

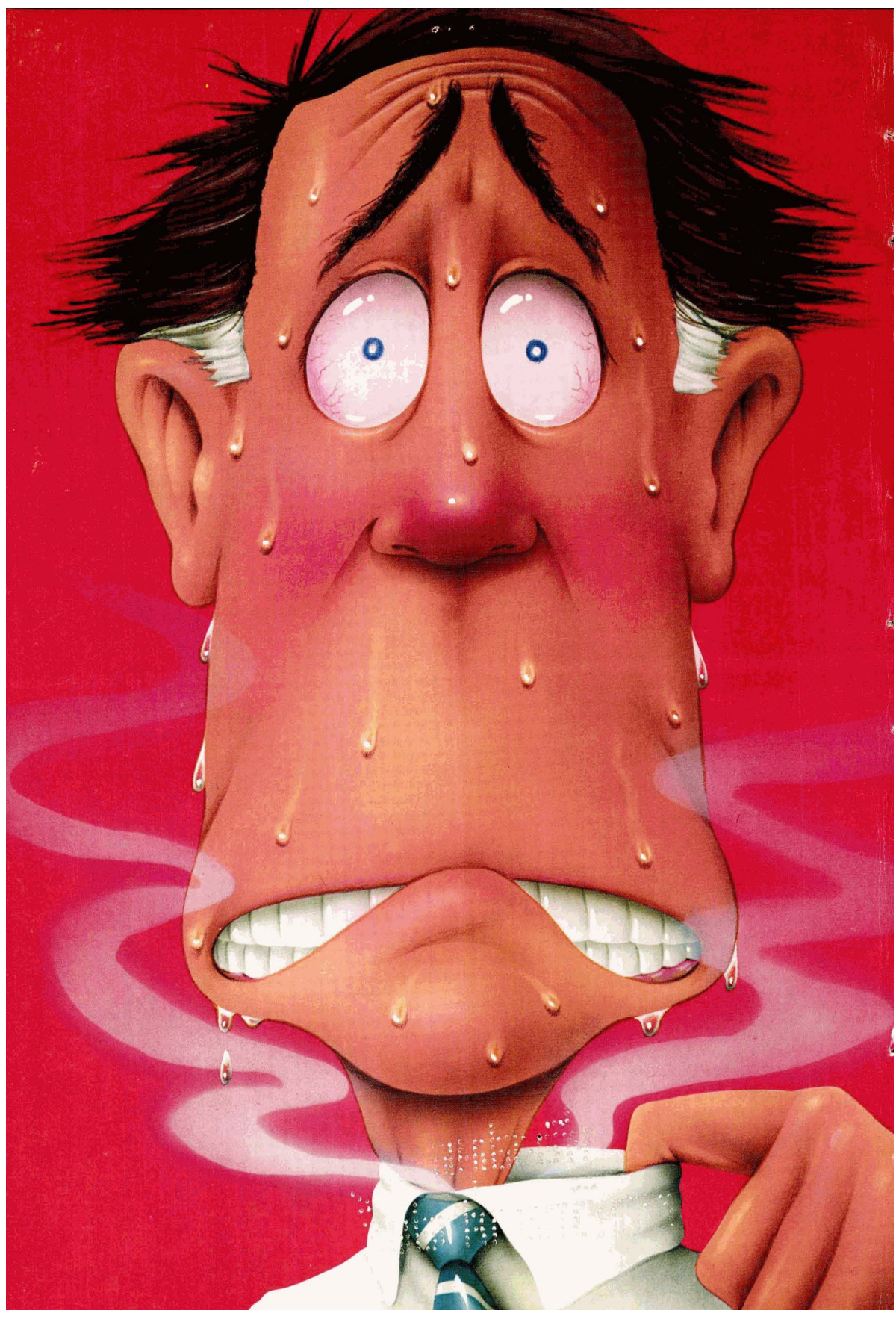
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November 1985

ict JOURNAL OF COATINGS TECHNOLOGY

Physical Properties of Epoxy-Primed Polyethylene and Epoxy Pipe Coatings





THE COMPETITION HAS BEGUN TO FEEL THE COMPETITION.

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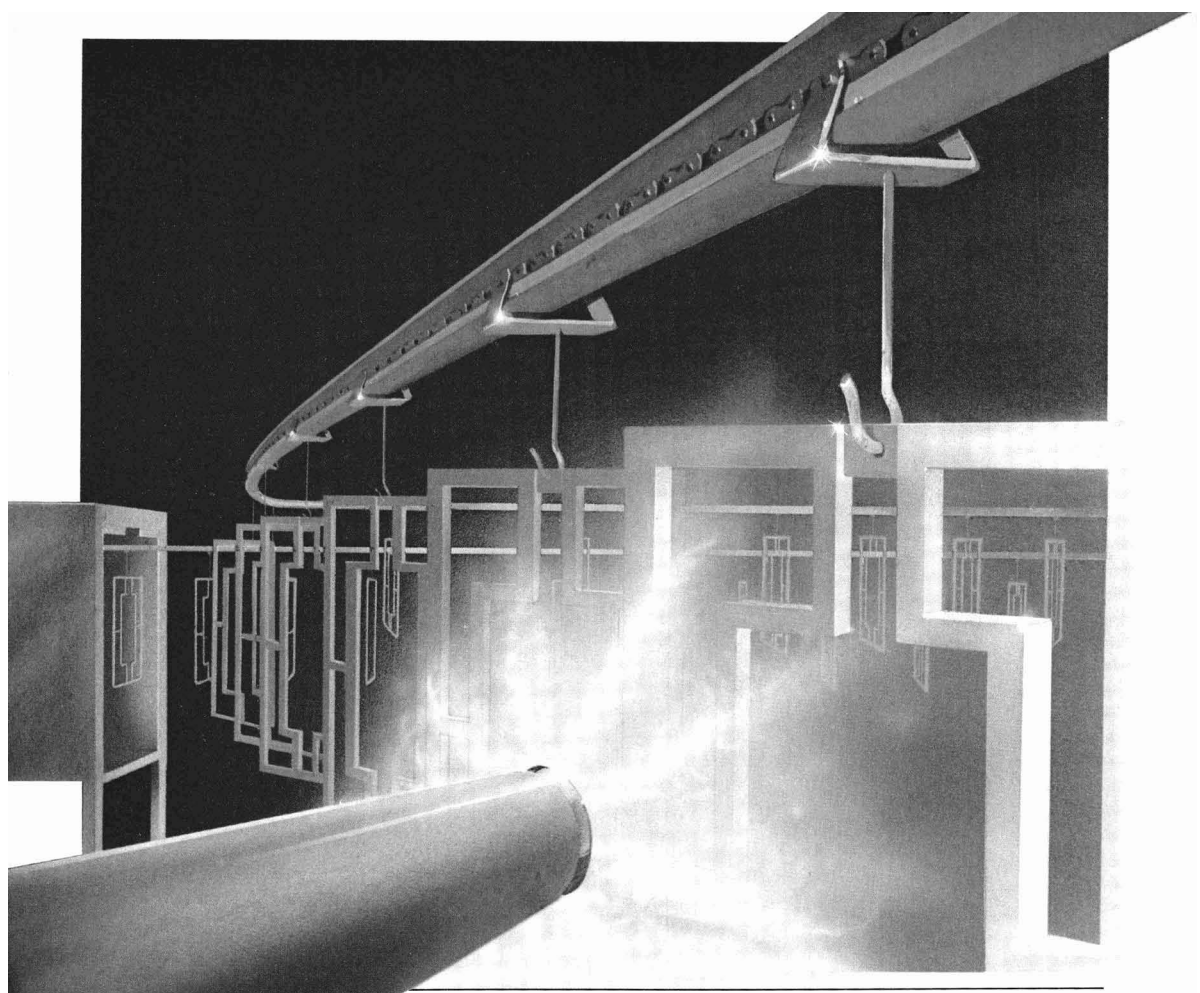
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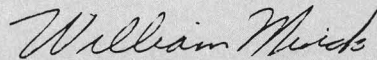
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Message from the President: Today's Goals

If I look back maybe ten to twelve years, the normal thing to do was to belong to my professional society, pay dues, and get involved. This certainly was very rewarding, but it really wasn't vital to my employment.

Today, because of increased activism of consumer groups and specific interest groups including the Federal government itself, I am forced to look beyond myself for help.

Therefore, I feel that the primary mission of today's Federation must be to assist you and me in solving the problems faced by our profession. With this necessary goal in mind, I am looking forward to working with all Federation members and especially the Board of Directors, Committee Chairmen, Officers of Societies, and staff.



William Mirick,
President



CIBA-GEIGY epoxy resins and the winning battle against VOC's.

With their lower viscosity, these two unique epoxy resins significantly decrease your need for solvent or diluent.

Their names are Araldite® XU GY 281 and Araldite XU GY 308. Two new products from the leading supplier of specialty resins and hardeners. Two new products you will want to use to decrease the volatile organic content (VOC) of the high

performance coatings you formulate for heavy duty service in such applications as petroleum refineries, tank linings, pulp and paper mills, industrial plants and the like.

These new epoxy resins from CIBA-GEIGY for low VOC coatings let you maintain high performance without adding unnecessary solvents or diluents.

Less diluent, less cost.

Adding solvent to a coating formulation can have a negative performance effect. Adding diluents can increase cost. The low viscosity of Araldite XU GY 281 and Araldite XU GY 308 reduces the need for solvents or diluents, and provides you with another major victory in the battle to solve the VOC problem.

Araldite XU GY 281 is an unmodified bisphenol F epoxy resin particularly suitable for



Gardner Bubble Tube Viscosity Test. On left: diglycidyl ether of bisphenol F resin (CIBA-GEIGY Araldite® XU GY 281). On right: diglycidyl ether of bisphenol A resin.

solventless and high solids coatings and linings requiring superior chemical and corrosion resistance. It also has outstanding resistance to solvents, excellent mechanical properties and conforms to 175.300 of the FDA Register.

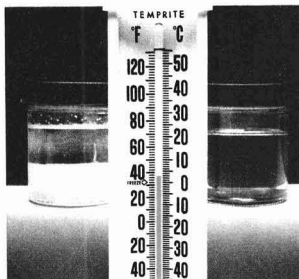
XU GY 281 Typical Properties

Visual Appearance	Clear
Color, Gardner	3 max.
Viscosity, cP @ 25°C	5,000-7,000
Weight per Epoxide	159-172
Hydrolyzable Chlorine	0.2 max.
Volatile Content, %	0.2 max.
Pounds per gallon	10

An extra added attraction.

Araldite XU GY 308 is our second new low viscosity liquid epoxy resin. It has all the major properties of Araldite XU GY 281. And one that's unique. That uniqueness is its resistance to crystallization under normal conditions, making it easy to handle and process. As you are well aware, most low viscosity, pure epoxy resins change to a waxy white solid if left unused at low

temperatures. That means heat must be applied before using. And heating a 55-gallon



Clear epoxy resin (right), Araldite XU GY 308, resists crystallization at low temperatures.

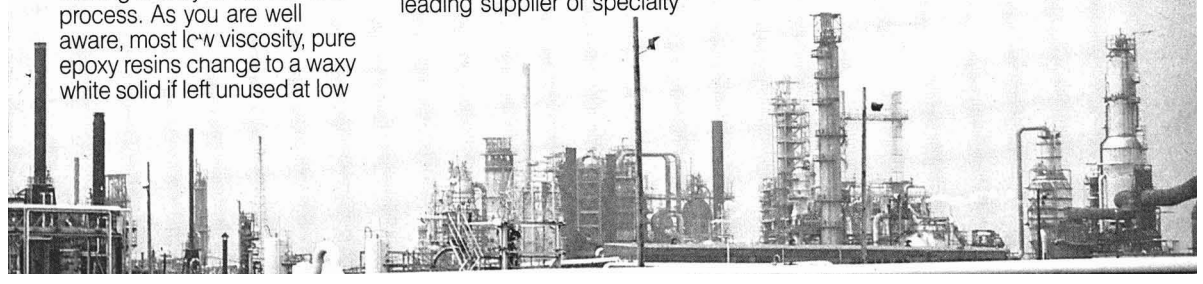
drum or a whole tank car is no easy task. Araldite XU GY 308's resistance to crystallization can, therefore, save you time, energy and money.

Special solutions for special problems.

At CIBA-GEIGY, we have built a reputation as the leading supplier of specialty

resins and hardeners. And we can offer the technological skill required to meet and solve the special problems that arise in formulating high performance coatings. One problem is the adverse impact of the VOC from coatings based on traditional epoxy resins. And our new products, Araldite XU GY 281 and Araldite XU GY 308, can help alleviate that problem by reducing the use of solvents and diluents in coatings. Both products, of course, come with the technical support for which we are also widely regarded. Call Rob Crespi at 800-431-1900 (in New York 914-347-4700). Or write Plastics Department, CIBA-GEIGY Corporation, Three Skyline Drive, Hawthorne, New York 10532.

CIBA-GEIGY



Abstracts of Papers in This Issue

PHYSICAL PROPERTIES OF EPOXY-PRIMED POLYETHYLENE AND EPOXY PIPE COATINGS—R.E. Sharpe and R.J. Dick

Journal of Coatings Technology, 57, No. 730, 25 (Nov. 1985)

Pipeline coatings protect line pipe from corrosion by providing an impervious barrier and electrical insulation. The effect of heat and moisture on selected physical properties was investigated for two coatings on steel pipe: a fusion-bonded epoxy coating and an epoxy-primed, extruded polyethylene system. Cathodic disbonding, impact resistance, electrical resistance, and penetration of the coatings after exposure to hot water were studied.

The epoxy-primed polyethylene coating provided cathodic disbonding protection equivalent to the epoxy coating. Rust formation was not observed in the disbonded area in any test situation. The epoxy-primed polyethylene system also provided greater mechanical protection to the pipe (impact and penetration resistance) and better electrical insulation (volume resistivity) than the fusion-bonded epoxy coating.

PRESENCE AND EFFECTS OF ANAEROBIC BACTERIA IN WATER-BASED PAINTS. II—EFFECTS ON PAINT INGREDIENTS—R.A. Oppermann

Journal of Coatings Technology, 57, No. 730, 33 (Nov. 1985)

It has been shown that anaerobic bacteria occur in contaminated water-based paints and raw materials. The materials metabolized by these organisms were unknown. Various ingredients of paint formulations were tested to determine if they would support the growth of anaerobes. Several surfactants, thickeners, glycols, and antifoams show the effects of metabolic attack and, thus, can be metabolized by anaerobic bacteria. Based upon these findings, we can now explain the slow production of gas or viscosity loss without apparent microbial contamination. Some hidden effects of microbial contamination and their magnitudes are suggested.

NEW NONAQUEOUS DISPERSIONS FOR HIGH SOLIDS BASE COAT/CLEAR COAT PAINTS—M.S. Chattha and J.C. Cassatta

Journal of Coatings Technology, 57, No. 730, 41 (Nov. 1985)

Stearate-capped poly(hydroxystearic acid) has been reacted with glycidyl methacrylate to obtain a nonpolar macromer. This macromer has been copolymerized with methyl methacrylate and hydroxyethyl methacrylate in nonpolar solvents to obtain finely dispersed polymeric particles. When the polymerization is carried out in the presence of hexamethoxymethyl melamines, dispersion of crosslinked particles is obtained. Increasing amounts of the macromer produce particles of smaller average size. These particles, when included in the base coat of a base coat/clear coat paint composition in wet-on-wet applications, provide coatings with high gloss and distinctness of image.

VISCOSITY OF METHACRYLATE OLIGOMER SOLUTIONS: EFFECT OF CARBOXYLIC ACID SUBSTITUTION—Z.W. Wicks, Jr. and L.G. Fitzgerald

Journal of Coatings Technology, 57, No. 730, 45 (Nov. 1985)

The effect of solvent structure on intrinsic viscosity and viscosity of oligomeric butyl methacrylate (OBMA) and a partially saponified oligomeric butyl methacrylate (OBMA-COOH) were studied. Dependence of relative viscosity on concentration was found to follow Erickson's equation with a power term added to the denominator. Apparent molecular weight of the saponified oligomer by vapor pressure osmometry in benzene was much higher than in acetone indicating strong inter-oligomer hydrogen bonding even in dilute solutions. Intrinsic viscosity of OBMA-COOH in *m*-xylene is higher than that of OBMA and that of OBMA-COOH in methyl isobutyl ketone (MIBK). Viscosities of solutions of OBMA-COOH in *m*-xylene are higher than in MIBK and higher than OBMA in either solvent. These data are all consistent with strong intermolecular oligomer hydrogen bonding through COOH groups especially in *m*-xylene.

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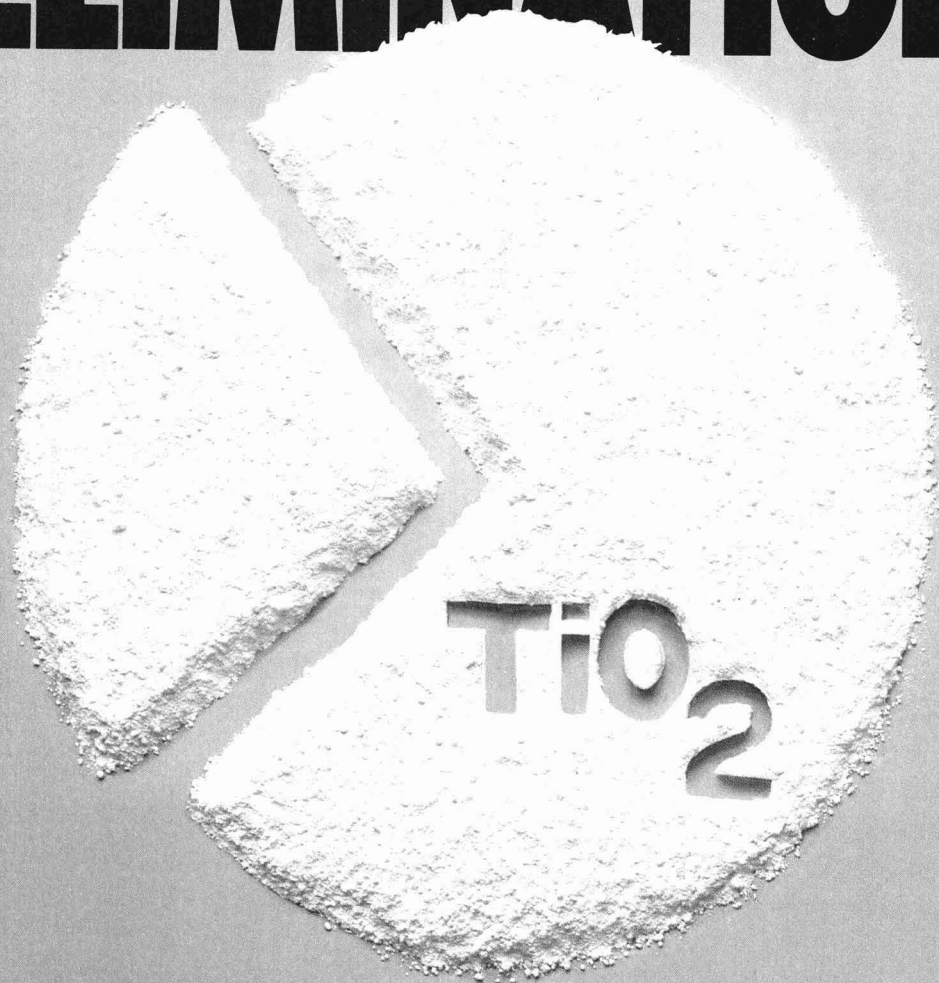
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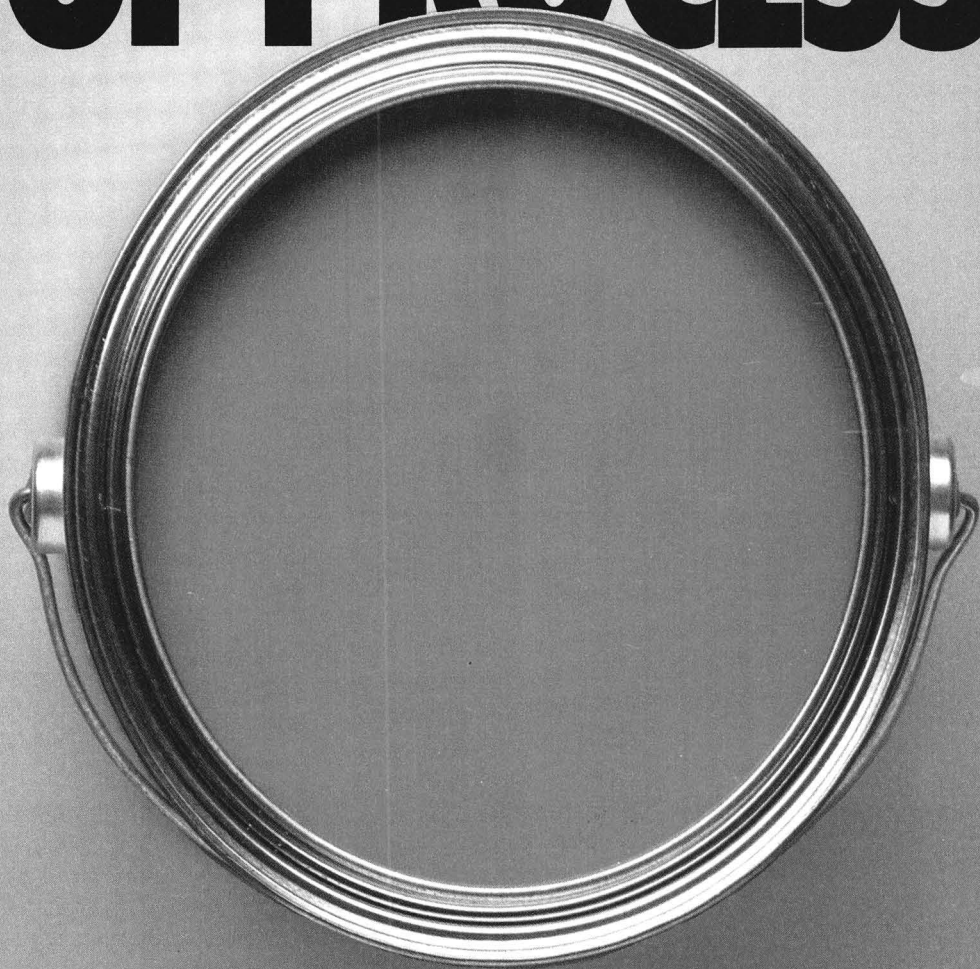
Like its predecessor Ropaque OP-42, new Ropaque OP-62 provides all the benefits of your existing paint formulation, but at a lower raw material cost. And it does so without losing

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With Ropaque OP-62, there's no need to create and test a series of paints to convert each formulation. On the average, it takes just two

steps to match the quality of your old formulation. It's that easy.

So try new Ropaque OP-62 in your next flat, sheen or semi-gloss paint. It's the opaque polymer to use for the elimination of process.

For more information, contact your Rohm and Haas technical representative. Or write our Marketing Services Department, Independence Mall West, Philadelphia, PA 19105.

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William Mirick, of C-D-I-C Society, Elected Sixty-Fourth President of FSCT

William Mirick, of Battelle Columbus Div., Columbus, OH, became the 64th President of the Federation of Societies for Coatings Technology on October 9 at the Federation's Annual Meeting in St. Louis, MO.

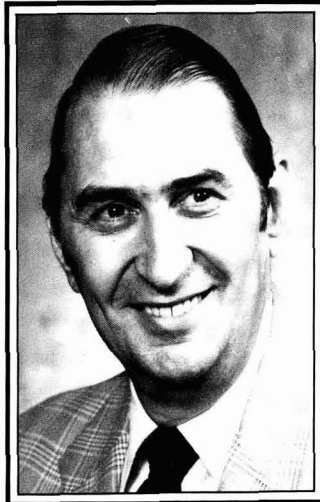
Carlos E. Dorris, of Jones-Blair Co., Dallas, TX, was named President-Elect; and Deryk R. Pawsey, of Rohm and Haas Canada, Vancouver, B.C., was elected Treasurer.

President Mirick

A Past-President of the C-D-I-C Society, Mr. Mirick has served as Society Representative to the Federation Board from 1975-83 and Society Representative Member of the Federation's Executive Committee from 1979-81. He was Chairman of the Annual Meeting Program Awards Committee from 1972-74. A Researcher at Battelle, he joined the division in 1956. Mr. Mirick attended Ohio State University.

President-Elect Dorris

Mr. Dorris is a Past-President of the Dallas Society and served as Society Representative to the Federation Board from 1977-84. A member of the Paint Industries' Show Committee for five years, he was also active on the Federation's Finance and Nominating Committees. Employed



with Jones-Bair for 22 years, Mr. Dorris is a graduate of University of Texas.

Treasurer Pawsey

Currently a member of the FSCT Executive Committee, Mr. Pawsey has served on the Federation's Finance, Technical Information Systems, and Corrosion Committees. In 1984 he received the George Baugh Heckel Award in recognition of his dedicated service to the Federation. A six-term Chairman of the Paint Industries' Show Committee, he also was a member of the Editorial Review Board of the *JOURNAL OF COATINGS TECHNOLOGY*. Mr. Pawsey is a Past-President of the Pacific Northwest Society and has served as Society Representative to the Federation's Board since 1980. Educated in England, Mr. Pawsey is the British Columbia Area Manager for Rohm and Haas.

Executive Committee

Daniel Toombs, Vice-President of D.N. Lukens, Inc., Westboro, MA, was elected to serve a three-year term as Society Representative to the Executive Committee. Mr. Toombs has served on the Federation's Mattiello Lecture and Nominating Committees. Within the New England Society, he was elected twice as President and

served on various committees. Mr. Toombs is a graduate of Northeastern University.

Kurt F. Weitz, Product Manager for Extender and Filler Products at Indusmin, Ltd., Toronto, Ont., was elected to serve a one-year term of office to fill the unexpired term of Mr. Pawsey. Active on the Room Awards Committee for six years, Mr. Weitz also served on the Federation's Finance Committee. He is a Past-President of the Toronto Society and has served as the Society Representative to the Federation Board since 1981. A graduate of the University of Toronto, Mr. Weitz has been employed by Indusmin for 17 years.

Board of Directors Elections

J.C. Leslie, Past-President of the Federation from 1974-75 and the Kansas City Society from 1957-58, has been elected to serve a two-year term on the Federation's Board of Directors as Past-President Member. Mr. Leslie served as the Society's Representative to the Federation Board for five years. Elected to Federation Honorary Membership in 1984, Mr. Leslie has headed the Federation's Corrosion Committee. He retired from Tnemec Co., Kansas City, MO, in 1979.

Elected to serve two-year terms as Members-at-Large on the Federation's Board of Directors are Richard M. Hille, Manager of Manufacturing at General Paint and Chemical Co., Cary, IL, and John A. Lanning, of Porter Paint Co., Louisville, KY.

Mr. Hille is a Past-President of the Chicago Society. Currently the head of the Federation Manufacturing Committee, he has also served on the Professional Development and Membership Committees. Mr. Hille chaired the 1984 Annual Meeting Host Committee. He graduated from the University of Kansas.

Mr. Lanning is Chairman of the Federation's Program Awards Committee and has served on its Paint Show Committee. A Past-President of the Louisville Society, he has served on the Society's Membership and Technical Committees. Educated at the University of Louisville, Mr. Lanning is Product Quality Manager for Porter Paint Co.

64th Annual Meeting of FSCT To Be Held In Atlanta

The 1986 Annual Meeting and Paint Industries' Show of the Federation of Societies for Coatings Technology will be held at the Georgia World Congress Center in Atlanta, GA, on November 5-7.

The event is the largest national exhibit of raw materials and equipment used in the manufacture of paints and related coatings.

The Annual Meeting Program will be chaired by Percy E. Pierce of PPG Industries, Inc., Allison Park, PA. James Geiger of Sun Coating, Inc., Largo, FL, will head the Annual Meeting Host Committee.

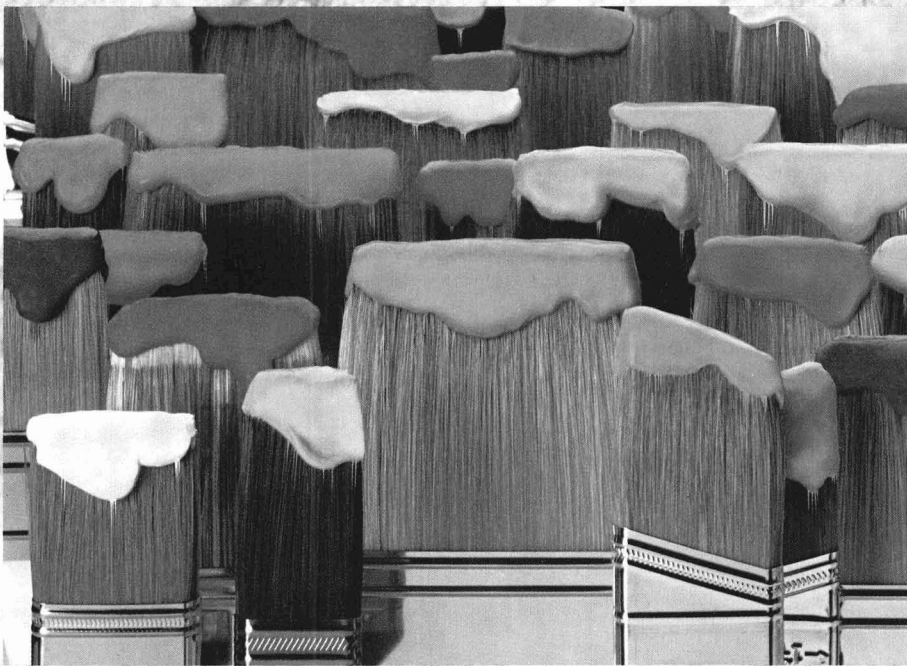
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President Mirick Appoints 1985-86 Committee Chairmen

Chairmen of the 30 committees of the Federation of Societies for Coatings Technology for 1985-86 have been named by President William Mirick. A complete roster of all committees will be published in the 1986 *Year Book*.

An asterisk (*) indicates re-appointment for 1986.

A.F. VOSS/AMERICAN PAINT & COATINGS JOURNAL AWARDS—Lloyd Haanstra, Guardsman Chemicals, South Gate, CA.*

BRUNING AWARD—Ralph Stanziola, Bridgewater, NJ.*

BY-LAWS—Fred Schwab, Coatings Research Group, Inc., Cleveland, OH.*

CORROSION—Alexander A. Chasen, U.S. Navy, Annapolis, MD.*

EDUCATION—Joseph Vasta, DuPont Co., Wilmington, DE.

ENVIRONMENTAL CONTROL—Joyce Specht St. Clair, Porter Paint Co., Louisville, KY.

FINANCE—Joseph Bauer, Porter Paint Co., Louisville, KY.

FUTURE PLANNING—Neil S. Estrada, Los Altos Hills, CA.

HECKEL AWARD—Percy E. Pierce, PPG Industries, Inc., Allison Park, PA.

HOST (ANNUAL MEETING)—James Geiger, Sun Coating, Inc., Largo, FL.

INTER-SOCIETY COLOR COUNCIL—Jacqueline Welker, PPG Industries, Inc., Springdale, PA.*

INVESTMENT—Neil S. Estrada.

LIAISON—Terry Johnson, Cook Paint & Varnish Co., Kansas City, MO.

MANUFACTURING—Rick M. Hille, General Paint & Chemical Co., Cary, IL.

MMA AWARDS—Felix Liberti, Koppers Co., Inc., Newark, NJ.

MATTIELLO LECTURE—Peter V. Robinson, Glidden Coatings & Resins, Strongsville, OH.

MEMBERSHIP SERVICES—Horace Philipp, Department of National Defense, Ottawa, Ont., Canada.*

MEMORIAL—Elder Larson, Houston, TX.*

NOMINATING—Joseph Bauer.

PAINT HISTORY—Joseph Boatwright, N. Ridgeville, OH.

PAINT INDUSTRIES' SHOW—John Ballard, Kurfees Coatings Inc., Louisville, KY.*

PROFESSIONAL DEVELOPMENT—F. Louis Floyd, Glidden Coatings & Resins, Strongsville, OH.

PROGRAM—Percy E. Pierce.

PROGRAM AWARDS—John Lanning, Porter Paint Co., Louisville, KY.*

PUBLICATIONS—Thomas J. Miranda, Whirlpool Corp., Benton Harbor, MI.*

DEFINITIONS SUBCOMMITTEE—Stanley LeSota, Rohm and Haas Co., Spring House, PA.*

ROON AWARDS—Philip W. Harbaugh, Reliance Universal, Inc., Louisville, KY.*

TECHNICAL ADVISORY—Saul Spindel, D/L Laboratories, New York, NY.*

TECHNICAL INFORMATION SYSTEMS—Helen Skowronka, Cleveland, OH.*

TRIGG AWARDS—Don Mazzone, The O'Brien Corp., S. San Francisco, CA.*

Delegates to Other Organizations

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY—Ray Tennant, Cars Paint Ltd., Birmingham, England.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS—Jay Austin, Halox Pigments, Hammond, IN.*

NATIONAL PAINT & COATINGS ASSOCIATION AND GOVERNMENT AGENCIES (ENVIRONMENTAL CONTROL)—Joyce Specht St. Clair.

STEEL STRUCTURES PAINTING COUNCIL—Jay Austin.*

FSCT Seminar Papers Available

Papers presented at two seminars sponsored by the Federation of Societies for Coatings Technology are available in limited quantities.

"Recent Developments in Home Painting"—seminar presented in Baltimore, MD, on May 14-15, 1985. Package includes the following presentations:

- "Future of the Home Market to the Year 2000"—Edward W. Bourguignon
- "Painting Metal and Masonry Surfaces"—Robert L. Collins
- "Performance of Exterior Flat Finishes on Medium Density Hardboard Siding"—Roger E. Haines
- "Architectural Wood Stains"—William S. Hahn
- "The Exterior Latex or Oil Paint Dilemma"—James N. Edwards
- "How the Architect Views Paint and Painting"—Stuart Liss
- "Drywall—Construction, Taping, Painting"—A.C. Boyce and M. Menard
- "Selecting and Using Caulks and Sealants"—Robert M. Evans
- "Common Paint Problems and How to Treat Them"—J.R. Raley
- "Quality in Paint"—Thomas E. Hill

- "The Role of the Painting Contractor"—W.W. Jolly
- "How the Paint Dealer Can Help"—Woody Cornetta

"Producing Paint Efficiently, Safely, Economically"—seminar presented in Louisville, KY, on May 15-16, 1984. Package includes the following presentations:

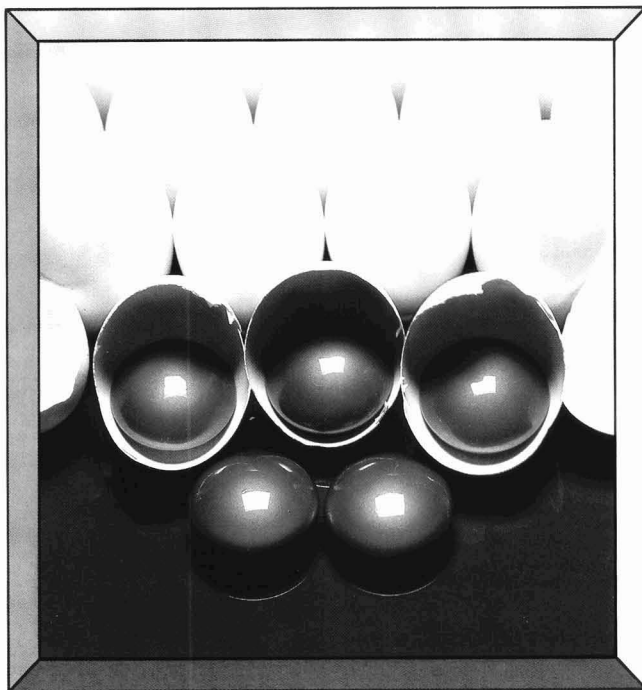
- "Importance of the Manufacturing Function"—J. Robert Pickering
 - "Employee Involvement in Action"—John F. Tripoli
 - "Resins and Polymers"—Hermon J. Lanson
 - "Production Planning and Scheduling"—Chet Yates
 - "Dispersion"—Earl E. Baumhart
 - "Storage and Distribution of Liquid Raw Materials"—Michael P. Kenes
 - "Instrumental Color Control—How to Keep It Out of the Red"—G. Nelson Auge and James A. Cave
 - "Paint Filling and Packaging"—Robert W. Zimmerman
 - "Warehousing and Shipping"—James Skaggs
 - "Managing Your Safety, Health, and Loss Control Program"—W. Horton Russell
 - "Waste Management"—Lawrence N. Streff
- Cost of each set of seminar papers is \$75 (includes shipping and handling). To order, please contact Ms. Kathleen Wikiera, FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107 (215) 545-1506.

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Special Purpose Coatings to Be Focus Of Seminar Scheduled for May 13 & 14

A seminar on "Special Purpose Coatings," sponsored by the Federation of Societies for Coatings Technology, will be held May 13 and 14, 1986, at the Sheraton Hotel at Station Square, Pittsburgh, PA.

The 1½ day event will explore the needs for new and improved coatings systems in several areas. A number of important research breakthroughs in recent years have yielded maintenance and refinish coatings of outstanding performance and durability; other developments have provided unusual convenience in paint application for the paint user.

Special Purpose Coatings is one of the categories used by the U.S. Census Bureau to report coatings manufacture in the United States. The other two are Architectural Coatings and Product Coatings (OEM). Special Purpose Coatings include those intended for industrial maintenance, auto refinishing, traffic marking, marine paints,

and a number of other specially formulated coatings, including metallics and aerosols.

Although they comprise only about 15% of the total volume of coatings, Special Purpose Coatings are now the fastest growing coating category—and likely the most profitable.

Speakers will discuss such topics as: how to choose the right coating system; how to apply it correctly and inspect the finished job; the importance of durable refinish coatings for heavy equipment and machinery; and the maintenance of ships and off-shore structures.

Complete details will be available shortly. In the meantime, further information may be obtained by contacting the Federation of Societies for Coatings Technology, 1315 Walnut Street, Suite 832, Philadelphia, PA 19107; Phone: (215) 545-1506.

Symposium on Automotive Color Control To Be Offered in June in Southfield, MI

A Symposium on Automotive Color Control (SACC) will be held June 3-6, 1986 at the Michigan Inn, Southfield, MI, to acquaint participants with the new SAE Recommended Practice J1545 for determining color match acceptability of automotive components.

The event is being sponsored by the Detroit Colour Council, Detroit Society for Coatings Technology, Federation of Societies for Coatings Technology, and Manufacturers Council on Color and Appearance.

The meeting format will combine general sessions with workshops and "hands-on" equipment demonstrations. Programming will be focused specifically on coatings, plastics, and soft trim, with each of the three topics addressed in two-day overlapping segments.

SAE Recommended Practice J1545, recently announced by the Society of Automotive Engineers, is the result of work carried out by an industry-wide committee formed by the Detroit Colour Council to develop the best test method for color difference measurement. It is expected that "J1545" will be widely adapted and will be useful for Statistical Process Control.

Symposium General Chairman is James E. Grady, Pigments Dept., CIBA-GEIGY Corp., Birmingham, MI. General program sessions are under the direction of William

V. Longley, Design Center, Ford Motor Co., Dearborn, MI. Arrangements for the workshops and instrument displays are being handled by the Manufacturers Council on Color and Appearance.

Complete details will be available shortly. Meanwhile, further information may be obtained by contacting the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107.

Tuition Scholarship Offered by Federation

The Federation of Societies for Coatings Technology has made a grant of \$2,000 in tuition scholarships available for students who enroll in and successfully complete the University of Detroit's two-semester course, "The Chemistry of Protective Coatings" taught by Dr. Taki Anagnostou, of Akzo Coatings America, Inc. Based upon the criteria of academic preparation, Q.P.A., and potential for employment in the coatings industry, two students will be awarded the grant.

Part One of the course began in September of 1985 and six students have applied for the scholarship.



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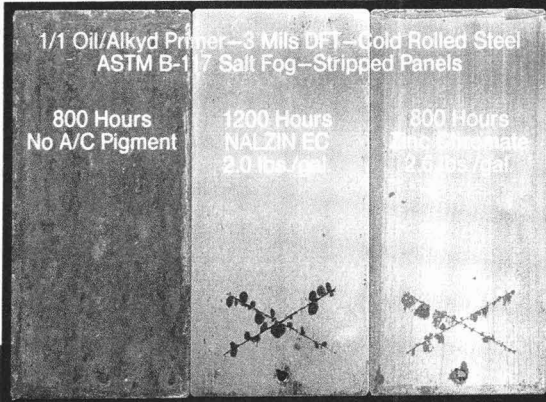
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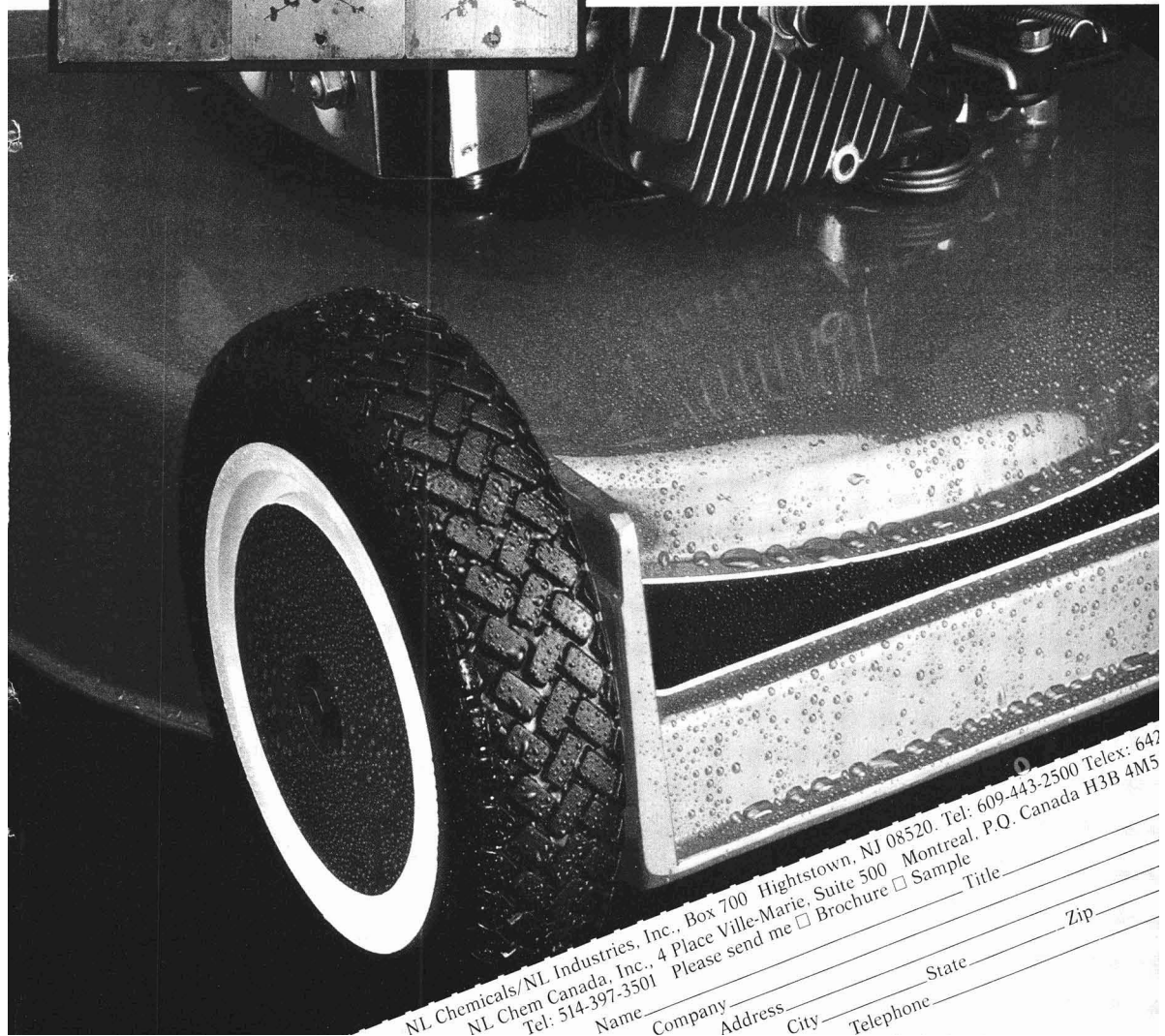
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NACE Issues Standard on Storage Systems

Three to five million underground storage tanks in the USA may be leaking their contents into the ground because of corrosion. Addressing this specific problem, the National Association of Corrosion Engineers (NACE) has issued a new standard entitled "Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems."

The standard gives procedures and practices for achieving effective control of external corrosion on ferrous metal tanks and associated piping systems. The use is described of electrically insulating coatings, electrical isolation, and cathodic protection as the corrosion control methods. Specific provisions are given for the application of cathodic protection to existing bare, existing coated, and new storage systems.

Sections of the document are devoted to the determination of need for corrosion control, design considerations, coatings, criteria for cathodic protection, design and installation of cathodic protection systems, control of interference currents, and the operation and maintenance of cathodic protection systems.

This NACE standard does not address double-walled tanks nor secondary containment systems which some regulatory agencies have suggested as systems that eliminate the need for coatings and cathodic protection. Double-walled tanks and secondary containment systems have nothing to do with corrosion prevention. Such systems deny the proven technology of ca-

thodic protection as the best means of stopping underground corrosion.

The new tank standard was published in the June issue of NACE's journal "Materi-

als Performance." Copies of the standard can be obtained from NACE (P.O. Box 218340, Houston, TX 77218), at \$4.00 per copy for members; \$5.00 for nonmembers.

Silberline Opens Facility in Hometown, PA

Silberline Manufacturing Co., Inc., Lansford, PA, has unveiled its new manufacturing and R & D facility located in Hometown, PA. Situated on 29 acres, the contemporary complex raises the number of Silberline's major manufacturing centers to four. The other centers are located in Lansford, PA; Decatur, IN; and Leven, Fife, Switzerland.

Formerly occupied by the Bundy Tubing Co. which vacated in 1981, the facility has been renovated for aluminum pigment de-

velopment and production on an international scale at a cost of \$6,350,000. A sizable portion of the costs was invested in an elaborate system of state-of-the-art environmental controls. Tanks containing raw materials are fully enclosed to prevent accidental leakage.

F.R. Hall Represents Halox And Hammond Lead Products

F.R. Hall, Inc., St. Louis, MO, now represents Halox Pigments Div. and Hammond Lead Products, Inc., to the paint, coatings, and allied industries. Serving as a stock distributor, Hall will cover the following states: Arkansas, Iowa, Kansas, Missouri, Nebraska, southern Illinois, and western Tennessee.

BASF Acquires Inmont

In an effort to expand further its position in North America, BASF America Corp., New York, NY, recently purchased Inmont Corp. from United Technologies Corp.

Inmont, with sales of approximately \$1 billion in 1984, is a supplier of automotive finishes and a manufacturer of inks and container coatings for the printing, publishing, and packaging industries. The acquisition complements BASF's activities in inks and finishes.

Angus Purchases Research Complex

To strengthen its in-house research and development capability and become more responsive to customers, Angus Chemical Co., Northbrook, IL, has purchased a 10,000 sq ft facility located in the Northbrook Sky Harbor Industrial Park, Northbrook, IL. Estimated at \$1.4 million, extensive renovation to the laboratory and purchase of state-of-the-art equipment is scheduled for completion in January of 1986.

Expected to double the company's staff and equipment capabilities, the complex will become headquarters for the technical service and R & D functions. "This move is part of our strategy to grow in ways complementary to our core nitroparaffin business," said President O. Wayne Chandler. "The Northbrook site is especially attractive because of its proximity to corporate headquarters, and because the adjoining land will allow significant expansion of the building, if we need it," added Mr. Chandler.

New Direction Determined for NPCA Public Relations

At its July meeting, the National Paint and Coatings Association Executive Committee approved a balanced budget and directed that funds be rechanneled from product promotion programs to public rela-

tions efforts stressing the safe use of paint industry products. Possible components of the new PR effort will include videotapes of product-safety tips for consumers and retailers, radio features, and materials directed at painting contractors.

The shift in emphasis requires curtailment of portions of the association's "Picture It Painted" program, including appearances by PIP spokesman Foster Meagher, and the elimination of the "Value Added" campaign to make consumers aware of the uses and value of industrial coatings. According to Richard B. Wiess, NPCA Public Relations Director, "One aspect of PIP that will be retained is the community service effort involving NPCA along with local paint and coatings associations."

Indusmin Obtains IMC

Indusmin, division of Falconbridge Limited, has purchased IMC Industry Group (Canada) Ltd. The major asset of IMC is its nepheline syenite operations, conveniently located adjacent to Indusmin's operations in Nephton, Ontario.

Production facilities operated by Indusmin are also in St. Canut, Quebec; Midland and Orillia, Ontario; and Spruce Pine, NC.

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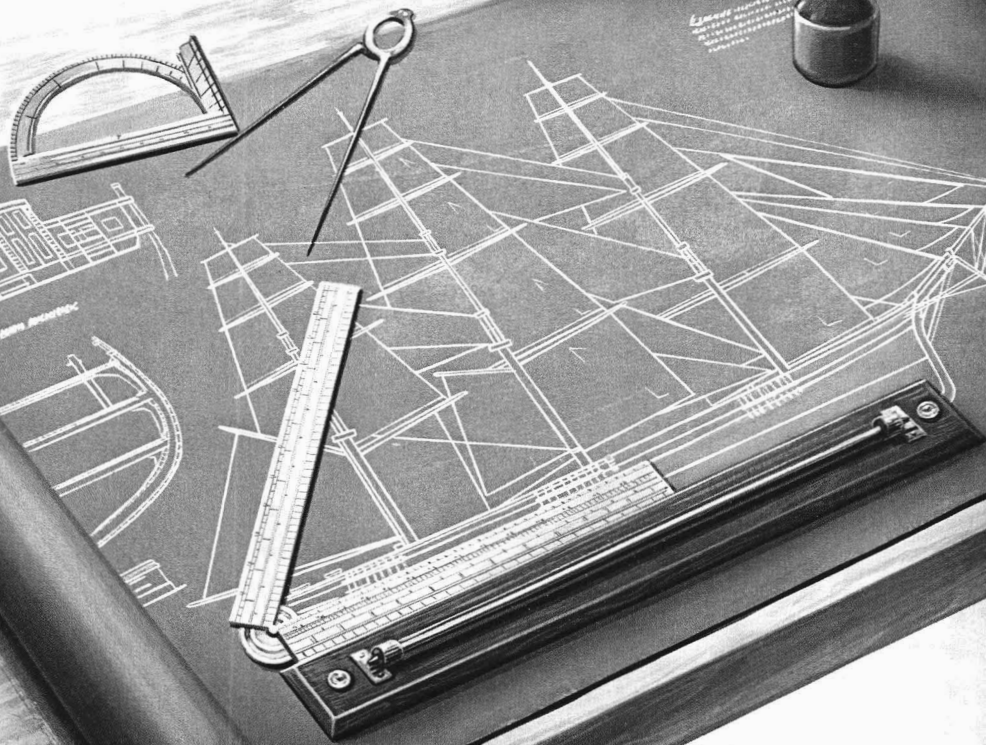
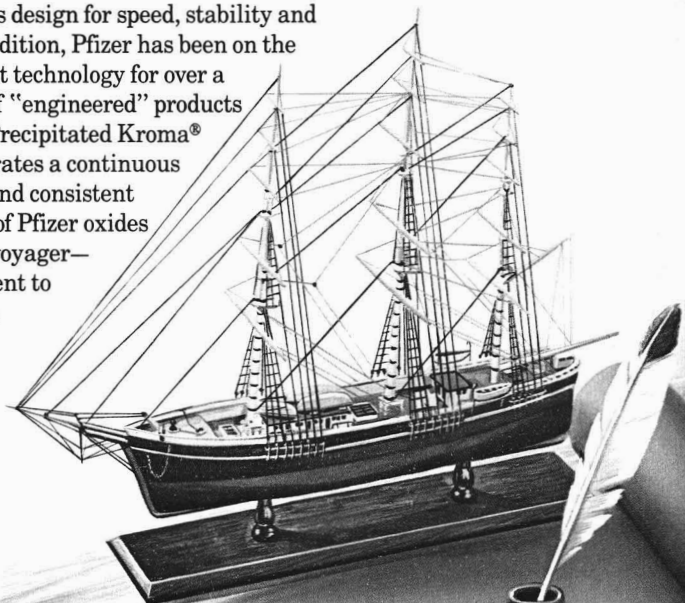
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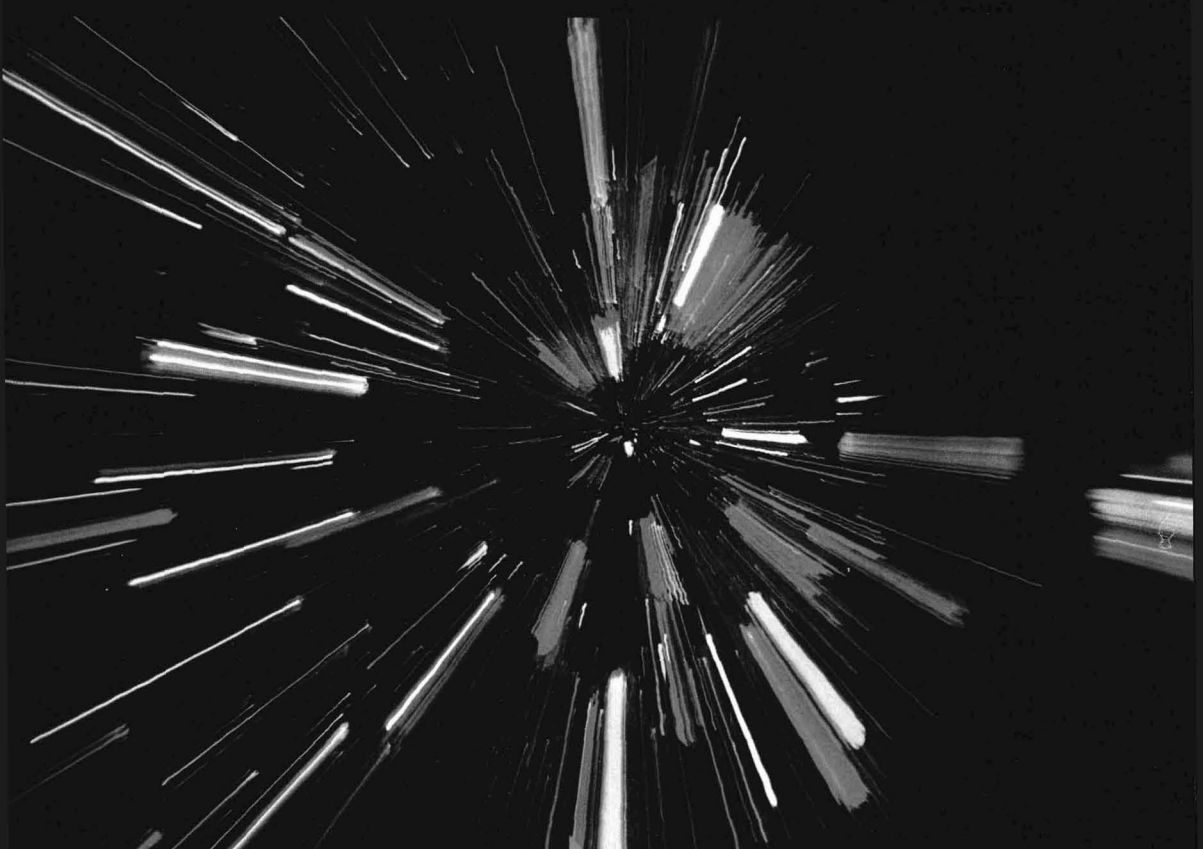
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Physical Properties of Epoxy-Primed Polyethylene and Epoxy Pipe Coatings

R.E. Sharpe and R.J. Dick
Battelle*

Pipeline coatings protect line pipe from corrosion by providing an impervious barrier and electrical insulation. The effect of heat and moisture on selected physical properties was investigated for two coatings on steel pipe: a fusion-bonded epoxy coating and an epoxy-primed, extruded polyethylene system. Cathodic disbonding, impact resistance, electrical resistance, and penetration of the coatings after exposure to hot water were studied.

The epoxy-primed polyethylene coating provided cathodic disbonding protection equivalent to the epoxy coating. Rust formation was not observed in the disbonded area in any test situation. The epoxy-primed polyethylene system also provided greater mechanical protection to the pipe (impact and penetration resistance) and better electrical insulation (volume resistivity) than the fusion-bonded epoxy coating.

INTRODUCTION

Protection against corrosion of underground pipelines is effectively accomplished by a two-part system consisting of (1) an impervious coating applied to the pipe and (2) a system of cathodic protection to minimize corrosion in the event of holidays in the coating resulting from damage incurred in shipping, handling, or in-service stress. A tough, continuous, impervious pipe coating provides mechanical protection to the pipe and provides not only lower costs of cathodic protection by allowing lower electrical energy demands, but also facilitates optimal cathodic protection and current distribution even under difficult soil conductivity conditions. Two major coating systems for providing physical protection for the pipe surface have been in general use for buried pipelines—

fusion-bonded, thin-film epoxy and thicker hot-applied polyethylene over an adhesive precoat.

It is generally held that the thin-film epoxy coatings have better adhesion to the steel pipe surface than polyethylene coatings. On the other hand, the thicker polyethylene film provides greater mechanical protection. A third coating system now in use is a combination of these two consisting of an epoxy primer, a thin adhesive interlayer, and a hot-extruded polyethylene topcoat.

In service, pipelines are routinely subjected to moisture and, in some applications, moisture and considerable heat (e.g., exit lines from a compressor). A comparison of selected physical and electrical properties of the epoxy (EP) and the new epoxy-primed polyethylene (EPE) coatings after exposure to water at elevated temperatures is the subject of this paper.

EXPERIMENTAL

Materials

All evaluations were conducted on specimens cut from coated pipe obtained from normal plant production. These steel line pipe samples ranged in diameter from 30 in. (76 cm) to 35 in. (91 cm) with wall thickness of 0.625 in. (16 mm) to 0.75 in. (19 mm).

The coating systems used in this study were: fusion-bonded epoxy powder (EP), 0.014 in. (0.36 mm) thickness; and a three-layer coating consisting of an epoxy primer, polyethylene copolymer adhesive layer, and a medium density polyethylene extrusion applied topcoat (EPE) 0.120 in. (3.0 mm) thickness.

Procedures

The experimental procedures followed, as closely as practical, standard ASTM procedures. Generally, only

*Columbus Laboratories, 505 King Ave., Columbus, OH 43201.

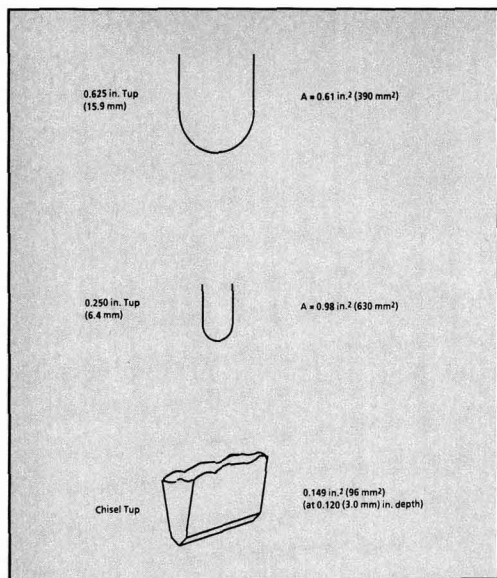


Figure 1—Impact tup configuration

the specimen configuration was altered. That is, sections cut from large-diameter production pipe were used instead of small diameter pipes especially prepared from the ASTM Test Method.

The ASTM procedures followed in this study are discussed below.

ASTM G-8 CATHODIC DISBONDING OF PIPELINE COATINGS: Method B was followed using 6 × 6-in. pipe sections (150 × 150 mm). In these studies, sections of 3.75 in. (95 mm) (I.D.) plastic tubing were positioned over the coated pipe specimens to form cells for the electrolyte for cathodic disbonding determinations. The original holiday in the epoxy coatings was 0.250 in. (6.4 mm), in the polyethylene coating it was 0.75 in. (19

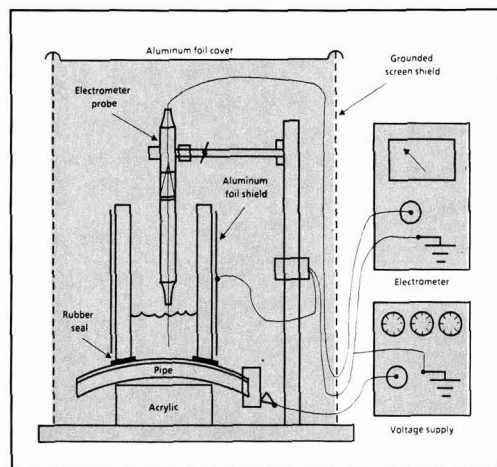


Figure 2—Volume resistivity apparatus

mm), and in the epoxy-primed polyethylene it was 0.625 in. (16 mm). The thicker coatings required larger original holidays to avoid formation of a gas bubble in the holiday which could restrict the flow of cathodic current.

ASTM G-14 IMPACT RESISTANCE OF PIPELINE COATING (FALLING WEIGHT TEST): Laboratory impact apparatus was used with maximum impact force of 160 in.-lb (4 lb weight dropped through 40-in. fall). Since the standard 0.625-in.-diameter hemispherical tup did not penetrate the polyethylene coating at maximum impact, direct comparison with the EP coating was not practical. For this reason, and since potential impact damage in the field may result from smaller round particles or contact with pointed or sharp-edged objects, a more severe 0.250-in.-diameter hemispherical tup and a tup prepared from a 5/8-in. cold chisel were also used. The chisel point was applied with the width of the chisel parallel to the axis of the pipe. A comparison of the profile and surface area of these tups is presented in Figure 1. The specimens were supported in the area of impact, thus ensuring that the impact energy was absorbed by the coating and did not cause plastic deformation of the steel substrate which may happen with relatively thin panels.

ASTM G-17 PENETRATION RESISTANCE OF PIPELINE COATINGS (BLUNT ROD): This test method determines the relative resistance of pipeline coatings to penetration by a blunt rod under a specified load. In this study, penetration of coating to the pipe surface was not observed, but relative deformation of the coating was determined.

ASTM D-257 D-C RESISTANCE OR CONDUCTANCE OF INSULATING MATERIALS: The experimental apparatus for obtaining volume resistivity measurements is shown in Figure 2. Procedures are described in a later section of this paper.

RESULTS AND DISCUSSION

Simultaneous exposure of pipeline coatings to heat and water could result in changes in many of the coatings' physical properties. The particular coating characteristics that have been investigated in this study were cathodic disbonding, impact resistance (falling weight), electrical resistivity, and penetration resistance. These properties (except cathodic disbonding) of fusion-bonded epoxy (EP) and epoxy-primed, extrusion wrapped polyethylene (EPE) coatings were determined before and after exposure to water at 80°C for periods of three or 30 days.

Cathodic Disbonding

Damage to the coating of a buried pipe exposes the steel to possible corrosion. In most cases cathodic protection is provided to mitigate against corrosion of pipe in the event of such damage. The applied potential of cathodic protection may cause loosening of the coating around the damaged area. Thus, the cathodic disbonding test is intended to measure the tendency of a coating to be loosened under conditions of access to electrolyte solutions and applied electrical voltage.

The results of the cathodic disbonding determination for three types of pipe coatings are compared in Table 1.

The EP coated pipe, after 30 days of exposure to cathodic potential, had an average disbonded distance (from the original holiday) of 0.35 in. (8.9 mm). The extruded polyethylene (PE) pipe coating disbonded an average of 1.2 in. (30.5 mm) under the same conditions. However, the newer EPE coated pipe under simulated cathodic protection conditions disbonded an average of only 0.23 in. (5.8 mm) (essentially the same as the EP coating). It should be noted that no rust formation was observed under the disbonded coatings, including the relatively larger disbonded area of the PE coating.

It can be concluded from these data that the epoxy primer of the EPE coating system provides resistance to cathodic disbonding equivalent to that of the fusion-bonded EP coating.

Impact Resistance

Falling weight impact resistance was measured using three impact tup head configurations: (1) standard ASTM 0.625 in. (15.9 mm) hemispherical; (2) 0.250 in. (6.4 mm) hemispherical; and (3) chisel point. The coatings were conditioned for three and 30 days in distilled water at 80°C. After that exposure, half of the number of samples were then cooled to -40°C and held for 48 hours before impact resistance evaluation. Impact determinations were conducted immediately after removal of the specimens from the test environment, essentially at the temperatures of pre-exposure. The results of duplicate determinations were averaged. For comparison, data are also presented for coatings subjected to 48-hour exposure at -40°C, 25°C, and 65°C under dry conditions.

IMPACT RESISTANCE OF EP COATING:

EP Coating, 0.625 in. (15.9 mm) Tup—The results obtained from impacting the EP coating with the standard 0.625 in. tup are shown in *Table 2*. Most of the values obtained fell in the range of 10 to 20 in.-lb (11.5 to 23.0 kg-cm). The impact resistance of the EP coating using the 0.625 in. tup was substantially greater after three days' exposure to water and heat (13.7 in.-lb) than after 30 days' (4.9 in.-lb). In both cases, post-exposure freezing resulted in somewhat greater impact resistance (17.0 in.-lb compared to 13.7 for three days and 11.6 to 4.9 for 30 days). There was little difference in the impact resistance between the 25°C and 65°C dry samples and that of the EP coatings exposed for three days at 80°C in water (~17 in.-lb compared to ~14). Dry freezing (-40°C) exposure resulted in higher impact resistance (22.4 in.-lb) than when freezing followed wet exposure at 80°C for three days (17 in.-lb) and wet exposure at 80°C for 30 days (11.6 in.-lb). A possible interpretation of these results which fits into the electrical resistance measurements reported later may support the conclusion that water absorption causes a reduction of impact resistivity and also that a subsequent -40°C storage period reduces the (reversible) water absorption of the epoxy resin.

EP Coating, 0.250 in. (6.4 mm) Tup—Using the more severe 0.250 in. (6.4 mm) tup with the EP coatings, the resulting impact values varied around 5 in.-lb (58 kg-cm), (*Table 2*), with essentially the same relationships as observed with the standard 0.625-in. tup.

Table 1—Cathodic Disbonding Tests (ASTM G-8)^a

Sample	Epoxy-Primed Polyethylene	Fusion-Bonded Epoxy	Extruded Polyethylene
Original holiday (D ₁) in.	0.375	0.25	0.75
Potential, ref. (Cu/CuSO ₄), V	-1.46	-1.50	-1.48
Disbonded (D ₂) in.	0.83	0.94	3.1
Disbonded distance $\left(\frac{D_2-D_1}{2}\right)$ in.	0.23	0.35	1.20

(a) Duration of tests was 30 days. Values are average of two determinations.

EP Coating, Chisel Tup—With the chisel point tup, slightly lower impact values were observed compared with those obtained when using the 0.250 in. tup (*Table 2*). For example, the impact values after three days' exposure to water at 80°C were 6 in.-lb for the 0.250 in. tup and 3.9 for the chisel tup. Since the impact values obtained for both tups varied around the 5 in.-lb level, no significant differences were noted.

IMPACT RESISTANCE OF EPE COATING:

EPE Coating, 0.625-in. (15.9 mm) Tup—When the standard ASTM tup was used with the laboratory impact test equipment to impact the EPE coated specimens, no failures were observed within the limits of the procedure (to 160 in.-lb (185 kg-cm)) for any of the exposure conditions examined.

EPE Coating, 0.250 in. (6.4 mm) Tup—The impact resistance values obtained for the EPE coated pipe using the more severe 6.4 mm impact configuration are shown in *Table 3*. Impact resistance values of 60 to 70 in.-lb (69 to 81 kg-cm) were obtained for coatings exposed for three and 30 days in water at 80°C and 25°C, dry.

All samples exposed to -40°C temperatures whether wet or dry yielded impact values (using the 0.250 in. tup) of 102 to 113 in.-lb (118 to 130 kg-cm). This was an increase of about 40-50 in.-lb over the samples exposed to heat and water or unexposed samples measured dry at room temperature.

EPE Coating, Chisel Tup—When the EPE coatings that had been exposed to water at 80°C were impacted

Table 2—Impact Resistance of Fusion-Bonded (EP) Coating

Exposure Conditions	Impact Resistance (in.-lb)		
	0.625 in. Tup	0.250 in. Tup	Chisel Tup
3 days at 80°C, wet	13.7	6.0	3.9
plus 2 days at -40°C	17.0	7.0	5.3
30 days at 80°C, wet	4.9	1.6	2.0
plus 2 days at -40°C	11.6	7.0	4.6
48 hours at 25°C, dry	17.3	6.2	8.8
48 hours at 65°C, dry	17.5	5.8	6.3
48 hours at -40°C, dry	22.4	12.0	7.8

Table 3—Impact Resistance of Epoxy-Primed Polyethylene (EPE) Pipe Coatings

Exposure Conditions	Impact Resistance (in.-lb)		
	0.625 in. Tup	0.250 in. Tup	Chisel Tup
3 days at 80°C, wet.....	>160	62	51
plus 2 days at -40°C.....	>160	102	103
30 days at 80°C, wet.....	>160	72	43
plus 2 days at -40°C.....	>160	113	118
48 hours at 25°C.....	>160	64	53
48 hours at 65°C.....	>160	—	—
48 hours at -40°C.....	>160	112	108

with the chisel tup, the results (Table 3) were somewhat lower (40 to 50 in.-lb) than the values (69 to 70 in.-lb) obtained using the 0.250 in. tup. The impact values observed at low temperatures (-40°C) with the chisel tup (103 to 118 in.-lb, 119 to 136 kg-cm) were essentially the same as the values obtained with the 0.250 in. tup (102 to 113 in.-lb). Impact values obtained at 25°C (dry) for the EPE coating were somewhat lower using the chisel tup (53 in.-lb) than when the 0.250 in. tup was used (64 in.-lb).

Distilled Water vs. 0.1M NaCl—In addition to exposure to heat and water, a limited number of coated pipe specimens were exposed to 0.1 Molar NaCl solution at 80°C. Impact resistance was evaluated after three days' exposure using the 0.625 in. (15.9 mm) and the 0.250 in. (6.4 mm) hemispherical tups and the chisel point. This work is discussed below.

EP Coated Pipe—In the case of the epoxy coated pipe, there was no significant difference in impact resistance whether water or 0.1M NaCl solution exposure were used (Table 4). With the 0.625-in. tup, impact values of 12 to 14 in.-lb were obtained. With the 0.250-in. tup, values were 6 in.-lb after exposure to water and 4 in.-lb after exposure to salt solution. Impact with the chisel tup yielded results of 4 in.-lb after both water and salt solution exposures.

EPE Coated Pipe—There was essentially no difference between the impact results obtained for EPE coated pipe after three days' exposure to water or after 3 days' exposure to 0.1M salt solution (Table 4). With the 0.625-in. tup, impact values, after both exposure conditions, were greater than 160 in.-lb. EPE protected panels which had been immersed in hot water, and others in NaCl solution at 80°C, possessed impact resistance values (standard 0.625 in. tup) of 60 and 50 in.-lb, respectively. Using the chisel point, impact values of about 50 in.-lb were obtained after exposure to water or the salt solution at 80°C.

From the above results, it is apparent that the presence of NaCl at a concentration of 0.1 mole/liter had no significant effect on the impact resistance of EP or EPE coatings for exposures of three days at 80°C when compared to similar exposures with water.

The results of evaluation of the impact resistance of pipe coatings exposed to heat and moisture can be summarized as follows:

Table 4—Impact Resistance of Pipeline Coatings After Exposure to Hot Water and Hot 0.1M NaCl Solution

Exposure Conditions	Impact Resistance (in.-lb)	
	Fusion-Bonded Epoxy	Epoxy-Primed Polyethylene
3 days at 80°C in water		
0.625 in. tup.....	13.7	>160
0.250 in. tup.....	6.0	62
Chisel tup.....	3.9	51
3 days at 80°C in 0.1M NaCl		
0.625 in. tup.....	12.2	>160
0.250 in. tup.....	3.9	49
Chisel tup.....	3.9	48

(1) Impact tests, using the three tup configurations described herein, are more useful in defining the impact resistance properties of pipe coatings than simply selecting the 0.625 in. tup;

(2) The ASTM Standard (0.625 in.) impact tup cannot be used to compare EP and EPE coatings because no defects in the EPE coating can be produced, but the 0.250 in. and chisel tup can be used with both coatings;

(3) Fusion-bond epoxy (EP) coating, using any tup configuration, possessed considerably lower impact resistance than the epoxy-primed polyethylene (EPE) coating;

(4) The impact resistance of the EP coating decreased with exposure time in water at 80°C;

(5) Impact resistance of the EPE coating is not affected by exposure times up to 30 days (essentially the same impact resistance for three or 30 days exposure to water and heat);

(6) The impact resistance of the EPE coating is not affected by exposure to water and heat and exposed samples had the same impact resistance as those of the unexposed coating;

(7) The impact resistance of the EPE coating was substantially higher at the low temperatures (-40°C) than at 25°C; and

(8) Salt solution exposure (0.1M NaCl at 80°C for three days) had no effect on impact resistance of EP or EPE coatings when compared to similar exposures in water.

Electrical Resistivity

A desirable property of pipeline coating materials is resistance to flow of electrical current (its performance as an electrical insulator). The efficiency of cathodic protection of the pipeline against corrosion is enhanced by insulating the pipe surface as completely as possible. The volume resistivity of a coating material is the electrical resistance of the material expressed as the resistance of a cube one centimeter on a side measured between parallel faces. The relation between the technically important "specific coating resistivity" (ρ)—which is inversely

proportional to the protective coating density—and volume resistivity (ρ) is expressed as $r = \rho \times s$, where s represents coating thickness. Figures 3 and 4 are presented in terms of volume and specific coating resistivities.

The electrical resistivity of the pipeline coatings was determined (ASTM Method D-257) after exposure to water at 80°C for three and 30 days and after exposure to 0.1M NaCl solution for three days. The volume resistivity was determined for unexposed coatings at 25°C to provide a basis for comparison for exposed coatings cooled to ambient temperatures.

The results of volume resistivity determinations after the EP and EPE coated pipe samples were exposed to 80°C water for three days are presented in Figure 3. Solid symbols represent the volume resistivity of the unexposed coatings at 25°C. The exposed specimens were measured at as near 80°C as possible and resistivity determinations were made periodically as the samples cooled to room temperature.

EPE COATING, 3-DAY EXPOSURE: After exposure to water at 80°C for three days, the volume resistivity of the epoxy-primed polyethylene (EPE) coating was slightly higher at the higher temperatures (2.2×10^{15} ohm-cm at 22°C and 2.2×10^{16} ohm-cm at 77°C). It would be expected that, if any changes were observed, it would be a slight decrease in volume resistivity with increase in temperature. However, the resistivity values are very high and the corresponding currents measured were very low, being near the lower limits of the electrometer used.

Thus, the apparent inverted slope for the EPE coating is probably not significant but within experimental error at the level measured. On cooling, the resistivity of the EPE coating was the same as that of the unexposed control.

EP COATING, 3-DAY EXPOSURE: After exposure to water at 80°C for three days, the volume resistivity of the EP coating decreased substantially (conductivity increased) with increased temperature (from 1.3×10^{13} ohm-cm at 22°C to 1.0×10^{10} ohm-cm at 80°C). On cooling, the electrical resistance did not return to the value observed for the unexposed coating (1.98×10^{15} ohm-cm). The increase in conductivity of the epoxy coating exposed to water is indicative of some change in the composition which apparently altered its electrical properties. The most likely mechanism is water absorption by the coating. This facilitates ion transfer and causes an increase in the conductivity of the film.

This change in electrical properties of epoxy coatings has been observed previously by H. Landgraf and co-workers*. The resistivity of fusion-bonded epoxy pipe coatings was measured during a cycle of heating from 20°C to 90°C and cooling back to 20°C. When this cycle was applied to a dry coating, the resistivity decreased upon heating and on cooling returned to the starting value. However, when the coating was heated and cooled in water, the resistivity of the coating after heating and cooling was substantially lower than the starting resistivity.

*3R Intern. 1981, Vol. 20, No. 9, pp 483-494, and private communication.

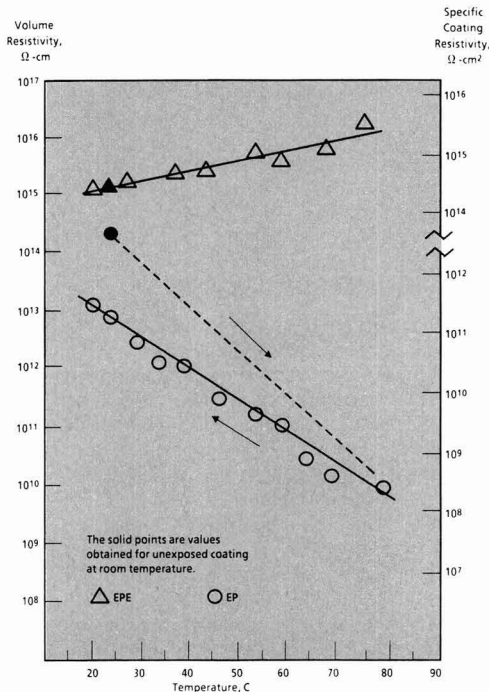


Figure 3—Volume resistivity and specific coating resistivity after three days in water at 80°C

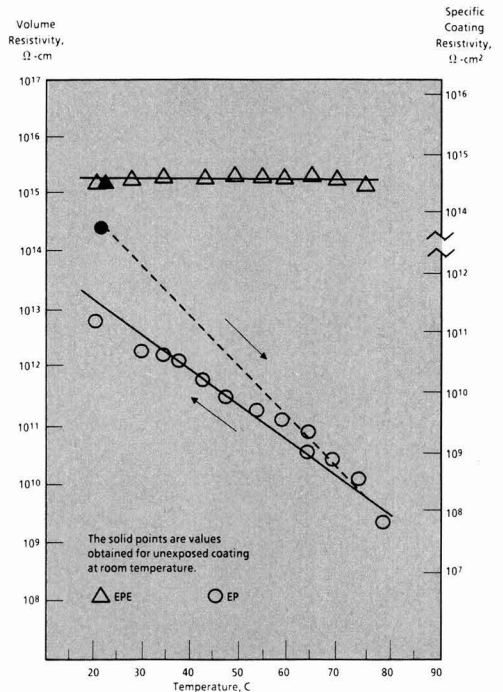


Figure 4—Volume resistivity and specific coating resistivity after 30 days in water at 80°C

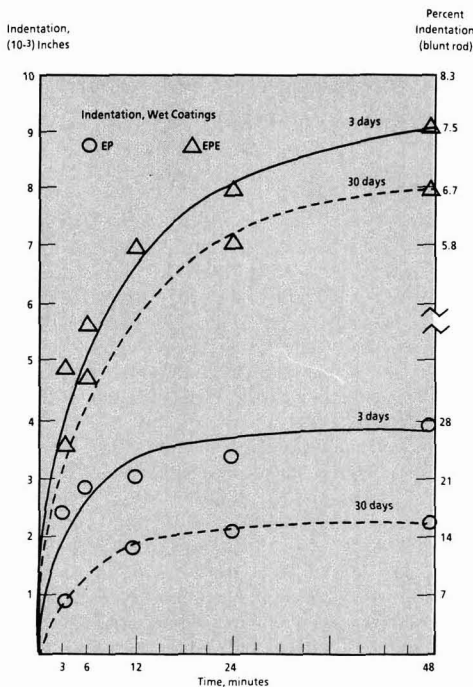


Figure 5—Indentation (blunt rod) of EP and EPE coatings (wet)

tance measurement of the coating. These results also indicate that the EPE coating undergoes a change when in contact with water at elevated temperature.

EP AND EPE COATINGS, 30-DAY EXPOSURE: After 30 days' exposure to water at 80°C, the electrical resistance properties of the coatings (Figure 4) were essentially the same as for three days' exposure. Temperature and moisture had no effect on resistivity of the EPE coating. The electrical resistance of the EP coating, again, was temperature-dependent and did not return to the same value as that of the dry control at room temperature.

EP AND EPE COATINGS, EXPOSURE TO NaCl SOLUTION: The volume resistivity values for the EP and EPE coatings exposed to 0.1M NaCl solution at 80°C for three days were identical to the values obtained after three days exposure to water at 80°C. Plots of the electrical resistivity of coatings versus temperature after exposure to the salt solution are identical to Figure 3.

The electrical insulating property of the EPE was not affected by exposure to water at 80°C during the 30 days test period. This fact was evidenced by the stable, high resistance of the coating after exposure, equivalent to the resistance of the unexposed coating film. Similarly, the coating was unaffected by exposure to 0.1M NaCl solution at 80°C for three days. The resistance of EP coating, on the other hand, was sensitive to both water exposure and elevated temperature. Electrical conductivity of the EP coating increased with increased temperature, and after exposure to water or NaCl solution at 80°C, the

conductivity of the EP coating was greater than that of the unexposed coating film.

Penetration

The blunt rod penetration test (ASTM G-17) is designed to evaluate the resistance of the pipeline coating to penetration or deformation by a blunt object under a constant load. In the test, a load of 200 psi (0.14 kgf/mm²) is applied over a 0.250 in. (6.4 mm) diameter flat rod, positioned on the coated pipe and the depth of penetration is measured. Rather than run the penetration test at 80°C in water to constant penetration (this could, in essence, double the term of the three-day test), the samples were tested immediately after removal from test and initial penetration properties were compared. The wet samples were sealed in plastic envelopes to maintain the moisture content of the coatings. The penetration value of the plastic envelope alone was not measurable using the test procedure.

Comparison of the penetration test results (Figure 5) showed (as would be expected) that the penetration of the EPE coating was greater than that of the EP coating. However, the average thickness of the EPE coating was 0.120 in. (3 mm) and that of the EP coating was 0.014 in. (0.4 mm). Therefore, the relative penetration of the EP coating was two to three times as great as that of the EPE coating. There appeared to be a decrease in indentation for both coatings after 30 days' exposure, but this is not deemed significant in view of the limited number of observations and the small real differences (0.001 in.) measured.

Blunt rod penetration did not increase with time of exposure to water at 80°C for either coating (EP or EPE). Although the penetration of the EPE coating was greater in absolute values than that of the EP coating, the relative penetration of the EPE coating was substantially smaller than that of the EP coating. Thus, it can be concluded that the EPE coating is an unusually effective barrier to exposure of the pipe surface by penetration of blunt objects such as rock fill.

SUMMARY AND CONCLUSIONS

Pipeline coatings protect the pipe from corrosion by providing a widely impervious barrier and electrical insulation. The purpose of this program was to examine the effect of heat and moisture on selected physical properties of two coatings on steel pipe: (1) a fusion-bonded epoxy coating (EP), and (2) an epoxy-primed, extruded polyethylene system (EPE). The EPE system combines the advantages of the fusion-bonded coatings (excellent adhesion) with those of the polyethylene (greater resistance to mechanical damage).

The coating properties that have been investigated in this study are cathodic disbonding, impact resistance (falling weight), electrical resistivity, and blunt rod penetration resistance. These properties of EP and EPE coatings were determined dry (as delivered) as well as after exposure to water at 80°C for periods of three or 30 days.

The EPE coating system provides resistance to cathodic disbonding equivalent to that of the EP coating. No rust

formation was observed under disbonded coatings, regardless of the coating type.

The EP coating, using any impact tup configuration, had considerably lower impact resistance than the EPE coating. Also, the impact resistance of the EP coating decreased with exposure time in 80°C water from three to 30 days. On the other hand, the EPE coating, after exposure to water at 80°C for three or 30 days, had essentially the same impact resistance as the unexposed EPE coating. Exposure of either EP or EPE coating to 0.1M NaCl solution for three days at 80°C had no significant effect on impact resistance compared to similar exposures using water alone.

The electrical insulation property of the EPE coating was not affected by exposure to water at 80°C during the 30 days test period, nor by exposure to 0.1M NaCl solution after three days at 80°C. The specific coating resistivity of the EPE coating was essentially the same (4.7×10^{15} ohm-cm) before and after exposure to heat and moisture. On the other hand, the resistivity of the EP coating was sensitive to both water and heat. Electrical conductivity increased (resistivity decreased) with increasing temperature. After exposure to water at 80°C, the EP

coating had lower volume resistivity (8.1×10^{12} ohm-cm) than the unexposed EP coating (4.7×10^{14} ohm-cm). This increase in conductivity indicates a change in the physical nature of the EP film such as might occur from water absorption. Blunt rod penetration of the EP or EPE coating did not increase significantly with the time of exposure to water at 80°C, indicating no measurable degradation of the films. Although the penetration of the EPE coating was greater in absolute value than that of the EP coating, the relative penetration of the EPE coating was substantially smaller than that of the EP coating.

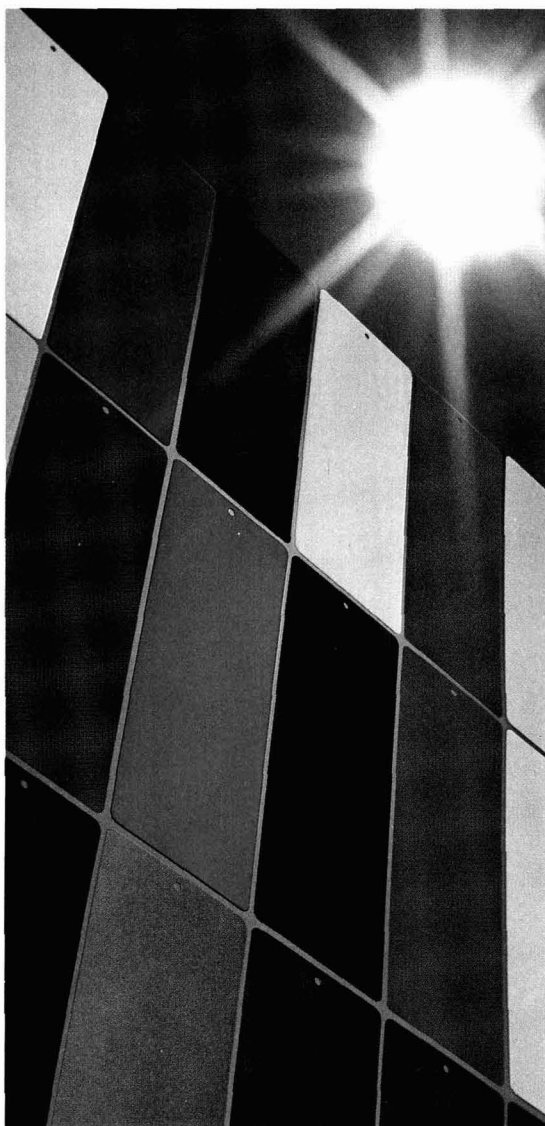
In summary, the EPE coating provides cathodic disbonding protection equivalent to that of the EP coating. The EPE coating system provides greater mechanical protection for the pipe (impact and penetration resistance) and better electrical insulation than does the EPE coating.

ACKNOWLEDGMENT

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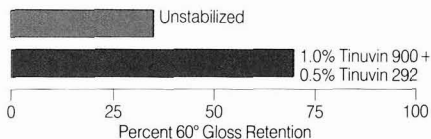
The first class is the hindered amine light stabilizers (HALS), such as Tinuvin® 292, Tinuvin 144 and Tinuvin 079L. They protect gloss and help prevent loss of physical properties that may result in chalking, erosion, water permeability and checking.

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Percent 60° Gloss Retention After Two Years of Exposure

Sample: Two-Component Solid White Acrylic
Aliphatic Polyurethane Coating
Exposure: 5° South Florida Black Box



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*U.S. Patent Nos. 4,314,933, 4,426,471, 4,426,472, and 4,344,876 assigned to CIBA-GEIGY Corporation.

CIBA-GEIGY

Presence and Effects Of Anaerobic Bacteria In Water-Based Paints. II

Effects on Paint Ingredients

Robert A. Oppermann
Cosan Chemical Corporation*

It has been shown that anaerobic bacteria occur in contaminated water-based paints and raw materials. The materials metabolized by these organisms were unknown. Various ingredients of paint formulations were tested to determine if they would support the growth of anaerobes. Several surfactants, thickeners, glycols, and antifoams show the effects of metabolic attack and, thus, can be metabolized by anaerobic bacteria. Based upon these findings, we can now explain the slow production of gas or viscosity loss without apparent microbial contamination. Some hidden effects of microbial contamination and their magnitudes are suggested.

INTRODUCTION

It has long been known that paints and coatings are subject to biological attack. Water-based paints, in particular, if unprotected, are susceptible to microbial invasion and growth resulting in spoilage. All the nutritive elements required for both life and metabolic activity for bacteria are present in the liquid paint.

The presence and activities of microbes in a paint can be deduced by the changes which occur in a paint. Gas production, for example, is due to respiration; viscosity loss is due to utilization or destruction of the thickener; pH change is produced by use of a material or production of a waste product. However, the final proof of microbial

contamination is the culturing and identification of the microbes.

In the past, all attempts at culturing and growing contaminating organisms have been done in the air, that is, under aerobic conditions. This method has produced generally satisfactory results; however, there are times when an obviously spoiled paint is examined and no chemical or microbiological cause can be found. The various explanations advanced have been more or less logical, but not completely satisfactory.

In a new investigation of these problems, we examined the concept that anaerobic bacteria could be involved. The anaerobes are bacteria which live and grow without the presence of air; in most cases, atmospheric oxygen is inhibitory or lethal to their continued existence. Such bacteria would not be seen in normal aerobic microbial assay or growth experiments.

The initial investigation showed that both finished paints and raw materials were often contaminated with anaerobic bacteria.¹ The anaerobes were isolated in pure culture and identified. Further research showed that the organisms could utilize hydroxyethyl cellulose and/or a surfactant of a type which is used in paint formulation.

A paint formulation contains many types of materials. In the survey of raw materials which was a part of the initial paper,¹ it was shown that some latexes, slurries, and color dispersions were contaminated with anaerobes. Presumably, the organisms were living on some component of these materials, for example, dispersants.

A paint also contains antifoams, thickeners, glycols, and coalescing agents. Members of each of these groups

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*400 Fourteenth St., P.O. Box 7, Carlstadt, NJ 07072.

were examined to determine if they could be utilized and/or degraded by anaerobic bacteria.

MATERIALS AND METHODS

The general anaerobic techniques and media used were presented in the earlier report.¹ All experiments were done in an anaerobic glove cabinet. In this manner, strict anaerobic conditions were maintained.

In all the experiments presented, a mineral medium was used as the test medium and was composed of: NH_4NO_3 , 0.1%; Na_2HPO_4 , 0.05%; KH_2PO_4 , 0.05%; $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 0.02%; CaCl_2 , 0.002%; FeCl_3 , 0.0005%; Yeast Extract (BBL, Cockeysville, MD), 0.02%; phenol red, 0.0013% (pH indicator); and the paint ingredient, 1.0%. Tap water was used to make up the medium which was adjusted to a pH of 7.5 before sterilization. Ten mL of the medium were placed in a screw-capped culture tube using a small internal inverted tube to indicate gas production. The tubes were autoclaved 15 minutes at 15 psi of steam, and, while hot, were placed in the anaerobic cabinet.

Each medium containing a paint ingredient was inoculated with pure cultures of the anaerobes isolated previously¹ and incubated for periods of up to six weeks. Observations were by comparison to uninoculated negative controls and were noted periodically, usually 1, 3, 5, and 7 days, and then weekly thereafter. An analysis of the gas formed by the fermentations was not made.

RESULTS

Several popular types of each class of ingredients were tested to determine the effect of anaerobic growth. The first group examined was dispersants. The results of the anaerobic challenge of four separate dispersants is shown in Table 1. All the anaerobes used in this experiment attacked at least one of the dispersants as determined by

pH changes shown by the phenol red indicator. The most active were members of the genera *Clostridium*, *Bacteroides*, and *Bifidobacterium*. The least active was the single *Actinomyces* species. In most cases, the course of the degradation followed the pattern of first forming acid followed by an alkaline reaction. Gas, if formed, generally appeared during the alkaline reaction. However, with the *Bacteroides* species identified as I and V, gas was formed during the time of acid reaction.

Bacterial degradation of lecithin produced an oily material which floated to the top of the culture tube. This may have been unsaturated fatty acid released by partial destruction of the molecule.

Antifoams

Table 2 shows the results of anaerobic growth on antifoams. The first effect was the production of acid which was followed by a more basic reaction. In the case of Antifoam A (a mixture of nonionic surfactants, mineral oil, and silicone oil), most of the bacteria did not produce enough basic materials to become alkaline, just enough to return to a neutral pH after first producing acid.

The culture medium, after addition of Antifoam A or B, was very turbid, much like a dilute milk. However, with the growth of several of the bacteria, the culture became clear in six weeks. This may have been due to degradation of a single ingredient, such as a surfactant, rather than total degradation of the mixture. The negative control did not show a similar reaction so the effect was caused by the bacteria.

Cellulosic Thickeners

The effect of anaerobic growth in a substituted cellulose medium has been examined before,¹ but was examined more completely here. The results of anaerobic growth on the cellulosic thickeners is shown in Table 3. Here again, it can be seen that the organisms followed the

Table 1—Effect of Anaerobic Bacteria on Plant Dispersants

Organism	Dispersant A ^a		Dispersant B ^b		Dispersant C ^c		Lecithin	
	1 Week	6 Weeks	1 Week	6 Weeks	1 Week	6 Weeks	1 Week	6 Weeks
<i>Actinomyces israelii</i>	NC ^d	NC	NC	NC	NC	NC	A	A.O
<i>Bacteroides fragilis</i>	NC	sl A	NC	NC	A	N	A	A.O
<i>Bacteroides hypermegas</i>	A	N	A	N	A	N	A	N
<i>Bacteroides ovatus</i>	A	N	NC	NC	A	sl A	A	sl B
<i>Bacteroides species I</i>	A	A.G	A	B	A	sl B	sl A	N
<i>Bacteroides species II</i>	NC	sl A	A	sl B	A	N	NC	NC
<i>Bacteroides species III</i>	A	A	A	N	A	N	A	sl B
<i>Bacteroides species IV</i>	A	A	A	B	A	N	A	B
<i>Bacteroides species V</i>	A	A.G	A	sl B	A	sl B	A	N
<i>Bifidobacterium adolescentis</i>	A	sl B	A	A	A	N	A	A
<i>Clostridium butyricum</i>	A	A	A	B	A	N	A	sl B.O
<i>Clostridium sphenoides</i>	N	sl B	NC	NC	A	N	A	A
<i>Clostridium subterminale</i>	A	B.G	A	B.G	A	B.G	A	A.O
<i>Clostridium species D</i>	A	N	NC	A	A	N	A	A.O
<i>Eubacterium aerofaciens</i>	A	sl B	A	A	NC	NC	NC	NC
<i>Lactobacillus fermentum</i>	A	sl B	NC	NC	A	sl B	A	N
<i>Streptococcus intermedius</i>	N	sl A	A	N	NC	NC	A	A.O

(a) Sodium salt of carboxylated polyelectrolyte.

(b) Nonylphenoxypoly (ethyleneoxy) ethanol.

(c) Alkylaryl polyether alcohol.

(d) A = Acid; B = Base; N = Neutral; G = Gas; O = Oil; NC = No Change; sl = Slight.

Table 2—Effect of Anaerobic Bacteria on Antifoams

Organism	Antifoam A ^a		Antifoam B ^b	
	1 Week	6 Weeks	1 Week	6 Weeks
<i>Actinomyces israelii</i>	A ^c	N	NC	sl B
<i>Bacteroides fragilis</i>	A	N	NC	sl B
<i>Bacteroides hypermegas</i>	A	B,K	NC	NC
<i>Bacteroides ovatus</i>	A	N,K	sl A	sl A
<i>Bacteroides species I</i>	A	B,K	sl A	sl A,K
<i>Bacteroides species II</i>	A	N,K	sl A	sl B
<i>Bacteroides species III</i>	A	N,K	NC	sl A
<i>Bacteroides species IV</i>	A	N	NC	sl B
<i>Bacteroides species V</i>	A	N	sl A	sl A,K
<i>Bifidobacterium adolescentis</i>	A	N	NC	N
<i>Clostridium butyricum</i>	A	B,K	NC	B,G
<i>Clostridium sphenoides</i>	A	N	NC	NC
<i>Clostridium subterminale</i>	A	B,G,K	sl A	B,G
<i>Clostridium species D</i>	A	N	NC	sl A
<i>Eubacterium aerofaciens</i>	A	N	A,K	A,K
<i>Lactobacillus fermentum</i>	A	N	NC	sl B
<i>Streptococcus intermedius</i>	A	sl A	NC	N

(a) Mixture of nonionic dispersants, mineral and silicone oils.
 (b) Mixture of nonionic dispersants and mineral oil.
 (c) A = Acid; B = Base; N = Neutral; G = Gas; K = Clear; NC = No Change; sl = Slightly.

general pattern of first producing an acid. The most significant effect was not acid production but loss of viscosity. Many of the cultures, especially the *Clostridium* species, caused a major viscosity loss within a week of growth. Others were slower, showing no change in one week, but showing acid production and viscosity loss in six weeks. Of the cellulosic thickeners used, carboxymethyl cellulose seemed the most resistant to the effects of the anaerobic bacteria used.

Glycols

Glycols and glycol type compounds are used for several purposes: freeze-thaw stability, leveling, and as co-

alescing agents. These ingredients were tested to determine their resistance to anaerobic attack. The results in Table 4 show that they were also susceptible to anaerobic degradation. Of the three glycol ingredients, ethylene glycol monobutyl ether was the most resistant. As a group, this class of materials was more resistant, although most of the bacteria would utilize one or more of them. It was notable that two of the *Clostridium* species had no effect.

Only polypropylene glycol was decomposed with the production of gas.

ALL RAW MATERIALS SUSCEPTIBLE

The data produced for these papers, "Presence and Effects of Anaerobic Bacteria in Water-Based Paints, I and II," indicate that all paint ingredients which contain an organic component may serve as growth nutrients for anaerobic bacteria. Pigment slurries, latexes, and color dispersants were sources for the anaerobic bacteria used in these experiments. Dispersants, antifoams, thickeners, glycols, and coalescing agents, which were used as substrates for the growth of the anaerobes, may have been the prime source of nutrient in the slurries and latexes.

In general, the first effect of anaerobic growth on one of the paint ingredients was the production of acid. If calcium carbonate, limestone, etc., were used as an extender pigment in the system, one might expect the production of carbon dioxide (CO₂) from the chemical reaction of acid and carbonate. That many of the organisms were slow in producing the acid or gas could account for the gassing of paints which is noted weeks after the canning of the product. When checked, the paint would appear to be sterile when cultured under aerobic conditions, would have a slight acid pH, and the oxidation/reduction potential (O/R) would be low or negative. A low or negative O/R potential is one indication of microbial contamination.² Because the acids produced during

Table 3—Effect of Anaerobic Bacteria on Cellulosic Thickeners

Organisms	Hydroxyethyl Cellulose		Carboxymethyl Cellulose		Methyl Cellulose	
	1 Week	6 Weeks	1 Week	6 Weeks	1 Week	6 Weeks
<i>Actinomyces israelii</i>	sl A ^a	sl B	sl A	sl A	sl A	A, sl V ^b
<i>Bacteroides fragilis</i>	NC	A, sl V	NC	NC	sl A	A
<i>Bacteroides hypermegas</i>	sl A	sl A,V	sl A	N	sl A	A, sl V
<i>Bacteroides ovatus</i>	NC	A,V	NC	NC	sl A	sl B
<i>Bacteroides species I</i>	A,V	A,V	sl A	N	sl A	A
<i>Bacteroides species II</i>	NC	sl A	NC	NC	NC	B
<i>Bacteroides species III</i>	NC	sl A,V	NC	NC	NC	NC
<i>Bacteroides species IV</i>	NC	sl A,V	NC	sl A	sl A	A
<i>Bacteroides species V</i>	NC	A,V	sl A	sl A	NC	sl A
<i>Bifidobacterium adolescentis</i>	A,V	A,V	NC	N,V	sl A	A,V
<i>Clostridium butyricum</i>	A, sl V	A,V	sl A	N	sl A	A
<i>Clostridium sphenoides</i>	A, sl V	A,V	NC	sl A	NC	sl B, sl V
<i>Clostridium subterminale</i>	NC	A,V	sl A	sl B,V	sl A	sl A,V
<i>Clostridium species D</i>	A,V	A,V	NC	sl A	sl A	A,V
<i>Eubacterium aerofaciens</i>	NC	sl A,V	NC	NC	sl A	A,V
<i>Lactobacillus fermentum</i>	NC	sl A	NC	NC	sl A	A
<i>Streptococcus intermedius</i>	sl A	sl A	NC	B	sl A	A

(a) A = Acid; B = Base; N = Neutral; V = Viscosity Loss ≤42 KU; NC = No Change; sl = Slight.
 (b) Slight viscosity loss was a loss of approximately 10 KU.

Table 4—Effect of Anaerobic Bacteria on Glycols and Coalescing Agents

Organism	Ethylene Glycol		Propylene Glycol		Ethylene Glycol Monobutyl Ether		Ester-Alcohol Coalescing Agent	
	1 Week	6 Weeks	1 Week	6 Weeks	1 Week	6 Weeks	1 Week	6 Weeks
Actinomyces israelii	NC ^a	NC	A	N	NC	NC	NC	NC
Bacteroides fragilis	NC	NC	NC	NC	NC	NC	NC	NC
Bacteroides hypermegas	A	A	A	B	sl A	sl B	NC	sl B
Bacteroides ovatus	NC	NC	A	sl A	NC	NC	sl B	N
Bacteroides species I	A	sl B	A	N	A	sl B	NC	sl B
Bacteroides species II	sl A	sl B	A	B,G	NC	NC	NC	sl B
Bacteroides species III	A	sl A	A	B	sl A	B	NC	sl B
Bacteroides species IV	A	A	A	A	A	sl A	A	sl B
Bacteroides species V	A	sl B	A	sl B	A	N	A	sl B
Bifidobacterium adolescentis	A	A	A	A	A	A	A	sl B
Clostridium butyricum	A	A	A	sl A	A	N	NC	sl B
Clostridium sphenoides	NC	NC	NC	NC	NC	NC	NC	NC
Clostridium subterminale	A	N	A	A,G	A	B	B	B,G
Clostridium species D	NC	NC	NC	NC	NC	NC	NC	NC
Eubacterium aerofaciens	A	A	NC	NC	A	A	NC	NC
Lactobacillus fermentum	NC	NC	NC	NC	sl A	N	A	N
Streptococcus intermedius	A	A	sl A	N	A	A	NC	NC

(a) A = Acid; B = Base; N = Neutral; G = Gas; NC = No Change; sl = Slight.

anaerobic incubation would most likely be longer carbon chain acids, they would be poorly ionized and, therefore, not show a low pH.

UNEXPLAINED PROBLEMS

In the past, a paint that lost viscosity over a long period of time posed a mystery if it had a stable viscosity at first, showed no microbial contamination (aerobic cultivation), and had a slightly low pH and a low O/R. One explanation was that no organisms were directly involved, but that "enzymes" (biological catalysts) which may cause the degradation of the cellulosic thickener were at fault. This did not explain the low O/R and pH, but it did explain the primary problem.

Another explanation for such problems was that there had been microbial contamination that had died, either from starvation, having used all the available nutrient, or had been killed by a slow acting preservative. This explained the effects and the finding of no microbes. This reasoning may now be used only if the product has been shown to contain no anaerobes.

The anaerobic bacteria used in these experiments could produce the above effects and still be living in the product. An explanation based on aerobic studies does not provide an answer to the effects of these bacteria. Paint with a viscosity loss must be discarded, blended-off, or rethickened. If the viscosity loss were due to an enzyme, the paint might very well be saved with a non-cellulosic thickener, but if it were due to growing anaerobes, the new thickener might also be susceptible to anaerobic dissimulation.

A survey of paint viscosity losses by the Dallas Society for Coatings Technology showed that 27% of the reported viscosity losses were due to "unknown causes," and not to enzymes, bacteria (aerobic), peroxides, or inadequate-

ly dispersed pigments.³ The same report indicated that 16% of the batches showing viscosity loss were not recovered. Perhaps, if these paints had been examined for anaerobic bacteria, a cause for the losses would have been identified and proper action taken so that some of them could have been recovered.

HIDDEN EFFECTS OF BACTERIAL GROWTH

Because the aerobes and/or anaerobes found in an un-protected paint and paint raw material will live and grow, no matter how slowly, at the expense of one or more of the basic ingredients of a paint, one must ask, "What are the unrecognized effects of such growth?," that is, "How will the paint be affected?"

When large numbers of bacteria are found contaminating a paint, it usually means that there has been growth from a small initial infection. Findings of 3 × 10⁷ bacteria per mL are not unusual in a contaminated paint or raw material. If we assume the product is a paint, then one gallon has grown 3 × 10⁷ × 3780 mL/gallon or 1.134 × 10¹¹ bacteria per gallon. One gram of dry weight of bacteria contains 1 × 10¹² individuals; therefore, in one gallon, there are 0.11 grams (dry weight) of bacteria (or 10.2 grams wet weight). Bacteria have a carbon assimilation efficiency of about 20% or less. This means that to obtain the 0.11 grams of dry bacteria, at least five times that amount of carbon compound had to be utilized or 0.6 grams or 0.02 ounces.

However, for each day that that bacterial population lives, a further amount is used to maintain its existence. Assuming the average nitrogen content of bacteria to be 14%, the maintenance energy of the above population is given as:

$$\begin{aligned} & \text{Grams of nitrogen} \times 50 \text{ Kcal/day,}^4 \text{ or} \\ & 0.11 \text{ grams} \times 14 \times 50 \text{ Kcal/day} = 0.79 \text{ Kcal/day} \end{aligned}$$

But, because bacteria are at best 40% efficient in retrieval of energy in a compound, 2.0 Kcal/day is needed. This would be:

- 0.34 grams a day for propylene glycol/gallon
- 0.43 grams a day for ethylene glycol/gallon
- 0.20 grams a day for amino methyl propanol (AMP)/gallon

if the carbon used aerobically for energy were obtained from those compounds.

Should all, or some, of the bacterial metabolism be anaerobic, the amount would be higher, as less energy is obtained per gram of nutrient, therefore, more compound must be used.

At this rate of use, it can easily be seen that some of the components being consumed by the microbial population would shortly be reduced to a point where they would no longer perform their function. In a paint formulation some of the ingredients are customarily added at a few grams/gallon (e.g., 1 pound/100 gallons is only 4.5 grams/gallon).

Assuming several elements of a formulation were metabolized, the prime noticeable effect, e.g., gassing, may not be the only result of contamination. Because some of the paint ingredients had to be metabolized to produce the gas, other effects must occur from the loss of these components.

The major problems due to biodeterioration, viscosity loss, gassing, etc., probably obscure problems not noticed in attempts to correct the obvious. For example, it is sometimes noticed that hiding power has degraded or that there is a slight clumping of pigment in paint with viscosity losses. These could be results of damage to the dispersant system as well as to the thickener.

PHYSICAL OR BIOLOGICAL CAUSES

Some problems blamed on physical or chemical conditions may really be due to biological deterioration, especially if they occur only occasionally, and some time after the paint is canned. Conditions that might occur in a finished paint due to partial microbial destruction of ingredients are shown in *Table 5*.

It is known that an imbalance or lack of sufficient dispersants can lead to many problems. In the past, some of these problems were thought to be due to an improper level of dispersant or a chemical reaction which decreased the effect of the surfactant, but the real cause could have been microbial utilization to reduce the concentration of one or more members of the dispersant system so that the system was unbalanced and no longer functioned properly.

In a paint which was gassing due to bacterial growth, no other effect was often noticed. Once the gassing problem had stopped, the paint was usually not subjected to a full battery of quality tests to determine its scrub resistance or adhesion properties, etc., but might have been sent out as a "normal" paint. Yet, some organic material must have been used to produce the gas. The loss of an ingredient in the paint should have affected it in some manner. Even if all the other parameters of performance were proper, there would be by-products of the fermenta-

Table 5—Probable Causes and Effects Of Partial Destruction of Ingredients in Finished Paints

Cause	Effect
Attack on HEC thickener	Viscosity loss Gas production pH Change
Attack on dispersants	Poor hiding Color shifts Precipitation of pigment Gelling
Attack on glycols, coalescing agents	Gloss reduction Poor freeze-thaw-stability Chalking Porous film Poor adhesion Poor leveling Gas production pH Change
Attack on antifoam	Foam Porous film pH Change Gas production
Attack on dispersed color	Off color Uneven color Poor dispersion of color

tion and the bacterial bodies themselves left in the paint. These could become food for mildew growth on the dried film or they could interfere with color fidelity or promote chalking, etc.

AEROBIC AND ANAEROBIC BACTERIA CAUSE SPOILAGE

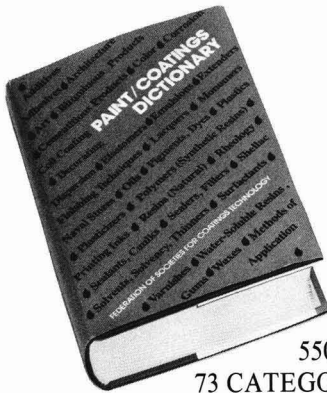
We have shown that anaerobic bacteria can degrade many of the ingredients in paint, and, therefore, could cause a deterioration of paint quality. This finding is different from that reported recently for bacteria obtained by aerobic culture.⁵ In that study, it was found that many surfactants and defoamers were not attacked by bacteria. If the difference in effects is due to the organisms used, anaerobic bacteria may be of great importance in the degradation of paint raw materials. Therefore, the anaerobic bacteria are potentially equal in importance to the aerobic bacteria for the paint industry.

SUMMARY

Bacteria growing in paint use some component(s) as their food source and cause a degradation of the paint. The aerobes can easily be identified and the proper counter-measures taken, usually by adding a preservative either to clean-up a contamination or prevent it from occurring. However, anaerobic bacteria may not be found unless special microbial culturing techniques are used and so insufficient preservative may be added. The still living bacteria may then cause trouble months after the paint has been canned, either in the liquid paint and/or in the dried paint film.

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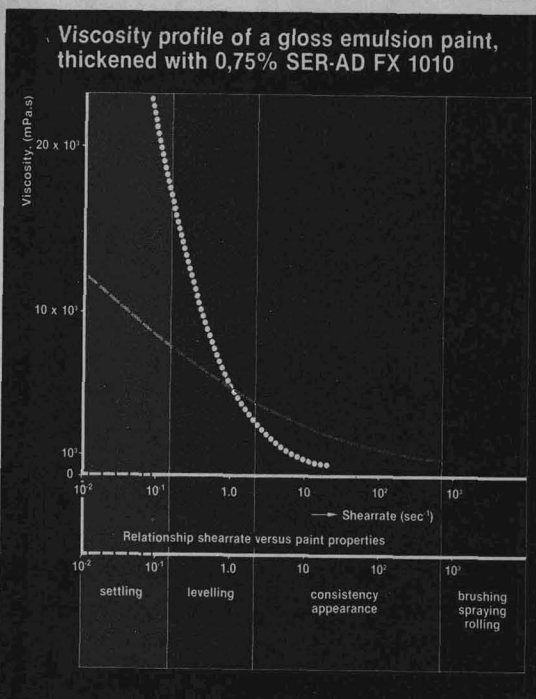
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New Nonaqueous Dispersions for High Solids Base Coat/Clear Coat Paints

Mohinder S. Chattha and Joseph C. Cassatta
Ford Motor Company*

Stearate-capped poly(hydroxystearic acid) has been reacted with glycidyl methacrylate to obtain a non-polar macromer. This macromer has been copolymerized with methyl methacrylate and hydroxyethyl methacrylate in nonpolar solvents to obtain finely dispersed polymeric particles. When the polymerization is carried out in the presence of hexamethoxymethyl melamines, dispersion of crosslinked particles is obtained. Increasing amounts of the macromer produce particles of smaller average size. These particles, when included in the base coat of a base coat/clear coat paint composition in wet-on-wet applications, provide coatings with high gloss and distinctness of image.

INTRODUCTION

High solids automotive coatings comprise high functionality low molecular weight polymers, oligomers, and crosslinkers which, on curing, produce durable and solvent-resistant networks.¹⁻⁴ Due to the low molecular weight of the oligomers and crosslinkers employed, the coatings display a tendency to sag both during spraying and in the bake oven. The flow of these coatings can be controlled by the addition of disperse particles such as bentonite clays, silicas, and certain organic thixotropes.⁵ However, most of the additives either cause reduction in gloss or do not provide proper metallic appearance in metallic paint. Improved gloss and metallic appearance have been achieved by the use of microgel particles.^{6,7} In base coat/clear coat paints, incorporation of microgel particles in the base coat can improve the resistance of the

base coat to attack by solvents in the clear coat in wet-on-wet applications, resulting in coatings with superior gloss and distinctness of image. These microgel particles have been prepared by lengthy synthetic routes involving a series of polymerizations.⁶⁻¹⁰ Recently we have described a convenient preparation of acrylic-urethane nonaqueous dispersions.¹¹ In this report, we describe a further simplified preparation to obtain a new class of crosslinked nonaqueous dispersions. Evaluation of these particles in high solids base coat/clear coat paints, in wet-on-wet applications, is described.

EXPERIMENTAL

Molecular weights were determined by gel permeation chromatography using polypropylene glycol, P2000 (Waters Associates, Inc.) as standard. Infrared spectra were recorded on a Perkin-Elmer 283 Spectrophotometer. Gloss of the coatings was determined using a D48D Modular Glossmeter (HunterLabs); distinctness of image (DI) was measured using a D7R-6 DI Meter (HunterLabs). Average particle size was determined by quasielastic light scattering.

Materials

Technical grade xylene, butyl acetate, and aliphatic naphtha (BP 127-140°C) were used as solvents. Glycidyl methacrylate, hydroxyethyl methacrylate (HEMA), and methyl methacrylate (MMA) were used without inhibitor removal. Stearic acid, 12-hydroxystearic acid, and hexamethoxymethylmelamine (Cymel[®] 303) were used as received. Tetraisopropyl titanate (Tyzor[®] TPT) was used as condensation catalyst and 2,2'-azobis-(2-methyl-

*Research Staff, P.O. Box 2053, Dearborn, MI 48121.

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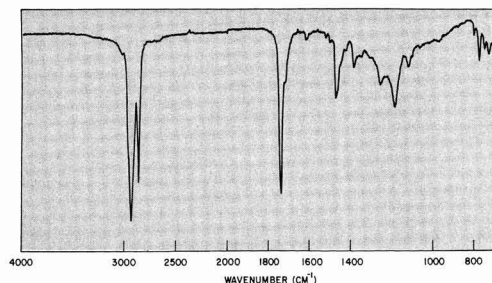


Figure 1—Infrared spectrum of capped poly(12-hydroxystearic acid) I

propionitrile), AIBN, was used as initiator in polymerization reactions.

Preparation of Capped Poly (Hydroxystearic Acid) I

Stearic acid (110g), 12-hydroxystearic acid (2090g), and xylene (500g) were placed in a five litre round-bottom flask and were heated to 100°C to obtain a homogeneous solution. Tetraisopropyl titanate (1.5g), was added to the above reaction mixture. The reaction mixture was refluxed under a Dean-Stark water separator until removal of condensation water was complete (30 hours). The molecular weight of the product was determined by gel permeation chromatography ($M_w/M_n = 3094/1745$), and the infrared spectrum of the product was recorded (Figure 1).

Preparation of Macromer II

Glycidyl methacrylate (193g), Cordova Accelerator $AMC^{TM}2$ (1g), and hydroquinone (0.05g) were added to the above solution (2454g) of the capped poly(hydroxystearic acid) I. The reaction mixture was heated to 50°C and was stirred at this temperature for six hours; it was then stirred at 62°C for 24 hours. The infrared spectrum of the product was recorded (Figure 2) and its molecular weight ($M_w/M_n = 3136/1984$) was determined.

Preparation of Dispersed Polymeric Particles, General

The procedure described below was followed to obtain the nonaqueous dispersions; the detailed compositions and other pertinent data are listed in Table 1.

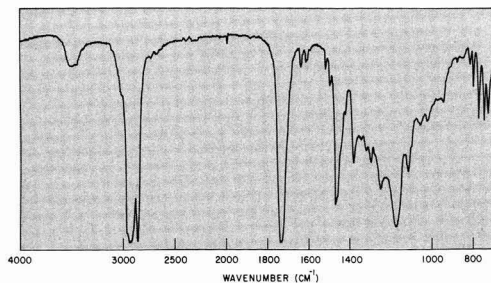


Figure 2—Infrared spectrum of Macromer II

Table 1—Composition of the Dispersions

Dispersion	Composition, g					Average Diam., Å	
	MMA	HEMA	Macromer Soln. wt. %	Cymel 303	PAP		
A	90	10	15	10.4	10	0.08	7129
B	90	10	26	16.7	10	0.08	6200
C	90	10	34	20.8	10	0.08	4500
D	90	10	55	29.8	10	0.08	2055
E	90	20	55	26.5	20	0.12	2440
F	90	25	5	11.3	5	0.08	7510
G	90	20	15	8.9	20	0.16	7670
H	90	10	55	31.9	—	—	2350

HEMA, Macromer II, Cymel 303, AIBN, and phenyl acid phosphate (PAP) were dissolved in MMA. Naphtha was placed under nitrogen in a round bottom flask and was brought to reflux. The reactants were added dropwise with continuous refluxing and stirring. The reaction mixture was refluxed for one hour after the addition was complete. A solution of 0.1g AIBN in 2mL acetone was then added to the reaction mixture and it was refluxed for additional two hours. Part of the solvent was distilled off to obtain a dispersion of the desired concentration. The particle size of the dispersed particles was determined (Table 1 and Figure 3). The infrared spectrum was recorded after evaporating the solvent.

Base Coat/Clear Coat Paint Composition

An acrylic/melamine silver metallic composition supplied by Ford Plastics, Paint & Vinyl Division was used. The base coat contained 38% solids by weight at 20 sec viscosity; the clear coat had 54% solids by weight at 22 sec viscosity, #4 Ford cup.

Evaluation of Dispersions In the Base Coat/Clear Coat Paint

The dispersions having average diameter smaller than 2500 Å were evaluated. The dispersions were blended with the base coat (10% by weight of solids) and the composition was applied to primed steel panels in two passes with one minute intermediate time for solvent evaporation (flash time). Flash times before applying the clear coat were chosen to be one and three minutes. The clear coat was applied in two passes with one minute intermediate flash time. The coating was then flashed for ten minutes and baked at 130°C for 17 minutes. The gloss and distinctness of image are listed in Table 2.

Weathering of the coatings was examined in QUV Accelerated Weathering Tester operating with a cycle of eight hours of light at 60°, followed by four hours of darkness and condensing humidity at 50°. The loss of gloss with time is shown in Figure 4.

RESULTS AND DISCUSSION

The reaction of stearic acid with an excess of 12-hydroxystearic acid produces stearate-capped poly (12-hydroxystearic acid) I (Scheme 1).

Complete esterification of the hydroxyl functionality is shown by the absence of any corresponding hydroxy absorption in the infrared spectrum of I (Figure 1). The molecular weight of I ($M_n = 1745$) indicates that there are about five hydroxystearic acid moieties and one stearic acid moiety in each molecule of I.

Reaction of Oligomer I with glycidyl methacrylate produces Macromer II. In the infrared spectrum of II (Figure 2) the absorption band at 3625 to 3350 cm^{-1} is due to the hydroxyl group created by the opening of the epoxide ring. The carbonyl group absorption at about 1740 cm^{-1} is caused by both the stearate and methacrylate ester groups, and it is broader than the corresponding peak in Figure 1, which is due to the stearate ester only. The absorption at 1640 cm^{-1} is due to the terminal unsaturation in II. The molecular weight ($M_w/M_n = 3136/1984$) of Macromer II further supports the reaction of I to produce Macromer II.

Free radical initiated copolymerization of Macromer II with MMA and HEMA produces copolymers with pendant poly(hydroxystearic acid) segments. When the polymerization is carried out in nonpolar solvents, in which the long chain pendant groups are soluble and the polar part of the polymer is insoluble, a polymeric dispersion is produced.¹² Addition of hexamethoxymethylmelamine introduces crosslinks within the particle through hydroxy-melamine condensation. Both the hydroxy groups from HEMA and those from the macromer may condense with hexamethoxymethyl melamine. The hydroxy-melamine condensation is supported by the infrared spectrum of the dispersion; however, a significant amount of hydroxy functionality remains unreacted even when the stoichiometric amount of melamine is employed. This may be due to self-condensation of melamine within the particle. Since the radical polymerization is faster than the hydroxy-melamine condensation, it is likely that only a fraction of the melamine crosslinking reaction occurs during the initial polymerization. Most of the melamine is probably trapped, unreacted or partially reacted, in the particle; the balance of the hydroxy-melamine and melamine-melamine condensation reactions likely occur upon further refluxing.

A comparison of particle size of dispersions D, E, and H (Table 1) indicates that changing the level of hydroxy and melamine reactants in the composition, and thus changing the extent of crosslinking of the dispersion, does not significantly alter particle size. This further supports the hypothesis that the formation of crosslinked particles in this reaction sequence is essentially a stepwise process. A comparison of dispersions F and G lends further support to the stepwise mechanism of particle

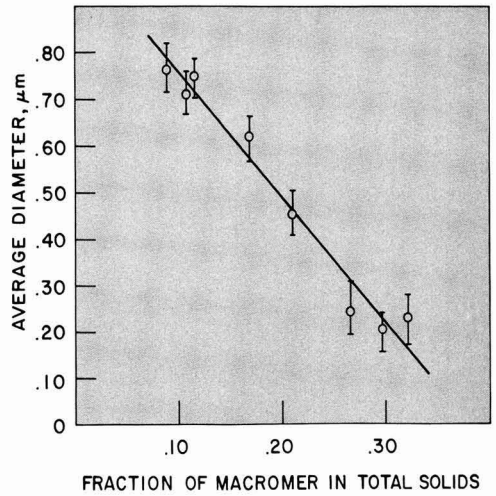


Figure 3—Particle size as a function of Macromer II in the composition

formation. The slightly larger diameter of E than of D is probably due to a slightly larger concentration of stabilizer in D and also due to faster crosslinking in E because of the higher concentration of the catalyst. The same trend is observed for compositions A and G. These data (Figure 3) lend further support to the observation that the particle

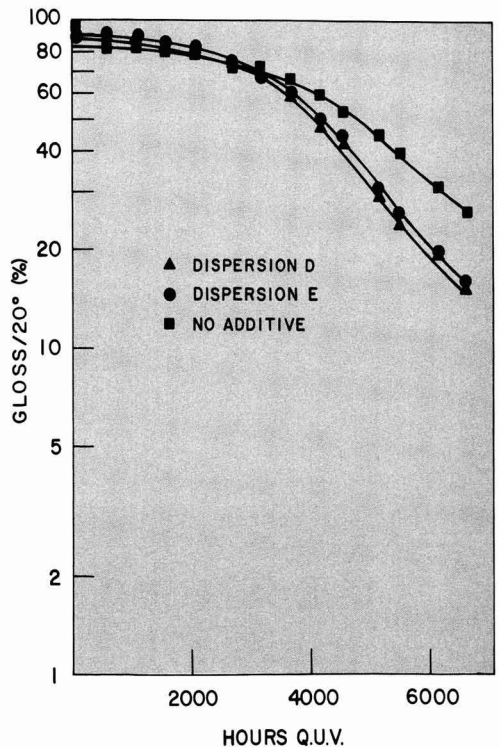
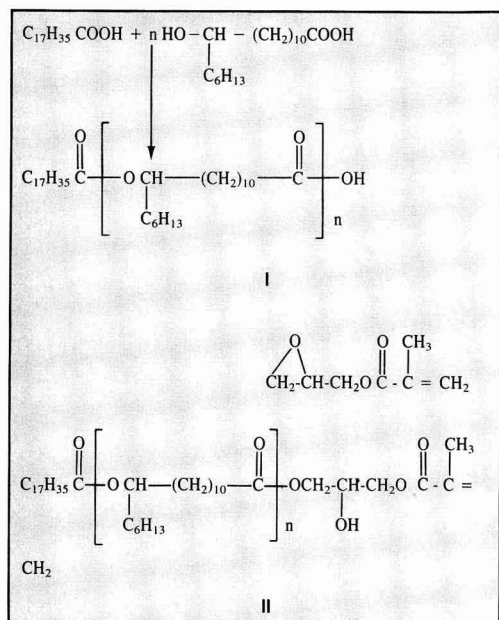


Figure 4—Accelerated weathering of coatings in QUV

Table 2—Evaluation of Dispersions in Base Coat/Clear Coat Paint

Dispersion	3 Min Flash		1 Min Flash	
	Gloss/20°	DI	Gloss/20°	DI
D	95	64	95	50
E	94	53	88	44
No Additive	93	60	52	11



Scheme I

size essentially is directly proportional to the fraction of the stabilizer in the particle.

In the base coat/clear coat paint composition, only crosslinked particles with an average diameter less than 2500Å (D and E, Table 1) were evaluated. With a three-minute flash time, the coatings containing dispersions D and E display a gloss and distinctness of image which are comparable to that of the coating with no additive (Table 2). However, the metallic appearance, as observed by visual inspection, in the coating containing D or E is far superior to that of the one with no flow control additive. However, when the flash time is reduced to one minute, dispersions D and E provide coatings with metallic appearance, gloss, and distinctness of image superior to that of the coating containing no additive (Table 2).

The accelerated weathering of base coat/clear coat metallic paints containing dispersed polymeric particles D

or E is essentially equivalent to that of the paint without any additive (Figure 4) for up to 3500 hours exposure. However, the dispersion-containing paints are somewhat inferior in gloss retention after 3500 hours exposure (Figure 4).

CONCLUSIONS

Stearate capped poly(12-hydroxystearic acid) reacts with glycidyl methacrylate to produce a monofunctional macromer. The macromer can be successfully copolymerized with acrylic monomers to obtain a stable dispersion. The particles can be crosslinked to any desired degree by including hydroxy monomers and melamines in their preparation. The particle size of these dispersions is essentially independent of the extent of crosslinking and is proportional to the ratio of stabilizer to particle weight. These dispersions, when included in the base coat of a base coat/clear coat high solids paint system, provide coatings with enhanced gloss and distinctness of image.

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Viscosity of Methacrylate Oligomer Solutions: Effect of Carboxylic Acid Substitution

Zeno W. Wicks, Jr.[†] and Lucy G. Fitzgerald**
North Dakota State University*

The effect of solvent structure on intrinsic viscosity and viscosity of oligomeric butyl methacrylate (OBMA) and a partially saponified oligomeric butyl methacrylate (OBMA-COOH) were studied. Dependence of relative viscosity on concentration was found to follow Erickson's equation with a power term added to the denominator. Apparent molecular weight of the saponified oligomer by vapor pressure osmometry in benzene was much higher than in acetone indicating strong inter-oligomer hydrogen bonding even in dilute solutions. Intrinsic viscosity of OBMA-COOH in *m*-xylene is higher than that of OBMA and that of OBMA-COOH in methyl isobutyl ketone (MIBK). Viscosities of solutions of OBMA-COOH in *m*-xylene are higher than in MIBK and higher than OBMA in either solvent. These data are all consistent with strong intermolecular oligomer hydrogen bonding through COOH groups especially in *m*-xylene.

INTRODUCTION

Formulation of high solids coatings with sufficiently low viscosity for application requires use of low molecular weight polymers, i.e., oligomers. While factors controlling the viscosity of polymer solutions have been widely studied, relatively little research on the factors controlling viscosity of oligomer solutions has been published. The available literature has been surveyed in a recent review paper.¹

Erickson proposed that the relationship of viscosity of oligomer solutions to concentration could be expressed by equation(1).²⁻⁴

$$\ln \eta_r = \frac{w_0}{k'_1 - k'_2 w_0} \quad (1)$$

In other work in these laboratories,⁵ equation (1) was tested as a model for viscosity dependence on concentration of *m*-xylene solutions of oligomeric butyl methacrylate (OBMA) and methyl methacrylate (OMMA). It was found by regression analysis that relatively high correlation factors ($r^2 > 0.96$) were obtained but that plots of residuals ($\ln \eta_{\text{robs}} - \ln \eta_{\text{rpred}}$) versus w_0 showed curvature. Higher correlation factors ($r^2 > 0.99$) and more random scattering of residual plots were obtained by adding a second order term to the denominator of equation (2). It was also found that equation (2) fit Erickson's data better than did equation (1).

$$\ln \eta_r = \frac{w_0}{k_1 - k_2 w_0 + k_3 w_0^2} \quad (2)$$

Equation (2) is still not a perfect model since it fairly consistently predicts slightly higher η_r values at low concentrations ($w_0 < 0.15$) than observed η_r values. A possible reason for this can be seen by considering the transformation of equation (2) to equation (3). It can be seen in equation (3) that the interaction term ($k_3 w_0 w_s$) maximizes at $w_0 = w_s = 0.5$. There is no evident reason why the interaction term should maximize at $w_0 = 0.5$. This implies that the last term in the denominator of equation (2) could have a power other than 2. Non-linear analysis allowing this power value to be a fourth adjustable parameter did give random scatter of residuals. However, within the accuracy range of data and the number of data points, the error range in the value of this power was too great to permit any conclusions. Further studies with many more data points are needed to test this hypothesis. Meanwhile equation (2) is a useful empirical equation for relating η_r and concentration.

$$\ln \eta_r = \frac{w_0}{k_1 w_s + \frac{w_0}{\ln \eta_0 - \ln \eta_s} - k_3 w_0 w_s} \quad (3)$$

Erickson showed that k'_1 in equation (1) is the reciprocal of weight intrinsic viscosity, $[\eta]_w$.³ This is also true for k_1 in equation (2). It has units of grams of

*Polymers & Coatings Dept., Fargo, ND 58105.

[†]Present address: 1755 Tetshor Blvd., Apt. 40, Las Cruces, NM 88001.

**Present address: Drakenfeld Colors, CIBA-GEIGY Corp., Washington, PA 15301.

solution per gram of oligomer.⁵ Intrinsic viscosity $[\eta]$ is properly calculated by dividing $[\eta]_w$ by the density of the oligomer solution at $w_o = k_1$ rather than by density of solvent.⁵

Solvent-oligomer interaction can have a significant effect on the viscosity of at least some oligomer solutions. Burrell found that hydrogen bond acceptor solvents reduced the viscosity of hydroxy functional oligomers more rapidly than non-hydrogen bond acceptor solvents.⁶ Erickson studied the effect of solvent structure on $[\eta]_w$.²⁻⁴ He concluded that $[\eta]_w$ decreases as the difference in solubility parameters between solvent and oligomer increase until the difference becomes large. Beyond that point $[\eta]_w$ increases.

On the other hand, Sherwin, et al. concluded, based on studies of a series of high solids resin solutions, that difference in solubility parameter has only a minor effect on intrinsic viscosity and relative viscosity of concentrated solutions when concentration is expressed as volume fraction.⁷ An exception to this was a COOH functional oligomer. In this case, $[\eta]$ was significantly lower in toluene than in oxygenated solvents while viscosity of concentrated solutions was significantly higher in toluene than in oxygenated solvents. It is difficult to compare Sherwin, et al.'s work with Erickson's. Their relative viscosities were calculated from kinematic viscosities. The method they used to calculate $[\eta]$ was equivalent to that obtained by dividing $[\eta]_w$ by solvent density rather than solution density within the isolated oligomer molecule and its associated solvent molecules. Also, it is not clear how volume fractions can be calculated when solutions are not ideal solutions.

This work was undertaken to compare oligomeric butyl methacrylate with a carboxylic acid functional oligomeric butyl methacrylate in a poor hydrogen bond accepting solvent, *m*-xylene, and a good hydrogen bond accepting solvent, methyl isobutyl ketone. For a listing of symbols used, see Table 1.

EXPERIMENTAL

Synthesis of OBMA^{8,9}

A 2L flask equipped with mechanical stirrer, addition funnel, condenser, N₂ inlet tube, and thermometer was purged at 100°C with N₂ which had been bubbled through acidic aqueous metavanadate, 10% NaOH, NaOH pellets, and Drierite to remove H₂O and O₂. When cool, 100 mL of distilled benzene, 24.5 g (0.33 mole) of *t*-butanol, and 6.5 g (0.058 mole) of potassium *t*-butoxide were charged

into the flask. The slurry was heated to 60°C, 145 mL (0.92 mole) of butyl methacrylate (BMA) were added dropwise over a period of 40 minutes. Temperature was maintained at 73-80°C, cooling with a water-ice bath when needed, and N₂ flow was maintained. The color became orange and viscosity increased. The reaction mixture was held at 73-80°C for a further 30 minutes. An additional 625 mL (3.95 mole) of BMA were added dropwise over a period of 90 minutes at a rate to maintain the temperature at 73-80°C. Then the reaction was held at this temperature for an additional 30 minutes. After cooling to 60°C, 10 mL (0.12 moles) of conc. HCl were added followed by addition of 250 mL of distilled H₂O. The heterogeneous mixture was transferred to a separatory funnel and washed several times with 1L portions of distilled water. The solution was vacuum filtered using Celite as a filter aid. The solution was concentrated by rotovapping under high vacuum at a temperature not exceeding 80°C. A sample was dried free of solvent (as checked by NMR) in a drying pistol at 60°C under high vacuum. \bar{M}_n was 2,100, as determined in duplicate by Galbraith Laboratories by vapor pressure osmometry (VPO) in benzene.

Synthesis of Saponified OBMA (OBMA-COOH)

A modification of the procedure of Lewis and Haggard^{8,9} was used to saponify part of the above OBMA. A 2L flask equipped with a mechanical stirrer, condenser, and thermometer was charged with 244 g OBMA ($w_o = 0.955$ in benzene) (0.11 mole) and 185 mL of 2-propanol. The mixture was warmed over a steam cone until a homogeneous solution was obtained. Then 7 mL (0.12 mole) of 18.6 M aqueous NaOH were added. As the reaction mixture was heated to reflux, 80-82°C, the solution turned bright yellow. After refluxing and stirring for 12 hours, the solution was cooled to 70°C and 260 mL (0.126 mole) of 0.486 M HCl were added. The system separated into two phases. It was washed several times with 1L portions of distilled water. The organic phase was vacuum filtered using Celite as a filter aid. The solution was concentrated by rotovapping under vacuum at a temperature not exceeding 80°C. The equivalent weight, after correcting for solvent content (as described below) was 2,500 (average of 3 values). A sample was dried in a solvent pistol as described in the OBMA section and submitted to Galbraith Laboratories for duplicate VPO determinations. \bar{M}_n by VPO in benzene was 5,500 and \bar{M}_n by VPO in acetone was 2,000.

Preparation of Solutions

A 200 g sample of concentrated oligomer (OBMA or OBMA-COOH) solution was transferred to a 1L round bottom flask. Approximately 250 mL of the desired solvent (MIBK or *m*-xylene) were added and the mixture warmed on a steam cone to make a homogeneous solution. Solvent was then distilled off with a rotoevaporator under high vacuum at a temperature not exceeding 80°C. When the concentration increased sufficiently that the oligomer was scarcely flowing, an additional 250 mL of solvent were added and the procedure was repeated five

Table 1 — List of Symbols Used

\bar{M}_n	= Number average molecular weight
\bar{M}_w	= Weight average molecular weight
W_o	= Weight fraction oligomer
w_s	= Weight fraction solvent
η	= Absolute viscosity mPa·s
η_r	= Relative viscosity; η/η_s
η_s	= Solvent viscosity mPa·s
$[\eta]$	= Intrinsic viscosity mL solution/g oligomer
$[\eta]_w$	= Weight intrinsic viscosity, g solution/g oligomer
ρ	= Density, g/mL
ρ_s	= Solvent density, g/mL

times. MIBK solutions were checked by NMR to determine that no aromatic signal could be detected.

Solids Determination

Since it had been shown in other work in these laboratories that conventional methods of solids determination, GPC and GC, did not give accurate results, a technique using a Du Pont 951 Thermogravimetric Analyzer (TGA) module with a model 990 Temperature Programmer was used.⁵ A high solids sample was placed in the sample pan and weighed at 25°C, the TGA was heated at 10°C/min with a 50 mL/min N₂ flow to 150°C and held at that temperature. A two pen recorder was used: one recorded weight loss, the other the first derivative of weight loss. The point where the derivative trace became parallel to the base line was taken as the point where solvent loss was complete. The weight at that time compared to the original sample weight was used to calculate weight fraction oligomer, w_o.

Density and Viscosity Determinations

A Paar DMA 46 Calculating Density Meter was used to determine densities at 25 ± 0.05°C. Cannon-Fenske capillary viscometers were used to determine kinematic viscosities at 25 ± 0.1°C. The viscometers were calibrated with standards from the Cannon Instrument Co. The smallest diameter viscometer was standardized with triply distilled and filtered water.

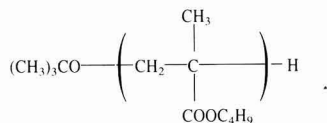
Statistical Analysis

Statistical analyses were carried out using SAS programs of the SAS Institute, Inc. GLM Model was used for linear analyses and NLIN model was used for non-linear analyses.

RESULTS

Oligomer Synthesis and Characterization

OBMA was synthesized by the anionic polymerization method of Lewis and Haggard.^{8,9} Potassium *t*-butoxide was used as the initiator and *t*-butanol as molecular weight regulator resulting in an oligomer with the following structure:



Lewis and Haggard report that methacrylate oligomers can be selectively saponified, for example, to give a mono-carboxylic acid using one mole of base per mole of oligomer.^{8,9} Their evidence for selectivity was lack of broadening of a gel permeation chromatography peak. In preliminary work, it was found that in parallel experiments, under the same conditions, a greater degree of saponification occurred in the same time under the same conditions when two moles of base were used as compared to one mole. This indicates that the reaction cannot

Table 2 — Densities and Viscosities at 25°C Of Oligomer Solutions as a Function of Concentration

Oligomer Solution	w _o (g/g)	ρ (g/mL)	η (mPa·s)
OBMA			
<i>m</i> -xylene	0.000	0.8600	0.581
	0.005	0.8602	0.591
	0.012	0.8610	0.600
	0.016	0.8618	0.617
	0.023	0.8624	0.627
	0.027	0.8634	0.641
	0.030	0.8640	0.656
	0.033	0.8645	0.664
	0.039	0.8652	0.679
	0.077	0.8718	0.812
	0.125	0.8795	1.03
	0.164	0.8861	1.23
	0.203	0.8922	1.61
	0.262	0.9027	2.39
	0.316	0.9118	3.54
	0.343	0.9163	4.41
	0.393	0.9252	6.92
	0.427	0.9312	9.41
	0.479	0.9405	16.5
	0.529	0.9498	29.6
	0.578	0.9589	56.7
	0.595	0.9617	76.4
OBMA			
MIBK	0.000	0.7957	0.54
	0.020	0.7995	0.58
	0.039	0.8034	0.63
	0.059	0.8072	0.68
	0.078	0.8111	0.74
	0.097	0.8150	0.81
	0.168	0.8294	1.14
	0.202	0.8367	1.38
	0.255	0.8483	1.90
	0.269	0.8511	2.11
	0.302	0.8607	2.77
	0.358	0.8710	3.99
	0.475	0.8981	11.4
	0.623	0.9324	61.1
	0.656	0.9412	106.
	0.698	0.9517	204.
	0.760	0.9681	729.
	0.831	0.9856	4,420.
OBMA-COOH			
<i>m</i> -xylene	0.021	0.8628	0.64
	0.042	0.8661	0.71
	0.061	0.8693	0.81
	0.080	0.8722	0.89
	0.096	0.8748	0.98
	0.149	0.8817	1.30
	0.293	0.9104	5.11
	0.370	0.9214	9.37
	0.513	0.9500	55.3
	0.590	0.9640	155.
	0.674	0.9827	832.
	0.773	1.0035	4,910.
OBMA-COOH			
MIBK	0.027	0.8016	0.606
	0.051	0.8067	0.676
	0.079	0.8125	0.769
	0.100	0.8172	0.857
	0.126	0.8229	0.979
	0.271	0.8550	2.33
	0.378	0.8782	5.60
	0.537	0.9163	30.4
	0.613	0.9360	92.1
	0.707	0.9609	503.
	0.816	0.9894	10,400.

Table 3 — Constants in Equation (2), $[\eta]$ and Calculated η for Oligomer Solutions at 25°C

Oligomer Solutions	k_1	k_2	k_3	$[\eta]$ (mL/g)	η at $w_o = 0.6$ (mPa-s)
OBMA, <i>m</i> -xylene	0.247 ± 0.003	0.248 ± 0.015	0.067 ± 0.016	4.49 ± 0.05	80
OBMA, MIBK	0.247 ± 0.004	0.186 ± 0.013	0.001 ± 0.010	4.78 ± 0.08	46
OBMA-COOH, <i>m</i> -xylene	0.198 ± 0.011	0.208 ± 0.036	0.080 ± 0.030	5.66 ± 0.33	207
OBMA-COOH, MIBK	0.230 ± 0.004	0.178 ± 0.013	-0.003 ± 0.010	5.15 ± 0.09	73

be completely selective. Volker, et al. studied the saponification of oligomeric methyl methacrylate and report that the rate constant for saponification of the first ester group is 10 times that for the second ester group.¹⁰

In order to study the effect of COOH substitution on viscosity, it was decided to saponify with 1.1 moles of sodium hydroxide. This would be expected to lead to a mixture of monosubstituted oligomer along with some unsaponified and disubstituted oligomer.

Since both refractive index and UV absorption depend strongly on molecular weight for oligomers in the range of $\bar{M}_n = 3,000$ or less, gel permeation chromatography is not a suitable method for determining molecular weight. Therefore, molecular weights were determined by vapor pressure osmometry (VPO). The unsaponified OBMA used in viscosity studies had an \bar{M}_n of 2,100. Loss of C_4H_8 by saponification of one ester group would yield a product with an \bar{M}_n of about 2,050. The equivalent weight determined by titration was 2,500 indicating that less than one ester per molecule has been saponified. However, the molecular weight by VPO in benzene was 5,500. This suggested that inter-oligomer hydrogen bonding was occurring even in the relatively dilute concentrations used for VPO analyses. The molecular weight by VPO using acetone as a solvent was run. \bar{M}_n determined this way was 2,000. The results indicate that, on average, there was approximately 0.8 COOH groups per mole. The fact that \bar{M}_n in benzene was more than twice \bar{M}_n in acetone is consistent with the probability that some oligomer molecules had more than one carboxylic acid group.

Viscosity of Oligomer Solutions

Densities, viscosities, and relative viscosities for solutions of OBMA and the OBMA-COOH in *m*-xylene and MIBK are given in Table 2. Non-linear regression analysis of density data showed that they fit equation (4)⁵ with r^2 values > 0.999.

$$\rho = \rho_s + c_1 w_o + c_2 w_o^2 \quad (4)$$

When Erickson's equation (1) was tested as a model for the relationship of relative viscosity with concentration, very high correlation factors ($r^2 > 0.99$) were obtained. However, plots of residuals ($\ln \eta_{r \text{ obs}} - \ln \eta_{r \text{ pred}}$) versus concentration showed a pronounced curved pattern indicating that the equation was an unsatisfactory model. Non-linear regression analyses using equation (2) gave still higher correlation factors ($r^2 > 0.9997$) and much more nearly random scatter of residuals. Values for constants k_1 , k_2 , and k_3 are given in Table 3.

$$\ln \eta_r = \frac{w_o}{k_1 - k_2 w_o + k_3 w_o^2} \quad (2)$$

Intrinsic viscosities in Table 3 were calculated by dividing the reciprocal of k_1 , $[\eta]_w$, by the density at $w_o = k_1$ calculated using equation (4). Non-linear analyses by equation (2) provides confidence limits for k_1 . There is no statistical method for calculating confidence limits of a reciprocal. The ranges given in Table 3 are the values calculated from the corresponding error ranges of k_1 . In both *m*-xylene and MIBK, the intrinsic viscosities of OBMA-COOH are higher than those of OBMA. The $[\eta]$ of OBMA in *m*-xylene is lower than in MIBK. Whereas, the $[\eta]$ of OBMA-COOH in *m*-xylene is higher than in MIBK.

In order to compare viscosities and viscosities of relatively concentrated solutions, η values were calculated at $w_o = 0.6$ using equation (2) and are also given in Table 3.

DISCUSSION

Sherwin, et al. report that $[\eta]$ of a S/EA/AA (42.5/42.5/15) acrylic resin $\bar{M}_w = 8,500$ is lower in toluene than in MIBK.^{7*} However, the viscosity of solutions in the range of 35-55 volume percent is higher in toluene than in MIBK. They explain the reversal on the basis that in very dilute solutions, greater intramolecular hydrogen bonding between carboxylic acid groups in toluene leads to "collapse," presumably compared to a more extended conformation with intermolecular hydrogen bonding between MIBK and COOH groups. On the other hand, at higher concentrations, MIBK would reduce inter-oligomer hydrogen bonding to a greater extent than toluene leading to lower viscosity in MIBK.

As can be seen in Table 3, both intrinsic viscosity and viscosity at $w_o = 0.6$ of OBMA-COOH solutions in *m*-xylene are higher than in MIBK. As with Sherwin, et al.'s resins, at higher concentrations presumably MIBK reduces inter-oligomer hydrogen bonding to a greater extent than *m*-xylene leading to lower viscosity in MIBK. It is of interest to note that when MIBK is used as a solvent the values of $k_3 \pm$ confidence limits include zero. When $k_3 = 0$, equation (2) becomes equal to equation (1). Perhaps, if a sufficiently "good" solvent is used, the interaction constant k_3 becomes negligible but much more data will be required to test such a hypothesis. The higher $[\eta]$ in *m*-xylene may result from inter-oligomer hydrogen bonding in *m*-xylene even in dilute solutions. This hypothesis is consistent with the observed

*Direct comparisons of Sherwin, et al.'s data with those in this paper cannot be made since they do not provide solution density data to permit conversion of their kinematic viscosities to absolute viscosities, volume solids to weight solids, or correct the $[\eta]$ data using solution densities rather than solvent densities. However, using estimated density figures, it is apparent that corrections for densities would not change the relative order of $[\eta]$ or viscosity between their toluene and MIBK solutions.

difference in apparent molecular weight by VPO of OBMA-COOH in benzene and acetone. It is also consistent with the fact that low molecular weight mono-carboxylic acids, such as acetic acid, exist as hydrogen bonded dimers even in dilute solutions in such poor hydrogen bonding solvents as benzene and toluene.¹¹ Sherwin, et al. do not provide \overline{M}_n for their resin nor do they state whether the monomer ratios are weight or mole percents. Assuming $\overline{M}_w/\overline{M}_n$ of 2.5 and that the fractions given are weight fractions, their resin had an average of about 7 COOH groups per molecule. In this case, it is possible that in dilute solutions, especially in toluene, hydrogen-bonding between COOH groups could be predominately intramolecular which would account for lower $[\eta]$ of their resin in toluene. On the other hand, the OBMA-COOH has primarily one COOH group per oligomer molecule and hydrogen-bonding between COOH groups in *m*-xylene would be predominately between oligomer molecules leading to higher $[\eta]$ in *m*-xylene than in MIBK.

It has been stated that solutions of low molecular weight polymers behave as if they are in the theta state, independent of solvent structure.¹² The decrease in $[\eta]$ with temperature of OBMA and OMMA reported elsewhere⁵ and now the difference in $[\eta]$ in both OBMA and especially OBMA-COOH with changing solvent cast doubt on this generalization.

The intrinsic viscosity of OBMA-COOH in *m*-xylene is substantially higher than that of OBMA in *m*-xylene although the molecular weight is slightly lower. This is also consistent with the possibility of inter-oligomer hydrogen bonding of OBMA-COOH in *m*-xylene. While the difference in intrinsic viscosity with and without a COOH group in MIBK is smaller than in *m*-xylene, the intrinsic viscosity of OBMA-COOH is higher. It is conceivable that even in MIBK there is some inter-oligomer hydrogen bonding through COOH groups in OBMA-COOH solutions. Similarly the difference in viscosity at $w_0 = 0.6$ between OBMA-COOH solutions and OBMA solutions is greater in *m*-xylene than in MIBK, but the carboxylic acid group increases the viscosity even in MIBK.

SUMMARY

The dependence of relative viscosity on concentration for solutions of OBMA and OBMA-COOH in *m*-xylene and MIBK fit equation (2) significantly better than they do equation (1) without the second order term.

$$\ln \eta_r = \frac{w_0}{k_1 - k_2 w_0 + k_3 w_0^2} \quad (2)$$

Constant k_1 is the reciprocal of weight intrinsic viscosity which is properly converted to intrinsic viscosity by dividing by density at $w_0 = k_1$.

Viscosities and intrinsic viscosities of solutions in *m*-xylene and MIBK of a carboxylic acid functional butyl methacrylate oligomer are higher than those of solutions of the OBMA from which it was prepared. It is suggested that this viscosity increase, in spite of the small molecular weight decreases, results from intermolecular hydrogen bonding. In line with this proposal, viscosities of OBMA-COOH solutions in a hydrogen-bond accepting solvent, MIBK, are lower than in *m*-xylene.

The intrinsic viscosity of the predominately mono-COOH substituted OBMA-COOH is higher in *m*-xylene than in MIBK. It is suggested that this results from inter-oligomer hydrogen bonding of COOH groups even in dilute solutions. The effect is especially apparent in *m*-xylene but may occur to some degree even in a hydrogen bond-accepting solvent like MIBK. The high molecular weight value determined by VPO in benzene as compared to that in acetone is further evidence for inter-oligomer molecule hydrogen bonding between carboxylic acid groups even in dilute solutions. These results on a very simple system may provide some insights for chemists designing oligomers for high solids coatings. However, they primarily indicate the need for further studies especially with well characterized oligomers having multiple polar group substitution.

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Ongoing research at DuPont's Haskell Laboratory for Toxicology and Industrial Medicine supports the use of DuPont DBE solvent as a substitute for E-series glycol ethers and acetates:

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	¢/LB.	\$/GAL.
Du PONT DBE	41.5-44	3.77-3.99
EE ACETATE	50.0-60.5	4.05-4.90
PM ACETATE	53.0	4.29
DPM ACETATE	53.0-69.5	4.29-5.63
DB ACETATE	64.5	5.06

*Delivered Tank Truck. Sources include *CMR*, industry sources and distributor price lists. Survey made in November 1984 in Chicago, Cincinnati, Detroit and Cleveland.

and finishes for appliances and metal furniture.

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	OLD FORMULA (WT.%)	REPLACEMENT* FORMULA (WT.%)	OLD FORMULA (WT.%)	REPLACEMENT* FORMULA (WT.%)	OLD FORMULA (WT.%)	REPLACEMENT* FORMULA (WT.%)
Du PONT DBE	-	15	-	12	-	5
PM ACETATE	-	25	-	38	-	8
MEK	-	-	47	50	26	26
N-BUTANOL	-	10	-	-	-	-
TOLUENE	-	-	-	-	61	61
XYLENE	50	50	-	-	-	-
EE ACETATE	50	-	53	-	13	-
\$/GALLON	2.65	2.51	3.28	3.22	1.95	1.95
LB./GALLON	7.58	7.54	7.34	7.37	7.13	7.17

Cost of solvent, cents/pound: DuPont DBE 41.5; PM Acetate 53.0; MEK 36.0; N-Butanol 36.0; Toluene 17.9; Xylene 17.3; EE Acetate 50.0
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EXXON
CHEMICALS

July 1985 Subcommittee Reports Of ASTM Committee D-1

The July meeting of ASTM Committee D-1 on Paint and Related Coatings and Materials was held on July 7-10, 1985 at the Town & Country Hotel, San Diego, California. In the three and one-half days preceding the final session and general meeting of Committee D-1, 114 members and guests met in 139 scheduled meetings of D-1 subcommittees and working task groups. The present membership of Committee D-1 is 494.

Special Highlight of the meeting was a talk on "Qualitative Service Life Prediction" by Dr. Mary E. McKnight of the National Bureau of Standards.

Awards presented were: Richard W. Scott and Harold D. Swafford—Society Award of Merit, and Carl W. Fuller—Henry A. Gardner Award.

Officer Appointments were made as follows: Sub. D01.33 on Varnish and Resins, Including Shellac—R.A. Orr to replace A.A. Abbott as Chairman; Sub. D01.41 on Purchase of Paints and Related Coatings—W.V. Moseley, Jr. as Chairman and S.L. Pitcher as Vice-Chairman; and Sub. D01.51 on Powder Coatings—D. Wilverding to replace K.K. Kipp as Vice-Chairman.

Highlights

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

EPA/D-1 Meetings—Sub. D01.08 met with EPA personnel associated with Air Quality measurement and control to work toward making D 3960 and EPA's Method 24 more compatible.

VOC Test Results—Sub. D01.21.13 reports considerable improvement shown in precision in a General Motors round-robin.

In-Container Spoilage—Sub. D01.28.01 running a round-robin on a new standard, "Presumptive Challenge Test of In-Container Preservative Efficacy Against Microbial Spoilage in Latex."

Residual Epichlorohydrin in Epoxies—Sub. D01.33.27 organizing round-robin to analyze for residual epichlorohydrin by head space gas chromatography.

Moisture and Surfactant Resistance of Primed Hardboards—Sub. D01.52.B discouraged by lack of interest shown in this subject. Seeking greater attendance at January meeting in New Orleans.

Labeling for Toxicity—Sub. D01.57 reports on the status of legislation relating to this subject for artists' paints.

Future Meetings

January 12-16, 1986—New Orleans, LA (Sheraton New Orleans).

June 15-19, 1986—Louisville, KY.

New Standards

New D-1 standards since the January 1985 meetings of D-1 approved by the ASTM Committee on Standards in the months shown: (subcommittee jurisdiction)

MAY

D 4487-85, "Test Method for Analysis of Calcium Borosilicate" (Sub. D0.21)

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.

DIVISION 1 ADMINISTRATIVE

SUBCOMMITTEE D01.07 GOVERNMENT CONTACTS

A.A. Chasan, Chairman

J.C. Weaver chaired the meeting in the absence of the chairman. Each of those present offered their views of the functions, goals and possible Work Plans for Sub. D01.07 as follows:

I. Bloom, Navy: There is a need to cover any and all agencies and to recruit members into active participation in D-1.

C. Hollis, GSA District 10 former lab operator, T. McAndrews, supervisor, and P. Yamasaki who acts on standards and deviation requests: Hollis reviewed briefly the May 14 & 15 invitational meeting of GSA in Auburn (Renton), WA, where many of the approximately 130 attendees expressed diverse industry and government views on new purchasing policies, trending toward buying commercial (branded) paints direct from the producer, without warehousing, to the government point of use. Another concern is how to man the District 10's new jurisdiction over Federal 595 color standards.

R. Martell, independent consultant: He is in recurring contacts with T. McAndrews at GSA and E. York, et al., at Fort Belvoir, among others. He will visit Fort Belvoir and report how D-1 may coordinate better the Federal Standard 141c standard methods re priority of 141 methods which ought to have D-1 counterparts and how to revise the 141/D-1 listings in the backs of Volumes .06.01, .06.02 and .06.03.

M. McKnight, NBS: She endorses better coordination and information transfer.

W.V. Moseley, Jr., State of Virginia: He finds the whole gamut too broad for efficient coordination.

P. Shaw, Davlin Coatings: She expressed ongoing interest in Sub. D01.07, limited now by her officership in the FSCT Golden Gate Society. Davlin has a major interest as a supplier of diverse paints to government agencies. She expressed a special interest in Federal 595 color standards, and may offer some suggestions.

J.C. Weaver, D-1 Chairman, appointed R. Martell as Vice-Chairman of Sub. D01.07. He also expressed puzzlement on the metes and bounds of DOD piecemeal approvals of single D-1 standards for federal use. He seeks a detailed explanation of how this system works versus the Belvoir jurisdiction over 141.

SUBCOMMITTEE D01.08 ENVIRONMENTAL CONCERNS

J.J. Brezinski, Chairman

It was reported that D-1 has been accepted as a voting member of the ASTM Coordinating Committee for Environmental Activities. J.J. Brezinski has been designated as the D-1 representative to that committee.

A meeting of Sub. D01.08 held June 4th at Durham, N.C. with 10 EPA persons associated with air quality measurement and control was productive and mutually beneficial. D-1 and EPA will work toward making D 3960, "Calculating VOC in Paints," and EPA Method 24 as compatible as possible.

Round-robin data from an EPA-contracted study of a laboratory method to measure transfer efficiency during application of coatings will be made available to D-1, possibly by the January 1986 meeting.

An annual (or more frequent, if desirable) meeting of EPA and D-1 personnel will be planned.

At the next meeting Sub. D01.08 will review updating of D 3630, "Standard Practice for Determining Constituents Classified as Hazardous Contained in Protective Coatings," particularly the up-front discussions of regulations affecting coatings and coating materials.

SUBCOMMITTEE D01.18 EDITORIAL

H.E. Ashton, Chairman

D01.18.02, Indexing, S. LeSota, Chairman, met with D. Savini, of the ASTM editorial staff, to discuss indexing of the paint volumes of the Book of Standards. Index cards were collected from the group members, which listed changes, additions and deletions in the index. These will be edited and then submitted to H. Shupak at Headquarters. Changes have already been made in the latest paint volumes that show a substantial improvement. However, there is still a long way to go.

SUBCOMMITTEE D01.94 AWARDS & MEMORIALS

H.K. Hammond III, Chairman

It was reported that two D-1 members received the Society Award of Merit.

R.W. Scott was cited "For outstanding leadership as Chairman of the Analytical Subcommittee of D-1, directing the work of 24 active task groups, and promoting

the use of ASTM standards by the U.S. Environmental Protection Agency."

H.W. Swafford was cited "For exceptional contributions in Committee D-1 in development of new analytical procedures for the determination of traces of heavy metals in paints."

C.W. Fuller was congratulated as the 1985 recipient of the Henry A. Gardner Memorial Award for the high productivity of Sub. D01.31 on Pigment Specifications, of which he has been chairman since 1978. The award plaque and check were not available for presentation on July 9th. The check will be mailed and the plaque will be presented at the January 1986 meeting of the committee. A 1986 candidate for this award has been presented to the Executive Subcommittee.

DIVISION 20 RESEARCH AND GENERAL METHODS

SUBCOMMITTEE D01.20 SAMPLING, STATISTICS, ETC.

H.E. Ashton, Chairman

It was reported that the Sampling Practice had received no negative votes or comments on the concurrent 85-1 ballot. The Specification for Test Conditions, D 3924, had received a negative vote because it was felt that it should be a Practice. The chairman pointed out that the parent Society standard is a Specification, so the corresponding Committee document should be in the same category. Also, the standard does specify what the standard environment must be for testing and conditioning coatings. With this explanation the negative was withdrawn.

Prior to the meeting, C.J. Sherman advised that he had not been able to prepare a computer program based on D 3980, but was hopeful that it could still be accomplished. This brought up the question as to how the program would be available. The chairman and others noted that ASTM was no longer providing computer analysis of round-robin results. It was suggested that someone familiar with computer programming might be willing to convert the initial program to ones suitable for other computers and make them available for a moderate price. The chairman agreed to approach two potential programmers.

SUBCOMMITTEE D01.21 CHEMICAL ANALYSIS OF PAINTS AND PAINT MATERIALS

R.W. Scott, Chairman

D01.21.13, Coordination of VOC Standards and Information, H. Fujimoto, Chairman, discussed for correction and approval revised copies of D 2369, "Volatile in Coatings." The basis of the revision is the elimination of "Procedure A" and retention of "Procedure B." The precision statement for "Procedure A" is placed in the Appendix as "Non-mandatory Information."

A suggestion to use a solvent other than 2-Ethoxyethyl Acetate (Para. 6.4) was rejected since the original study found this solvent to be universal for dissolving the test paint samples used.

The revised D 2369 will be submitted to concurrent Sub. D01.21/D-1 ballot.

Data obtained from a round-robin initiated by E. Praschan, of General Motors, to evaluate and to determine the precision which can be obtained on the VOC of automotive topcoats (both water- and solvent-reducible) using the ASTM methods referenced in EPA's Method 24 (RM24), are startling in that the results are contrary to what Sub. D01.21.56's chairman, M.E. Sites, reported in that group's round-robin. Those results showed wide VOC variability, especially with water-reducible coatings. GM's results show very good precision. Copies of the data were distributed for study and evaluation.

In the GM study, standard deviations for VOC were around 0.17 lb for the water-reducibles and around 0.03 lb for the solvent-reducibles. The standard deviation for the % water ran between 0.67-1.12%.

J. Smith, of PPG, ran the GM data for the 60 min @ 110°C bake through her computer using ASTM E180 for statistical evaluation, which is the only program available to her. Precision was good and only a few outliers had to be thrown out. The results are the best obtained so far on VOC in any of Sub. D01.21's round-robins.

Two points are brought out in this round-robin: (1) the ASTM test methods used to determine VOC of coatings are adequate, and (2) laboratories familiar with the test methods can obtain good precision.

The chairman suggested there is a need to hold workshops, through D-1, to educate others on the proper use of ASTM test methods.

The precision information on GM's round-robin data will be placed as an annex to D 3960, specifying the selected range of coatings tested.

Also discussed were improvements in D 4017, "Water Content-Karl Fischer

Method," by use of the "Hydranal" reagent, the use of the pycnometer to determine dried coating film density and the development of a method to determine halo-hydrocarbons.

E. Praschan reported on the work done on developing a laboratory transfer efficiency (TE) method. It was felt it would be useful to the industry, as well as regulatory agencies to have an acceptable TE measurement method. This fall there should be a public statement, probably in the *Federal Register*, of a TE method that has been under development and study during the last three years. EPA is thinking of using it to monitor the consistency of application equipment or comparing pieces of equipment against one another. The method could be put into ASTM format as a standard. C. Darwin, of EPA, is sending out quarterly update bulletins on the progress of the TE studies.

D01.21.22, Analysis of Electrocoat Bath Samples, W.B. Van DerLinde, Chairman, met, with R.W. Scott chairing the meeting in the absence of the chairman. A negative by H.E. Ashton on the 85-2 ballot on D 4399, "Method for Measuring Electroconductivity of Electrocoat Bath Samples," was withdrawn after it was agreed to make the changes he suggested, which included eliminating the word "Samples" from the title and changing in Para. 8.6 "average the readings" to "calculate the mean."

A procedure for the determination of amines/solvents was distributed for review. A round-robin with four participants will be started.

D01.21.23, Thermoplastic Traffic Marking, J. O'Brien, Sr., Chairman, reviewed the results of the April round-robin #1 for the chemical and gravimetric analysis of white and yellow thermoplastic traffic markings, which contain lead chromate and titanium dioxide. Analysis included % binder, % glass beads, titanium dioxide, and lead chromate. The data looks very good and is undergoing statistical analysis. To tighten up the methods, minor revisions were made. Another round-robin will be initiated immediately with new test samples. Additional collaborators will be obtained from other state laboratories, such as Alabama, Florida and California.

D01.21.42, AAS Analysis of Pigment, W.V. Moseley, Jr., Chairman, discussed editorial changes made in a revised copy of "Standard Method of Test for the Determination by AAS of TiO₂ Content of Pigments Recovered from Whole Paint," as a result of comments and a negative received on the 85-1 ballot. These changes were approved along with other suggestions by task group members. The changes made will be reviewed with H.E. Ashton. If satisfactory, it will be submitted to Society ballot.

D01.21.46, X-Ray Analysis of Pigment, A.M. Snider, Jr., Chairman, focused discussions primarily on the results of a recent round-robin on "Standard Method for Determination of TiO₂ in Paint by X-Ray Fluorescence Spectroscopy." One of the six laboratories participating has not reported as yet. When its report is received final statistical analysis in accordance with E 180 will be completed. The method will be revised to reflect suggestions of participants and a precision statement will be added, after which it will be presented for review.

Before the next meeting a round-robin will be conducted on "Standard Method for Identification and Determination of Pigment in Paint Films by X-Ray Diffraction." Five attendees agreed to participate. Others willing to do so should contact M. Snider at 412-487-4500.

D01.21.53, Trace Levels of Monomers in Paints, J. Benga, Chairman, was chaired by R.W. Scott in the absence of the chairman. The recent history of the task group was reviewed. A copy of "Test Method for Determining the Free Monomer Content of Latexes Using Gas Chromatography" was distributed and discussed. A number of corrections were proposed. After correction and addition of a reference chromatogram, it will be submitted to Sub. D01.21 ballot.

A method for the "Determination of Iso-cyanates in Resins by Derivatization and Separation by a Liquid Chromatograph" was also discussed. Five members agreed to participate in a round-robin to evaluate the method. It was to be started by September, provided suitable test samples could be found.

D01.21.55, Halo-hydrocarbons in Paints, C. Niemi, Chairman, was chaired by S. Clark in the absence of the chairman. The purpose of the meeting was to address a recommendation by J. Berry, US-EPA, Research Triangle Park, NC, to adopt editorial changes and include a 5/16/80 *Federal Register* reference within the "Significance and Use" section of D 4457. The recommendations were approved by the group unanimously.

D 4457 received no negatives on the Society ballot. Following approval of the above editorial changes, it will be printed as a separate standard and will be included in the next printing of the Book of Standards.

D 4457 has been referenced in the revision of D 3960-81, "Standard Practice for Determining VOC of Paints and Related Coatings," which is currently undergoing Society balloting. With the objective of this task group completed, it was placed on "inactive status."

D01.21.56, Revision of D 3960-81, Standard Practice for Determining VOC of

Paints and Related Coatings, M.E. Sites, Chairman, reported that a modified "Hydranal" method for determining water shows better results than those obtained in previous round-robins. For this reason Sub. D01.21.54, Water in Paints, has been resurrected into "active" status, and a new round-robin is planned by Chairman T. Abbamondi.

There were no negatives, but three editorial comments were received on the subcommittee ballot on D 3960. These will be incorporated and it will be placed on the next D-1 ballot. A discussion on the wording of the scope resulted in a rewrite of 1.3 as follows: "This practice includes all organic materials volatile under the test conditions. Allowances have been made for organic materials which are considered to be negligibly photochemically reactive. For the purpose of brevity in this document, these materials are referred to as exempt."

The group reviewed the data showing between laboratory coefficient of variation and precision for the two round-robins run by the group. Also reviewed were the summary results from the round-robin run according to D 3960 between General Motors and its four paint suppliers. It includes four solvent- and three water-reducible automotive coatings. Results were a startling improvement over the tests run by Sub. D01.21.56, which seems to show that these methods give good VOC data when run by laboratories familiar with them.

The GM test precision numbers will be evaluated and included in the precision statement for D 3960 prefaced by the narrow range of test samples used.

D01.21.80, Exploratory Analytical Research, K. Leavell, Chairman, discussed results of a comparison of % VNV using D 2697 vs Quantachrome's Gas Pycnometer. Two laboratories generated data that looks very promising. The Pycnometer readings are very comparable to the D 2697 results and they are obtained in minutes versus two to three hours. Details of sample preparation need to be worked out since three to five g of dried film are necessary for the Pycnometer. A task group is being set up to develop a method. Availability of the Pycnometer is a problem. Five labs volunteered to participate in a round-robin.

W.B. Van Der Linde still plans to initiate a round-robin on cations and anions in electrocoat ultrafiltrate samples using ion chromatograph in Sub. D01.21.22.

R.W. Scott reported that the Quintel Corp.'s Computrac Moisture Analyzer can be nitrogen purged to run flammable samples. The instrument measures loss-on-drying; it automatically calculates, calibrates, and weighs. No task group members have this equipment and concerns were raised about the perceived slowness of the instrument (one sample at a time).

The Particle Size Analyzer via laser light scattering was discussed briefly. Several instruments are now available for measuring average particle size, but distribution is still a problem. R.W. Scott agreed to investigate whether or not other ASTM groups (latex house paints, etc.) might be interested.

SUBCOMMITTEE D01.22 HEALTH AND SAFETY

H.A. Wray, Chairman

Revision of D 1310-84 (Tag Open Cup Flash Point)—The negative votes on the last concurrent D-1/D01.22 ballot were resolved. At the suggestion of A.H. Landrock, the following statement will be added: "No estimate of bias of flash point tests can be determined as no absolute values are available: the tests values are equipment and method dependent." With the changes included the method is ready for Society ballot.

Revision of D 3278-82 (Setaflash method)—As a result of a negative and three comments on the ballot, the following additions were made to the method: (1) a Significance and Use statement, and (2) a reference to the specific precautionary statement in A-6 at the end of the generic hazard statement in the scope. After inclusion of these changes, the method will be rebaloted.

D 3630, "Determining Constituents as Hazardous," Update—The "up-front" section will be referred to Sub. D01.08 for review and update. The analytical methods in the Practice will be referred to Sub. D01.21 for review and update. The issue of "Practice" or "Guide" will be reconsidered.

Other Matters—The updating of the bibliography of Health and Safety prepared by D. Campbell for D-1 members was discussed. The document in its present form is considered of only limited value. The decision to update was put on hold.

The activities of the ASTM Coordination Committee for Flash Point and Related Properties were summarized by Sub. D01.22 Chairman H.A. Wray, who was unable to attend this meeting.

D01.22.01 on Precautionary Statements, J.J. Brezinski, Chairman, discussed the proposed changes in Section A13-Safety Precautions (Circular Letter #676) developed by the Society Form and Style Subcommittee.

It was agreed that the chairman will revise the method incorporating the changes agreed upon. The revised method will then be sent to all D-1 subcommittee chairmen with a copy of the proposed changes in Section A13 by the Society subcommittee, with a cover letter requesting review for compatibility and comment.

A copy of the D-1 guide will be sent to the Society Form and Style Subcommittee for review for compatibility with the proposed ASTM policy. Following approval, the guide will be incorporated in the D-1 standards.

SUBCOMMITTEE D01.23 PHYSICAL PROPERTIES OF APPLIED PAINT FILMS

M.P. Morse, Chairman

D01.23.10 on Adhesion, H.E. Ashton, Chairman, reported that the proposed revision of D 2197, "Adhesion of Organic Coatings," that eliminates the use of the Arco Microknife, was approved on the D-1 ballot. Suggested editorial changes have been incorporated in the method. The revision will be submitted to Society ballot.

This group is conducting a study to determine how the cross hatch/tape removal test can be modified to handle thick coating films. A method for determining pull-off adhesion by tensile tester is being investigated.

D01.23.11 on Wet Film Thickness, H.A. Ball, Chairman, reported that the revision of D 1212, "Measurement of Wet Film Thickness by Interchemical and Pfund Gages," was approved on the D-1 ballot. Suggested editorial changes have been made. The revision will be submitted to Society ballot.

This group has completed its program of activities. It will be placed on inactive status.

D01.23.14 on Hardness, Mar and Abrasion Resistance, M.P. Morse, Chairman, reported that a revision of D 1474, "Indentation Hardness of Organic Coatings," was approved by D-1 ballot. After suggested editorial changes have been incorporated, it will be submitted for Society ballot.

An interlaboratory test to establish the precision of the Persoz pendulum test procedure has been completed. A precision statement will be formulated from the results of this study. This statement and a corresponding one on the Koenig pendulum test procedure will be submitted to subcommittee ballot for inclusion

in the method for hardness of coatings by the pendulum damping test.

The results obtained from a questionnaire sent to the D-1 member indicate there is a need for an instrumental method to determine mar resistance of coatings. An investigation of instrumental measuring techniques is being initiated that may be useful in evaluating that property.

D01.23.15 on Slip Resistance, M.P. Morse, Chairman, reported that a new method for measuring static friction of coatings was approved by D-1 ballot. After incorporation of suggested editorial changes, it will be submitted to Society ballot. An interlaboratory test is being initiated to determine the precision of the method.

D01.23.16 on Water Vapor Permeability, M.P. Morse, Chairman, reported that a major revision of D 1653, "Water Vapor Permeability of Coatings," has been approved by D-1 ballot. It will be submitted to Society ballot after incorporation of suggested editorial changes. Participants are being sought for an interlaboratory test to establish the precision of the method.

D01.23.18 on Elongation, M.P. Morse, Chairman, reported that a revision of D 522, "Elongation of Coatings by Conical Mandrel," and a revision of D 1737, "Elongation of Coatings by Cylindrical Mandrel," have been approved by D-1 ballot. These methods with suggested editorial changes will be submitted to Society ballot.

Future activity will consist of drafting an elongation bend test method that combines the conical and cylindrical mandrel test procedures in one document.

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

C.K. Schoff, Chairman

D01.24.19, Viscosity by Efflux Cups, J. Peters, Acting Chairman, again discussed D 4212, "Viscosity by Dip Cups." The method had been broken into two documents, one for Zahn cups and one for Shell cups and balloted on the subcommittee level. A number of editorial comments will be incorporated into the methods. The single negative on each method was cast by P. Gardner. Some of his comments were found to be editorial and will be incorporated, but both negatives were voted unanimously as not being persuasive or germane. We understand his concerns regarding the condemnation of Zahn cups in that method, but nothing can change the fact that they give very poor precision and should only be

used to control viscosity within one plant or laboratory and should not be used to check compliance with specifications. Both methods will be submitted for D-1 ballot after editorial changes have been made. D 4212 will be balloted for withdrawal on the condition that the two methods will replace it.

D01.24.26, Electrical Properties of Liquid Paints and Paint Materials (including Solvents), J. Peters, Acting Chairman, discussed the method on Measurement of Electrical Resistance of Liquid Paint and Paint Materials. P. Gregg, of Ransburg, attended to explain the use of their D.C. device for measuring electrical resistance. He volunteered to write a draft of the Procedure Section for the method. The first draft (really more of an outline) of the method was reviewed and some changes were made. It was noted there were other suppliers of electrical resistance equipment and that their devices should be included. Further work will be done on the method at the January 1986 meeting.

D01.24.27, Flocculation, did not meet. The main topic of discussion was supposed to be the proposed practice for testing for degree of flocculation. A survey of D-1 members indicated a fair amount of interest in such a practice, but not an overwhelming need. Very few people have attended working group meetings or indicated a willingness to work on such a practice. If more people are not willing to become involved, the project will be dropped.

SUBCOMMITTEE D01.26 OPTICAL PROPERTIES

C.J. Sherman, Chairman

D01.26.02, Color Measurement, C.S. McCamy, Chairman, was chaired by C.J. Sherman in the absence of the chairman. Sherman reported on McCamy's work on D 1535, "Method for Specifying Color by Munsell System." The present luminous reflectance factor vs Munsell value table is relative to magnesium oxide. The new table developed by McCamy is on an absolute basis, so when $Y = 100\%$, $V = 10$. Equations for computing V from Y directly were developed and the results compared to the original table to study the difference (error). The maximum was 0.0035. The equation and table will be included in the revision of the method. There was discussion about the precision statement. W.N. Hale will furnish a new statement. The revised draft will be submitted for concurrent Sub. D01.26/D-1 ballot.

A negative received by M.P. Morse on D 2244, "Method for Instrumental Evaluation of Color Differences of Opaque Materials," was withdrawn when his editorial revisions were included in the method. Editorial comments by Landrock and Ashton were also included. The method will be submitted for Society ballot.

There was discussion about the origin of the precision statement in D 2244. It was taken from an MCCA report several years ago and is definitely not the latest. Fairman and Ashton volunteered to look at MCCA's latest report and make a recommendation as to whether or not to keep the present statement, use the latest MCCA data, or to conduct a round-robin.

W.N. Hale circulated the latest draft of D 3134, "Recommended Practice for Selecting and Defining Color and Gloss Tolerances of Opaque Materials and for Evaluating Conformance." Additional editorial comments were incorporated. The practice will be submitted for concurrent Sub. D01.26/D-1 ballot.

D 4086, "Practice for Visual Evaluation of Metamerism," and D 1729, "Practice for Visual Evaluation of Color Differences of Opaque Materials," will be reviewed by C.J. Sherman and submitted for reapproval by Sub. D01.26.

A proposed practice for Preparation and Maintenance of Color Standards for Coatings will be written by Fairman and Sherman by the next meeting.

D01.26.06, Hiding Power, L. Schaeffer, Chairman, discussed the results of the recent concurrent ballot on Draft #4 on the revision of D 2805, "Test Method for Hiding Power of Paints." Three negatives received were withdrawn on the basis of agreed upon editorial changes. These will include the referencing of Kubelka-Munk tables and graphs so that it will still be possible to use D 2805 without the aid of a computer.

A letter was read from F.W. Billmeyer agreeing that it is reasonable and appropriate to proceed with the present revision, without introducing previously discussed Saunderson correction equations.

W.N. Hale suggested that E 284, "Definitions of Terms Relating to Appearance of Materials," be referenced in this method. This will be done. This draft with editorial revisions will be submitted for Society ballot.

D01.26.11, Gloss and Goniophotometry, M.P. Morse, Chairman, discussed the comments received from the D-1 ballot of D 523, "Test Method for Specular Gloss." Most were editorial in nature. They were adopted. Some of the important changes made were: (1) specifying that the refractive index given for the black gloss standard be that determined for the sodium D

line; (2) the discarding of divergent value should be done according to D 3980; and (3) tolerances for the source image in the perpendicular to plane measurement be inserted in Table 1. With these changes the method will be submitted to Society ballot.

The reapproval of D 4309, "Test Method for Reflection Haze of High Gloss Surfaces," was discussed. It was agreed that a note should be inserted in the Calculation Section stating that "Because of the difference in the assigned values for the black gloss standard, the gloss values for the specimens without haze will be approximately 5." The method will be submitted with this change to concurrent Sub. D01.26/D-1 ballot.

The need for establishing gloss scales that are linear with respect to visual rating scales was discussed. It was agreed that this would be a worthwhile project and, as a first step, it was agreed that a set of coated panels satisfactory for evaluating differences in visual and instrumental gloss should be developed. C.J. Sherman agreed to prepare such a set of panels and determine their 20 and 60 degree D 523 glosses. In the meantime, members are to give some thought as to how the visual ratings should be conducted. Suggestions should be sent to M.P. Morse, who will distribute them to the other group members for their comments.

D01.26.22, Sample Preparation, H.K. Hammond III, Chairman, was chaired by C.J. Sherman. A negative on D 3964, "Practice for Selection of Coating Specimens and their Preparation for Appearance Measurement," was withdrawn because the practice was up for reapproval and not for revision as noted on the ballot. Comments received were editorial and were incorporated in the practice with a change in title to "Practice for Selection of Coating Specimens for Appearance Measurement." It was the consensus of the group that the old title was misleading in that a method to actually prepare panels is implied. It is now ready for Society ballot.

D01.26.23, Reflectance of Horizontal Coatings, N. Johnson, Chairman, will revise D 4061, "Test Method for Specific Luminance of Horizontal Coatings," and submit it to concurrent Sub. D01.26/D-1 ballot. The first draft revision did not contain all of the updated terminology of E 308 and CIE Publication 54. Therefore, a second draft revision will be provided by N. Johnson to C.J. Sherman for balloting. A task group, consisting of J. Renilson (chairman), J. Ritter, and W.N. Hale, was formed to survey and conduct an interchange of test panel preparation techniques for beads on paint test panels. A round-robin of a more closely controlled version of D 4061 is in preparation. The new round-robin will be limited to angle calibration using the 86 degree prism method

and sample hold-down using a flat vacuum plate. Four laboratories have agreed to participate. Details of the round-robin will be reviewed at the next meeting.

D01.26.24, Tinting Strength, C.J. Sherman, Chairman, reported that the latest balloting of the revision of D 332, "Test Method for Tinting Strength of White Pigments," received several comments. It was decided to leave the procedure using the hand muller in the method. The other editorial comments will be included. It will be submitted for concurrent Sub. D01.26/D-1 ballot.

The latest revision of D 2745, "Test Method for Instrumental Tinting Strength of White Pigments," will be submitted for concurrent Sub. D01.26/D-1 ballot.

D 387, "Test Method for Color and Strength of Color Pigments with a Mechanical Muller," will be reviewed and submitted for reapproval.

ISCC and AIC are meeting in Toronto next June at the same time as the D-1 meeting. E-12 has decided to meet in Toronto in conjunction with the ISCC meeting and not with D-1 as usual. Since a greater percentage of active Sub. D01.26 members also belong to E-12, it was proposed that Sub. D01.26 meet at the same time and place as E-12. However, because it would be difficult to schedule Sub. D01.26 task groups without adding another day to an already full week of meetings and because there would be poor attendance at a normal Sub. D01.26 meeting due to the ISCC conflict, it was the consensus that the Sub. D01.26 would not meet in June 1986.

Publications—The success of R.S. Hunter's compilation of ASTM methods on Appearance has been very good. The first printing sold out within a short time, necessitating a second printing. It has been suggested by J.C. Weaver, D-1 chairman, that a similar compilation of methods for paint be made, but that it be more than just a compilation. It should be tutorial in nature. Much discussion followed, but no decision was made as to who should compile, write, and edit it, or not to do it at all.

There was also discussion on Weaver's plan to do something about the revision and publication of the next edition of the Gardner-Sward Paint Testing Manual (STP 500). It was agreed that the Sub. D01.26 chairman should compose a letter expressing concurrence on this matter and that revisions of chapters be published as soon as completed. Each chapter can then be inserted into a binder similar to the Federation's series on coatings technology. It was the group's opinion that this would alleviate the future problems of revising obsolete chapters or adding new ones and that it could always be published. This letter will be sent to R.L. Meltzer, Vice-President, ASTM Publications and Marketing Division.

SUBCOMMITTEE D01.27 ACCELERATED TESTS FOR PROTECTIVE COATINGS

B.L. Williamson, Chairman

D01.27.02, Water Tests, G.W. Grossman, Chairman, was chaired by B.L. Williamson in the absence of the chairman. There were no negatives on four methods balloted on the 85-1 subcommittee ballot. Those comments found to be valid will be incorporated in the methods for review prior to submitting them to D-1 ballot.

(G.W. Grossman passed away the end of August.)

D01.27.04, Light and Water Exposure Apparatus, S.M. Totty, Chairman, reported that a new "Standard Practice for Conducting Tests on Paint and Related Coatings Using a Fluorescent UV-Condensation Light and Water Exposure Apparatus" has been submitted for the next D-1 ballot.

D01.27.09, Corrosion, B.L. Williamson, Chairman, is evaluating various cycle tests which are being used by the industry to duplicate the scab-like corrosion which occurs in use. The goal is to establish a standard based on one or more of these cycle tests.

Results of an initial round-robin on various scab corrosion cycles were reviewed by F. Lutze. Unexplained variations in the data occurred. A second round-robin is planned to investigate the probable causes of these. The results of the additional tests should be available for the next meeting.

D01.27.14, Filiform Corrosion, F.W. Lutze, Chairman, reported that screening tests, designed to determine if the development of filiform corrosion can be accelerated over the current D 2803 method, have been delayed due to equipment malfunction. These tests, which will include variations in substrate topcoat qualities, phosphating systems, and exposure conditions, are expected to be completed prior to the January 1986 meeting.

D01.27.16, Chalking, J.S. Robbins, Chairman, reported that the recent D-1 ballot on D 659, "Standard Method of Evaluating Degree of Chalking of Exterior Paints," had no negatives. Three editorial comments were included in the method after group discussion. The method will be submitted to Society ballot. This task group will become inactive for the present time.

D01.27.17, Evaluation of Weathering Effects, A.S. Allen, Chairman, reviewed the latest draft of a revised D 660, "Evaluating Degree of Checking of Exterior Paints." Several minor editorial changes

were suggested. After the changes are made it will be submitted for subcommittee ballot.

SUBCOMMITTEE D01.28 BIODETERIORATION

D.L. Campbell, Chairman

Chairman Campbell reported that he has set up liaison with Committee G-3. He also reported that Sub. D01.28 will organize a presentation on Biodeterioration to last approximately two hours at the D-1 meeting in New Orleans in January 1986.

D01.28.01, Package Stability, A.R. MacGillivray, Chairman, approved revisions to D 2574, "Resistance of Emulsion Paints in the Container to Attack by Microorganisms," and also discussed the need for a precision statement for it. Laboratory data for it will be generated before the 1919 revision deadline.

A round-robin will be performed in the next six months on a new standard, "Presumptive Challenge Test of In-Container Preservative Efficacy." The cooperators will be Nuodex, Buckman Labs, Hercules, and Vanderbilt Labs.

D01.28.02, Rapid Determination of Enzyme Presence, A.J. Desmarais, Chairman, presented the results of the round-robin completed since the last meeting. Measurements of viscosity retention CMC/Acrylic paint mixtures inoculated with cellulase enzymes followed the expected pattern. However, the rate of viscosity loss differed significantly between cooperators. Variability may be due to techniques of preparing and incorporating the enzyme. A comment on excessive foaming during enzyme solution preparation was received and could also be a factor. A suggestion was made that the initial solution prep should be 1000 cc rather than 100 cc to cut down on foaming.

Prior to the next meeting a comparison will be made of a more highly substituted CMC with the CMC-4H1. This will cause a slower rate of viscosity loss, but hopefully a more controllable rate. Another round-robin will be run with the CMC solutions only.

D01.28.04, Resistance of Paint Films to Attack by Algae, A.R. MacGillivray, Chairman, discussed the comments on the proposed method for Algae Resistance. A round-robin on this method will be run within the next six months. Cooperators will be Hercules, Buckman Labs, and Vanderbilt Labs.

D01.28.05, Recoating Mildewed Surfaces, D.L. Campbell, Chairman, reported that the sixth draft of the "Standard

Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings" has been revised to accommodate negatives and comments received from the previous ballot. It will be rebalotted by Sub. D01.28.

DIVISION 30 PAINT MATERIALS

SUBCOMMITTEE D01.31 PIGMENT SPECIFICATIONS

C.W. Fuller, Chairman

The subcommittee reviewed 21 standards and voted to place them on the next ballot. Four were approved for removal from the Book of Standards as follows: D 209, (Lamp Black), which is no longer produced in the U.S.; D 2744, (Tri-basic Lead Phospho-Silicate), which also is no longer produced in the U.S.; D 477, (Zinc Sulphite), which is no longer produced; and D 3360, "Test Method for Particle Size Distribution of the Common White Extender Pigments by Hydrometer," because of low interest in its usage.

The subcommittee has one new member, Larry F. Pitchford, of Reynolds Metal, who will chair Sub. D01.31.05 on Metallic Flake Pigments.

SUBCOMMITTEE D01.32 DRYING OILS

P.C. Stievater, Chairman

Two negatives received from the 84-3 letter ballot were withdrawn prior to the meeting after a discussion with the negative voter, F. Raffo. A third negative was discussed with the negative voter, L. Schaeffer, present. His negative on D 1963, "Specific Gravity of Drying Oils, Varnishes, Resins and Related Materials at 25/25 C," was found persuasive. It was withdrawn with the understanding that D 1963 be combined with D 1475 (under the jurisdiction of Sub. D01.24) and then be balloted for removal. This will be discussed with the chairman of Sub. D01.24.

In addition to combining the two methods, the negative favors dropping the term, "specific gravity," in favor of "density." D 1475 uses "density" and is

applicable to all the materials covered under D 1963.

Editorially revised versions of 11 methods from previous ballots (D 1358, D 1466, D 1541, D 1950, D 1951, D 1952, D 1954, D 1957, D 1960, D 1967, D 1981) were submitted for inclusion in the next D-1 ballot. Revised drafts of other methods due for reappraisal in 1985 will be submitted in time for the next D-1 ballot.

SUBCOMMITTEE D01.33 VARNISH & RESINS, INCLUDING SHELLAC

R.A. Orr, Chairman

It was reported that D 1545, "Viscosity of Transparent Liquids by Bubble Time Method," and D 1725, "Standard Test Method for Viscosity of Resin Solutions," were reapproved by Sub. D01.33 ballot. They will be submitted for D-1 ballot.

D 3680, "Test Method for Residual Vinyl Chloride Monomer Content of PVC Resins, Compounds, and Copolymers by Solution Technique," was balloted for withdrawal at the Society level by Committee D-20 on Plastics, Sub. D01.33 voted to request the D01.90 Executive Subcommittee to obtain jurisdiction of D 3680 and assign it to Sub. D01.33.

D01.33.23, Phenolic Resins, H.D. Marshall, Chairman, was chaired by C.M. Winchester in the absence of the chairman. The following proposed methods have passed Sub. D01.33 ballot and with appropriate editorial revisions will be submitted to D-1 ballot: "Standard Method for Stroke Cure on Thermosetting Phenol-Formaldehyde Resins," "Standard Method for Free Hydroxyl Ion Concentration (pH) of Water Insoluble Phenol-Formaldehyde Resins," and "Standard Method for Non-Volatile Matter of Phenolic Resins."

D01.33.24, Nitrogen Resins, J.H. Smith, Chairman, reported that preliminary results in one laboratory using a proposed method for determining free formaldehyde content in melamine resins are encouraging. Cooperators are needed for a round-robin to further evaluate the method.

D01.33.25, PVC and PVB Resins, J.J. Brezinski, Chairman, reported that on the Society ballot on D 3680 cited above, the task group chairman voted negative because this method is part of EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) for Vinyl Chloride, and because it is widely used in

industry for specification and compliance with regulations.

D01.33.26, Emulsions, R.M. Schiller, Chairman, reviewed Draft #3 of a proposed test method for filter-retained solids content of latex vehicles. A round-robin is being organized to obtain data precision and bias.

D01.33.27, Epoxy Resins, R.A. Orr, Chairman, is organizing a round-robin to analyze residual epichlorohydrin in epoxy resins by head space gas chromatography using Dow Method RPM 900A. Cooperators are welcome.

SUBCOMMITTEE D01.35 SOLVENTS, PLASTICIZERS AND CHEMICAL INTERMEDIATES

L.R. Thurman, Chairman

D01.35.10, Solvents—Hydrocarbons and Ketones, S.A. Yuhas, Jr., Chairman, discussed round-robin data to substantiate the precision of D 1364, "Water in Volatile Solvents by Fischer Reagent Titration Method." Nine laboratories participated in an Exxon sponsored round-robin. Hexyl acetate, containing 5 levels of water ranging from 0.015% to 0.10%, was tested in duplicate on each of two days. Precision was magnitude dependent; generally better than now reported in D 1364. Bias was excellent; 94-99% at water levels of 0.03% to 0.10%. Different test methods, reagents, equipment, and sample introduction techniques were used with excellent reproducibility. This indicates the Fischer reagent precision can support a water content specification level of 0.05%.

An inquiry concerning the "Doctor Test" (D 235) was discussed, including applicability, detectability limits, and practical experience. In general, the "Doctor Test" is used as a qualitative indicator of mercaptan sulfur content.

D01.35.20, Reactive Monomers—Vinyl Monomers and Aldehydes, T.H. Golson, Chairman, held a discussion on removal of inhibitors from vinyl monomers. Due to the instability of uninhibited monomers, they should be used immediately and not stored. A method for determining polymer content of monomers will be discussed in January.

D01.35.30, Chemical Intermediates, J.R. Morrison, Chairman, reported that test methods for the purity of propylene glycol monomethyl ether and dipropylene glycol monomethyl ether will be returned to committee for review due to negatives received on the last Sub. D01.35 ballot.

The ad hoc committee for gas chromatographic analysis of 2-ethylhexanol re-

viewed data presented by T. Rendl, of Alltech, for G.C. analysis of 2-ethylhexanol and other alcohols. After additional data are received, a method for 2-ethylhexanol analysis will be prepared in ASTM format and presented at the January 1986 meeting. E15.53 on Alcohols and Polyalcohols will be informed of the work on alcohol analysis.

D01.35.40, Plasticizers and Ester Solvents, R.L. Smith, Chairman, reported that specs for propylene glycol monomethyl ether acetate and test methods for it will be returned to committee for review due to negatives received on the last Sub. D01.35 ballot.

D01.35.50, Liaison, Lucille P. Field, Chairman, reported that lists of referenced standards under other committees were presented to each chairman. Standards were listed by number, title, ASTM Committee jurisdiction and other interested agencies.

New Business—Secretary W.J. Frost announced his resignation. Sub. D01.35 wishes to express its sincere thanks to "Jack" Frost for his many years of earnest and dedicated service to ASTM. His valuable technical contributions and work as subcommittee secretary have been much appreciated.

DIVISION 40 PAINT PRODUCTS APPLIED ON SITE

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

J.C. Weaver, Chairman pro tem

D01.41.01, Title and Scope, J.C. Weaver, Chairman, heard arguments, without much agreement, on scope, but did approve a new title: "Purchasing of Paints and Related Coatings." This was approved by the Sub. D01.90 Executive Subcommittee on July 10th. After a review of the history of the subcommittee and the original scope, further wrangling seemed unproductive without direct inputs, especially on terminology, by two large and separate paint purchasers, U.S. GSA and DOD, to learn which, if any, ASTM potential consensus documents they can join in and use, among those in ASTM Blue Book, Part B on specifica-

tions, and Part C, "Other Types." Underlying the wrangling was detected nearly universal rejection by both D-1's major component and paint producer member classes of any and all quantitative composition limits in paint specifications, while not necessarily opposing purely performance specification. Sub. D01.41's new officers may now deal with a new scope.

D01.41.02, D 3927, Standard Guide for State and Institutional Purchasing of Paint, W.V. Moseley, Jr., Chairman, had two activities: (1) D 3927-80, which is overdue on the ASTM five-year review rule. A negative on the May 10 Sub. D01.41 ballot was resolved. The standard will be submitted for D-1 ballot; (2) W.V. Moseley's extensive revision of the Active Ingredients/Cost Ratio sections of D 3927, as a new "Standard Guide for Purchasing Commercial (Architectural) Paints by Weighted Cost of Active Ingredients," which was on the May 10 Sub. D01.41 ballot as Item 1. Four negatives received on that ballot were negotiated by Moseley as editorial revisions. In the Sub. D01.41 meeting a unanimous motion approved submission of these changes to the negative voters and, upon their agreement, for D-1 ballot.

D01.41.05, Latex Flat Wall Paint Specification, I.V. Bloom, Chairman, voted to approve the minutes of the interim May 7th meeting in Washington, DC and to submit the draft of the subject specification, when available, to a Sub. D01.41 ballot.

D01.41.06, Purchasing Community, is a newly formed task group. Action will be taken by Moseley on results of his independent mailing of May 20, under a Commonwealth of Virginia letterhead, to about 80 "Members of the Purchasing Community and Members of Consumer Organizations" on his proposed title and scope for Sub. D01.41, asking for a response. He received about 30 responses, of which only 3 are D-1 members. Others might be potential ASTM members, upon further action by Moseley.

New Business—GSA was reported to having evolved a new paint purchasing policy following a May 14 meeting of about 130 invitees at Auburn (Renton), WA. Interest is indicated in buying architectural and related coatings without GSA warehousing, but direct from the stock of a producer or seller to a government point of use. Methods for initial quality acceptance and subsequent quality control and audit on brand named paints are under study by GSA.

A labeling guide for packages of architectural paints, for both proximate analysis and performance quality, was mentioned as a possible activity for Sub. D01.41.

SUBCOMMITTEE D01.42 ARCHITECTURAL PAINTS

R.H. Rowland, Chairman

D01.42.02, Practical Soil and Stain Removal, C. Tatman, Chairman, was chaired by L. Schaeffer in the absence of the chairman. A decision that came out of this meeting was the tentative reconstruction of the Sub. D01.42.01 for the investigation of the ease of stain removal with a mechanical device (Scrub Tester) in place of the hand cleaning method utilized by Sub. D01.42.02. T. Sliva has agreed to head up the new task group and will review various Federal specifications, as well as D 3450, "Test Method for Washability Properties of Interior Architectural Paints," for potential staining agents to be used. Four to five stains will be selected and the ease of stain removal will be evaluated by checking reflectivity before and after scrubbing. Time will be set aside at the next meeting to discuss the method further.

D01.42.04, Wet Adhesion, F.M. Winkelman, Chairman, reviewed the two procedures under consideration for a round-robin. A suitable negative control paint (one displaying poor wet adhesion) has been found and will be included in the round-robin work. The chairman solicited the help of other members in supplying latex coatings which would demonstrate a range of wet adhesion results. Consideration will be given to formulating a paint with varying PVC to provide for such a range of wet adhesion results. An additional method for conducting wet adhesion tests will be reviewed prior to the next meeting.

D01.42.06, Standard Practice for Testing Latex Semi-Gloss and Gloss Paints, S. LeSota, Chairman, reviewed the negative ballots and editorial changes received from the last balloting. The negatives were all resolved and the editorial changes made. It was decided to add the typical 20° gloss range for gloss paints and 60° gloss range for semi-gloss paints. These ranges are included in the *Paint/Coatings Dictionary*, which was a consensus of many reviewers from the paint industry. As an expedient, the technical changes will be submitted to both Sub. D01.42 and D-1 for balloting without including the rest of the guide.

D01.42.13, Brushability, D. P. Leopold, Chairman, was chaired by A. Demarais in the absence of the chairman. Correlation between hand brushouts and ICI viscosities in the results of the last round-robin was excellent. Agreement between 14 cooperators on ranking hand brushouts for five paints was very good.

These results reaffirm earlier results with only five cooperators.

M.P. Morse will be contacted to help with the statistical analysis of the data in order to prepare a precision statement. A method will be written and circulated among the subcommittee members for comment prior to the next meeting.

It was decided that the title, "Brushability," was too broad for the method. "Ease of Brushing" or "Brush Drag" are being considered as new titles for the method.

D01.42.16, Opacity (Practical Method), was chaired by L. Schaeffer in the absence of a new chairman to be appointed. It was reported that the round-robin data and information accumulated to date by the former chairman, R. Armstrong, was no longer available. R. Schiller agreed to assemble all available material from cooperators and the subcommittee chairman and decide what additional steps will be required to write a test method or, otherwise bring the current program of the task group to a conclusion.

D01.42.17, Roller Spatter, J.F. Price, Chairman, presented the recently written method to the group. Following discussions, several revisions were made which will be incorporated in a rewrite along with a new precision statement, prior to being submitted for Sub. D01.42 ballot.

SUBCOMMITTEE D01.44 TRAFFIC COATINGS

R.L. Davidson, Chairman

D01.44.01, Thermoplastic, J.M. O'Brien, Chairman, discussed some of the discrepancies of the recent round-robin. Suggestions were made to further standardize the test methods. These revised methods will now be evaluated in another round-robin. The rest of the time was spent wrestling with the issue of the relevance of the tests suggested—whether the tests are control tests or whether they relate to the durability of the material on the road.

D01.44.02, Traffic Paint, C.M. Winchester, Chairman, that all negatives and comments from the D-1 ballot on D 868, D 869, D 969, and D 2205 were resolved. These methods will now be submitted for Society ballot. Draft #3 of D 713, "Method for Conducting Road Service Tests on Traffic Paint," which reflects all the editorial changes from the Sub. D01.44 ballot of Draft #2, was reviewed. It will now be submitted for D-1 ballot.

D01.44.03, Night Visibility, J.R. Ritter, Chairman, read, reviewed, and re-

vised the most recent draft for the use of a retro-reflectometer. Another draft will be written for review. The data for the most recent round-robin on glass beads is not yet complete, but it was reported that another round-robin will be needed.

SUBCOMMITTEE D01.45 MARINE COATINGS

L.S. Birnbaum, Chairman

D01.45.06, Dynamic Testing, D. Laster, Chairman, was chaired by L. S. Birnbaum in the absence of the chairman. The revised Draft #1 of the proposed Standard Test Method for Marine Antifouling Coating Systems under Hydrodynamic Flow, prepared by D. Laster, was distributed and approved for Sub. D01.44 ballot.

T. Dowd distributed a proposed method for dynamic testing of antifouling paint systems using high velocity flow. He reported that Ocean City Research, under contract with a private vendor, obtained a number of measurements using their equipment which indicates that the rotating drum procedure does not correlate well with performance in service. This conclusion was based on the erosion of Formula 121 in Navy rotating drum tests in contrast to its retention in the Ocean City Research tests. Although data from Ocean City Research has not been released, Dowd reported that generally good correlation existed between ship measurements and the dynamic channel test with respect to erosion results. There was some discussion as to how these thicknesses were made both on ships and on panels.

The establishment of a working group to prepare a draft of a standard method to determine the erosion/polishing rate of paint antifouling systems using high velocity flow channels was approved. T. Dowd accepted chairmanship of this group with J. Kelly and L. Birnbaum volunteering their services. Dowd also agreed to contact George Gehring of Ocean City Research to request his services as a member of this group. It was suggested that January 1986 be used as the target date for reporting results at the New Orleans meeting of D-1 scheduled for the week of the 12th.

D01.45.08, Organo-Tin Release Rate, R. Gangi, Chairman, was chaired by L. Birnbaum in the absence of the chairman. Birnbaum submitted a proposed text covering "Scope," "Summary of Method," and "Significance and Use" sections for an initial draft of a standard for organotin release rates of antifouling paint systems in sea water. There was general consen-

sus with the text by both Navy and industry with some minor suggestions for editorial changes.

T. Dowd reported that the Navy planned to proceed with implementation of use of organotin AF paints with low level release rates using the method developed by P. Schatzberg, of NSRDC, and as described in DOD-P-24647 as a basis for approval at this time.

Presentations were made by the following:

(a) P. Schatzberg, DTNSRDC, on the Annapolis protocol; basis for maximum tin release rate requirements, including some aquatic organism toxicity levels and organotin levels at selected Navy berthing sites; data obtained on selected organotin AF paints; and need for development of high performance AF's with lower tin release rates. He offered to provide hard copies of his view graphs to the acting chairman for subsequent distribution to attendees.

(b) P. Seligman, NOSC, on the *in-situ* protocol developed at NOSC; data obtained on some Navy ships; and some comments and recommendations on standardized leach rate measurements. A hard copy of his view graphs was provided for subsequent distribution to attendees.

(c) C. Anderson, International Paint, on comparison of IP and NSRDC methodology, tin release results of Inter-smooth Hisol 200 Series copolymer AF (with statistical analysis and effect of temperature) solubility of TBTO in sea water; and further trials in progress. Details were provided in a report to attendees.

It was agreed to concentrate initial Sub. D01.45.08 efforts on development of a standard laboratory protocol. An ad hoc group was established to develop objectives, prepare a proposed draft, and propose a test program with L. Birnbaum as chairman and P. Schatzberg, T. Dowd, P. Seligman, and C. Anderson as members. There were no other industry volunteers. Birnbaum offered to contact C. Beiter of M&T to assist. He also indicated he would try to arrange for a group meeting in September with a target date for reporting results of January 1986 at the Sub. D01.45 meeting in New Orleans.

D01.45 Meeting—T. Dowd of NAVSEA was announced as the new vice-chairman to replace W. Briggs, who retired. It was also reported that Sub. F 25.02 on Coatings had sent out a ship inspection guide for balloting and that Sub. F25.02 was still working on paint specification drafts. The chairman has requested copies of Sub. F25.02's minutes be sent out to Sub. D01.45 members.

R. Martell reported on development of an SSPC specification for aluminum vi-

nyl paint to replace red lead vinyl paint, which was being phased out by the Navy.

SUBCOMMITTEE D01.46 INDUSTRIAL PROTECTIVE PAINTING

K.A. Trimber, Chairman

D01.46.02, Surface Preparation, K.A. Trimber, Chairman, did not meet. However, during wrapup session, W. Johnson recommended that the group be reactivated in order to develop a test method for evaluating the chloride content of abrasives. He presented a procedure he has developed for in-house use at KTA and offered to rewrite it into ASTM format. The subcommittee agreed that the development of such a test method was worth pursuing. Johnson will head up this effort and prepare a draft test method for circulation to Sub. D01.46 members prior to the next meeting.

D01.46.03, Repainting, R. Wakefield, Chairman, reported that Draft #4 of "Standard Methods for Field Identification of Coatings" received one negative (H.E. Ashton) and several written comments (E.R. Lewis, R.S. Shane, D.M. Berger, M.E. McKnight). After discussion of the negative and comments, minor revisions were made in the method. It was felt that the negative was resolved and the comments handled satisfactorily. It was recommended that the method be submitted to D-1 ballot.

D01.46.04, Pull-Off Adhesion. A. Cunningham, Chairman, reported that Draft #8 of a proposed "Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" received one negative (L.J. Murphy) and comments from A.H. Landrock, J. Peters, R.K. Fisher, and H.E. Ashton. The negative was identical to one previously submitted by a different member of the same company. It was discussed and a minor editorial change made. Based on this, Murphy withdrew his negative by phone on 7/9/85. The comments were also resolved by minor editorial changes. The method will now be submitted for Society ballot.

A round-robin was established to prepare a precision statement for the test method. Round-robins were conducted in the past, but problems were encountered with the coatings selected. The coatings generally possessed adhesion values greater than the limits of the test instruments. Coatings with adhesion/cohesion strengths less than 1000 psi are necessary for a proper test.

Two coating systems have been selected for this new round-robin: alkyd and inorganic zinc-rich/epoxy. R. Wakefield

and A. Cunningham agreed to supply the respective panels. The variables to be evaluated or controlled are: (1) substrate; (2) adhesive (Hysol 907); (3) scribing around dolly; (4) test equipment (Elcometer Model 106/2, 0-1000 psi, adhesion tester and the Fisher 2000 pneumatic adhesion tester); and (5) referee method (Instron). The subcommittee minutes give more details on these variables.

D01.46.07, Inspection. R. Martell, Chairman, reported that three negatives were received on the Sub. D01.46 ballot on Draft #7 of the proposed revision of D 3276. "Standard Guide for Painting Inspectors." The negatives were found to be persuasive. Changes were made to the document. One of the most significant changes is that the guide will address the inspection of metal substrates only. A footnote will be added to this new document directing the reader to the 1980 version of D 3276 should information be required for the inspection of non-metal substrates. A revised copy, Draft #8, will be submitted for concurrent Sub. D01.46/D-1 ballot.

D01.46.10 Condition Assessment, M. McKnight, Chairman, reported that no negatives were received on the recent concurrent ballot on D 610, "Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces." Comments received from A.H. Landrock and H.E. Ashton resulted in editorial changes. A corrected copy will be submitted to Society ballot.

A draft outline, dated May 1985, for a practice on the assessment of the condition of paint and the underlying surface of a steel structure was circulated to members prior to the meeting. The draft was based on the practices apparently followed in the ship industry when evaluating the condition of hulls. The draft was reviewed. It was decided that the requirements were too detailed for practical use on structures such as bridges. The suggested changes will be incorporated into Draft #2, which will be circulated to D01.46 members for review prior to the next meeting.

D01.46.11, Zinc-Rich Coatings, R.H. Wakefield, Chairman, discussed a first draft (dated 6/18/85) of a MEK solvent rub test for assessing the cure of ethyl silicate zinc-rich coatings prepared by L. Smith. Points addressed were: (1) emphasize that the method is intended to assess when a zinc-rich coating is ready for topcoating; (2) de-emphasize any inference that the method is designed to evaluate degree of cure; and (3) clarify the procedure for improved reproducibility.

K. Trimber agreed to supply Wakefield with a copy of the National Coil Coaters Association method for conducting a solvent rub test. Some of this information may be of value. Draft #2 will be prepared for

distribution to Sub. D01.46 members prior to the next meeting.

D 2092, "Recommended Practices for Preparation of Zinc-Coated Steel Surface for Painting," will be reviewed and, depending upon the nature of the changes needed, may be submitted for Sub. D01.46 ballot.

DIVISION 50 PAINTS FOR FACTORY APPLICATION

SUBCOMMITTEE D01.52 FACTORY-COATED WOOD BUILDING PRODUCTS

S.B. Schroeder, Chairman

Negative votes by C.M. Winchester and H.E. Ashton on D 2793, "Standard Test Method for Blocking Resistance of Organic Coatings on Wood Substrates," were discussed at the January meeting and found to be persuasive. Ashton's suggestion that D 2793 be combined with D 3003, "Standard Test Method for Pressure Mottling and Blocking Resistance of Organic Coatings on Metal Substrates," was implemented in a proposed modified D 3003, which was submitted to Sub. D01.53 for their approval. However, D01.53 did not meet at this session, so this issue will remain unresolved until the next meeting.

D 2921, "Standard Method for Qualitative Tests for the Presence of Water Repellents and Preservatives in Wood Products," continues to generate no support for its continuance. The subcommittee agreed that this method should be submitted to Society ballot for withdrawal unless response to a questionnaire indicates a need for it.

Negative votes were received from P. Shaw and H.S. Fairman on D 3719, "Standard Test Method for Dirt Collection on Coated Exterior Panels," in addition to several sets of comments. Although the negatives were found persuasive, no action will be taken as yet pending response to a questionnaire on the need for this standard.

On D 2336, "Standard Practice for Specifying Properties from Liquid through Cured State for Coatings Factory Applied to Wood Products," the chairman volunteered to make minor editorial changes prior to the next meeting at which time the subcommittee will discuss its submission for reappraisal.

A review of D 2691, "Standard Methods for Microscopical Measurements of Dry Film Thickness of Coatings on Wood Products," indicated that it is outdated and needs substantial revision to conform to industry practice. The chairman will prepare a tentative revision for discussion at the next meeting.

After brief discussion, it was decided that the chairman will prepare a "Significance and Use" statement for D 2366, "Standard Test Method for Accelerated Testing of Moisture Blister Resistance of Exterior House Paints on Wood," for discussion at the next meeting.

D01.52B, *Hardboard*, S.B. Schroeder, Chairman, noted that the very poor attendance of this task group made serious discussion of new methods impossible. There has been considerable interest expressed by several hardboard companies recently, however, and it is anticipated there will be much more activity at the next meeting. At that time, a productive discussion is anticipated of alternative tests for moisture and surfactant resistance of primed hardboard, with a proposal for one or more round-robin tests.

D01.52.13, *Prefinished Siding*, K. Kruse, Chairman, also noted that poor attendance at this task group prevented meaningful discussion. Consideration of the DSET lab "EMMAQUA" test and other proposed new methods was postponed until the next meeting.

SUBCOMMITTEE D01.55 FACTORY-APPLIED COATINGS ON PREFORMED PRODUCTS

F. Zurlo, Chairman

In the absence of Chairman Zurlo, who had a recent job change, J.M. Behrle chaired all the meetings.

D01.55.01, *Coatings for Wood Products*, reported that five methods have been reviewed for reapproval in 1986, but, since no one was present with the results, consideration must be postponed until the next meeting.

The small attendance of only two members and two visitors emphasized the need for additional participation by those who use or manufacture coatings for wood products.

D01.55.07, *Industrial Water-Reducible Coatings*, F. Zurlo, Chairman, reported one negative was received on the recently balloted "Guide for Testing Industrial Water-Reducible Coatings." It covered a number of items previously brought up by a negative vote in 1984 and approved then for adoption. They will now be incorporated and the guide will be submitted for the next ballot.

SUBCOMMITTEE D01.56 PRINTING INKS

J.M. Fetsko, Chairman

D01.56.01, *Fineness of Grind*, J. Cichon, Chairman, conducted a review of the revised text of D 1316, "Test for Fineness of Grind of Printing Inks by the Production Grindometer." A paragraph is to be incorporated to the effect that, despite poor between-lab reproducibility, speckle endpoints provide an excellent measure of overall dispersion quality.

D01.56.02, *Lightfastness of Prints*, J. Daugherty, Chairman, distributed comparative results showing ratings of 16 test prints by sun exposure at various locations and seasons and by accelerated fading devices. The subcommittee was encouraged by the reasonably good correlation obtained between sun exposure and the carbon arc fadeometer. The subcommittee will have to ballot formally on the disposition of the existing D 3424, "Lightfastness of Printed Matter."

D01.56.04, *Viscosity of Paste Inks*, J.M. Fetsko, Chairman, discussed proposed changes in conjunction with the scheduled five-year review of D 4040, "Viscosity of Printing Inks by the Falling Rod Viscometer." Methods for obtaining various parameters of non-Newtonianism will be incorporated; an expanded precision statement can be based on existing round-robin data.

D01.56.06, *Ink Tack*, C. Shepard, Chairman, reported that a set of proposed revisions was received for D 4361, "Apparent Tack of Printing Inks by the Inkometer." It was agreed that zeroing of the instrument can be done only during calibration and that action be taken to have an appropriately revised paragraph appear in the 1986 Book of Standards. The task force will review other proposed revisions prior to the next meeting.

D01.56.09, *Tinting Strength*, W. Riedel, Chairman, heard a report by J. Fetsko on behalf of the chairman that 12 laboratories participated in round-robin designed to compare ZnO and TiO₂ white bases for testing yellow dispersions. Although participants reported difficulties in seeing strength differences, especially with the TiO₂ white base, results were comparable to those obtained previously with a light blue base. The proposed new method will allow a blue base with the warning that its use with greenish-yellows might give erroneous results.

D01.56.10, *Water Uptake of Litho Inks*, G. Bien, Chairman, reported that 11 laboratories returned results of a round-robin designed to show the influence of quantity of water added initially to the Duke Tester.

It was recommended that the single point screening test be conducted with 50 mL water for normal inks and 100 mL for inks expected to take up more than 100% water. At the suggestion of J. Cichon, the industry will be surveyed to determine interest in developing a water uptake test using the Pope & Gray Litho Break Tester.

D01.56.11, Nonvolatile Content of Printing Inks, B. Blom, Chairman, reported that the D-1 statistics chairman disallowed the within lab repeatability statement because the round-robin data were taken at one time. Because of EPA's interest in the method, D-1 Executive Subcommittee agreed that the proposed new test can be submitted for a concurrent D-1/D01.56 ballot with only a between lab reproducibility statement. A new round-robin will be conducted to test repeatability according to guidelines set forth in D 3980, "Practice for Interlaboratory Testing of Paint and Related Materials."

D01.56.12, Viscosity of Liquid Inks, J. Cichon, Chairman, will examine the Zahn cup method with a view toward improving reproducibility. Suggestions included calibration, temperature correction, and filling rather than dipping the cup.

D01.56.13, Ink Mileage, B. Blom, Chairman, reported that a round-robin on ink mileage using pairs of unemulsified and emulsified inks exhibited poor reproducibility. Problems that have to be addressed include nonuniformity within a single laboratory print and discrepancies between visual and densitometer-based matches.

D01.56.16, Abrasion of Gravure Inks, J. Hart, Chairman, reported that a proposed new method to test abrasiveness of publication gravure inks is not sufficiently reproducible to consider round-robin testing at this time. G. Vandermeersche described a new instrument, the Comprehensive Abrasion Tester, which is claimed to test print ruboff more quickly and more reliably than existing methods. It was agreed that a new task force on rub resistance would be appropriate if the instrument is accepted by a sufficient number of ink manufacturers and printers.

SUBCOMMITTEE D01.57 ARTISTS' PAINTS

J.T. Luke, Chairman

D01.57 Planning Meeting—The purposes of this meeting were: (1) to give an update on California Bill 3438 (Toxic Substances: labeling of art and craft ma-

terial) since it includes D 4236, "Practice for Labeling Art Materials For Chronic Health Hazards;" (2) to get an update on the relabeling positions of manufacturers; (3) to go over the status of seven other states chronic labeling laws; (4) to go over editorial changes in D 4236; (5) to discuss possible subcommittee involvement with artists and conservators on contemporary painting delamination problems; (6) revision of D 4302, "Specification for Artists' Oil and Acrylic Emulsion Paints;" and D 4303, "Test Methods for Relative Lightfastness of Pigments Used in Artists' Paints," for inclusion of alkyd paints; and (7) the task group on consumer evaluation.

The effective date of the California Bill 3438 is January 1, 1986. The chief enforcement officer, Michael Bogumill—Product Safety Coordinator, was a speaker at the following day's Public Session. He has previously visited "Zora's Artists Materials" store to become acquainted with the many varieties of materials available to artists. Most manufacturers expressed concern over enforcement of the law because of large inventories of filled and empty tubes already printed that would not have conformance statements as they go through the distribution cycle, making it impossible to meet the effective date of the law.

É. Flax, who was on the panel at the Public Session representing the manufacturers, canvassed the manufacturers to get individual updates of the approximate relabeling positions of each, so that he could present a general industry update. T. Kockx, representing some European manufacturers, talked on the disadvantages of this group, because of a longer turn-around period and interpretation involving the Arts and Crafts Materials Institute (ACMI). So far, Woodhall Stopford, M.D., the toxicologist representing ACMI, has reviewed 3538 product formulations submitted by 36 ACMI members as follows: Products requiring chronic labeling = 879; Products requiring acute labeling = 427; Products requiring no precautionary labeling = 2224; and Products recommended changes = 184.

G. Moss, representing Artists Equity Association, gave an update on the Oregon law on chronic toxicity labeling. This law, like the California law, states that if a material complies with D 4236, the material will comply with the provisions of the Oregon law, unless the department determines that the label does not satisfy the purpose of the law. Six other states that have passed, or are in the process of drafting legislation, contain a statement of compliance if the material conforms to D 4236.

Chairman Luke reported that every effort has been made by Artists Equity As-

sociation and other members of the Art Supplies Labeling Coalition to get the Consumer Product Safety Commission to adopt federal rules that would pre-empt state laws. CPSC has not done this for three reasons: (1) they were not convinced that artists' materials posed enough hazards; (2) they were precluded by the 1981 amendments; and (3) there is a thrust towards decentralization. CPSC Commissioner Scanlon wants to use D 4236 as an example of an effective voluntary standard. There is a possibility that D 4236 could be brought under CPSC through the Federal Hazardous Substance Labeling Act, or that legislation could be introduced in Congress to mandate federal, rather than state, control over hazard labeling.

Recently, Chairman Luke was a speaker at a meeting of conservators held at Wintertur. The conservation of contemporary paintings was discussed. There is some concern on the delamination of some 10-15 year-old oil color paintings from both oil and some acrylic grounds. Jack Beal, an artist who has experienced some of these problems and other concerned artists, have approached Chairman Luke to determine if Sub. D01.57 would get involved with this problem. After much discussion, the subcommittee voted to meet with the group of artists (time, place, and date to be worked out) to attempt to develop a questionnaire on the techniques used by the artists in their painting styles. A questionnaire for conservators was also discussed. If enough useful data is collected, possibly a "Standard Practice on Proper Canvas Preparation" could be written.

Chairman Luke reported on some of the problems the task group on Consumer Evaluation experienced using the Blue Wool Standards. When they rate the results of the participants, the Blue Wools all looked different at level 6. The task group is seeking help in this matter.

The subcommittee has been approached as to lightfastness testing of painting inks used by artists. In the past, Sub. D01.56 on Printing Inks has not wanted to work on printing inks used by the artists since the printing ink industry, as a whole, is not interested in the same degree of lightfastness.

D01.57.02, Lightfastness of Pigments, H.W. Levison, reviewed recommended changes to D 4303. It also discussed on how long, following exposure under glass to the sun, specimens can be stored in the dark without distorting subsequent measurements to determine color change due to the exposure. Specimens must be exposed in southern Florida and, then in some cases, shipped overseas before being measured. It was suggested that conditioning in moderate light following shipment, but

prior to measurement, might be necessary in these cases. P. Staples volunteered to send 10 specimens to South Florida Test Service, Inc. to be exposed, measured, stored and monitored for continuing color change. The Yellowing Index will be used to keep track of color change in specimens during storage.

D01.57.04, Specification for Artists' Paints, A. Spizzo, Chairman, reviewed recommended changes to D 4302. P. Staples presented results of lightfastness testing on 37 alkyd paints for review by the subcommittee. Test results indicated that lightfastness ratings of pigments in alkyd and linseed oil paints are very similar. These ratings could just be added to the existing oil color lightfastness ratings or can become a separate column in the present Table 1 of D 4302.

J.T. Luke reported that H.W. Levison had recommended that zinc oxide be included in the formula for the alkyd mixing white to be used in testing pigments for lightfastness in an alkyd vehicle. Zinc was not included in the white used in the Winsor and Newton tests, because this suggestion was not made soon enough. However, since the test results submitted coincide very closely with test results for the same pigments in an oil paint that did contain zinc, it was voted to accept these test results for inclusion in Table I of D 4236, but to require zinc in the formula for future tests which might include pigments where the presence of zinc would affect test results.

D01.57.08, Labeling for Toxicity, J.T. Luke, Chairman, discussed the interpretation of Section 1.5 of D 4236-83a. The discussion centered around whether conformance to the OSHA-Hazard Communication Standard (29 CFR 1910.1200) would qualify for performance to D 4236 and also California Bill 3438. The subcommittee was undecided as to whether or not a change in 1.5 is needed. R.J. Connor, A. Hoffman, and P. Willard agreed to correspond by mail on this issue before the next meeting.

Comments and subcommittee recommendations received on D 4236 were reviewed.

D01.57.09, Watercolors, E.T. Vonderbrink, Chairman, reviewed a report submitted by R. Johnston-Feller and C. Bailie

entitled, "Sample Preparation for the Determination of the Tinting Strength of Water Colors." In the method, a weighed amount of watercolor is added to a weighed amount of water and thoroughly mixed. A piece of filter paper is taped to a smooth surface. About 1 mL of the diluted watercolor is discharged onto the filter paper and drawn down. The filter paper is untaped and hung to dry with subsequent baking overnight at 50° C. The dried drawdown is then read on an appropriate instrument. Dilutions and drawdowns are made until a drawdown with a reflectance of 40% at the absorption maximum is achieved. Repeatability of the drawdown was about $\pm 10\%$ standard deviation in terms of unit K/S at the maximum absorption. Reproducibility of the drawdowns of the same samples at a given concentration was ± 4 standard deviation.

T. Vonderbrink reported the above drawdown method was much faster and more reliable than air brushing. The subcommittee was asked if anyone objected to lightfastness data from panels made from filter paper rather than on a good grade of watercolor paper. It was the consensus that the filter paper was an acceptable substitute for watercolor testing. The above sample preparation method using filter paper will be used for lightfastness testing.

To get an idea of the durability of the filter paper during outdoor under glass lightfastness testing, eight colors have been prepared and will be sent to southern Florida for testing before proceeding to test most pigments used in watercolor paints.

T. Vonderbrink asked manufacturers to assemble and send to him a list of all prospective pigments which should be tested once the final tests are formalized.

D01.57.10, Consumer Evaluation, H. Brown, Chairman, held a discussion on the difficulties encountered in deciding on lightfastness category names to be given to art materials and Blue Wool standards tested under glass to sunlight and evaluated visually for fading. These categories must be broad because of the variation to be expected in the visual evaluation.

A list of the possible category names was distributed in an attempt to get a consensus. A consensus could not be obtained. After further discussion, Chairman Brown decided to make a separate mailing of possible category names to see if better agreement can be obtained.

DIVISION 60 PAINT APPLICATION

SUBCOMMITTEE D01.61 PAINT APPLICATION TOOLS

F.B. Burns, Chairman

The following Sub. D01.61 scope was proposed: "To develop test methods, nomenclature, definitions, and recommended practices (including use) for paint application tools used for on-site application of coatings by contact transfer to a surface." After considerable discussion, the scope was recommended for a Sub. D01.61 ballot.

With the increase in testing activity and discussions of test methods for paint application tools, it was determined desirable to begin a glossary of nomenclature and definitions for the subcommittee. W. Kappeler, of Baltimore Brush, accepted appointment as chairman of Sub. D01.61.04, Nomenclature and Definitions, for this purpose.

D01.61.01, Paint Brushes, T.J. Sliva, Chairman, reported that six of eight cooperators had returned results of the first round-robin on testing brushes for discharge rates and leveling. Discussion of the results, which had poor correlation, revealed that improvements in the procedures were necessary. Comments were recorded for use in revising the procedures. The new procedures will be presented at the next meeting for a second round-robin.

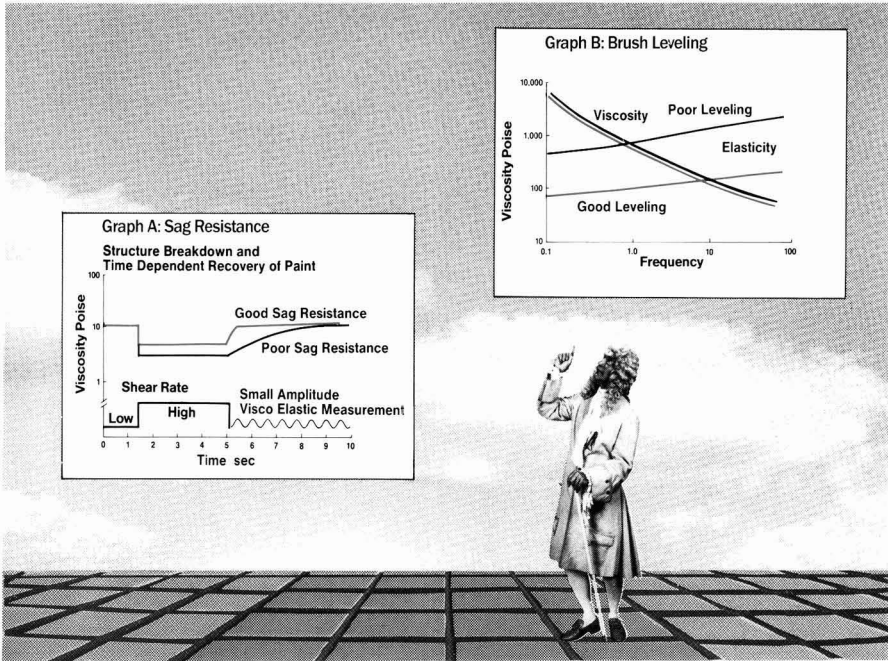
D01.61.02, Paint Rollers, J.F. Price, Chairman, introduced conceptual revisions of the methods which had been used in the first round-robin on roller discharge capacities and rates. He also introduced a new concept on roller leveling efficiency which might be incorporated. Considerable discussion was held on this information, and the chairman was encouraged to continue adapting these concepts to a practical procedure for the round-robin series.

D01.61.03, Pressure-Fed Rollers, E. Martin, Chairman, reported that the first meeting objectives were to determine interest and establish parameters for the group. Task group participation was not encouraging from an interest point of view. The chairman agreed to contact producers and users to determine if further interest will increase.

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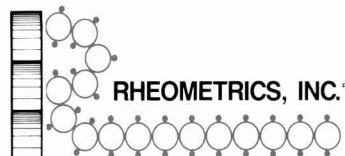
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Future Society Meetings

Chicago

(Jan. 6)—“SOLVENT SELECTION; COPING WITH TOXICITY DEVELOPMENTS”—Richard C. Wise, Union Carbide Corp.

(Feb. 3)—“RESOURCE CONSERVATION AND RECOVERY ACT”—Ken Bechely, Environmental Protection Agency. “LABELLING FOR HEALTH AND SAFETY”—C. Robinson, DeSoto, Inc.

(Mar. 3)—“APPEARANCE ANALYSIS”—Richard Harold, Hunter Associates Laboratories. “DISTILLATION TECHNOLOGY: PAST, PRESENT, AND FUTURE”—Earl Pifer, Finish Engineering Co.

(Apr. 7)—“TOOLS AND RULES OF ADHESION SCIENCE”—Doug Rahrig, S.C. Johnson and Son, Inc.

(May 9)—AWARDS NIGHT BANQUET.

Cleveland

(Jan. 21)—JOINT MANUFACTURING SYMPOSIUM WITH CPCA.

(Feb. 18)—Tour of Case Western Reserve University's Major Analytical Instruments and the Facilities of Edison Polymer Innovation Center.

(Mar. 18)—“COMPUTER CONTROL FOR THE MODERN PAINT PLANT”—Speaker from Applied Color Systems, Inc.

(Apr. 15)—AWARDS NIGHT, ANNUAL MEETING. “ORGANIC COATINGS USED IN THE MICROELECTRONICS INDUSTRY”—C.C. Liu, Case Western Reserve University.

(May 20)—“AFTERMARKET AUTOMOTIVE COATINGS: HISTORY AND TECHNOLOGY”—Charles Berg, Sherwin-Williams Co.

Detroit

(Dec. 17)—“PEARLESCENT PIGMENTS”—Harold Miller, Mearl Corp.

(Apr. 8)—“ANNUAL FOCUS SEMINAR: TROUBLESHOOTING II.”

(May 14)—JOINT MEETING WITH DPCA.

Kansas City

(Jan. 9)—“A NEW APPROACH TO THE EVALUATION OF VARIOUS EXTENDER PIGMENT BLENDS”—Dan Dixon, Engelhard Corp.

(Feb. 13)—“BIOCIDES AND NEW GOVERNMENT REGULATIONS”—Bill Machemer, Troy Chemical Co.

(Apr. 10)—“DISTILLATION TECHNOLOGIES: PAST, PRESENT, AND FUTURE”—Earl E. Pifer, Finish Engineering Co.

(May 8)—“POLYURETHANE COATINGS—ENJOYING THEIR ADVANTAGES WHILE UNDERSTANDING AND CONTROLLING HEALTH RISKS”—Paul Ziegler, Mobay Chemical Corp.

(June)—JOINT MEETING WITH ST. LOUIS SOCIETY.

Louisville

(Jan. 15)—PAST PRESIDENTS' NIGHT.

(Feb. 19)—“DISPOSAL OF HAZARDOUS COMBUSTIBLE WASTE”—Melvin C. Eifert, Systech Corp.

(Mar. 19)—“SOLVENTS POINT THE WAY TO HIGH QUALITY COMPLYING ACRYLIC COATINGS”—Robert E. Moran, Exxon Corp.

New England

(Jan. 16)—JOINT MEETING WITH NEPCA.

(Feb. 20)—“RADIATION CURING OVERVIEW”—Alice Pincus, Pincus Associates.

(Mar. 20)—FEDERATION NIGHT.

(Apr. 8 or 22)—ANNUAL WESTERN MASS. MEETING.

(May 15-16)—SYMPOSIUM—“LAUNCHING THE NEW REVOLUTION—COMPLIANCE FOR THE 21ST CENTURY.”

Pacific Northwest

(Jan. 15)—“SOLVENTS POINT THE WAY TO HIGH QUALITY COMPLYING ACRYLIC COATINGS”—Robert E. Moran, Exxon Corp.

(Mar. 19)—“PROTECTIVE POLYURETHANE COATINGS”—Terry Potter, Mobay Chemical Corp.

(Apr. 16)—“CLOSING THE GAP WITH HIGH SOLIDS”—Robert M. Price, Spencer Kellogg/NL Industries, Inc.

(May 21)—“TITANIUM DIOXIDE—WHY SO MANY GRADES?”—Richard I. Ensminger, NL Industries, Inc.

Pittsburgh

(Dec. 2)—“DEVELOPMENT OF PROPER COATINGS DISPERSIONS”—Ken Madonia, PPG Industries, Inc.

Western New York

(Dec. 17)—“HIGH SOLIDS URETHANE COATINGS”—Bernard Taub, Spencer Kellogg/NL Industries, Inc.

(Feb. 18)—“EXTERIOR LATEX PAINT STUDY—FIVE-YEAR EVALUATION OF VARIOUS EXTENDER PIGMENT BLENDS”—Dan Dixon, Engelhard Corp.

(Mar.)—JOINT MEETING HOSTED BY BPCA.

(Apr. 15)—MANUFACTURING NIGHT. “ADVANTAGES AND DISADVANTAGES OF DISPERSION EQUIPMENT”—Earl Baumhart, Coatings Engineering & Systems.

(May 20)—FEDERATION NIGHT. “RECENT ADVANCES IN RADIATION COATINGS TECHNOLOGY”—Richard Kemmerer, Celanese Chemical Co.

FSCT Membership Anniversaries

50-YEAR MEMBERS

Birmingham

Robert E. Howse, Thomas Howse Ltd.
Kenneth G. Cooke, Retired.

Chicago

Eugene Holda, of Sullivan Chemical Coatings
John G. Ulreich, Retired

25-YEAR MEMBERS

Chicago

Kenneth W. Coleman, of Elpaco Chemicals
Herbert J. Meyer, of McWhorter, Inc.
Eugene M. Murphy, of Whittaker Corp.
Harold E. Peter, of Elpaco Chemicals
Robert Zimmerman, of The Enterprise Cos.

Golden Gate

Barry Adler, of Royelle, Inc.

Los Angeles

William H. Ellis, Retired
George Firth, Applied Plastics Co.
Walter D. Janssens, Retired
Mel Lipscomb, of Lipscomb Chemical Co.
Frank Peters, Dunn-Edwards Corp.
Hiro Takesako, Pervo Paint Co.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's Eudwood, Towson, MD). ED COUNTRYMAN, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA.

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

CHICAGO (First Monday—meeting sites vary). RAYMOND CZICZO, Reliance Universal, Inc., 1915 Industrial Ave., Zion, IL 60099.

CDIC (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; and Nov., Feb. in Dayton). SAMUEL KRATZER, D&L Paint Co., 215 Brownsville Ave., Liberty, IN 47343.

CLEVELAND (Third Tuesday—meeting sites vary). RICHARD ELEY, Glidden Coatings & Resins, Div. of SCM Corp., D.P. Joyce Research Center, P.O. Box 8827, Strongsville, OH 44136.

DALLAS (Thursday following second Wednesday—Executive Inn, near Lovefield Airport). FREDERICK T. BEARD, Glidden Coating & Resins, Div. of SCM Corp., 1900 North Josey Ln., Carrollton, TX 75006.

DETROIT (Fourth Tuesday—meeting sites vary). PETER KNIGHT, Dow Chemical Corp., 2020 Dow Center, Midland, MI 48640.

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabela's Restaurant on Fisherman's Wharf and Francesco's in Oakland, CA). KARL SAUER, Pfizer, Inc., MPM Div., 776 Rosemont Rd., Oakland, CA 94610.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX). JAMES A. HARRELL, Buckman Laboratories, 5127 Wightman Ct., Houston, TX 77069.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). STEVEN JOHNSON, Cook Paint & Varnish Co., P.O. Box 389, Kansas City, MO 64141.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). MELINDA RUTLEDGE, Allo Chemical Co., P.O. Box 443, Ontario, CA 91761.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). LARRY F. PITCHFORD, Reynolds Metals Co., P.O. Box 3530, Plant III, Louisville, KY 40232.

MEXICO (Fourth Thursday—meeting sites vary).

MONTREAL (First Wednesday—Bill Wong's Restaurant). W. WILDE, Hoechst Canada, Inc., 4045 Cote Vertu, Montreal, Que., Canada H4R 1R6.

NEW ENGLAND (Third Thursday—LeChateau Restaurant, Waltham, MA). GAIL POLLANO, Polyvinyl Chemical Industries, Inc., 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). JOHN W. BURLAGE, Pacific Anchor Chemical, 14 Ridgedale Ave., Cedar Knolls, NJ 07927.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). JOAN B. LAMBERG, Horton-Earl Co., 750 S. Plaza Dr., St. Paul, MN 55120.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). YVON POITRAS, General Paint Co., 950 Raymur Ave., Vancouver, B.C., V6A 3L5, Canada.

PHILADELPHIA (Second Thursday—Dugan's Restaurant, Philadelphia, PA). THOMAS L. PETA, J.C. Osborne Chemicals, Inc., P.O. Box 1310, Merchantville, NJ 08109.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood Exit of I-85, High Point, NC). CHARLES HOWARD, DeSoto, Inc., P.O. Box 22105, Greensboro, NC 27420.

PITTSBURGH (First Monday—Montemurro's, Sharpsburg, PA). MARK TROUTMAN, Bradley Paint Co., 608 W. Crawford St., Connellsville, PA 15425.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). MARCY S. BAUGH, Hutson Industries, 60 Tejon St., Denver, CO 80223.

ST. LOUIS (Third Tuesday—Engineers Club). JAMES N. McDERBY, F.R. Hall & Co., 6300 Bartmer Ind. Dr., St. Louis, MO 63130.

SOUTHERN (Gulf Coast Section—Third Thursday; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—bi-monthly on Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). C. LEWIS DAVIS, Ambrosia International, 802 Black Duck Dr., Port Orange, FL 32019.

TORONTO (Second Monday—Cambridge Motor Hotel). HANS WITTMAN, BASF Canada Ltd., 10 Constellation Ct., Rexdale, Ont., Canada M9W 1K1.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). JEAN L. LUCK, Pratt & Lambert Inc., Powder Coatings Div., P.O. Box 22, Buffalo, NY 14240.

BIRMINGHAM

Active

CARTER, KEITH S.—Wolstenholme Bronze Powders Ltd., Bolton, England.
CROWLEY, DENNIS—Intercoat Paints Ltd., West Midlands, Eng.
GRAHAM, DAVID—Harlow Chemical Co., Essex, Eng.
HALL, BERNARD—Intercoat Paints Ltd., Walsall, Eng.
HOPE, PETER I.—LVH Coatings Ltd., Birmingham, Eng.
KITCHINGMAN, R.J.—Holden Surface Coatings Ltd., Birmingham.
PASMORE, DAVID F.—H. Haeffner & Co. Ltd., Warwicks, Eng.
VANES, R.I.—LVH Coatings Ltd., Birmingham.
WILDASH, PETER J.—Tioxide UK Ltd., Manchester, Eng.

LOUISVILLE

Active

BABCOCK, DONALD E.—Celanese Specialty Resins, Jeffersontown, KY.
BEALL, GARY N.—United Catalysts, Inc., Louisville, KY.

Associate

BOEHLER, PAUL M.—Diamond Shamrock Chemicals Co., Louisville, KY.
FARRELL, YOLANDA—BF Goodrich Chemical, Louisville.

NEW YORK

Active

FRANKLIN, FRANCIS E.—Byk Chemie USA, Palisades Park, NJ.
GARBOWSKI, MICHAEL L.—NL Chemicals, NL Industries, Inc., Hightstown, NJ.
MAX, RICHARD E.—Standard Coating Corp., Ridgefield, NJ.
OCHS, JAMES—William Zinsser & Co., Somerset, NJ.
SANHUEZA, MANUEL C.—Randolph Products Co., Carlstadt, NJ.

Associate

BREEN, DAN L.—Engelhard Corp., Severna Park, NJ.
MURPHY, MICHAEL—Metal Finishing, Hackensack, NJ.
OSMER, DENNIS—Ciba-Geigy Corp., Hawthorne, NY.
SMITH, MICHAEL F.—Smith Chemical & Color Co., Inc., Jamaica, NY.

Retired

PAGE, PAUL L.—Hockessin, DE.
VELARDI, NAT—Glen Rock, NJ.

Frederic M. Guist has been elected President of Engelhard Specialty Chemicals Division and Vice-President of Engelhard Corp., Iselin, NJ. Previously, Mr. Guist served as Senior Vice-President of the catalysts group for Engelhard's Specialty Chemicals Division.

Gary A. Welp has been named Vice-President/General Manager for the Pacific Northwest region of The McCloskey Corporation. He will have overall responsibility for the company's operations in Portland, OR. Mr. Welp is a member of the Pacific Northwest Society.

In order to insure rapid response to customers requiring technical information about its products, Angus Chemical Co., Northbrook, IL, has created the position of Technical Services Administrator. Chosen for the post is **Jim Edwards**. A member of the Chicago Society, Mr. Edwards brings 15 years of nitroparaffin experience to the position.

Angus has assigned new territories to two of its Sales Representatives. **Cindy Byrne** is now responsible for the Midwestern region including Iowa, Nebraska, Colorado, and North and South Dakota. **Irene Dorosky** becomes responsible for the northeastern U.S. and eastern Canada.

James M. Fitzpatrick has accepted the position of Vice-President of Sales for the Wilbur & Williams Industrial Coatings Div. of California Products Corp., Cambridge, MA. He will be responsible for all marketing and promotional activities of the division's industrial maintenance product line.

Succeeding **Francis B. O'Neil** as Vice-President of corporate communications and government affairs for PPG Industries, Inc., Pittsburgh, PA, is **Richard M. Rompala**. Mr. Rompala will direct the firm's long-range planning, corporate marketing, and business growth development.

Also announced by PPG is the appointment of **David G. Kanuck** to the position of Market Manager of furniture and storage systems products for the company's Coatings and Resins Group.

Newly appointed to the position of National Sales Manager for Kenrich Petrochemicals, Inc., is **Jeffrey J. Buda**. Mr. Buda most recently served as District Sales Manager for the company.



F.M. Guist



G.A. Welp



D.L. Peterson



M.J. Wiedmann

Eiger Machinery, Inc., Bensenville, IL, has appointed **Dave L. Peterson** to the position of National Sales Manager. A member of the Chicago Society, Mr. Peterson brings nine years of sales experience to his new post.

Thomas H. Applewhite has been appointed Editor of the *Journal of the American Oil Chemists' Society*, succeeding **A.R. Baldwin** who served as Editor for the past 37 years.

The Chemicals Group of BFGoodrich Co., Cleveland, OH, has named **John E. Fitzwater** Marketing Manager for the Carboset® business unit of the Chemicals Division. A member of the New England Society, Mr. Fitzwater is located at company headquarters.

James H. Robbins also has joined BFGoodrich Specialty Polymers and Chemical Div. as a Marketing Representative for Carboset® resins. Previously, Mr. Robbins served in the firm's technical center.

Gary Cappeline has been named Vice-President and General Manager of the domestic operations of Ashland Chemical Co.'s Drew Industrial Division. In this position, Mr. Cappeline is responsible for directing the growth and profitability of the division's operations in the U.S.

F.R. Hall, Inc., Hot Springs, AR, has named **James N. McDerby, Jr.** to Company Sales Manager. Mr. McDerby brings 17 years of technical, sales, and management experience in coatings and plastics to his new position. He serves as Secretary and Educational Committee Chairman of the St. Louis Society and is also a member of the American Chemical Society.

Mark J. Wiedmann has been promoted to National Technical Marketing Manager for Croda Inks Corp., Niles, IL. Mr. Wiedmann will serve from the firm's Atlanta, GA, plant.

Pratt & Lambert, Inc., Buffalo, NY, has promoted **Walter Greizerstein** to Director of its International Division. In his new position, Dr. Greizerstein will be responsible for centralizing, at the corporate level, all international activities presently dispersed among the firm's five operating divisions. A member of the Western New York Society, Dr. Greizerstein has been affiliated with Pratt & Lambert since 1968.

Robert A. Hicks, retired from Benjamin Moore & Co., Ltd.; **Cyril Shore**, retired from Tioxide Canada Ltd.; and **Kenneth G.W. Smith**, of DuPont Canada, Inc., were the 1985 recipients of the Industry Statesman Award of the Canadian Paint and Coatings Association. Messrs. Hicks and Smith are Past Chairmen of the Board of CPCA. Mr. Shore chaired the 1980 CPCA convention.

Ferro Corp., Cleveland, OH, has promoted three employees within its Color Division. **Kenneth G. Crissman** has been named Plant Manager of the company's facility in Pittsburgh; **Thomas J. Sonnevile** has been promoted to Plant Manager of the Cleveland plant; and **Vincent J. Costanzo, Jr.** has accepted the position of Production/Quality Control Laboratory Manager at the Cleveland plant.

In addition, **Michael Wilczynski** has joined Ferro's Coatings Division as a Sales/Service Engineer for metal coatings. Mr. Wilczynski becomes responsible for sales and technical service of metal coatings in the southern district of the firm.

Color Corporation of America, a division of The Valspar Corp., has appointed **Michael A. Wood** to the position of Sales Service Coordinator. He will be responsible for processing of colorant orders, order follow-up, and telemarketing.

Kevin F. Christopher has been promoted to the position of Technical Director for United Paint Co., Inc., Memphis, TN. In addition to the supervision of the development and control laboratories, he will have responsibility for technical service, labeling requirements, and environmental affairs. Mr. Christopher is a member of the Southern Society.

Mobay Chemical Corp., Pittsburgh, PA, has appointed **Michael J. Dvorchak** as Senior Development Representative in its Coatings Division. In this new position, Mr. Dvorchak will be responsible for marketing the firm's line of raw materials for elastomeric roof coatings.

VIP Enterprises, Inc., Miami, FL, has promoted **Linda L. Garcia** to Vice-President of Marketing and Sales. Ms. Garcia will direct all marketing and sales support programs for the firm.

Obituary

John J. Hughes, Jr., owner of Dozier & Gay Paint Co., Jacksonville, FL, died in April. He was 69 years old. A past member of the Federation's Board of Directors, Mr. Hughes also served as a President of the Southern Society and a Chairman of the FSCT Ernest T. Trigg Award Committee.

Irwin Podell, Founder and President of Podell Industries, New York, NY, died in August. He was 61. Mr. Podell was active in the New York coatings industry and the National Paint and Coatings Association.

Copies of articles from this publication are now available from the UMI Article Clearinghouse.

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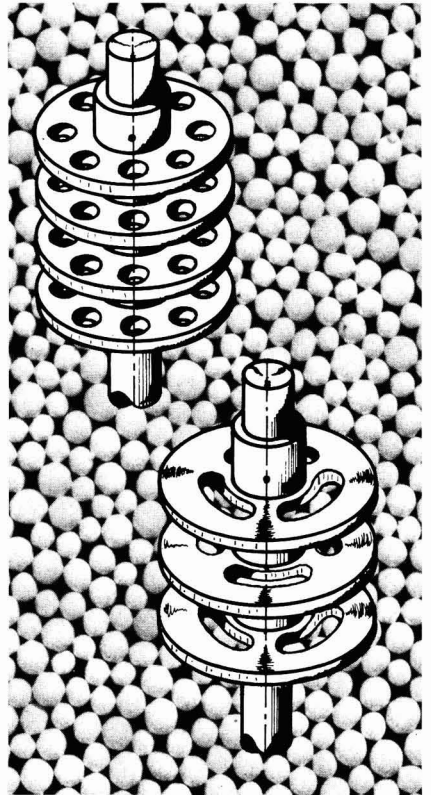
Additional benefits resulting from smooth fusion-produced zirconia-silica beads include a reduced wear rate on equipment, a lower fracture rate for these stronger beads and a highly improved cleaning ability. Furthermore, the number of passes (re-cycles) or residence time needed to achieve a given product size will be reduced.

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 (201) 757-0044 Telex: 138-678





OIL & COLOUR CHEMISTS' ASSOCIATION

SURFEX 86

Exhibition of the latest developments in raw materials and equipment used in the manufacture of paints, printing inks, colour, adhesives and allied products to be held at

Harrogate Exhibition Centre,
Yorkshire, England.

Wednesday 14 May 1986

09.30–17.30 hrs

Thursday 15 May 1986

09.30–17.30 hrs

Admission Free

The "Official Guide" will be printed in the April 1986 issue of the Association's Journal (JOCCA) and will be freely available at the entrance to the Exhibition.

Oil & Colour Chemists' Association,
Priory House, 967 Harrow Road,
Wembley, Middlesex, HAO 2SF, England.
Tel: 01-908-1086 Telex: 922670 OCCA G

FTIR Equipment Purchased for NDSU

Through the combined efforts of coatings industry organizations and the state of North Dakota, a \$50,000 Mattson Fourier Transform Infrared Spectrophotometer (FTIR) has been acquired for the Polymers and Coatings and Chemistry Departments of North Dakota State University.

Based on a proposal submitted by Dr. Mark Gordon, Chair of the Chemistry Department, and Dr. Frank Jones, Chair of the Polymers and Coatings Department, the acquisition enables NDSU to upgrade their current infrared instrumentation. Two \$7,500 grants from the Chicago Society for Coatings Technology and the Chicago Paint and Coatings Association, \$25,000 from NDSU, \$5,000 each from the Departments of Chemistry and Polymers and Science were combined towards the purchase.

Dr. Jones cited the following areas in which the new FTIR would allow NDSU to expand its research scope:

- (1) Use of difference spectra to observe the chemical reactions that occur during crosslinking of films and to establish their rates;
- (2) Kinetic studies of reactions of model compounds;
- (3) Polymer structure determination;
- (4) Attenuated total reflectance mode to study chemistry near the surface of coatings films; and
- (5) Use of the diffuse reflectance mode to record spectra of adherent films without having to remove them from the substrate.

While most substances absorb infrared light, the FTIR is designed to measure exactly the amount of infrared light of each wavelength absorbed by a substance. The resulting infrared spectrum can reveal a wealth of information about the structure and behavior of the chemicals making up the substance. According to Dr. Jones, the FTIR makes use of two new technologies—lasers and computers—to improve the capabilities of such instruments.

Adhesion Society Plans Tenth Annual Meeting

Williamsburg, VA, has been selected as the site for the Adhesion Society's Tenth Annual Meeting to be held February 22-27, 1987. The Society plans to make this meeting an international affair with four to five days of technical sessions comprised of presentations by a broad range of the world's leading adhesion scientists and technologists. Each session will be organized and chaired by a representative from a major geographical area.

General Chairman for the event is Lawrence T. Drzal. Inquiries regarding all aspects of the meeting should be directed to Professor Drzal at the Dept. of Chemical Engineering, Michigan State University, East Lansing, MI 48842-1226.

Detroit Society Offers Training Presentations

The Detroit Society invites member companies to borrow, free of charge, its selection of Federation slide-sound presentations retained by the Society Education Committee. The presentations can be kept for a period of two weeks and require the use of a 35 mm slide projector and cassette player.

Ideal for training new employees, the presentations consist of the following topics: Test Methods I, Test Methods II, Causes of Discoloration in Paint Films, High-Speed Dispersion, Introduction to Resin Operations, the Setaflash Tester, Batch Operated Mini-Media Mill, and Color-Matching Aptitude Test Set. Interested companies should contact James H. Jakubowski, Mobay Chemical Co., 3221 West Big Beaver Rd., Troy, MI 48084-2803.

CLASSIFIED ADVERTISING

R & D FINISHER/APPLICATION DEVELOPMENT

We are a large manufacturer of specification leathers for the automotive and furniture upholstery industries; and a division of a fortune 500 company.

The responsibilities of this job include formulating new specification leather finishes and developing improved application techniques in order to maintain Garden State Tanning as a leader in its field.

This position does not include styling, color matching or production responsibilities.

We prefer that the applicant have at least a bachelors degree and ten years' experience in coating formulation and application.

Salary commensurate with experience and ability.

All inquiries will be kept confidential.
Reply to:

Bruce D. Miller
Director of Manufacturing
Garden State Tanning
Fleetwood, Pennsylvania 19522

Detroit Society Jointly Sponsors Coating Courses

Five short courses in coatings technology, jointly sponsored by the Detroit Society, the Detroit Paint and Coatings Association, and the University of Detroit were conducted at the University of Detroit this autumn.

Those courses offered included:

"Coatings Laboratory"—taught by Gabriel Gabriel, Mercury Paint. This "hands-on" introductory course covered use and operation of equipment used in quality control and R & D laboratories.

"Principles of Color Technology"—Harold Kuntze, Inmont Corp. An introductory course for those having no previous education in the field, the course covered color matching and color control.

"Surface Coatings Technology"—Donald Mordis, Ford Motor Co. Designed for new employees entering the coatings industry, course topics included formulation, color concepts, pigments, and driers and additives.

"Fundamentals of Automotive Paint Systems-I"—Donald Mordis, Ford Motor Co. This course is the first of a two-part comprehensive survey of basic automotive paint raw materials and process systems.

"Polymer Technology for Coatings"—David Nordstrom, Ford Motor Co. Emphasizing automotive coatings, this course covered polymer concepts, commonly used polymers in coatings, and the relationship between the structure of polymers and the properties of coatings.

Evaporometer

A recently published brochure outlines the benefits and performance capabilities of a new evaporometer. This compact evaporation rate analyzer gives formulators and quality control personnel a fully-automated means of evaluating drying profiles and evaporation rates in volatiles and solvents. Copies of the brochure are offered by Quintel Corp., 2078 E. University Dr., Tempe, AR 85281-4098.

Polyethylene

A liquid polyethylene which reportedly eliminates surface imperfections while acting as a foam suppressant is the subject of a product bulletin. Designed for use in solvent-based systems, this silicone-free surfactant maintains gloss and clarity of a film. Further details are offered by Shamrock Chemicals Corp., Foot of Pacific St., Newark, NJ 07114.

Color Meter

The newest addition to a line of industrial meter products is detailed in a bulletin. Designed to measure reflected subject color, the new meter is suitable for use in controlling color density, ink characteristics, and colors reproduced through printing and coatings. Contact John T. McCasland, Minolta Corp., 101 Williams Dr., Ramsey, NJ 07446, for details on the Chroma Meter CR-121.

Glycol Ethers and Acetates

A new 10-page technical brochure provides information on the characteristics, performance, and safety considerations of a complete line of propylene glycol ethers and acetates. For copies of "The Case for Arcosolv® Solvents," write to Marketing Communications Dept., Arco Chemical Co., 1500 Market St., Philadelphia, PA 19101.

Testing Instruments Catalog

A new catalog outlines the entire product line of a company's testing instrumentation. The instruments cover a broad range of materials durability testing including: abrasion, friction, stress, tensile, impact, flammability, and flow rate. Inquiries for copies of the catalog should be addressed to Henry Bultman, Custom Scientific Instruments, Inc., A Subsidiary of Atlas Electric Devices Co., 13 Wing Dr., Cedar Knolls, NJ 07927.

Corrosion Prevention Guide

The National Association of Corrosion Engineers (NACE) has published a book on coatings by Charles G. Munger entitled, *Corrosion Prevention by Protective Coatings*. Complete coverage of high performance protective coatings used to prevent corrosion is provided in the 19-chapter, 531-page hard-bound volume. A useful reference tool, the text includes 570 figures and a nine page subject index. Copies can be ordered from NACE, P.O. Box 218340, Houston, TX 77218, at \$60 for NACE members and \$75 for nonmembers.

Monitoring System

Technical data of a new automatic in-process color measurement system is offered in a brochure. Benefits of the system include obtaining consistent color in a variety of products. Performance specifications are available from Hunter Associates Laboratory, Inc., 11495 Sunset Hills Rd., Reston, VA 22090.

Polymer Emulsions

Recently released brochures feature two new polymer emulsions. A new vinyl acetate-acrylic copolymer emulsion is detailed in a "Vinyl-Acrylic Emulsion" guide and a new wet adhesion terpolymer is described in "Emulsion for Quality Semi-Gloss Paints." Both chemicals reportedly improve the performance of interior and exterior house paints. Copies of the brochures are offered by Air Products and Chemicals, Inc., Polymer Chemicals Div., P.O. Box 538, Allentown, PA 18105.

Iron Oxide Powder

The benefits of a new iron oxide powder are outlined in a technical pamphlet. The powder, with an average particle size of 1.5 microns, can be used to make fine polishing compounds for the paint industry because of its mildly abrasive qualities. Further details on RPS-M25 are offered by Pea Ridge Iron Ore Co., 7733 Forsyth Blvd., Clayton, MO 63105.

Thickness Gauge

Performance features of a high precision wet film thickness gauge are outlined in a brochure. Reported to minimize errors, the instrument is produced in a range of sizes. Details are available from Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061.

Gum Arabic

The product characteristics of a new pound-for-pound substitute for gum arabic are detailed in a bulletin. The blend of starch and water-soluble gums reportedly can be used in levels as high as 18% as a direct 1 to 1 replacement for spray dried gum arabic in coating and adhesive applications. Write to TIC Gums, Inc., 144 E. 44th St., New York, NY 10017, for complete details.

Rheology Newsletter

The latest rheological test methods, equipment, and services are posted in a free quarterly newsletter. To receive "Rheology Profiles" newsletter, contact Haake Buchler Instruments, Inc., 244 Saddle River Rd., P.O. Box 549, Saddle Brook, NJ 07662.

Hardness Tester

Test specimens up to 12 inches square and one half inch thick can be accommodated in a new instrument for testing hardness properties. The tester is applicable in evaluating products such as: coated sheet metal, coated wood, paper, plastic, woven products, floor coverings, and leather. For full details, write to Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061.

Protective Coatings

Literature has been published detailing a line of high performance protective coating products for use in new or existing buildings on both structural and process surfaces. The products are suitable for applications in any heavy duty industrial environment where tough chemical and abrasion resistant finishes with minimal maintenance are required. Further details can be obtained from Robert D. Edwards, International Paint, 2270 Morris Ave., P.O. Box 386, Union, NJ 07083.

Labelling Guide

A guide providing detailed instructions for labelling consumer paint and related products as required by the Federal Hazardous Products Act has been issued by the Canadian Paint and Coatings Association. Inquiries on the "Paint and Coatings Industry Consumer Products Labelling Guide" should be forwarded to CPCA, Suite 825, 515 St. Catherine St. W., Montreal, Quebec H3B 1B4, Canada.

Diluent

A reactive diluent especially formulated for epoxy resins is detailed in technical literature. The eight-page booklet gives formulations for adhesives, coatings, and potting and encapsulating compounds. To receive copies, contact Borg-Warner Chemicals, Inc., International Center, Parkersburg, WV 26102.

Spectrophotometer

An advanced spectrophotometer designed for color and appearance analysis is covered in a product bulletin. Featuring a sphere optical sensor and new software to be interfaced with an IBM PC XT[®], the system reportedly achieves a high degree of precision and reliability. Contact Hunter Associates Laboratory, Inc., 11495 Sunset Hills Rd., Reston, VA 22090, for complete details.

Analyzer

Technical specifications on a moisture/solids analyzer are offered in a four-color brochure. Consisting of an electronic balance, a microwave drying system, and a microprocessor digital computer, the analyzer offers accuracy and precision. For copies, write to CEM Corp., P.O. Box 9, Indian Trail, NC 28079.

Calorimeter

Featured in a pamphlet is a new calorimeter designed to allow heat flow measurement while performing reactions on a bench scale. Controlled and monitored from an IBM PC[®], the meter communicates in menu technique. Complete specifications are available from Mettler Instrument Corp., Analytical Instruments Div., P.O. Box 71, Hightstown, NJ 08520.

Epoxy Resin

A new low viscosity, unmodified liquid epoxy resin based on bisphenol F is featured in laboratory data sheets. The new resin is highly suited for the production of solventless and high solids maintenance coatings requiring superior chemical resistance. For copies, contact Plastics Dept., CIBA-GEIGY Corp., Three Skyline Dr., Hawthorne, NY 10532.

Tint Dispenser

Benefits and features of an improved tint dispenser are highlighted in a brochure. Molded from corrosion resistant acetal resin, the large, seamless, one piece canisters offer accurate, easy-to-read steel metering gauges. Write to Red Devil, Inc., 2400 Vauxhall Rd., Union, NJ 07083, for technical specifications.

Solvents

Two new pyrrolidone solvents are discussed in a technical bulletin. Both products combine the pyrrolidone characteristics of polar solvency and water solubility with outstanding high temperature properties. For additional information, contact GAF Corp., 1361 Alps Rd., Wayne, NJ 07470.

Spectroscopy Software

A software bulletin contains programs for ultraviolet visible spectroscopy applications. Included are programs for uses such as repetitive wavelength scanning, least squares curve fitting, and quality control threshold determinations. For a free copy of the publication, request order No. SNU-114 from Perkin-Elmer Corp., UV/Vis Product Dept., Oak Brook Instrument Dept., 2000 York Rd., Oak Brook, IL 60521.

Water-Borne Resin

A new water-borne, environmentally acceptable coating resin is the subject of a recently released publication. The water reducible dispersion coating resin reportedly requires no grinding or special handling to mix quickly and easily with other paint ingredients. Contact Goodyear Chemicals Data Center, P.O. Box 9115, Akron, OH 44305, for additional information.

Batch Filler

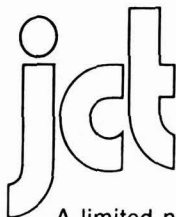
A new filling machine reported to meet the need for a highly portable filler is the subject of a product leaflet. The new model is designed to fill a range of viscosities from solvent and stain to heavy latex and near paste without splashing and can be purchased with or without level sensing controls. For further details, contact Beltron Corp., P.O. Box 893, Red Bank, NJ 07701.

Soluble Dyes

A special line of solvent soluble dyes is highlighted in a brochure. Particularly recommended for non-grain raising wood stains, the dyes are fast to light and reportedly possess excellent solubility in ethanol and methanol. Write to Berncolors-Poughkeepsie, Inc., Poughkeepsie, NY for further details.

Viscometer

Listed in a leaflet are ASTM specifications describing the use of a viscometer and its accessories. Over 20 different specifications covering a wide variety of materials are contained in the publication. For free copies, contact Brookfield Engineering Laboratories, Inc., Dept. NR 48, 240 Cushing St., Stoughton, MA 02072.

The logo for the Journal of Coatings Technology (JCT) features the lowercase letters 'jct' in a stylized, outlined font. The 'j' has a dot, and the 't' has a vertical bar extending downwards.

1984 BOUND VOLUMES

A limited number of bound volumes of the Journal of Coatings Technology are available for sale. These books make a handsome and lasting addition to any library. In addition to 1984, volumes for the years 1974, 1979, and 1980 are also available. Price—\$50.00

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URETHANES IN COATED FABRICS Volume 3

Collection of
Major Papers
from the
Journal of Coated Fabrics

Published by
Technomic Publishing Co., Inc.
Lancaster, PA
137 pages

Reviewed by
H. Earl Hill
Lord Corp.
Erie, PA

This book, volume 3 of a series, is a historical collection of papers from the *Journal of Coated Fabrics* for the period 1978 to 1984. Topics in 14 self-contained chapters include: 100% Solid Urethanes, Water Dispersible Urethanes, Urethane Oligomers, plus chapters on equipment, formulation, and marketing aspects.

A number of deficiencies immediately stand out. In numerous instances, the printing was blurred in both text and figures. Proofreading appeared to have been done, but cursorily, with several typos and misspellings being noted.

Although several chapters deal with related subjects, overall the chapters are very brief. In many cases, this reviewer was just getting caught up in the material when the chapter ended. References, where present, are also brief and give only a cursory overview of the subject matter of the chapter.

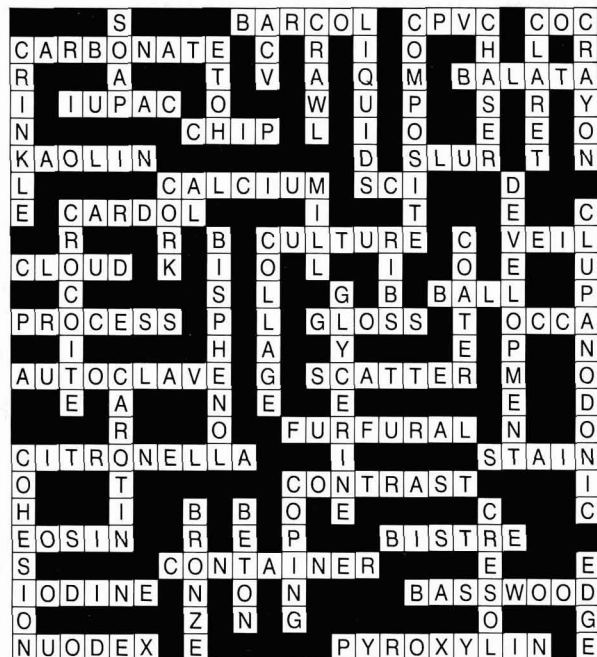
In content, Chapter 1 is a brief review of the work of others in the field of fungal attack. Chapters 2 and 3 deal with equipment used to coat industrial fabrics, a very necessary aspect since so much of the science of this industry is intimately connected with the equipment used. Chapter 2 is essentially devoted to the Zimmer Melt Roll Process, and gives an excellent in-depth presentation of this process. The figures are based on slides dated 1977, so this presumably represents the state of the art at that time. Chapter 3 is an excellent discussion of transfer coating; however, again the marketing tables of usage end at 1978 so the information is of historical interest only. Chapters 6 and 7 give a good overall picture of the book's title, "Urethanes in

Coated Fabrics." Chapter 11 on urethane oligomers is informative and interesting. The non-fabric applications should be of interest to coating technologists in general. Chapter 13 on polyurethane patent leather is also informative. However, the subject matter is remote to the book's title of coated fabrics applications. Chapter 14 is an instructive and interesting discussion of leather-like materials prepared from polyurethanes and fabric. As an afterthought on Chapter 6 on the formulation requirements for urethane fabric coatings, it is unfortunate that the discussion on the hydrolysis resistance of polyurethanes does not mention the utility of stabilizers in polyesterurethanes, a formulating technique which was well known even in 1978.

Several of the chapters in the book are informative but out of place in a book on "Urethanes in Coated Fabrics." For example, Chapter 9 discusses floor polish and floor finishes (for wood). Other chapters

discuss printing inks, coatings for rigid plastics, and top coats for resilient floor coverings. Chapter 12 is devoted entirely to coatings of utility only for rigid substrates.

In summary, the utility of the book is in a historical view of urethane fabric coatings. The book will also be of value to those who are maintaining a collection of volumes in the series, for the sake of completeness. The references, where available, should provide a starting point for a literature search in the field. As mentioned, several of the chapters, while not germane to the title, do have some information that could be of interest to coatings technologists in general. Conversely, these chapters may provide some serendipity to those persons concerned primarily with fabric coatings. If not, I would suggest that persons interested only in fabrics should skim certain parts and chapters of the book.



Solution to October "Crosslinks"

SURFACE COATINGS
Volume II: Paints
and Their Applications

Written by
Oil and Colour Chemists'
Association, Australia

Published by
Chapman and Hall
London and New York
490 pages, \$65.00

Reviewed by
Thomas J. Miranda
Whirlpool Corp.
Benton Harbor, MI

This is the companion volume to *Surface Coatings* published in 1983. This book is a comprehensive coverage of the technology of decorative and industrial coatings practice in Australia.

Included are the following topics: Rheology, Formulating Principles, Paint Manufacture, Architectural Coatings, Automotive Coatings, and Lacquers. Also covered are conversion coatings, printing inks, color matching, surface coatings defects, and computer use in the industry.

The chapters are well laid out. For example, the chapter on Heavy Duty Protective Coatings provides excellent illustrations on various aspects of metal preparation, with line drawings illustrating the

Letters to the Editor

Author Corrects Error; Expands References

TO THE EDITOR:

We made an error in our paper "Viscosity of Oligomer Solutions," *JOURNAL OF COATINGS TECHNOLOGY*, 57, No. 725, 51 (1985). We wrongly attributed the following statement to Dr. L.A. Utracki: "Utracki²⁵ proposed that the data for these low molecular weight compounds fit a step series of Arrhenius relationships, but apparently did not recognize that several of 'his' steps occurred at temperatures where changes in method of viscosity measurement had been made." In his paper, *J. Macromol. Sci. Phys.*, B 10, 477 (1974), Dr. Utracki found that none of the then available equations, including the Arren-

hius equation, described the experimental dependence of viscosity on temperature in the whole range of temperatures. He proposed a new dependence based on the free volume concept and cell-hole liquid theory.

Three additional papers by Dr. Utracki should be added to our list of references: L.A. Utracki and R. Sinha, *J. Rheology*, 25, 329 (1981); L.A. Utracki, *Polym. Eng. Sci.*, 22, No. 2, 81 (1982); and L.A. Utracki, *Polym. Eng. Sci.*, 25, 655 (1985).

ZENO W. WICKS, JR.
North Dakota State University

problem, typical application, and solution to design problems. The chapter on Automotive Coatings uses good illustrations and formulae for NAD coatings, surfacers and topcoats.

Surface Coatings concludes with chapters on regulatory requirements, and standards for inspection but these are relevant to the Australian scene and may not be

applicable elsewhere. The appendix contains a well written section on paint calculations, a glossary of terms and useful data, as well as conversion tables.

The Textbook Committee is to be congratulated on an excellent contribution to the literature on coatings. Both volumes should be in all technical libraries of coatings firms.

JCT DECEMBER 1985

—Post-Convention Issue—

The December issue of the *JOURNAL OF COATINGS TECHNOLOGY* will offer complete coverage of the 1985 Annual Meeting and Paint Industries' Show which took place at the Cervantes Convention Center on October 7-9.

Special features in the issue will include:

- Annual Meeting Awards
- Annual Meeting and Convention News
- Technical Proceedings
- Exclusive Convention Photos
- Exhibitor Booth Descriptions
- Additional Highlights

Coming Events

FEDERATION MEETINGS

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

1986

(May 13-16)—Federation "Spring Week." Seminar on "Special Purpose Coatings" on 13th and 14th; Society Officers on 15th; and Board of Directors on 16th. Sheraton Station Square, Pittsburgh, PA.

(June 3-6)—Symposium on Automotive Color Control (SACC). Sponsored jointly by FSCT, Detroit Society, Detroit Colour Council, and Manufacturers Council on Color and Appearance. Michigan Inn, Southfield, MI.

(Nov. 5-7)—64th Annual Meeting and 51st Paint Industries' Show. World Congress Center, Atlanta, GA.

1987

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

SPECIAL SOCIETY MEETINGS

1986

(Feb. 5-7) — Southern Society and University of Southern Mississippi. Thirteenth Annual "Water-Borne and Higher Solids Coatings" Symposium, New Orleans, LA. (Ronald R. Brown, Union Chemicals Div., Union Oil Co. of Calif., P.O. Box 26845, Charlotte, NC 28213).

(Mar. 25-26)—Chicago Society. Manufacturing Committee Seminar. "Back to Basics and on to the Future." Nordic Hills Resort, Itasca, IL. (Audrey LeNoble, Carl Lechner, Inc., 700 Deerfield Rd., Deerfield, IL 60015).

(Apr. 2-5)—Southern Society. Annual Meeting. DeSoto Hilton Hotel, Savannah, GA. (Ronald R. Brown, Union Chemicals Div., P.O. Box 26845, Charlotte, NC 28213).

(Apr. 9-11)—Southwestern Paint Convention of Dallas and Houston Societies. Wyndham Hotel, near Houston Intercontinental Airport, Houston, TX. (Mike Winters, Ribelin Distributors, Inc., 7766 Blankenship, Houston, TX 77055).

(Apr. 29-May 1)—"Advances in Coatings Technology" Conference sponsored by the Cleveland Society for Coatings Technology. NASA, Lewis Research Center, Cleveland, OH. (Dr. Rosemary Loza, Standard Oil Co. (Ohio), 4440 Warrensville Center Rd., Cleveland, OH 44128).

(May 1-3)—Pacific Northwest Society Annual Symposium. Marriott Hotel, Portland, OR. (Gerald A. McKnight, Rodda Paint Co., 6932 S.W. Macadam Ave., Portland, OR 97219).

(May 15-16)—New England Society. Symposium: "Launching the New Revolution—Compliance for the 21st Century." (Maureen Lein, Davidson Rubber Co., Industrial Park Dr., Dover, NH 03820).

(May 22)—Birmingham Club. Symposium: "Miracle '86." Strathallan Hotel, Birmingham, England. (David Heath, Holden Surface Coatings Ltd., Bordesley Green Rd., Bordesley Green, Birmingham B9 4TQ, England).

1987

(Feb. 23-25)—Western Coatings Societies' Symposium and Show, Monterey Convention Center, Monterey, CA. (Barry Adler, Royell, Inc., 1150 Hamilton Ct., Menlo Park, CA 94025).

OTHER ORGANIZATIONS

1985

(Dec. 4-5)—Symposium on "Finishing and Refinishing of Vehicles." Sponsored by Paint Research Association. West Hotel, Earls Court, London, England. (D. Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

1986

(Jan. 22-24)—"Technology Transfer." Conference sponsored by Martin Marietta Energy Systems, Inc., Oak Ridge, TN. (Cathy G. Ackermann, Butler Communications, Suite 202, Executive Plaza, 9041 Executive Park Dr., Knoxville, TN 37923).

(Feb. 9-12)—Ninth Annual Meeting of Adhesion Society. Marriott Hotel, Hilton Head, SC. (Dr. R.A. Draughn, Medical Univ. of South Carolina, Materials Science Dept., Charlestown, SC 29425).

(Feb. 9-12)—"The Colors of History: Identification, Re-Creation, Preservation" Conference sponsored by Inter-Society Color Council. Colonial Williamsburg, VA. (T.G. Webber, 1722 Forest Hill Dr., Vienna, WV 26105).

(Feb. 24-27)—Steel Structures Painting Council Annual Meeting and Symposium. Peachtree Plaza Hotel, Atlanta, GA. (Harold W. Hower, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

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(Mar. 4-6)—“Coatings Inspection of Chemical Plants.” Seminar sponsored by KTA-Tator, Inc., Pittsburgh, PA. (Bill Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 10-14)—“The Basic Composition of Coatings” Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Chemistry Dept., University of Missouri-Rolla, Rolla, MO 65401).

(Mar. 11-13)—Electrocoat/86. Sponsored by *Products Finishing Magazine*. Drawbridge Inn, Ft. Mitchell, KY. (Tom Robison, Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(Mar. 17-21)—Annual Meeting of Chemical Coaters Association. Georgia International Convention and Trade Center, Atlanta, GA. (CCA, P.O. Box 241, Wheaton, IL 60189).

(Mar. 26-28)—“Bridges and Highway Structures Coating Inspection.” Seminar sponsored by KTA-Tator, Inc., Pittsburgh, PA. (Bill Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Apr. 5-6)—Workshop on “Size-Exclusion Chromatography.” Sponsored by ACS Div. of Polymeric Materials: Science and Engineering. New York, NY. (Theodore Provder, Glidden Coatings & Resins, Div. of SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 6-11)—“Advances in Size-Exclusion Chromatography” Symposium. Sponsored by ACS Div. of Polymeric Materials: Science and Technology. New York, NY. (Theodore Provder, Glidden Coatings & Resins, Div. of SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 7-11)—“Paint Formulation” Introductory Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(Apr. 9-16)—“Surface Treatment '86” sponsored by the World Center for Industrial Technology. Hannover Fairgrounds, Hannover, West Germany. (Hannover Fairs USA Inc., P.O. Box 7066, 103 Carnegie Center, Princeton, NJ 08540).

(Apr. 14-15)—ASTM Symposium on “Testing of Metallic and Inorganic Coatings.” Chicago, IL. (Teri Carroll, ASTM Standards Development Div., 1916 Race St., Philadelphia, PA 19103).

(Apr. 22-24)—PaintCon '86. O'Hare Expo Center, Chicago, IL. (PaintCon, Suite 205, 2400 E. Devon Ave., Des Plaines, IL 60018).

(Apr. 28-May 2)—“Applied Rheology for Industrial Chemists” Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 5-9)—“Physical Testing of Paints and Coatings” Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(May 12-16)—“Adhesion Principles and Practices for Coatings and Polymer Scientists” Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 13-15)—11th Annual Powder & Bulk Solids Conference/Exhibition. O'Hare Exposition Center, Rosemont, IL. (Patricia Dickinson, Show Manager, c/o Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017).

(May 14-15)—Surfex '86. Oil and Colour Chemists' Association Exhibit. Harrogate, England. (OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF).

(May 19-22)—“Basic Microcomputer Programs for Coatings” Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(June 2-6)—“Dispersion of Pigments and Resins in Fluid Media” Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(June 10-16)—CHINAPLAS 86. International Exhibition Centre, Beijing, China. (Kallman Associates, 5 Maple Court, Ridgewood, NJ 07450).

(June 15-18)—60th Colloid and Surface Symposium. Georgia Institute of Technology, Atlanta, GA. (Symposium Chairman, M.J. Matteson, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332).

(July 3-6)—Oil and Colour Chemists' Association Australia. 28th Annual Convention. The Estate, McLaren Vale, South Australia. (OCCAA, 6 Wilson Ave., Felixstow, South Australia 5090, Australia).

(Sept. 7-12)—Symposium on High Solids Coatings. Sponsored by the ACS Div. of Polymeric Materials: Science and Engineering. Anaheim, CA. (George R. Pilcher, Hanna Chemical Coatings Corp., P.O. Box 147, Columbus, OH 43216).

(Sept. 8-13)—190th National Meeting. American Chemical Society. Chicago, IL. (ACS, A.T. Winstead, 1155 16th St. N.W., Washington, D.C. 20036).

(Sept. 9-11)—RadCure '86—Association for Finishing Processes of the Society of Manufacturing Engineers Conference and Exposition. Baltimore Convention Center, Baltimore, MD. (AFP/SME Public Relations, Society of Manufacturing Engineers, One SME Dr., Dearborn, MI 48121).

(Sept. 15-17)—13th International Naval Stores Meeting. Waldorf-Astoria, New York, NY. (Douglas E. Campbell, Executive Director, Pulp Chemicals Assn., 60 E. 42nd St., New York, NY).

(Sept. 21-26)—XVIIIth Congress of FATIPEC. (Federation of Associations of Technicians in the Paint, Varnish, and Printing Ink Industries of Continental Europe). Venice, Italy. (C. Bourgerie, Secretary General of FATIPEC, 76 Blvd. Pereire, 75017 Paris, France—or Amleto Poluzzi, AITIVA, Piazzale R. Morandi 2, 20121 Milano, Italy).

(Sept. 22-25)—“Your Chosen Finish.” FINSTRAT Conference and Exposition sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Long Beach, CA. (Gerri Andrews, SME, Public Relations Dept., One SME Dr., P.O. Box 930, Dearborn, MI 48121).

(Oct. 21-23)—Symposium on “New Chemistry for Product Diversification and Specialization in Coatings.” Sponsored by Eastern Michigan University. Ann Arbor, MI. (Alan Green, Technology Services Center, Eastern Michigan University, 150 Sill Hall, Ypsilanti, MI 48197).

CALL FOR PAPERS “TROUBLESHOOTING — PART II”

11TH ANNUAL **FOCUS** CONFERENCE
FOCUS OF COATINGS UNDER STUDY

Detroit Society for Coatings Technology

April 8, 1986
Management Education Center
Troy, Michigan

Conference will FOCUS on procedures, techniques and the latest instrumentation which can assist in resolving paint-related problems as experienced by automobile manufacturers. Solicited papers should cover one of the following areas:

- Optimizing spray booth operations
- Testing that can detect undercured paint films
- Pollution
- Health and safety considerations
- How to detect an unstable batch
- Craters - continued

Those wishing to participate are urged to submit a letter of intent including a tentative title of paper as soon as possible and an abstract of about 200 words by January 31, 1986.

Abstracts on any subjects related to troubleshooting would be welcomed. Please forward all communications to: The Detroit Society for Coatings Technology, 765 Dellwood Drive, Ann Arbor, Michigan 48103. Telephone (313) 956-6586.

(Oct. 21-25)—"Physical Testing of Paints & Coatings" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(Oct. 27-30)—Fire Retardant Chemicals Association Fall Conference. Pinehurst Hotel, Pinehurst, NC. (James D. Innes, FRCA, 851 New Holland Ave., P.O. Box 3535, Lancaster, PA 17604).

(Nov. 3-5)—Paint Research Association. Sixth International Conference, Sheraton Hotel, Brussels, Belgium. (D. Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

(Nov. 4-5)—"Painting Processes: Industrial Paint Application Technology" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(Nov. 4-6)—"Estimating for Painting Contractors and Maintenance Engineers" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(Nov. 4-6)—National Paint and Coatings Association. 98th Annual Meeting. Hilton Hotel, New Orleans, LA. (Karen Bradley, NPCA, 1500 Rhode Island Ave. N.W., Washington, D.C. 20005).

(Nov. 5-6)—Resins and Pigments Exhibition. Sheraton Hotel, Brussels, Belgium. (M. Tarrant, *Polymer Paint Colour Journal*, Queensway House, 2 Queensway, Ridhill RH11 1QS, England).

(Nov. 6-8)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency Dearborn, Dearborn, MI. (Tony Carroll, NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Nov. 13-15)—"Nuclear Power Coatings Inspection." Seminar sponsored by KTA-Tator, Inc., Pittsburgh, PA. (Bill Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Nov. 15-17)—38th National Decorating Products Association Show. McCormick Place, Chicago, IL. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Nov. 18-19)—Seminar on "Fine Particles and Fillers—Overlooked Opportunities." Sheridan Park Conference Center, Mississauga, Ont., Canada. (H.G. McAdie, Ontario Research Foundation, Sheridan Park Research Community, Mississauga, Ont., Canada, L5K 1B3).

(Nov. 18-21)—"Introduction to Coatings Technology" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(Dec. 4-6)—Short Course on "Advanced Chemical Coatings for Technical Managers." Sponsored by Eastern Michigan University, Ann Arbor, MI. (Alan Green, Technology Services Center, Eastern Michigan University, 150 Sill Hall, Ypsilanti, MI 48197).

(Dec. 9-10)—Short Course on "Introduction to Paint Job Estimating." Sponsored by Eastern Michigan University, Ann Arbor, MI. (Alan Green, Technology Services Center, Eastern Michigan University, 150 Sill Hall, Ypsilanti, MI 48197).

(Dec. 11-13)—Short Course on "Update on Coatings for Painting Contractors." Sponsored by Eastern Michigan University, Ann Arbor, MI. (Alan Green, Technology Services Center, Eastern Michigan University, 150 Sill Hall, Ypsilanti, MI 48197).

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
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I certify that the statements made by me above are correct and complete. (signed) Robert F. Ziegler, Editor.

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'Humbug' from Hillman

Some months ago, Tom Miranda wrote me: "The garbage truck just went by and I found more trash from our extinguished sage, Mr. Robert Ahlf." From that delivery and several subsequent ones, I have collected enough Ahlfisms to create quite a storage problem in the trash bin. The time has come to reduce those bulging files and dump a good part of Bob's mess of brilliant observations on the innocent folks in Humbug's Readership Land. Be forewarned—this will probably not be the last of them.

- When you wake up to what's going on, you can't sleep nights.
- *Your Horoscope for Today*: It would be very bad luck for you to mow the lawn.
- Hell froze over!! NOW you'll get that pay increase.
- I don't know of any secret plans.
- Winners never believe in luck.
- Quality is the responsibility of the inspector and the meteorologist causes bad weather.
- *Your Horoscope for Today*: Try to stand in the back and blend in with the crowd.
- Find out how many friends you have. Buy a cottage on the lake. (*Or a home in the mountains of Vermont.—Humbug*)
- Are you a man of principle or are you an opinionated, stubborn old bull-head.
- To err is human but your explanation is divine.
- Excitement is better than nostalgia.
- Adam was indispensable.
- If you can't remember, forget it.
- When you venture into the unknown, you don't know what you'll find.
- One day my mother told me I was the greatest. I don't want a second opinion.
- I reconsidered. You changed your mind. He has gone back on his word.
- We are gathered together because it seems impractical to gather apart.
- My problem: I work five days and live two.
- I woke up, looked in the mirror, and reached out to change channels.
- Wouldn't it be nice, some day when you're winning to meet someone who is for the upperdog.

- Subordinates almost always understand their bosses better than: (a) their bosses think and (b) the other way around.
- I was just thinking, maybe it's better that no one listens to you.
- Your career is what goes on while you are making other plans.
- Preservatives in food make me think of fireproof gasoline.
- I know what I like but I don't like what I know.

Our old friend Max Saltzman observes Tom Swiftly: "Corfam was made for uppers, he said loftily."

Max also noted in the Wall Street Journal that the Taiwanese Government approved a \$160 million dollar investment application by DuPont to produce "titanic" dioxide. To paint icebergs??, Max coolly asks.

Dick Kiefer was the first of several to remark:

In Germany: ALL IS PROHIBITED! (except what is permitted)

In France: All is permitted, except what is prohibited.

In Russia: ALL IS PROHIBITED, INCLUDING WHAT IS PERMITTED!

In Italy: All is permitted; even what is prohibited is permitted.

— My apologies to Mr. Rich Hall, the author of "Sniglets" and the clever definitions of Alponium, Cabnicreep, Carperpetuation, etc. which appeared in the September issue, for not being aware of their origin and thus not giving him proper credit.

—Herb Hillman
Humbug's Nest
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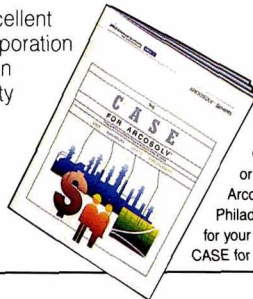
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