negatives in the 88-4 ballot. Comments have been added to the methods and they will be sent to Society ballot. D 1544 and D 1545 will be removed from D01.33.23 and new task groups formed for each method, for revising them.

D01.33.24, Nitrogen Resins, J.H. Smith, Chairman, announced that round-robin testing of a new, proposed test method for the free formaldehyde content of amino resins is in progress. Partial results are in, along with several comments which will help to improve the procedure. Once the remaining laboratories have submitted their results, a new draft of the method will be prepared, incorporating the necessary changes. Nitrogen resin suppliers will then be solicited to review the method again.

It is planned to present the next draft of the formaldehyde test method and to organize a new round-robin to determine its precision at the June 1989 meeting.

Results from this method will be used as a reference point for a gas chromatographic procedure being explored in D01.21.80. Broader applicability of the proposed titration method will also be explored in appropriate task groups.

D01.33.26, Water-Reducible Polymers, D.E. Waldrep, Chairman, announced that the "Standard Guide for Testing Latex Vehicles" (D 4143-88) passed balloting with no negatives. Two comments concerning editorial statements were discussed and will be included. Reballoting will not be necessary.

The round-robin data for a method to determine grit in a latex was discussed. The method will be prepared for balloting. A precision statement will be developed, based on the collected data.

D01.33.28, Turbidity of Resins, W.C. Golton, Chairman, stated that the purpose of the group is to develop a standard method for instrumental determination of turbidity of resins and other clear liquid materials. A preliminary evaluation of resin turbidity measurements was discussed. At meeting time, three labs had reported with nearly identical results on two resins. The results

were so encouraging that it was decided to expand the evaluation to a full round-robin. The chairman will arrange to send more resin samples to the participants: W. Golton (Du Pont), J. Smith (PPG), J. Lamberton (Reichhold), C. Winchester (Hercules), R. Orr (Dow), and T. Englehart (Hach).

The chairman will send out instructions for the round-robin of the current and additional samples and will report back the results at the next meeting.

SUBCOMMITTEE D01.34 NAVAL STORES, INK RESINS AND VEHICLES

C.M. Winchester, Chairman

D01.34.01, Resin Solutions, C.M. Winchester, Chairman. A fourth round-robin has been planned to obtain data for a precision statement for proposed methods for preparing ink resin solutions by blender and hot-plate procedures, respectively. Details of an inert gas blanket system were resolved as follows: (1) The blender or flask should be swept with gas for one minute before starting. (2) The gas inlet should be above the surface of the circulating solution. (3) The means of measuring gas flow will be left to the discretion of the user. J. Thomas, will send a flow meter to G. Bien, to get a measure of the flow rate being used. The results of the fourth round-robin will be discussed in June. Thomas will be the new task group chairman for Group I.

D01.34.02, Dilutability, J.W. Daugherty, Chairman, clarified the differences in the dilution vs tolerance calculations in the proposed ink resin dilutability method. Some editorial comments, such as including metric dimensions in the appropriate places, were also discussed.

Discussion of the precision statement led to the suggestion that the hexane dilutions and the ink-oil dilutions be reported separately in the precision statement if the hexane dilutions looked more precise than the ink oil. Daugherty will make this evaluation upon review of the data.

The changes will be made, and if the precision statement conforms to the ASTM standards, the proposed method will be forwarded to the main committee for ballot.

D01.34.03, Gelability, A.N. Scarlatti, Chairman, is working on two procedures for gelation of an ink vehicle. The first, using a standard resin kettle, was discussed in detail including points concerning the apparatus set-up and configuration. J.M. Fetso offered valuable assistance so that the procedure would more closely fit ASTM editorial style. The second, using a microwave oven, also needs editorial polishing. The chairman will have both revi-

sions sent out to the subcommittee in March 1989.

D01.34.06, Vehicle Tack, T.J. Sayers, Chairperson. This is a joint task group with Sub. D01.56. Please refer to the Sub. D01.56 report.

Old Business—The problem of a standard ink oil solvent that can be used to analyze resins was discussed. All seemed to be in agreement that the situation warranted study. Some question as to whether the inconsistency of ink-oil-based analysis was the fault of the oil or the procedure. This will be reviewed also. A new task group, D01.34.04, was set up with J. Daust as the Chairman.

A history of the Old Naval Store group was presented. It was a consensus among the members that if the old Naval Store's committee members were not going to participate, then we would take over the responsibility of maintaining their ASTM standards. J. Lambertson will head this task group. New members interested in working on the Naval Store's standards are needed.

Sub. D01.34 voted to recommend changing its name to Naval Stores, Ink Resins and Vehicles. The new title better defines the activities of the subcommittee.

SUBCOMMITTEE D01.35 SOLVENTS, PLASTICIZERS AND CHEMICAL INTERMEDIATES

L.R. Thurman, Chairman

D01.35.10, Solvents-Hydrocarbons & Ketones, S.A. Yuhas, R.L. Hinrichs, Co-Chairmen, discussed a request from Committee D-16 for opinions regarding the setting of benzene content limits in specifications for aromatic hydrocarbon solvents. A letter by R.L. Hinrichs to D-16 covering this subject was read and his position was approved by the group. Benzene limits should be in ASTM standards where relevant. Allowable benzene levels should vary with product using nationwide regulations as a guide. A maximum of 0.1% would be suitable in most cases.

D01.35.20, Reactive Monomers. The Capillary Gas Chromatography Method for dimer concentration in Acrylic Acid is proceeding. The work is being handled by D01.35.60.

D01.35.30, Chemical Intermediates, J.R. Morrison, Chairman. E.J. Parks cast a negative ballot for D 1258, "Methods for Sampling and Testing High Gravity Glycerin," because the method for Section 6.3 Appearance and Odor lacks explanation or guidance for this qualitative test. This negative was found persuasive by the group

because of safety implications and Section 6.3 will be removed from this standard. The odor and appearance specification will also be removed from D 1257, "Specification for High Gravity Glycerin." These two standards will be rebaloted at the Sub. D01.35 level.

J. LeBeau voted negative on the new "Standard Specification for 2-Ethylhexanol," due to differences between the 25°C/25 Specific Gravity range specifications and results generated in his laboratory. This specification will be held until this is resolved.

D01.35.40, Plasticizer and Ester Solvents, R.L. Smith, Chairman. S.A. Yuhas proposed that a new standard specification for hexyl acetate be developed. Yuhas will prepare a proposed specification in the ASTM format and will determine if Method D 3545 can be used to determine the purity of the material.

D01.35.50, Coordination, L.P. Field, Chairman, discussed the problem of reconciling government and ASTM documents so that ASTM Standards can be substituted for DcD Standards. The differences in commercial and government documents are largely in the areas of packaging, quality assurance, chemical, and physical requirements. Of these, the packaging problem will be the most difficult to resolve. A comparison of D 329, "Specification for Acetone," and the Federal Specification O-A-5G was presented outlining the differences in these specifications. S.A. Yuhas and R.L. Hinrichs, D01.35.10, will attempt to resolve these differences to develop an ASTM specification which will be acceptable for government use.

D01.35.60, Methods Development, T.W. Rendl, Chairman, reported on the results of a screening method to determine if it would be feasible to establish a Gas Chromatography Method for the determination of the purity of nine alcohols, three ether alcohols, and five glycols for which standard specifications exist but which do not have a GC assay method. It was decided that the task group will continue the development of the method using four representative alcohols. Consideration is being given to the use of internal standards, response factors, and identification of major impurities.

New Business—Due to the quality emphasis in industry, Sub. D01.35 is proposing using target and control limits (min/max) specifications. As a test case, D 3620, "Specification for Glacial Acetic Acid," is being balloted in this new format. Current process and analytical capability are being considered in establishing this specification.

DIVISION 40 PAINT PRODUCTS APPLIED ON SITE

SUBCOMMITTEE D01.41 PURCHASE OF PAINTS AND RELATED COATINGS

H.L. Ammlung, Chairman

D01.41.05, D 4717, New Standard Specification for Flat Interior Latex Paint, M.E. McKnight, Chairman, reported that two negatives and one set of comments had been received on the D-1 ballot relating to Draft #6 with the revised table on hiding power. The comments from H. Wray were editorial in nature and will be incorporated into the next draft. The negative from W. Vander Linde was withdrawn after it was pointed out that the sections he thought should be added were not listed in the Blue Book Format for Specifications. The negative from L. Schaeffer was in four parts and covered areas he had voted against during a previous Society ballot.

The first part of his negative was on the opacity (hiding power) requirement. The voter felt the hiding power requirements in the revised draft were still too low since there are a number of commercial products with higher hiding power. Also that any paint specification proposed by D-1 for Society approval should aim to assure top quality products by today's standards. It was pointed out that any consensus specification must take into consideration the overall quality level of paints that are available and establish specification requirements accordingly. Past experience with the requirements stated in the revised table has shown they are satisfactory in this respect. This portion of the negative was found not persuasive on the basis that the position stated represented the personal opinion of the voter; current limits are not technically deficient, and extensive experience over the years has confirmed that they are acceptable for a general purpose product. The vote was 5-2-8.

The second part of the negative stated that the specified maximum of 20 for 85° gloss (sheen) was too high. The voter cited test results with six flat latex paints and information supplied by seven producers as to their sheen requirements. It was pointed out that the value had been lowered to 10 in an earlier draft and this action drew an immediate negative stating the lower value was too restrictive and might impact on film integrity. The limit was restored to 20 and had not been challenged again until his Society ballot negative. This portion of his negative was found not persuasive on the basis that there is no general agreement on acceptable maximum 85° gloss limits for flat paints; and that the currently specified

maximum is satisfactory and helps to provide producers with greater flexibility in formulating paints to meet other performance requirements such as washability and abrasion resistance. The vote was 6-2-7.

The third part of his negative dealt with film integrity (wet abrasion resistance) and claimed that there was a serious discrepancy between the gravimetric and volumetric erosion requirements. This was based on the belief that they were supposed to be equivalent. It was noted that the volumetric requirement had not been in the original drafts but had been added at the request of a previous negative voter to provide a basis for those that preferred to use the volumetric approach. The value given (0.03 mL) was considered an acceptable average to compensate for different densities of the paint films. This portion of the negative was found not persuasive on the basis that the limits given are not considered to be equivalent. Also, the gravimetric value is listed as the basic requirement but buyer and seller are given the option of using the volumetric calculation in lieu of the gravimetric should they so desire. The vote was 4-1-9.

The fourth part of the negative stated that D 4717 should be withdrawn for rebalancing because of the absence of supporting data or information. Without it the voter felt many of the affirmative votes would be merely expressions of confidence or good will rather than individual technical judgments. It was pointed out earlier that the development of the requirements was based on information from a number of sources such as previous round-robins, other similar specifications, technical data sheets, etc., and that some screening tests were run at NBS to determine whether the original proposed limits appeared practical. In addition D01.41.05 and Sub. D01.41 files had been reviewed to confirm that all negatives and comments had been given due consideration and handled in the prescribed manner. Copies of all actions are in Sub. D01.41 files. This portion of the negative was found not persuasive on the basis that it did not address a technical deficiency but rather a procedural matter not required by ASTM regulations. The vote was 5-1-9.

Sub. D01.41 Meeting—The results of the Sub. D01.41 ballot on disbanding the subcommittee and transferring jurisdiction over two standards, D 3927 and D 4717, to Sub. D01.42 were reported. There was one negative out of the 29 replies received. The negative stated Sub. D01.41 should not be disbanded until D 4717 is finalized. Chairman noted that it had never been intended to disband before action is completed on D 4717. There was also one comment related to the possible impact of disbandment on adoption of D-1 specifications to replace Federal and Military items. Actions

taken by D01.41.05 on the resolution of the four part negative from L. Schaeffer were approved by an omnibus resolution. The vote was 11 affirmative, no negatives, and two abstaining.

SUBCOMMITTEE D01.42 ARCHITECTURAL FINISHES

L. Schaeffer, Chairman

D01.42.01, Soil and Stain Removal-Mechanical Test, T.J. Sliva, Chairman distributed the results of the latest round-robin, in which cooperators applied various stains following procedures outlined in D 4828. The stains were removed mechanically using a straight line washability apparatus and an abrasion boat. The chairman proposed that this technique be inserted as an addendum into D 4828. He will prepare this addendum, showing how it would be incorporated into the present text of that method, and have it available for discussion at the next meeting.

D01.42.02, Porosity of Paint Films, C.C. Tatman, Chairman, is evaluating the effects of the major variables which contribute to the porosity of a paint film. The porosities determined by pore volume and immersion techniques are being compared to currently used film-staining procedures. The results of these studies will be discussed at the next meeting.

D01.42.04, Wet Adhesion of Latex Paints, W. Vanderslice, Chairman, summarized the results of the first round-robin involving a cross-hatch tape-pull method with a cross-hatching tool that has 1.5 mm fixed-space cutting edges. The interlaboratory data showed adhesion differences among four out of five test paints applied on special alkyd-primed steel panels. In contrast, with the same cross-hatching tool and test paints but applying the paints on an exterior gloss alkyd primer, the tests showed no differences in wet adhesion, all five paints failing both the least and most severe testing conditions.

In a variation of the tape-pull method, cross-hatched panels were scrubbed under water using a standard washability machine, but there was no evidence of correlation. The task group will pursue other methods involving the pulling off of fabric strip embedded in the dried paint film.

D01.42.05, Chalky Surface Adhesion, R. Schiller, Chairman, discussed the results of the first round-robin. The data showed that the method did not differentiate paints of known, good, or poor adhesion. The following changes will be incorporated into the next round-robin: 1) increasing the width, length and mesh

size of the organdy strips; 2) embedding the strip into the test paint using the draw-down method; 3) using parallel cuts on both sides of the strip to overcome the edge effect; 4) changing the synthetic chalk formulation; 5) increasing the curing time from 24 hr to 7 days; and 6) testing the painted panels with and without moisture application.

D01.42.09, Color Acceptance, D. Hess, Chairman, reviewed the third draft of the color stability procedure. The results of the first round-robin, involving four cooperators, were discussed. The Delta E value for the brushed vs drawdown area was determined on the same instrument for each sample. The Delta E values varied significantly between cooperators even though each was supplied with the same sample. An alternate method will be reviewed and test panels prepared prior to the next meeting.

D01.42.13, Brushability (Brush Drag), L. Burmeister, Chairman, reported that Draft #6 of the method passed the D-1 ballot with all negatives being resolved. The method will now be submitted for Society ballot. Discussion next focused on the ability of D 4287, "Viscosity at High Shear Rate by the ICI Viscometer," to give viscosity values that can be used to evaluate brush drag objectively. The need is to show that high shear viscosities correlate with the brush drag ratings that are obtained using the just-developed brush application test. Both latex and alkyd paints will be tested for ICI viscosity values by round-robin. Correlation of the viscosity measurements among laboratories, and how well they relate to brushout tests results, will be discussed at the next meeting.

D01.42.18, Block Resistance Test Method, S. LeSota, Chairman, reported that the third draft of this method had passed D-1 ballot, with all negatives withdrawn and only minor editorial revisions required. The method now goes to Society ballot.

D01.42.19, Wet-to-Dry Hiding Change, L. Schaeffer, Chairman, reported that the Sub. D01.42 ballot on Draft #2 had received no negatives and only minor editorial comments. He also reported that round-robin #5 had shown poor reproducibility with strongly chromatic colors, for which reason it was decided to restrict the method to white and tinted paints. A precision statement prepared on the basis of round-robin #4 was discussed, and it was agreed that the next draft, which would include the precision statement and revisions in response to the Sub. D01.42 ballot comments, should be submitted for D-1 ballot.

D01.42.20, Water Repellency of Wood, V. Scarborough, Chairman, reported the

results of the second round-robin. The data indicated little differences in the results between a 30 min immersion in the results between a 30 min immersion of Ponderosa pine and Southern yellow pine. An extended four hour immersion time showed decreased water repellent efficiency and the standard deviation increased significantly. In the next round-robin we will test a low solids solvent-borne water repellent, a higher solids solvent-borne water repellent, and a water-borne water repellent to determine the applicability, bias, and precision of the method.

D01.42.22, Test Guides for Architectural Coatings, H.E. Ashton, Chairman, reported that the first draft had been revised and a second draft sent to the members in December. A suggestion to delete the section on Chemical Analysis was rejected because some specifications contain composition requirements. As only one of the four Practices has a subsection on Water Content, the chairman asked for advice on its retention in the document. It was decided to retain this test because water content is important in the determination of VOC in solvent-borne coatings. The chairman put the question of what to do about the duplicate test methods in U.S. Federal Test Method Standard No. 141 for brush, roller, and spray application properties. In response to this question, it was agreed to delete 141 Methods 4321, 4335, and 4331 as redundant. A third draft will be prepared for submission to Sub. D01.42 ballot, subject to task group approval.

D01.42.—Two proposed new standards, one on the measurement of Brush Drag and the other on Block Resistance, were reported to have passed D-1 ballot and now go to Society ballot. The decision of D01.42.19 on "Wet-to-Dry Hiding Change," to submit a revised draft for D-1 ballot, was discussed and approved.

The need to convert certain Federal test methods within the Sub. D01.42 scope to ASTM format was discussed. This is in line with the Committee D-1 objective of having ASTM alternatives to any such methods perceived to be of value. These alternatives would be used to eventually replace all Federal test method references that now appear in D-1 standards, with the immediate objective for Sub. D01.42 of making as many such replacements as possible in the test guides for architectural coatings now being revised. Volunteers will be sought for this project.

The numerical criteria for gloss level terminology were discussed in detail. S. Lesota volunteered to assemble some current information on how coatings producers view gloss level terminology and will refer to the *Paint/Coatings Dictionary* for the appropriate definitions. The resulting conclusions will be incorporated into the test guides for architectural coatings.

SUBCOMMITTEE D01.44 TRAFFIC COATINGS

R.L. Davidson, Chairman

D01.44.03, "Thermoplastics." Negative at Society ballot withdrawn to "Standard Methods for Evaluation of Color for Thermoplastics Traffic Marking Materials."

D01.44.02, "Traffic Marking Materials." D 711, "Test Method for No-Pick-Up of Traffic Paint" was reappraised.

D01.44.03, "Night Visibility." D 1155, "Test Method for Roundness of Glass Spheres," and D 1214, "Test Method for Sieve Analysis of Glass Spheres," were reappraised after editorial changes. There will be round-robins conducted for both test methods this spring.

SUBCOMMITTEE D01.45 MARINE COATINGS

L.S. Birnbaum, Chairman

D01.45.06 Dynamic Testing, T. Dowd, Chairman:

Group A, Rotating Drum Method, D. Laster, Chairman. In the absence of D. Laster, L. Birnbaum reported no negatives had been received on the D-1 ballot, Item 20 of D 0104 (88-4) and that the item would be placed on the March 1989 Society ballot. The typographical error in 8.3 reported by F. Winkelman will be corrected.

Group B, Flowing Water Method, T. Dowd, Chairman. No negatives had been received on the D-1 ballot, Item 21 of D 0104 (88-4). The item will be placed on the March 1989 Society ballot. F. Winkelman discussed his editorial comments on the standard. The approved corrections will be forwarded to ASTM headquarters.

D01.45.08, Organotin Release Rate, L. Birnbaum, Chairman, reviewed an EPA recommended revision of ASTM draft 8a of 4/5/88 which was received in September 1988. Several of the EPA proposed changes were technical and required discussion prior to submission to D-1 ballot. The proposed EPA draft was circulated to Sub. D01.45 members in October 1988 for review and resolution at this meeting. No technical data to support proposed changes were received from EPA prior to this meeting.

EPA in Federal Register of 10/4/88 announced their decision to cancel registration of all TBT antifouling paints unless certain conditions were complied with. This included review of registrant-submitted release rate data, determination whether the study was valid, followed by EPA certification that the release rate meets the Organotin Antifouling Paint Control Act (OAPCA). OAPCA (HR 2210), signed

into law in June 1988, established a release rate limit of 4.0 micrograms per square centimeter per day using a modified ASTM Draft #6 which EPA required in its 7/29/86 data call-in notice; or any similar method specified by the EPA Administrator.

D. Spatz, in response to a request for data supporting the changes recommended by EPA, presented a series of slides which showed variations in release rates on replicate samples taken at different times in one day over a 35-day test period using three different paints. He also reported that tests on spinning vs nonspinning specimens in the holding tank showed no significant differences in release rate values.

C. Anthony discussed calibration and standardization. He conclusively demonstrated in a series of slides that three points were adequate to establish a straight line curve in lieu of the five points required by the EPA method. He also showed some graphs indicating variation in TBT release rates for both the old procedure and the new procedure over a test period of 42 days by plotting all values for EPA standard paint in release rate tests for clients of Case Laboratories.

L. Birnbaum reported that a working group consisting of respondents to the Sub. D01.45 October 1988 letter requesting comments to the EPA draft had prepared a proposed modification incorporating most of the comments received. They recommended that this replace Draft #8a (no negatives in a Sub. D01.45 ballot). Copies of this new modified EPA draft were distributed to the attendees.

C. Beiter presented the proposed changes together with the rationale for these changes. D. Spatz was provided an opportunity to express an EPA position on these changes. D. Spatz offered no objections to those changes which were approved by the attendees.

L. Birnbaum agreed to prepare a new Draft #9 incorporating all of the D01.45.08 approved changes and submit them for concurrent Sub. D01.45 and D-1 ballots.

P. Schatzberg discussed a motion to delete the short term, cumulative measurement of release rate from the ASTM method and limit it to the determination of release rate after 21 days exposure. He pointed out that most, if not all, TBT paints that comply with the statutory limit also comply with the cumulative limit set by EPA; and that the cumulative measurement would burden a round-robin required to determine precision and bias. It was decided to table action on this motion until the next meeting.

D01.45.09, ASTM Specification Conversion, D. Sowell, Chairman. In the absence of D. Sowell, L. Birnbaum reported that paint specification drafts are moving along rapidly in Sub. F25.02 (Shipbuilding Coatings). Sub. F25.02 will meet in Atlan-

tic Beach, FL on February 1, 1989. L. Birnbaum again recommended that Sub. D01.45 members who were interested in commenting and voting on paint specification drafts promulgated by F25 should request membership on Sub. F25.02.

D01.45.10, Compliance Certification, W.W. Allanach, Chairman. The standard for Paint Certification of Conformance Sheet was balloted with one negative from A. Beitelman. This negative was withdrawn and changed to affirmative in a telephone conversation with L. Birnbaum after editorial modification in Certification statement. A Draft #2 dated 10/21/88 was submitted for D-1 ballot.

SUBCOMMITTEE D01.46 INDUSTRIAL PROTECTIVE PAINTING

K.A. Trimmer, Chairman

D01.46.02, Surface Preparation, K.A. Trimmer, Chairman, reported that Draft #6 of the newly proposed "Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives," received no comments or negatives from the Fall 1988 D-1 ballot. It will be included in the March 1989 Society ballot.

D 4417, "Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel," received a negative from J. Montle when submitted to a concurrent Sub. D01.46/D-1 Fall 1988 ballot. Montle stated that Method B (depth micrometer) should be deleted from the standard as round-robin testing by NACE T-6G-19 showed that the results obtained were significantly different than those from Methods A and C. Montle had previously provided Trimmer with raw data from the NACE round-robin in order to develop a precision statement for this ASTM standard. A preliminary review of the data was conducted by W.C. Johnson. The review showed that the replica tape had one-half the standard deviation of the depth micrometer, and that the depth micrometer appeared to provide low values for profiles less than 2.0 mils with reasonable values at profiles of approximately 4.0 mils and higher. Based on the preliminary review of the data, the task group agreed that further investigation is necessary. If it is found that the method provides acceptable results at deeper profiles, the group recommended that Method B be retained in the standard, but that a bias statement be prepared based on various profile ranges. The test data with appropriate changes to the standard will be submitted to a Sub. D01.46 Spring 1989 ballot.

D 610, "Standard Method of Evaluating Degree of Rusting on Painted Surfaces," and D 2200, "Pictorial Surface Preparation Standards for Painting Steel Surfaces," are due for reapproval in 1989. The task group

recommended that the standards be submitted to a concurrent Sub. D01.46/D-1 ballot, but that it be recognized that D 2200 will require further revision within a few years because the Swedish Standards will be replaced with an ISO standard, and SSPC visual standards also will be available. Therefore, the book of photographic standards described in D 2200 will no longer exist in its current form, but until these other standards are available, D 2200 should remain as is.

Possible future work was discussed and includes: a standard for determining the grease or oil cleanliness of an abrasive in the field; surface preparation cleanliness standards for concrete or wood substrates; the detection of oil deposits on a surface after preparation; and the preparation of corroded test plates, contaminated (e.g. chloride) test plates, and properly prepared and protected plates for coating evaluation. With regard to this latter suggestion, the task group acknowledged that D01.27.29 is already formed for the preparation of test specimens, but that its work typically does not address samples for industrial coatings evaluation. In addition, SSPC has also formed a task group to investigate the preparation of test panel substrates. Therefore, the task group suggests that consideration be given to combining the efforts of SSPC, Sub. D01.27, and Sub. D01.46 for this effort.

D01.46.03, Repainting, L.M. Smith, Chairman, received comments from five members on the subcommittee balloting of Draft #3 of the newly proposed "Standard Recommended Method for Testing Coating Compatibility." No negatives were received. Comments from M.E. McKnight were primarily editorial, with the exception of 6.9. McKnight questioned how defects caused by coating application could be distinguished from defects caused by incompatibility. A similar comment was offered by E.R. Lewis. The task group agreed to modify this section by defining application defects as runs, sags, dry film thickness, skips, and misses. Defects such as wrinkling, blistering, peeling, and so forth will be moved to a later section as examples of compatibility defects.

B.D. Flowers questioned whether further guidance on the interpretation of results and recommendations to the user could be provided at the end of the document. The task group agreed to investigate this. B.R. Appelman recommended a better definition of the "varying conditions" in 6.1 that are used as the basis for test patch selection, and recommended that the test patch size be increased to a minimum of 10 sq ft in section 6.2. Appropriate changes to these sections were made. Appelman questioned the length of cure prior to testing in 6.10. It was unclear whether the temperatures listed were averages or minimums. Further, he suggested that two

curing intervals be provided; a long term cure of six-months minimum for greatest reliability of test results, and a short term cure of a few days when more rapid results are required. The task group agreed to modify section 6.10 accordingly. The final comments were received from R.A. Wakefield. He recommended that the procedure allow for the use of alternative methods of surface preparation beyond those that will be specified on the job. Such a statement will be included in 6.3. The comments will be incorporated into Draft #4 and submitted to a Spring 1989 subcommittee ballot.

D01.46.04, Pull-Off Adhesion, A. Cunningham, Chairman, reported that D 4541, "Standard Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," completed the Fall 1988 concurrent Sub. D01.46/D-1 reapproval ballot with no negatives or comments. It will be included in a Society ballot in March 1989.

Round-robin tests of pull-off adhesion methods commenced in December 1988 with 11 laboratories participating. Four alkyd coating materials specially formulated by Rust-Oleum to break cohesively at various values less than 1000 psi (using an Elcometer) are being used in the evaluation. The coatings were applied to 1/4 in. thick steel plates by KTA-Tator using automatic spray equipment to eliminate the application variable.

Four different adhesion testers are being evaluated: Elcometer Model 106; Patti Jr.; HATE; and Dyna. In addition, cross-hatch testing in accordance with D 3359, "Measuring Adhesion by Tape Test," has also been included.

K.A. Trimmer offered that if any of the participating laboratories have not had the calibration of their Elcometer verified within the last six months, that he has made special arrangements with Pittsburgh Testing Laboratory to provide such a service at roughly a 50% discount (\$45). Those wishing to take advantage of this offer should contact Trimmer.

Results from five laboratories and seven operators were presented at the meeting. Preliminary findings indicate that the Patti Jr. shows excellent repeatability with a standard deviation less than 10. HATE also shows good repeatability with a slightly higher standard deviation, and the pull-off strength values appear similar to those obtained by the Patti Jr. The Elcometer provides lower values, with the Dyna values even less than the Elcometer. H. Ashton agreed to conduct pull tests on the samples using an Instron to serve as the referee.

The cross-hatch adhesion tests on the samples have been conducted using spacing of 2 mm as the coating thicknesses are 2.0-3.0 mils. The results have typically been 4B and 5B, showing no discrimination relative to the various tensile strengths recorded by the test instruments. The task group agreed to further cooperate in an

analysis of cross hatch testers by circulating a new cutting head presented by M.R. Euverard (Paul N. Gardner Company). The head contains spacing from less than 1 mm to greater than 2 mm, which when used will provide a lattice pattern comprised of squares and rectangles of progressively greater surface area. It is hoped that the size of the squares at which disbonding does or does not occur may provide an assessment of adhesion. The special cutters will be supplied to the participating laboratories. It is expected that all of the test results along with a statistical analysis will be completed prior to the June 1989 meeting.

D01.46.07, Inspection, R.J. Martell, Chairman, was unable to attend the meeting which was subsequently cancelled. However, Martell indicated that he will prepare a draft of a new guide for the inspection of nonmetallic substrates that will parallel the existing D 3276, "Standard Guide for Painting Inspectors (Metal Substrates)." The draft will be circulated to task group members prior to the June 1989 meeting.

D01.46.10, Condition Assessment, M.E. McKnight, Chairman, reported that one negative was received from W.C. Johnson on the Sub. D01.46 ballot of Draft #5 of the proposed "Standard Guide for Assessing the Condition of Aged Coatings on Steel Surfaces and the Condition of the Underlying Substrate." Comments were also received from four others.

The Johnson negative indicated that in 4.5, the guide places emphasis on the detection mill scale and rust, but does not require an inspection for evidence of previous surface preparation. Further, he provides suggestions on how to identify the presence of corrosion (e.g., evidence of pit formation, black anode spots or corrosion scale, or through tests conducted using potassium ferricyanide paper for ferrous ion). The task group agreed that the negative was persuasive and the appropriate changes will be made.

A comment by D.M. Berger referred to work conducted by D-33 that may be of value to this task group. He again repeated his previous position that the diagrams of the distribution of corrosion that originated with F-25 and the Navy, would be of assistance to this document. During previous meetings, the task group had deleted the diagrams and the F-25 approach as being too complex for the scope of this document. McKnight also reported that the document referenced by Berger is now a part of an F-25 committee standard that could be incorporated by reference in this document.

A comment by B.D. Flowers indicated that an "interpretation" section attached to the end of the document would be quite helpful to establish how the information

should be interpreted. McKnight stated that the purpose of the document is to identify the type of data that should be collected in order to have enough information to make a thorough analysis of the condition of a coating and the underlying substrate, but an interpretation of the data along with recommendations (e.g., should the structure be recoated) is beyond its scope.

Comments by Appleman were primarily related to Table 2. The task group agreed that some of the Appleman recommendations were an improvement and a new table will be prepared. E.R. Lewis questioned the need for the flow chart, but made suggestions for changes should the task group determine that it is necessary. The task group agreed that the flow chart was of value, and will improve it based on the Lewis recommendations. All of the changes will be incorporated into Draft #6 which will be submitted to a Spring 1989 subcommittee ballot.

Draft #6 of the newly proposed "Standard Method for Field Identification of Coatings" received three comments in the Fall 1988 Sub. D01.46 ballot. No negatives were issued. The comments were from B.D. Flowers, R.H. Wakefield, and H.R. Stoner and were deemed to be editorial by McKnight. They will be incorporated into Draft #7 which will be submitted to a concurrent Sub. D01.46/D-1 Spring 1989 ballot.

SUBCOMMITTEE D01.47 MASONRY COATINGS

F. Gale, Chairman

D01.47.01, The Efficiency of Water Repellent Materials on Brick, R.C. Herring, Chairman, distributed Drafts #3 and #4 of the procedure, incorporating a method of determining the spreading rates of the coatings to be applied in addition to the immersion method. T. Brown, of the Brick Institute of America, distributed a detailed revision of the method and discussion followed. It was the decision of the task group to proceed with a round-robin on the method using both methods of application and to discuss any modifications at a future meeting. Ten cooperators agreed to participate.

D01.47.03, Active Solids Determination of Silanes, Siloxanes and Silane/Siloxane Blends Used in Masonry Water Repellent Treatments, T.J. Sliva, Chairman, reported on the results of an interlaboratory round-robin of a new procedure to be used which will be effective for both water-borne and solvent-borne materials. Excellent reproducibility was noted among the eight labs involved. A discussion of Draft #3 of the procedure followed. It was the decision of the group to complete results for repeatability and to submit the method for Sub. D01.47 ballot.

D01.47.04, Surface Preparation, F. Gale, Chairman. In the absence of the chairman, T.J. Sliva advised the group that all comments on Draft #2 of a guide for surface preparation entitled, "Standard Practice for Surface Cleaning of Architectural Sandstone," have been received and the practice will be submitted to Sub. D01.47 ballot before the June meeting.

D01.47.05, Permeability of Treated Masonry Substrates, N. Weiss, Chairman, distributed and discussed a paper prepared by Co-chairman J. Jacob of Columbia University entitled, "Laboratory Measurement of Water Vapor Transmission Rates of Masonry Mortars and Paints." This work involved measuring MVT on various mortars and coatings using E 96. The group discussed other methods, including NBS 883 and NCHRP 244, Series II testing. Members have agreed to bring test data and results using both methods to the next meeting for discussion.

D01.47.06, Adobe, D.R. Varina has agreed to chair this group. He presented samples of adobe substrate and a method for determining water absorption. It was the decision of the task group to initiate a round-robin on the method. Five cooperators have agreed to participate.

D01.47.07, Alkali Resistance of Masonry Treatments, A.J. Sanders, Chairman, notified the task group that the test solutions and substrates were now available. It was the decision of the task group to initiate a round-robin using two test solutions; namely, 0.1N KOH and 0.2N CaOH. A revised test method will be sent out. Five cooperators have agreed to participate.

D01.47.08, Rapid Chloride Ion Intrusion, C. Coletta, Chairman, provided a report on his evaluation of existing procedures used to evaluate rapid chloride intrusions, i.e., AASHTO, NCHRP and State DOT procedures. A method is now being investigated using 1 in. mortar cubes and soaking in a NaCl solution @ 120° F for 48 hr and determining the percent chloride content. A round-robin will be started in June.

DIVISION 50 PAINTS FOR FACTORY APPLICATION

SUBCOMMITTEE D01.52 FACTORY-COATED WOOD BUILDING PRODUCTS

S.B. Schroeder, Chairman

D01.52B, Hardboard, S.B. Schroeder, Chairman, reviewed the tentative method

for the Cobb-ring water permeability test. Since the statistical design for the first round-robin remains incomplete by some participants, the method will be submitted to Sub. D01.52 ballot without fully developed precision and bias.

There was a brief discussion of possible revision of D 2793, "Standard Test Method for Block Resistance of Organic Coatings on Wood Substrates," to make it more useful as a measure of coating cure and a predictor of blocking performance. K. Oschwald and T. Rieth agreed to review the method and propose changes.

It was also decided that the chairman will draft a tentative method for the detergent edge wick test for review at the summer meeting.

D01.52.13, Prefinished Siding, K. Kruse, Chairman. The primary discussion centered on proposed verification of past studies showing good correlation between test fence exposures and a soak, freeze, thaw, and concentrated sunlight accelerated test. Test fence weathered samples of prefinished hardboard and unweathered retains were provided by T. Rieth for submission to this accelerated method as well as a modified cycle XENON-arc weatherometer method. Results are anticipated at the 1990 winter meeting.

D01.52.15, Film Thickness, R. Matějka, Chairman, reviewed a tentative re-write of D 2691, Standard Method for "Microscopical Measurement of Dry Film Thickness of Coatings on Wood Products." Round-robins were planned for furniture coatings as well as both smooth and textured hardboard coatings. Eight laboratories have offered to participate.

Sub. D01.52—All of the methods under Sub. D01.52 jurisdiction have been reappraised on schedule except D 3259, "Infrared Determination of the Temperature of Applied Coatings on Wood Products During the Curing Cycle." This method was reviewed at the last meeting, and since there has been no additional comment, it is being submitted to Sub. D01.52 ballot with no change except the addition of appropriate keywords.

There was some additional discussion of the industry need for improved cure tests as reported by the hardboard task group. The meeting minutes will request candidate cure methods from all Sub. D01.52 members.

It was also announced that J.G. Cuddy, recently appointed vice-chairman of Sub. D01.52 has been forced to resign due to changes in job responsibilities. The position remains vacant.

SUBCOMMITTEE D01.53 COIL COATED METAL

R.J. Tucker, Chairman

A report was given on the results of the five standards that had been submitted for reapproval by D-1 ballot in late 1988. Three standards were approved and will be included in the February 1989 Society ballot. These are: D 3281-84, "Standard Test Method for Formability of Attached Organic Coatings with Impact-Wedge Bend Apparatus"; D 3363-80, "Standard Test Method for Film Hardness by Pencil Test"; and D 4146-83, "Standard Test Method for Formability of Zinc-Rich Primer/Chromate Complex Coatings on Steel."

Two additional standards receiving negative votes were discussed in the committee. Accepted changes were agreed to by both the negative voters and the subcommittee, and both of the following standards will be submitted for Society ballot later in the year 1989: D 3794-79, "Standard Practice for Testing Coil Coatings"; and D 4145-83, "Standard Test Method for Coating Flexibility of Repainted Sheet."

Discussion continued on: 1) The effect of acid rain/coating resistance material for the building products industry (nonautomotives). It was learned that the SART test is in the beginning stage of development by the NCCA, and it will be a considerable length of time before positive results are known. It was recommended to halt discussion on the subject until more information is known; 2) The effectiveness of the "Pencil Hardness Test"; and 3) Standardization of outdoor testing of samples for the building products industry (nonautomotive).

G.R. Pilcher was requested to write a brief press release that will appear in several paint and metal related journals seeking comments, suggestions, and recommendations on the subject of "cure determination." Current "cure tests," such as "Pencil Hardness" and "Solvent Resistance" are frequently challenged regarding both their meaning and validity. The press release should start appearing in the journals by mid-year 1989.

D01.53.01, Pretreatment, reported on current industry practices for HDB and galvanized, galvalume, aluminum or aluminized steel, and CRS. An evaluation of these practices will be done by the task group and reported to the subcommittee.

D01.53.02, Cure Test for Coil Coated Material, reported that they discussed current industry practices and their effectiveness. Discussion will continue at the next meeting.

SUBCOMMITTEE D01.56 PRINTING INKS

J.M. Fetsko, Chairman

D01.56.02, Lightfastness of Prints, J. Daugherty, Chairman, distributed copies of the proposed revisions of Test Method D 3424, "Lightfastness of Printed Matter." A round-robin is in progress in which 16 prints are being exposed to natural daylight under glass, xenon lamps, enclosed carbon arcs, and HPUV. A special meeting will be held for the purpose of selecting appropriate color difference endpoints.

D01.56.04, Viscosity of Paste Inks, J.M. Fetsko, Chairman, reported that the revised Test Method D 4040, "Viscosity of Printing Inks and Vehicles by the Falling Rod Viscometer," passed the D-1 ballot without comments or negatives. The Society ballot is next.

D01.56.06, Ink Tack, T. Sayers, Chairman, reported that a joint meeting was held with Sub. D01.34, "Naval Stores." The Sub. D01.56 ballot of the revised Method D 4361, "Apparent Tack of Printing Inks and Vehicles by the Inkometer," had received two comments relating to the availability and operation of new equipment. A revised text with ensuing changes was distributed. It was also agreed that the distribution time be changed from 5 s to 15 s.

D01.56.09, Tinting Strength, J.M. Fetsko, Chairman, distributed copies of the proposed new test method, "Relative Color and Strength of Printing Ink Dispersions." A round-robin is in progress in which colored inks are being tested instrumentally and visually.

D01.56.10, Water Pickup of Litho Inks, G. Bien, Chairman, reported that the proposed new test method, "Water Pickup of Lithographic Printing Inks and Vehicles in a Laboratory Mixer," passed the D-1 ballot and was assigned the number D 4942.

D01.56.12, Viscosity of Liquid Inks, J. Cichon, Chairman, reported that a joint meeting was held with Sub. D01.24.19, "Viscosity of Efflux Cups." Because of a mix-up in samples, a new round-robin will be held in which oils, solvent-based and water-based inks will be tested by the Zahn cup.

D01.56.14, Setting of Heatset Inks, A. Urdea, Chairman, distributed copies of a proposed new test method, "Relative Setting of Heatset Printing Inks by the Sinvatrol Tester." A round-robin is planned in which three blue inks varying in setting time will be distributed along with a reference sample.

D01.56.17, Practice for Printing Inks, A. Scarlatti, Chairman, distributed a list of ASTM test methods that are applicable to printing inks. It was agreed an index for-

mat was preferable to that of a practice format.

D01.56.19, Print Intensity, P. Legnetti, Chairman, described a proposed test method in which weighed prints are measured densitometrically. It was suggested that by printing onto a black-and-white substrate, the test could easily be expanded to include opacity of printing inks.

D01.56.21, Print Abrasion, G. Bien, Chairman, distributed copies of a proposed new test method, "Abrasion of Printed Matter by the CAT Comprehensive Abrasion Tester." G. Vandermeersche agreed to organize a round-robin in which offset and gravure prints will be distributed to cooperating laboratories.

D01.56.23, Degree of Dispersion by Microscopy, P. Legnetti, Chairman, reported that an exploratory round-robin of a proposed new test method, "Particle Size Distribution in Printing Ink Dispersions by Microscopy," gave excellent agreement among cooperating laboratories. A full scale round-robin will be conducted with four paste and four liquid inks.

D01.56.24, Grit Determination, M. Fuchs, Chairman, reported that an exploratory study of grit in flushes gave poor results. It was suggested that flushes be let down in a varnish prior to dilution in a solvent. Rather than developing a new method, it was recommended that appropriate paragraphs and corresponding precision statements be added to Test Method D 195, "Coarse Particles in Pigments, Pastes and Paints."

D01.56.25, Radiation Curing, L. Drucker agreed to chair a new task force set up to develop a test method for "Completeness of Cure of UV & EB Coatings and Printing Inks."

D01.56.26, Chemical Resistance, B. Blom agreed to chair a new task force to develop test methods for resistance of printed ink films to water, alkali, soap, and other such agents. A comparative study will be made of ISO, DIN, BSI, and other published tests.

D01.56.33, Drying of Sheet-Fed Inks, G. Bien, Chairman, reported that drying tests on two inks conducted by the in-house methods of six labs gave widely divergent results. The next study will be restricted to tests on glass and in bulk according to definitive instructions.

SUBCOMMITTEE D01.57 ARTISTS' PAINTS AND RELATED MATERIALS

J.T. Luke, Chairman

D01.57.01, Drawdowns of Artists' Paints, T. Pamer, Chairman. Chairman

Pamer could not be present so J.T. Luke reported that the "Practice for Preparing Drawdowns of Artists' Paste Paints" has completed the Sub. D01.57/D-1 balloting levels with no negatives. The one comment from G.A. Stearns questioned whether the aperture on a drawdown bar should be referred to as a 'gap' or a 'gate'. In Section 3.1.1 the definition of a drawdown bar reads: "a metal applicator with a specified gap designed to deposit a wet paint film uniformly on a specified test panel." Both 'gap' and 'gate' are used in the industry. The task group voted unanimously to retain the word 'gap' because it is more descriptive to individuals not familiar with the industry. It is also the term used in the Leneta catalogue in descriptions of the drawdown bars they market. The practice was balloted at the Society level in March 1989, and should be approved by June 1989.

D01.57.02, Lightfastness of Pigments, T. Vonderbrink, Chairman. Standards D 4302, "Specification for Artists' Paints: Oil, Acrylic Emulsion, Alkyd and Resin Oil," and D 4303, "Test Methods for Lightfastness of Pigments Used in Artists' Paints," each contain several sections, i.e., sections on oil, resin-oil, acrylic and alkyd paints. A section on watercolors is ready and a section on gouache paints is being prepared. It was decided at the last meeting that both standards have become confusing to users. It was further decided that D 4303 should contain only the instructions for lightfastness testing and D 4302 should be broken into separate specifications based on the type of vehicle. Instructions for preparing lightfastness test specimens would be included in the separate specifications rather than being in D 4303. It was decided that oils, resin-oils, and alkyds could remain in one specification, but there should be separate specifications for acrylics and for watercolors. A decision will be made later on whether gouache will be included in the watercolor specification or should be a separate specification.

Chairman Vonderbrink had prepared a draft of the new D 4303. The sections describing the preparation of test specimens were removed from D 4303 and wording changes were agreed upon.

R. Kinmonth led a discussion on the problems of exposure of test specimens under different light sources, focusing on the instruments used to monitor the amount of exposure.

[Note: Following the meeting Chairman Luke has asked T. Vonderbrink to write a short report on the instruments and methods used to monitor the exposures he has made on oil, acrylic and watercolor paints; and to outline the issues involved with input from R. Kinmonth and T. Takigawa.]

D01.57.03, Tinting Strength, T. Pamer, Chairman. Subcommittee Chairman Luke reported that D 4838, "Test Method for Determining the Relative Tinting Strength of Chromatic Paints," has been approved at the Society level of balloting on October 31, 1988, and will be the 1989 *Book of Standards* Vol. 06.01 with the other Sub. D01.57 standards.

Luke reminded the task group that the original plan had been to use this standard to evaluate current artists' paints and to establish a minimum tinting strength that would be acceptable for conformance with D 4302. There was a tinting strength requirement in the old CS 98-62 and it was planned to have one in D 4302. She remarked that this requirement would make it impossible for diluted student grade products to claim conformance to the standard. To do this will take substantial laboratory time from several laboratories and there have not been any volunteers to date.

The first step would be to examine a range of artists' paints to establish a minimum acceptable tinting strength for each pigment. During preliminary work for the standard, a few pigments were evaluated in a number of well known brands of acrylic emulsion paint. A couple of brands had high tinting strength, a larger group had very similar but lower tinting strength, and there were two or three brands of those tested with very low tinting strength. Considering the fact that other properties besides tinting strength are desirable in an artist's paint, it seemed feasible to establish a minimum tinting strength that would accommodate the majority of high quality brands and weed out those that include a large amount of fillers. It also would be possible for companies that do market paints with exceptional tinting strength to use D 4838 to demonstrate this fact.

D01.57.04, Artists' Paints, A. Spizzo, Chairman. During a planning session on Sunday afternoon, the task group began revision of D 4302, "Specification for Artists' Paints: Oil, Acrylic Emulsion, Alkyd and Resin-Oil," to divide it into separate specifications for vehicles containing oil, for acrylics, and for watercolors. T. Vonderbrink and J. Luke had each prepared a draft specification of the oil, resin-oil, and alkyd sections of D 4302. Elements from both documents were combined in a version for balloting.

Vonderbrink also presented a draft of the acrylic section of D 4302 as a separate specification. It was agreed that the proposed specification for acrylic emulsion paints should parallel the specification for oil, resin-oil, and alkyd paints. It will combine the sections in the current D 4302 that apply to acrylic emulsion paints and the sections on preparation of test specimens for acrylic paints that are in the current D 4303, "Test Methods for Lightfastness of Pigments Used in Artists' Paints."

D01.57.07, Physical Properties, H. Brown, Chairman. There was no report because no further work had been done on the study of adhesion among paints with unlike vehicles.

D01.57.08, Toxicity Labeling, W. Stopford, Chairman. The new federal law includes several additional requirements beyond those in D 4236, "Practice for Labeling Art Materials for Chronic Health Hazards." The task group took up the question of whether D 4236 should be revised to include those provisions and whether to use identical language.

The first discrepancy is that the new law uses different wording than D 4236 does in defining art and craft materials. D 4236 reads: "... as intended for and suitable for users as defined herein"; whereas the law reads: "... as suitable for use in any phase of the creation of any work of visual or graphic art of any medium."

There was agreement among Task Group members that the meaning is identical. Charles Jacobson of the Consumer Product Safety Commission said that CPSC considers that the law applies to all consumer products since almost any consumer product can be used in some type of art or craft. If the product can be purchased by the public in a retail store without a requisition form, CPSC considers it a consumer product. This interpretation of the definition of an art or craft material is broader than California's interpretation has been. California has considered as art or craft materials all products sold in art or craft stores, or in departments in stores featuring art and/or craft supplies. Since both Jacobson and Dr. Robert Schlag of the California Department of Health Services said that the difference in wording between D 4236 and the law would not affect their interpretation of the products covered, it was decided not to revise the wording in D 4236.

It was decided that the next two additional requirements in the law apply exclusively to the CPSC and did not belong in D 4236. The next difference between the two documents involves Section 5.7 of D 4236: "The precautionary label shall contain a statement identifying a source for additional health information substantially in conformance with one of the phrases listed below: For more health information—(24 hr cost-free telephone number), contact a physician for more health information, or call your local poison control center for more health information." The federal law reads: "All art materials that require chronic health labeling pursuant to this section must include on the label the name and address of the producer or repackager of the art materials and an appropriate telephone number and a statement signifying that such art materials are inappropriate for use by children."

It was commented that other federal laws already require manufacturer's name and

address on the product; however, there is merit in including the statement since overseas companies use D 4236 and they may not be familiar with all other federal laws. There was concern when D 4236 was drafted that the customer have access to a source of reliable information about a product's ingredients and any possible hazards after company hours. This was the reason for requiring either a 24 hr phone or referring the customer to a local poison control center, which have access to product formulations. Luke said that she always objected to the inclusion of the phrase to "contact a physician" because the physician would not have information on the contents of a specific product. Others had felt that the physician could get the necessary information from a poison control center. It was agreed that the D 4236 telephone provision should remain as being stronger and there was interest in eliminating the option for companies to refer customers to a physician.

The other difference in this section is that the law mandates that a specific warning about children has to go on all products that require hazard labeling. Stopford pointed out that he already requires warnings about children on the labels of hazardous products and he felt that the requirement should be added to D 4236.

A further requirement in the law would affect Section 3.5 of D 4236. The law requires that: "If an art material producer or repackager becomes newly aware of any significant information regarding the hazards of an art material or ways to protect against this hazard, this new information must be incorporated into the labels of such art materials that are manufactured after 12 months from the date of discovery. If a producer or repackager reformulates an art material, the new formulation must be evaluated and labeled in accordance with the standard referred to in subsection (a) as modified by this subsection." D 4236 requires that products have a toxicological review as necessary, but at least every five years. The task group recommended adding this provision to D 4236.

The law also adds further requirements for small products. D 4236 requires only that products smaller in size than one fluid ounce or one ounce net weight carry the signal word "Warning" and a list of potentially harmful or sensitizing components. The law requires that the product include a package insert carrying the full warning and precautionary statements if the CPSC determines that the product presents a health hazard in spite of its small size.

B. Heath and J. Luke voiced concern that the requirement for package inserts would drive some single sticks of pastels or colored pencils and small pans of watercolor from the market. There was a discussion on the meaning of the requirement. Several people were asked to propose

wording to add the requirement of D 4236 for presentation at the subcommittee meeting.

Luke reminded members that there had been no action on two of the precautionary phrases presented for approval to the task group at the last meeting in New York. She reported that ASTM Sub. C21.08 agreed with the actions Sub. D01.57 took on the other phrases proposed by W. Stopford and have added them to C 1023, keeping C 1023 and D 4236 parallel. In New York Sub. D01.57 rejected the phrase 'Shower after use' on the ground that consumers should not be using products that are so dangerous that it is necessary to shower after using them. W. Spangenberg, who is a member of Sub. C21.08, pointed out that dusts can penetrate clothing and present a hazard in ceramics, sculpture, and wood-working. The task group agreed to add the phrase.

In New York there was an objection to the wording of the other phrase 'Exposure may induce angina in individuals with pre-existing coronary artery disease.' Sub. C21.08 agreed that the wording could be improved but believes that this warning is needed for methylene chloride and perhaps other substances. M. Rossol was asked to see if she could develop better wording. Rossol reported that she has talked with a number of experts and has several alternative phrases. Luke asked her and M. Golden to recommend a phrase to the subcommittee.

D01.57.09, Watercolors, T. Vonderbrink, Chairman, presented lightfastness data from a series of exposures of pigments dispersed in a watercolor vehicle again, this time based on 1260 MJ/m² of radiant exposure. At the last meeting in New York, Vonderbrink had recommended rating watercolors after 630 MJ/m² of exposure because a higher correlation with lightfastness tests on acrylic emulsion paints was found at that point. (The acrylic emulsion vehicle is judged to be more similar to watercolor than to oil vehicles, although the watercolor vehicle probably offers less protection to the pigments.) The point was raised in New York by H. Brown and R. Johnston-Feller that framing under glass, as watercolors are displayed, does not offer increased protection from fading. Luke then raised the question whether it is valid to use the same lightfastness categories for watercolors as is used for other types of artists' paints, when the watercolor test specimens have been exposed to only half as much irradiation, since the glazing offers no extra protection.

In his tests, Vonderbrink had continued the exposures to 1260 MJ/m² and following the New York meeting he reexamined the data and reported to the task group that it is practical to base the ratings, and placement in categories, on this much exposure.

Thus all artists' paints will be rated by the same criteria.

Seventy-two watercolor specimens containing different pigments were tested. Of these, 43 would fall into the Lightfastness I category, eight would fall into Lightfastness II, seven would fall in Lightfastness III, while 14 faded too badly to be placed into any of these categories. Of the 72 pigments, 22 had not been tested in an acrylic emulsion vehicle but 50 could be compared with the acrylic test results. Thirty-five of the 50 pigments fell into the same category as they did in an acrylic emulsion vehicle, a 70% agreement. Fifteen will fall into a different category, all of these into a category indicating less lightfastness. Eight moved down one category, while seven moved down two categories. (For example, from Lightfastness I to Lightfastness III.)

Luke moved, it was seconded and approved, that all pigments that rated in the same category as they did in the acrylic emulsion vehicle be accepted for that category. Pigments that had not been tested in earlier tests would be placed in the categories indicated by these tests, at least until tests by other companies indicate otherwise. Vonderbrink proposed that the 15 pigments where the test results did not agree with previous tests on those pigments be retested and he volunteered to do this. B. Heath said Winsor & Newton may also retest some of the watercolor pigments but this will depend on the situation at the firm's laboratory in England.

Chairman Vonderbrink had prepared a draft of a specification for watercolors modeled on the standards for oil and acrylic paints. There was a reminder to make provisions for watercolor cakes (pans) as well as the tube colors. Vonderbrink will write a second draft to include this and also parallel sections that had been added to the acrylic emulsion paint specification earlier in the day when appropriate.

D01.57.10, Consumer Evaluation. H. Brown, Chairman. In the course of developing a proposed method for evaluation of art materials for lightfastness by artists, a number of tests using the ISO Blue Wool card as a visual monitor were completed by H. Brown, J. Luke, Z. Pinney and M. Gottsegen. At the last task group meeting in New York, 20 individuals used the AATCC Gray scale to rate the amount of color change on three exposed samples of Blue Wool Standard #3 and three samples of Blue Wool Standard #6. The results and the exposed Blue Wool cards from Luke's 18 tests were sent to R. Johnston-Feller and C. Bailie at the Research Center on the Materials of the Artist and Conservator. Each of the eight blue wools on each card was measured, the data studied, and an excellent report submitted to the task group. Chairman Brown passed out copies

of the report and read through the major sections.

The report showed (1) that the average Gray Scale rating of color change between the exposed and unexposed sections of Standards #3 and #6 by the 20 observers resulted in a smooth curve when plotted against the instrumental measurements, implying that there is a good correlation between the GS rating and the measured color difference, ΔE^* . (2) When the measured color difference for all eight standards on the six cards were plotted, the sets of eight Blue Wool standards formed a smooth curve (until the color was almost gone), except for Standard #4, indicating that Standard #4 should not be used as a control in lightfastness tests. (3) In all instances, Standard #3 reached a contrast between its exposed and unexposed sections equal to GS 2.5 (2-3) at the time when Standard #6 showed a perceptible change in color. (4) Since it is difficult to see a small change in Standard #6, yet the test method calls for exposing specimens until Standard #6 shows such a change, it is recommended that the exposure be controlled by removing specimens from exposure at the time that Standard #3 shows a contrast equal to GS 2.5. This will also simplify the standard because only one standard and one gray scale step is needed.

Chairman Brown led a discussion on whether the test method should be divided into two sections, one for artists and the other for art technicians. Since it was felt that framing under glass does not necessarily offer increased protection from fading, the statement will be removed that says the method was only for use on materials that will be displayed under glass. J. Luke pointed out that the task group had voted to use the categories 'Lightfast,' 'Moderately Lightfast,' and 'Fugitive' for art materials tested in this way. She believed that artists would equate this 'Lightfast' category with the 'Lightfastness I' category in artists' oil, resin-oil, alkyd, and acrylic emulsion paints and yet the pigments would have received less exposure. She based her opinion that there has been less exposure on the fact that the Blue Wool Standard #6 had faded severely when exposed in Levison's lightfastness tests on oil and acrylic paints.

Luke suggested that either the category name be changed or exposure continued until there is a larger color change in Standard #6. The method for artists' use, where simplicity is a major consideration and the artist is making his own judgment on what to accept, might require only Standard #3 faded to GS 2.5; while the method planned for use by technologists might require both Standards #3 and #6, affording an extra check that exposure conditions were not abnormal in some way, and exposure be continued until #6 showed definite color loss. She displayed the exposed Blue Wool cards to demonstrate that Standard

#3 still retained some color when Standard #6 showed definite loss of color and there was a barely perceptible change in Standard #7. It was pointed out that only Levison's exposure of Standard #6 to natural light is relevant since the xenon arc and fluorescent exposures may fade Standard #6 in an abnormal way. Brown is to look at the Blue Wool clothes that were exposed with Levison's lightfastness tests on oil and acrylic emulsion paints and kept in the dark since, to check the degree of fading of Standards #3, #6, and #7. It was agreed that these questions would be looked into and a new draft prepared.

D01.57.11, Gouache Paints. T. Takgawa. Sub. D01.57.11 did not meet in Fort Lauderdale in January but will meet Saturday, May 19, 1989, in conjunction with the National Art Material Trade Association convention in San Francisco. Many of its members are from overseas and can only be in the United States at that time.

D01.57.12, Determination of Toxicity. W. Stopford, Chairman. Charles Jacobson, Compliance Officer of the U.S. Consumer Product Safety Commission (CPSC), reported that the federal legislation on health hazard labeling for art and craft materials, which includes D 4236, "Practice for Labeling Art Materials for Chronic Health Hazards," was signed into law on November 18, 1988. CPSC must publish guidelines for determining chronic health hazards within a year. D 4236 becomes law in two years.

It is expected that CPSC will issue proposed guidelines for determining carcinogenicity by March and public hearings will be held in May or June. By the end of the fiscal year, that is September 30, guidelines for neurotoxic and fetotoxic hazards should be defined and issued. If the guidelines are too stiff or too lenient there will be lawsuits. There could be a delay since the CPSC presently has only two commissioners. There will not be a quorum until President Bush appoints a third commissioner. CPSC will only be able to maintain current programs until the third commissioner is appointed and confirmed.

In the meantime, CPSC must decide how to implement the requirements in the new law that (1) producers describe the criteria used to determine whether a product has the potential for producing chronic health hazards and provide a list of their products requiring warning labels; and (2) producers submit, upon request from CPSC, product formulations. Luke said that during discussions between legislators and the Coalition for Health Labeling of Art and Craft Supplies while the legislation was being written, the understanding was that individual companies, or certifying bodies responsible for labeling determinations, must furnish the criteria used in evaluating the products for possible health haz-

ards to CPSC; and that CPSC could also require detailed product formulations in cases where there was reason to question the labeling.

Sandra Eberly, Program Director, will be formulating the evaluation steps. Jacobson feels she would welcome input. She can be reached at (201) 492-6554. Dr. Andrew Ulsamer, Director of Health Science, will be directing the process of producing the guidelines. In addition, CPSC must prepare general information on health hazards from art and craft materials for public dissemination. A one or two page Safety Alert will be issued shortly. Jacobson suggested that anyone who would like to suggest text for the Alert contact Kenneth Giles of the CPSC Public Affairs section at (301) 492-6580.

Jacobson stated that CPSC hopes to base chronic health hazard decisions on information on hazards presented by a specific product rather than on the presence of arbitrary levels of hazardous substances in the product. This is why CPSC is interested in solubility determinations and studies relating solubility to illnesses in test animals. If reliable methods are not established to evaluate individual products for toxicity, then CPSC will set levels of hazardous substances that will trigger warning labels, as has been done in the past.

Dr. Robert Schlag reported that the budget of California's Department of Health Services has been cut by 10%. The three assistants working on the implementation of the California's law containing D 4236 have been transferred to other projects. This means less research, less surveillance and more reliance on industry and on Dr. Stopford's program for the Art and Craft Materials Institute (ACMI). Schlag referred to the current California regulations as 'shadow regulations' since there are no funds for implementation. He hopes this can be rectified.

Schlag will send copies of California's guidelines on art and craft materials to Luke for distribution to interested subcommittee members. The California list of art materials approved for use in kindergarten through 6th grade includes most of the products deemed safe by ACMI, but there are a few types of products that ACMI certifies as nontoxic that California does not allow schools to purchase. This includes oil paints, where the hazard is not due to the paints but to solvents that may be used in cleaning up. Schlag said the California list will be updated periodically and he and Stopford are conferring on ways to reconcile it and the ACMI list. It costs California around \$30,000 to publish the school list.

Schlag stressed the need for studies measuring the amounts of exposure for both children and professional artists while using art and craft materials. This information is important in assessing what the hazards are.

J. Brezinski mentioned that there was a Scandinavian study published about 10 years ago that seemed to establish that the brain was irreversibly damaged by exposure to petroleum solvent vapors. However, the same group has recently published data refuting their earlier study. This study suggests there is temporary neurological damage due to solvent exposure but nothing has been established to date about permanent brain damage due to solvent absorption.

Mr. George Brandt reported that the Illinois Department of Public Health is recommending an amendment to the Illinois law that would substitute a requirement to publish an approved list of art materials for grades K-6 as a substitute for the current requirement to publish a list of materials forbidden for K-6. The department's laboratory is busy 24 hour a day on AIDS blood analysis and analysis of soils from across the state for lead content.

Chairman Stopford described progress on the round-robin to develop a test method for determining solubility of heavy metals in art supplies. Two solubility methods are in general use, i.e., the French method that has proven the most accurate, but is difficult to use; and the British method that has shown more variability. The round-robin requires laboratories to test three art materials, i.e., a watercolor, an oil paint and a ceramic glaze, all containing cobalt, using both the French method and an improved version of the British method. There are seven participating laboratories: Sun Chemical, Kirby Memorial Health Center, Twinning Laboratories, the state of California, the state of Illinois, Hallmark Laboratories, and CPSC. Each laboratory is to analyze the three samples in some cases eight times by each method.

To date, test results have been returned by two laboratories. Results from Laboratory A, which regularly performs solubility determinations, showed small variability. Laboratory B had problems with acidification and filtration procedures. Both laboratories found it impossible to properly disperse the oil paint. Based on the two reports, the French method showed the higher amounts of soluble cobalt. About $\frac{1}{2}$ of the known cobalt content of the watercolor was found to be soluble, about $\frac{1}{3}$ of the known cobalt in the glaze was soluble and about $\frac{1}{10}$ of the cobalt in the oil paint was soluble; however, the oil paint was not well dispersed. It was agreed that documentation should be improved and this will be done before the remaining laboratories use the method. The two reporting laboratories will be asked to repeat portions of their work.

Sub. D01.57—The status of balloting of the subcommittee's standards and revisions was reviewed. The recommendations of the various task groups were reviewed and

approved, i.e., the changes in D 4302, D 4303, D 4236, the new specification for acrylic emulsion paints, and the new watercolor specification. The subcommittee voted to send these standards out for Sub. D01.57 ballot.

DIVISION 60 PAINT APPLICATION

SUBCOMMITTEE D01.61 PAINT APPLICATION TOOLS

F.B. Burns, Chairman

D01.61.01, Paint Brushes, T.J. Sliva, Chairman, provided materials and apparatus so that the proposed "Practice for Preparation of Paint Brushes for Evaluation," and proposed "Test Method for Manual Determination of Paint Discharge Characteristics of a Brush" could be run at the meeting. There was time for only two cooperators to perform the tests. Time also did not permit multiple replications by these cooperators. A preliminary review of these results suggested little objectivity from the tests. It was agreed that further analysis will be made, and some suggested modifications and experimental tests will be performed by the chairman and cooperators for discussions at the next meeting.

D01.61.02, Paint Rollers, J.F. Price, Chairman, reported that the materials for a new round-robin relating to "Evaluation of Shorter Nap Paint Roller Covers" had been sent to four cooperators very recently and that it was too soon to receive results. Plans are to receive and review these test results for discussion at the next meeting in June. The chairman provided the cooperators with copies of his results on one unidentified roller to provide an idea of the order of magnitude expected in the testing.

D01.61.04, Nomenclature and Definitions, E.C. Harsch, was appointed Chairman. It was reported that the list of 15 definitions developed by this task group had been submitted to Sub. D01.16 and that a written ballot is being arranged for that group.

D01.61.05, Bulk Density of Filaments and Bristles, T. O'Brien, Chairman, reported initial data on the force to remove a filament from a brush ferrule which had not been set with adhesive. The initial data base will be expanded by more testing and hand-filled round-ferrule filament removal forces will also be determined. In addition, filament forces will be determined from a calibrated trough unit. The concept is to

measure bulk density under specified packing conditions.

Circumferential measuring apparatus was presented and techniques related to using this apparatus to calculate bulk density were discussed. A picker weight system using a seamless round ferrule is being developed by another cooperator.

D01.61.06, Buckling Resistance of Filaments, W.B. Bond, Chairman, described experiments measuring buckling force applied axially for tapered and level filaments. The tests included a range of filament types and cross-sections. Graphs of force vs compression were presented for a range of filament cross-sections and poly-

mer types. The equipment was demonstrated. The filament length proposed for the test is about 10mm.

The group agreed the chairman should write up a draft of a test method and apparatus to prepare for potential round-robin testing.

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Society Meetings

BALTIMORE FEB.

FSCT Officers Visit

Federation President James E. Geiger, of Sun Coatings, Inc., and Executive Vice-President Robert F. Ziegler were in attendance.

Mr. Geiger's topics of conversation included the 1988 Paint Show in Chicago, IL; the possible incorporation of the Federation; the proposed new Federation office building; and international membership in the Federation.

Mr. Ziegler discussed the up-coming 1989 Paint Show in New Orleans, LA; the 1990 Paint Show in Washington, D.C.; Spring Week in Los Angeles on May 16-19; the Federation budget; and the 1989 Yearbook.

Mr. Geiger presented Howard G. Sholl with a 50-Year Pin for his dedicated service and longevity in the Society. Mr. Sholl is a Federation and Society Honorary Member.

The speaker for the evening was Society member John Covington, of Covington Manufacturing Consultants. Mr. Covington talked on the "ROLE OF INVENTORY."

The speaker defined productivity as any activity that takes an organization closer to its goal, and the goal for any manufacturing company is to make money. This is accomplished through net profit, return on investment, and cash flow. The goal for manufacturing operations, according to Mr. Covington, is throughput, inventory, and operating expenses.

In conclusion, the speaker described the differences between high and low inventories. Mr. Covington stated the key to low inventory is synchronized manufacturing. He also touched on how other countries use zero inventory.

GARY MORGERETH, *Secretary*

CDIC FEB.

"Coatings for Treated Wood"

The educational portion of the meeting included a viewing of the 57-minute videotape "Safety in the Paint Industry." The tape, produced by the Vancouver, British Columbia, section of the Pacific Northwest Society, covers a broad range of aspects related to safety during the manufacture of coatings.

Pittsburgh Society member Allan S. Ross, of Kop-Coat, Inc., was the meet-

ing's technical speaker. Dr. Ross's presentation was "COATINGS FOR TREATED WOOD PRODUCTS."

The speaker focused on the following areas: a history of wood preservation, types of preservatives used for pressure treated wood, types of coatings compatible with pressure treated wood, and proper coating techniques for pressure treated wood.

W.E. WHITLOCK, *Secretary*

CHICAGO FEB.

"UV/EB Curable Coatings"

Frank Kosnik, of Radcure Specialties, Inc., discussed "ADVANCES IN UV/EB CURABLE COATINGS."

Mr. Kosnik stated the use of ultraviolet or electron beam radiation as sources for polymerizing acrylate functional materials has become an increasingly important technology for the coating, ink, and adhesive industries. The speaker gave a brief review of the history and advantages and disadvantages associated with this technology. The key formulating principles and recent advances in research and development also were described.

The second speaker was Robert S. Henderson, of Mobay Corp. Mr. Henderson, a member of the Pittsburgh Society, spoke on "POLYURETHANE COATINGS FOR THE BAKING INDUSTRY—POWDER, WIRE, COIL."

The talk was an overview of polyurethanes, including the chemistry and properties of one- and two-component systems. The speaker said baking polyurethanes based on hydroxy-functional resins with isocyanate crosslinkers form light stable, durable films with high hardness combined with low temperature flexibility and outstanding solvent and chemical resistance. According to Mr. Henderson, many applications in powder, wire, and coil demand urethane performance, but without the ambient cure requirement. Blocked isocyanates are suitable building blocks for these applications.

KARL SCHMIDT, *Secretary*

Mr. Geiger spoke about the 1988 Paint Show held in Chicago and commended the Host Committee for their excellent hospitality. He presented Gifts of Appreciation to: Co-Chairmen Audrey LeNoble, of Emco Chemical Distributors, and Rudolph C. Albrecht, of Ace Paint Div., Ace Hardware; and Committee members Ross C. Johnson, of Valspar Corp.; Thomas R. Drucker, of Graham Paint & Varnish Co., Inc.; Natu C. Patel, of Ace Paint Div., Ace Hardware; and Thomas P. Yates, of United Coatings, Inc.

Also discussed were the plans to build a new Federation office and the possibility of international membership in the Federation.

Mr. Ziegler commented on the 1989 Paint Show to be held in New Orleans, LA, and discussed the Joseph A. Vasta Scholarship which has been instituted by the Coatings Industry Education Fund.

S. Peter Pappas, of North Dakota State University, spoke on "LOW VOC COATINGS: GENERAL CONSIDERATIONS AND APPLICABILITY OF LIQUID CRYSTALLINE BINDERS." Dr. Pappas is an Educator Member of the Northwestern Society.

The speaker discussed the advantages and challenges relating to the formulation of high solids coatings. He introduced the potential for lowering VOC of air-dry alkyds by incorporation of liquid crystalline groups. Dr. Pappas referred to ongoing studies at North Dakota State University on novel liquid crystalline polymers and oligomers for coatings binders, highlighting the studies on air-dry alkyds and acrylic lacquers. He said results indicate that liquid crystalline binders form stable NAD, making them attractive for low VOC coatings and as sag control agents in baking finishes. According to Dr. Pappas, these materials also show unusual combinations of hardness and flexibility, together with good adhesion and fast dry—properties which are not attainable with corresponding amorphous binders.

CLIFFORD O. SCHWAHN

CLEVELAND FEB.

Environmental Program

The meeting's first environmental speaker was William T. Skowronski, District Chief of the Northeast District Office of the Ohio Environmental Protection Agency (EPA). He presented an "INTRODUCTION TO OHIO EPA AND NEW ISSUES FACING ALL OF US."

CHICAGO MAR.

Federation Visit

Attending the meeting were Federation President James E. Geiger, of Sun Coatings, Inc., and Executive Vice-President Robert F. Ziegler.

The speaker prefaced his talk with an explanation of the Ohio EPA. The state agency is not directly affiliated with the federal EPA; however, they can issue permits which are valid for both the state of Ohio and the federal EPA. Mr. Skowronski stated that the Ohio EPA is a regulating agency that drafts permits, inspects facilities, takes and analyzes samples, and investigates complaints.

According to the speaker, one major area of concern for the Ohio EPA is air pollution. The agency currently is reviewing toxic emissions which are self-reported by plants under new regulations, as well as inspecting auto emissions in the Cleveland and Cincinnati areas.

Mr. Skowronski talked about public water supplies and how they are being monitored for bacteriological and chemical toxic values. Filtration processes also are being monitored. Lead in soldering compounds is being banned to reduce water contamination and well-head legislation is in the works.

The speaker discussed water pollution control and solid and hazardous waste. According to Mr. Skowronski, under House Bill 592, counties will no doubt be the basis for controlling solid waste disposal. By 1991, it is anticipated that 39 counties in the state will have no landfill capacity. Mr. Skowronski said there will be a need to schedule for opening, closing, and expanding of facilities. Industrial facilities are not included in the state plan. There are eight Federal Superfund sites in Northeastern Ohio but funds are not available for cleaning up smaller magnitude, very seriously contaminated sites.

The speaker said that 5,000 Emergency Response cases are reported each year, but only about one-third are responded to because of a lack of manpower. If individuals are not cooperative in cleaning up spills, therefore, they can be charged for the Ohio EPA taking care of the problem. A large percentage of such spills are petroleum spills.

In conclusion, Mr. Skowronski indicated that the Ohio EPA encourages public meetings to make people aware of problems and to receive feedback from the taxpayers.

The second speaker was Harry N. Finkbone, Manager of Safety and Toxicology at The Glidden Co. Mr. Finkbone's subject was "IF ONLY I HAD KNOWN."

The focus of the speaker's presentation was to give regulations from the Toxic Substances Control Act (TOSCA) as relating to the paint and coatings industry, to spell out the processes, and to give examples of the consequences for not following or planning for the regulations.

TOSCA 8E, for example, makes one subject to civil/criminal penalties for not reporting substantial risks. Mr. Finkbone said that if all chemicals are not on the TOSCA list when a new company is purchased, a plant shut down is possible. All Material Safety Data Sheets have to be revised and distributed within three months to implement any hazardous chemical exposures.

Other agencies involved include: the National Sanitation Foundation, responsible for potable water; and the USDA whose approval is needed when coatings are used in meat packing.

Mr. Finkbone noted that, because of their risk of causing cancer, crystalline silica and styrene have caused the paint profession to be listed as an occupational hazard.

Q. Since many U.S. companies are owned or affiliated with foreign countries, will government agencies try to set up rapport with foreign countries?

A. The EPA has made a reasonable effort to work with foreign countries.

Q. Will extra cost cause imports to take over?

A. It seems reasonable that this will happen unless our legislators can be convinced to react to the problem.

RICHARD J. RUCH, *Secretary*

DALLAS JAN.

"TiO₂ Update"

The evening's technical speaker was Louis Griffis, of Kerr McGee Chemical Corp. The title of Mr. Griffis' talk was, "TiO₂ UPDATE: DOMESTIC AND WORLD."

The speaker's focus was on the outlook of TiO₂ for the next five to six years, the impact of the U.S. economy on TiO₂, and the effect of currency value on availability of imports.

Mr. Griffis discussed TiO₂ growth rate and consumption, stating that, since the mid-1970s, U.S. consumption of TiO₂ has exceeded U.S. domestic supply. Imports, which account for 20% of U.S. TiO₂ consumption, make up the difference in consumption and supply. According to the speaker, recent TiO₂ import reductions have further aggravated the supply situation. The reduction can be tied to the lower growth rate of TiO₂ consumption in the U.S. (2%) compared to other areas of the world [Japan (3.1%) and the Far East (4.7%)].

Mr. Griffis also noted that the value of TiO₂ in North America has not increased relative to other areas of the world. He predicted that U.S. supply would not catch up to demand until 1993 or 1994, not taking into account the 11-14% of U.S. TiO₂ that is exported. The speaker said it is expected that world supply will exceed demand in 1991 due to debottlenecking, new plant construction, and plant expansions.

Mr. Griffis also discussed the possibility that the titanium ores from which TiO₂ is derived could be allocated to other areas such as welding and metal works. Furthermore, the trend in TiO₂ production away

HOST COMMITTEE RECOGNIZED—Federation President James E. Geiger presents Gifts of Appreciation to 1988 Federation Host Committee Chairmen Rudolph C. Albrecht and Audrey LeNoble





FEDERATION OFFICER VISIT—Karl Schmidt is joined by Federation Executive Vice-President Robert F. Ziegler and Mr. Geiger at the Chicago Society March meeting

from the old sulfate process to the newer chloride process has resulted in lower availability of the sulfate process ores.

The speaker said that, from an economic standpoint, a recession could help the TiO₂ shortage problem. The U.S. is attractive to TiO₂ importers because of the good value and stability of the currency and the good return on investment.

In conclusion, Mr. Griffiths summarized the coming year's performance of the TiO₂ industry as being similar to last year, which corresponds to low inventories, operation of plants at high capacity levels, and close monitoring of distribution.

RONDA MILES, *Secretary*

KANSAS CITY FEB.

"Hardboard Study"

Steve Bussjaeger, of Davis Paint Co., talked about the ongoing projects of the Society Technical Committee. Included among the group's endeavors are:

PHASE 1, HARDBOARD STUDY—A five-year exterior study of medium density hardboard. Siding coated with exterior flat finishes based on styrene-acrylic, cross-linked acrylic, vinyl acrylic, and terpolymer binders.

PHASE 2, HARDBOARD STUDY—PVC adjusted, vinyl acrylic, acrylic, terpolymer binders.

PHASE 3, HARDBOARD STUDY—Surfactant effects on coating performance.

ARTIFICIAL VS NATURAL WEATHERING—Project is in its sixth month. QUV, carbon arc, xenon vs natural (Kansas City, Arizona, and Florida).

PROPOSED EXTENDER STUDY—Project to determine the relative merit of some extender suppliers' claims on exterior exposure.

Q. What are some of the differences you have seen on hardboard now vs five years ago or longer?

A. Board density variations among the same manufacturers were greater five years ago than they are today. Primed hardboard five years ago were of the VT alkyd type;

today, styrene acrylic/acrylic primers. Oriental Strand Board, although it is not a hardboard in the traditional sense (consists of wood shavings rather than fibers), may become a factor in the market.

Q. Have you seen advantages of one binder system over another?

A. It varies. It depends on the hardboard substrate, but I have seen some advantages of straight acrylics vs terpolymer binders. However, I also have seen some anomalies where vinyl acrylic was better than 100% acrylic.

Q. As a rule of thumb, what appears to be a good coating system for hardboard?

A. One coat of alkyd wood primer plus one coat of a premium exterior latex paint, or two coats of the premium exterior latex paint.

MARK D. ALGAIER, *Secretary*

LOS ANGELES MAR.

Past-Presidents' Night

A moment of silence was observed in memory of Robert E. Minucciani, of The Glidden Co., who died recently. Mr. Minucciani, Chairman of the FSCT Environmental Affairs Committee, was a member of the Golden Gate Society.

Past-Presidents in attendance included: Ray DiMaio, of Koppers Co., Inc. (1987-88); Henry J. Kirsch, of Trans Western Chemicals, Inc. (1986-87); Michael Gildon, of A & M Specialties, Inc. (1985-86); Earl B. Smith, Retired (1984-85); Romer E. Johnson, of Dorsett & Jackson, Inc. (1982-83); Jan P. Van Zelm, of Byk Chemie U.S.A. (1981-82); Donald I. Jordan, of Cargill, Inc. (1980-81); Albert Seneker, Retired (1979-80); Fred Croad, of Tnemec Co., Inc. (1978-79); Gerald L. West, of Decratrend Corp. (1976-77); Kenneth J. O'Morrow, of Oil & Solvent Process Co. (1975-76); William H. Ellis, Society Honorary Member (1971-72); Dermont G. Cromwell, of Sinclair Paint Co. (1970-71); Trevellyan Whittington, Society Honorary

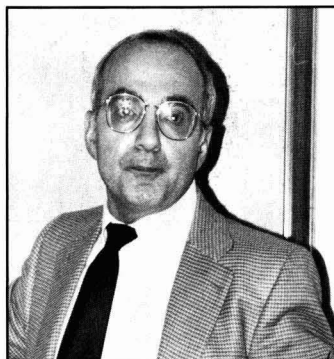
Member (1969-70); Alan U. Hershey, Retired (1961-62); Leonard S. Feldman, Retired (1959-60); and Clyde L. Smith, Society Honorary Member (1946-47).

Manufacturing Committee Chairman Anne M. Probizanski, of Ampro Technologies, Inc., gave an update on the status of the Manufacturing Seminar. The seminar has been rescheduled to Tuesday, June 20. Regulatory issues will be covered with "toxic hot spots" highlighting the seminar. The morning will consist of formal presentations and the afternoon will be a panel discussion.

Thad T. Broome, of J.M. Huber Co., gave the meeting's technical presentation. Mr. Broome, a member of the Southern Society, spoke on "A COMPARISON OF VARIOUS TYPES OF KAOLIN CLAYS IN AN INTERIOR LATEX FLAT WALL PAINT."

The speaker began his discussion with an introduction to kaolin—the white, earthy, pseudo-hexagonal platy material. Mr. Broome stated that kaolin is feldspar, the most abundant product on earth, altered by weathering. A more accurate definition, according to the speaker, is hydrated aluminum silicate.

Mr. Broome spoke about a typical interior flat wall paint formula at 59 PVC which



TECHNICAL SPEAKER—Dr. S. Peter Pappas speaks on low VOC coatings to members of the Chicago Society

Constituent Society Meetings and Secretaries

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

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

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

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

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

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). RHONDA MILES, Union Carbide Corp., 2326 Lonacker Dr., Garland, TX 75041.

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

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

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

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

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

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

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

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

NEW ENGLAND (Third Thursday—Sheraton, Lexington, MA). ARTHUR LEMAN, Samuel Cabot Co., 100 Hale St., Nept, MA 01950.

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

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). TERRY STROM, Ti-Kromatic Paints, Inc., 2492 Doswell Ave., St. Paul, MN 55108.

WINNIPEG SECTION (Third Tuesday—Marigold Restaurant, Winnipeg). EDWIN R. GASKELL, Guertin Bros. Coatings & Sealants Ltd., 50 Panet Rd., Winnipeg, MB, R2J 0R9 Canada.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday following second Wednesday; SEATTLE SECTION—the day after Portland; BRITISH COLUMBIA SECTION—the day after Seattle). JOHN BERGHUIS, NL Chemicals Canada Inc., 3450 Wellington Ave., Vancouver, B.C., V5R 4Y4 Canada.

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

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

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

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

ST. LOUIS (Third Tuesday—Salad Bowl, St. Louis, MO). TERRY GELHOT, Spatz Paint, 1439 Henley Industrial Court, St. Louis, MO 63144.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). JAMES R. SALISBURY, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084.

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

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

contained all the usual additives, including: dispersants, thickeners, and others. Experimental versions were varied by pigmentation only. The cost and PVC were the same and the inert levels were varied. According to the speaker, the change in properties was detailed as ultrafine hydrous clay, delaminated clay, and calcined clay of two grades used in the place of calcium carbonate.

Also discussed was a new kaolin-based pigment designed for the paint industry.

Q. What effect does kaolin have on exterior performance, for example, color retention and chalking?

A. Lamar Brooks, of Freeport Kaolin, did excellent work on the use of delaminated clays in latex house paint. You can learn a lot by finding that published work. It is excellent work. Delaminated clays are one of the best pigments I know of in exterior latex house paint. You have some play nature that helps improve mildew resistance. The theory, from electron microscope work, is when you use a particle that is nodular and is slightly water soluble, it can leave the paint film and produce a hole where mildew spores can begin growing. The play nature of delaminated clays can be an improvement. It is a good material for tint retention. It has excellent performance. The product I recommend most often is the coarse, 3-5 micron, hydrous clay such as Huber 35 or ASP-400. It gives excellent performance. You do not have any acid rain or frosting worry like you have with some of the other materials. The oil absorption goes way down when you get up in the larger particle size kaolins. Kaolin is naturally hydrophilic. It loves water. But, I have never seen a latex paint blister or lose adhesion because it was pigmented with kaolin. Kaolin is very much underused. Of course, calcium carbonate and some other things are cheaper, but kaolin does a good job in exterior latex house paint. Calcined clays will give you the best hiding power, but I do not recommend a real high loading of calcined clay in latex house paint for wood structures. You will embrittle the film. For paints designed for Southern California with a 50-65 PVC interior exterior paint, the best way in the world to keep your cost down and allow you to use a little bit of quality binder is by the use of calcined. On masonry and concrete surfaces interior exterior calcined clay does a beautiful job. Tint retention is excellent.

Q. I have read that clay or talc mixed with mica in certain ratios will make excellent industrial quality primers. Is this true? If so, what ratios do you recommend?

A. Mica is a very much underused paint pigment. Mica offers you a great deal as a functional filler. In primers, mica can do great things for you. It lowers the moisture

vapor permeability. One of the papers that I did for the Roon Awards competition a few years ago was on the permeability of paint films. Much of this work back in 1963 and 1964 was on the use of mica. Mica really reduces the permeability of latex paint and improves corrosion resistance. It really improves adhesion by keeping the water away from the interface of the paint film and the metal. Also, mica has been proven to be of great benefit in zinc primers. In most zinc primers, up to 25% of the zinc can be replaced with mica with no loss in properties. Primers need mica. Stain resistant primers, especially over knots and cedar, can often be improved by the use of mica.

JAMES D. HALL, *Secretary*

LOUISVILLE FEB.

"Formation of Latex Films"

Federation President-Elect John C. Ballard, of Kurfees Coatings, Inc., spoke about the Federation plans for a new office building.

The meeting's speaker was Dennis H. Guthrie, of The Dow Chemical Co. The title of Dr. Guthrie's presentation was "HUMIDITY AND TEMPERATURE EFFECTS UPON THE FORMATION OF LATEX FILMS COMPENSATED BY COALESCING AGENTS."

The speaker stated that the effects of humidity and temperature upon the formation of latex films have been investigated from a theoretical computer modeling perspective. He presented data which demonstrated how the selection of a proper coalescent package can help to compensate for adverse atmospheric conditions that could be encountered during the application of latex coatings.

JAMES U. SIMPSON, *Secretary*

LOUISVILLE MAR.

"Radiation Coatings Industry"

The Executive Committee nominated Membership Committee Chairman Kris Grauer, of Kurfees Coatings, Inc., for Secretary for 1989-90.

Stephan Peeters, of Radcure Specialties Europe, Belgium, was the evening's speaker. Dr. Peeters gave an "OVERVIEW OF THE RADIATION COATINGS INDUSTRY."

The speaker presented details of electron beam and ultraviolet curing systems. He explained the chemistry of monomers, polyols, prepolymers, additives, and initiators. Dr. Peeters also discussed the economics of

radiation curing and how it is used to lower costs, save energy, and protect the environment. The different prepolymers used, namely polyester, epoxy, and urethanes, were highlighted during the talk.

JAMES U. SIMPSON, *Secretary*

NEW ENGLAND NOV.

"Inerting in Coatings Plants"

Environmental Affairs Committee Chairman Joseph H. Weinburg, of Permethane Coatings, discussed the current health and safety regulations affecting the use and manufacture of DMF. He said the new legislation passed in Canada requires all U.S. manufactured products sold in Canada to have their Material Safety Data Sheets and labels printed in both French and English. This new legislation is known as Workman's Hazardous Material Information System (WHMIS).

The two speakers for the evening were Harry Russell and Richard Russell, of Neutronics, Inc. Their talk was on the subject of "INERTING IN COATINGS PLANTS: ECONOMIC AND SAFETY."

According to the speakers, Inerting Control Systems monitor the amount of oxygen present in a processing system. They maintain a certain "safe" oxygen level by adding inert gas to displace hazardous levels of oxygen. The advantages of using this type of system are that it reduces the risk of fire by keeping oxygen at a safe level and it adds inert gas only when needed, not continuously, so that inert gas is not wasted. The speakers stated that inerting control systems result in a cost savings and a safer control method over other fire protection techniques.

Q. What if there are many tanks in the system to be tested?

A. Inerting Control Systems can use many sensors in order to monitor a process that uses several vessels. However, the sensors need to be close to each tank for proper monitoring.

Q. Can people save on the use of inert gas with your system?

A. Yes, because the control system adds inert gas only when needed, not continuously, so inert gas usage can be reduced.

ARTHUR A. LEMAN, *Secretary*

NEW ENGLAND JAN.

"1989 Economic Forecast"

Environmental Affairs Committee Chairman Joseph H. Weinburg, of Per-

methane Coatings, discussed the environmental regulations concerning DMF. He said that DMF has been determined to be a carcinogen and that more stringent government regulations concerning the use of DMF will likely develop soon.

Mr. Weinburg also reported that a study done by the Environmental Protection Agency (EPA) showed that community residents and workers have been apathetic towards the community and workplace right-to-know provisions in SARA Title III. He said that the EPA has expected more people to inquire about the chemicals used by local industry, but community response to this has been very slow.

Dave Hefter, of Du Pont Co., presented an "ECONOMIC FORECAST FOR 1989."

Mr. Hefter explained the current state of the economy in relation to changes and trends in the economy since 1980. He focused on the chemical industry and said the industry is now producing at full capacity for the first time since 1951. This situation is essentially the driving force behind significant price increases in raw materials because the demand for chemicals is up, but capacity is full without any ability to increase supply at this point.

The speaker's forecast for 1989 included some negative aspects of slow growth in consumer spending, weak housing markets, and higher interest rates. However, his positive outlook included an increase in exports which would reduce the trade deficit, and increase in capital spending, and restrengthening of U.S. agriculture. Also, Mr. Hefter stated that he does not foresee a recession in 1989.

Q. How big a problem is the federal deficit?

A. Economists are seeing that it is less of a problem than originally thought. Right now the deficit is declining and it will probably continue to do so. I think the current trade deficit is more of a problem.

Q. Do you foresee an increase in gasoline prices for 1989?

A. No, because when oil prices went down, gasoline prices remained fairly constant, so if oil prices go up, gas should remain constant then too.

ARTHUR A. LEMAN, *Secretary*

PIEDMONT FEB.

"Compliant Epoxy Coating"

The meeting's speaker was James Mergen, of Dow Chemical. Mr. Mergen's presentation was "COMPLIANT EPOXY COATING WITH 1,1,1-TRICHLOROETHANE."

GARY L. WATERS, *Secretary*

Elections

BIRMINGHAM

Active

CLARKSON, KEN—MacPherson Industrial Coatings, West Bromwich, West Midlands.

CDIC

Associate

HAYS, MICHAEL B.—Reichhold Chemicals, Westerville, OH.

PAULSON, TERRY R.—Michelman Inc., Cincinnati, OH.

SIKORA, JON A.—SCM Chemicals, Cincinnati.

CHICAGO

Active

GABER, DENNIS J.—Northwest Coatings Corp., Oak Creek, WI.

MCINTOSH, BRUCE R.—Graphic Color Corp., Elk Grove Village, IL.

MODI, JAYENDRA A.—Dexter Specialty Coatings, Waukegan, IL.

RICHARDS, THOMAS D.—The O'Brien Corp., South Bend, IN.

ROSENTHAL, WILLIAM S.—The O'Brien Corp., South Bend.

Associate

EHLERT, BRIAN R.—Engelhard Corp., Evanston, IL.

KRAFT, RICHARD E.—Kraft Chemical Co., Inc., Melrose Park, IL.

ZAMLER, BRIAN K.—Reliance Resins, Louisville, KY.

KANSAS CITY

Associate

LOEFFLER, NINA L.—Angus Chemical Co., Tulsa, OK.

NEW ENGLAND

Active

ANZUONI, ALBERT R.—K.J. Quinn Co., Inc., Seabrook, NH.

DUFOR, EILEEN M.—Raytheon Co., Lowell, MA.

QUARANTIello, MARK J.—K.J. Quinn Co., Inc., Seabrook.

Associate

EBBRECHT, CHRISTIAN J.—Washburn-Linder Co., Framingham, MA.

NEW YORK

Active

FRASCA, HARRY J.—Pan Chemical Corp., Hawthorne, NJ.

PHILADELPHIA

Active

HARRIS, ALICIA Y.—Hercules Incorporated, Wilmington, DE.

LEONTIDIS, DEAN—Stulb Paint & Chemical Co., Norristown, PA.

PROGNER, PATRICIA P.—M.A. Bruder & Sons Inc., Philadelphia, PA.

STURGILL, J. LOGAN—Hercules Incorporated, Wilmington.

VORNDRAW, JEFFREY—Lilly Industrial Coatings, Inc., Paulsboro, NJ.

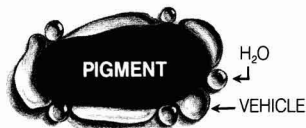
WINICK, RICHARD M.—Witco Chemical Corp., Trainer, PA.

Associate

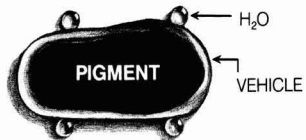
FENSTERMAKER, TILGHMAN G.—GJ Chemical Co., Inc., Newark, NJ.

PREVOZNAK, STEPHEN J.—Collids, Inc., Westfield, NJ.

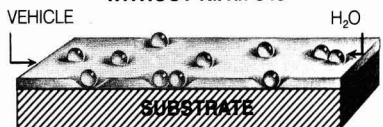
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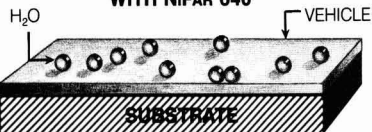
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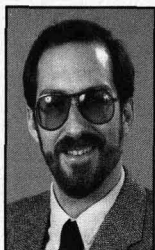
People

Rohm and Haas Co., Philadelphia, PA, has named **Lisa Moore** a Market Specialist/Trade Sales Coatings. Ms. Moore joined the company in 1985 as a Process Engineer at the firm's Bayport, TX, plant. For the past year, she has served as a Sales Specialist/Trade Sales and Industrial Coatings.

Bringing over 12 years' combined experience in the custom colorant and plastic industries, **John Wooten** has been appointed Technical Sales Representative for the southeastern United States for Charles B. Edwards and Co., Minneapolis, MN. Mr. Wooten's responsibilities will include providing technical support and service to the appliance, automotive parts, toy, houseware, computer, and electronic industries.

Edward P. Macey has been named Product Specialist for the Specialty Minerals and Colors Group, Pigments and Additives Division of Engelhard Corp., Edison, NJ. He will be responsible for administrative support in the marketing of attapulgate-based products including marketing research and technical support.

Thomas J. Sliva, Assistant Technical Director of D/L Laboratories, was recently presented with a Certificate of Appreciation by ASTM Committee D-1. Mr. Sliva has been an active member of D-1 for many years, serving as Chairman of numerous committees. He is a member of the New York Society.



Charles R. Hegedus, Materials Engineer with the Naval Air Development Center, Warminster, PA, has joined the Editorial Review Board of the JOURNAL OF COATINGS TECHNOLOGY. He received the B.S.

Degree in Chemical Engineering from Drexel University, Philadelphia, PA, in 1979 and the M.S. Degree in Materials Engineering from Drexel in 1982. He is also a Doctor-



L. Moore



J. Wooten



M.L. Danley



J.D. Harigan

Witco Corp. has announced the appointment of **Mary L. Danley** as Corporate Traffic Manager in its distribution and traffic department. Ms. Danley has held a series of administrative positions since she joined Witco in 1961, most recently serving as Assistant Traffic Manager. She will continue to be based at the company's headquarters in New York City.

Cosan Chemical Corp., Carlstadt, NJ, has appointed **Don Karl** as Customer Service Manager. With total responsibility for the Customer Service Department, Mr. Karl's duties include order entry, shipping, traffic, and warehousing requirements.

Robert M. Costin has been appointed Account Manager for Fitz Chem Corp., Elmhurst, IL. Mr. Costin assumes responsibilities for a sales territory that includes accounts in western Michigan, Iowa, and the greater Chicago area.

al Candidate and Guest Lecturer at the university. Mr. Hegedus has been in the coatings industry for 13 years and is responsible for one patent and two patents pending. He was the recipient of the SME and Aluminum Finishing Achievement Awards, and the 1988 Scientific and Engineering Award at NADC. His areas of interest include coatings formulation; physical, chemical, and optical effects; polymers characterization; and pigment-polymer interactions. Mr. Hegedus serves on the Technical Committee of the Philadelphia Society.

The Specialty Chemical Group of Morton Thiokol, Inc., Chicago, IL, has promoted **John D. Harigan** to Vice President/Powder Coating Group. Prior to this promotion, Mr. Harigan was Vice President/Automotive Products for Bee Chemical Co. in Detroit, part of Morton Thiokol. His responsibilities included Bee's pilot plant, color matching laboratory, trial line facility, sales, and automotive marketing. Mr. Harigan has been with Morton Thiokol since 1986.

Pacific Micro Software Engineering, Long Beach, CA, has assigned its newest member to its programming staff. **Seth Abady** joins the firm as an Applications Programmer, and will be assisting in both technical support of BatchMaster Plus+ and new product development.

The appointments of **Jeffrey Roemer**, Western Regional Sales Manager, and **Tony Rocci**, Sales Engineer, have been announced by Akzo Coatings Inc., Aerospace Finishes, headquartered in Orange, CA. In his new position, Mr. Roemer will direct the day-to-day sales activities for the company's aerospace coatings products in the commercial and military aircraft, ground support vehicles, and missiles industries. Mr. Rocci will be responsible for the sales activities of Akzo aerospace coatings to military, OEM, and domestic accounts located in the southwestern United States.

Marianne Benink has joined Avecor, Inc., San Fernando, CA, as Sales Representative covering parts of two counties in southern California. She brings to this position over 10 years of professional sales experience.

FATIPEC Names Ms. Annik Chauvel Its 1989-1990 President

At the Annual General Meeting of FATIPEC, during the XIXth FATIPEC Congress in Aachen, Germany, Ms. Annik Chauvel was elected President for 1989-1990.

Born in 1927, Ms. Chauvel received a degree in Science and Arts and began her professional career in the field of Communications and Publishing. After receiving additional training at the French CNRS-Laboratory for Macro-Molecular Chemistry, she moved into the fields of science and technology. Ms. Chauvel joined Bourigeaud Co. in 1965 and now serves as President/General Manager for this manufacturer of adhesives.

She is one of the founders of EREC Co., consultants in colors, colorimetry and paints. Ms. Chauvel is currently Managing Director of EREC and is Director and Chief Editor of the magazine, *Double Liaison—Chimie des Peintures*. She also recently became



Editor of the periodical *Science et Technologie de la Conservation et de la Restauration des Oeuvres d'Art et du Patrimoine*, which focuses on the preservation and restoration of masterpieces.

Ms. Chauvel has been a member of the French Association of Technicians in the field of Paints, Varnishes, Printing Inks, Glues and Adhesives (AFTPV) since 1965. She was appointed to the national board of AFTPV in 1976, and sits on the association's Working Group for Academic Teachers.

Ms. Chauvel played a great part in the foundation of the International Committee to Coordinate Activities of Technical Groups (ICCATCI) in 1979, and has been a member of the FATIPEC Board since 1986.

In 1990, under her chairmanship, FATIPEC will celebrate the 40th anniversary of its founding during its XXth Congress in Nice, France.

Raymond B. Seymour, Professor of Polymers Science at the University of Southern Mississippi, is the 1989 recipient of the Society of Plastics Engineers International Award.

Prof. Seymour has been a leading researcher and educator in polymer science and engineering for more than a half century. He has served as a Distinguished Professor of Polymers Science at USM since 1976. During his tenure at USM, the Polymer Science Department has grown from a faculty of two to a faculty of 14 Ph.D. scientists. The recipient of numerous awards, Prof. Seymour has been granted 45 U.S. patents and is the author/coauthor of 36 books and over 1750 articles in encyclopedia and scientific journals.

Wayne Pigment Corp., Milwaukee, WI, purchased in 1975 from PPG Industries, has announced the acquisition of the company by key management personnel. **W. Thomas Pettijohn** has been elected President; **James E. Boldt**, Vice President in charge of administration and production control; **Michael D. Denesha**, Vice President for manufacturing and engineering; and **Lawrence E. O'Connell**, Corporate Secretary and Treasurer.

Mr. Pettijohn is a member of the Chicago Society.

The promotion of **Tina Onderbeke** to Outside Sales Representative has been announced by Dowd and Guild, Inc., located in San Ramon, CA. She will be responsible for the paint, ink, and adhesive manufacturers in the northern California area. Her activity in the coatings industry includes serving on several committees for the Western Coatings Societies' Symposium and the Golden Gate Society for Coatings Technology.

The American Society for Testing and Materials (ASTM), Philadelphia, PA, has announced the election of a new chairman, vice chairman, and six directors to the 1989 ASTM Board of Directors. They are: Chairman—**David M. Greason**, Newark, OH; Vice Chairman—**John A. Millane**, Tinius Olsen Testing Machine Co., Willow Grove, PA; (Directors—three years terms) **Edward F. Diekmann**, GFDS Engineers, San Francisco, CA; **John J. Henry**, Pennsylvania State University, University Park, PA; **A. Ivan Johnson**, A. Ivan Johnson, Inc., Arvada, CO; **Anthony G. Keane**, Irish Airports Authority (Aer Rianta), Dublin, Ireland; **C. Ross Thomson**, National Association of Forest Industries, Canberra, Australia; and **Grover C. Williams**, Trinity Engineering Testing Corp., Austin, TX.

Georgia-Pacific Corp.'s Chemical Division has promoted **Peter E. McCabe** to District Sales Manager/Paper Chemicals. Mr. McCabe, who will be based in Green Bay, WI, will manage sales efforts in the upper Midwest and Northeast.

Also, **Dennis R. Chassaniol** has joined the Division as Senior Sales Representative/Tall Oil and Derivative Products. Mr. Chassaniol brings more than 15 years experience in development, production, and marketing of adhesives and tall oil products to this position. He will be working out of St. Louis, MO.

Polyomx Industries, Inc., a division of Surface Protection Industries, Wilmington, MA, has announced the appointment of **Douglas Mattscheck** to the position of Senior Vice President/General Manager. Mr. Mattscheck brings to this position years of experience in the building products industry.

PPG Industries, Pittsburgh, PA, has named **Vincent A. Sarni** its Chairman of the Board and Chief Executive Officer. Mr. Sarni joined PPG as Vice President of Marketing in the former Industrial Chemical Department in 1968 after 12 years with Olin Corp. He was named Vice President and General Manager of that department in 1969. In 1975, Mr. Sarni was elected Vice President and General Manager of the former Chemical Division, and was elected Group Vice President/Chemicals in 1977. He was elected Senior Vice President of the company in 1980, Vice Chairman in January 1984, and became Chairman in November 1984.

Obituary

Barney Pallia, retired Chemist with Colony Paint Center, died December 17, 1988. He was 80.

Mr. Pallia was born in Chicopee, KS, and moved to Kansas City in 1940. He served as a Chemist for the Colony Paint Center from 1958 until he retired in 1973. Mr. Pallia was a substitute high school teacher in the North Kansas City School District from 1975 to 1985.

He moved through the chairs of the Kansas City Society, serving as Treasurer in 1966, Secretary in 1967, President in 1968, and Vice-President in 1969. He became a Society Honorary Member in 1973, and remained active in the Society until the last few months in 1988.

Survivors include his wife, Ann; a son, Donald; and two grandchildren.

1989 Gordon Research Conferences to Feature Coatings and Films Program, July 31-August 4

The 1989 Gordon Research conferences, "Frontiers of Science," designed to foster and promote education and science by organizing and operating meetings of research scientists with common interest in the fields of chemistry or related sciences, have been scheduled at various academic locations in New Hampshire and Rhode Island from June 12 to August 25.

The purpose of the program is to bring experts up-to-date on the latest developments, to analyze the significance of these developments, and to provoke suggestions concerning the underlying theories and profitable methods of approach for scientific research.

One of the many topics to be presented during the conference is "Coatings and Films," scheduled for July 31-August 4, at Proctor Academy, Andover, NH. The classes will be chaired by Gordon P. Bierwagen, and vice-chaired by George R. Pilcher, of Hanna Chemical Coatings Co.

The following areas of discussion will be included during the week-long program:

"New Techniques for the Surface Analysis of Polymers"—J. Gardella

"New Techniques for the Measurement and Prediction of Coating Lifetimes"—J. Gerlock

"Expert Systems for Coatings"—E. Mahler

"Recent Developments in Langmuir-Blodgett Film Research—Use of Computer Techniques to Simulate Film Behavior"—J.A. Mann, Jr.

"New Polymers for Coating Use"—J. McGrath

"Modern Reactor Technology for Coating Latexes"—J. Schork

"Two-Component, Non-Isocyanate Polymer Systems"—A. Noomen

"Electrochemical Noise Measurements to Predict Corrosion Resistance of Coatings"—B. Skerry

"Corrosion Protection of Magnetic Media Films"—W. Smyrl

"Depletion Layer Effects on Coatings Flow"—J.E. Glass

"Rheology of Microgel Containing Coating Systems"—R. Prud'Homme

"Physics of Roll Coating (Update) and Work on Deformable Rollers"—D. Coyle

"Spin Coating of Ceramic Films—Sol-Gel Processing"—B. Higgins

"Recent Developments in Langmuir-Blodgett Film Research—Implications for Coatings"—J.A. Mann, Jr.

"Computer Modeling of Adsorption on Solid Particles"—G. Fleer

"Self Assembling Monolayers: Building Blocks for Future Organic Materials"—A. Ulmann

"New Developments in Aircraft Coatings"—R. Burton

"Pressure Sensitive Adhesive Films"—A.J. Gotcher

"New Developments in Characterization of Color of Coatings"—D.C. Rich

"First Principles Modeling and Prediction of Coating Optical Performance"—J. Jafolla

For additional information on the conferences, write to: Alexander M. Cruickshank, Gordon Research Conferences, Gordon Research Center, University of Rhode Island, Kingston, RI 02881-0801.

12th Annual Polymerization Short Course Slated for August 21-25, in Davos, Switzerland

The 12th annual short course "Advances in Emulsion Polymerization and Latex Technology" will be held August 21-25, at the Schatzalp Berghotel, in Davos, Switzerland. Course organizers are Gary W. Poehlein, of the Georgia Institute of Technology, and John W. Vanderhoff and Mohamed El-Aasser, of Lehigh University.

The course is designed as an in-depth study of the synthesis, characterization, and properties of high polymer latexes. The subject matter includes a balance of

theory and practical problems. Lectures (in English) will begin with introductory material and progress through recent research results.

The course is structured for engineers and scientists who are actively involved in emulsion work as well as for those who wish to develop expertise in the area.

For more information, contact Gary W. Poehlein, Graduate Office (Savant), Georgia Institute of Technology, Atlanta, GA 30332-0265.

CALL FOR PAPERS

Analysis of Paints and Related Materials Symposium Pittsburgh, PA

May 14-15, 1990

The American Society for Testing and Materials (ASTM), Philadelphia, PA, is seeking papers for the two-day symposium, "Analysis of Paints and Related Materials," scheduled for May 14-15, 1990, in Pittsburgh, PA. The program is sponsored by ASTM standards-writing Committee D-1 on Paint and Related Coatings and Materials.

Papers are being sought on the latest developments in coatings analysis under the following general headings: overview of application of modern analytical techniques to paint problem solving; separations; vehicle characterization; analysis of volatile materials; analysis of additives; contaminant analysis; pigment analysis; and defects and other failures.

Papers should be problem and/or formula oriented as opposed to being technique oriented.

Prospective authors are requested to submit a title, a 300-500 word abstract, and the ASTM Submittal Form by July 1 to Dorothy Savini, Symposia Coordination, ASTM, 1916 Race St., Philadelphia, PA 19103-1187.

A special Technical Publication (STP) based on the symposium proceedings is anticipated by ASTM. More information is available from Symposium Chairman William C. Golton, E.I. Du Pont de Nemours & Co., Inc., Marshall Laboratory, P.O. Box 3886, Philadelphia, PA 19146.

Golden Gate Manufacturing Committee Conference, June 19 To Focus on "Image Building Through Communication"

The Manufacturing Committee of the Golden Gate Society for Coatings Technology will hold an all-day conference on "Image Building Through Communication," on June 19, at the Holiday Inn in South San Francisco, CA. The conference is designed to provide an understanding of how to deal with an emergency and the public reaction that may follow. Presentations are intended to help inform attendees on responsible actions which can be taken in the event of a difficult situation to avert negative reaction and mass media attention. Scheduled presentations include:

"How to Set Up a Communications Program"—Virginia Wiltshire, of DeSoto Chemical Corp.

"Educating the Community on Toxic Chemical Emission—Sara Tital III"—Lisa Zanoni, of NPCA.

"An Environmental Point of View"—The Sierra Club.

"News Media Expectations"—Robert Haulman, of KCBS Radio.

"A Case Study of Media Response Training"—Brent McGinnis, of Ashland Chemical.

"Proposition 65—A Point of View"—Julia Epley, Attorney of Philsbury, Morrison and Sutro.

"Wasteful Methods in Production"—Leo Schinasi, of Hüls America.

"Chemical Waste Management—Labeling Regulations"—Speaker to be announced.

"Reporting Traffic Conditions and Hazards"—Robert Halligan, California State Dept. of Transportation.

For additional information, contact Ron Hughes, Ashland Chemical, 8600 Enterprise, Newark, CA 94560.

Jubilee Dinner to Highlight Birmingham's 60th Anniversary

The Birmingham Paint, Varnish, and Lacquer Club will kick-off the celebration of its 60th Anniversary with a Jubilee Dinner at the Botanical Gardens, Edgbaston, Birmingham, on June 8.

Federation President James E. Geiger, of Sun Coatings, Inc., and his wife Lynn, will head the list of visiting guests from the United States.

Highlighting the post-dinner agenda will be speaker David Gunson, a well known comedian who has been featured on television.

For additional information, contact Michael J. Wright, Holden Surface Coatings Ltd., Bordesley Green Rd., Birmingham B9 4TQ, England.

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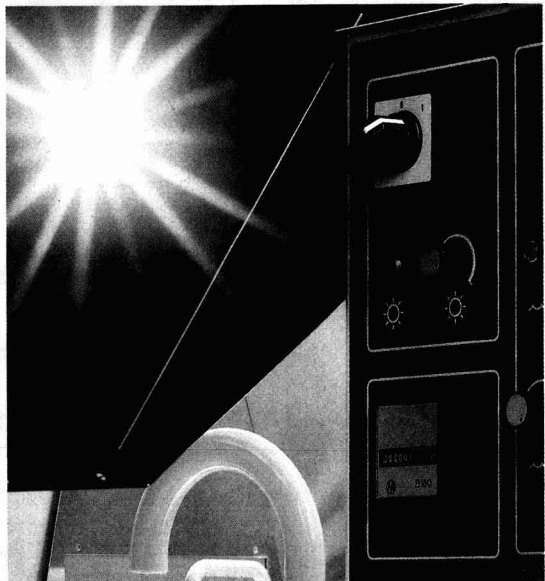
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MSDS Software

A technical data sheet discusses a system which includes information required by SARA Title III, Section 313. The program lists chemicals reportable for SARA Title III on MSDS. For further information on BatchMaster PLUS + MSDS Subsystem, contact Pacific Micro Software Engineering, 6511 Salt Lake Ave., Bell, CA 90201.

Microscope Cameras

Two microscope cameras are described in a new 18-page color brochure. Examples of photomicrographs taken with these cameras are included in the brochure, as well as a data chart which compares the two cameras and their accessories. Copies of the new Microscope Camera Brochure are available on request from Carl Zeiss, Inc., One Zeiss Dr., Thornwood, NY 10594.

Paint Industry Study

The 1988 edition of "The U.S. Paint Industry: Technology Trends, Markets, Raw Materials" has been published by the National Paint and Coatings Association. First produced for the use of NPCA members and staff during the petroleum products shortage of the 1970s, the report includes production and consumption data on basic raw materials, industry raw materials, formulated coatings, and end use markets, as well as an assessment of technology trends and forecasts. The price of this 249-page report is \$200 for NPCA members, and \$600 for nonmembers. For further information, write to: Juliette Benedicto, NPCA Management Information, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005.

Sampling Kit

A sampling kit designed to assist paint and coating manufacturers in their evaluation of surfactants and defoamers for reformulated products as they seek to comply with tightening environmental and workplace regulations is obtainable. Each kit contains a 4 oz. bottle of eight different surfactants/defoamers which represent a cross-section of agents that will satisfy a majority of formulation requirements. Contact the Organics Div., Witco Corp., 520 Madison Ave., New York, NY 10022-4236, for more information on the surfactant sample kit for paint and coatings.

Surfactants

The effects of temperature on the foam characteristics of surfactants widely used in cleaning formulations is detailed in a recently released bulletin. Described are results obtained by evaluating these surfactants with the Ross Miles test, an industry standard that supplies internally consistent surfactant foaming information under low mechanical energy input conditions. Copies of the bulletin titled, "Pluronic® and Tetronic® Block Copolymer Surfactants Temperature/Foam Relationships," may be obtained, without charge, by contacting BASF Corp., Performance Chemicals, 100 Cherry Hill Rd., Parsippany, NJ 07054.

Silica Pigment

Technical data introducing a precipitated silica pigment designed for saturating paper grades used in decorative laminates has been released. The pigment is supplied in multiwall bags containing 40 pounds each, which are unitized for shipping on expendable wood pallets and are available in truckloads or carloads. For further information on San-Sil™ AN 45 functional pigments, write to Austin R. Proctor, Market Development Manager, Paper Industry Specialty Chemicals, PPG Industries, One PPG Place, Pittsburgh, PA 15272.

High Purity TBA

A six-page brochure detailing a high purity tertiary butyl alcohol (TBA) has been issued. Typical properties and use recommendations are presented. Information on using TBA in a variety of applications areas is given. Handling and storage recommendations also are included. Copies of "TEBOL™ 99 High Purity Butyl Alcohol," are available from ARCO Chemical Co., Marketing Communications Dept., 3801 West Chester Pike, Newtown Square, PA 19073.

Product Catalog

A 60-page product catalog which lists tradenames, product codes, and applications for available chemicals and proprietary systems has been printed. It lists more than 2,000 specialty chemicals offered by the company. For more information about the product guide, write to M&T Chemicals, Inc., Rahway, NJ 07065.

Vane Pump

A full-color, four-page illustrated brochure detailing a new vane type pump has been issued. The pumps described operate at speeds up to 950 RPM, with nominal capacities to 400 GPM, pressures up to 125 psi, and temperatures to +225°F. To request a copy of the brochure designated #490, contact Viking Pump, Inc., 406 State St., Cedar Falls, IA 50613.

Solvent Guide

A 12-page booklet detailing the physical properties of alcohols, glycol ethers, esters, and ketones used in water-borne coatings has been issued. Also included is a tabular selector that matches a range of fast, medium, and slow evaporating solvents with their use in various types of coatings. Copies of the booklet, "UCAR® Solvents Selection Guide for Coatings," designated F-7465Z, are available from Union Carbide Corp., Solvents and Coatings Materials Div., Dept. L4488, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Organic/Inorganic Polymer

A 16-page, four-color technical brochure featuring color photographs, chemicals corrosion resistance tables, design properties, and data on an organic/inorganic polymer coating is being offered. Full color photographs show current uses of this product in the transportation, chemical process, power, and hazardous waste industries. For further details on how to obtain the SILOXIRANE® brochure, contact Denise F. Keehan, Advanced Polymer Sciences, Inc., Avon, OH 44001.

Carbonates

A 40-page, full-color brochure on an ethylene carbonate and a propylene carbonate has been issued. The catalog details specifications, a discussion of applications, and data on the product's electrochemical, solvent, physical, and chemical properties. Information also includes handling and storage, shipping, and safety and toxicity, along with an extensive bibliography listing 348 references. Copies of the brochure on TEXACAR® ethylene and propylene carbonates are available from Dr. Phillip Valkovich, Call-the-Doc™ Service, Texaco Chemical Co., P.O. Box 27707, Houston, TX 77227-7707.

Lab Attritors

Technical information has been released on two small laboratory-size batch attritors complete with both discharge valve assemblies and pumps to provide their own circulation systems. The models are designed for a wide range of label grinding and dispersing needs. For complete specifications and features on the laboratory 01 and 01-HD Attritors, contact Union Process, Inc., 1925 Akron-Peninsula Rd., Akron, OH 44313.

Enclosure Coolers

Two thermostatically controlled cold pump enclosure coolers, designed to operate on standard 120 V/AC current, are the topic of recently released literature. A mounting template, detailed installation instructions, and complete operator's manual simplify installation and operation by plant maintenance personnel. Contact Karen Thee, Application Engineer, Vortec Corp., 10125 Carver Rd., Cincinnati, OH 45242-9976, for additional information.

VOC-Compliant Coatings

High-performance VOC-compliant polyurethane coatings designed to protect concrete, steel, and wood from abrasion, impact, and corrosion are being introduced in literature. For additional information on Chemglaze® coatings, write Lord Corp., Industrial Coatings Div., 2000 West Grandview Blvd., P.O. Box 10038, Erie, PA 16514-0038.

Inverted Microscopes

A new 24-page color brochure describing a line of inverted microscopes for the materials sciences has been introduced. The features of all four microscopes are outlined in this bulletin, and their performance is documented with photomicrographs. Write to Carl Zeiss, Inc., One Zeiss Dr., Thornwood, NY 10594, for a free copy of the brochure on AXIOVERT® inverted microscopes.

Pressure Hose

A technical data sheet describes a pressure hose product line available in various formulations and a wide range of sizes for numerous applications in the areas of automotive, sewer cleaning, painting, industrial maintenance, and general hydraulics. Contact Polymer Corp., 2120 Fairmont Ave., P.O. Box 422, Reading, PA 19603, for more information on the Nylaflo® Pressure Hose product line.

Weathering Test Machine


A xenon-arc artificial weathering machine, which features irradiance control, is highlighted in technical literature. The bench-top machine, with its horizontal tray, can be used to test both flat and three-dimensional parts for their resistance to sunlight. Write to DSET Laboratories, Inc., Box 1850, Black Canyon Stage 1, Phoenix, AZ 85027, for full details on the Heraeus Suntest CPS weathering machine.

Acrylic Emulsion

A modified-acrylic emulsion developed for exterior flat and trim paints is the subject of a technical data sheet. The new latex reportedly provides high levels of wet adhesion and early water resistance. More information on UCAR® Acrylic 525, including formulations, can be obtained from Union Carbide Corp., UCAR Emulsion Systems, Dept. L4488, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

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Epoxy Resin

Technical data is available on a specialty epoxy resin with a low viscosity of 500 cps @ 25°C. Possible applications include potting compounds, laminates, adhesives, and prepregs. For further information or samples of CARDOLITE NC-551, contact Cardolite Corp., 500 Doremus Ave., Newark, NJ 07105.

Flat Cell

The availability of a two-page, two-color brochure describing a flat cell designed for simplified electrochemical corrosion and impedance measurement on any flat specimen larger than .75 in., has been announced. Specifications, accessories, current distribution, and applications also are covered. More information on the Model K0235 Flat Cell can be obtained by writing to EG&G Princeton Applied Research, Electrochemical Instruments Div., CN 5206, Princeton, NJ 08543-5206.

Newsletter

A four-page publication containing valuable reports on current technical developments in the manufacturing of coatings or related industries has been introduced. To receive the newsletter entitled "Straight Talk from Troy," contact the Customer Service Dept., Troy Chemical Corp., One Avenue L, Newark, NJ 07905.

Video Series

The completion of a new tape in five-part video series on color technology has been announced. This latest tape is entitled, "The Observing Situation: The Link Between the Computer and the Eye," which discusses the way that different light sources influence our description of color, and also talks about the DIE standard observer and calculation of tristimulus values. For more information of ACS's video series, "Industrial Color Technology, Theory and Applications," contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543.

Weathering Products And Services

Weathering products and services are presented in a new 28-page, four-color catalog. Included are descriptions of conventional and accelerated weathering test services offered in Arizona and Florida, as well as artificial weathering products such as a new, bench-top xenon-arc weathering machine. To obtain this guide, write DSET Laboratories, Inc., Box 1850, Black Canyon Stage I, Phoenix, AZ 85027.

Research Study

A research study conducted by Air Products and Chemicals, Inc., (Bethlehem, PA) and TAFE Inc. (Concord, NH), has established that the use of inert gases (e.g., argon, nitrogen) instead of compressed air can substantially extend arc spray coating technologies. For instance, by essentially eliminating oxygen in and near the arc zone, metal oxidation is minimized. Consequently, feedstock loss by oxide fuming as well as oxide inclusions in the coating are reduced significantly. For further details, write Robert H. Unger, TAFE Inc., 146 Pembroke Rd., Concord, NH 03301.

Precipitated Silicas

Micronized precipitated silicas for optimum flattening and rheology applications are the subject of an eight-page, four-color brochure. In folder format, with a pocket for product data sheets, the brochure also details the company's offerings in research and development, quality control, sales, and applications support. For a free copy of the Tixosil™ package, designated FF-502, write Manville Inquiry Dept., 1601-23rd St., Denver, CO 80216.

Water-Based Adhesives

An 11-page, full-color brochure which features the variables in selecting water-based adhesive resins is in print. The publi-

cation highlights include: choosing a resin suited to the backbone polymer and a dispersion system compatible with that of the latex polymer; particle size; film color; pH; softening point; film clarity; and colloidal stability. For a copy of "Products for Water-Based Adhesive Systems," write Hercules Incorporated, Product Information, Hercules Plaza, Wilmington, DE 19894.

In-Line Homogenizer

Literature introduces a portable, in-line homogenizer designed for wet processing paints and inks. The lightweight, self-contained homogenizers are available with four mixing head/rotor combinations and designed to disperse and emulsify at flow rates from 300 to 5000 gal/hr. Further information about the Ultrashear™ homogenizer is available from Premier Mill Corp., Exeter Industrial Park, Birchmont Dr., Reading, PA 19606.

Pigment Dispersions

Dry powdered pigment dispersions designed for use in the latest technology coatings including: powder, UV- and EB-cured, two-component, high-solids systems, and conventional solvent-thinned coatings are the subject of product literature. Details on Tint-Ayd PC are obtainable from Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

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May 16—FSCT Spring Seminar

May 17—Seminar Continues

May 18—FSCT Society Officers Meeting

May 19—FSCT Board of Directors Meeting

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

Coming Events

FEDERATION MEETINGS

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

1989

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

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

1990

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

1991

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

SPECIAL SOCIETY MEETINGS

1989

(June 2-3)—Joint meeting of St. Louis and Kansas City Societies. Holiday Inn, Lake of-the-Ozarks, MO. (Howard Jerome, Mozel Equipment Co., 4003 Park Ave., St. Louis, MO 63110).

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

(June 19)—Golden Gate Society. "Conference '89—Image Building through Communications." Holiday Inn, S. San Francisco, CA. (Ron Hughes, Ashland Chemical, 8600 Enterprise, Newark, CA 94560).

1990

(Mar. 14-16)—Southwestern Paint Convention. Houston and Dallas Societies. Doubletree at Post Oak, Houston, TX. (Neil McBride, P.O. Box 841156, Houston, TX 77284-1156).

(Apr. 4-7)—Southern Society. Annual Meeting. Sandestin Beach Hilton, Destin, FL. (James R. Salisbury, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084).

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(Feb. 18-20)—Western Coatings Societies' 20th Biennial Symposium and Show. San Francisco Hilton, San Francisco, CA.

OTHER ORGANIZATIONS

1989

(May 15-17)—Eighth Annual Meeting of the Powder Coatings Institute. Marriott's Marco Island Resort, Marco Island, FL. (The Powder Coating Institute, 1800 Diagonal Rd., Suite 370, Alexandria, VA 22314).

(May 15-18)—14th Annual Powder & Bulk Solids Conference/Exhibition. O'Hare Exposition Center, Rosemont, IL. (Show Manager, Powder & Bulk Solids Conference/Exhibition, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060).

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

(May 15-19)—"Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Renaissance Hotel—Buffalo Airport, Buffalo, NY. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(May 15-20)—"Interpretation of IR and Raman Spectroscopy." Course sponsored by Vanderbilt University, Nashville, TN. (Clara Craver, Director, Fisk Infrared Institute, Box 15, Fisk University, Nashville, TN 37203).

(May 22-23)—"Introduction to Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters

and Surface Finishers Society. Holiday Inn—Cleveland Airport, Cleveland, OH. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

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

(May 23-26)—ASTM Committee B-8 Meeting. Hyatt Regency Kansas City, Kansas City, MO. (Peggy Loughran, ASTM, 1916 Race St., Philadelphia, PA 19103).

(May 24-25)—"Accelerated Versus Natural Weathering" Symposium sponsored by the TNO Paint Research Institute. World Trade Center, Amsterdam, The Netherlands. (F.H. de la Court or T. Doorgeest, TNO Paint Research Institute, P.O. Box 203, 2600 AE, The Netherlands).

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

(May 25-26)—"Waste Treatment Simplified." Course sponsored by the American Electroplaters and Surface Finishers Society. Quality Inn, Waltham, MA. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

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

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

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

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

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

(June 12-August 25)—Gordon Research Conferences. Various academic locations in New Hampshire and Rhode Island. (Alexander M. Cruickshank, Gordon Research Conferences, Gordon Research Center, University of Rhode Island, Kingston, RI 02881-0801).

(June 13-15)—Seventh Annual Hazardous Materials Management International Conference and Exhibition. Atlantic City Convention Center, Atlantic City, NJ. (John J. Frett, Show Manager, Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E-Suite 408, Glen Ellyn, IL 60137-5835).

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

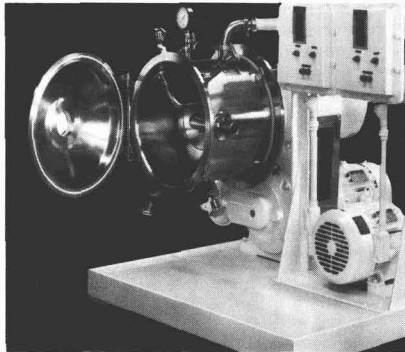
(June 19-23)—"Corrosion Control by Coatings." Short Course sponsored by Lehigh University, Bethlehem, PA. (Henry Leidheiser, Jr., Zettlemoyer Center for Surface Studies, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

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

(June 25-28)—ASTM Committee D-1 Meeting. Sheraton St. Louis, St. Louis, MO. (David Bradley, ASTM, 1916 Race St., Philadelphia, PA 19103).

(June 28-30)—"Chemically Modified Oxide Surfaces" Symposium. Holiday Inn, Midland, MI. (W.T. Collins, Mail Stop C41C00, Dow Corning Corp., Midland, MI 48686-0994).

(July 10-14)—15th International Conference on "Organic Coatings Science and Technology." Athens, Greece. (Angelos V. Patsis, Institute in Materials Science, CSB 209, State University of New York, New Paltz 12561).



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(July 19-20)—"Paint Volatile Organic Compounds (VOC)." Workshop sponsored by ASTM Standards Technology Training. Holiday Inn—Chicago, Des Plaines, IL. (Kathy Dickinson, ASTM Standards Technology Training, 1916 Race St., Philadelphia, PA 19103).

(July 27-29)—27th Annual Convention of the Oil and Colour Chemists' Association New Zealand. Rotorua, New Zealand. (Mike Rowlands, OCCANZ, P.O. Box 5192, Auckland, New Zealand).

(Aug. 3-6)—31st Annual Convention of the Oil and Colour Chemists' Association Australia. Fairmont Resort, Leura, New South Wales. (Peter Parsons, Tioxide Australia P/L, 2A/6 Tooronga Terrace, Beverly Hills, NSW, Australia 2209).

(Aug. 9-11)—"Radiation Curable Coatings." Short Course sponsored by North Dakota State University, Fargo, ND. (Frank N. Jones, NDSU, Fargo, ND 58105).

(Aug. 21-25)—12th Annual "Advances in Emulsion Polymerization and Latex Technology" Short Course. Schatzalp Berghotel, Davos, Switzerland. (Gary W. Poehlein, Graduate Office [Savant], Georgia Institute of Technology, Atlanta, GA 30332-0265).

(Aug. 21-25)—"Electroplating and Surface Finishing for Electronic Applications." Course sponsored by the American Electroplaters and Surface Finishers Society. Hyatt Palo Alto, Palo Alto, CA. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Aug. 22-26)—"Surface Phenomena and Fine Particles in Water-Based Coating and Printing Technology." International Symposium sponsored by the Fine Particle Society. Marriott Copley Place, Boston, MA. (Mahendra K. Sharma, Research Laboratories, Eastman Kodak Co., Box 1972, Kingsport, TN 37662, or F.J. Micala, Sinclair Laboratory, Bldg. 7, Lehigh University, Bethlehem, PA 18015).

(Sept. 6-7)—"Introduction to Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Oakbrook 3, Elmhurst, IL. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 11-15)—"Laboratory Corrosion Testing." Short Course sponsored by the Southwestern Ohio Section of NACE and NACE/Fontana Corrosion Center at Ohio State. Ohio State University, Columbus, OH. (John Beavers, 2704 Sawbury Blvd., Columbus, OH 43235, or Steve Corey, 1020 W. Park Ave., Kokomo, IN 46901).

(Sept. 12-14)—Haztech International Fourth Annual Conference and Exhibition. Cincinnati Convention Center, Cincinnati, OH. (Rachelle Scheinbach or Ursula Barril, Haztech International, 13555 Bel-Red Rd., C-96870, Bellevue, WA 98009).

(Sept. 14-15)—"Waste Treatment Simplified." Course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Chandler, Chandler, AZ. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 18-22)—"Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Oakbrook 3, Elmhurst, IL. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 23-28)—12th World Conferences on Non-Destructive Testing sponsored by the Dutch Non-Destructive Testing Society. RAI International Exhibition and Congress Center, Amsterdam, The Netherlands. (RAI International Exhibition and Congress Center, Europaplein, 1078 GZ, Amsterdam, The Netherlands).

(Sept. 25-27)—Third Annual Hazardous Materials Management Conference and Exhibition of Canada (HazMat/Canada '89). Harbour Castle Westin Conference Centre, Toronto, Ont., Canada. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Suite 408, Glen Ellyn, IL 60137-5835).

(Sept. 25-29)—"Electroplating and Surface Finishing for Electronic Applications." Course sponsored by the American Electroplaters and Surface Finishers Society. Sheraton University Center, Durham, NC. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 25-30)—American Chemical Society. 196th National Meeting, Los Angeles, CA. (B.R. Hodson, ACS, 1155—16th St. NW, Washington, D.C. 20036).

(Sept. 26-27)—Finishing '89. Telford Exhibition Center, Telford, Shropshire, England. (Nigel Bean, Turret Group Plc, Turret House, 171 High St., Rickmansworth, Herts, WD3 1SN).

(Sept. 26-28)—"Inspection of Coatings and Linings for Immersion Service" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Sept. 27-29)—Liquitec Expo '89 (Carolyn Mesce, Liquitec Expo, P.O. Box 630, West Paterson, NJ 07424).

(Sept. 27-29)—Haztech International Fourth Annual Conference and Exhibition. San Francisco Civic Auditorium, San Francisco, CA. (Rachelle Scheinbach or Ursula Barril, Haztech International, 13555 Bel-Red Rd., C-96870, Bellevue, WA 98009).

(Oct. 4-6)—National Coil Coaters Association (NCCA) Fall Meeting. Hyatt Regency at O'Hare Airport, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Oct. 23-25)—"High-Coatings." 9th International Conference of the Paint Research Association. Sheraton Hotel, Frankfurt, West Germany. (Dip Dasgupta, Head of Information Dept., PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

(Oct. 24-26)—8th International Conference on the Internal and External Protection of Pipes. Cosponsored by BHRA and Snamprogetti. Florence, Italy. (Conference Organizer (Pipe Protection), BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ, England).

(Oct. 31-Nov. 2)—"Maintenance/Industrial Painting Practices" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

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'Humbug' from Hillman

Owen Carpenter retired a few years ago and, like most retirees, keeps busy sorting and discarding memorabilia collected over his 40 years of activity in the coatings industry. So that it shouldn't be a total loss, Owen sent us one of the discards from the August 1, 1982 *Chicago Sun Times*. With luck and perseverance, Owen hopes to clear up the accumulation by December 1992. If the sample below is typical, keep us on your mailing list, Owen.

● If there is an answer to the riddle of life, chances are it is brief, brisk, and subversively brilliant. It creeps up on you. An aphorism like "the grass is brown on both sides of the fence" is an anodyne to the pain of desire. "Fools rush in where fools have rushed before"; Ah yes, you nod knowingly. It is a succinct summation of the findings of sociologists, psychologists, and above all, political scientists. Compiled by John Peers:

- He who laughs last has no sense of humor.
- If you don't grow vegetables, it helps to praise and admire the garden in your neighbor's yard.
- It's better to be rich and healthy than poor and sick.
- The genuineness of a couple's affection for each other is inversely proportional to the cuteness of their pet names for each other.
- The trouble with resisting temptation is that it may never come again.
- Life is what happens to you when you are making other plans.
- Only a mediocre person is always at his best.
- Forecasting is a difficult thing, especially when it deals with the future.
- A leap beyond the state of the art may be into a bucket of worms.
- A taxpayer is someone who doesn't have to take a civil service examination to work for the government.
- A drunken man's words are a sober man's thoughts.
- Riley's rumination! Don't let anyone kid you about the life of Riley.
- All things being equal, a fat person uses more soap than a thin person.
- Halitosis is better than no breath at all.
- Logic is a systematic method of coming to the wrong conclusion with confidence.
- Chicken Little only has to be right once.
- Grandma Soderquist's thought: There are those who don't even like to be rubbed the right way.
- It is a mistake to allow any mechanical object to realize you are in a hurry.

● A diplomat is someone who can tell you to go to hell in such a way that you will look forward to the trip.

● If you tell the boss you were late to work because of a flat tire, the next morning you will have a flat tire.

—From the book *1001 Logical Laws*; 1979, Doubleday and Company

Humbug, with due consideration for those uninformed folks who don't keep up with widely circulating stories, publishes one that has been making the rounds for some time. It was sent to us by Willy C. P. Busch with credit to Paul Harasim in the *Houston Post*. Here is Humbug's somewhat shortened and distorted version:

A husband, weary of his wife's shopping spree on a trip to New York City, decided to wait for his spouse in front of a prestigious Madison Avenue shop. As he watched the passing scene, a flashily dressed woman of the streets sidled up and asked if he was interested in some fun.

A bit amused and to pass the time, he asked, "How much?"

"One hundred dollars," came the response, accompanied by a sexy pursing of the lips.

"Sorry," he said with a smile, "I've only got twenty."

"Forget it, baby," she said as she sauntered away.

Moments later, his wife left the store and as they walked down the avenue, they passed our lady of the streets at her post in a nearby doorway.

With a smile, she patted him on the back as he walked by, "You sure get what you pay for, don't you, honey?"

Today's mail brought the usual dependable contribution from Roy Tasse.

—A rich Texan, attracted by a crowd on the beach, rushed over and discovered that his wife was being revived after nearly drowning.

"What are you doing to her?" he asked the lifeguard.

"Giving her artificial respiration," the lifeguard replied.

"Artificial, hell," the Texan shouted angrily. "Give her the real thing, I can afford it!"

—Notice in a department store: "God may help those who help themselves, but we prosecute."

—*American Legion Magazine*

—Herb Hillman
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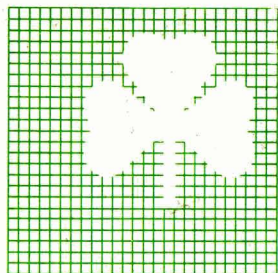
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