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JANUARY 1983

jct JOURNAL OF COATINGS TECHNOLOGY

FSCT
61st Annual Meeting
48th
Paint Industries' Show

MONTRÉAL
October 12-14, 1983

QUALITY
DESIGNED
CONFIDENCE
RENEWED

1982 Convention Wrap-Up: Washington, D.C.

JANUARY 1983

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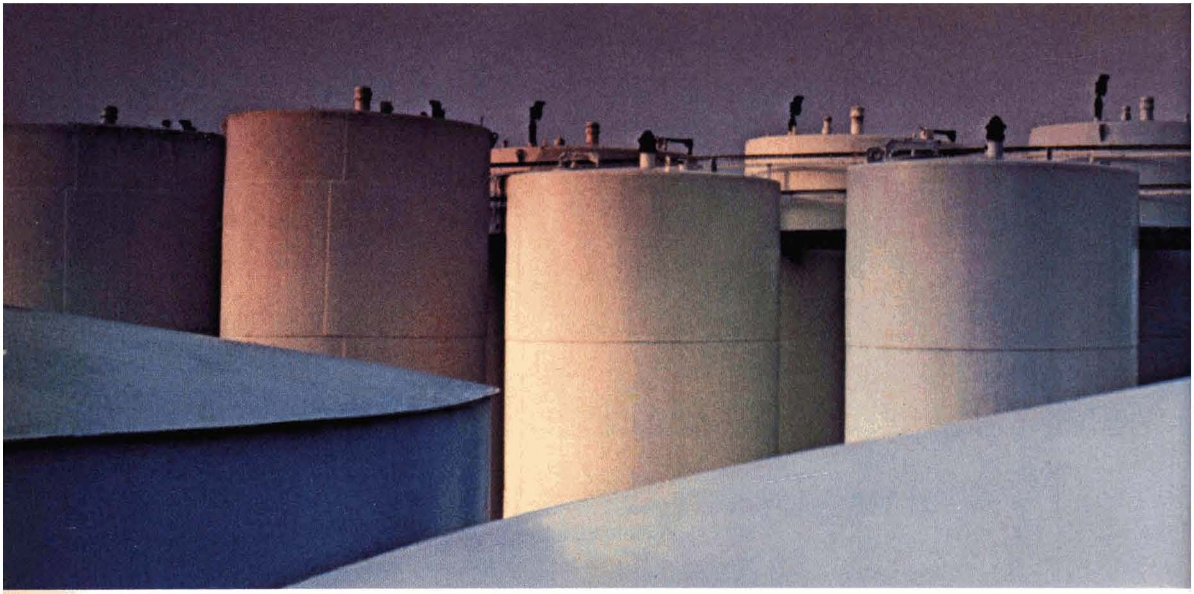

CIBA-GEIGY epoxy resins vs. the toughest applications around

XU-252 based coating.

Aggressive chemicals and organic solvents are tough on storage tank linings. Formulating a coating that resists them is not an easy job if you don't have the right components. Now, three new products from CIBA-GEIGY can help you change that.

Coatings based on XU-252.

Our new high performance novolac epoxy resin can take on many aggressive chemicals—including chlorinated solvents, ethanol, methanol, aromatic amines, acids, caustic and ammonia—under a variety of service temperatures.

Chemical exposure cell proves outstanding performance.

One of the most realistic tests for chemical resistance, the chemical exposure cell, is designed to simulate service conditions as closely as possible. A coated panel is attached to the end of a cylinder so that the chemical being tested makes direct contact with only the coated surface.

As you can see in the panels, an XU-252 based coating showed no sign of failure even against a solvent like methylene chloride, while one formulated with a standard bisphenol-A based epoxy resin softened and blistered.

Bisphenol-A based coating.

We also tested XU-252 based coatings for resistance against a range of other chemicals. The chart shows some of the toughest ones. In all cases these coatings exhibited excellent resistance to continuous exposure for a minimum of eight months.

Chemical and solvent resistance of XU-252 based coatings

Reagents	Months to date/test duration 8 months						
	1	2	3	4	5	6	7
Acetic acid (10%)						Failed	
HCl (36%)							
NH_4OH (30%)							
Acetone							
Methylene chloride							
Methanol							

cure conditions: 10 hours @ 80°C (176°F)

Two new hardeners increase chemical resistance.

HY-943 and HY-2969 when formulated with XU-252 provide a variety of new properties.

HY-943 produces solvent-free and high solid coatings with excellent alcohol and chlorinated solvent resistance.

HY-2969 produces solvent-free systems resistant to acids and aromatic solvents even as tough as benzene.

Tell us about your toughest applications.

Storage tank linings are only one of the tough applications CIBA-GEIGY epoxy resins and hardeners can handle. They're also ideal for such applications as pickling lines, hot waste disposal and nuclear containment areas, pollution control equipment, and flooring in pulp and paper mills.

If you have a tough application that demands a durable, long lasting coating, tell us about it and we'll tell you how our epoxy resins and hardeners can help you formulate one. Write CIBA-GEIGY Corporation, Resins Department, 3 Skyline Drive, Hawthorne, New York 10532, or call 800-431-1900. In New York 914-347-4700.

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JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., Pa. 19107

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Comment

Looking Back: A Year of Pride; Ahead: A Year of Firsts

As is traditional this time of the year, like the Roman god Janus people tend to reflect on the past and plan for the future. And also like this month's namesake, the Federation looks in two directions—to the past year with pride and to the future with anticipation.

Although the year 1982 was difficult for many organizations, the Federation not only survived but prospered. Not altogether untouched by the ailing economy, the FSCT has maintained its balanced budget. There were renewed efforts on the part of many Societies in Technical Committee activity, with increased participation by their representatives to the Federation's Manufacturing and Educational Committees. The 1982 Paint Show in Washington was the Federation's second largest and one can only wonder at what the attendance would have been in good economical times.

This next year should be an exciting one. Roy Brown, FSCT Technical Advisor, has proposed an evaluation program for paint test methods and instruments which will be placed before the Executive Committee this month. The Federation will hold its first technical seminar, "The Efficient Operation of an Up-to-Date Paint and Coatings Laboratory," in Kansas City, April 26–27, and Roy Brown is developing a program to show you how to get the most out of whatever you have to work with. Finally, another first—the initial appearance of the Annual Meeting and Paint Show in Canada. The Montreal and Toronto Societies will play host when Federation members gather in Montreal on October 12–14, for what is sure to be an exciting and memorable meeting.

So, to get you in the mood, all members of the Federation staff wish you *á Bonne Année.*

Robert F. Ziegler

Robert F. Ziegler,
Editor

Successfully formulating corrosion-inhibitive emulsion system coatings

Performance—or stability: The great dilemma in formulating non-toxic, corrosion-inhibitive water-based coatings. Use an inhibitive pigment with too low a water solubility, and you may lose performance. Use a more soluble pigment, and risk instability.

Preventing irreversible phase separation, hockey pucks, high viscosity, and cottage cheese.

Instability can take any of these forms in water-thinnable coatings. In one approach, HALOX® Pigments chose, from among many, two representative resin systems to work with: A typical styrenated acrylic emulsion similar to that in coatings now being evaluated by the State of California, and a straight acrylic resin known for generally good performance against corrosion.

Working with these resin systems, we elected to evaluate two classes of pigments: *borosilicates* (HALOX CW2230, 17% B_2O_3, and CW221, 10% B_2O_3), which provide good performance but may present stability problems in water-thinnable coatings, and *phosphosilicates* (HALOX BW191), which offer excellent stability because of comparatively lower solubility parameters. HALOX BW191 was favored over our BW111 because of lower water and vehicle demand.

Pigment selection naturally follows your resin system selection. From there, successful formulations depend on a vast number of variables: pigment solubility... pigment vehicle demand... water demand... and many more, including surfactant and wetting agent choice, order of addition, and dispersion parameters and techniques. To name just a few.

		Oil Absorption	Solubility constant gm/100ml H_2O
CW221	Calcium borosilicate (10% B_2O_3)	35	0.35
CW2230	Calcium borosilicate (17% B_2O_3)	42	0.40
BW191	Barium phosphosilicate	25	0.06

Formulating practice for stable high performance

Styrenated Acrylic Paints—

All three styrenated acrylic paints, regardless of pigment, proved to be stable up to one month when carefully made, but the high boron pigment tended toward irreversible phase separation and seeding, believed to be due to soluble cation presence.

The borosilicate pigmented paint tended to foam and froth, so in accelerated corrosion testing there was some rust failure in a "measles" pattern in single-coat. This was not seen in multiple-coat applications because the additional coverage filled in broken bubble craters. The phosphosilicate paint generally retained less air, hence foaming and frothing less, giving better single-coat corrosion test results.

A good formula incorporating the phosphosilicates in this vehicle is:

WHITE LATEX METAL PRIMER (H-81-10)

Initial Grind: Disperse the following, in order, on a high-speed dispersion mill to a 5 n.s.u. grind:

	lb.	gal.
Water	133.28	16.00
Igepol CO-630 (GAF Corp)	2.80	0.32
Cellulosic Thickener[1]	1.50	0.13
Tamol 731 (Rohm & Haas Corp)	9.20	1.00
Defoamer[2]	1.00	0.13
Surfynol 104E (Air Products Inc.)	2.10	0.25
Ethylene Glycol	9.31	1.00
Titanium Dioxide[3]	100.00	2.90
HALOX BW191	125.00	5.25
Wollastonite (NYCO, Inc.)	50.00	2.07
Then let down with: (at low speed)		
Styrenated Acrylic Emulsion[4]	581.85	66.00
Water	24.77	2.95
Dalpad A (Dow Chemical)	13.75	1.50
Surfynol 104E	4.15	0.50
Total:	1058.71	100.00

Premix the Dalpad A with water, then slowly add this premixture to the emulsion under agitation.

PVC = 24.97
Viscosity = 70-80 Ku @ 75°F
V.O.C. = 89 g/l (0.74#/gal.)
Salt fog expectations: 2 coats at 1.5 mils d.f.t. each—2500 hours.

[1] Cellusize QP-4400—Union Carbide Corp. Ethylene Glycol
[2] Troykyd 999 or equivalent—Troy Chemical
[3] Ti-Pure R-900—E.I. du Pont de Nemours & Co.
[4] Styrenated Acrylic Emulsion Arolon 820—Spencer-Kellogg Division, Textron

With the styrenated acrylic vehicle, HALOX Pigments found that the best surfactant-wetting aid combination in our systems is Tamol 731 and Surfynol 104E. Also, to improve stability and performance, the coalescing agent should be pre-mixed with the latex resin and then added very quickly to the pigment grind, so the coalescent is absorbed onto the vehicle, not the pigmentation. An extender pigment of high pH was chosen to provide a buffer effect, and flash and early rust resistance.

Straight Acrylic Latex Primer—

A good formula incorporating the phosphosilicates in this vehicle is:

WHITE LATEX METAL PRIMER (H-81-07)

Initial Grind: Disperse the following, in order, on a high-speed dispersion mill to a 5 n.s.u. grind:

	lb.	gal.
Water	83.30	10.00
Cellulosic Thickener[5]	0.75	0.04
NH_4OH	1.00	0.14
Methyl Carbitol (Union Carbide Corp.)	50.00	5.79
QR-681M Dispersant[6]	18.14	2.00
Igepol CO-630 (GAF Corp)	2.70	0.31
Surfynol 104E (Air Products, Inc.)	4.10	0.49
Titanium Dioxide[7]	50.00	1.46
Calcium Carbonate[8]	50.00	2.20
HALOX BW191	60.00	2.54
Zinc Oxide[9]	5.00	0.11
Then let down with: (at low speed)		
Acrylic Emulsion[6]	526.35	60.00
Texanol[10]	5.50	0.70
*Aroplaz 1271 & Driers[11]	58.00	6.94
Defoamer[12]	1.00	0.13
Preservative	2.00	0.23
QR-708 Thickener	15.00	1.67
Water	43.73	5.25
Total:	976.57	100.00

*Premix the driers with the Aroplaz 1271, then slowly add this mixture to the let-down phase under agitation.

Drier combination:	Aroplaz 1271	93.4%
	Zirconium Drier 6%	5.6%
	Cobalt Drier 6%	0.5%
	Manganese Drier 6%	0.5%
		100.0%

PVC = 16.30
Viscosity = 130 Ku @ 75°F
V.O.C. = 170g/l (1.42#/gal.)
Salt fog expectations: 2 coats at 1.5 d.f.t. each—1200 hours.

[5] Natrosol 250MR or equivalent—Hercules, Inc.
[6] QR-681 Dispersant—Rohm and Haas Co.
Acrylic Emulsion Rhoplex MV-23
Skane M-8 Preservative
QR-708 Thickener
[7] Ti-Pure R-900 or equivalent—E.I. du Pont de Nemours & Co.
[8] Atomite Calcium Carbonate or equivalent—Thompson, Weinman & Co.
[9] Kadox 515 or equivalent—New Jersey Zinc Co.
[10] Texanol Coalescent—Eastman Chemical Products, Inc.
[11] Aroplaz 1271 Alkyd—Spencer-Kellogg Division, Textron; Driers—Mooney Chemical
[12] Foamaster VL or equivalent—Diamond Shamrock Chemical Co.

For maximum performance, stability, viscosity control and easy dispersion in the straight acrylic emulsion, it was found necessary to use the resin manufacturer's suggested dispersants, surfactants, and thickeners. We further suggest that the levels of cellulosic thickener be kept at 0.70 to 1.0 lb/gal, and the PVC be held between 16 and 22 per cent. Accelerated testing performance is also improved by the use of French process zinc oxide, alkyd modification, and a fast-release freeze/thaw stabilizer such as diethylene glycol monomethyl ether. Proprietary QR-708 rheological modifier improves flow, leveling, and brushing properties. Reduced levels of QR-708, or use of a post-addition of diethylene glycol monobutyl ether, will provide a lower apparent viscosity if desired. It has also been our formulating experience that a pigment level of 0.5 to 1.0 lb/gal exhibits better performance and stability. Phosphosilicate pigments were selected because of lower solubility parameters at this loading level, and because phosphosilicates tend to foam less than borosilicates in this resin system.

From our data and in our opinion, non-toxic water-based corrosion-inhibitive coatings can in fact be formulated successfully to achieve good stability—*and* high performance.

If you would like our suggestions on additional starting formulations, please request them on your letterhead. Full data on coatings performance in application and under accelerated testing will be forthcoming in future reports.

Roon Awards Competition Offers $4,000 in Prizes For Winning Technical Papers Presented in 1983

The Roon Foundation Awards, established in 1957, will be continued at the Federation's 1983 Annual Meeting in Montreal, Que., Canada, where the best technical papers offered for presentation will be eligible for up to $4,000 in cash prizes donated by Leo Roon, former President of Nuodex Products Co., and a Director of the Roon Foundation.

Darlene Brezinski, Chairman of the Federation's 1983 Roon Awards Committee, stated that the papers submitted in competition for the Awards must: (1) Be of such caliber that they will reflect a step forward in real scientific contribution to the coatings industry; (2) Be directly related to the protective coatings industry; and (3) Shall describe original work not previously published or presented.

The 1983 Annual Meeting of the Federation will be held in Montreal, Que., Canada from October 12 to 14 and the deadline for receipt of papers is June 1.

Winners of the 1982 Competition:

FIRST PRIZE ($1,000)—"Comparative Solvent Evaporation Mechanisms for Conventional and High-Solids Coatings"—William H. Ellis, Chevron Research Co., El Segundo, CA.

SECOND PRIZE ($750)—"Popping of Water-Soluble Baking Enamels"—Zeno W. Wicks, Jr., of North Dakota State University, Fargo, ND., and Ben C. Watson, of the Sherwin-Williams Co., Chicago, IL.

THIRD PRIZE ($500)—"Predictive Model for Cracking of Latex Paints Applied to Exterior Wood Surfaces"—F. Louis Floyd, of Glidden Coatings and Resins, Div. of SCM Corp., Strongsville, OH.

FOURTH PRIZE (tie—$375 each) —"Presence and Effects of Anaerobic Bacteria in Water-Based Paints"—Robert A. Opperman, of Cosan Chemical Corp., Carlstadt, NJ; and "Interrelationships Between Pigment Surface Energies and Pigment Dispersions in Polymer Solutions"—G. Dale Cheever and John C. Ulicny, of General Motors Research Laboratories, Warren, MI.

Principles Governing the Roon Awards

These awards, established in 1957 by Mr. Leo Roon, a Director of the Roon Foundation, and since 1977 have been administered by the Paint Research Institute, are for the best technical papers (other than those by a Constituent Society of the Federation) submitted for presentation at a Federation Annual Meeting.

Papers to be considered for the competition will be those by individuals associated with the organic coatings industry, including raw material suppliers and educational institutions.

The Paint Research Institute, as sponsor of the competition, will supervise the judging of the papers. The principles governing the awards are as follows:

(1) The papers will be of such caliber that they will reflect a step forward in real scientific contribution to the coatings industries. The papers shall describe original work which has not been previously published or presented.

(2) Papers must be directly related to the protective coatings industry.

(3) None of the work shall originate from, be guided by or be any part of a Coatings Technology Society. These awards shall in no way detract from the cooperative efforts of Societies' Technical Committees and their convention papers.

(4) An Award Committee shall consist of five members who shall be appointed by the President of the Federation.

(5) The committee is not obligated to award prizes if in its opinion none of the submitted papers are of a caliber to be worthy of such recognition.

(6) The submitted papers may be presented at the Annual Meeting with the consent of the President of the Federation and the Chairman of the Program Committee. Although it is the intent of the Roon Awards that winning papers will be presented at the Annual Meeting, papers accepted for presentation and papers awarded prizes are separate and distinct. An invitation from the Program Committee to present his paper should not be construed by any author as an indication that the Roon Committee has awarded his paper a prize.

(7) Winning papers will be published in the JOURNAL OF COATINGS TECHNOLOGY, which has prior rights to publication of all submitted papers.

(8) The papers shall be concise and informative discussions of up to approximately 6,000 words. Papers greatly exceeding this length should be divided into more than one paper. Multiple entries in the competition from a single author are acceptable. It is requested that manuscripts be prepared in accordance with JOURNAL OF COATINGS TECHNOLOGY style, as outlined in the Guide for Authors. Copies are available from the Federation office in Philadelphia upon request.

(9) A 75 to 100 word abstract shall accompany the paper.

(10) Papers will be rated with emphasis on: (a) Originality (40%); (b) Scientific Importance (20%); (c) Practical Value (20%); and (d) Quality of Composition (20%).

(11) The Awards will be open to anyone involved in study of or engaged in work related to the protective coatings industries, including paint, varnish and lacquer manufacturers, raw material suppliers, research laboratories and universities. (The committee, however, will not accept papers which involve raw material sales promotion or are self-serving in regard to exploiting a proprietary product.)

(12) The Committee may award three or four prizes, the total of which is not to exceed $4,000. Maximum for first prize is $1,500.

(13) It is requested that all papers be accompanied by company or educational institutional clearance for publication.

(14) Those planning to submit a paper in 1983 must let the Chairman (Darlene Brezinski, DeSoto, Inc., 1700 E. Mt. Prospect Rd., Des Plaines, IL 60018) know by March 1. She must have seven publication manuscripts by June 1.

(15) The 1983 Awards, and accompanying certificates, will be presented during the Annual Meeting in Montreal, Que., Canada.


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1983

48th PAINT INDUSTRIES' SHOW

48e Exposition de L'Industrie de la Peinture

MONTREAL, QUE., CANADA

Place Bonaventure

October 12, 13, 14, 1983

An Educational Exhibit
Of Materials and Equipment
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Being Held in Conjunction
With the 61st Annual Meeting
Of the Federation of Societies
for Coatings Technology

Se Tient Conjointement
Avec la 61e Réunion Annuelle
Des Fédération des Sociétiés
Des Techniques du Revêtement

Abstracts of Papers in This Issue

COMPARATIVE SOLVENT EVAPORATION MECHANISMS FOR CONVENTIONAL AND HIGH SOLIDS COATINGS—W.H. Ellis

Journal of Coatings Technology, 55, No. 696, 63 (Jan. 1983)

Solvent volatility has traditionally been used to control initial flow and resulting qualities of a conventional coating. As evaporation progresses, the rate limiting factor changes from volatility to diffusion. Developed here is a precise method for determining the transition point. Comparison of laboratory data with typical formulas demonstrates that conventional alkyd coatings are formulated at resin concentrations below the transition point, high solids polyester coatings above. Thus, diffusion limits the total evaporation process in a high solids coating and solvent volatility cannot be used to control setting and other initial flow properties.

PREDICTIVE MODEL FOR CRACKING OF LATEX PAINTS APPLIED TO EXTERIOR WOOD SURFACES—F.L. Floyd

Journal of Coatings Technology, 55, No. 696, 73 (Jan. 1983)

While it is well-known that paints applied to exterior wood substrates will eventually develop cracks, and may, if their adhesion is deficient, subsequently peel or flake off, attempts to explain this phenomenon on the basis of tensile properties have been unsuccessful to-date. The present work shows that a two-parameter model, employing fracture energy (energy required to propagate a crack through a paint film) and liquid water permeability, successfully accounts for cracking behavior over a wide range of compositional variables. From these observations, a mechanism for the cracking behavior of latex paint films applied to exterior wood surfaces is proposed.

RECENT ADVANCES IN COATINGS FOR HOUSEHOLD APPLIANCES—T.J. Miranda

Journal of Coatings Technology, 55, No. 696, 81 (Jan. 1983)

Appliance coatings have experienced significant changes in the last decade. The thermosetting acrylic is being replaced by high solids top coats and flow coat primers which have been converted to water-soluble types or by epoxy-based cationic electrocoats. Many of the changes were prompted by increasing concern for environmental matters, with the appliance industry and its coating suppliers responding well to the challenge.

This paper provides a review of coatings, the appliance market, and future trends in coatings.

EVAPORATION DURING SPRAYOUT OF A TYPICAL WATER-REDUCIBLE PAINT AT VARIOUS HUMIDITIES—A.L. Rocklin

Journal of Coatings Technology, 55, No. 696, 89 (Jan. 1983)

Solvent balance during sprayout of a water-reducible paint at various humidities and spraygun settings is close to that of a corresponding model system composed of neat solvent blend thickened to the same viscosity as the paint. Using measured degree of evaporation from the model, paint solvent balance can be estimated with a previously developed computer program that predicts evaporation of water and cosolvents at any humidity. During sprayout the concentration of 2-butoxyethanol cosolvent is relatively insensitive to evaporation conditions. Tert-butanol cosolvent is affected less than expected because humidity has opposite effects on evaporation rate and on depletion of volatile cosolvents.

SOLUBILITY PARAMETER CONCEPT IN THE DESIGN OF POLYMERS FOR HIGH PERFORMANCE COATINGS. I. ACRYLIC COPOLYMERS—A.J. Tortorello and M.A. Kinsella

Journal of Coatings Technology, 55, No. 696, 99 (Jan. 1983)

Coatings for aircraft application are required to meet a variety of severe conditions including flexibility over a broad temperature range and resistance to fluids covering the spectrum of polarity from hydrocarbons to water. Upon consideration of all the various film performance requirements, fluid resistance is considered to be the most crucial.

The design of synthetic resins to resist the test fluids began with the characterization of the solubility parameter value for each fluid. A spectrum of fluid solubility parameter values was then constructed and a region corresponding to resistance to the entire body was identified. Acrylic copolymers having the desired solubility parameter as calculated by group contribution theory were synthesized. Both anionic and cationic aqueous dispersions were prepared and evaluated for clear-film performance. The performance was as expected for all fluids except water.

Federation of Societies for Coatings Technology

QUALITY DESIGNED CONFIDENCE RENEWED

1982 Convention Wrap-Up: Washington, D.C.

Over 5200 Registrants Participate In 1982 Annual Meeting and Paint Show

The Federation Annual Meeting and Paint Industries' Show returned to the nation's capital November 3-5, and drew a total of 5279 registrants to the Sheraton Washington Hotel for three days of technical sessions and exhibits. The effects of the sluggish economy were not reflected in the attendance figure, which was off only slightly from the near-record turnout last year, nor in the paid exhibit space in the Paint Show, which almost matched the largest-ever 1982 Show.

Chairman John Ballard and his Program Committee scheduled concurrent technical sessions all three days to accommodate a record number of presentations, and from the opening Keynote Address by Jules Bergman, Science Editor of ABC-TV News, on through the Mattiello Lecture by Dr. Shelby Thames, Executive Vice-President of the University of Southern Mississippi, and the closing session on performance of non-lead, non-chrome pigments, registrants were treated to discussions on a variety of theoretical and practical topics, keyed to the theme of "Quality Designed/Confidence Renewed." Among the program features were seminars on computers and scientific instrumentation, a record number of Roon Awards competition papers, PRI symposium honoring Dr. Raymond Myers, Society papers, and sessions on information retrieval and promotion of career opportunities in the coatings industry. The sessions were well attended throughout and the high level of interest was reflected in the many spirited question-and-answer sessions.

In the exhibit area, meanwhile,registrants crowded the aisles to view the latest products and equipment displayed by the 169 supplier companies taking part in the Show and to chat with their technical personnel. All available booth space was occupied, and exhibitors were generally pleased with both the attendance and the interest shown in their displays.

More than 350 registrants attended the luncheon on Friday, November 5, and, following the Awards ceremonies (see Awards story), they were entertained by humorist Mark Russell, who good naturedly spoofed the Administration, Congress, the bureaucracy, and any and all aspects of the current political scene.

The AM&PS was, all in all, a very successful event, and the Federation is indebted to the attendees, program participants, exhibiting companies and their personnel, members of the working committees, and all who gave of their time, talents, and efforts. Special thanks are extended to the members of the Baltimore Society, particularly those who served on the Host Committee under the direction of Gordon Allison.

1983 Annual Meeting and Paint Industries' Show Scheduled for October 12–14 in Montreal, Quebec

The 61st Annual Meeting and 48th Paint Industries' Show of the Federation of Societies for Coatings Technology will be held at the Place Bonaventure in Montreal, Quebec, Canada, October 12-14, 1983.

This is the first time that these events will be held outside of the United States.

Chairman of the Program Committee is Peter Hiscocks, of C-I-L Paint, Inc., Toronto, Ont. Members of both the Toronto and Montreal Societies, under the chairmanship of Horace Philipp, of Sherwin-Williams Co. Canada Ltd., Montreal, will serve on the Host Committee.

Deryk Pawsey, of Rohm and Haas Canada Ltd., Vancouver, B.C., will continue as Chairman of the Paint Show Committee.

President Howard Jerome and wife, Gene (center), opened the 1982 Paint Show with traditional ribbon-cutting ceremony. Looking on are (left to right): Treasurer Terryl Johnson and wife, Bonnie; Rose Borrelle; Executive Vice-President Frank Borrelle; President-Elect A. Clarke Boyce and wife, Marjorie; and Treasurer-Elect Joseph A. Bauer and wife, Dorothy

Dr. Percy E. Pierce, of PPG Industries, Inc., Receives 1982 George Baugh Heckel Award From FSCT

Dr. Percy E. Pierce, Manager of Physical/Analytical Research of PPG Industries, Inc., Allison Park, PA, was honored by the Federation of Societies for Coatings Technology with the 1982 George Baugh Heckel Award for his many years of dedicated service to the Federation and the industry. The presentation was made at the FSCT Annual Luncheon on November 5, in Washington, D.C.

The award plaque is presented each year to the individual whose contribution to the general advancement of the Federation's interest and prestige have been outstanding.

Dr. Pierce, a member of the Pittsburgh Society, is a Trustee of the Paint Research Institute and is a member of the Federation's Publications Committee and the Editorial Review Board of the *Journal of Coatings Technology*. He has also been active as a member of the Federation's Liaison Committee and as a delegate to the International Union of Pure and Applied Chemistry (IUPAC).

Dr. Pierce has given numerous lectures both overseas at the 1974 and 1978 FATIPEC Congresses and at the Gordon Research Conferences. He was the Joseph J. Mattiello Memorial Lecturer at the Federation's 1980 Annual Meeting presenting, "Physical Chemistry of Cathodic Electrodeposition."

Dr. Pierce is a member of the American Chemical Society, the American Association for the Advancement of Science, and the American Institute of Chemists. He is the 1983 Chairman of the Gordon Research Conference Seminar on Physics and Chemistry of Coatings and Films.

Distinguished Service Award

This award was presented to Howard Jerome, of the St. Louis Society, in grateful acknowledgment of his valuable contributions to the progress of the industry and the Federation while serving as President of the Federation in 1981-82. Mr. Jerome is Vice-President and Technical Director of Spatz Paint Industries, Inc., St. Louis, MO.

Roon Foundation Awards

These awards, established by Leo Roon, Director of the Roon Foundation, and administered by the Paint Research Institute, are for the best technical papers entered in the competition and submitted for presentation at the Federation's Annual Meeting by individuals associated with the organic coatings industry.

FIRST PRIZE ($1,000)—"Comparative Solvent Evaporation Mechanisms for Conventional and High-Solids Coatings"—William H. Ellis, Chevron Research Co., El Segundo, CA.

SECOND PRIZE ($750)—"Popping of Water Soluble Baking Enamels"—Zeno W. Wicks, Jr., of North Dakota State University, Fargo, ND., and Ben C. Watson, of the Sherwin-Williams Co., Chicago, IL.

THIRD PRIZE ($500)—"Predictive Model for Cracking of Latex Paints Applied to Exterior Wood Surfaces"—F. Louis Floyd, of Glidden Coatings and Resins, Div. of SCM Corp., Strongsville, OH.

FOURTH PRIZE (tie - $375 each)—"Presence and Effects of Anaerobic Bacteria in Water-Based Paints"—Robert A. Opperman, of Cosan Chemical Corp., Carlstadt, NJ; and "Interrelationships Between Pigment Surface Energies and Pigment Dispersions in Polymer Solu-

Dr. Percy E. Pierce (right) accepts the 1982 George Baugh Heckel Award from Heckel Award Committee Chairman, Roy Tess

President-Elect A. Clarke Boyce (left) presents the Distinguished Service Award plaque to President Howard Jerome

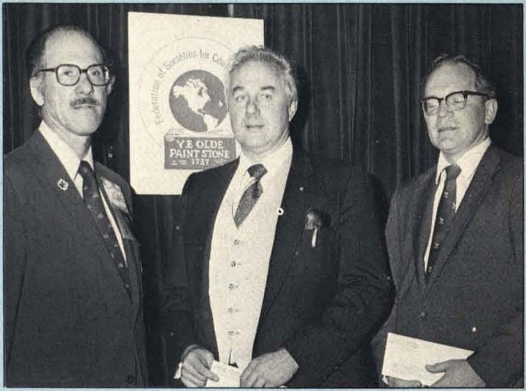
Roon Awards Committee Chairman, Darlene Brezinski presents awards to the winners (left to right): William H. Ellis, First Prize; Zeno W. Wicks, Jr. and Ben C. Watson, Second Prize; F. Louis Floyd, Third Prize; Robert A. Opperman and G.D. Cheever (co-author with John C. Ulicny, not present), tied for Fourth Prize

Union Carbide Award is presented to the Southern Society for its effort in producing the brochure, *Consumer Guide to Trade Paint Quality.* Accepting the award from President Jerome (left) is Dan Dixon, President-Elect of the Southern Society

Dr. Eugene M. Allen, of Lehigh University, (right) is presented with the Armin J. Bruning Award for his outstanding contributions to the science of color in the field of coatings technology. Presenting the award is S. Leonard Davidson, of the New York Society

Material Marketing Associates Awards were presented by Douglas Everett, (far left) representing MMA, and Al Heitkamp, Chairman of the MMA Awards Committee, to winners (left to right): John R. Green, for the Birmingham Club; John E. Fitzwater, Jr., for the New England Society; Donald Emch, for the Northwestern Society; and Dan Dixon, for the Southern Society

Winners of the 1982 Trigg Award for the most interesting reports of Society meetings and discussions are (from left to right): Nelson W. Barnhill, Secretary of C-D-I-C Society (Tie for Second Prize); N. Bradford Brakke, Secretary of New England Society (tie for Second Prize); and Earl B. Smith, Secretary of Los Angeles Society (First Prize)



Program Awards Chairman, Horace Philipp (left) presents checks for best presentation of Society papers to Jan Grodzinski (center), of Toronto Society (First Prize) and Dean Owen Harper, of Louisville Society (Second Prize)

tions"—G. Dale Cheever and John C. Ulicny, of General Motors Research Laboratories, Warren, MI.

Union Carbide Coatings Technology Award

Established in 1979 by the Union Carbide Corp., the 1982 Award was presented to the Southern Society for Coatings Technology for its distinguished effort in producing the brochure, *Consumer Guide to Trade Paint Quality.*

The Guide, entitled "Know Paint Quality Before You Buy," focuses on latex interior flat paint and depicts the performance characteristics of low, average, and high-quality products.

Written and developed by members of the Southern Society, the brochure helps to promote an appreciation of paint quality features and an understanding of paint application. It is designed for point-of-purchase use to help the consumer understand what to look for in paints.

The Award ($2000 in cash and a plaque) is given to an individual (or group of individuals) in recognition of an extraordinary contribution to: (1) the advancement of coatings technology, or; (2) the furtherance of research and education in the field of coatings technology.

Armin J. Bruning Award

Dr. Eugene M. Allen, Emeritus Professor of Chemistry at Lehigh University, Bethlehem, PA, was named the recipient of the Federation's Armin J. Bruning Award. The award was presented to Dr. Allen for his outstanding contributions to the science of color in the field of coatings technology.

Dr. Allen is a published authority in the fields of color science, radiant energy, and laser microprobe spectroscopy. His research activities have been responsible for many of the current mathematical techniques being used for computer colorant formulation.

Ernest T. Trigg Awards

These awards are for the Secretaries of Constituent Societies of the Federation who furnish to the *Journal of Coatings Technology* the most interesting reports of Society meetings and discussions following the presentations of papers at those meetings.

FIRST PRIZE ($100)—Earl B. Smith (Spencer Kellogg Div. of Textron), Secretary of Los Angeles Society.

SECOND PRIZE (tie - $50 each)—Robert A. Burtzlaff (Potter Paint Co. of Indiana), Secretary of CDIC Society; and N. Bradford Brakke (Lilly Chemical Products), Secretary of New England Society.

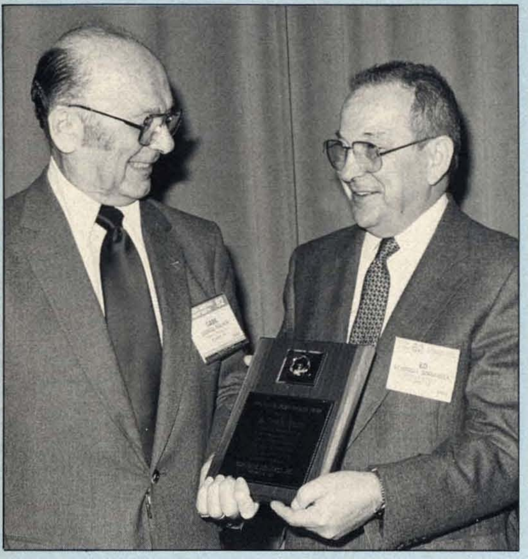
MMA Awards

Established in 1975 by Materials Marketing Associates, these cash awards and plaques are for notable achievements by Constituent Societies of the Federation, other than Society papers presented at the Federation Annual Meeting.

Class A Competition ($350) was won by the Southern Society, for its contribution through the production of the brochure, *Consumer Guide to Trade Paint Quality,* "Know Paint Quality Before You Buy."

Class B Competition (tie - $175 each) was won by the New England and Northwestern Societies. New England Society was recognized for its contribution to the coatings industry derived from the 1982 Coatings Tech Expo hosted by the Society; Northwestern Society, for its contribution through the Society's educational programs.

A.F. Voss/American Paint & Coatings Journal Awards were presented to (left to right): Robert D. Athey, accepting for the Los Angeles Society; Carlos Dorris, accepting for Dallas Society; Andrew Jones and Jan Grodzinski, accepting for Toronto Society



Gabriel Malkin (left) is the recipient of Morehouse Industries' Golden Impeller Award presented by Edward J. Szkaradek

William Lane (right), of Atlas Electric Devices Co., accepts plaque commemorating the company's 40 years of participation in the Paint Show from Deryk Pawsey, Chairman of the Paint Show Committee

Class C Competition ($350) was won by the Birmingham Club for its production of the audio-visual program "Introduction to the Paint Industry."

A.F. Voss/American Paint & Coatings Journal Awards

These cash awards are presented by the *American Paint & Coatings Journal* for the most constructive papers by constituent Societies of the Federation in connection with the research, development, manufacture, or application of the industry's products, or of the raw materials entering into their fabrication.

FIRST PRIZE ($200)—"Reactive Silane Modified Pigments II: A Designed Experiment in Silanized Talc/Latex Formulations"—Los Angeles Society (Robert D. Athey, Athey Technologies, of the Technical Committee)

SECOND PRIZE ($150)—"Computer-Design of Latex Flats to Meet a Required Film Integrity and Paint Cost"—Dallas Society (Raymond C. Pierrehumbert, Union Carbide Corp., Subchairman of the Technical Committee)

THIRD PRIZE (tie - $75 each)—"The Influence of Cosolvents on the Stability and Film Properites of Water-Soluble Alkyds"—Toronto Society (Andy J. Jones, Degussa Canada Ltd., Technical Committee); and, "Factors Affecting Wear in Small Media Pigment Grinding Mills"—Toronto Society (Jan Grodzinski, S.C. Johnson & Sons Ltd., Technical Committee).

Program Committee Awards

These awards are presented to individual members of Societies who present Society papers at the Annual Meeting in the best form and manner.

FIRST PRIZE ($100)—Jan Grodzinski (S.C. Johnson and Son Ltd.), Toronto Society.

SECOND PRIZE ($50)—Dean Harper (University of Louisville), Louisville Society.

Golden Impeller Award

This award, presented by Morehouse Industry, Inc., is presented for outstanding service to the chemical processing industry for innovative designs and applications in the field of dispersion technology.

This year the award was presented to Gabriel Malkin, a licensed Professional Engineer, for his work in the area of dispersion. Mr. Malkin, a member of the New York Society, is widely-known as an expert in the design and production engineering of materials handling and milling and grinding in the paint industry.

Members of the International Coordinating Committee (left to right): Federation President Howard Jerome; Dr. Kenji Uecki, President of the Japan Society of Colour Material; Prof. Andre Toussaint, President of FATIPEC; William Griffiths, of OCCA-Australia; Charles Hansen, of the Scandinavian Association, SLF; and Donald Morris, President of OCCA

Recipients of the 1982 Paint Show Awards were (left to right): Richard Saskiewicz, of Rohm and Haas Co.; Cindy Byrne, of Angus Chemical Co.; Kenneth Breindel, of Diamond Shamrock Chemical Co.; Peter Birrell, of Dominion Colour Co. Ltd.; Al Krumholtz, of Chicago Boiler Co.; and David Malthouse, of Applied Color Systems, Inc.

Atlas Electric Is Cited At 1982 Paint Industries' Show

Atlas Electric Devices Co., Chicago, IL, was cited recently for having been an exhibitor for 40 years in the Paint Industries' Show, sponsored by the Federation of Societies for Coatings Technology.

A plaque commemorating the occasion was presented to Atlas by the Federation during the 47th Paint Show, held November 3–5 at the Sheraton Washington Hotel in the nation's capital.

This brings to eleven the number of exhibitors so honored by the Federation. In 1975, 40-year plaques were presented to Cities Services Co., Rohm and Haas Co., and Union Carbide Corp.; In 1976, to Reichhold Chemicals, Inc., and Tenneco Chemicals, Inc.; in 1977, to Hercules, Inc.; in 1979 to Ashland Chemical Co., Neville Chemical Co., and Spencer Kellogg Div-Textron, Inc.; and in 1981 to Cargill, Inc.

Six Exhibitors Win Paint Show Awards

Angus Chemical Co., Applied Color Systems, Inc., Chicago Boiler Co., Diamond Shamrock Corp., Dominion Colour Co. Ltd., and Rohm and Haas Co. were recipients of the C. Homer Flynn Awards at the 1982 Paint Industries' Show of the Federation of Societies for Coatings Technology, held November 3–5 at the Sheraton Washington Hotel in Washington, D.C.

These awards are for outstanding exhibits in the Show on the basis of technical excellence, educational value, attractiveness, and novelty. The awards are divided into three catagories: Raw Material Suppliers (single, double, 3–5, and 6-plus booth exhibits), Equipment Manufacture, and Service Industries.

The prizes (engraved plaques) were awarded as follows:

RAW MATERIAL SUPPLIERS:

Single-Booth Exhibit—Dominion Colour Co. Ltd., Toronto, Ont. (2 years in Show).

Double-Booth Exhibit—Diamond Shamrock Corp., Morristown, NJ. (27 years).

Three-to-Five-Booth Exhibit—Angus Chemical Co., Northbrook, IL (31 years).

Six-or-More-Booth Exhibit —Rohm and Haas Co., Philadelphia, PA (47 years).

EQUIPMENT MANUFACTURING: Chicago Boiler Co., Chicago, IL, (23 years).

SERVICE INDUSTRIES: Applied Color Systems, Inc., Princeton, NJ (13 years).

President Jerome presents 1982 Mattiello Memorial Lecturer Shelby F. Thames with a certificate of appreciation for his presentation "Bunte Salts as Cross-Linking Agents in Thermosetting Water-Borne Polymers"

Margaret Allison, Veronica Behan, and Helen Keegan served as hostess for the Spouse's Wine and Cheese reception

Members of the 1982–83 Executive Committee. Front Row (left to right): Treasurer—Joseph A. Bauer, Porter Paint Co., Louisville, KY; President—A. Clarke Boyce, Nacan Products Ltd., Toronto, Ont.; President-Elect—Terryl F. Johnson, Cook Paint & Varnish Co., Kansas City, MO. Back Row (left to right): John T. Vandeberg, DeSoto, Inc., Des Plaines, IL; Fred G. Schwab, Coatings Research Group, Inc., Cleveland, OH; Horace S. Philipp, Sherwin-Williams Co., Montreal, Que.; and Immediate Past-President—Howard Jerome, Spatz Paint Industries, Inc., St. Louis, MO.

Milton A. Glaser, Elected Federation Honorary Member

The Federation of Societies for Coatings Technology is pleased to announce that Mr. Milton A. Glaser was elected to Honorary Membership by its Board of Directors during the Federation's Annual Meeting, held November 3–5 in Washington.

Mr. Glaser, a consultant to the coatings industry, is a Past-President of the Federation and the Chicago Society, as well as the Paint Research Institute. He has served as Chairman of many Federation Committees, including 17 years as it representative to IUPAC and, most recently, as Chairman of the Liaison Committee.

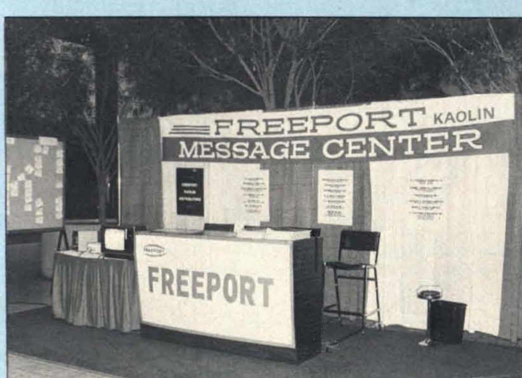
He was the recipient of the George Baugh Heckel Award in 1963, and was the Federation's Mattiello Lecturer in 1974.

Mr. Glaser retired from Midland Div. of the Dexter Corp. in 1978 and established a consulting service specializing in innovation enhancement of R&D laboratories. On July 22, 1982, Midland-Dexter dedicated its new research facility as the Milton A. Glaser Research Laboratories, in Waukegan, IL.

Opening Session kicks-off the 1982 Annual Meeting and Paint Show

Registrants crowd the aisles of the exhibition area on the opening day of the Paint Show

Program speakers were pleased with the high attendance of program sessions



The Freeport Kaolin Message Center was augmented this year with TV monitors placed throughout the Sheraton lobby

The Manufacturing Committee sponsored its Seminar on "Computers in the Coatings Manufacturing Process"

Overseas and Federation members attended the Liaison Committee luncheon sponsored by the Federation

Dr. Raymond Myers, Retiring PRI Research Director, Is Honored at Annual Meeting PRI Symposium

Dr. Raymond R. Myers is awarded a certificate of appreciation by Federation President Howard Jerome and PRI President Peter Robinson

Dr. Raymond R. Myers, who retired January 1 after serving 18 years as Research Director of the Paint Research Institute, was honored by PRI Trustees of the Federation at the recent Annual Meeting in Washington, D.C.

The PRI Symposium, a feature at the Annual Meeting, was dedicated to Dr. Myers, who was presented with a certificate citing his "invaluable contributions and dedication to the Paint Research Institute, the Federation, and the Coatings Industry." The certificate was presented by Federation President Howard Jerome and PRI President Peter Robinson at the conclusion of the afternoon Symposium.

In his acceptance remarks, Dr. Myers expressed his appreciation to those who assisted him during his years as PRI Research Director. He particularly thanked his friend and long-time associate, Dr. Carl Knauss, Professor of Chemistry at Kent State University, where Dr. Myers is a University Professor.

Dr. Myers was appointed Research Director in January 1964, succeeding Dr. J. S. "Shorty" Long. At the time, Dr. Myers was Research Professor of Chemistry at Lehigh University.

A graduate of Lehigh, Dr. Myers received his M.S. Degree from the University of Tennessee in 1942 and his Doctorate from Lehigh in 1952. He spent several years teaching at Tennessee and the University of Dayton before joining the Lehigh faculty in 1952 as a Research Associate. He rose to full Professorship.

Dr. Myers moved to Kent State University, Kent, OH, in 1965 as a Professor and Chairman of the Chemistry Dept. In 1977, the University Trustees named him a University Professor, the top rank at KSU. Only four other persons at KSU held that title, established to provide unusual opportunities for scholars who have demonstrated talents on a national scale.

Dr. Myers, a long-time member of the Federation, was the recipient of the Federation's George Baugh Heckel Award in 1973. Two years later, he presented the Mattiello Memorial Lecture, "A Prospectus for Basic Research," at the Federation's Annual Meeting.

In 1970, Dr. Myers received the American Chemical Society Award in the Chemistry of Plastics and Coatings, sponsored by the Borden Foundation. He was Chairman of the ACS Div. of Organic Coatings and Plastics Chemistry in 1965 and Chairman of the Gordon Research Conference on Organic Coatings in 1962. He currently serves on the ACS Council and on the Joint Board-Council Patent Committee.

Dr. Myers, who is listed in "Who's Who in the World," is the Editor of the Society of Rheology, and a member of Sigma Xi and the Oil and Colour Chemists Association. He is a Fellow of the American Institute of Chemists and the New York Academy of Science whose A. Cressy Morrison Award was presented to him in 1958.

The Symposium's program, developed by PRI Trustee Dr. Percy E. Pierce, reflected Dr. Myers' interests in that three of the presenters were former students of his at Kent State. The fourth presenter, Dr. Richard Crang, spoke on mildew control, a favorite subject of Dr. Myers.

The presentations were:

"Nondestructive Evaluation of Polymer Surfaces, Interfaces, and Films Via Ultrasonics"—*D.L. Hunston* and J.A. Koutsky, of the National Bureau of Standards, Washington, D.C.

"Characterization of Organic Coatings by Dielectric and Dynamic Mechanical Relaxation Techniques"—K. Varadarajan, of Barrington Technical Center, American Can Co., Barrington, IL.

"Thermosetting Coatings—Analytical and Predictive Capability by Chemorheology"—Dr. Richard R. Eley, Glidden Coatings & Resins Div. of SCM Corp., Strongsville, OH.

"Mildewcide Testing on Growth and Ultrastructural Response of the Fungus *Aureobasidium pullulans*"—Dr. Richard E. Crang, of the University of Illinois at Urbana-Champaign, Urbana, IL.

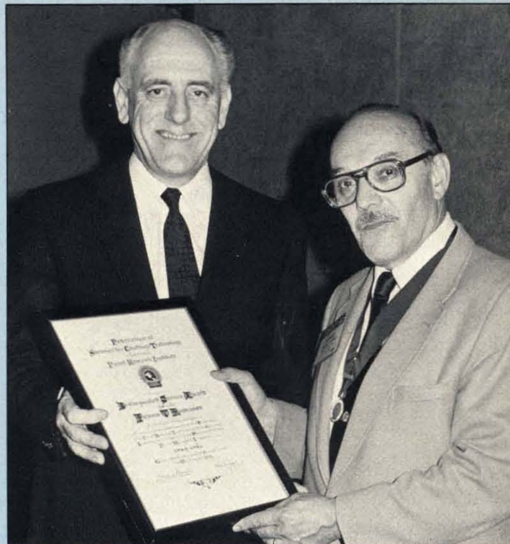
Thomas J. Miranda, of Whirlpool, Elected President of PRI for 1982–83

Dr. Thomas J. Miranda, Staff Scientist at Whirlpool Corporation's Elisha Gray II Research and Engineering Center, Benton Harbor, MI, was elected President of the Paint Research Institute of the Federation of Societies for Coatings Technology for 1982–83.

Other officers elected to serve are: Vice-President—Dr. Darlene Brezinski, of DeSoto, Inc., Des Plaines, IL; Secretary—Dr. Howard Bender, of General Motors Research Laboratories, Warren, MI; and Treasurer—Joseph A. Bauer, of Porter Paint Co., Louisville, KY.

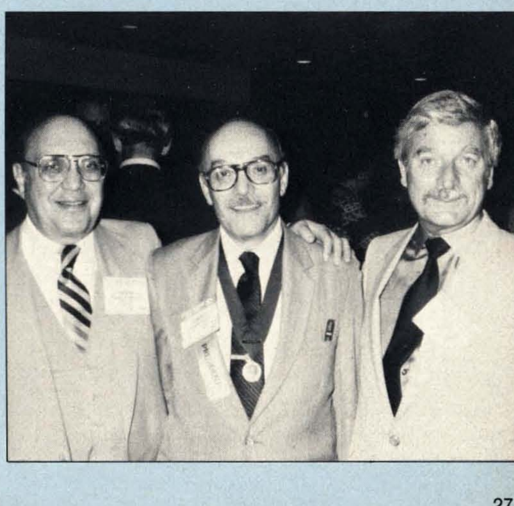
The remaining Trustees are: Mary G. Brodie, of The Sherwin-Williams Co., Cleveland, OH; Dr. F. Louis Floyd, of Glidden Coatings and Resins Div. of SCM Corp., Strongsville, OH; Dr. C. Malcolm Hendry, of Hemple Technology, Inc., Houston, TX; Dr. Loren W. Hill, of Monsanto Co., Indian Orchard, MA; Dr. Joseph V. Koleske, of Union Carbide Corp., S. Charleston, WV; Colin D. Penny, of Hampton Paint Manufacturing Co., Hampton, VA; and Dr. Percy E. Pierce, of PPG Industries, Inc., of Allison Park, PA.

Dr. Seymore Hochberg will begin his duties as Executive Director of PRI on January 1, 1983. Dr. Raymond R. Myers, the retiring Research Director, will serve as Director Emeritus.



Retiring PRI President Robinson receives certificate of appreciation from Federation President Howard Jerome

Federation Liaison Committee Reception



The Six Exhibiting Companies Which Received the 1982 C. Homer Flynn Awards

Angus Chemical Co., an exhibitor for 31 years, was awarded for its 3-to-5 booth exhibit as a raw material supplier

A 13-year exhibitor, Applied Color Systems, Inc. was cited in the service industries catagory

Chicago Boiler Co., which has been exhibiting for 23 years, was awarded in the catagory of equipment manufacturing

A 27-year exhibitor, Diamond Shamrock Corp. won in the raw materials suppliers category for its double-booth exhibit

The winner in the single-booth exhibit for raw material suppliers was Dominion Colour Co. Ltd., a two-year exhibitor

Rohm and Haas Co., a 47-year exhibitor, was awarded for its six-or more-booth exhibit in the raw material supplier catagory

1982 Paint Show Exhibits

The 1982 Paint Industries' Show of the Federation of Societies for Coatings Technology was held at Sheraton Washington Hotel, Washington, D.C., November 3-5. With 172 exhibitors, it was the second largest show in Federation history.

As a continuing service to JCT readers, we present (in the following pages) a description of the products and services which highlighted the exhibits of exhibitor companies. These are reprinted exactly as published in the Federation's "Paint Show Program," which was given to all registrants at the convention.

Any requests for information from the exhibitor companies should be sent to the JCT office (1315 Walnut St., Philadelphia, PA 19107). All inquires will be forwarded.—Ed.

ACETO CHEMICAL CO., INC.
Flushing, NY 11368

The company is offering a wide range of chemicals for the coatings industry. These include titanium dioxide, organotin compounds, antiskinning agents, electrostatic spray paint additives, UV photoinitiators, and aziridine-based chemicals.

ACT-ROPER PLASTICS
City of Industry, CA 91748

On display are polyethylene shipping containers from 3½ gallon to 6 gallon, with a broad range of covers and fitments.

AIR PRODUCTS AND CHEMICALS, INC.
Allentown, PA 18105

Emphasized is the company's broad line of Surfynol nonionic surfactants which produce significant performance improvements in various water-based systems. Live demonstrations show the many benefits that these products bring to coatings formulations, including excellent coverage over oily surfaces and defoaming. Performance results of Surfynol GA, a product specifically designed as a grinding aid for organic pigments, are also shown.

ALUMINUM CO. OF AMERICA
Pittsburgh, PA 15219

The exhibit features aluminum pigments for automotive finishes, product finishes, maintenance paints, and aluminum asphalt roof coatings. Technical personnel are available to assist visitors and provide specification and product data for all aluminum powder and flake grades.

C. M. AMBROSE CO.
Redmond, WA 98052

Equipment on display includes PF5P-81D, five-gallon filler and the new PF9BP-81D filler, filling one gallon to pints. Also displayed are machines filling by weight and units for light liquid products.

ANGUS CHEMICAL CO.
Northbrook, IL 60062

This 40-foot display highlights ANGUS Chemicals' (formally International Minerals and Chemical Corp.) full line of chemicals for coatings, including NiPar S-30® to protect your solvent system from weather, water and corrosion; AMP-95, the multi-functional additive for coatings; and Bioban CS-1135, the nonmercurial in-can paint preservative. Technical representatives are on hand to discuss the company's products and capabilities. Technical literature is also available.

APPLIED COLOR SYSTEMS, INC.
Princeton, NJ 08540

Featured is the Visual Color Simulator for color designing and communication within the paint industry. Computation of the data from the simulator is demonstrated on the newly designed ACS-550M Color Control System. Also featured is the newly released Spectrosensor II automated spectrophotometer which has integrated a number of important new features to the already accepted Spectrosensor device. An ACS-100 Quality Control System is also demonstrated in the exhibit.

ARMSTRONG CONTAINERS, INC.
Westchester, IL 60153

The exhibit features the company's line of coating containers in all sizes from 1/4 pint through tall gallons and emphasizes their new improved one-gallon Polystrong plastic paint container.

ASHLAND CHEMICAL CO.
Industrial Chemicals & Solvents Div.
Columbus, OH 43216

On display is a complete line of solvents, exempt solvents, and specialty chemicals for paint formulations. Information about the company's new chemical waste service, computerized solvent reformulation service for paint manufacturers, and their 61 bulk plants located in major markets is also available.

ATLAS ELECTRIC DEVICES CO.
Chicago, IL 60613

On display are the latest developments in accelerated weathering instruments, including the Atlas Uvcon - fluorescent UV weathering tester and Atlas LM-3 integrating outdoor light monitor system.

B.A.G. CORP.
Dallas, TX 75218

This exhibit includes flexible, semi-bulk material handling containers known as "Super Sacks"®. The Super Sack container is used for shipping and storing dry, flowable solids. It is available in sizes from 6-85 cu ft capacities. Auxiliary equipment for loading and handling is also available.

BATTELLE-COLUMBUS
Columbus, OH 43201

The company has over 50 years experience serving the paint industry through contracted research. This exhibit shows examples of the firm's technological capabilities and experiences in solving practical problems by the innovative application of multidisciplinary technology and engineering sciences. The results of applying these skills to the development of new products and processes and to solving existing materials, products, and manufacturing problems are shown.

BAUSCH & LOMB, INC.
Rochester, NY 14603

The company is displaying systems for the measurement, formulation, and correction of color. The Match-Mate 3203 computer colormatching system includes a Match-Scan II spectrophotometer, the latest computer hardware and terminals from Digital Equipment Corp. and proprietary software. New routines on display include: Infrared measurement, job queuing, easier alignment of small samples and options for plotting. All previous features are retained including automatic loading, waste work-off, batching and limited add for production corrections.

BELTRON CORP.
Red Bank, NJ 07701

This booth display introduces a new, automatic, electronic filling machine, with one moving part, that cleans up in one minute using one quart of solvent. This new generation filling system remains 99.9% accurate after years of service and can be run by an inexperienced operator.

BEROL CHEMICALS, INC.
Westport, CT 06880

Bjorn Borg can't make it this year, but other specialists from Sweden are introducing the company's line of Bermocoll E cellulosic thickeners for water-based paints. Bermocoll E is ethyl hydroxyethyl cellulose, available in several grades of a broad viscosity range. A unique display of Bermocoll's chemical structure and performance attributes is provided.

BLACKMER PUMP DIV.
Dover Corp.
Grand Rapids, MI 49509

Products exhibited include the company's complete line of pumps designed for the coatings industry for handling solvents, resins, emulsions, pigment paste and finished products. Flow rates range from 5 to 700 GPM with differential pressures to 150 PSI.

BRINKMANN INSTRUMENTS, INC.
Westbury, NY 11590

Featured is the Mini Spray Dryer for research work on preparation of new, or revision of old, formulations of pigments and dyes. It is applicable for small lab runs, and features easy cleanup and minimal turn-around time. Space consumption is only 2 × 2 × 3'. This is the only model available on the market.

BROOKFIELD ENGINEERING LABORATORIES, INC.
Stoughton, MA 02072

The company is exhibiting a complete line of instrumentation for the measurement and control of viscosity. New this year is the Wells-Brookfield Cone/Plate Digital viscometer, which can continuously measure and record the absolute viscosity of a variety of paint and coating products.

BUCKMAN LABORATORIES, INC.
Memphis, TN 38108

The exhibit features the latest development of nonmercurial fungicides and bactericides for coatings preservation, as well as nonlead nonchromate corrosion inhibitors for metal coatings. Personnel are available to discuss formulations and application. The company is a manufacturer of microbiocides, corrosion inhibitors, dispersants, defoamers, flame retardants, and catalysts.

BURGESS PIGMENT CO.
Sandersville, GA 31082

Savings and improved quality are demonstrated with Thermo-Optic Silicates. From TiO_2 reductions, upwards of 75 lbs/100 gal, in exterior paints to low cost interior contractor lines examples are presented with panels depicting exacting formulation approaches to maximizing performance.

BYK-MALLINCKRODT USA, INC.
Wallingford, CT 06492

This year's exhibit displays panels evidencing performance benefits of utilizing the company's new wetting agent for carbon black, Disperbyk 130; powdered anti-float agent, Byk LP-5018; efficient defoamer, Byk Defoamer 080. Also, panels displaying advantages of using blocked pTSA catalysts; Anti Terra 202 for anti-sag properties; and Byk 341 for substrate wetting are available for viewing. The display of instruments features a new item, the full line of "Dispermat" dispersers.

CABOT CORP.
Cab-O-Sil Div.
Tuscola, IL 61953

The corporation's centennial year and the Cab-O-Sil® Division's 25th anniversary features the new hydrophobic N70-TS and its applications in corrosion-resistant primers and epoxy coatings. Also featured are the properties of hydrophilic Cab-O-Sil® fumed silica and its applications as an anti-sag, anti-settling agent in high-solids coatings. Reprints are available of the technical paper presented.

CARGILL, INC.
Minneapolis, MN 55440

The booth features water-extendible high-solids resins for industrial coatings. Agrisource resins are introduced which are designed to minimize the dependency of raw material sources from oil or gas wells. A new line of epoxy resins with liquid, solution and epoxy esters are now available. New resins for high-solids, water-reducible and powder coatings are shown. The famous "Helping Hand" is outreached through technical sales-service people, technical brochures and coating formulations, and a new resin catalogue for U.S. coating manufacturers.

CDI DISPERSIONS
Newark, NJ

New high tint strength blacks, phthalo blues, and phthalo greens in alkyd, aqueous, and universal type vehicle systems are featured. The exhibit also includes information on standard and custom-designed pigmented dispersions available in various types of vehicles. Blacks, colors, and conductive compounds are specialties of the company.

CELANESE CHEMICAL CO., INC.
Dallas, TX 75247

Application technology for ultraviolet and electron-beam cured systems for adhesives, inks, and coatings are featured. Emphasis is given to the use of multifunctional monomers in high-solids and water-borne systems, as possible solutions to energy conservation and environmental problems.

CEM CORP.
Indian Trail, NC 28079

The exhibit features the company's newest model Moisture/Solids Analyzer, AVC-80, and a Microwave Drying/Digestion System, MDS-81. The AVC-80 provides for a rapid and accurate method for solids determinations in paints and coatings. The instrument utilizes microwave drying and is applicable to liquids, solids, and slurries. The MDS-81 is a general purpose microwave system for rapid drying, evaporations, chemical digestions, and numerous other applications.

CERTIFIED EQUIPMENT & MFG. CO.
Springfield, IL 62705

The company has provided bulk storage and handling systems to a variety of industries for more than 35 years. Our experienced sales and engineering staff welcome the opportunity to serve you and promise to fulfill your requirements promptly and professionally.

CHEMICAL AND ENGINEERING NEWS
American Chemical Society
Washington, DC 20036

The display features *Chemical and Engineering News*, a chemical newsweekly and the official publication of the American Chemical Society. C & EN is designed to perform a double, but related, function. It keeps readers informed of all the news of the chemical world, generally, as it interrelates with the world at large, and of policies and activities of the ACS.

CHEMISCHE WERKE HÜLS AG
4370 Marl, West Germany

The company's agents: Huels Corp.; Thorson Chemical Corp.; and Kingsley and Keith; are featuring isophorone derivatives, aliphatic isocyanates, and aliphatic epoxy coating systems. Also on display are: Nylon 12 coating powders; special purpose resins such as acetophenone/formaldehyde: urethane modified keton. Samples and coatings produced with these products are on exhibit. Technical advice and brochures are available.

CHICAGO BOILER CO.
Chicago, IL 60614

This 30-foot display highlights the company's full line of small media mills for the coatings industry. On display are numerous sizes of laboratory thru production "Red Head" open vertical mills and sealed horizontal Dyno-Mills. The various grinding medias used with these mills are also displayed. Representatives of both divisions are available to provide technical assistance and discuss specific application needs.

CLAWSON TANK CO.
Clarkston, MI 48016

On display are a complete line of portable shipping containers featuring the Jumbo™ Bin and Jumbo™ Drum. These containers, which may be used for storing, transporting, and processing liquid and dry materials, are on display along with accessory items. Information regarding Jumbo™ Bins and Drums may be obtained by picking up a new brochure, available at the booth.

COLOR CORP. OF AMERICA
Div. of The Valspar Corp.
Rockford, IL 61101

On display are the merchandising aids utilized in both the Color Studio and Decorator Trade Sales Tinting Programs. The Decorator Program is brand new and features the POPAI award winning chip strip displays.

COLUMBIAN CHEMICALS CO.
Tulsa, OK 74102

"Quality, Dependability, Bottom Line Performance" is the company's 1982 theme. Highlighted are a new line of easy-dispersing Mapico® synthetic red iron oxides and Raven® 5000, an innovative, high-color, automotive-quality carbon black.

COMMERCIAL FILTERS DIV.
Kennecott Corp.
Sanborn, NY 14132

The company is exhibiting Fulflo® filters and cartridges, used for a variety of filtrations within the paint industry.

CONTINENTAL FIBRE DRUM CO.
Stamford, CT 06904

On display are the company's latest fibre drums designed especially for water-based paints and powder coatings. Included are samples of new Liquipak® drums with linings made of LDPE and aluminum foil for the containment of products with high moisture content. Drums with modified copolymer linings for hard to hold additives and more sophisticated polyester laminates for products containing solvents are also on display.

CORDOVA CHEMICAL CO. OF MICHIGAN
North Muskegon, MI 49445

This exhibit features the use of XAMA®-2 and XAMA®-7 Polyfunctional Aziridines as crosslinkers, wet adhesion promoters, and modifiers for coatings systems. Information is also available on Corcat® Polyethylenimines and Cordova Accelerators AMC®-2 and ATC®-3 epoxy curing agents.

COSAN CHEMICAL CORP.
Carlstadt, NJ 07072

Two new biocides, Cosan 101—a liquid and Cosan 265—a powder, are featured. Both products, designed for water-based systems, have a broad spectrum of activity against gram positive as well as gram negative organisms. Personnel are available to discuss these products as well as the company's complete line of fungicides, bactericides, driers, chemical specialties and catalysts.

CUSTOM CHEMICALS CO.
Elmwood Park, NJ 07407

The exhibit highlights a complete line of aqueous colorants available as fine powders or pourable paste. These colorants are designed to enable the coatings industry to meet stringent environmental regulations. Included in this color line is a shelf-stable, aqueous aluminum pigment concentrate for use in water-based or water-reducible paints or inks. The popular Mikrolour® pigment dispersions for industrial coatings are also displayed.

DANIEL PRODUCTS CO.
Jersey City, NJ 07304

Emphasis is on problem-solving additives for high-solids, water-thinned, and conventional coatings. Featured are displays showing the benefits of Slip-Ayd surface conditioners for resistance to marring and metal-marking; Dapro interfacial tension modifiers for resistance to cratering and crawling; Disperse-Ayd pigment dispersing agents; and Dapro foam suppressors. Technical experts are on hand to discuss these products and to provide complete data on Tint-Ayd pigment dispersions for most industrial and trade sales coatings applications.

DEGUSSA CORP.
Teterboro, NJ 07608

The exhibit features Aerosil® 200 for thixotropy and anti-settling of pigments, Aerosil® R972 for corrosion-resistant coatings and Flatting Agent OK412 for efficient flatting of clear and pigmented coatings.

DIAMOND SHAMROCK CORP.
Process Chemicals Div.
Morristown, NJ 07960

On display is a presentation of the company's specialty additives for paint: Nopcocide® N-96 and N-40-D Fungicides, defoamers, and dispersants. The exhibit also introduces a new emulsifier for polymerization, Trem®LF-40. All these products demonstrate the division's problem-solving capabilities in coatings technology.

D/L LABORATORIES
New York, NY 10003

"Consultants to the Industry" is the highlight of the display. The booth features examples of the services provided to the coatings, caulks and sealants, and plastics industry, including formulation, testing and evaluation, corrosion studies, inspection, industry and market surveys, market development, preparation of specifications and manuals, personnel training and legal assistance. Key personnel are available to discuss your ideas and problems.

DOMINION COLOUR CO. LTD.
Toronto, Ontario, Canada M8V 2E9

The exhibit displays a selection from the broad range of the company's inorganic and organic color pigments for the coatings, plastic and graphic arts industries. These pigments are sold by 20 distributors, worldwide. Highlights include nonlead alternatives, panels displaying color quality and durability, literature on specific pigments and their applications, as well as technical personnel to participate in confidential discussions and recommendations. Representatives from our distributor network welcome their customers.

DOW CHEMICAL U.S.A.
Midland, MI 48640

Chlorothene SM® and Aerothene MM®, chlorinated solvents exempt from State Implementation Plans in most states, D.E.R.® epoxy resins, and a representation of the broad line of products designed for coatings manufacturers by this foremost supplier to the coatings industry are displayed. Sales and technical information are available for select Dow-developed products and technologies.

DRAISWERKE, INC.
Allendale, NJ 07401

The company presents the newest additions to their product line, including a continuous Vacuum Perl Mill for grinding, dispersing, and de-aerating highly viscous, hard to grind, and heat sensitive products. Also on display is a Direct Dispersion System which completely eliminates pre-mixing and pre-dispersing. The highlight of the exhibit is the re-designed modular agitated bead mills which promise to increase versatility and simplicity of mill operations. Constructed in a modular fashion, they utilize state-of-the-art micro processors and computers. They are available in various designs.

DREW CHEMICAL CORP.
Boonton, NJ 07005

Featured at this booth are the chemical additives most needed by today's paint formulators. Defoamers especially effective in high gloss systems, products to eliminate compatibility problems, i.e., flow and levelling aids, wetting agents, anticratering agents and our newest low cost, high solids defoamer line are all highlighted. Case histories and product literature are available and marketing and technical personnel are present to supply additional information and answer all questions.

DSET LABORATORIES, INC.
Phoenix, AZ 85029

The booth contains a full line of outdoor weathering services for the coating industry. These services include both Arizona and Florida exposure. In addition, the EMMAQUA® Test Method, which uses natural sunlight to accelerate the weathering processes, is displayed. Diagnostic measurement services are highlighted as an essential element of all weathering evaluation programs. We're here to serve you. Please come visit with us.

EASTMAN CHEMICAL PRODUCTS, INC.
Kingsport, TN 37662

Featured are solvents for high-solids and water-borne coatings, solvents for electrostatic spraying lacquer, replacement solvent for certain glycol ethers, and Texanol coalescing aid. Low cost wood coatings based on CAB, wet-on-wet and dry-on-wet coatings are shown, as well as inks and overprints based on CAP, and glycols and intermediates for high-solids and water-reducible air dry alkyds, polyester coil coatings, low bake powder coatings.

EBONEX CORP.
Melvindale, MI 48122

Examples of areas where the company's line of specialty black pigments can be used to advantage are presented.

EIGER MACHINERY, INC.
Bensenville, IL 60106

Motormills, the unique direct-drive horizontal bead mill are featured. For Q.C. and R & D, the 'Mini' Motormill is the world's smallest fully self-contained 50ml bead mill, making 100 to 350ml samples in minutes. New at the show is the self-contained 'Mini' 250ml for larger samples of 250 to 1000ml. The dual purpose inter-changeable .75L/1.25L chamber Motormill is used for lab & small batch requirements. Production Motormills include the 40 liter HTM, capable of 500 GPH whites and the 75 liter for producing colors at 250 to 500 GPH.

ELEKTRO-PHYSIK, INC.
Virginia Beach, VA 23455

The company, a wholly-owned subsidiary of one of the oldest and most experienced manufacturers of precision tools for the measurement of paint and plating thicknesses on all metals (Elektro-Physik Koln), is displaying the following gages: Pentest, Mikrotest, Certotest, Minitest, Minitest FD Digital (our newest addition, which offers a digital read-out and extremely high accuracy), Elektrotest, Porotest, and the Galvanotest.

EM CHEMICALS
Hawthorne, NY 10532

This exhibit presents the Afflair® pearl lustre line of titanited mica pearl pigments. You are invited to view the many unique features inherent in the use of these products. See the entire line of Afflair® products displayed for your viewing. The use of these products in plastics and coatings is limited only by the imagination. Available, also, are the Iriodin® line of lead carbonate products and Darocur® photoinitiators.

ENGELHARD CORP.
Minerals & Chemicals Div.
Iselin, NJ 08830

Costs down, quality up. We've got the evidence. You be the judge! See for yourself. Our versatile extender pigments push cost per gallon down, keep quality up, across a surprising range of paints. And our practical-minded coatings research can prove it. Join us at booth 506-508 at the Paint Show. Ask for our specific formulas and eye-opening draw-downs. You'll see how our extender pigments can be used in many systems, aqueous or solvent-based, high PVC or low—how they maintain or improve film appearance and optical characteristics—and how they cut your production costs.

EPWORTH MANUFACTURING CO. INC.
South Haven, MI 49090

The company's brand-new X-Entri Mill is presented. It offers high-efficiency grinding for coatings of the 80's, with lower horsepower, higher thru put, closed system, and temperature contolled grinding for smaller investment cost. In addition, the SWMill is displayed, designed for batch operation for finished product within an hour. See this booth for a full line of ball and pebble mills, high quality medias of all types, and the all new X-Entri Mill.

ERWIN, SCHAFER, & ASSOCIATES, INC.
Louisville, KY 40223

The exhibit features computer software designed and implemented especially for the paint and coatings industry. Information is displayed and distributed concerning profitable opportunities, both in the office and plant, utilizing this specialized computer software. The software includes computerized formulations, RM requirements, batch ticket preparation, raw material and finished goods inventory reports, purchasing reports, and inquiries plus all financial applications.

FAWCETT CO., INC.
Richfield, OH 44286

On display are the company's air-operated mixers, stirrers, and accessories. Also displayed is the company's new air-driven disperser.

FEDERATION OF SOCIETIES FOR COATINGS TECH.
Philadelphia, PA 19107

Featured is a display of Federation publications and educational and training aids. Publications on display include "An Infrared Spectroscopy Atlas for the Coatings Industry," the "Paint/Coatings Dictionary," the "Glossary of Color Terms," the new edition of the "Pictorial Standards of Coatings Defects," the 27 booklets in the Series on Coatings Technology, the *Journal of Coatings Technology*, and the 1982 Membership Directory (Year Book). Federation slide/tape training programs are also displayed, along with the Color-matching Aptitude Test Set.

FILTER SPECIALISTS, INC.
Michigan City, IN 46360

A full line of liquid bag filters, filter bags, and accessories for the process industry is on display. Introduced are new, in-line strainers from 6" to 16" pipe size. Technical personnel are in attendance to discuss applications and processes.

FREEPORT KAOLIN CO.
New York, NY 10166

Discover your friends at the Freeport Message Center. We, the innovators of the Kaolin industry, hope that you enjoy and benefit from the Federation convention.

FRICKE ENTERPRISES
Granite Falls, WA 98252

The following machines are on display: Model 12-M-P roll-thru type Closer for ¼ pt. to 1 gal. steel friction lids and 1 gal. to 6 gal. plastic lids; also, equipment and attachments for the efficient filling and sealing of containers for the paint industry. You are invited to visit our exhibit and discuss new and better ways of increasing your productivity.

FRYMA, INC.
Middlesex, NJ 08846

This exhibit features the CoBall-Mill, a new and unique design of media mill. Niether a vertical nor a horizontal mill, the CoBall-Mill represents a new technology in the fine grinding of pigmented products. Using a narrow, winding path, small volume of grinding chamber, the CoBall-Mill achieves a high grinding efficiency at low cost. A mill made of plexiglass is displayed to demonstrate the internal structure of this very different and interesting concept.

GAF CORP.
New York, NY 10020

This exhibit emphasizes a "Solvent Safety" theme with its low toxic, specialty solvents. Also featured are surfactants for water-based coatings, polymeric dispersants for solvent-based, high-solids coatings, and reactive monomers, oligomers, and coatings for UV/EB radiation-curing technology. Products are: M-Pyrol®, THF®, BLO®, Butanediol, V-Pyrol®, Gafgard™, Alipal®, Blancol®, Gafac®, Ganex®, Igepal®, Nekal®, and Thickener LN®.

GEORGIA KAOLIN CO., INC.
Elizabeth, NJ 07207

The company is exhibiting several new TiO_2 extender pigments for both flat and semi-gloss applications. Among the new products featured are Altowhite™ TE calcined aluminum silicate which has low gloss characteristics with exceptional hiding power; and Kaomer™ 350 hydrated aluminum silicate, an ultra fine platy kaolin with excellent brightness and whiteness for semi-gloss emulsions. The company's complete line of calcined, delaminated, and hydrated aluminum silicates are also displayed.

THE GOODYEAR TIRE & RUBBER CO.
Akron, OH 44316

The company introduces a newly-developed, Pliolite, water-reducible resin for use in exterior and interior coatings on concrete and masonry surfaces. The new resin is water reducible but not water sensitive, and matches or exceeds the properties of the company's standard, solvent-based resins. It meets air-quality regulations and is easy to disperse. The firm also demonstrates their fast-drying traffic paints with high shear stability; clear coatings with excellent clarity; and water-proofing sealers with high build and good breathability.

W. R. GRACE CO.
Davison Chemical Div.
Baltimore, MD 21203

Visit our booth for up-to-date information on our high-efficiency flatting agents for: trade sales varnish, vinyl topcoats, high-solids industrial finishes, coil coatings and clear wood finishes.

GRACO, INC.
Minneapolis, MN 55440

The company is introducing the new Auto Tint 8000 automatic colorant dispenser. Also featured is the MT80 manual colorant dispenser, the Colormatic semi-automatic dispenser, and the Auto Sperse high-speed paint mixer. The firm manufactures a line of tinting equipment for accurate, repeatable dispensing at all levels of business.

GREGORY GROUP, INC.
North Bergen, NJ 07047

Explosion proof, UL approved, rider and pedestrian operated lift trucks for use in Class I, Group D, Division 1 and Class II, Group G, Division 1 locations are featured. Latest developments in construction and features are demonstrated in the EX unit on display. Photos of other, special lift trucks and details of air-operated handling equipment for other hazardous locations are available at the booth. Many units can be designed to meet user specifications for special applications.

HALOX PIGMENTS
Pittsburgh, PA 15220

Corrosion-resistant and tannin stain-blocking pigments, free of lead and chromate, are featured. Performance in water-emulsion, water-reducible and traditional solvent-thinned systems is demonstrated. Strong emphasis is placed on coatings, formula recommendations and guidance which satisfy regulations pertaining to air quality, work practices, safe handling, transportation and disposal.

HARSHAW CHEMICAL CO.
Cleveland, OH 44106

On display is an "acid rain" test cabinet which creates acid rain within the controlled environment of a 300 liter chamber. Also exhibited is a "salt fog" test cabinet which performs various automotive, governmental, and A.S.T.M. tests.

HARSHAW CHEMICAL CO.
Cleveland, OH 44106

Visit the "People Who Know Color" and sample our full palette of colors for architectural, OEM, and special purpose coatings. See our new Auracryl™ dispersions for OEM and industrial water-borne coatings, as well as our spectrum of inorganic and organic dry colors, and aqueous, resin and universal dispersions.

HENKEL CORP.
Minneapolis, MN 55435

The Resins Division exhibit presents G-Cure® acrylic resins for gloss retentive urethane coatings; Versamid® polyamide resins, the industry standards for industrial and maintenance coatings; Genamid® amidoamine resins for higher solids, higher build coatings; and resin systems for CARB compliance in water-borne and water-reducible coatings.

HERCULES INCORPORATED
Wilmington, DE 19899

The exhibit features nitrocellulose, Natrosol® hydroxyethylcellulose, and Parlon® chlorinated rubber. A twice life-size drum, symbolic of the commercial nitrocellulose drum, appears modified to show all the extra features that accompany this product to the customer. New resins and Pulpex™ synthetic pulp are on display. Specialists able to discuss the company's Pentaerythritols, Pamolyn® fatty acids, Hercoflat® polypropylene texturing and flattening agent, Di-Cup® dicumylperoxide, Vul-Cup® vulcanizing agent, ethylcellulose and EHEC are available to disperse literature and answer customer questions.

DR. HANS HEUBACH GMBH & CO. KG
Goslarer Farbenwerke
Langelsheim, Germany

On display is the company's full production range: zinc oxides, zinc dust, lead oxides with low dust properties, innovative chromium yellow and molybdate red pigments of high properties and also new anti-corrosive pigments on phosphate base free of any heavy metals to improve health and safety at work without loss of efficiency.

HILTON-DAVIS CHEMICAL GROUP
Cincinnati, OH 45237

"Extraordinary Colorant Concepts and Quality" is the theme of this exhibit. A wide spectrum of high-quality colorants for the coatings industry are featured. Highlighted are new water-based and solvent-based dispersions for high-solids aqueous industrial and trade sales applications. Technical literature is available on specific colorant systems.

HOCKMEYER EQUIPMENT CORP.
Harrison, NJ 07029

Featured is a demonstration of high-speed dispersion as it compares to low-speed agitation. The effects of speed and baffles are shown, as they relate to different viscosity products. All blade styles are available for inspection and discussion. Also featured is the improved design model 2L, 2 horsepower laboratory variable-speed discperser.

HOOKER CHEMICALS & PLASTICS CORP.
Niagara Falls, NY 14302

Ferrophos® enhancer for zinc-rich protective coatings is featured. Ferrophos provides improved weldability and topcoatability while retaining full corrosion resistance. Developed as a partial substitute for zinc dust in zinc-rich primers, the enhancer also improves adhesion and conductivity.

HOOVER UNIVERSAL, INC.
Memphis, TN 38119

Bulkdrum, a new, economical 275 gallon liquid shipping container is exhibited. Bulkdrums offer the handling advantages of semi-bulk containers at prices competitive with drums. Bulkdrums are completely self-contained. Rigid high density polyethylene inner tank is encased in galvanized steel and affixed to its own wooden pallet.

J. M. HUBER CORP.
Havre de Grace, MD 21078

Amorphous precipitated silica and silicate pigments are featured. Functional spacing pigment to reduce RMC in trade sales coatings, low cost flatting pigment for solvent and water-reducible systems, and cost effective silica thixotrope for epoxies and other systems are also displayed.

HUNTER ASSOCIATES LABORATORY, INC.
Reston, VA 22090

The display features LabScan, the company's newest spectrocolorimeter which has just been added to their product line of color and appearance measuring instruments. LabScan is a full scanning spectral based colorimeter which measures color difference, detects metamerism, and provides precise spectral analysis of raw materials and finished products in 1.6 seconds. Also shown is the D25-9 microprocessor based colorimeter, the D48-7 modular specular glossmeter, and the Dorigon.

ICI AMERICAS, INC.
Wilmington, DE 19897

Something truly new and newsworthy is introduced by the company in the form of Haloflex 202 latex, a vinyl acrylic copolymer that can be formulated into primer paints for steel protection. These water-based, air-drying coatings emit no volatile organics while drying, but, more important, perform in a manner far superior to conventional latexes.

IDEAL MFG. & SALES CORP.
Madison, WI 53704

Information on the company's full line of filling and sealing equipment for the coatings industry is available. The exhibit features advanced design of semi-automatic, fully-pneumatic filling and sealing equipment with capacities from ½ U.S. pints to 5 Imperial gallons. Also displayed is their simplified, automatic lid dropper and other accessories to increase production efficiency.

INTERSTAB CHEMICALS, INC.
New Brunswick, NJ 08903

Serving the paint and coatings industry since 1931, the company is featuring additives for water-reducible coatings. Also presented is literature on a complete line of driers, defoamers, wetting agents, biocides and anti-skinning agents. The company is a wholly owned subsidiary of Akzo Chemie, Amesfoot, the Netherlands. Come try your hand at dart throwing and win some interesting gifts.

ISC ALLOYS LTD.
Bloxwich, Walsall, England

Exhibited is Delaphos 2 zinc phosphate, a nontoxic, white pigment conforming to BS5193 "zinc phosphate pigment for paints," and designed for ease of dispersion. It has found widespread use as a replacement for the highly toxic lead and chromate based anticorrosive pigments, in a wide variety of media. Delaville zinc dusts, providing the highest corrosion protection, are available in grades to suit particular formulae. Advanced processing and blending techniques provide top quality products to meet customers' individual requirements.

JOHNSON WAX
Racine, WI 53403

The exhibit features the company's line of polymer products for industrial coatings. Included are solvent-borne vehicles for low VOC coatings and water-borne, rheology controlled polymer emulsions for general metal finishing and wood coatings.

KAY-FRIES, INC.
Member Dynamit Nobel Group
Rockleigh, NJ 07647

The exhibit features product displays and technical information on the company's full line of polyester resins, ethyl silicates, silanes, and titanates. As a leader in polyester resin technology, thirty (30) polyester resins are available for all your coating requirements. For all inorganic, zinc-rich coating requirements, the company has the ethyl silicates to meet your needs. Special emphasis is given to cost/performance opportunities of inorganic zinc rich primer systems. Organo functional silanes and titanates are available to increase productivity, improve adhesion and improve pigment and filler dispersion.

KENRICH PETROCHEMICALS, INC.
Bayonne, NJ 07002

The exhibit features field samples and data on the use of Ken-React titanate coupling agents to replace metal chromates in polyamide-cured epoxy; increase productivity; improve pigment dispersion; reduce viscosity; increase sand loadings to epoxy flooring compounds; promote adhesion; lower bake temperatures; achieve high solids and solvent elimination; prevent corrosion; improve acid resistance; and increase scrubbability and prevent flash rusting in latex paint. Kenplast ES-2 (cumylphenyl acetate), a nonmutagenic epoxy reactive diluent, is offered.

KTA-TATOR, INC.
Pittsburgh, PA 15275

The company is exhibiting a comprehensive line of field coating equipment for ambient conditions, surface cleanliness and profile, film thickness and adhesion. Featured in the exhibit is a complete line of high-voltage pinhole and holiday detectors. The company is also featuring a new, digital handheld coating thickness gage. KTA coatings consultants, failure and analysis, laboratory testing and inspection services are also present.

LABELETTE CO.
Forest Park, IL 60130

LAPORTE (UNITED STATES) INC.
Hackensack, NJ 07601

Pigments for the paint industry are on display. In addition to the company's own manufactured titanium dioxide they are now marketing a full range of pigments for the paint industry, including organic and inorganic colored pigments, anti-corrosive pigments, and fluorescent colors. Additionally, Laponite, a synthetic clay, and Caprolactone monomer are being shown.

LIQUID CONTROLS CORP.
North Chicago, IL 60064

On display are a series of positive displacement liquid meters. These include an M-7-NX 100 GPM, 150 PSI electric demonstrator model, an MS-7 spherical steel case 100 GPM, 150 PSI model, and the series 1000 Electronic Liquid Batch Controller. The series 1000 Batch Controller is designed for interfacing with the company's positive displacement meters and control valves to provide a remote electrically controlled, accurate, reliable, and (when desired) repeating batching system.

LORCON CHEMICALS INC.
Dorval, Quebec, Canada H9P 2N9

The use of the company's JK 270 resin in a wide variety of applications is shown. These include emulsion systems and alkyd applications. Clears, stains, primers, industrial finishes and traffic paints are on display. Formulations to meet CARB requirements are illustrated.

3M COMMERCIAL CHEMICALS DIV.
St. Paul, MN 55144

This booth features a broad range of epoxy curing agents, UV cure initiators, diluents, wetting agents, flow control agents and fluorochemical surfactants. These materials are designed for high solids and 100% epoxy systems.

MACBETH
Div. of Kollmorgen Corp.
Newburgh, NY 12550

The company introduces its new Series 1500/Plus color measurement system which features nonvolatile memory; and the CMS/III color matching system for formulation and batch correction. In addition, the Series 1500 color measurement system; the SpectraLight color matching booth, equipped with the three most common light sources; and the Munsell Book of Color, color vision tests, color standards and tolerances are exhibited.

MANCHEM, INC.
Princeton, NJ 08540

The booth features the use of aluminum organic compounds as solutions to difficult coatings problems. Featured is Manalox 403/60.WS, a nonsilicone water-repellent for brick, stone, cement, and wood. Aluminum organic compounds for high-solids are also exhibited.

MANVILLE PRODUCTS CORP.
Denver, CO 80217

The company's Celite® functional fillers, Micro-Cel® extenders, and fiber glass and yarn-wrapped filter cartridges are on display.

MATTER MIXERS, INC.
Bluffton, IN 46714

Equipment on display includes the Model MR1, a one horsepower small batch disperser with variable speed drive, manual hydraulic lift, and a capacity range of one quart to five gallons; and the Model MC25, a 25 horsepower disperser with variable speed, air/oil lift and a capacity range of 50 to 250 gallons. Also on display is the company's impeller designed for dispersing solids or liquids in liquid materials.

MEADOWBROOK CORP.
Subsidiary of T. L. Diamond & Co., Inc.
New York, NY 10112

Featured are high-quality zinc-dust pigments produced at the company's West Virginia smelter. Included is its low-micron, high-metallic zinc dust.

MEARL CORP.
New York, NY 10017

The company's Pearl Pigments Div. displays high-luster coatings based on nonlead, nonmetallic "metallic-like" pearl pigments. Also exhibited are several new weather-resistant grades intended for long-term exterior exposure. The Franklin Mineral Products Div. displays advantages of high-quality, wet-ground mica in a variety of coating applications. Representatives of both divisions are available.

MERCK & CO., INC.
Rahway, NJ 07065

The display introduces Tektamer® 38 A.D., an important new preservative for water-based systems having a broad antimicrobial spectrum with a remarkably low hazard potential for manufacturing personnel, end-users, and the environment.

METTLER INSTRUMENT CORP.
Hightstown, NJ 08520

The company's balances and weighing systems for quality control applications (checkweighing, formulating, parts/piece counting, etc.) are featured. Sauter scales and associated systems (high capacity units with top resolution) are displayed.

MILLER PAINT EQUIPMENT, INC.
Addison, IL 60101

Demonstrated is the company's answer to the small batch cost problem: automated tinting and gyromixing. Operating is the Accutinter 400—a super-fast, accurate, computerized colorant dispenser: up to 8 colorants dispense simultaneously with shots down to 1/200 oz. @ ± 2% error. Also shown are 1 and 5 gallon dual axis gyromixers: thorough mixing in 15, 30, 60, or 120 seconds, depending on material.

MINERAL PIGMENTS CORP.
Beltsville, MD 20705

Pictorial displays of vehicles and equipment where the inorganic chemical products are used including zinc phosphate, zinc chromate, medium and light chrome yellow, strontium chromate, and iron oxides. New anticorrosion products are exhibited.

MiniFIBERS, INC.
Weber City, VA 24251

The company displays its entire line of Short Stuff® Polyethylene Fibers. The technical staff demonstrates how these engineered fibers are widely used in reinforcing, bridging, and thickening of coatings. New ideas on suggested uses are offered, complete with practical starting formulations.

MINOLTA CORP.
Ramsey, NJ 07446

The company is announcing two new additions to its Industrial Light Meter line. They are the Chroma Meter II Reflectance for measuring reflected subject color (painted or printed materials), and the Chroma Meter II Incident for measuring light-source color. These highly accurate meters are the most compact and lightweight tristimulus color analyzers on the market. Also shown is the Minolta Illuminance Meter (foot candle meter) and the Minolta Luminance Meter 1° (foot lambert meter).

MODERN PAINT AND COATINGS
Atlanta, GA 30328

Complimentary copies of the October Show Issue are being distributed at the booth. The Paint Red Book, the only directory in the coatings field, is on display, as are technical books of other publishers available from Communication Channels, Inc.

MOREHOUSE INDUSTRIES, INC.
Fullerton, CA 92632

The exhibit features all new equipment including a M4: 7-15PX multivessel small media mill capable of variable speed at each vessel and controllable by an interlock microprocessor; a J-25X Cowles Dissolver featuring pneumatic variable speed control, capable of being interlocked with a microprocessor; and a 7-15PX single vessel small media mill with variable speed capability, offering peripheral speed ranges from 1500-3500 fpm.

MYERS ENGINEERING
Bell, CA 90201

The latest developments in multi-shaft dispersers/mixers are on display. Factory and field engineers are available to answer questions on dispersion problems.

NALCO CHEMICAL CO.
Oak Brook, IL 60521

The theme for the exhibit is "Dynamic Dimensions in Coatings Additives." This theme aptly describes the firm's rapidly expanding line of innovative coatings additive products. The product line includes antifoams, thickeners, dispersants, and biocides. The focus of the exhibit is the total additive line and extensive technical service capabilities.

NETZSCH INC.
Lionville, PA 19353

Featured in the booth are grinding and dispersion machines used in the manufacture of paints, coatings and magnetic dispersions. Audio visual presentations give visitors an overview of the unique features of the machinery. The presentation also shows proven milling processes used in the manufacture of automotive paints: coil, release and high performance coatings, and magnetic dispersions.

NEUTRONICS, INC.
King of Prussia, PA 19406

The company, a manufacturer of digital oxygen analyzers, has designed an inerting system which ensures safe operation of paint manufacturing vessels. This is accomplished by reducing the oxygen concentration in the vessel to a level unable to support combustion. The analyzer activates the inert gas solenoid only when needed to maintain a safe oxygen level in the vessel, thus, yielding savings in inert gas usage. Design choices include both portable and fixed systems.

NEVILLE CHEMICAL CO.
Pittsburgh, PA 15225

This exhibit encompasses the company's wide range of petroleum hydrocarbon resins, Cumar® coumarone-indene resins and Unichlor® chlorinated paraffins. Of interest is technical information on the utilization of the firm's resins and chlorinated paraffins in coating systems. Technical representatives are on hand to discuss the company's capabilities and products for the coatings industry.

NL CHEMICALS/NL INDUSTRIES, INC.
Hightstown, NJ 08520

Featured are two major additions to the company's product line. The first and most significant is Bentone SD-1 super dispersible rheological additive for use in aliphatic solvent-based paints and coatings. It simplifies paint making and provides greater formulating and production flexibility. The second is Nalzin 2 pigment, an improved nonlead/nonchrome zinc phospho oxide corrosion inhibiting pigment. It has a finer particle size and greatly reduced oil absorption, which enable greater ease of dispersion and formulation of improved anti-corrosion coatings.

NYCO
Div. of Processed Minerals, Inc.
Willsboro, NY 12996

The company is exhibiting data on NYAD® wollastonite and Wollastokup® surface-modified wollastonite. Technical data emphasizes wollastonite as a pH buffer in acrylic and PVA latex systems and as a stabilizer and gellation preventer in exterior latex paints containing zinc oxide. Data is available on wollastonite in metal and wood primers to aid salt fog resistance, nonblistering, and anti-corrosion. Technical staff is present for discussion.

O'BRIEN INDUSTRIAL EQUIPMENT CO., INC.
San Francisco, CA 94124

The booth of this paint filling equipment company emphasizes their strong and widespread representation across the country, as can be seen in the theme "We're covered by the best reps in the country."

OMYA, INC.
Proctor, VT 05765

OMYACARB UF, the extender of the 80's (a wet ground, ultrafine calcium carbonate) is one of the most significant technological breakthroughs in the industry in the last 50 years and is featured in this year's exhibit. New information is available on Omyacarb UF as an optimum spacer for titanium dioxide and on its versatility in gloss, semi-gloss and flat trade sales and industrial finishes. Come visit our booth and discuss the energy efficiency and economy of "the extender of the 80's - OMYACARB UF."

OTTAWA SILICA CO.
Ottawa, IL 61350

Clay and silica extender pigments are displayed with samples available. Snow*Tex brand calcine clays are featured along with hydrous kaolins and special silicas for texture and wear resistant coatings. Sand Mill Media and ASTM Testing Sands are also available. Six subsidiaries are located nationwide. The Texas subsidiary, Texas Industrial Minerals, is the only calcine clay producer located outside the Southeast.

PACIFIC SCIENTIFIC CO.
Gardner/Neotec Instrument Div.
Silver Spring, MD 20910

A wide selection of quality control testing instruments for the valuation of color, gloss, viscosity, and other physical parameters of color are shown. See the leading color laboratory instrument, the Spectrogard® Color System, an easy-to-use spectrocolorimeter that meets your color measurement needs in process control, quality assurance or research. Also featured is the Gardner Abrasion Tester, ICI Cone and Plate Viscometers, the complete line of Gardner Glossmeters as well as the XL-800 Series of Colorimeters including the unique XL-825 with a remote optical sensor that can be presented to samples of virtually any size.

PAINT RESEARCH INSTITUTE
Philadelphia, PA 19107

Mildew and corrosion prevention are emphasized in demonstrations. Project plans of current mildew cooperative research and proposed corrosion research are available, as well as reprints of PRI research publications. PRI trustees and research directors are in the booth.

PENN COLOR, INC.
Doylestown, PA 18901

Innovation, advancement, and technical service in pigment-dispersion technology are highlighted at the exhibit. Along with quality dispersion lines which currently serve the coating, ink, and plastic industries, the company also features the latest advancements in water-borne and radiation-curable pigment dispersions.

PENNSYLVANIA GLASS SAND CORP.
Pittsburgh, PA 15235

The exhibit features information documenting the benefits of using Min-U-Sil (micron-sized silica) and Supersil (custom-ground silica) as filler-extenders, and Min-U-Gel 400 (colloidal attapulgite clay) as a thickener-gelling agent.

THE PFAUDLER CO.
Rochester, NY 14692

Specialists are available to discuss the company's resin reactor systems, solvent recovery wiped film evaporator systems, and rotary piston paint fillers.

PFIZER, INC.
MPM Div.
New York, NY 10017

The exhibit features a full line of pigments and fillers for the coatings industry, including the company's RO-2097 light shade Kroma® red iron oxide. Also featured are Pferrisperse® iron oxide slurries and pure talcs.

PLASTICAN, INC.
Leominster, MA 01453

A full line of plastic containers, including an exclusive straight-sided one gallon paint can, are displayed. The exhibit includes decorated containers and closures up to six and one half gallons with various fitments.

POLYVINYL CHEMICAL INDUSTRIES, INC.
Wilmington, MA 01887

On display are components for business machines, transportation, and construction equipment coated with the company's high performance water-borne acrylics and urethanes and solution acrylic formulations, along with a wide variety of test panels to highlight the physical performance properties of their coatings and a new line of color dispersions from Permuthane. An audio visual presentation of the firm's facilities and capabilities also illustrates the wide variety of performance applications. Technical staff is present to help with formulating needs; supporting them is a Formulation Center with computerized library, where attendees can obtain formulating information for specific coating applications.

PPG INDUSTRIES, INC.
Pittsburgh, PA 15222

Lo-Vel® flatting agents for coil coatings, lacquers, clear finishes, textured finishes, vinyl, and furniture are featured. Also shown is Hi-Sil® 422 silica paint pigment for flat and semi-gloss latex interior paints, latex exterior paints, oil-based house paints, and traffic paints. Hi-Sil® T-600 synthetic thicknener and thixotrope provides anti-sag action on vertical walls and keeps coarse particles in suspension in paints.

PREMIER MILL CORP.
New York, NY 10018

On display is a Horizontal Pressurized Media Mill equipped with unique improved controls including an improved Wash Flush System for easy product changeover; a laboratory, table top version of the Horizontal Media (1.5 liter); a colloid mill; an homogenizer; and dispersers.

Q-PANEL CO.
Cleveland, OH 44145

On display is the QUV Weathering Tester which simulates the damage caused by sunlight and rain or dew. Sunlight is simulated by fluorescent UV tubes, and dew is simulated by direct condensation of water on the test panel. Advantages include fast, low-cost tests, conformance to ASTM practice, and comparability with over 1,000 standard QUV's now in service. The QUV is now the world's most widely used weathering tester.

REICHARD-COULSTON, INC.
New York, NY 10010

The company's exhibit features "207" Irox cost cutters for organic pigments. "207" Irox is successfully used at much higher loading than conventional yellow oxide yet still retains a bright clean organic color. Also featured is 1475 Super Strength primer oxide for high quality primers, Super Strength easy dispersing umbers, reds, and maroons. Don't miss 317 Zop for quality nontoxic conventional and water-reducible anti-corrosive primer systems.

REICHHOLD CHEMICALS, INC.
White Plains, NY 10603

The exhibit emphasizes the company's latest developments in the area of environmental resins which include water-reducible and high-solids systems. Paint formulators will find this booth of special interest given the wide range of products shown, including alkyds, thermoset polyesters, uralkyds, copolymers, amino resins, epoxy resins and hardeners, emulsions (acrylics, vinyl acetate-acrylics, styrene butadienes, etc.) and phenolics. Also offered are additives and pigments for coatings and specialty compounds.

REYNOLDS INDUSTRIES, INC.
Fort Mill, SC 29715

The company's "convertible" series mixer is the focal point of this display, demonstrating the three-position rotating head and removable turntable. Also featured is a photo montage of the firm's equipment applicable to the paint industry, for example, flusher drives, bridge mount mixers and jacketed vessels.

RIGID-PAK CORP.
Bayamon, Puerto Rico 00621

The display highlights the Plastic Gallon, a patented, market proven container for latex paint. The Plastic Gallon is shown as it is subjected to tough conditions such as it may encounter in everyday use to show its superior performance.

ROHM AND HAAS CO.
Philadelphia, PA 19105

The latest developments for the trade sales, maintenance, industrial finishing and roof mastics markets are featured. They include a new exterior latex vehicle with outstanding film build and adhesion, especially to chalky surfaces; Ropaque® hiding additive, and other additives with improved cost/performance value; an aqueous lacquer vehicle providing adhesion to engineering plastics; and a variety of water-borne and high-solids vehicles for coil, board and general product finishing.

RUSSELL FINEX, INC.
Mt. Vernon, NY 10550

The latest version of the Russell Finex 22 HighSpeed vibratory strainer, together with accessories covering the coatings industry are featured.

SANDOZ COLORS AND CHEMICALS
E. Hanover, NJ 07936

The exhibit displays the firm's diverse product line for the coatings industry. Featured are Sandorin and Graphtol pigments for powder coatings, Acetosol solvent-soluble dyes, lead-free shades developed with Sandorin and Graphtol pigments and Sanduvor 3206, a new, nonvolatile, high solids, liquid UV absorber. Also in the booth is an audio-visual over-view of the company's product line.

SANYO-KOKUSAKU PULP CO. LTD.
Tokyo, Japan 100

The company's Chemicals Division is showing their new grades in Superchlon Chlorinated Polyolefines (CPP & CPE). To add to the Superchlon 500 series which has won popularity, the company developed a new grade 515 for heavy duty anticorrosive coatings. Another new grade 602 has markedly superior heat stability to a chlorinated rubber. Resins for coatings on polypropyrene are introduced.

SCHOLD MACHINE CO.
St. Petersburg FL 33702

The exhibit contains a display of the F-800 high-speed, pressurized, variable speed, quick clean 10 gallon shot mill for particle size reduction of paint and ink. Process color change can be accomplished in less than one hour. Also shown is the 60 HP VHLS concentric shaft co-axial disperser with 4 to 1 variable speed range, single expl. mtr. tub scrapers, chrome plated axial flow turbine, and high shear blade and shaft.

SEMI-BULK SYSTEMS, INC.
St. Louis, MO 63114

The exhibit features the Air-Pallet System, an effective method of handling and shipping such powdered products as pigments, clays, carbon blacks, calcium carbonate, resins, silicas and other materials, in a completely closed system. The Air-Pallet container, heart of the system, is reusable. It comprises heavy-duty coated fabric and a unique palletized base with built-in fluidizing floor and discharge port. Highly effective dust control is achieved. Systems are also available for automatic batch feeding directly into process or storage.

SHAMROCK CHEMICALS CORP.
Newark, NJ 07114

The exhibit features a wide line of polymers in fine particle size. They find wide use in industrial finishes where they increase mar and abrasion resistance. Technical people are on hand to discuss product application.

SHERWIN-WILLIAMS CO.
Container Div.
Oak Brook, IL 60521

Featured is a plastic one-gallon container which is compatible with all existing equipment in paint plants today. Also shown are metal containers. A video display of filling runs as well as demonstrations of opening and filling containers can be seen.

SILBERLINE MANUFACTURING CO., INC.
Lansford, PA 18232

For the inside story on all facets of metallic coatings, speak to the expert technical people at the booth. From the quality-assured regular grades to the superior leafing of EternaBrite® and the glamour and "whiteness" offered by Sparkle Silver® grades, the company's aluminum pigments represent the highest in technical achievement. Learn how to use these pigments to best advantage in your formulations. Tomorrow's metallic coatings can be yours today.

SOUTH FLORIDA TEST SERVICE, INC.
Miami, FL 33178

A continuous slide presentation highlights an up-to-date look at 50 years of environmental testing and illustrates the company's complete facilities for conducting conventional exposures in Florida, Arizona, and Illinois, as well as a totally equipped laboratory for accelerated testing. Representatives are on hand to answer questions regarding capabilities and costs and to discuss research in test method development, correlation studies, and the company's PET Theory (Programmed Environmental Testing).

SOUTHERN CLAY PRODUCTS, INC.
Gonzales, TX 78629

Featured at the display is the Claytone series of organophilic bentonites for use as rheological control additives. A variety of Claytones are offered for use in aromatic, aliphatic, polyester, and various other systems.

SPENCER KELLOGG
Div. of Textron, Inc.
Buffalo, NY 14240

The latest developments in alkyd, polyurethane, polyester, epoxy and acrylic resins for water-dispersible, high solids, two component and elastomeric coatings and stains are presented, with the assistance of experts, by means of test panels and coated display items. Technical data including formulation guidance, is available on these newer products at the booth.

STANDARD CONTAINER CO.
Fairfield, NJ 07006

The exhibit features "Plastite"—tomorrow's one gallon plastic paint can for today's water-based paints and processing lines. Also shown are the firm's traditional line of metal paint cans and plastic and metal pails.

SUN CHEMICAL CORP.
Pigments Div.
Cincinnati, OH 45232

Panels and displays illustrate the company's extensive line of organic pigments, with special emphasis on Quinacridone, Monoarylide Yellows, Phthalocyanine Blues and Greens. The Dispersions Div. is also featured in a free-standing unit with displays and literature. Technical literature on the company's complete line of pigments is available, including environmental data and system specific information for the coatings industry.

SWECO, INC.
Los Angeles, CA 90051

The firm demonstrates its new high-speed separator, capable of screening solids from heavy, high-viscosity liquids including latex coatings, and iron oxide slurries. A 30" diameter unit is shown in operation, and a 48" diameter unit is also available.

SYSTECH CORP.
Xenia, OH 45385

This firm, specializing in providing technical services for solid and hazardous waste management, features a service by which they recycle combustible liquid wastes for use as supplemental fuels. The display describes the process, the detailed waste analysis services provided, and a discussion of the legal, economic, and environmental advantages of the service.

TECHNOLOGY MARKETING CORP.
Norwalk, CT 06851

The exhibit includes the company's books, Buyer's Guides, periodicals, and newsletters on the following subjects: radiation curing; high-solids coatings; water-borne coatings; and powder coatings. A leading publisher of energy efficient, nonpolluting technology news, the company has over a decade of leadership in this field.

TENNECO CHEMICALS, INC.
Piscataway, NJ 08854

The exhibit features industrial color systems in addition to illustrative information and display material on all varieties of the company's colorant dispersions and chemical additives for the coatings industry.

THIBAUT & WALKER CO., INC.
Newark, NJ 07105

The centerpiece of the display is Parcryl® 900, the latest addition to the company's broad line of 100% acrylic emulsions. The entire line of Parcryl products offers mechanical stability, water resistance, and wet adhesion. Complementing this newest introduction is the company's full line of Super Alkyds®, Super Thanes® (oil-modified urethanes), Parco® vinyl acrylic copolymer emulsions, concentrated varnish stains, and other specialty products.

THIELE ENGINEERING CO.
Minneapolis, MN 55435

Along with the fully automatic Twin-Head Paint Filler with automatic cap placement and closing unit, the company introduces their fully automatic lid placer for 5-gallon plastic lids to enhance the operation of their fully automatic 5-gallon Filler. Also demonstrated is a semi-automatic submerged filler manufactured by Bexuda.

TROY CHEMICAL CORP.
Newark, NJ 07105

Four new product ideas, plus the company's line of wood preservatives, are featured this year. For solvent-based industrial coatings, the firm is introducing a new rheology modifier, and an improved slip agent. For aqueous systems, two new defoamers are presented, one designed for water-reducible industrials, and the other a cost effective defoamer for latex paints. The company's line of wood preservatives is presented along with results from their extensive research and testing program.

U F STRAINRITE
New Haven, CT 06513

This exhibit features bag filters and vessels for paint, varnish, and related coatings. They are micron-rated from 1 to 800. The company also offers replacement bags for all major manufacturers.

UNION CAMP CORP.
Wayne, NJ 07470

The exhibit features Uni-Rez polyamide resins, tailor-made for high-solids and for weatherable epoxy coatings. Uni-Rez polyamide resins are derived from trees—the renewable, natural resource grown in the USA.

UNION CARBIDE CORP.
Danbury, CT 06817

The exhibit features materials for conventional coatings, industrial finishes, and trade paints. Special emphasis is given to the cost/performance advantages of UCAR Acrylics and the state-of-the-art performance of UCAR Latex 376, a new vinyl acrylic latex for trade paints. Solvents for electrostatic spray and high-solids coatings; and cycloaliphatic epoxides for photocurable coatings are also featured.

UNION CHEMICALS DIV.
Union Oil Co.
Schaumburg, IL 60195

Amsco/Res® emulsion polymers, solvents, and chemicals for use in both water- and solvent-based coatings are featured in the exhibit. A new game, a new booth, and as always, prizes!

UNION PROCESS, INC.
Akron, OH 44313

Featured is fine grinding and dispersion equipment for batch, continuous, and circulation processing. Attritors are available in a variety of sizes from laboratory to production models. Production units can be built to meet specific requirements. Attritor benefits include shortened processing times, consistent particle size results, reliable temperature control, easy maintenance and operation, energy efficiency, and low wear.

UNITED CATALYSTS, INC.
Louisville, KY 40232

The exhibit features the Tixogel line of organo clays and activated bentonites. Literature available describes the products and applications for solvent, water-borne, and emulsion systems.

UNITED STATES MOVIDYN CORP.
Chicago IL 60610

The exhibit displays a variety of low cost defoamers for the coatings industry. Highlighted is a new silica-based product which does not detract from gloss or color development.

UNIVERSAL COLOR DISPERSIONS
Lansing, IL 60438

Featured is an all new exhibit. On display is our family of color systems; A, N, Q, and V Lines and our custom designed systems for addition by weight or volume, for water or solvent to meet your all important industrial, marine, maintenance and high performance trade sales coatings requirements. Other new product concepts are introduced in conjunction with our V Line Color Deck and Formula Book.

UNIVERSAL COLOR SYSTEMS
Alexandria, VA 22312

The exhibit introduces a completely new, low cost, extremely accurate, completely solid state spectrophotometer—featured as the color transducer in the company's new color measurement systems. Discover first hand the outstanding features and ease of use offered by the CMS-2000 and CMS-3000 color measurement systems on display.

UNIVERSITY OF MISSOURI-ROLLA
Rolla, MO 65401

In-plant training programs can be arranged. Information on Coatings Technology Short Courses and Seminars and UMR's undergraduate coatings science program is available.

R.T. VANDERBILT CO., INC.
Norwalk, CT 06855

Featured is Vantalc 6H, a high-purity, platy, hydrous magnesium silicate pigment. It is a superfine grade exhibiting high brightness and oil absorption. Effective for gloss control of coatings, it has a 90 dry brightness rating and 6.0 Hegman fineness. It is useful in industrial coatings where film smoothness and pigment suspension are important.

VORTI-SIV DIV.
M & M MACHINE, INC.
Salem, OH 44460

On display is the recently introduced, enclosed, and more efficient gyratory Vorti-Siv, as well as two other gyratory screening and straining machines. These models have American Standard nuts, bolts, and threads, and also can be produced in the metric system. The company has complete rebuilding and machine shop facilities, and a complete stock of parts for the older Lehmann Vorti-Siv.

WACKER CHEMICAL CO.
New York, NY 10017

Applications for HDK fumed silica are displayed, with particular emphasis toward the paint industry. Dr. J. Doppelberger of the company's technical staff, as well as other technically capable personnel, is available for consultation. A second line of products, including binders for high-solids, cementitious coating systems and soluble vinyls and polyvinyl butyrals for a variety of inks and industrial coatings, is introduced.

THE WARREN RUPP CO.
Mansfield, OH 44901

The exhibit contains two operating displays of SandPIPER double-diaphragm, air-powered pumps, one demonstrating the ability to pump highly viscous materials and the other pumping pipe-size solids. Also on display are cutaway models of V.I.P. Teflon-equipped, corrosion-resistant SandPIPER, plus other models.

WELLCO PRODUCTS DIV. & ITASCO DIV.
IWI Industries, Inc.
Summit, IL 60501

The exhibit includes a new line of high impact tank cleaning spray nozzles, with information on complete tank washing systems. Also displayed is a 325 gallon, D.O.T. 57 approved portable shipping tank for use in shipping and storage of both flammable and nonflammable products and its new 300 gallon size aluminum shipping tank.

WILDEN PUMP & ENGINEERING CO.
Colton, CA 92324

On display is an air-operated, double-diaphragm, positive displacement pump designed to handle very thick and very abrasive materials. The pump handles up to 90% solids to over 250 foot heads in permanent, submerged and self-priming operations. Four models are available: the M2, for flow rates up to 30 gpm; the M4 for flow rates to 70 gpm; the M8 for flow rates to 135 gpm; and the M15 for flow rates up to 240 gpm. These pumps are used to transfer waste sludges, thickener under-flow, filter press operations and secondary sewage.

WITCO CHEMICAL CORP.
Organics Div.
New York, NY 10022

The exhibit features the Witcobond urethane aqueous dispersions series, both anionic and cationic types, developed for a wide range of coating applications.

ZEELAN INDUSTRIES, INC.
St. Paul, MN 55101

This exhibit introduces the company's new, fine particle size, high strength, microspherical extender, Zeeospheres®. It provides information on the use of Zeeospheres to increase solids in high solids and water-based industrial coatings; to enhance hardness, abrasion resistance, and durability in a variety of industrial and maintenance finishes; and to reduce costs by partial replacement of resin and TiO_2.

GUIDE FOR AUTHORS

INTRODUCTION

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology. Some 6,500 technical men of the paint industry—associated with 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico—make up the membership of the Federation.

The purpose of the JOURNAL is the advancement of knowledge of the formulation and manufacture of paints, varnishes, lacquers, resins, and related coatings. Its worldwide circulation is about 9,000.

Papers should present new or original data of either a practical or scientific nature. *Papers written in a manner which tends to promote proprietary products are specifically not acceptable.* Papers must meet the standards of the JCT Editorial Review Committee and are accepted with the understanding that they are contributed exclusively to the JOURNAL OF COATINGS TECHNOLOGY and that the material has not been published elsewhere.

The JOURNAL OF COATINGS TECHNOLOGY has first rights to the publication of papers presented at the Annual Meeting of the Federation and at local and regional meetings or symposia of the Constituent Societies. These papers, and others, submitted for publication, must be approved by the JCT Editorial Review Committee, which has authority in all matters affecting the acceptance or rejection of papers and other technical material. Manuscripts not accepted for publication will be returned to the author.

MANUSCRIPT COPIES

GENERAL PAPERS: Four complete copies are required. Send to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, Pa. 19107.

CONSTITUENT SOCIETY PAPERS (*for presentation at the Annual Meeting*): Ten copies of manuscript are required. They should be mailed as directed in this year's "Guide for Speakers."

ROON FOUNDATION AWARD PAPERS: Seven copies of the manuscript must be sent to the Chairman of the Roon Awards Committee. For complete details, see the "Roon Awards" section of the January 1982 JCT.

MANUSCRIPT PREPARATION AND STYLE

In general, follow the "Handbook for Authors" published by the American Chemical Society Publications, 1155 Sixteenth St., N.W., Washington, D.C. 20036.

Manuscript should be typed, double spaced, on 8½ × 11 paper, typing on one side only with at least one-inch margins around all four sides. Indent paragraphs five spaces.

Title

Keep the title informative, yet as brief as possible consistent with defining the subject matter covered in the paper.

Authors

Give complete names and correct company affiliations and addresses of all authors. A photo (glossy 5 × 7) and brief biographical sketch of each author should be included with the manuscript. Photos should be identified by printing the subject's name on the reverse side, in the margin so as to avoid defacing the photos. Do not clip or staple.

CONSTITUENT SOCIETY PAPERS: Submit names and company affiliations of each member of Technical Committee which prepared paper. Include, if possible, a group photo of committee.

Abstract

A 75-100 word abstract should accompany the manuscript. Avoid exceeding the length, if possible. The abstract, which is published immediately after the by-line and on the abstract pages, should contain an informative, not descriptive, statement concerning the (a) scope, (b) experimental methods, and (c) results or conclusions.

Presentation Data

If the paper has been presented at a monthly or special meeting of a Society for Coatings Technology, or to some other technical group, list the name of the organization and the date of presentation. If someone other than the author presented the paper, this, too, should be noted. Papers presented to associations other than the Federation must be released before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY.

Oral presentations submitted for publication should be rewritten to conform to publication style and format.

Text

This Guide has been prepared in accordance with general publication style, except the type, which is 9 pt. instead of 10 pt. Note the use of subheads. These serve to divide the paper into sections and also to break up the monotonous appearance created by long, continuous lines of type. Use simplicity in word selection whenever consistent with content. Be neither stiff and trite, nor lax, but direct and concise. Include only as much history as necessary to provide background for the particular material covered in the paper.

Metric System

Metric units are to be used wherever applicable and are to be shown in parentheses after the English or other units.

An excellent reference publication for metric conversions is the ASTM Metric Practice Guide (E 380-72) published by the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103. A conversion slide, in accordance with E 380-72, is also available.

Tables

Tables should be used sparingly, especially extremely long or wide ones. It is preferred to have tables typed on a separate sheet of paper rather than included in the text. All tables must be referenced in the text, e.g., "see *Table* 1."

Illustrations

Submit *original* drawings or sharp prints and good, clear glossy photographs. Graphs should be on good quality white, or blue-lined, graph paper. They should not exceed the 8½ × 11 size. Lines or curves should be relatively bold. The ordinate, abscissa, and title should be drawn outside the borders of the graph. Number all illustrations on the back. Captions are usually set in type, so they should be typed all on one separate sheet of paper. All illustrations must be black and white, as color is not acceptable. Slides, also, are not acceptable.

Nomenclature

Follow nomenclature style of *Chemical Abstracts.* Use chemical or common names when meaningful. Where trademarks are helpful for more complete descriptions, show them in footnotes or in an appendix, rather than in the text. If special nomenclature is used, include a nomenclature section at the end of the paper giving definitions and dimensions for all terms.

Equations

These must be typed, or written, clearly. Number each consecutively. If special symbols or Greek letters are used, write out their names in the margin of the sheet at point of first use. Place superscripts^{a} and subscripts$_{b}$ accurately.

Summary

The paper should be concluded with a summary which is intelligible without reference to the main text.

Acknowledgment

If used, it should follow the summary.

References

These should appear in numerical order within the text and be listed at end of manuscript in same order. Authors' names may or may not be shown in text with reference numbers. If possible, include titles of articles referenced in the literature. The following is a suggested style for periodicals[1 2 3] and books:[4]

(1) Wilkinson, R.F., "Uses for Water-Soluble Trimellitate Resins," *Official* DIGEST, *35*, No. 457, 129 (1963).

(2) Woo, J.T.K. and Heinert, D.H., "Coatings from Vinyl Isocyanate Monomer," JOURNAL OF COATINGS TECHNOLOGY, *49*, No. 632, 82 (1977).

(3) Hobden, F.W., *J. Oil & Colour Chemists' Assoc.*, *41*, 24 (1958).

(4) Mattiello, J. J., "Protective and Decorative Coatings," Vol. IV, John Wiley & Sons, Inc., New York, 1955.

OTHER INFORMATION

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

Reprints may be purchased in quantities of 100 or more. Authors will receive quotations.

Each author will receive a complimentary copy of issue in which his paper is published.

Copies of this Guide for Authors are available from the
Federation of Societies for Coatings Technology
1315 Walnut St., Philadelphia, Pennsylvania 19107

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

Fall 1982 Board of Directors Meeting

Thirty-six members and 26 guests attended the Fall Meeting of the Board of Directors of the Federation of Societies for Coatings Technology, on November 2, 1982, in Washington, D.C.

The following were in attendance:

Officers

President	Howard Jerome
President-Elect	A. Clarke Boyce
Treasurer	Terryl F. Johnson

Society Representatives

Baltimore	Alex Chasan
Birmingham	John Green
Chicago	John T. Vandeberg
C-D-I-C	William Mirick
Cleveland	Fred G. Schwab
Dallas	Carlos Dorris
Detroit	Harry B. Majcher
Golden Gate	A. Gordon Rook
Houston	Willy C.P. Busch
Kansas City	Norman Hon
Los Angeles	Robert Koperek
Louisville	Joseph A. Bauer
Mexico	Antonio Pina
Montreal	Horace Philipp
New England	Daniel Toombs
New York	Saul Spindel
Northwestern	Lowell Wood
Pacific Northwest	Deryk R. Pawsey
Philadelphia	John A. Stigile
Piedmont	Gary Marshall
Pittsburgh	Edward Vandevort
Rocky Mountain	James E. Peterson
Southern	Berger Justen
St. Louis	Merle Held
Toronto	Kurt F. Weitz
Western New York	Robert L. Hoerner

Other Members

William H. Ellis	Los Angeles
William F. Holmes	Dallas
Elder C. Larson	Houston
Stanley LeSota	Philadelphia
Hugh W. Lowrey	C-D-I-C
John J. Oates	New York
Helen Skowronska	Cleveland

Guests

Prof. Andre Toussaint, President of the Federation of Associations of Technicians in the Paint, Varnish, and Printing Ink Industries of Continental Europe (FATIPEC).

Donald J. Morris, President of the Oil and Colour Chemists' Association.

The following Past-Presidents of the Federation: S. Leonard Davidson, William Dunn, Neil S. Estrada, J.C. Leslie, Michael W. Malaga, James A. McCormick, and Carroll M. Scholle. (Board members William H. Ellis, Elder C. Larson, and John J. Oates, are also Past-Presidents)

Peter V. Robinson, and Dr. C. Malcolm Hendry, President and Vice-President, respectively, of the Paint Research Institute; Dr. Raymond R. Myers, retiring Research Director of PRI; and Dr. Seymore Hochberg, incoming Executive Director of PRI.

Incoming Board members Carl Fuller, of Philadelphia; and Morris Coffino, of New York.

Federation Committee Chairmen Peter Decker (Public Relations); James Hoeck (Educational); Sidney Levinson (Delegate to SSPC); Richard Max (Manufacturing); Dr. Roy Tess (Heckel Award); and John Ballard (Program).

Other guests included: Harry Scott, President-Elect of Cleveland Society; Ted Young, President of New York Society; Joseph Vasta, of Philadelphia Society; Abel Banov, of *American Paint & Coatings Journal;* and Royal A. Brown, Federation Technical Advisor.

From left to right: Federation Treasurer—Terryl F. Johnson; Executive Vice-President—Frank J. Borrelle; President—Howard Jerome; and President-Elect—A. Clarke Boyce

Staff

Frank J. Borrelle, Executive Vice-President; Thomas A. Kocis, Director of Field Services; and Robert F. Ziegler, Editor of *Journal of Coatings Technology.*

Mr. Borrelle called the roll of members and reported all present.

A moment of silence was observed in memory of two Federation Past-Presidents who died during the year: Frank C. Atwood, of New England Society, and Newell P. Beckwith, of Detroit Society.

The report of the Spring 1982 Board of Directors meeting was approved as published in the August 1982 *Journal of Coatings Technology.*

Reports of Officers And Staff

PRESIDENT JEROME

The mixed emotions of regret and satisfaction I feel as this final report is written must be well known to every Federation Past-President. The regrets come as a result of the frustrations in not being able to accomplish all of the goals I set for myself. The satisfaction is derived from knowing I did my very best. I can take solace in the knowledge that capable leaders will follow who will serve the Federation well.

The travel demands on the President are heavy, but "come with the territory." During my term of office, I visited the following Societies: Detroit, Rocky Mountain, Golden Gate (Executive only), Los Angeles, New England, New York, Southern, Louisville, Northwestern, Baltimore (50th Anniversary), St. Louis, Southwestern Paint Convention, Birmingham, and the joint Kansas City–St. Louis meeting.

On these trips, I made every effort to be frank and open about Federation activities and policies. Members have a right and a need to know what the Federation is doing, what actions are being taken—and why. I requested, and received, from each Society the time to explain the Federation position.

In addition, there were meetings of: the Host and Executive Committees, the Board of Directors, the Joint Paint Industry Coordinating Committee (JPICC), and the National Decorating Products Association. I was fortunate to represent the Federation at the grand opening of NDPA's new headquarters building in St. Louis.

Meetings of the JPICC provide a necessary forum for the exchange of viewpoints among the four major paint industry associations. A new agenda format this year contributed significantly to the value of this meeting. Hopefully, future contacts will be even more productive.

In the company of my wife, Gene, I was pleased to represent the Federation at the FATIPEC Congress and meeting of the International Coordinating Committee in Liege, Belgium, the Canadian Paint and Coatings Association annual meeting in Toronto, and the annual meeting of the Association Nacional de Fabricantes de Pinturas Y Tintas in Puerto Vallarta, Mexico. The hospitality accorded us at all of these meetings out of the country, including the Birmingham Club, was superb.

There have been accomplishments this past year that bode well for the future of the Federation:

(1) The addition of Royal Brown as the Technical Advisor to the Federation. He has worked well with the Paint Research Institute Mildew Consortium and the Federation's Technical and Educational Committees.

(2) The Federation's first national seminar—"Efficient Operation of an Up-to-Date Paint and Coatings Laboratory"—next April. Mr. Brown is arranging the program sessions.

(3) The brochure on "Paint Quality" by the Southern Society. It has been a success and will be followed by another on exterior paints.

A major disappointment was the termination of the financial arrangement with the University of Southern Mississippi with respect to the Correspondence Course. The Federation is no longer directly involved in the production of this course.

Dr. Raymond R. Myers, Research Director of PRI for the past 19 years, will retire from this position at the end of the year. Speaking for both myself and the entire Federation, I thank Dr. Myers for his conscientious and dedicated service to the PRI, the Federation, and industry while at the research helm of PRI.

Any successes of this administration are due to the efforts of many people—Federation Committee Chairmen, the Officers, the Board of Directors, the Officers and Trustees of PRI, and many rank-and-file members who took the time to convey their ideas to me during my travels. To them I extend my sincere thanks. Without their input and dedicated efforts, the office of President would be an almost impossible task.

I particularly extend my appreciation to Frank J. Borrelle and the Federation staff. Frank is a dedicated professional, a seasoned veteran who knows and responds efficiently to the needs of the Federation. His staff consists of capable and devoted employees who have done much to assist me during my term. I will always be grateful to them.

HOWARD JEROME,
President

PRESIDENT-ELECT BOYCE

This is my final report as President-Elect and it has been a very informative and interesting year. It was a pleasure working with the other Federation officers. The credit of having a balanced budget and co-ordinating our Society and other visits must go to the excellent staff.

This year's visits involved the following:

(1) Investment Committee, Finance Committee and Executive Committee in January.

(2) Pittsburgh and Western New York Societies.

(3) Joint Paint Industry Co-ordinating Committee in Washington.

(4) Officers/Executive/Host Committee in Washington.

(5) 1983 Host Committee in Montreal.

(6) Marjorie and I had the pleasure of visiting, together with other Federation officers and their wives, the Baltimore Society's "50th" Anniversary, Pacific Northwest Symposium in Vancouver, and the Canadian Paint and Coatings Association convention in Toronto.

Selection of Committee Chairmen for 1982–83 is complete and I thank those who have accepted committee assignments.

Next year is a first for the Federation with its Annual Meeting and Paint Show moving to Canada. It will be a great time and we want everyone to come and enjoy our Canadian hospitality in Montreal.

CLARKE BOYCE,
President-Elect

TREASURER JOHNSON

Time flies fast when you are having fun and enjoying your endeavors, such is how it has been in being your Treasurer the past year.

PRI is operating within its budget and is developing plans to raise contributions to allow additional PRI-sponsored projects.

The Federation is still within budget and all signs indicate ending the year well within the operating budget.

Since our last meeting in Boston I have represented the Federation at: St. Louis-Kansas City Joint Meeting, PRI Trustees meeting, Executive Meeting, and Host Committee Meeting.

I give my thanks to the Board, the Officers, the Federation Staff and all Federation members for the assistance given me during the year.

TERRYL JOHNSON,
Treasurer

EXECUTIVE VICE-PRESIDENT BORRELLE

To borrow from the theme of the Annual Meeting, Federation activities in 1982 have been conducted on a quality level. At the end of three quarters, most income and expense accounts are in keeping with budget and activity, and we have confidence that the year will be another of which the Federation can be proud.

PUBLICATIONS

JCT: As with many other industry publications, advertising sales are not up to expectations. Editorially, however, we are very healthy and about 100 more pages will be published this year, most being technical papers. The supply of manuscripts, from authors everywhere, continues to be good.

The circulation of the JCT, October 1982, was 9,307 (U.S.—6,768; Canada—860; and 68 foreign countries—1,679). The totals for October 1981 and 1980 were 8,912 and 9,148, respectively.

Thanks are extended to the Publications Committee (Dr. Thomas J. Miranda, Chairman) and the Editorial Review Board for their faithful service during the year. A constructive joint meeting of the committee and the board was held this spring in Philadelphia.

Year Book: Reminders have been sent to Society Treasurers re the 1983 edition. The Southern Society submitted both its 1983 roster and due$ on September 17—a new record!! (Thank you, Jim Geiger).

Series Units: Sorry, but the new titles which have been mentioned in previous reports have not materialized. A special subcommittee of the Publications Committee met in September and reviewed the current and future status of these world-recognized booklets. A report and recommendations will be submitted for consideration by both the Publications and Executive Committees.

Brochure on Paint Quality: By the end of the year, the initial 100,000 print order of "Latex Flat Interior Paint" by the Southern Society should be depleted. President Howard Jerome, John Ballard, and Roy Brown have each addressed the issue of Paint Quality before local groups of the National Decorating Products Association—in non-FSCT capacities.

Special Publications: Sales of the Infrared Book, Pictorial Standards Manual, and the Dictionary are satisfactory. Our advertisement of the latter in *C&E News* generated some sales. We will also advertise the Infrared Book and the Color-matching Aptitude Test Set.

OTHER SERVICES

Color-Matching Aptitude Test Set: We are now marketing the second production (400) of the set. Thirty have been sold this year.

Audio-Visual Programs: In cooperation with the Federation's efforts to promote careers in the coatings industry, the Birmingham Club has submitted a program, "Introduction to the Paint Industry." It was referred to Dr. Herman Lanson, Chairman of the Ad Hoc Committee on Careers.

FEDERATION MEMBERSHIP

Membership in the Federation has shown gradual growth, as evidenced by:

	Active	Associate	Other	Total
1978	4,600	1,526	298	6,424
1979	4,626	1,591	310	6,527
1980	4,666	1,586	314	6,566
1981	4,616	1,678	322	6,616
1982	4,650	1,783	368	6,801

The increase is: Active—13%; Associate—68%; and Other—19%.

ANNUAL MEETING AND PAINT SHOW

Despite the cancellation of 24 spaces by 12 companies in recent weeks, the 1982 Paint Show will be the second-largest in Federation history, and with the same number of paid exhibitors as in 1981. Comparative figures are:

	1982	1981
Net Square Feet, Paid	36,498	38,186
Net Square Feet, Comp. ...	420	980
	36,918	39,166
Paid Exhibitors	169	169
Comp. Exhibitors	3	8
	172	177

John Ballard and his Program Committee are to be commended for assembling the biggest technical program ever. The number of papers submitted in the Roon Awards competition (20) is a major factor in the expanded program. Seventeen were accepted for presentation, another record. Congratulations to Darlene Brezinski, Chairman of the Roon Awards Committee.

1983: The exhibit brochure for the 1983 Paint Show in Montreal will be distributed at the Exhibitors Reception in D.C. Our first AM&PS in Canada looks so promising that we have reserved 3,300 hotel rooms in the beautiful city.

PAINT RESEARCH INSTITUTE

Staff assistance to PRI has increased in recent years to the point where I recently suggested to the PRI President that PRI would benefit from the services of its own "Staff Coordinator." Although I still believe this, the coordinating responsibility will be shared by Tom Kocis and myself, as neither has the time to handle it alone. In this regard, I submitted a summary of "Staff PRI Duties" to the Executive Committee on September 10.

We have cooperated with President Peter Robinson throughout the year. And also with Dr. Seymore Hochberg, the incoming Executive Director, in an effort to acquaint him with both PRI and the Federation.

Staff extends its thanks and appreciation to Dr. Raymond R. Myers, the retiring Research Director of PRI, for 19 years of dedicated and meritorious service.

FSCT Technical Advisor

We have worked closely with Roy Brown, FSCT Technical Advisor. Through his work with the PRI Mildew Consortium, the Federation's Technical and Educational Committees, and the 1983 Seminar, he is fulfilling the initial objective of the Technical Advisor: that of improving services to the membership and the industry. Mr. Brown also set up the contacts which will enable high school chemistry teachers in the DC area to visit the Paint Show on Friday.

Federation's First Seminar

The Federation's first seminar under its sole sponsorship—"Efficient Operation of an Up-to-Date Paint and Coatings Laboratory"—will be held in Kansas City, April 26–27. The budget was approved by the Executive Committee on September 10. Fees will be: $80 for members, $90 for non-members, up to April 1. After, it will be $100 for everyone. Mr. Brown is arranging the program sessions and speakers. Staff will handle other details.

Society Officers Meeting

The sixth Society Officers meeting in Boston (during the Spring Meetings) was another success. This annual orientation session continues to be one of the best investments the Federation can make in itself and the Societies.

Officer / Staff Visits

Officer/Staff visits to the Societies during 1981–82 were to: Detroit, Rocky Mountain, Golden Gate (Executive only), Los Angeles, New England, Pittsburgh, New York, Southern, Western New York, Baltimore (and its 50th anniversary), Louisville, Northwestern, St. Louis, Southwestern Paint Convention, Pacific Northwest Symposium, and the joint St. Louis/Kansas City meeting.

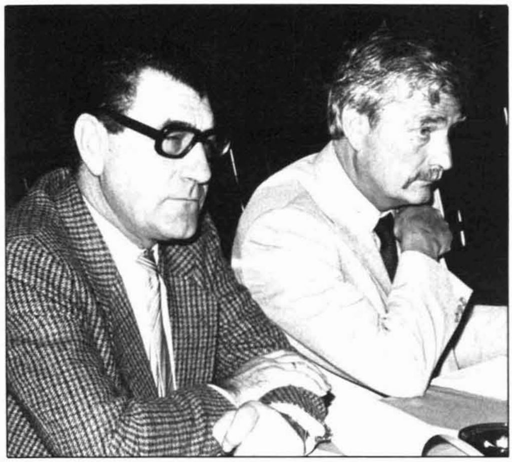
We also attended the annual convention of the National Decorating Products Assn., the annual meeting of the Joint Paint Industry Coordinating Committee, and the recent annual meeting of the Canadian Paint and Coatings Association.

Miscellany

ASC—The Organic Coatings and Plastics Chemistry Division of ACS has expressed interest in the joint sponsorship of a seminar on a suitable technical subject. Upon instructions from the Executive Committee, I advised ACS that the Federation is interested, too, but will hold off any decision until mid-year 1983 (after the April seminar).

Exhibits—The Federation exhibited in the New England Society's Coatings Tech Expo last May. We also plan to have a booth in the February Western Coatings Societies Show in San Francisco.

Building—Utilizing the services of a real estate consultant, the Executive Committee is exploring the advantages/disadvantages of ownership vs. leasing of office space in Philadelphia. The consultant submitted a preliminary analysis in September. He has been invited to the Executive/Finance Committee meetings in Philadelphia, January 28.



Guests included Andre Toussaint (left), President of FATIPEC, and Don Morris, President of OCCA

Staff

Members of the staff are: Audrey Boozer, Rosemary Falvey, Kathryn Ferko, Dick Gross, Linda Hanratty, Tom Kocis, Lorraine Ledford, Jane Paluda, Dorothy Robinson, Mary Sorbello, Kathy Wikiera, and Bob Ziegler. You will have an opportunity to meet the whole crew as they will all be on our convention team at the AM&PS in DC. I thank this fine group of people for their professional work, cooperation, and contributions to the progress made this year for the Federation.

Outgoing Administration

On behalf of staff, sincere thanks to President Howard Jerome, the other officers, Executive and Board members, committee chairmen, and the PRI Officers and Trustees for their cooperation and service throughout a busy, interesting, and enjoyable year. They are all super people and it was a pleasure for us to have worked with them.

Frank J. Borrelle,
Executive Vice-President

DIRECTOR OF FIELD SERVICES KOCIS

Committee Liaison

Program—Major involvement in recent months has been in providing staff support for development of the 1982 Annual Meeting program. In addition to the Program Committee, this included continuing liaison with the Manufacturing, Technical Information Systems, Educational and Corrosion Committees, as well as the Roon Awards and Mattiello Lecture Committees, and the Paint Research Institute, all of whom contributed to the programming effort. Staff has been responsible for accommodating committee and speaker needs, and arranging for on-site considerations.

A full complement of excellent presentations—including nine Society papers and a record 17 entries in the Roon Awards competition—address a wide variety of topics, in a total of 13 sessions.

Programming arrangements for the 1983 Annual Meeting are underway. Committee will hold organizational meeting in conjunction with '82 AM to develop theme and initiate suggestions for session presentations for the Montreal event. Follow-up discussions will be held at a subsequent meeting, probably sometime in December.

Educational—Steering Committee met with Society Educational Committee Chairmen in Detroit on April 16. Among major agenda items were discussions of scholarship program. Several procedures for administering the program were recommended (and subsequently approved by Executive Committee) to more closely monitor effectiveness of programs at schools being funded.

Committee reaffirmed its interest in the revision/updating of Federation booklets on coatings technology; in response to its recommendation, Publications Committee is developing guidelines so that the booklets reflect a more uniform structure and content.

Interest was also reaffirmed in promoting coatings career opportunities. Educational session at Annual Meeting will address this subject; D.C.-area science teachers and guidance counselors will attend as Federation guests to gain further insight into the industry and its attractions as a career opportunity.

Reports on Society educational activities were compiled and published in September JCT.

Technical Advisory—Testing of the anchored-biocide polymer developed by PRI's Mildew Consortium by Societies is underway. Initial batch quantities have been distributed for formulation into paint systems and testing in outdoor exposures. In related project, Societies are cooperating in collecting samples of paint chips supporting mildew growth to determine and identify new micro-organisms causing film defacement, which have evolved as a result of formulation changes from predominantly oleoresinous to latex.

TAC members will meet with Society Technical Committee Chairmen at AM to review programs at national and local level.

Reports on Society technical project work were published in August JCT.

Manufacturing—Arrangements have been made for Committee members and Society Manufacturing Committee Chairmen to tour the Duron, Inc. facility in Beltsville, MD on November 2, in conjunction with the AM.

Committee-sponsored session at Annual Meeting will focus on use of computers in the manufacturing process. Committee will meet during AM to discuss plans for the coming year.

Corrosion—Sponsoring session at Annual Meeting on performance of non-lead, non-chrome pigments in aqueous and solvent-based coatings.

Committee will meet at AM to discuss proposed programs for coming year.

MISCELLANEOUS

Liaison and staff support also provided for activities of MMA Awards Committee and Ad Hoc Committee on Paint History . . . Annual update of "Talks Available to Constituent Societies" was completed and distributed—record number of 72 presentations offered for the 1982–83 meeting year . . . Reports on Society educational and technical activities compiled and edited for publication in JCT . . . Providing assistance for development of laboratory seminar to be sponsored by Federation next Spring.

THOMAS A. KOCIS,
Director of Field Services

TECHNICAL ADVISOR BROWN

I began work as Technical Advisor to the Federation on March 1, 1982. A list of duties for my position has been developed by the Officers and approved by the Executive Committee. It is my understanding that these duties will be revised and/or expanded as the need arises.

NATIONAL SEMINAR

Plans have been made and approved for a 1½ day national seminar to be held next Spring. The title will be, "The Efficient Operation of an Up-to-Date Paint and Coatings Laboratory". This will be held at the Hilton Plaza Inn, Kansas City, MO, April 26–27. Two news releases have been distributed describing the seminar and its content. I am presently recruiting speakers and arranging the program. We envision this seminar as a beneficial service by the Federation to our industry and we expect a large attendance from all areas of the United States as well as from other countries.

COMMITTEES

I will be attending the Federation-sponsored national meetings of the Technical Advisory, Educational, Manufacturing, and Corrosion committees and will work with the Chairman of these committees in an advisory capacity. Activities to date have been:

Technical Advisory: Attended the Spring meeting held in St. Louis to which all Society Technical Committee Chairmen are invited. I am compiling a list of all Society Technical Committee projects. These will be kept in a continuing file and will be published periodically. This information will also be used to aid Technical Committees and to help coordinate their work.

Educational: Attended the Spring meeting held in Detroit at which time it was decided to invite Washington, D.C.-area high school science teachers to visit the 1982 Paint Show. Contacted Science Coordinators in the Washington-area school systems and invitations were sent to 110 high school science teachers in the Washington, D.C. area school systems. The teachers have been invited to attend the "Careers in Coatings" program to be presented by the Educational Committee as well as the Paint Show.

Manufacturing and Corrosion Committees: Have not yet attended meetings of these committees but will do so at the next ones scheduled. I work closely with Tom Kocis in committee activities.

PAINT RESEARCH INSTITUTE

Prepared a general questionnaire for PRI which was published by both the JOURNAL OF COATINGS TECHNOLOGY and the *American Paint and Coatings Journal.* The questionnaire is intended to acquire information from the Federation membership and the paint industry in general concerning the type of research needed by our industry, as well as suggestions for future PRI research projects. More than 200 completed questionnaires have been received to date and we expect more. I will analyze and compile the information obtained and report to the PRI Board of Trustees.

Mildew Consortium: Attend Mildew Consortium steering committee meetings as FSCT Coordinator, Summary reports are written following each Consortium meeting and are distributed by the Executive Vice-President. Acting as liaison between the Mildew Consortium and the Society Technical Committees who are cooperating in providing exterior exposures of paints made from biocidal polymers developed by the Consortium-sponsored research.

OTHER PROJECTS

The Federation President and Executive Vice-President have asked that I submit ideas for potential Federation projects, publications, activities, etc. I have suggested a project in which the Federation would instigate a program to investigate and correlate quality control test methods and instruments for those

Other guests included (left to right—front row): Dr. Roy Tess, Chairman of Heckel Committee; Dr. Seymore Hochberg, Executive Director of PRI; Harry Scott, President-Elect of Cleveland Society; James Hoeck, Chairman of Educational Committee; and Dr. Raymond R. Myers, Research Director Emeritus, PRI

companies who wish to participate. We all know the difficulties experienced in getting accurate test results when several laboratories conduct the same tests on the same coating. I am presently making a detailed outline of such a program and it will be discussed further by appropriate groups in the Federation. The objective would be to upgrade test methods and instrumentation in the industry.

ROYAL A. BROWN,
Technical Advisor

Amendments To By-Laws

Adopted

The following amendment to the By-Laws was given first reading at the April 30, 1982 Board of Directors meeting and was adopted at the November 2, 1982 meeting.

Article IV—Nominations and Elections

A. (2) NOMINATIONS

WHEREAS the monthly publication date of the JOURNAL OF COATINGS TECHNOLOGY has been advanced and this earlier publication date makes it impossible to meet this By-Laws' requirement of reporting nominations for elective offices in the *July* issue, be it

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

"(2) The report of the Nominating Committee shall be announced at the Spring Board of Directors meeting, after which it shall be published in the August issue of the JOURNAL OF COATINGS TECHNOLOGY. Nominations for any elective office may also be made from the floor, by any Society Representative at the Fall Board meeting, prior to the election of Officers, or by a petition signed by 25 Active Members and forwarded to the Federation Executive Vice-President in time for publication in the August issue of the JOURNAL OF COATINGS TECHNOLOGY.

"The Federation Executive Vice-President shall place such nominees-by-petition in nomination at the annual election meeting of the Federation Board."

The following amendment to the Standing Rules was adopted at the November 2, meeting.

Article SR I—Constituent Societies

B. CONSTITUENT SOCIETY BOUNDARIES

WHEREAS the Montreal Society has requested the addition of New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and Labrador to its boundaries, be it

RESOLVED, that the Standing Rules be revised as follows:

"*Montreal Society*—All of the Canadian Provinces of Quebec, New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland, and Labrador, and that part of Ontario within a 125-mile (200 km) radius of Montreal."

Given First Reading

The following amendment to the By-Laws was given first reading on November 2. It will be presented for adoption at the Board of Directors meeting of May 20, 1983.

Article IV—Nominations and Elections

A. (2) NOMINATIONS

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

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

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

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

Comment: The By-Laws Committee recommends adoption.

Report of Ad Hoc Committee On Federation Voting and Office-Holding Privileges

The committee recognizes the historical changes that have taken place within both the Constituent Societies and the Federation which have broadened the participation by other than the original paint chemists and production people.

The contributions of the broadened membership are recognized, and with an aim to encourage the further participation of all the people of our industry, the proposal of the committee is to provide for an orderly continuation of this trend.

Specifically, we have been presented with a proposal by the Pittsburgh Society that would immediately produce vast and sweeping changes that would grant Associate members the right to vote and serve in all offices at the Federation level.

We propose for early consideration by the By-Laws Committee a resolution which deals with the right to vote and to participate in the affairs of the Constituent Society. This resolution will clearly set forth the right of the Constituent

Society to determine the rights and privileges of its own members. We believe this resolution to be in accord with the principle of self-government in a federated body as expressed in the By-Laws in the present Article II, Section B.

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

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

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

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

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

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

IV A. (2) . . . Nominations for any elective office may also be made from the floor, by any Society Representative at the Fall Board Meeting, prior to the election of Officers, or by a petition signed by 25 (Active) *Voting* Members and forwarded to the Federation Executive Vice-President . . .

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

XI A. ORIGINATION

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

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

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

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

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

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

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

The committee further recommends that the status of membership for Society Representatives, Members-at-Large of the Federation Board of Directors, and Federation Officers be addressed individually at later dates. We believe that time should be allowed for the changes proposed in this report to be in effect and evaluated before further consideration is given to the other points of the Pittsburgh proposal. Thus, the orderly course of change previously mentioned, may be allowed to proceed without sudden shock to the fabric of the Federation.

The Ad Hoc Committee was composed of: *Chairman* Fred G. Schwab, of Cleveland Society; N. Bradford Brakke, of New England Society; Morris Coffino, of New York Society; J.R. Kiefer, Jr., of Philadelphia Society; and Stanley LeSota, of Philadelphia Society.

FRED G. SCHWAB
Chairman

The report of the Ad Hoc Committee was accepted, the committee discharged, and its recommendations referred to the By-Laws Committee for preparation of the enabling resolutions.

Report of Ad Hoc Committee On Career Opportunities

The Ad Hoc Committee was established by the Federation Executive Committee to "study and suggest ways and means for the Federation to promote and publicize career opportunities in the coatings industry". President Jerome appointed a committee consisting of: Joseph Bauer, of Louisville Society; Mitchell Dudnikov, of Baltimore Society; Jeffrey Kaye, of New York Society; Carl J. Knauss, of Cleveland Society; Herman Lanson, of St. Louis Society; and Zeno Wicks, of North Dakota State University.

The committee with the exception of Dr. Wicks, who had prior commitments, met in Detroit the evening of April 15, 1982 to discuss means and programs to achieve the objectives of the Ad Hoc Committee.

It is generally agreed that many high school students today enter college without a definite idea of the careers that they want to prepare for. The technological revolution in the coatings industry in recent years has created many technical problems, many of which remain to be solved. This situation presents excellent professional opportunities to science-oriented young people, especially those with special training in coatings and polymer science. The problem is to reach them and let them know about our industry and the many interesting scientific challenges that it offers. The most effective way is to present the story of our industry to their science teachers and to have them tell their students that this important industry needs technical people with specialized training in coatings and polymer science.

For the past seven years the St. Louis Society has invited high school chemistry teachers to their annual Education Night. As many as 34 educators have attended these meetings and considerable interest has been expressed by them. The requirements for the success of such a meeting are:

(1) Developing or acquiring an up-to-date mailing list of teachers.

(2) An effective letter to the teachers.

(3) An effective speaker in academia or industry.

(4) A demonstration experiment pertaining to coatings or polymers.

(5) Kits containing the materials required for the experiment to be performed by the teachers in their classes or science clubs.

While these meetings have been enthusiastically received, they have encouraged very few science-oriented students to enter colleges offering special curricula in coatings science. Obviously, this activity must be augmented by other programs.

A unanimous opinion of our committee was that a pamphlet or booklet telling about our industry should be prepared. John Gordon has written a draft of a text entitled "Chemical Careers In Coatings", which could form the basis of a hand-out for students that would describe our industry—its importance and technical complexity, its problems and need for scientists trained in the many disciplines required by our industry. The Birmingham Club has recently completed an excellent slide/tape program, "An Introduction to the Paint Industry", which they are showing to student groups to promote interest in promoting careers in the coatings industry. A copy of this slide/tape program has been sent to us and the Federation office can provide it for presentations by the various societies.

We need an audio-visual presentation that could be shown in chemistry classes, science clubs and Society programs directed to high school and junior college chemistry educators. It was felt that a modernized version of the Federation motion picture film prepared many years ago would be highly effective. Since the cost would probably be prohibitive, we contacted Shell Chemical Company who some years ago prepared a film strip entitled, "The Paint Industry". We were informed that this film was no longer available. In lieu of a motion film we are preparing a slide presentation showing modern laboratories and production facilities utilized in the coatings industry. A slide presentation would augment such a presentation. In the St. Louis area several high school chemistry teachers have indicated an interest in a brief presentation on the coatings industry for a Science Club meeting.

The Federation provides a fund of $18,000 for scholarships at North Dakota State University, University of Southern Mississippi, University of Missouri at Rolla, University of Detroit, Kent State University, and Eastern Michigan Univ. The availability of these scholarships should be publicized at our meetings. Many of our individual Societies provide funds for scholarships and notices of these scholarships should be sent to all the high schools in their respective areas. With rapidly increasing costs of college tuition, these scholarships should be sought by students interested in chemistry as a profession.

In recent years letters and articles in publications of the American Chemical Society have been critical of chemistry curricula being offered in many universities. The authors have complained that there is insufficient interface with the chemical industry, and that students are not taught practical skills by emphasizing the application of theoretical concepts to the solution of practical problems. Many universities have become sensitive to this criticism and are offering courses in industrial chemistry with lectures by persons from industry and required by chem majors. The St. Louis Society has cooperated with the Chemistry Department of St. Louis University in the development of such a course in which we present each year two lectures on "Polymers, Plastics and Paints". This can be done in other cities where there are universities and colleges that train large numbers of chemists and chemical engineers. This can encourage undergraduate students to pursue graduate studies in polymer and coatings science.

Many cities have Science Fairs and Career Days and these offer excellent opportunities to interest young people in our industry. This year the Federation will present for the first time a "Careers In Coatings" program at the 1982 FSCT Annual Meeting. John Gordon has lined up an impressive list of speakers. The program is directed to Washington-area science teachers and guidance counselors. Good attendance by the educators will provide an excellent forum to discuss our industry and the career opportunities that it offers to their students. If successful, similar sessions will be held at future Annual Meetings.

Several years ago Sid Lauren of the Cleveland Society described our industry as the "bashful giant". The image of the coatings industry as a "pot and paddle" industry is much too prevalent not only among the general public but also among science educators. They must be shown that ours is a mature industry involving more science disciplines than any other segment of the chemical industry. To do this we must increase our interface with science and technology organizations such as the American Chemical Society, the American Institute of Architects and others.

This report represents the input of our committee members. We are providing Tom Kocis with the following for possible use by the various societies in arranging an Education Night for chemistry teachers:

(1) A typical letter to the teachers.
(2) Details on experiments for demonstrations.
(3) A list of possible subjects for Science Fair exhibits.

HERMAN J. LANSON,
Chairman

Paint Research Institute

PRESIDENT ROBINSON

The last two years of PRI activity has been a period of transition. The Federation Ad Hoc Committee established to inquire into the operations of PRI and the Board of Trustees of PRI itself were of essentially the same opinion in seeking a change in the management and focus of PRI. During the last two years, therefore, Dr. R. Myers, Research Director, and the President have worked towards establishing the changes that both the Federation and the PRI Board of Trustees thought necessary. When Dr. Myers and the President retire from the Board at the end of 1982, they will feel that new directions and management of PRI activities will have been established.

The Board of Trustees, during the last two years, will have experienced almost a 100% turnover in its membership. The President of PRI has been able to advise two Federation Presidents (from whom the utmost in cooperation has been received) on the selection of Trustees, and responding to comments from the Ad Hoc Committee and the field a significantly better balance of Board membership is now evident. In addition to representation from paint manufacturing companies, members of the PRI Board now represent raw material suppliers, paint users, the smaller company, and hopefully, in the future, equipment suppliers. Continued focus being experienced in industry on an improvement in paint transfer efficiency, the participation of qualified equipment supplier representatives is essential.

In January 1983, Dr. Seymore Hochberg assumes his position of Executive Director, Paint Research Institute, and during the last nine months he has been working with Dr. Myers and the President in order to effect a smooth transition. The President wishes to report that the transition has indeed been very smooth with Dr. Hochberg rapidly taking charge of all of his duties and responsibilities in a professional and energetic manner.

One of the major comments of the Ad Hoc Committee concerned the general frustration felt by the Federation Board, the local Societies, and the general membership in not being able to influence the directions of research that PRI should pursue. The Chairman of the Applied Research Subcommittee of PRI, Mrs. Ruth Johnston-Feller, carried out a survey of local Society wishes via the Chairman of the local Technical Advisory Committees. A very high response to Mrs. Johnston-Feller's questionnaire, which dealt with high solids coatings research, was received and the results of the survey will be incorporated in both PRI General Research Programs and the PRI High Solids Consortium should adequate support be obtained.

PRI Trustee Roy Brown, designed a general questionnaire for inclusion in simultaneous issues of the JOURNAL OF COATINGS TECHNOLOGY and the *American Paint Journal.*

Approximately 10,000 copies of the survey were distributed and while a significant number of completed surveys were returned, the Trustees requested that the survey appear for a second time, which was arranged for the JOURNAL OF COATINGS TECHNOLOGY only.

Dr. Hochberg, working with Mrs. Johnston-Feller, has proposed a limited program of jointly funded research at local universities. This program also is in response to comments and observations received from the Ad Hoc Committee and the field, and would work as follows. If a local Society is able to fund some paint-oriented research work at a local university, then PRI will offer matching funds for this activity in order to promote interactions and communications between local universities and local sections. The role of the Executive Director in this activity would be largely advisory with program monitoring and assistance being carried out by the local Society. This program is obviously highly dependent on sufficient funds being available.

The Mildew Consortium continues to work with latex samples being sent to selected local Societies for paint formulation activities. Problems have been encountered with one of the latexes in that, as formulated by the university investigator, it was difficult to formulate paint using it as a binder. Corrective action is being taken by arranging for a paint formulation methodology to be established before further latex samples are disseminated. A Prospectus for a Corrosion Consortium has been prepared and Dr. Hochberg is engaged in developing interest in the Prospectus of potential Consortium participants. Dr. Hochberg is satisfied with the results so far. The High Solids Consortium will receive Dr. Hochberg's attention next. It will build on Dr. Myers' earlier proposals and will include the conclusions obtained from Mrs. Johnson-Feller's survey. There has been no significant activity on a potential Aqueous Coatings Consortium.

The Five Year Plan for PRI will be ready for implementation in January 1983. The Chairman of the Basic Research Subcommittee, Dr. Percy Pierce, has proposed the establishment of PRI Basic Research Fellowships at selected universities with funding being provided by PRI and major corporations. The Fellowships would be established in the name of PRI and would be administered and monitored by the Executive Director, assisted by an Advisory Committee. Specific directions for this type of Basic Research were proposed by Dr. Pierce. Mrs. Johnston-Feller's Applied Research Committee, supported by Dr. Hochberg, has proposed a Technological Program which includes studies aimed at improving paint application technology, the control of adhesion, and the establishment of improved accelerated tests of paint film durability. The Communications Committee, headed by Dr. Hendry, has completed its plans for the PRI Booth at the 1982 Washington Paint Show. Dr. Richard R. Eley, of Glidden, has prepared a tutorial on "Rheology" and this has been presented under the auspices of PRI at both the CDIC and the Cleveland Societies. Dr. Eley reports that interest in his tutorial is high and he has monthly engagements to present his tutorial from January 1983 until the end of Society activity in the Spring.

In 1981, a very poor response to the Roon competition was obtained and as a consequence, PRI decided to increase the Roon Award and to more widely publicize the existence of the Roon competition. In 1982, the Roon Award Committee, chaired by Dr. Darlene Brezinski, received 20 papers and Dr. Brezinski reports that these were of exceptionally high quality. Indeed, *seventeen* of these papers will be presented at the Annual Meeting in Washington. Dr. Brezinski and her committee are to be congratulated for this outstanding achievement.

The continuing recession has had its effect in providing a less than anticipated level of funding for PRI from industry. PRI programs in common with industry programs may have to be curtailed.

The President wishes to point out that, as always, the future of PRI is in your hands. The Board of Trustees has worked hard to respond to the comments and suggestions provided by the Ad Hoc Committee, the local Societies and the general membership, and more than ever they need the support of the general membership. The President feels that the current Board of Trustees is outstanding in balance, experience, commitment, and personal influence within the companies they represent. It would be difficult to identify a better Board anywhere. The Board of Trustees will elect a new President and Officers at the 1982 Annual Meeting, and these Officers, together with Dr. Hochberg (Executive Director) supported by Dr. Myers (Director Emeritus) will need all the support that you can provide.

PETER V. ROBINSON,
President, PRI

RESEARCH DIRECTOR MYERS

This is my last report as your PRI Research Director. Although I will hold the title, Emeritus, there will be no call for reports on a regular basis.

The past 19 years have been enjoyable ones. Being in the center of activity of one of the Federation's major programs has been an invigorating experience, and my only regret is that I could not steer it into the mainstream of your effort as you responded to ecological and economic pressures to create new technologies.

We have only one active consortium on which to report. Mildew research is proceeding along the lines established for it by the group of industrial supporters who have seen fit to continue the program well past the three-year initial period of their commitment. Sooner or later, there will be a resignation, but the campaign for new members continues in the good hands of Program Manager Yeager.

The management of PRI will be in good hands, also, when a change is made on January 1 to a full-time Executive Director located in Philadelphia. Dr. Seymore Hochberg has spent this year familiarizing himself with the programs that have been more or less moribund for the past two years, and the direction in which he will take them deserves your full support.

In parting, I would like to point out that Federation associates have become as dear to me as have many individuals in my field of academia. A story told by Homer Flynn during my first year in office typifies the treatment accorded by a succession of Federation Officers and staff. During one of our trips to Europe Homer had laid out such an ambitious schedule of events that we asked why he had gone to such pains. His reply was "my pappy told me to treat every customer like your best customer." Although I never quite mastered the logical sequel to that admonition ("always ask for the order"), I did apply Homer's homily to the effort put into PRI activities. Despite the fact that the directorship was only a part-time job, it never played second fiddle.

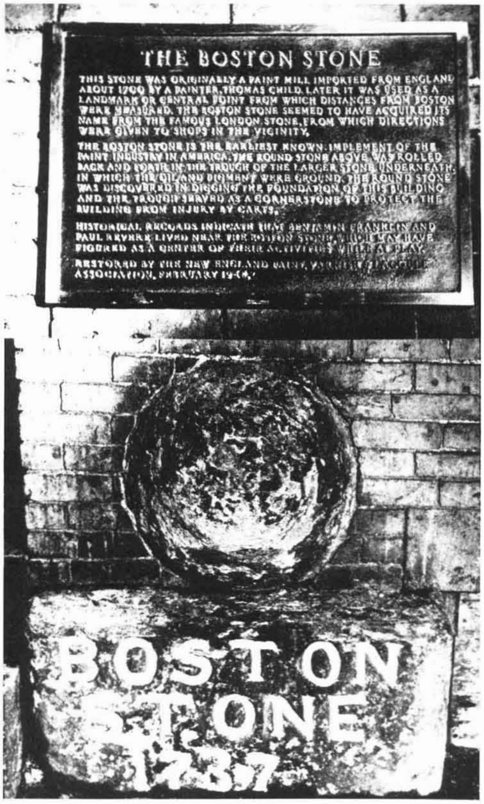
RAYMOND R. MYERS,
Research Director

Following the presentation of his report, Dr. Myers was given a standing ovation in appreciation of his 19 years of dedicated service as Research Director of the Paint Research Institute.

Society Business

BOSTON STONE

The New England Society is spearheading efforts to preserve and perhaps relocate this historical symbol of the Federation. Later, some financial assistance may be sought from the Federation and the Societies.



The Boston Stone

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

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

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

CONTRIBUTIONS TO PRI

During the meeting, contributions to the Paint Research Institute were presented by the Houston, Kansas City, Louisville, and New York Societies. They were gratefully acknowledged by PRI President Peter V. Robinson.

Review of Actions Of Executive Committee

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

The actions of the Executive Committee at its meeting of September 10, 1982, are listed below.

All were approved by the Board of Directors.

September 10, 1982

That the Federation's First Half Statement of Income and Expense be accepted.

That the Paint Research Institute's First Half Statement of Receipts and Disbursements be accepted.

That Dr. Thomas J. Miranda be reappointed Technical Editor of the JCT, 1982–83.

That the Federation Pension Plan Trustees in 1982–83 be the then President-Elect, Treasurer, and Executive Vice-President.

That the First Quarter budget for 1983 be set at one-quarter of the 1982 budget, for operational purposes only.

That the Federation continue to pay (in 1982–83) certain transportation expenses (round trip air coach fare from home city to meeting city) as follows: (1) To all members of the Board of Directors and Executive Committee who attend their meetings, except any held in conjunction with the Annual Meeting; (2) To specified members of Federation committees to attend their meetings (those held during the Annual Meeting excluded) but only when funds to cover these meetings have been appropriated by the Executive Committee; (3) To Past-Presidents of the Federation who attend the Board of Directors meeting held during the Annual Meeting.

That the Federation continue to pay (in 1982–83) the complete travel expenses (within the budget) of Federation officers and the Immediate Past-President on matters of official Federation business. Also, that the Executive Committee deem it appropriate and in the best interests of the Federation that spouses accompany the officers on certain Executive Committee-approved travel during the year at the expense of the Federation.

That the complete travel expenses of the Society Representative members of the Executive Committee be paid by the Federation to the winter and summer meetings of the Executive Committee, effective with the January 28, 1983 meeting.

That the registration fees for the Federation's April 26–27, 1983 seminar be: prior to April 1—\$80 for members, \$90 for non-members; after April 1—\$100 for everyone.

That the duties of the FSCT Technical Advisor be revised as stated in the minutes.

That the Federation is interested in sponsoring another Symposium on Color and Appearance Instrumentation (SCAI), along with MCCA and ISCC, and that details regarding the date, etc., be referred to the Federation's ISCC Committee for study and recommendation.

That the various duties listed under "Federation Staff Assistance to PRI" be approved.

That exhibit rental rates for the 1983 Paint Show be increased by 5%.

That a tentative hold be placed on the dates October 7–9, 1991, in the City of Boston, for the Annual Meeting and Paint Show.

Nominations And Elections

The following slate of candidates for Federation Office (1982–83) was presented by the Nominating Committee Chairman William H. Ellis at the Spring 1982 meeting of the Board, and were re-presented at this meeting.

No other nominations were made from the floor.

By unanimous vote, the slate, was elected.

President-Elect—Terryl Johnson, of the Kansas City Society (Cook Paint & Varnish Co.). One-year term. He is currently Treasurer.

Treasurer—Joseph A. Bauer, of the Louisville Society (Porter Paint Co.). One-year term.

Executive Committee—John T. Vandeberg, of Chicago Society (DeSoto, Inc.). Three-year term.

Board of Directors (Members-at-Large)—Morris Coffino, of New York Society (D.H. Litter Co., Inc.); and Rudolph C. Albrecht, of Chicago Society (The Enterprise Companies). Two-year term for each.

Board of Directors (Past-President Member)—William Dunn, of Toronto Society (Monarch Coatings, Inc). Two-year term.

Old Business

CORRESPONDENCE COURSE

President Howard Jerome reported that on October 18, 1982, the Federation received a check in the amount of $35,110 from the University of Southern Mississippi. This represents a refund of the monies previously advanced by the Federation to USM for the preparation of a Correspondence Course on Surface Coatings and Technology, and terminates the agreement dated May 18, 1979.

New Business

FEDERATION HONORARY MEMBERSHIP FOR PAST-PRESIDENT MILTON A. GLASER

Milton A. Glaser, a Past-President of the Federation (1956–57) had been proposed by the Chicago Society for Federation Honorary Membership. As specified in Standing Rules II, the Secretaries of each Society and the Board of Directors were advised of the nomination.

A secret ballot was taken and, by unanimous vote, the Board of Directors elected Mr. Glaser a Federation Honorary Member.

THREE-QUARTERS FINANCIAL REPORT

Mr. Borrelle was instructed to include an additional column—"Actual ¾, Previous Year" in the ¾ Statement of Income and Expense.

MEMBERSHIP CERTIFICATE

Mr. Borrelle was also instructed to produce a Federation Membership Certificate for use by all Societies. Each Society will be responsible for filling in member's name, Society name, dates, etc.

Committee Reports

CORROSION

The Corrosion Committee has not met since the last report was submitted to the Board of Directors on April 30, 1981.

The primary activity of the committee since that report has been organizing and arranging a workshop presentation at the Federation Annual Meeting on the subject of the Performance of Non-Lead, Non-Chromium Pigments in Solvent Based and Water Based Primers. The Workshop will be Chaired by Fred Lafferman (Enterprise) with presentations by the following: Andrew Panozzo, of BASF—Wyandotte; Ken Haagenson, of Buckman; Jay Austin, of Halox; Milton Kaplan, of Mineral Pigments; Alan Smith, of NL Chemicals; and Dave Lewis, of Sherwin Williams.

The following persons have accepted appointment to the Corrosion Committee for 1982–1983: Dean Berger, of Gilbert Associates; Alex Chasan, of U.S. Navy; Gary Gardner, of Porter Paint Co.; Thomas Ginsberg, of Union Carbide Corp.; Theodore Hopper, of Jotun Baltimore Copper; Sidney B. Levinson, of D/L Laboratories; Richard E. Max, of Synkote Paint Co.; Horace S. Phillip, of Sherwin-Williams (Canada); Lothar S. Sander, of Amchem Products Co.; and Armand Stolte, of NL Industries.

Saul Spindel
Chairman

DEFINITIONS

A very perceptive secretary in the paint industry pointed out that all the defined terms in the *Paint/Coatings Dictionary* begin with a capital. Hence, she could not tell which words should be capitalized and which should not. In response to her complaint, all noncapitalized terms in the second edition will start with lower case letters. Since the *Paint/Coatings Dictionary* is on a word processor tape, changing to a lower case will be easy; deciding on which words should or should not be capitalized will not be easy. This is why we decided on capitals in the first place.

Stanley LeSota
Chairman

EDUCATIONAL

The annual Educational Committee Luncheon was held during the 1981 Annual Meeting in Detroit. The meeting was presided over by retiring Educational Chairman, John A. Gordon. This meeting is held primarily for the "Educators" of the Federation. The following universities were represented: University of Southern Mississippi; Kent State University; North Dakota State University; University of Missouri, Rolla; and Eastern Michigan University.

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

The Federation Board of Directors has approved a total of $18,000 for the Scholarship Fund for the 1982–83 academic year. Funds have been awarded to the following institutions: University of Southern Mississippi—$6,000; North Dakota State University—6,000; University of Detroit—2,000; Kent State University—2,000; University of Missouri, Rolla—1,000; and Eastern Michigan University—1,000.

The annual Educational Committee meeting was held at the Hilton Airport Inn, Detroit, MI, on April 16, 1982. The annual meeting was presided over by the new Educational Chairman, James A. Hoeck, of the Louisville Society.

Highlights of the Educational meeting are as follows:

(1) Report on the status of the correspondence course at the University of Southern Mississippi.

(2) Presentation of the newly-produced video tape, "PRI—Present and Future," featuring PRI President Peter Robinson.

(3) Dr. John Graham reported on the first year of the "Polymers and Coatings Technology" program at Eastern Michigan University.

(4) Review of the Scholarship Program. The Educational Committee recommended that a sub-committee be formed to review annual requests for scholarship funding, and based on these requests, make recommendation to Board of Directors for future funding.

(5) Update on Federation Series on Coatings Technology.

(6) Society Reports. Reports on the annual activities in each Constituent Society.

(7) Promoting career opportunities in coatings, Chairman Dr. Herman Lanson, and his committee are developing ways and means to promote careers in the coatings industry.

(8) Educational Committee presentation at 1982 Annual Meeting. To develop a special and original program for presentation at the Annual Meeting. Royal A. Brown has invited selected high school science teachers and/or guidance counselors in the D.C. area to attend this unique presentation.

JAMES A. HOECK,
Chairman

INTER-SOCIETY COLOR COUNCIL

Newly-elected officers of the Inter-Society Color Council include Ms. Joyce Davenport as President-Elect. She is a member of the Federation (Chicago Society) and also a member of the Federation delegation to the ISCC.

The ISCC Committee continues its effort to obtain a final report from ISCC Project Committee 10 on the Color-matching Aptitude Test. Committee 10 was placed on the inactive list without finishing the promised measurement and evaluation report on the 1978 edition of the CAT Set. Visual comparisons of the 1978 edition with the 1964 edition were conducted by members of the Federation's ISCC Committee and constitute the only available data on visual evaluations. Although Committee 10 was supposed to measure chips from both editions with the Match-Scan Spectrophotometer, no data has been received. In May 1981, Frank Borrelle wrote to the then President-Elect of ISCC and requested that Committee 10 be reactivated so that its evaluation work could be completed. Nothing happened. A year later, the same person (now the President of ISCC) instructed Committee 10 to measure the chips and submit the data. We trust their results will be forthcoming soon.

In the meantime, the Birmingham Club's Technical Committee is accumulating data on the visual results of the 1978 edition. This will add to our comparisons between observers on this current version. Such information will help to establish the norm. Copies of our present results have been sent to them in their analysis.

The Manufacturer's Council on Color and Appearance (MCCA) has suggested making plans for a third Symposium on Color and Appearance Instrumentation (SCAI) for 1984 or 1985. This will be explored further at our committee meeting during the Annual Meeting.

The publication endorsed by the ISCC, *Color Research and Appearance,* is published quarterly by the Wiley Publishing Co. to their profit, and contains many interesting articles about color. It has not published articles directly concerning the paint industry, however, which we would rather have published in JCT, so we do not feel that it is competitive.

The next annual meeting of the Inter-Society Color Council will be held in Louisville, KY, April 10–12, 1983. There will be a conference on "Color and Illumination—Man Lights, and So Colors His Environment"—at Williamsburg, February 6-9, 1983, sponsored jointly by the Illuminating Engineering Society and the ISCC.

RUTH JOHNSTON-FELLER,
Chairman

MANUFACTURING

The Manufacturing Committee has planned a full, morning seminar at the Annual Meeting. The November 4th session will feature seven speakers who will address the topic of "Computers in Paint Manufacturing" with both formal presentations and discussions.

In addition to the Seminar at the Annual Meeting, the Manufacturing Committee has arranged for a plant visitation to the Duron, Inc. facility in Beltsville, MD. This will be conducted on November 2, and the members of the Manufacturing Steering Committee, as well as the Chairman of the Constituent Society Manufacturing Committees, have been invited to attend.

The committee roster has been completed for 1982–83 and a few new members have replaced some who wished to step down. The committee will hold a brief, organizational breakfast meeting at the Annual Meeting and will schedule a full-day meeting for sometime in February or March. All of our current activities are continuing.

Chairman Max attended the June 14th Golden Gate Society Manufacturing Committee Seminar on computers as a Federation representative. The program, chaired by Louie Sanguinetti, was excellent and speaks well for the West Coast segment of the industry. Chairman Max has been invited to address the 16th Biennial Western Coatings Societies Symposium and Show in February.

As with all of the Federation committees, the Federation staff has to be commended for all their work done on our behalf during the past year. In particular, Tom Kocis' outstanding efforts have really made possible the progress and achievements of this committee and we extend our sincere gratitude to him.

RICHARD E. MAX,
Chairman

MEMBERSHIP

At the Spring Board of Directors' Meeting, a rather comprehensive analysis of the membership status was given. Hence this report will be rather brief.

Non-Members Attending Conventions: Last year the Membership Committee distributed lists totaling approximately 300 prospective members to Society Representatives at the Spring Board Meeting for follow-up by Society Membership Chairmen. Many interesting stories developed from this distribution, which made the effort worthwhile. This year the Federation staff sorted out the names of non-members attending the Detroit Convention by computer and sent read-outs to each Society Membership Chairman. The computer sorted these names by Society location.

Membership Certificates: Many organizations give their members a membership certificate to give their members a feeling of pride in belonging. The Los Angeles, Golden Gate, Rocky Mountain, and Pacific Northwest Society request that the Federation have certificates made and available to individual Societies for issuing to their membership on a one-time basis.

Los Angeles Society Survey: The Los Angeles Society has completed a very inclusive survey of its membership determining their composition, background, attitudes, and desires. It is hoped that they will make the results available to the other Society Representatives and that they will be inspired to make similar surveys of the talents available in their individual Societies.

A. GORDON ROOK,
Chairman

PROGRAM

A full complement of presentations which address a variety of coatings topics has been scheduled for the Annual Meeting.

A record number of Roon Awards competition entries, along with nine Society papers, provided a substantial addition to those generated by the Committee.

Presentations were also developed by the Educational, Manufacturing, Technical Information Systems, and Corrosion Committees, and the Paint Research Institute.

These, along with the Keynote Address and the Mattiello Lecture, made for an abundance of presentations to be accommodated in the three-day event. Accordingly, concurrent sessions have been scheduled, and attendees will have an assortment of program offerings to sample.

In concluding my duties as Chairman, I wish to express thanks to the members of the Program Committee and all who contributed to developing the presentations for this year's Annual Meeting.

JOHN C. BALLARD,
Chairman

PUBLICATIONS

Planning is underway to review and update membership on the Editorial Review Board.

Roon Award papers have been reviewed with a short review time to accommodate the Roon Award Committee's schedule.

The Ad Hoc Committee on the Federation Series on Coatings Technology has met and formulated a plan for upgrading the booklets. The report will be forwarded to the Publications Committee for review and to the Executive Committee for approval. Plans include Editors, an Advisory Board, and uniform format for booklets. Action plans will be implemented upon approval by the Executive Committee.

Foreign journal articles have now been reprinted in the JOURNAL OF COATINGS TECHNOLOGY as suggested at our Spring Meeting. Work is underway to continue to seek out suitable articles from foreign journals.

A new JCT department, Open Forum, appeared in the August 1982 issue and will be continued.

"Humbug from Hillman" will continue.

The long awaited Federation-sponsored symposium will be held in April 1983.

THOMAS J. MIRANDA,
Chairman

ROON AWARDS

A total of 19 papers were accepted for the 1982 Roon Awards Competition. In addition to the obvious increase in quantity of manuscripts submitted, the quality of the manuscripts was also very good. The papers were also representative of all aspects of the industry. Five winning papers were selected inclusive of the obvious first, second, third place, and a tie for fourth place.

It is hoped that through increased recognition and publicity, the response for the 1983 Roon Awards Competition will be equally as rewarding and challenging.

Winners of the 1982 competition are:

FIRST PRIZE ($1,000)—"Comparative Solvent Evaporation Mechanisms for Conventional and High-Solids Coatings," William H. Ellis, of Chevron Research Co., El Segundo, CA.

SECOND PRIZE ($750)—"Popping of Water-Soluble Baking Enamels," Zeno W. Wicks, Jr., of North Dakota State University, Fargo, N.D., and Ben C. Watson, of Sherwin-Williams Co., Chicago, IL.

THIRD PRIZE ($500)—"Predictive Model for Cracking of Latex Paints Applied to Exterior Wood Surfaces," F. Louis Floyd, of Glidden Coatings and Resins, Div. of SCM Corp., Strongsville, OH.

FOURTH PRIZE (tie—$375 ea.)—"Interrelationships Between Pigment Surface Energies and Pigment Dispersion in Polymer Solutions," G. Dale Cheever and John C. Ulicny, of General Motors Research Labs., Warren, MI.

"Presence and Effects of Anaerobic Bacteria in Water-Based Paints," Robert A. Opperman, of Cosan Chemical Corp., Carlstadt, NJ.

DARLENE BREZINSKI
Chairman

TECHNICAL INFORMATION SYSTEMS

Activities during 1982 of the Technical Information Systems Committee (TISCO) were:

(1) Four members are participating in the TISCO-sponsored session at the FSCT 1982 Annual Meeting. The theme of the session is "Technical Information Sources and Services for the Coatings Industry—An Update."

(2) Members have completed the 1982 Annual Subject/Keyword Index to the JOURNAL OF COATINGS TECHNOLOGY, for publication in the December issue.

(3) Members continue to compile "Technical Articles in Other Publications" for publication in the JCT.

TISCO is willing to offer bibliographic assistance, on request, to all Federation and Constituent Society committees. TISCO will compile a *basic* bibliography on a subject pertaining to the committee's project, or will assist the respective committee in the preparation of this bibliography.

HELEN SKOWRONSKA,
Chairman

DELEGATE TO SSPC

The fall meeting of The Steel Structures Painting Council (SSPC) was held in Pittsburgh on September 28-30, 1982. A total of 130 suppliers, users and representatives of government agencies attended. About one third are members of the Federation.

The following minutes were submitted in time to report to the Federation:

SURFACE PREPARATION

Kenneth S. Trimber—Chairman & Acting Secretary

(1) *Power Tool Cleaning to Bright Metal* (J. Belisle)—A test panel study to compare power tool cleaning methods to achieve a "Near White" degree of cleaning will be carried out at

Metalweld, Philadelphia, PA. The prepared panels will be incorporated in the PACE program. Guidelines for the use of power tools will also be prepared for review at the next meeting.

(2) *Abrasive Specifications and/or Guides* (W. Hitzrot)—The Maritime Administration is working on similar guidelines for abrasive evaluation. Therefore, Hitzrot will act as liaison with SSPC.

(3) *Wet Blast Cleaning* (T. Dowd)—Guides will be prepared for both water blast cleaning and wet blast cleaning. The guides will include inhibitors, flow rates, disposal of debris and safety.

(4) *Centrifugal Wheel Blast Cleaning* (D. Hale)—A guide will be prepared to supplement information on equipment and abrasives described in Volume I. The guide will include control of operating mix, adjusting wheel pattern, maintaining abrasive flow rate, ventilation and avoiding grease/oil contamination.

(5) *Organic Acid Cleaning* (H. Gewanter)—A specification will be developed including guidelines for cleaning methods and procedures.

(6) *Miscellaneous* (L. Schwab)—New cleaning methods will be investigated including a rust removal paste (PVP and EDTA in water), Xenon flash lamps, CO_2 pellets, and ultrasonic cleaning.

Surface Preparation for Maintenance Painting (B. Appleman)—The Maintenance Painting Committee needs guides for power tool and wet blast cleaning prior to repainting. Appleman will act as liaison to submit these anticipated guides for review by the committee.

SSPC Surface Preparation Manual (H. Hower)—SSPC is interested in preparation methods including the guides and specifications to be prepared by the Task Groups. The projected publication date is early Summer 1983.

Bridge Painting Research

Dr. Lloyd M. Smith—Chairman & Acting Secretary

The Federal Highway Administration is contemplating the development of a painting inspectors course. Suggestions are solicited as to format, content and length.

Reports on Improved Field Reliability of High Performance Coatings and Coatings for Non-Blast Cleaned Steel Surfaces will be available in a few months.

The following projects are underway at the present time:

(1) The National Bureau of Standard's short term evaluation and analysis for predicting coating life. One method uses thermography for detecting underfilm corrosion.

(2) Florida Dept. of Transportation evaluation of and recommendations for the bridge corrosion cost model.

(3) The National Cooperative Highway Research Program to investigate the removal of lead-based bridge paint.

Federal Highway Administration research projects will be curtailed because of recent funding cutbacks.

PACE—Evaluation of Paints

Dr. Bernard R. Appleman—Chairman
Lloyd M. Smith—Secretary

The PACE program was started in 1974 in order to locate acceptable replacements for lead and chromate pigments, organic solvents and silica abrasives, all of which are being strictly regulated.

Phase I was sponsored by Penn. DOT, EPA, and several industry groups. Phase II, started in 1980, was sponsored by 25 state highway departments, FHwA, and EPA. The sponsorship is due to end in May 1984.

PACE III—Proprietary Paints—It has been proposed that coating manufacturers and raw material suppliers absorb the major cost of this evaluation on their coatings since government funds have decreased considerably and will run out in 1984.

Task groups were formed to initiate a program for selecting and testing paints under PACE III, as well as the method of reporting the data obtained.

Water-Borne Epoxies

Dr. Edward Bozzi—Chairman
Arthur L. Cunningham—Secretary

The draft of the specification was mailed to the members of the Committee for review and ballot. The comments received were reviewed and the document revised where they were considered to be valid.

A revised draft will be submitted to the Committee members for letter ballot.

Sidney B. Levinson,
Delegate

[*We regret that because of space limitations we are unable to publish here the full text of Mr. Levinson's report. However, the complete report will appear in the February issue under "Committee Activities".—Ed.*]

Society Reports

Baltimore

Celebrated 50th anniversary in April . . . Technical Committee active in determining reflectance measurements of coatings and pigment constituents in the near infrared region . . . Education Committee conducting coatings course at Essex Community College . . . Environmental Committee monitoring waste disposal problems . . . Reinstituted moral support of PRI . . . Society acting as Host Society for 1982 Annual Meeting.

Birmingham

Membership at highest total in Club history—152 . . . Hosted Federation President Jerome and wife, Gene, at May meeting . . . Continuing to act as agent of Federation for sale of FSCT publications in U.K.

Chicago

Society membership stands at 818. Monthly meetings average 135 attendees . . . Sponsored SYMCO '82 in April, with good attendance . . . Technical Committee active in high-solids oligomers, oven vs. shelf stability, water-borne anticorrosion coatings, renewable resources, and bound biocides projects . . . John T. Vandeberg presented Outstanding Service Award . . . Society's first Grant-in-Aid Award given . . . Presented award to coatings project in Chicago's Science Fair . . . Provided scholarships at NDSU, USM (Rolla), and Elmhurst College . . . Nominated Milton A. Glaser to FSCT Honorary Membership.

Cleveland

Sponsored plant tour of PPG Industries' facility in Cleveland . . . Held combined meetings with Cleveland PCA and local chapter of NACE . . . Celebrated 60th anniversary in May . . . In March, held 25th "Advances in Coatings Technology Symposium"; in October, symposium on use of computers presented by Manufacturing Committee . . . Provided three $100 awards for local science fair . . . Members active in planning and lecturing at Kent State coatings courses . . . Charles Beck and Paul Houck given Society's Award of Merit.

Dallas

Membership remained stable during 1982 with a slight increase in monthly meeting attendance . . . Renewed support for PRI . . . Technical Committee presenting two papers at 1982 Annual Meeting.

Detroit

Held FOCUS Symposium in May, "New Frontiers in Applications Techniques" . . . Education Committee continuing courses at University of Detroit

Golden Gate

Manufacturing Committee held annual seminar, topic—"Uses of Computers in Coatings Industry" . . . Technical Committee working on correlation between salt spray and exterior exposure testing, and current PRI Mildew Consortium projects . . . Environmental Committee active in task force reviewing architectural rule . . . Education Committee forming four different courses using FSCT Series on Coatings Technology booklets . . . Contributed volumes to coatings section established at Redwood City library.

Houston

Membership now stands at over 200 . . . Established Scholarship Program . . . Hosted 1982 Southwestern Paint Convention in April with 318 attendance . . . Donated $150 to PRI.

Kansas City

Manufacturing Committee planning to update FSCT A/V unit on sand mill operation . . . Held successful fund raiser—Beef-A-Rama—raffle of a side of beef . . . Voted to support PRI with donation in 1982 . . . By-laws changed to allow Associate members right to vote.

Los Angeles

Membership increased to 612 with monthly meeting average at 133 . . . Technical Committee presenting three papers at Annual Meeting . . . Nine students completed Education Committee course in Polymer Technology at Calif. State Univ. at Fullerton; 12 students graduated from Paint Technology course at L.A. Technical Trade College; over $9,000 awarded in scholarships in 1982, with scholarship fund approaching $100,000 . . . Conducted organization survey among membership . . . Providing professional secretarial help to officers . . . Continuing successful advertising program for yearbook.

Louisville

Held joint meetings with Louisville PCA . . . Average monthly attendance is 70 . . . Dean Harper, of Univ. of Louisville, won APJ and Program Awards at 1981 Annual Meeting . . . Presenting paper at 1982 AM . . . Technical Committee completed literature search on corrosion inhibitive pigments for 1983 project . . . Working with PRI and other Societies on Mildew Consortium project . . . Sponsored video tape production of Peter Robinson's PRI talk; presented Federation with three copies . . . Educational Committee presented course at University of Louisville Speed Engineering School.

Montreal

Membership increased by 26 . . . Translated by-laws to French . . . Accepted advertising for monthly meeting notices . . . Education Committee Paint Technology course held for 24 students . . . Held annual joint symposium with Toronto Society on theme, "Coatings Directions of the Eighties" . . . Technical Committee working on projects on settling and adhesion of latex paints . . . Manufacturing Committee presented April panel discussion on waste disposal.

New England

Held successful Second Biennial Coatings Tech Expo—attendance of 500 . . . Formed Boston Stone Committee on preservation of the Federation symbol.

New York

PaVaC Award presented to Eli Singer . . . Ongoing scholarship program . . . Education sponsored two courses: "Fundamentals of Coatings Technology" and "Laboratory Training for Technicians" . . . Technical Committee active with six projects: Utilization of computers in coatings industry; surfactants and polymeric thickeners in aqueous systems; modern methods for viscosity determination; surface tension related problems in high solids coatings; biocidal polymers in paints; and flash point of water reducible coatings . . . Manufacturing Committee conducted two surveys of membership for symposium topics . . . Changed by-laws to allow Associate members to vote and hold office . . . Contributed $500 in support of PRI.

Northwestern

Presented $500 to NDSU scholarship fund . . . Recorded highest attendance—130—at March symposium, "Present and Future Equipment for Economical and Efficient Application of Compliance Coatings" . . . Education Committee initiating area Vo-Tech coatings course . . . Changed by-laws allowing Associate members to vote and hold office.

Pacific Northwest

Total membership now at 211, with monthly meeting average of 35 . . . Successful 32nd Annual Spring Symposium drew 278 . . . Seven members received 25-year pins . . . Reinstated financial support of PRI . . . Accepted generous $1,000 donation to scholarship fund from L.A. Society . . . Changed by-laws to allow Associate members to vote and hold office.

Piedmont

Established polymer chemistry course, with enrollment of 34, at Univ. of North Carolina—Greensboro.

Pittsburgh

Averaging 50 attendees at monthly meetings . . . Continued support of high school science fair with two awards.

Rocky Mountain

Education Committee planning training program in over-the-counter sales of paints and related products.

Toronto

Membership reached all-time high of 412, with a monthly attendance average of 120 . . . Held successful technical symposium on formulation of industrial coatings . . . Accepted advertising in monthly newsletter . . . Presenting two papers at 1982 Annual Meeting.

In Memoriam

We report with deep regret the passing of the following members during the last year:

Baltimore

LEONARD H. COHAN—Retired (Hanline Bros., Inc.) Society Past-Pres.
ALBERT SHUGER—Retired (Baltimore Paint & Chem. Co.)

Chicago

WAYNE S. MADDEN—Process Design Associates
FRANK L. SULZBERGER—Retired (Enterprise Co.)

C-D-I-C

LAWRENCE BING—Wilson Paint Co., Society Past-Pres.
ELMER JONES, JR.,—Paul Uhlick & Co.
PAUL F. MARLING—Retired (Monsanto Co.)

Cleveland

DOUGLASS CANNELL—Retired (Sherwin-Williams Co.)
EDWARD W. GEIS—Glidden Coatings & Resins
ARTHUR HOLTON—Retired (Sherwin-Williams Co.)
RUDOLPH ZIMKA—Retired (Sherwin-Williams Co.)

Detroit

NEWELL P. BECKWITH—Retired (Inmont Corp.) Federation Past-Pres., Society Honorary Member
LEO PESOLA—Retired (Pratt & Lambert, Inc.) Consultant, Wyandotte Paint

Golden Gate

HAROLD M. BREZ—Ishihara Corp.; Society Past-Pres.
CHARLES H. CARY—A. J. Lynch & Co.
ROY G. LANDIS—Retired (Sherwin-Williams Co.)
ROBERT M. ROEDER—Morwear Paint Co.

New England

FRANK C. ATWOOD—Retired (Atlantic Research Associates) Federation Past-Pres.; Federation & Society Honorary Member
ROBERT J. DELACK—Delack Associates
ALAN R. LUKENS—Retired (Lukens Chemical Co.)
HENRY B. TWOMBLY—Retired (Devoe & Raynolds Co).; Society Honorary Member

New York

JOHN J. HENDRICKS—D/L Laboratories, Inc.
JOSEPH KAMEN—Retired (Penn-Jersey Paint & Varnish Co. & Cargill, Inc.)
MERRITT T. METZ—Retired (Empire State Varnish Co.)
CHARLES G. OSWALD—Retired (Daniel Products Co. & Keystone Paint & Varnish Co.)
WM. F. SCHAUFELBERGER—Retired (Irvington Varnish Co.)
VINCENT C. VESCE—Retired (Harmon Colors Corp.); Mattiello Lecturer 1959

Pacific Northwest

CHARLES J. ALEXANDER—Simpson Research Center

Philadelphia

DANIEL M. GREENBERGER—Best Brothers Paint Co.

Rocky Mountain

GEORGE NEIBERGER—Kwal Paints; Society Past-Pres.

St. Louis

GEORGE C. ROBBINS—Retired (Robbins Varnish Co.) Society Past-Pres.
STANLEY T. SCHELLENBACH—Retired (Steelcote Mfg. Co.) Society Past-Pres.

Southern

CHARLES A. COFFEY—Retired (Harris Paint Co.)
JOHN EMORE—Zaclac Paints
HERMAN J. FRITZ—Retired (Mobile Paint); Soc. Past-Pres.
M.G. MCGREGOR—Retired (Zaclac Paints)
SANDOL E. WERNER—Air Products & Chemicals

Toronto

J.E. LYONS—Lyons Chemical Co.

Western New York

CONNIE C. SISK—Tenneco Chemicals, Inc.

Affiliated

LEO L. CARRICK—Retired (Professor of Chemistry and Protective Coatings—Consultant—at North Dakota State Univ., Michigan Univ., & Colorado State Univ.)
ROBERT F. MCTAGUE—Glidden Corp. Tintas Ypiranga, Brazil

CARROLL M. SCHOLLE,
Chairman, Memorial Committee

William A. Bours III Receives 1982 NPCA Heckel Award

William A. Bours III, recently retired Vice-President, Fabrics and Finishes of E.I. DuPont de Nemours & Co., Inc., Wilmington, DE, was named the 1982 winner of the George Baugh Heckel Award by the National Paint and Coatings Association (NPCA) at its 95th annual meeting, held in Washington, DC on November 1-3.

After receiving a B.A. degree and a B.S. degree from Princeton University, and an M.S. degree from Columbia University, Mr. Bours joined DuPont in 1941. His first position was in the company's Engineering Department, where he remained until he became Sales Development Manager of the Fine Chemicals Division of the Organic Chemicals Department in 1950. He held various sales management positions until he was appointed Assistant General Manager of the Industrial and Biochemicals Department in 1969, a position he continued to hold in the Biochemicals Department when it was formed in 1972. In 1975 he was promoted to the position he held at retirement.

Mr. Bours is a past President of NPCA and has also served on its Board of Directors and Executive Committee. He also served as Chairman of the NPCA Executive Committee's Ad Hoc Policy Subcommittee for SRI Review that monitored the Association's half-million-dollar occupational health research program.

William D. Kinsell Is Elected President of NPCA

William D. Kinsell, Jr., of the Glidden Coatings & Resins Div. of SCM Corp., Cleveland, OH, was elected President and Chief Executive Officer of the National Paint and Coatings Association (NPCA) at its 95th annual meeting, held in Washington, DC. Also elected were: Charles J. Fisher, Reliance Universal Inc., Louisville, KY, as Vice President, and Keith C. Vander Hyde, Guardsman Chemicals Inc., Grand Rapids, MI, as Treasurer.

Regional Vice-Presidents were chosen from seven geographical zones: New England—Ralph C. Swanson, Raffi and Swanson, Inc., Wilmington, MA; Eastern—Edward C. Rabon, Charles A. Wagner Co., Inc., Philadelphia, PA; East Central—Joseph M. Walton, Jamestown Paint & Varnish Co., Jamestown, PA; West Central—Raymond H. Frederick, Reynolds Metals Co., Inc., Shawnee Mission, KS; Southern—William C. Warlick, Warlick Paint Co., Inc., Statesville, NC; Southwestern—Max L. Powers, PPG Industries, Inc., Houston, TX; and Western—Clyde L. Smith, Ameritone Paint Corp., Sub. of Grow Group, Inc., Long Beach, CA.

Elected to the Board of Directors for a one-year term was Rex Reade, Rust-Oleum Corp., Vernon Hills, IL. Elected to the Board of Directors for a two-year term was J. David Porthouse, Carboline Co., St. Louis, MO.

The following were elected to the Board of Directors for a three-year term: James H. Davis, Porter Paint Co., Inc., Louisville, KY; Harry Feinberg, Duron, Inc., Beltsville, MD; Bernhard F. Mautz, Jr., Mautz Paint Co., Madison, WI; Joseph B. Milgram, Jr., DeSantis Coatings, Inc., Willoughby, OH; Richard R. Missar, DeSoto, Inc., Des Plaines, IL; Malcolm G. Slaney, PPG Industries, Inc., Pittsburgh, PA; Raymond D. Stevens, Jr., Pratt & Lambert, Inc., Buffalo, NY; M.C. Workman, Benjamin Moore & Co., Montvale, NJ; James D. Zogg, Gaco Western, Inc., Seattle, WA; Hanspeter N. Fesenmeyer, Ciba-Geigy Corp., Ardsley, NY; Donald C. Garaventi, Rohm and Haas Co., Philadelphia, PA; and Nathan L. Zutty, Union Carbide Corp., Danbury, CT.

NPCA Industry Statesman Awards Presented at 95th Annual Meeting

The National Paint and Coatings Association (NPCA) honored six men with long and illustrious careers in the U.S. paint and coatings industry at its 95th annual meeting in Washington, DC.

Receiving the Association's Industry Statesman Award were: Royal A. Brown, recently retired Vice-President, Technical, NPCA; E. Arthur Cowman, recently retired Honorary Chairman of the Board of the Cowman-Campbell Paint Co. of America, Inc.; Lyle E. Frohberg, recently retired Senior Vice-President, Automotive, Inmont Corp.; James C. Hendershot, Chairman and Chief Executive Officer of Reliance Universal Inc.; Ralph I. Lieberman, recently retired Vice-Chairman of the Sinclair Paint Co.; and Ralph S. Michael, Jr., Vice-President of Industrial Products for the Coatings & Resins Div. of PPG Industries, Inc.

Royal A. Brown held technical and manufacturing management positions with several industry companies before joining the NPCA staff in 1966 as Technical Director. He was appointed Vice-President, Technical in 1978. He continues to be active as a consultant and is employed by the Federation of Societies for Coatings Technology as Technical Advisor.

E. Arthur Cowman joined his father in the retail paint business in Oklahoma in 1927 and joined the General Paint Corp. in Seattle in 1934. In 1937, he and J. Robert Campbell started their own firm, the Cowman-Campbell Paint Co. Mr. Cowman was President of the firm until the late 1970's, when he became Chairman of the Board.

In 1937, Lyle E. Frohberg joined Berry Brothers and remained with the firm until 1948 when he joined the Rinshed-Mason Co., which was acquired by Inmont in 1966. Remaining with the Inmont Corp., he attained the position of Senior Vice-President, Automotive.

James C. Hendershot joined Reliance Universal Inc. in 1983 and rose through the positions of Executive Vice-President, President and General Manager of two of the firm's coatings operations, and President and Chief Operating Officer. In 1977, he attained his present position.

Ralph I. Lieberman has been with the Sinclair Paint Co. since 1929. He was promoted to the position of General Manager in 1946, Vice-President of Operations in 1956, and Executive Vice-President in 1968. He assumed the position of Vice-Chairman in 1975.

Ralph S. Michael, Jr. joined PPG Industries, Inc. in 1940 as an industrial sales trainee. He attained the position of Manager of Industrial Finishes in 1960 and the position of General Sales Manager of Industrial Finishes in 1965. He was elected to his present position in 1977.

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FIRST PLACE WINNER IN THE 1982 ROON AWARDS COMPETITION

Comparative Solvent Evaporative Mechanisms For Conventional and High Solids Coatings

William H. Ellis
Chevron Research Company*

Solvent volatility has traditionally been used to control initial flow and resulting qualities of a conventional coating. As evaporation progresses, the rate limiting factor changes from volatility to diffusion. Developed here is a precise method for determining the transition point. Comparison of laboratory data with typical formulas demonstrates that conventional alkyd coatings are formulated at resin concentrations below the transition point, high solids polyester coatings above. Thus, diffusion limits the total evaporation process in a high solids coating and solvent volatility cannot be used to control setting and other initial flow properties.

INTRODUCTION

Although a solvent resides in a paint film only briefly, evidence of its quality and behavior remain for the life of the coating. The purpose of the solvent is to control film flow during and shortly after application. If flow is too much or too little, a poor film develops. Appearance, drying time, adhesion, and even durability are affected.

As the solvent evaporates, film viscosity increases. Achieving the proper viscosity at various stages of drying is critical. A solvent must evaporate relatively quickly during initial drying to prevent excessive flow, and it must evaporate slowly enough to give sufficient leveling and adhesion.

Selecting a solvent with the proper volatility (and solvency) to control flow of a conventional alkyd coating is a common, straightforward procedure. Controlling flow of a high solids coating through solvent selection is a frustrating endeavor, with little hope of success. One of the differences is that high solids resins are inherently more fluid than most alkyds, as shown by the typical viscosity data in *Figure* 1. As solvents evaporate and the resin concentration becomes greater, viscosity of the alkyd solution increases more rapidly and is higher at each concentration. Also, as the literature and our data indicate, solvents evaporate faster, especially in the initial stage, from the alkyd coating. Thus, high solids polyester will flow more at all stages of drying.

Volatility, a traditionally valid factor in solvent selection for conventional coatings, has very limited value in the selection of solvents for high solids coatings. Diffusion rate of the solvent molecules to the surface of the resin film is of much greater importance.

It is common industrial practice to select solvents by comparing only evaporation rates of neat solvents. This procedure is satisfactory in many cases with conventional alkyd resins because "set" time depends upon volatility of the initial solvent increment. However, solvent evaporation is a two-stage process; the second stage depends upon solvent diffusion rather than volatility. First-stage evaporation is much faster than second stage.

A mathematical-graphical technique for determining precisely the resin concentration at which the transition from volatility-controlled to diffusion-controlled evaporation occurs was developed at Chevron Research. For a given resin-solvent combination, one can thus determine whether or not the solvent will contribute to the setting of the coating.

High solids vehicles are formulated beyond the transition point, volatility has little significance, and diffusion is too slow for solvent evaporation to create initial "setting" of a high solids coating. Avoiding excessive flow is a primary problem with high solids coatings, and solvent selection to control it is a very limited tool.

Presented by Mr. Ellis at the 60th Annual Meeting of the Federation of Societies for Coatings Technology, November 4, 1982, in Washington, D.C.
*P.O. Box 97, El Segundo, CA 90245.

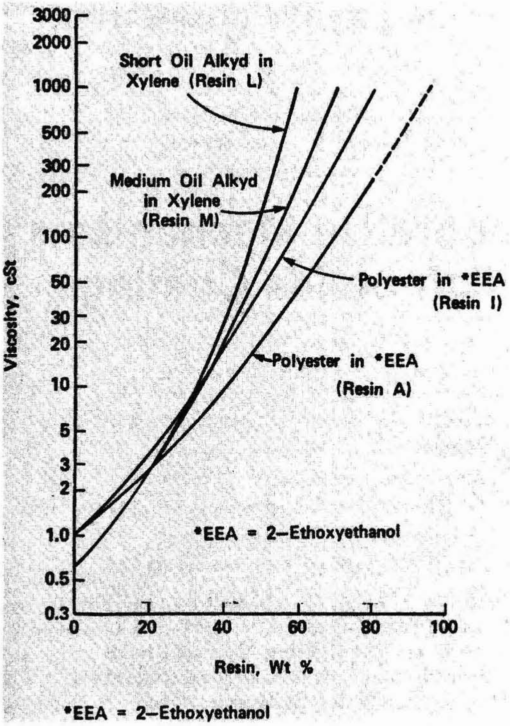


Figure 1—Typical viscosity reductions for high-solids and alkyd resins

EVAPORATION RATE MEASUREMENT

Evaporation data for this study were determined with the Chevron Research Evapocorder, a sophisticated electronic balance. Details of the instrument were described by Saary and Goff.[1] The instrument recorder produces a plot, illustrated in *Figure* 2, showing weight percent of solvent evaporated as a function of time during the evaporation process. Evaporation of neat solvent or

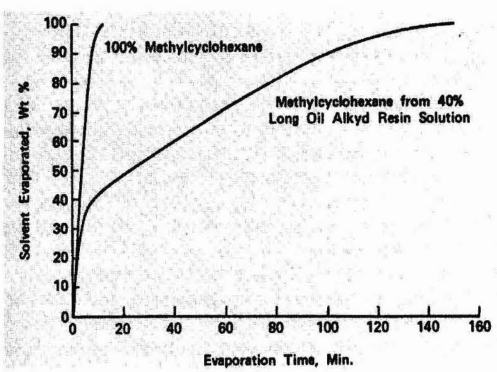


Figure 2—Typical Evapocorder plot showing wt % solvent vs time

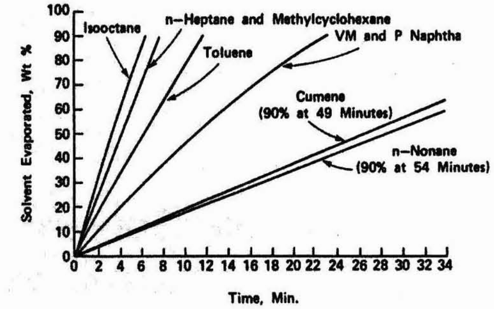


Figure 3—Evaporation rates of selected pure compounds and VM&P naptha (Evapocorder, 27°C)

solvent from a solution can be examined. A second pen on the recorder plots the derivative of the first curve (not shown). The derivative is the instantaneous evaporation rate at any point. The instantaneous evaporation rate, as discussed later, is important in this method for determining the transition from volatility-controlled to diffusion-controlled evaporation of solvent from a resin solution.

EVAPORATION STAGES AND MECHANISMS

Neat Solvent Evaporation and Volatility

Neat solvent evaporation is relatively straightforward; it depends upon vapor pressure and, in practical situations, ambient conditions. Vapor pressure, of course, varies with temperature; for blends, it also varies with molecular interactions.[2]

Evapocorder data are shown in *Figure* 3 for a number of pure compounds used in this project and for one petroleum thinner, a VM&P naphtha. The VM&P naphtha is included to illustrate a subtle difference between evaporation behavior of a pure compound and a petroleum thinner. The VM&P naphtha data show a curvature, indicating that the volatility is decreasing as the solvent evaporates; its vapor pressure is also diminishing. This pattern is characteristic for petroleum distillates and other mixtures. Pure compounds yield essentially straight-line evaporation data. Their evaporation rates are also proportional to their vapor pressures (*Table* 1). These phenomena can be used to distinguish a pure compound from a mixture. The information in *Table* 1 also serves to identify solvents in later figures.

Overall Evaporation from Resin Solutions

A resin in solution complicates the evaporation of the solvent. Exploratory experiments were carried out using 40% by weight of a long oil alkyd resin (obtained at 100% solids) in a variety of solvents, which are listed in *Table* 1. In all cases, the evaporation rate of the neat solvent was faster than from the resin solution. A typical system is shown in *Figure* 2.

Comparison of the 90% evaporation times for a given solvent with and without the resin solute shows that the

Table 1—Solvent Vapor Pressures And Evapocorder 90% Evaporation Times

Solvent	Identification	Vapor Pressure at 25°C, Torr.	Evapocorder 90% Evaporation Time, Minutes
1	Isooctane	49	6.7
2	n-Heptane	47	8.0
3	Methylcyclohexane	47	8.0
4	Toluene	32	12
5	n-Octane	15	20
6	Ethylcyclohexane	13	20
7	Ethylbenzene	10	27
8	p-Xylene	9	31
9	Isobutyl alcohol	13	36
10	Cumene	5	49
11	n-Nonane	5	51
12	n-Butyl alcohol	6	51
13	n-Propylbenzene	2	65
14	1,2,4-Trimethylbenzene	1	99
15	n-Decane	<1	129
16	2,2,5-Trimethylhexane	17	16
17	2-Ethoxyethanol acetate	2	100
18	n-Butyl acetate	13	34
19	Isobutyl acetate	20	25

relative difference is less for the slower evaporating solvents. The ratios of 90% evaporation times from resin solutions to those of the neat solvents decrease in a regular pattern as times become longer. This is shown in *Figure* 4.

The five identified solvents in *Figure* 4 have higher evaporation time ratios than others of corresponding volatility, indicating that the resin retards evaporation of these solvents the most. All of the other solvents are naphthenic, aromatic, or normal paraffinic hydrocarbons. There are some plausible explanations for this apparent anomaly. Isobutyl alcohol and normal butyl alcohol may hydrogen bond to the resin. This, however, is not sufficient explanation for the isobutyl alcohol, which has the same molecular weight and functional group and is more volatile in its neat state than the n-butyl alcohol. There is some evidence in the literature that diffusion is retarded by molecular branching.[3] The isobutyl molecule has a bulky, branched hydrocarbon structure, a property that it has in common with the isoparaffins. The 2-ethyoxyethanol acetate (EEA) also has a large cross-sectional area, as well as a functional group.

First-Stage Evaporation: Volatility Controlled

Evaporation data published in trade literature and used by most formulators is for neat solvents. It is useful because it does give a measure of the early, critical drying rate of a conventional coating Sletmoe[4] demonstrated that loss of solvent during this initial stage is limited by boundary layer resistance. He found that the critical factor was solvent activity and also that pigmentation of a coating had a negligible effect on evaporation.

Much attention has been given to the first evaporation

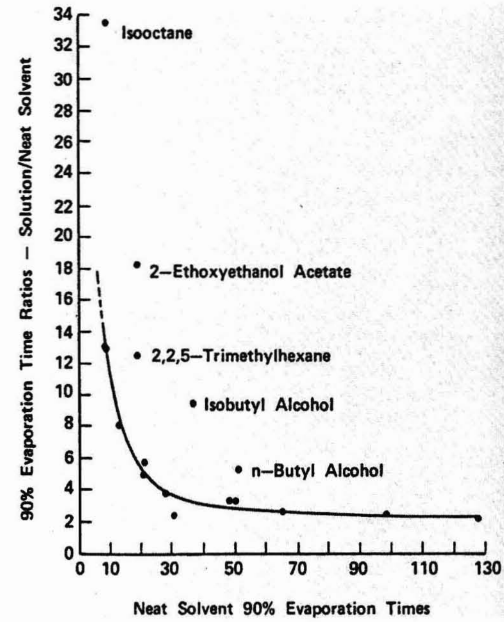


Figure 4—Solution/neat solvent 90% evaporation time ratios vs neat solvent 90% evaporation times

stage, which depends only upon the particular vapor pressure of the solvent. Raoult's Law[5,6] states that for an ideal system the partial pressure of the solvent is reduced by the mole concentration of the resin solute. However, a resin has such a high molecular weight that it exerts little effect; and the partial pressure of the solvent in the early stages of drying is similar to the vapor pressure of the neat solvent. The practical consequence of this is shown in *Figure* 2 for a typical system, a long oil

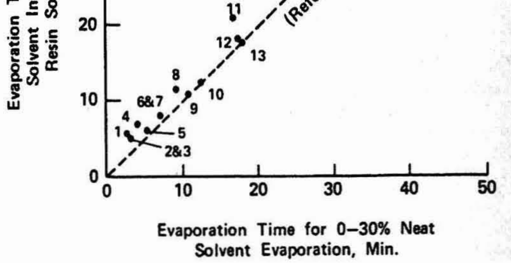


Figure 5—Evaporation time of 0–30% neat solvent increment approximates time for 0–30% evaporation from long oil alkyd resin solution (solvents identified in *Table* 1)

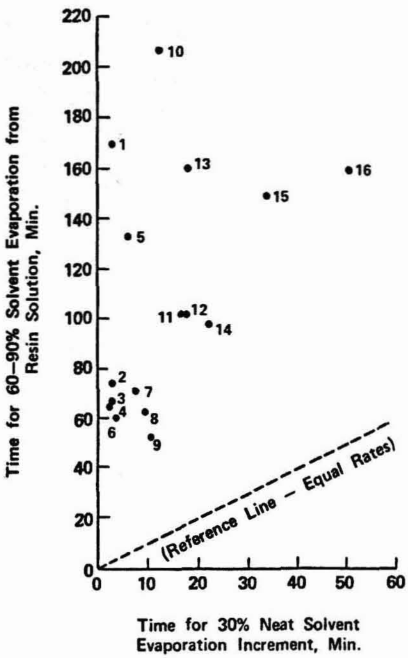


Figure 6—Evaporation time for 60–90% solvent increment from resin solution in much slower than 30% neat solvent increment (Solvents identified in *Table* 1)

line, showing that the resin exerts little influence on evaporation of this first solvent portion.

alkyd resin in methylcyclohexane. The initial evaporation rate for the solvent from the resin solution is virtually identical to that for the neat solvent. At later stages, the curves diverge. More extensive data are shown in another form in *Figure* 5, where evaporation times for the first 30% solvent increment are compared with times for evaporation of the same increment from long oil alkyd resin solutions. All values are near the reference line, showing that the resin exerts little influence on evaporation of this first solvent portion.

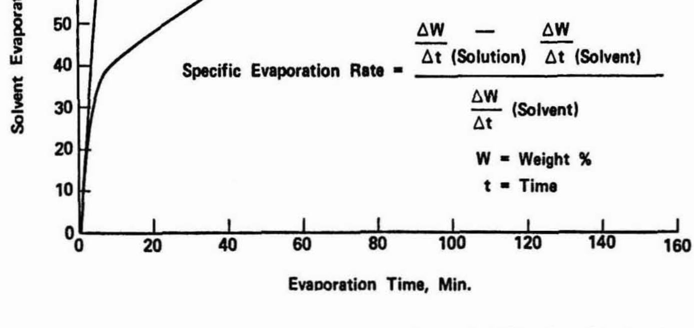
Second-Stage Evaporation: Diffusion Controlled

When similar data for evaporation times near the end of the evaporation process are compared, as in *Figure* 6, it is apparent that solvent evaporation from the long oil alkyd resin solution is much slower than neat solvent evaporation. This implies that evaporation in the later stages from a resin solution is not simply a function of solvent volatility. Hansen[7] elucidated most effectively that the later stages of evaporation are controlled by diffusion of the solvent molecules to the surface where they can evaporate. He states that the diffusion process depends upon size and shape of the solvent molecule and free volume of the polymer.

Newman and Nunn[3] point out that a single solvent may have different diffusion coefficients in different polymers, but its relative ranking will remain the same. They also report that plasticizing a resin increases solvent diffusion and that a solvent molecule will diffuse much faster through a resin that is above its glass transition temperature than through one that is below.

As diffusion slows near the end of the evaporation process, small amounts of solvent are sometimes retained in the film for long periods of time. This phenomenon has been studied by a number of investigators, including Hays,[8] Baelz,[9] Hansen,[7,10] Newman and Nunn,[3] and Weigel and Sabino.[11] Collectively, they have found that thermoplastic resins, especially, can retain small amounts of solvents for days or even months. Vinyl and acrylic solutions, on drying, may retain 5–15% solvent for many weeks. Retention depends upon both the resin and solvent types. The consensus is that hard resins retain solvents longer than more fluid ones and that plasticizing of the resin reduces solvent retention. Baelz,

Figure 7—Specific evaporation rate calculation



Hansen, and Newman and Nunn showed differences in retention behavior among different polymers. However, for a series of solvents in any of these polymers, the order of residual solvent loss is the same. The data suggest that the general level of solvent retention is affected by the polymer but that specific interactions are not important, i.e., the phenomenon is physical rather than chemical.

EVAPORATION MECHANISM TRANSITION

Historically, the transition from volatility-limited to diffusion-limited evaporation was of limited practical importance and studies of the subject were few. Hansen,[10] however, has presented a mathematical treatment. He showed a transition point by plotting the logarithm of the diffusion coefficient versus the volume fraction evaporated. The point of transition was selected when the evaporation rate due to volatility equaled the evaporation rate limited by diffusion. At this point, the evaporation rate was slowing significantly.

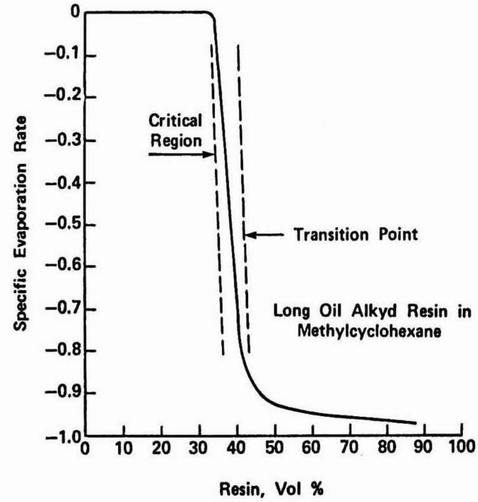


Figure 8—Transition from vapor pressure to diffusion limited evaporation is shown clearly by specific evaporation rate

"Specific Evaporation Rate"

A calculation scheme was devised which determines precisely where the transition from volatility-controlled to diffusion-controlled evaporation occurs. The calculation is based on Evapocorder data and requires two test runs, one for the neat solvent and one for a resin solution. It was found that a 40% by weight resin solution is normally the most satisfactory, but a lower concentration may be necessary if the transition occurs at a lower concentration. From these data, one can calculate a function the author calls the "specific evaporation rate." For a given percent evaporated, the specific evaporation rate is the ratio of the evaporation-rate-decrease caused by the resin to the evaporation rate for the neat solvent:

$$\text{Specific Evaporation Rate} = \frac{\frac{dW}{dt}_{(soln)} - \frac{dW}{dt}_{(solv)}}{\frac{dW}{dt}\ (solv)}$$

W = Weight percent solvent evaporated
t = Time, minutes

Therefore, specific evaporation rate is a dimensionless quantity which indicates the retarding power of the resin. The effect of neat solvent volatility is suppressed by treating the evaporation rate decrease relatively.

Evaporation rate values can be taken directly from the derivative plot on the Evapocorder chart or approximated by the incremental method illustrated in *Figure* 7. In this method, 10% increments have proved satisfactory most of the time. If the specific evaporation rate value is changing rapidly, 5% increments are more desirable.

Specific evaporation rate usually has limits of zero to minus one. The only exceptions are rare cases when resin-solvent interactions cause the solvent activity coefficient to exceed one during the initial evaporation stage. In these cases, the solvent evaporates slightly faster from the resin solution than it does in the neat state.

Table 2—Properties of Resins Used in Experiments

	Resin Type	Solids, Wt %	Solvent	Oil
A	Polyester	88.0	EEA	Oil free
B	Polyester	83.6	EEA	Oil free
D	Polyester	72.2	EEA	Oil free
E	Polyester	90.0	Aromatic naphtha	Oil free
H	Polyester	80.8	EEA	Oil free
I	Polyester	81.9	EEA	Oil free
J	Alkyd, melamine	55.0	Xylene/butanol	Short (dehydrated castor & coconut)
K	Rosin mod. alkyd	100	(Xylene/VM & P)[a]	Short (soya)
L	Alkyd	100	(Xylene/VM & P)[a]	Short (soya)
M	Alkyd	100	(VM & P)[a]	Medium (soya)
N	Alkyd/ melamine	75	Xylene	Short (coconut)
O	Alkyd	100	(Mineral Spirits)[a]	Long (soya)

(a) Resin is 100% solids. Solvents listed are those used in coating formulations.

Evaporation Stage Transition

The transition from volatility-controlled to diffusion-controlled evaporation is very apparent when the specific evaporation rate is plotted as a function of volume percent resin, as shown in *Figure* 8. (Inasmuch as diffusion rate involves solvent migration through a thickness of film, we believe it is more meaningful to convert Evapocorder weight percent data to volume percent resin. This requires considerable arithmetic and knowledge of the weight percent resin in the original product and the densities of the solvent and solid resin, which sometimes must be calculated or determined in the laboratory.) The key value we have selected for compar-

Table 3—Properties of Resins Used in Experiments

Resin	Acid Number	Oil, Wt, %	Phthalic Anhydride, Wt %	Viscosity, Gard.-Holdt	Molecular Weight Data M_n	M_w	M_z	D (M_w/M_n)
A	10	0	—	23-25	599	1,092	1,731	1.8
B	10	0	—	24-26	1,004	1,866	2,980	1.9
D	6	0	—	24-26	1,974	13,200	65,700	6.7
E	15	0	—	2-22	785	1,356	3,236	1.7
H	15	0	—	24-26	1,199	2,940	8,155	2.5
I	15	0	—	24-25	1,118	3,929	16,200	3.5
J	—	—	—	—	—	—	—	—
K	30	33	44	U-V[a]	—	—	—	—
L	10	41	42	J-N[a]	—	—	—	—
M	10	57	31	I-L[b]	2,000	57,900	310,400	29.0
N	10	32	44	K-N[a]	—	—	—	—
O	9	65	24	Y-Z[c]	1,380	24,300	257,700	18.0

(a) 50% in xylene.
(b) 50% in mineral spirits.
(c) 70% in mineral spirits.

ing resin and solvent performance is the volume percent resin where the specific evaporation rate equals minus 0.50. This is the midpoint of the evaporation stage transition, and the value is referred to later as the "transition point." The initial part of the curve, when the specific evaporation rate is near zero, is the range where solvent diffusion predominates.

FACTORS AFFECTING TRANSITION POINTS

Both the resin and solvent types affect the transition point. The solvents used in our various experiments have already been identified (*Table* 1). Resins chosen were alkyds, high solids polyesters, and one bodied linseed oil. Except for the bodied linseed oil, they are listed in *Tables* 2 and 3. The long oil alkyd used in experiments described previously was Resin O. Although this resin would not be used in baking finishes nor in the solvents studied, it was chosen because it was available at 100% solids and is readily soluble in a wide variety of solvents.

Table 4—Long Oil Alkyd Resin Concentration At Transition Point With Various Solvents

Solvent	Resin % at Transition Point
Isooctane	36
n-Heptane	38
Methylcyclohexane	39
Toluene	40
2,2,5-Trimethylhexane	45
n-Octane	39.5
Ethylcyclohexane	41.5
Ethylbenzene	45
p-Xylene	48.5
Isobutanol	44
Cumene	47
n-Nonane	42
n-Butanol	45
n-Propylbenzene	50.5
1,2,4-Trimethylbenzene	55.5
n-Decane	55

Solvent Volatility and Transition Point

The concentration of Resin O in a variety of solvents at their solution transition points are tabulated in *Table* 4. The same transition point data are plotted in *Figure* 9 as a function of Evapocorder 90% evaporation times for the neat solvents (as a measure of volatility). The transition point occurs at higher resin concentrations as solvent volatility decreases. This may indicate that a

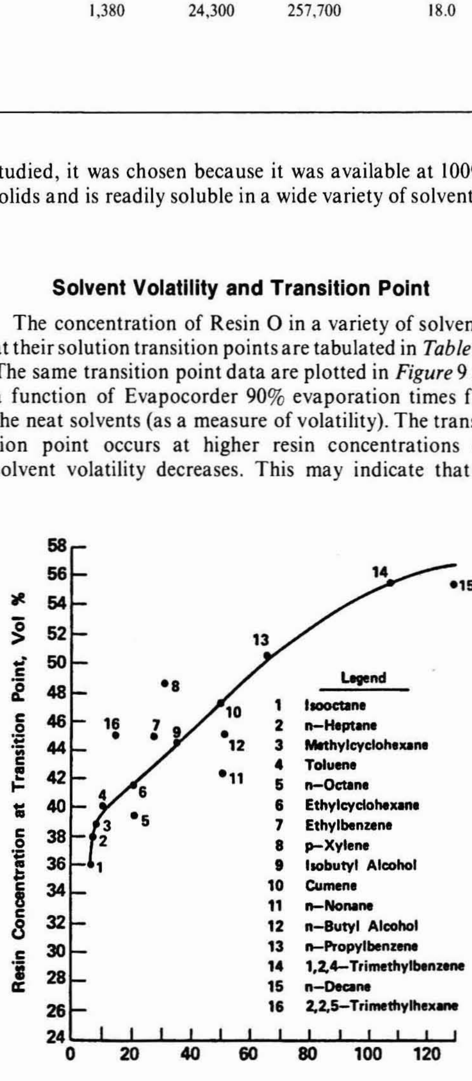


Figure 9—Long oil alkyd resin concentration at transition point increases with neat solvent volatility

Table 5—Resin Concentration at Transition Point

3 Resins and 4 Solvents

Resin	Solvent Methyl-Cyclo-hexane	n-Heptane	Isooctane	Toluene	Avg. Effect of Resin
Medium oil alkyd	36	39.25	38	39	38.0
Long oil alkyd	39	38	36	40	38.3
Bodied linseed oil	45	47	49.5	47	47.1
Avg. effect of solvent	40.0	41.4	41.2	42.2	

Table 6—Viscosity at 25°C, cSt, of Resin Solutions At Their Transition Points

Resin	Solvent Methyl-Cyclo-hexane	n-Heptane	Isooctane	Toluene	Avg. Effect of Resin
Medium oil alkyd	48	400	900	24	343
Long oil alkyd	52	47	68	26	48
Bodied linseed oil	7.5	4.7	8.1	7.2	6.9
Avg. effect of solvent	36	151	325	19	

lower solvent concentration gradient develops in the resin film when solvents are less volatile; i.e., if a solvent evaporates slowly from the surface, the concentration throughout the film remains more uniform. Although, technically, the solvent evaporation may remain volatility-limited, little surface depletion occurs relative to the remainder of the solution. Vaporized molecules are replaced by diffusion, but the system remains at the borderline of the transition point while a large part of the solvent evaporates. Diffusion in this type of solution is also slow because Fick's First Law says that the diffusion rate depends upon the concentration gradient:

$$dQ = -D \frac{dc}{dx} dt$$

D = Diffusion coefficient
Q = Quantity of solvent diffusing
x = Distance diffused
c = Concentration of solvent
t = Time

Outlying points in *Figure* 9, e.g., p-xylene, may be due to experimental error. However, it may be significant that all points below the curve represent linear molecules: three normal paraffins and a normal alcohol.

Four of the solvents in the series had approximately the same volatility and represented the four naturally occurring hydrocarbon types in petroleum solvents. Transition points for these four solutions and for similar solutions of a medium oil alkyd and a bodied linseed oil are shown diagrammatically in *Table* 5. Differences between values for the two alkyd resins and among the four solvents are not significant, but the transition point resin concentration for the bodied linseed oil in all four solvents is higher than for the alkyds. Thus, resin type also affects transition points. The similarity of data among the four solvents is probably because they have similar volatilities and are nonpolar; the medium oil alkyd resin concentration at its transition point in EEA was 44.

Because the linseed oil is much more fluid than the alkyd resins, it is reasonable to suspect viscosity as a factor. However, as shown in *Table* 6, viscosity is not a factor. Viscosities of the *Table* 5 solutions at their transition point are shown in *Table* 6. The viscosities vary widely, depending upon both the resin and solvent, but all solutions of the linseed oil are indeed very fluid. (Viscosity data were obtained with a Zeitfuchs cross-arm

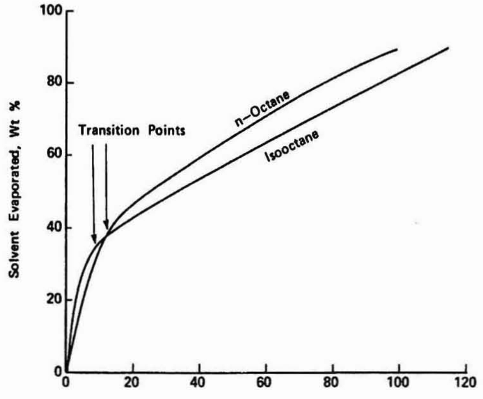


Figure 10—Evaporation of n-octane and isooctane from long oil alkyd resin solution (Resin O)

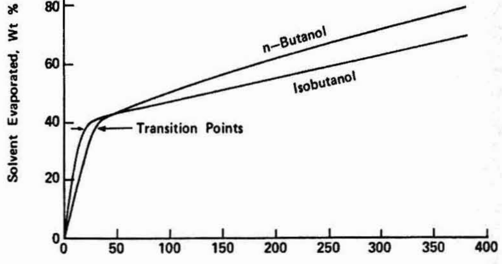


Figure 11—Evaporation of n-butanol and isobutanol from long oil alkyd resin solution (Resin O)

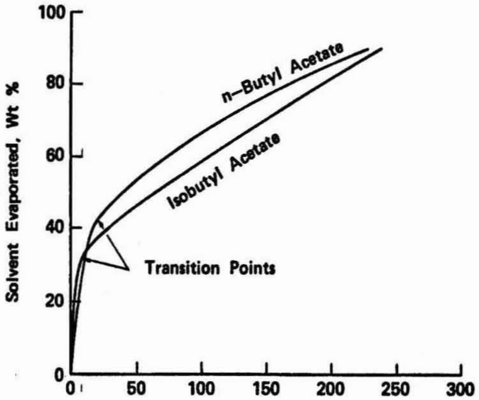


Figure 12—Evaporation of n-butyl acetate and isobutyl acetate from high-solids polyester solutions (Resin A)

viscometer.) As mentioned before, Hansen[7] states that free volume of the polymer is responsible.

Solvent Molecular Type and Transition Point

The effect of hydrocarbon molecular shape, as well as that of volatility, can be seen clearly in *Figure* 10. Isooctane is more volatile and evaporates faster in the early stages, where volatility is the predominant factor. Beyond the transition point, however, the greater cross-sectional area of the isooctane retards its evaporation during the diffusion-limited state. The curves actually cross near the transition points. The resin in these solutions is the long oil alkyd, Resin O. These solutions are uncomplicated by solvent functional groups or resulting hydrogen bonding.

Similar data are shown in *Figure* 11, for n-butanol and isobutanol solutions of the same long oil alkyd resin. Again, the linear molecule has a lower volatility but a faster diffusion rate. The curves cross as the very extreme evaporation rate change occurs with both solvents. These compounds are capable of strong hydrogen bonding, which is probably a factor in their slow diffusion rates.

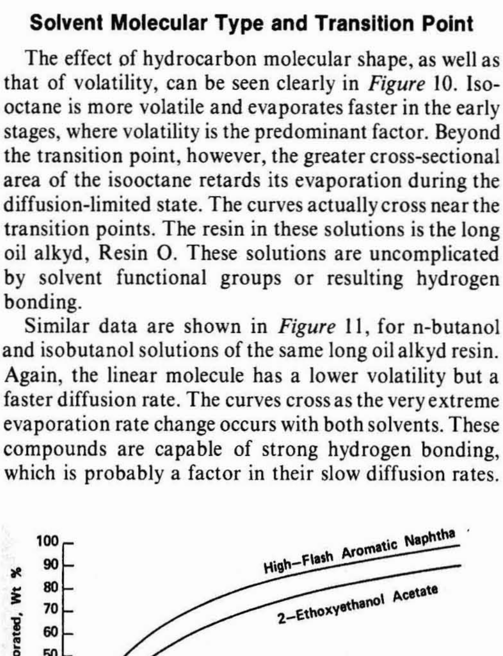


Figure 13—Evaporation of high-flash aromatic naptha and 2-ethoxyethanol acetate from high-solids polyester solution (Resin E)

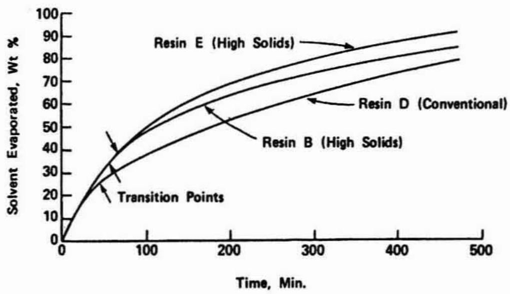


Figure 14—Evaporation of 2-ethoxyethanol acetate from three polyester resins

The effect of molecular branching is superimposed on this and is also apparent; i.e., the isobutanol is slower evaporating than n-butanol during the diffusion-limited stage.

The same phenomena occur with the completely different system shown in *Figure* 12. The isobutyl acetate initially evaporates faster than n-butyl acetate from a high solids polyester solution (Resin A) because of volatility differences. In the diffusion-limited stage, the n-butyl acetate evaporates faster. In this particular comparison, there is also a significant difference in the transition points. Evaporation during the diffusion-limited stage is faster for both solvents from this resin than for the two alcohols from the long-oil alkyd solutions depicted in *Figure* 11. This may be influenced by the difference in resin free volume and by the lower propensity of the acetates to hydrogen bond.

One of the high solids polyesters used in our experiment was supplied in a high flash aromatic naphtha, but the manufacturer recommended EEA as the reducing solvent. Evaporation experiments with the two solvents are compared in *Figure* 13. The two neat solvents have approximately the same volatility but differ in molecular structure. The transition points are the same, which is consistent with our finding that solvents of similar volatilities will have approximately the same transition point with a given resin. However, the difference in molecular structure apparently makes the aromatic naphtha evaporate faster. Also, these solvents are much lower in volatility than most of those discussed previously, and the transition point is not readily apparent in these basic evaporation curves. It is necessary to use the specific evaporation rate calculation to locate it precisely.

Polyester Type and Transition Point

With a single solvent, EEA, recommended by the resin manufacturers for use with three different polyesters, evaporation rates and transition points vary, as shown in *Figure* 14. Solids contents of the resins, as supplied, decrease in the order: E>B>D. This is, therefore, probably the order of solubility and hardness of the resin. It also proved to be the order of evaporation rates and transition points.

Table 7—Vehicle Solids in Suggested Conventional Alkyd White Baking Enamel Formulations Are Below Transition Point

	Vehicle Solids, Volume %		Difference
	In Suggested Formula	at Transition Point	Formula-Transition
J	27	45	−18
K	34	44	−10
L	36	44	− 8
M	32	38	− 6
N	40	46	− 6

(a) Solvents were those recommended by the resin manufacturer and shown in *Table* 2.

Table 8—Vehicle Solids in Suggested High-Solids Polyester White Baking Enamel Formulations[a] Are Above Transition Point

	Vehicle Solids, Volume %		Difference
	In Suggested Formula	at Transition Point	Formula-Transition
A	71	46	+25
B	68	45	+23
E	76	48	+28
H	67	42	+25
I	66	46	+20

(a) Solvent in all formulations was 2-ethoxyethanol acetate.

PRACTICAL FORMULATING IMPLICATIONS

Flow properties, especially setting rate, depend upon whether or not the resin percentage in a vehicle is above or below the evaporation transition point. Setting of a coating occurs as viscosity increases rapidly with initial solvent evaporation.[12] We now know that this early evaporation depends upon solvent volatility only and is essentially independent of other factors such as solvent or resin type. If this initial rapid solvent loss does not occur, sagging and runs and nonuniformity will develop in the film. Leveling of the film surface continues for a much longer time during solvent evaporation and, therefore, depends upon both volatility and diffusion rate.

If the resin percentage in a formulation is below the transition point, volatility will control initial solvent evaporation, and proper setting of the film will occur. If the resin percentage is above the transition point, solvent evaporation will depend upon diffusion only. Therefore, solvent evaporation will be too slow to affect setting and may cause excessive flow.

The difference in evaporation rate above and below the transition point is very large. In an extreme case, the isobutanol/alkyd system illustrated in *Figure* 11, the ratio of volatility-limited to diffusion-limited evaporation rate is 6:1. In most cases, the ratio will be somewhat less but still very significant. With less volatile solvents, the ratio is not so high and changes more gradually, for example, the polyester/EEA system shown in *Figure* 13.

Conventional Alkyd Formulations And Transition Point

Five commercial medium and short oil alkyds were evaluated. Vehicles based on white baking enamel formulations recommended by the resin manufacturer were used. Vehicle resin percentages in the recommended formulations and at their transition points in the solvents used are compared in *Table* 7. Solvents varied depending upon the recommended formulas. They are shown in *Table* 2.

In all cases, the vehicle solids recommended were below the transition point. Thus, initial solvent evaporation would be volatility-limited and relatively rapid. Proper film setting should occur. The resins and formulas were chosen arbitrarily, but we suspect that this pattern is essentially universal.

High Solids Polyester Formulations And Transition Point

Five high solids polyesters were also selected at random and evaluated. Vehicle resin percentages in white baking enamel formulations recommended by the manufacturer and at the transition points are compared in *Table* 8. The recommended solvent in all formulations was EEA, which was used in these evaluations.

The resin percentage in every recommended vehicle was above the transition point for the resin-solvent combination. Thus, solvent evaporation throughout the entire process depends only upon diffusion. Volatility cannot be used to control initial setting of a coating. This is a major problem which must be compensated for by some other formulating approach if high solids coatings are going to perform satisfactorily.

SUMMARY

Solvent volatility has traditionally been used to control initial flow and resulting qualities of a conventional coating. As evaporation progresses, the rate-limiting factor changes from volatility to diffusion. Diffusion-limited evaporation is much slower. A precise method was developed for determining the transition point. With a given resin, the transition point occurs at increasing concentrations as volatility of the solvent decreases. With a given solvent, the transition point decreases as resin solubility decreases.

Comparison of laboratory data with typical formulas demonstrates that conventional alkyd coatings are for-

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mulated at resin concentrations below the transition point, high solids polyester coatings above. Thus, diffusion limits the total evaporation process in a high solids coating and solvent volatility cannot be used to control setting and other initial flow properties.

ACKNOWLEDGMENT

The excellent work of Mr. J. D. Gollner is gratefully acknowledged.

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Errata

In the article, "Ellipsometric Studies on the Cathodic Delamination of Organic Coatings on Iron and Steel," by Joseph J. Ritter (December 1982, pp 51–57), the captions for Figures 7 to 10 are out of sequence. They should read:

Figure 7—(Δ) and (Ψ) plotted vs time for the steel/acrylic "A" system undergoing corrosion in 0.05M NaCl. Acrylic "A" was heat-cured

Figure 8—Phase retardation (Δ) and amplitude attenuation (Ψ) plotted vs time for the steel/polybutadiene system undergoing corrosion in 0.05M NaCl. The coating was heat-cured. The open ellipses shown in the inset indicate the three regions on the specimen face where ellipsometric measurements were made. The curves are labeled corresponding "a," "b," and "c"

Figure 9—Δ, Ψ, and pH plotted vs time for the segmented iron/acrylic "A" system in 0.05M NaCl. Inset shows a facial view of the specimen and open ellipses indicate regions studied ellipsometrically

Figure 10—Δ, Ψ, and V plotted vs time for uncoated iron in saturated NaOH. Changes in Δ and Ψ when potential is lowered to −1200 mV indicate the dissolution of the air-formed oxide film

THIRD PLACE WINNER IN THE 1982 ROON AWARDS COMPETITION

Predictive Model For Cracking of Latex Paints Applied to Exterior Wood Surfaces

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Glidden Coatings and Resins, Division of SCM Corporation*

While it is well-known that paints applied to exterior wood substrates will eventually develop cracks, and may, if their adhesion is deficient, subsequently peel or flake off, attempts to explain this phenomenon on the basis of tensile properties have been unsuccessful to-date. The present work shows that a two-parameter model, employing fracture energy (energy required to propagate a crack through a paint film) and liquid water permeability, successfully accounts for cracking behavior over a wide range of compositional variables. From these observations, a mechanism for the cracking behavior of latex paint films applied to exterior wood surfaces is proposed.

INTRODUCTION

One of the main problems associated with the performance of exterior paints is that of cracking after a certain period of time. Cracking will frequently lead to flaking and peeling if adhesion is deficient. Much effort has been directed towards understanding the cause of cracking, but the results are often confusing and contradictory among researchers. For example, Jaffe and Fickenscher[1] suggested that the larger the elongation-at-break (λ_b) for a free paint film, the higher the crack resistance. Later, Schur, Hay, and van Loo[2] proposed the opposite conclusion. They argued that the higher the tensile strength (σ_b) of the free paint film, the better crack resistance for the paint. This would mean a relatively low λ_b, in direct contrast with Jaffe and Fickenscher. Moreover, neither took into account the fact that random flaws and voids within the paint film will give highly irreproducible results, especially between films obtained by draw-down blade (for free films) and by brush application on a porous substrate (wood).

The field of fracture mechanics has arisen to reconcile such contradictory results, and would appear to be of value to the coatings industry. Fracture mechanics recognize that the mechanical properties of free films (e.g., λ_b and σ_b) are strongly influenced by flaws in the samples, and take this into account by deliberately introducing flaws of sufficient and controllable sizes so that these are the main sources of any stress-concentration in the sample.[3,4] A good review of this process is given by Andrews.[5]

Since the primary stresses which develop in wood substrates are due to water absorption, it is naturally expected that the permeability of a paint film to water (particularly liquid water) will also play a role in the cracking process.

A subsidiary hypothesis at the outset of this work was that a predictive model for cracking would probably require at least two parameters. This was based on personal observations over the years that one-parameter models for paint film behavior rarely work, and then only over unrealistically narrow ranges of compositional variables. Such was indeed seen to be the case in the present work.

Since latex paints are recognized as having intrinsically greater crack resistances than alkyds, they were chosen for this work. This better performance is probably related to their considerably higher molecular weight.[6]

Presented by Mr. Floyd at the 60th Annual Meeting of the Federation of Societies for Coatings Technology, November 4, 1982, in Washington, D.C.
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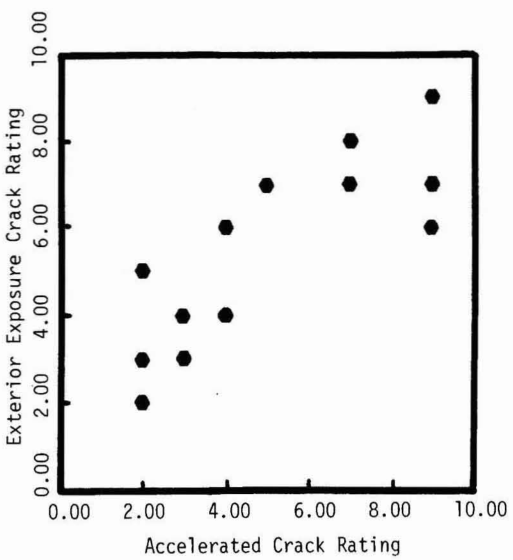

Figure 1—Accelerated cracking test: binder variations

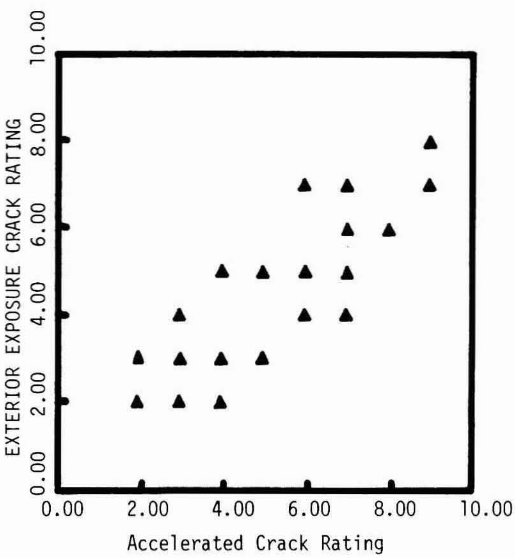

Figure 2—Accelerated cracking test: pigment variations

THEORETICAL

The theoretically ultimate strength of filled materials can be calculated from bond strengths. However, it is always observed that the ultimate strength is much higher than can be realized experimentally, frequently by as much as two or three orders of magnitude. In performing the theoretical calculations, it is assumed that all the bonds support an equal share of the load, and that they will all rupture simultaneously. Thus, the theoretical crack velocity is infinite. In reality, the crack velocity is finite, and the bonds break sequentially rather than simultaneously. Regions of relatively high stress occur, and from these regions, fracture is initiated.[3,4] In other words, the discrepancy between the theoretical and observed values of the ultimate strength can be attributed to flaws which act as stress-concentrators. The wide scatter in data usually found in the results of determining ultimate strengths can be explained by assuming a statistical distribution of flaws in the samples studied. Such a statistical theory also explains the observed inverse dependence of strength on sample size (the larger the sample, the more likely that a critical flaw will be encountered).

The first serious study of the conditions needed for propagation of a crack in a material was by Griffith,[7] who in 1920 studied crack propagations in glass. He argued that the increase in surface free energy provided by tearing must be less than the loss of elastically stored energy from the deformed sample. For an infinite plate of elastic material containing a sharp central cut of length 2a lying in a plane perpendicular to the stress, Griffith showed that

$$\sigma_b = \left(\frac{2E\gamma}{\pi a}\right)^{1/2} \tag{1}$$

where E = Young's modulus,
γ = Specific surface energy (fracture energy),
σ_b = Tensile strength.

Brown and Strawley[8] noted that specimens of finite width with a flaw in one edge, possess a stress field at the crack-tip which is influenced by the proximity of the free edges, so that a modification of equation (1) is required:

$$\sigma_b = \left(\frac{2E\gamma}{ay^2}\right)^{1/2} \tag{2}$$

where y is a shape correction factor calculated as follows:

$$y = 1.99 - 0.41\,(a/w) + 18.7\,(a/w)^2 - 38.48\,(a/w)^3 + 53.85\,(a/w)^4 \tag{3}$$

and w = specimen width
a = one half the initial crack length.

Since the strain energy W (work-at-break) is given by

$$W = \frac{1}{2}\,\sigma^2/E, \tag{4}$$

Table 1—Reliability of Laboratory Crack Resistance Test

Study	Dependent Variable	Independent Variable	Correlation Coefficient	Confidence Level
Binder variations	Exterior crack resistance	Accelerated crack resistance	0.863	99+%
Pigment variations	Exterior crack resistance	Accelerated crack resistance	0.840	99+%

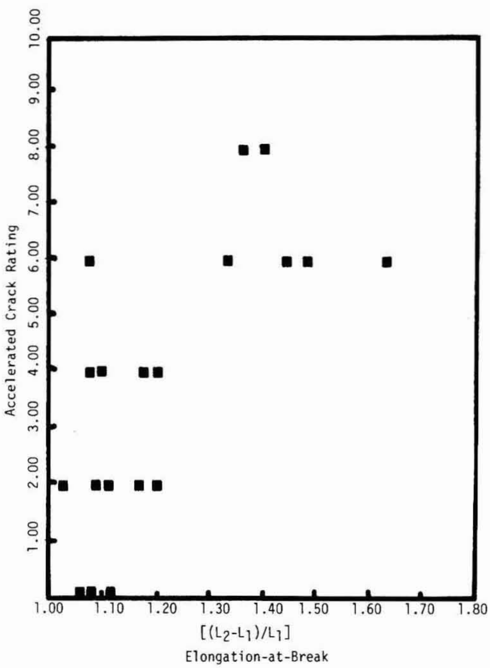

Figure 3—Correlation to elongation

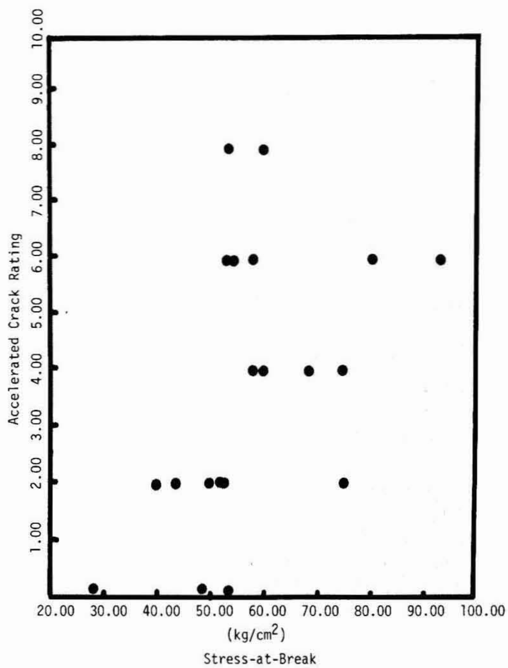

Figure 4—Correlation to tensile strength

substituting the value of W from equation (4) into equation (2) yields

$$W = \gamma/ay^2. \qquad (5)$$

Thus, tests of specimens containing various flaw sizes can be employed to determine γ as the slope of a plot of W vs $1/ay^2$. The parameter γ is the energy required to create a unit area of new surface in a body, and is therefore, a property of the material alone. Indeed, experiments by Rivlin and Thomas[9] showed that γ is independent of the sample shape.

More recently, Reid[10] utilized fracture mechanics to explain the cold-checking behavior of lacquer films. Unfortunately, statistical analysis was not employed to quantify the correlation found. The present work employed the procedures suggested by Reid, and multiple regression techniques[11] were employed to quantify the results.

EXPERIMENTAL

Fracture Energy Studies

Using a sharp razor blade and a low-powered microscope with a calibrated eyepiece, cuts of definite lengths were introduced across one edge of the tensile test piece. The cuts were placed as accurately as possible half-way between the upper and lower ends of the test piece being stressed. Cut lengths varying between 0.5 mm and 7.6 mm were obtained on different specimens. Stress-strain measurements on these specimens were then obtained

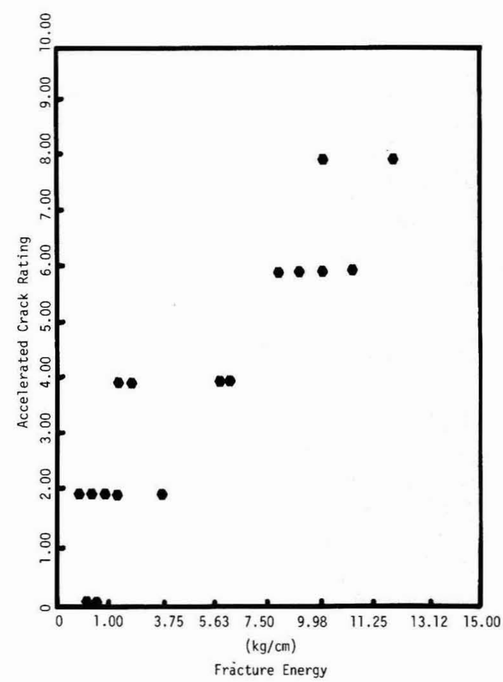

Figure 5—Correlation to fracture energy

Table 2—Correlations for Plastic Pigment Variations

Independent Variable	Dependent Variable	Correlation Coefficient[a]	Confidence Level
Crack resistance	Fracture energy	0.907	99+%
	Tensile stress	0.155	Low
	Tensile strain	0.212	Low
Fracture energy.....	Crack resistance	0.907	99+%
	Tensile stress	0.245	Low
	Tensile strain	0.220	Low

(a) 17 Data points.

on an Instron Tensile Tester. Sample dimensions were 1″ × 0.75″.

The value of W from equation (5) can be determined from a calibration plot of W against various elongations for an uncut specimen. From measurement of elongation-at-break for the cut specimen, the value of W for the specimen can then be obtained. From a plot of W *vs* $1/(ay^2)$, the fracture energy can be obtained from the slope of the plot.

Laboratory Freeze/Thaw/Wet/Dry Cycling

On a 8″ × 18″ board of Douglas fir plywood, the surface area was equally divided to accommodate four paints being tested, plus a control paint for each panel

Table 3—Effect of Binder Variations

Binder I.D.	Binder Type	PVC	Fracture[a] Energy	Accelerated[b] Crack Rating
R-88	Acrylic	24	16.90	9
R-88	Acrylic	32	10.00	8
R-88	Acrylic	40	4.96	6
R-88	Acrylic	48	2.57	4
R-88	Acrylic	56	1.91	3
P-10	Acrylic	24	30.30	7
P-10	Acrylic	32	11.00	7
P-10	Acrylic	40	6.20	3
P-10	Acrylic	48	3.20	2
P-10	Acrylic	56	1.90	2
U-08	Vinyl Acrylic	24	32.30	9
U-08	Vinyl Acrylic	32	21.80	9
U-08	Vinyl Acrylic	40	11.20	5
U-08	Vinyl Acrylic	48	3.50	3
U-08	Vinyl Acrylic	56	1.01	2
K-45	Styrene-Acrylic	24	31.04	10
K-45	Styrene-Acrylic	32	10.92	9
K-45	Styrene-Acrylic	40	5.30	4
K-45	Styrene-Acrylic	48	2.52	3
K-45	Styrene-Acrylic	56	1.57	2

(a) kg/cm.
(b) 28 Freeze/Thaw/Wet/Dry Cycles - ASTM Vaues.

Table 4—Effect of Binder Variations on Correlation

Dependent Variable	Independent Variable	Correlation Coefficient[a]	Confidence Level
Accelerated crack resistance	Fracture energy	0.814	99+%

(a) 20 Data Points.

(Spred® House Paint Y-3600). The paints were self-primed and allowed to dry for 24 hours before the second coat was applied. The underside and edges were sealed with an alkyd primer (Glidden's Y-1951). Panels were allowed to dry for one week before testing.

Testing included the following steps for a complete cycle: (1) soaking the painted panels in water for one hour; (2) freezing the wet panels at about −20°F overnight; (3) thawing at room temperature; and (4) letting the panels dry at room temperature, completing a 24-hour cycle. ASTM numerical ratings were assigned to each sample. Panel-to-panel variations were minimized by normalizing the data to the control paint:

$$\text{Normalized Value} = \begin{pmatrix}\text{Test}\\ \text{paint}\\ \text{rating}\end{pmatrix} - \begin{pmatrix}\text{Control}\\ \text{paint}\\ \text{rating on}\\ \text{same panel}\end{pmatrix} + \begin{pmatrix}\text{Mean}\\ \text{control}\\ \text{paint}\\ \text{rating}\end{pmatrix} \quad (6)$$

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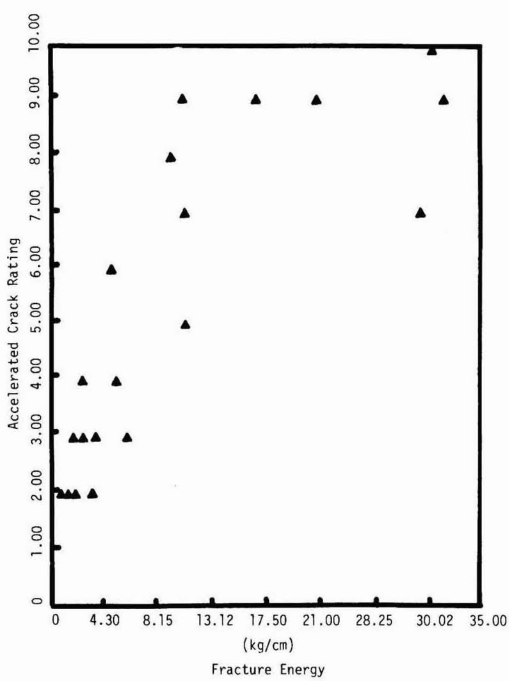

Figure 6—Effect of binder variations

Table 5—Effect of Variations in Pigmentation

Extender Pigment Varied	Paint Formulation	Pigment Volume Concentration	Fracture[a] Energy	Ext.[b] Crack Rating	Acc.[c] Crack Rating	Permeability[d] Time (Minutes)
Talc 1-2μ	Low Cost	40	31.50	7	6	14.0
		48	13.20	5	5	17.0
		56	6.30	3	4	14.0
		64	2.30	3	3	9.0
	Premium	40	9.96	8	9	7.0
		48	4.08	4	7	7.0
		56	3.54	2	4	4.0
		64	1.05	2	3	ND
Talc 10-30μ	Low Cost	40	14.70	5	7	12.5
		48	8.80	5	6	7.1
		56	3.60	3	2	4.0
		64	2.20	3	2	2.0
	Premium	40	13.70	8	9	9.0
		48	5.40	6	8	7.5
		56	2.20	5	4	5.0
		64	1.10	4	3	ND
Clay .5μ	Low Cost	40	20.51	2	4	11.0
		48	10.03	2	3	7.0
		56	3.00	2	3	2.0
		64	1.25	2	2	1.3
	Premium	40	5.74	6	2	6.0
		48	3.38	2	2	9.0
		56	1.89	2	2	1.2
		64	1.35	2	2	ND
Mica <40μ	Low Cost	40	6.82	8	9	23.0
		48	4.59	7	9	23.0
		56	2.20	7	7	15.0
		64	1.62	4	6	4.0
	Premium	40	6.01	7	10	21.0
		48	2.46	7	9	22.0
		56	1.77	6	7	7.0
		64	1.02	3	5	2.0

(a) kg/cm.
(b) ASTMA values, 6 months exposure @ S-45° in Cleveland, Ohio.
(c) ASTM values, 30 cycles of accelerated test.
(d) Higher values represent lower permeability; hence, correlation is positive. ND = Not determined.

Exterior Exposure

Panels submitted for exterior exposure were prepared as above. Exposure was in Cleveland at 45° facing south. After six months the panels were removed and examined for cracking. Ratings were assigned as above.

Permeability

Filter paper was soaked in a 3% solution of $CoCl_2$ in water. The filter paper was then dried in an oven so that it became blue in color. The blue filter paper was sandwiched between a free film of the coating being evaluated and a piece of glass and secured to the glass with electroplating tape in which five 1 cm diameter holes had been cut. The glass plate was then submerged in water, tape side down, and the amount of time for the $CoCl_2$ paper behind three out of five of the tape holes to turn from blue to red was measured in minutes. Higher numbers therefore correspond to lower permeability.

Regression Analysis[11]

The BMPD statistics package of the University of California (particularly P-1R and P-9R) was used to correlate data. A multiple correlation option was employed to look for linear and nonlinear correlations of various combinations of independent variables with cracking. The best fits were reported. The magnitude of experimental error in the measurement of the dependent variable (cracking) was considerable, preventing high correlations except in the simplest case. For example, the mean crack rating of the control paints in Figure 5 was 7.4 with a standard deviation of 2.7. This means that 7.4 ± 5.4 is the 95% confidence interval for this mean.[1]

Table 6—Effect of Extender Pigment Variations on Correlations

Dependent Variable	Independent Variable(s)	Correlation Coefficient[a]	Confidence Level
Exterior crack resistance	Permeability, log [fracture energy]	0.726	99+%
	Permeability	0.621	95%
	Fracture energy	0.301	90%
Accelerated crack resistance	Permeability, log [fracture energy]	0.748	99+%
	Permeability	0.655	99+%
	Fracture energy	0.244	70%

(a) Sample size of 32.

Fortunately, normalization techniques filtered out enough of this variability so that meaningful correlations could be observed. For this study, the author chose to recognize only those correlations which exceeded the 99% confidence level due to inherent data scatter. This means that there is less than one chance in 100 that the correlations occurred by chance.

RESULTS AND DISCUSSION

Accelerated Test

In order to study the phenomenon of cracking of paint films on wood substrates, it was first necessary to develop an accelerated test for such behavior. The test described in the preceding section (freeze/thaw/wet/dry cycling) was employed (30 cycles) in comparison to six months of exterior exposure at 45° south in Cleveland, Ohio. The comparisons were made for two separate systems employed in this study: binder variations and pigmentation variations. The results can be seen graphically in *Figures* 1 and 2.

By employing a simple linear regression analysis technique, the correlations shown in *Table* 1 were obtained. From these data, it can be seen that the laboratory test can indeed predict exterior results in approximately 1/6th the time. While the correlation is less than perfect, it is within the limits normally encountered for this type of testing; i.e., experimental errors involved in cracking behavior prevent the correlation coefficient from rising above the 0.7–0.9 range.

Preliminary Experiments

The initial experiments involved an examination of selected exterior prototype products from the author's work on plastic pigment.[12] Since these were already under study in a separate program, they were chosen for the initial test of the fracture energy concept.

The prototype systems were based on Glidden's Spred House Paint, and involved substitutions of various plastic pigments for various extenders, and of various commercially available acrylic latex binders for the latex originally employed. All systems were prepared as PVC ladders, holding volume solids and TiO_2 level constant, as is typical of commercial development studies. PVC ladders were used throughout this work in order to obtain a range of cracking behavior for each system studied. The PVC ranges chosen all centered roughly on CPVC.

Since previous workers have strongly adhered to tensile properties as the controlling properties for crack resistance, stress- and strain-at-break versus accelerated cracking were determined and are shown in *Figures* 3 and 4, respectively. The fracture energy of these systems vs accelerated cracking is shown in *Figure* 5.

While the tensile strength (σ_b) and elongation (λ_b) display classical responses to PVC changes,[13] the correlation to cracking is poor. *Figure* 5 illustrates the high correlation between cracking and fracture energy.

Table 2 summarizes the results of linear regression analysis of the data in *Figures* 3–5. As can be seen, tensile properties do not account for cracking behavior, while fracture energy provides a highly significant correlation. Indeed, the tensile properties do not even adequately predict fracture energy, which readily agrees with theory.

Effect of Binder Variations

In order to determine the effect of binder type on cracking resistance, four latex binders were formulated into PVC ladders using a low cost prototype exterior house paint formula, again keeping volume solids and TiO_2 level constant. The binders were acrylic in nature, some pure and some copolymers. The first three are commercial products; the fourth was synthesized for this study.

Table 3 displays the results, from which one can see the expected PVC effect (inverse) and apparent correlation between fracture energy and cracking. *Figure* 6 illustrates this latter correlation graphically, and *Table* 4 summarizes the regression analysis results. From these results it is apparent that the two properties are highly correlated, although experimental error is still significant.

Effect of Pigmentation Variations

Pigmentation effects were studied by varying the extender pigments in both low cost and premium exterior house paint formulations. Each change was constructed into PVC ladders as before. *Table* 5 lists the extenders studied, together with the test results. *Table* 6 lists the results of the regression analysis of the data in *Table* 5.

Contrary to the findings of the first two studies, the exterior exposure and accelerated exposure crack ratings were not predicted by fracture energies. The regression analyses provided very low correlations of 0.30 and 0.24 with nonsignificant T values on 32 data points.

However, it was observed that exterior crack ratings were correlated to permeability as demonstrated in *Table* 6, with a correlation coefficient of 0.62 with a T value of 4.12 on 29 data points (confidence level: 99%). This suggested that a multiple-parameter model may well be more appropriate than the single-parameter model.

Additional calculations bore out this speculation. In *Table* 6, it can be seen that the best correlation to cracking (either exterior or accelerated) was with the combination of permeability and log (fracture energy). This yielded correlations of 0.726–0.748, with a confidence level in excess of 99%, based on 29 data points.

Permeability measurements were subsequently made for the first two studies, but this parameter was not significant. It therefore appears that permeability is largely controlled by pigmentation, while fracture energy is jointly determined by binder and pigment type and level. It is such behavior which leads to multiple parameter models, and which prevents single parameter models from working well. It also suggests why earlier workers drew erroneous conclusions: their range of variables was inadequate.

Effect of Artificial Weathering On Fracture Energy

In this work, the free film samples evaluated for fracture energy were aged six days at ambient conditions and one day at 70° F and 50% relative humidity prior to testing. In order to evaluate the effect of aging on the relative values of these fracture energies, a series of paints were evaluated for fracture energy after 0, 500, and 1,000 hours of Weather-Ometer® exposure. The paints employed were the R-88 variations of the Low Cost House Paint Formula described in *Table* 3. *Figure* 7 provides a graph of fracture energy vs Weather-Ometer exposure (carbon arc with Corex D filters) and demonstrates that although some fracture energies decreased slightly after extended exposure, the values obtained with virgin samples maintained their relative rank orders during exposure. This lack of variation was probably due to the choice of a highly durable acrylic binder, and is not expected to hold true for less durable systems such as alkyds.

SOURCES OF ERROR

This project did not attempt to develop improved theories of fracture energy, but rather, concentrated on determining the value of an existing approach. A post evaluation of this project, however, illuminated three areas of possible oversimplification, with possible corrections.

First, although elastic behavior was assumed in the mathematical derivations, the samples evaluated in this work were viscoelastic in behavior. It is possible that the more brittle lacquers employed in Reid's evaluations broke prior to extensive yielding, therefore, approaching elastic behavior more closely than the thermoplastic materials evaluated in this work. A possible solution to this problem would be to not apply the elastic behavior assumptions of equations (1) to (5), but instead to obtain the fracture energy by obtaining the slope of a graph of "σ^2" vs $\frac{\text{"}2E\text{"}}{ay^2}$ as flaw size is varied [see equation (1)].

The second area of concern was the use of a calibration

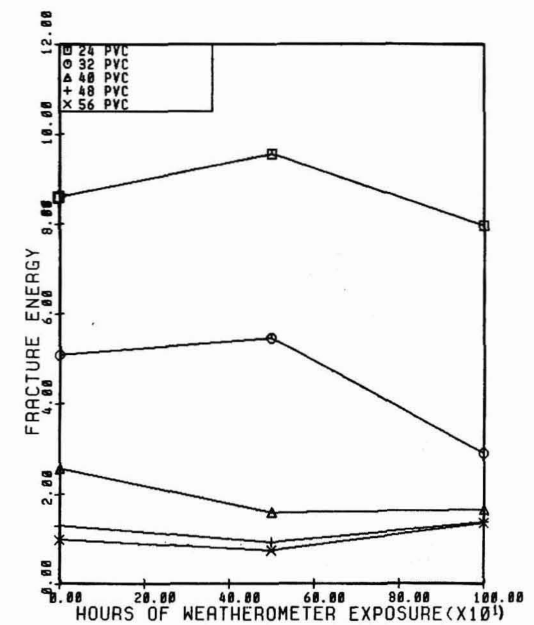

Figure 7—Effect of Weather-Ometer exposure

curve to determine the Work-at-Break of the flawed samples. This assumed identical shape for the Instron curves of the flawed and unflawed samples when in reality the Instron shapes often differed considerably. Evaluation of the actual Work-at-Break of the flawed samples would avoid this concern.

The third area of concern was that, contrary to the theory, the graphs of "W_B" vs $\frac{\text{"}1\text{"}}{ay^2}$ from equation (5) were slightly convex rather than linear and did not pass through the origin.

While all of these elements can affect the absolute value of fracture energies obtained, available literature suggests that such errors should occur equally in all samples. Thus, rank orders, which were our real interest, would be unaffected. Such was seen to be the case within the limits of the work reported here.

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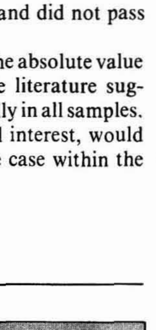

Weather-Ometer is a registered trademark of Atlas Electric Devices Co.

PROPOSED MECHANISM FOR CRACKING

As a result of the accumulated data and observations, the following speculations for grain cracking are offered:

(1) Differences in coefficients of expansion along grains of the wood substrate generate cracks in the wood itself, during exposure to weather cycles.

(2) As cracks in the wood propagate or widen, paint films bridging the cracks become highly stressed.

(3) Inclusions in the paint film generate different stress distributions in different parts of the film. These inclusions may consist of voids, pigments, microcracks, etc. They become stress-concentrators when the film is stretched across the wood crack. Cracks are initiated at these sites.

(4) As further stress is applied to the film, these cracks will propagate until the strain energy is consumed in generating new surfaces.

(5) The rate of initiation of cracks is related to the permeability of the paint film to water. A film with low permeability to water will protect the wood substrate from swelling, hence minimizing the initiation step in cracking.

(6) The rate of new surface generation (crack propagation) is related to the surface energy of the composite; i.e., the fracture energy. A composite with low fracture energy thus requires low strain energy and, therefore, propagates cracks more easily.

(7) Actual cracking behavior of a given paint film will be a composite result of its intrinsic permeability and fracture energy. Such behavior will tend to be highly variable due to the nonuniformities inherent in brush-application of paints. Statistical analysis is thus required to obtain quantitative results.

SUMMARY

(1) An accelerated laboratory test has been designed which reasonably predicts the cracking behavior of paints applied to exterior wood surfaces.

(2) Single parameter models are inadequate for describing coatings behavior. In the present case, a two-parameter model involving fracture energy and permeability was required to account for cracking behavior.

(3) Statistical analysis is required of such data since experimental error tends to be great, and the correlations of multiple parameter models are not obvious by inspection.

(4) Normalization procedures were introduced to minimize the impact of experimental error in cracking tests.

(5) Earlier claims that tensile properties *per se* accounted for cracking behavior were clearly shown to be in error.

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Recent Advances in Coatings For Household Appliances

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Appliance coatings have experienced significant changes in the last decade. The thermosetting acrylic is being replaced by high solids top coats and flow coat primers which have been converted to water-soluble types or by epoxy-based cationic electrocoats. Many of the changes were prompted by increasing concern for environmental matters, with the appliance industry and its coating suppliers responding well to the challenge.

This paper provides a review of coatings, the appliance market, and future trends in coatings.

INTRODUCTION

The major appliance industry has grown from a few hand held appliances at the turn of the century to an industry producing over $10 billion worth of products in 1980. Much of this growth has been attributed to the development of the fractional horse power motor and the availability of electricity, whose impetus came about with the rural electrification programs of the Federal government. The hand of the Federal government was also to be felt in the changes brought on by the appliance industry in the 1970's.

Early appliance coatings were based on slow drying varnishes derived from shellac and drying oils. These coatings gave way to faster drying phenolics modified with tung oil which have excellent acid, alkali, and corrosion resistance.[1]

The introduction of nitrocellulose lacquers revolutionized the industry with rapid drying topcoats. The alkyd resin developed by Kienle[2] in the early 1930's became a mainstay of appliance finishing until replaced by the thermosetting acrylic which was developed by Strain[3] and made practical by Christenson[4] and others.[5] The chemistry of thermosetting acrylics has been reviewed by a number of authors.[1,6,7] In addition to organic coatings, porcelain enamel is used in laundry products, ranges, and refrigerators.

Appliance coatings are applied to appliances in highly automated production lines in which the parts are carried on conveyers throughout the process. This approach favored the flow coat primer system in which the coating literally floods the metal surface. Flow coating requires a flash off chamber containing solvent rich vapors which permit flow, leveling, and bubble removal. (*Figure* 1)

Topcoats are applied by electrostatic bells or discs which have been adopted by the appliance industry because of high efficiency, wrap around, and automation. Touch up is applied by electrostatic or conventional hand spray. For tall parts such as refrigerator doors or cabinets the electrostatic bell is preferred. (*Figures* 2, 3)

Up to the mid-sixties flow coat dominance prevailed but was challenged by the introduction of anodic electrocoating. The first anodic electrocoating tank was installed in the Whirlpool Corporation's Clyde, Ohio division in 1966, replacing flow coating and providing improved corrosion resistance for washing machine cabinets. Electrocoating had previously been introduced to the automotive industry by Brewer.[8]

By the end of the sixties, the appliance coatings picture may be summarized as follows:

Primers:	Application Method	Product
Epoxy Modified acrylics	Flow coat, Electrocoat	Washer, Dryer Refrigerator Dishwasher
Top Coats: Thermosetting Acrylic Alkyd	Electrostatic Disc or Bell Disc	Washer, Dryer Refrigerator, etc. Freezer

The thermosetting acrylic was the hallmark of appliance finishes and was applied at about 34% volume solids.

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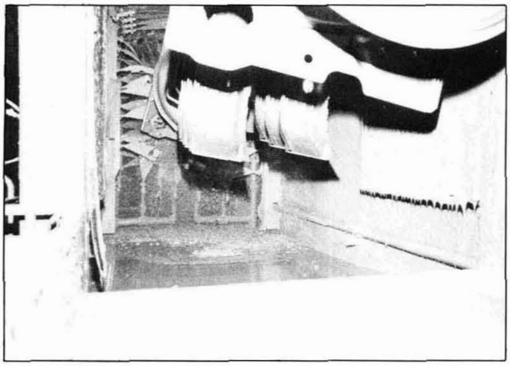


Figure 1—Flow coatings of dryer parts

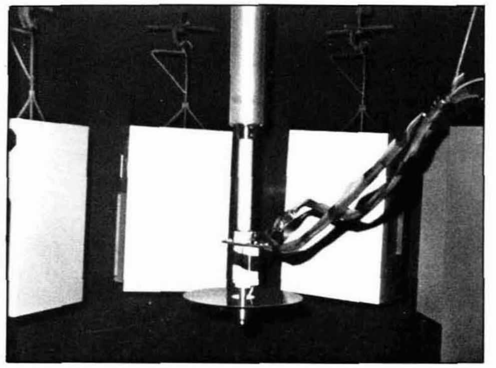


Figure 2—Electrostatic disc

APPLIANCE MARKET

The appliance market consumes a large volume of coatings, adhesives, and plastics. In 1980 over 383 million units were sold.[9] Of these, major appliances represent some 35 million units. *Table* 1 summarizes major appliance shipments for 1980. The quantity of paint per unit for several appliances is shown in *Table* 2, while the total gallonage varies, the per unit value provides a means for estimating the yearly consumption of coatings in the industry. Although several appliances such as the refrigerator and washer are mature products, the ongoing replacement market opportunity prevents the products from becoming obsolete.

New major appliances are difficult to develop. The last new major appliance to be marketed was the trash compactor, which followed the dryer introduced 35 years earlier. The appliance market exceeded the $10 billion mark in 1980.

The number of major appliance producers has decreased in recent years through acquisition and mergers, so that today there are five major producers who account for the biggest market share. For example, in refrigerators, four suppliers share 93% of the market.

COATING PROCESS

Coating of appliances involve several key steps: cleaning; metal treatment; priming; baking; application of top coat; and baking.

Cleaning

Cleaning is generally carried out in a multiple stage operation which includes the treatment with zinc or iron phosphate. The objective is to remove oils used in forming parts as well as mill oils applied during the manufacturing of steel.

Alkaline cleaners and detergents are used in spray washers followed by hot water rinses. Water temperatures of 74°C are required to melt fats and oils and to facilitate removal of smut or other dirt on steel. With the advent of the energy crisis of 1974, there has been a significant effort to reduce the temperature of the cleaning process. Some systems developed operate as low as 40–45°C.[11] One of the difficulties of lower wash temperatures is that some of the oils are below their melt temperatures and cannot be effectively removed in the washing cycle.

The cleaning and phosphating process is very energy intensive and consumes up to 50% of the process energy in an appliance plant. On the other hand, the cleaning process is the most critical step in the coating process and, until recently, has not received the proper attention by process engineers.

Methods for determining surface cleanliness are too involved for online evaluation so that simple tests such as water break are employed. Recently, Buser reported a rapid method based on surface tension.[12] Evaporative Rate Analysis[13] has also been used to determine surface cleanliness as well as more sophisticated methods employing Scanning Auger Spectroscopy.[14]

Phosphating

Steel is the primary metal used in major appliances. Both iron and zinc phosphate are used. Zinc phosphate is preferred where severe environments are encountered. For example, on automatic washer cabinets when corrosion and detergent resistance are required, zinc is the preferred metal treatment applied at 180–210 mg/ft.[2] Iron phosphate is used when lower corrosion resistance can be tolerated and is applied at 70–100 mg/ft.[2]

A typical system for cleaning and phosphating of refrigerators may involve the following steps:

Tank 1—Cleaner @ 160–170°F (70–75°C)
Tank 2—Rinse @ 145°F (62–68°C)
Tank 3—Cleaner @ 145–155°F (62–68°C)
Tank 4—Rinse @ 145°F (62°C)
Tank 5—Zinc phosphate @ 150–160°F (65–70°C)
Tank 6—Cold water rinse
Tank 7—Chromic acid rinse
Tank 8—Deionized water rinse (Ambient)

Baking

Baking is carried out in oil or gas fired ovens with high air flow to keep the Limiting Explosive Level (LEL) at a safe range. Until recently, steam fired ovens were not practical because of the high bake temperatures (350–450°F) required. Porcelain is fired at 1475–1500°F.

Priming and Top Coating

Priming and top coating are discussed later in this paper.

IMPACT OF ENVIRONMENTAL REGULATIONS

In the late sixties the Federal government became heavily involved in the environmental matters and passed legislation restricting solvent emissions to the atmosphere. The impact on the coatings industry was very significant. The earliest form of regulation was peculiar to Los Angeles County in California who promulgated Rule 66 designed to control photochemically active hydrocarbons. The net effect was an extensive program designed to eliminate or reduce the content of toluene, xylene, and other aromatics as coating solvents and chemicals such as lead from coatings.[15]

"Exempt Solvents" became the environmental option for reducing emissions, although the actual level of solvent emission was still significant.

The remaining portions of this paper will be devoted to addressing the challenge of government regulations in the seventies and to describe the advances made in appliance coatings.

TECHNOLOGICAL FORECASTING

In 1970, technological forcasting identified a number of major emerging internal and external factors which would have a major impact on the appliance business. These include: Energy; Government; Material Resources; Competition; Quality; and Emerging technology.

Of these, energy, materials, resources, and government, were seen as the most significant and requiring a planned strategy for the next 20 years. A list of significant needs which would adequately respond to these factors is, in part, shown in *Table* 3. Of these, low energy cure coatings and organic coatings to replace porcelain appeared to have the greatest long term impact. Any technology directed to solving these problems should satisfy the major factors cited above.

LIAISON FUNCTION

A planned liaison program was developed between the research center at Whirlpool and the research centers of leading coating manufacturers. The objective was to bring long range needs to coatings researchers and provide the opportunity to learn of emerging technologies. Using Profile Methodology, a management technique which outlines our needs in detail, meaningful paths to goal attainment were provided.

One of the tasks was to evaluate the state of the art in coatings and project which technology would provide long term solutions to the emerging scenario of the next two decades. For example, exempt solvents were viewed as a short term solution which would require costly

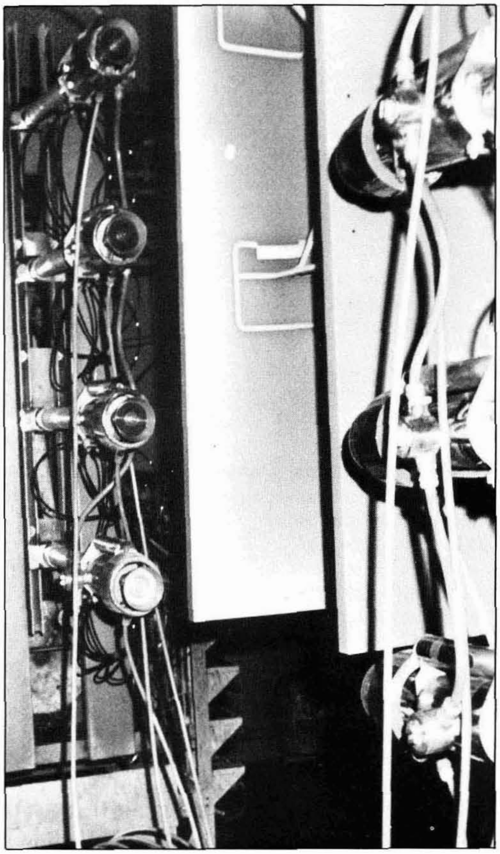


Figure 3—Electrostatic bell

changes. From this analysis, the following technologies appeared to represent the future for appliance finishes: High solids coatings; Water-borne coatings (including electrodeposition); and Powder coatings.

High solids coatings would allow the use of existing equipment, rapid color change, lower energy consumption, and lower emission.

Water-borne coatings provide safety and low emission coatings.

Powder coating was considered because of its low emission and high performance but would require new capital equipment. However, by judicious choice of these systems both coating requirements and the necessary environmental compliance could be achieved.

EMISSION AND ENERGY REDUCTION

As anticipated, the impact of government regulations was felt in the early seventies as a compelling effort was being exerted by the government to reduce emissions. This was soon to be aggravated by the energy shortages brought on by severe winters and the Arab oil embargo.

Table 1—Major Appliance Shipments 1980[9]

Appliance	Units (Millions)
Automatic Washer	4.5
Dryers (Gas and Electric)	3.5
Dishwashers	3.5
Disposers	3.3
Trash compactors	0.29
Ranges (Gas, Electric & Microwave Ovens)	7.8
Refrigerators	5.1
Freezers (Chest and Upright)	1.7
Air conditioners	6.0
Furnaces	2.3
Water heaters	5.3
Television	16.4

Source: Appliance—March 1981

Incineration was being recommended but the capital and operating costs as well as energy availability made this remedy unacceptable.

The first success at Whirlpool was effective at a plant manufacturing dishwashers and dryers. The primer was a solvent-based flow coat epoxy system while the top coat was a thermosetting acrylic based on methylol acrylamide chemistry.

A joint research program with a coating supplier was initiated to develop a water-based flow coat system. This system was developed after four months of intensive effort which replaced the solvent-based flow coat with a dramatic lowering of emission, a saving in solvent loss, and a major improvement in safety.

The top coat was applied with a Ransburg No. 2 disc at 900 rpm and at 34% volume solids. While working with the top coat supplier, a new polyester system was developed which could be applied at 45% volume solids. Heating was provided for the coating, but by increasing the disc speed to 1800 rpm, heating was not required. After three years the solids were raised to 52% volume solids. With the water-borne primer flow coat and polyester topcoat, overall emission was reduced by 85%, emission requirements were satisfied, and new coating technology was attained for the appliance industry. Other solvent-borne flow coat systems were converted to water-borne systems in the next few years.

Table 2—Quantity of Paint Used Per Appliance[10]

Appliance	Gal/Unit	Total (Million Gal)
Room air conditioner	0.6	1.8
Gas dryer	0.5	.385
Electric dryer	0.5	1.4
Automatic washer	0.4	1.96
Electric range	0.3	0.81
Refrigerator	0.6	3.48
Central air conditioner	0.2	0.42
Color TV	0.02	0.164
Total		10.4

Source: 1976 Appliance Manufacturer

ELECTROCOATING

Anodic electrocoating, as a replacement for flow coating on the automatic washer, was so successful that by 1968 anodic tanks were installed for dryer cabinets, compactor parts, and air conditioner compressors.

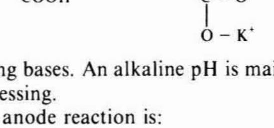
About 10 years after the first anodic electrocoat application, Whirlpool installed the first cathodic electrocoat tank proving the feasibility and viability of this system.

Air conditioners are subjected to a variety of exposure conditions which require a continued effort to seek out improved coatings which have good corrosion and outdoor exposure resistance.

Cationic electrocoating had just emerged from the laboratory and offered a solution looking for a problem.[16] Salt spray tests confirmed that the cathodic system was significantly better (300 to 1200 hours) than the existing anodic coating. Coated compressor cases confirmed the finding. Shortly after, a change was made from the anodic to the cathodic system. This system has been operating since 1972.

Anodic Vs Cathodic Systems

Anodic electrocoating is based on solubilization of a polymer containing a carboxyl function to form a polymeric anion. Amines and hydroxyl amines are also used



as solubilizing bases. An alkaline pH is maintained during the processing.

The basic anode reaction is:

$$2H_2O \rightarrow 4H^+ + O_2 + 4e^-$$

Anodic polymers may be prepared by copolymerization of acrylic acid and styrene or acrylate monomers, from trimellitic anhydride polyesters, from maleic anhydride adducts, or from acid modified polyols.[17]

Cathodic polymers are prepared by reactions which include an amine or sulfur compound which can be quaternized to produce a cationic polymer backbone. An acidic pH is required and maintained during the process.

The cathode reaction is:

$$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$$

A major factor in the cathodic process is the generation of hydrogen which can lead to film rupture. The physical chemistry of cathodic electrodeposition was recently described by Pierce.[18]

Comparisons of cationic and anionic systems are shown in *Table* 4. The major claim for improved corrosion resistance is the lack of dissolution of phosphate at the cathode which reduces the amount of trapped soluble ion in the deposited film. Anderson[19] has shown that trapped ions do indeed form in the film, but the concentration does not exceed 2.5–14% of that found in anodic coatings depending upon the substrate.[18]

To illustrate the difference in cathodic and anodic films washed, non-phosphate steel panels were coated with anodic and cathodic films. After 10 days of 5% salt spray, the anodic coating delaminated while the cathodic film remained intact after 14 days with nominal creepage at the scribe.

APPLICATIONS OF CATHODIC SYSTEMS IN APPLIANCES

Air Conditioners

Following the successful implementation of cathodic electrocoating on compressors, the process was used to coat air conditioner cabinets. These cabinets were previously coated with a flow coat primer followed by an acrylic top coat.

The two coat system was replaced by a single coat, cationic electrocoating, about one mil thick over zinc phosphated galvanized steel. Tropical exposure was excellent and the system has operated successfully for over seven years (*Figure* 4).

Dryer

The dryer drum and bulkhead requires a coating which must resist heat, moisture, fabric softeners, impact, abrasion, and corrosion over the life of the unit. Previously, a flow coat solution epoxy has been used at 2.0 mils thickness. A cationic electrocoating applied over zinc phosphate at 0.4 mils was installed to coat dryer drums. This represents a single coat application of cationic electrocoating which has proved the acceptability of cationic electrocoating and satisfied the need for a single coat appliance coating.

PORCELAIN REPLACEMENTS

Following the success of the cationic electrocoating system mentioned above, an opportunity to replace porcelain emerged in response to energy constraints. The excellent corrosion and detergent resistance of the cationic epoxy type coating suggested that this would be a good foundation upon which to build a porcelain replacement coating.

Porcelain applications in appliances are as follows:

Appliance	Part
Dishwasher	Tub
Washer	Tub, Basket
	Top, Lid
Regrigerator/Freezer	Liner
Range	Top
	Burner Box
	Oven Interior

Of the appliances cited above, the range represents a severe test for organic coatings, while the others appear to be within the realm of achievement.

Using a systems approach involving careful metal preparation, removal of burrs, zinc pretreatment followed by cationic electrocoating and an aliphatic polyurethane topcoat, a practical porcelain replacement was realized.

Properties of the coating are shown in *Table* 5. Of significant interest are the high detergent and corrosion resistance, plus resistance to 190°F boiling water and hot bleach 140°F.

Tests were conducted on tubs and baskets under controlled laboratory conditions which reflect up to two life cycles. Field tests after four years indicate proof of the technical feasibility of using a cationic electrocoat primer.

Other applications for cationic electrocoating have been developed. Recently, cationic acrylic white coatings have been developed. These coatings have high gloss, adequate salt spray resistance, and chip resistance. This system was recently installed in favor of a powder coating system to coat freezer baskets. Other applications are being planned.

A significant proof of the value of cationic electrocoating over anodic is not in panel testing but in actual product comparison. Dryer cabinets were coated with anodic and cathodic coatings then subjected to 500 hours salt spray. The cationic system showed a notable improvement over the anodic.

ALTERNATE SYSTEMS

Although the urethane/cationic epoxy system satisfied cost, toxicity, low solids, and emerging EPA emission rules, an ongoing search for alternative coatings was pursued. This work yielded systems using a polyester powder coating over a cationic electrocoat primer and a high solids polyester over the same primer. Other coatings are continually under investigation.

Table 3—Long Range Needs

Improved Metal Treatment Technology
Low Energy Cure Coatings
100% Solids Coatings
Single Coat Electrocoat Systems
Low Emission Coatings
Organic Coatings to Replace Porcelain

Table 4—Comparisons of Anodic and Cathodic Systems

	Anodic	Cathodic
Chemistry	Amine or base soluble	Acid soluble
Ground	Tank	Stainless or carbon anode
Phosphate treatment	Dissolves	Little or no dissolution
Salt spray resistance	Good	Better
Film	Trapped ions	Few soluble ions
Ultra filter	Few problems	Problems
Cost	Lower	Higher (10%)
Color	White	White difficult

Figure 4—Cationic electrocoating of an air conditioner cabinet

Table 6—Physical Properties of Home Laundry Finish Over Anodic Electrocoat Primer

Test	Results
Solids	62% volume
Bake schedule	20 ft @ 350°F (177°C)
Color	White
Substrate	20 Gauge E-coated EP-10 CRS
Film thickness	0.3–0.5 Mil Primer Plus 0.9–1.1 Topcoat Average 1.5 Mils total
System	
Pencil hardness	2H-3H
60°/20° Gloss	85/60
Flexibility	1" Medium cracks
(1/8 Conical)	No flaking
Adhesion to primer	Very good
Recoat adhesion	Excellent
Taber abrasion	11 mg Average loss/100 Cycles SC-10 Wheels 1000 G wt

POWDER COATING

Powder coating has made some penetration into the appliance field. Its advantages include low emission, high performance, and high utilization of material. Range cabinets, dryer drums, and refrigerator liners are being coated with epoxy, polyester, and acrylic powders.

Powder coating has been of good value in replacing porcelain and plating. For example, refrigerator shelving has been replaced with an epoxy powder eliminating a plating operation and waste disposal problems.

In one plant, chest freezer liners which had been porcelain enameled are now coated with epoxy powder eliminating pickeling and its attendant waste disposal problem and providing a quality image and sales feature.

Powder coatings can also replace porcelain on certain laundry applications such as the top and lid. Good metal pretreatment, zinc phosphate, is required for optimum performance. The technical feasibility of using powder for washer tubs and baskets has been demonstrated. Other applications for powder include coating of wire goods used in dishwashers. Racks are coated in a fluid bed using vinyl powder. A primer is required to assure adhesion.

The major disadvantage of powder is the capital expense requirement. Unless a new facility is planned or an obsolete system is being replaced, it is difficult to change existing equipment. That is why the high solids coating holds much promise in appliance finishing.

Table 5—Properties of Porcelain Replacement Coating

Physical properties:

Coating	Primer	Top coat
Type	Cationic epoxy electrocoat	Urethane
Solids % w/w	10	34
Solvent	Water, coupling solvents	Cellosolve acetate Xylol Ketone
Stability @ 77°F	1 Year	1 Year
Film		
Hardness	5H Min.	5H Min.
Color	Gray	White
Adhesion	Pass	Pass
Detergent hr	1000	1000
Abrasion taber		5Mg Max.
Bleach (neat) 72 hr/140°F		Pass
Impact in./16		40
Flexibility ½" Dia.		Pass
Thickness (System)mil (1.2–1.5)		
Heat resistance 200°F 200 hr		No change

HIGH SOLIDS COATINGS

Reference was made earlier to a higher solids polyester coating used to improve emission standards. A major effort was launched to develop high solids coatings since the EPA set limiting emission levels effective in 1982. For the appliance industry, 2.8 lb/gal or 0.34 kg/liter of solvent is the allowable limit. This corresponds to 62% volume solids. Acrylic top coats are normally applied at 34% volume solids. Increasing the solids, increases viscosity such that conventional bells or discs could not be used to apply top coating. Controlling molecular weight in conventional acrylic copolymer was also not a feasible solution. As a result, the coatings industry turned to polyesters which have low viscosity and can be applied at higher solids. Consequently, polyesters captured a good share of the market enjoyed by acrylics. Acrylic producers responded with reactive acrylic oligomers which have lower viscosity, higher functionality, and could be crosslinked with newly developed melamine resins[20] or urethanes.

A major bottleneck was resolved in application equipment by the equipment suppliers. They recognized the need for improved equipment involving heating of coatings to reduce viscosity or higher speed discs or bells. As a result, a number of new high speed turbines were developed[21,22] which, at speeds of 20,000 rpm or higher, can adequately break up the coating and apply smooth films.

Table 7—Chemical Resistance Properties of Home Laundry Finish Over Anodic Electrocoat Primer

Test	Results
Salt spray: (500 hours)	Less than ⅛" creepage. No blistering or through film corrosion
Humidity: (1000 hours)	No blistering. No creepage. No through film corrosion.
Detergent: (250 Hours)	Few #8 blisters. H hardness after exposure (5 min recovery time).
Stain resistance: (24 Hours)	Liquid All®—Pass Sta-Puf®—Pass Clorox®—Pass

Table 8—Physical Properties—Single Coat Refrigeration Finish

Property	Results
Solids	62% Volume
Bake schedule	20 ft @ 290°F
Substrate	EP-10 or Metabond 50
Film thickness	1.2–1.4 Mils
Hardness	2H–3H
Adhesion (Cross-Hatch)	No film removal
Flexibility (⅛" Conical Bend)	No visible cracks
Impact resistance	50/20
Abrasion resistance (Taber, SC-10 Wheels, 1000 GWTS)	9.6 mg/100 Cycles
Recoat adhesion (Unsanded)	Excellent
Overbake—300%	$\Delta E = 0.51$ NBS

Coupled with water-borne flow or electrocoat primers, high solids coatings have allowed appliance manufacturers to satisfy EPA requirements.

The physical and chemical properties of a 62% volume solids top coat for laundry products are shown in *Tables* 6 and 7, respectively. *Tables* 8 and 9 list the physical and chemical properties of a single coat refrigeration finish.[23]

Further reductions in emission levels are not cost effective nor is the impact on the environment that significant. Coatings in the U.S. are responsible for less than 9% of the total emissions, and any further efforts to reduce emissions should be concentrated on other industries.

The benefits of high solids coatings have been in permitting the use of existing equipment, application of thin films, and lower baking temperatures. In one facility, top coats are now cured below 300°F so that steam fired ovens are employed.

SURFACE TREATMENT

Perhaps the most important aspect of the coating process is the substrate. Many coating failures can be attributed to poor metal preparation. The importance of metal treatment on coating has been demonstrated on a number of occasions. In one study of single coat application of two component urethanes, it was shown that the coating performance was directly related to the type of zinc phosphate coating and final rinse.

Process control of cleaning and phosphating must be put on a more sound basis. Attempts are now being made to apply microcomputer control to monitor and control phosphate process.

Because of waste disposal problems, i.e., sludge, there has been a trend away from zinc phosphate to iron phosphate. However, for optimum performance, zinc is still preferred. A number of studies have been carried out to characterize the phosphate coating.[24,25] A rapid test for online testing for zinc phosphate coating was developed by Cheever[26] and is now offered by Foxboro for measuring zinc phosphate coating weight. The method is based upon ratioing of infrared absorption peaks of zinc phosphate. Efforts are underway at a number of research centers to characterize steel surfaces using Scanning Auger Spectroscopy and other techniques.

FUTURE TRENDS

Metal Treatment

Reference was made to the metal treatment process. There must and will be greater emphasis on a systems approach to metal treatment. This may involve controlling the nature and types of oils used in treating the steel from the steel mill through the forming and cleaning stage. Today, the appliance manufacturer does not have a systematic knowledge of the oils used, rendering the cleaning process less specific. Is the phosphate process, dating back to Egyptian times, still the most viable method for stabilizing the steel surface? What are the alternatives?

Baking

Because of the increasing cost of energy, coating cure temperatures will trend downward. This will involve new curing mechanisms, polymers, and processes. The growth of UV and EB curing are examples of this approach. Multi-component systems such as the two component urethane and aliphatic epoxy resin are methods for achieving ambient cure.[27,28]

Coil Coating

Coil coating has been used in appliance manufacturing. For example, freezer liners of precoated aluminum

Table 9—Chemical Resistance Properties Of a Single Coat Refrigeration Finish

Salt spray	1/16" Creepage
500 Hrs.	No TFC
Humidity (100% RH, 100°F, 37,8°C):	
1000 Hrs.	No effect
Moisture resistance:	
750 Hrs. Aerated Water (120°F, 48.9°C):	No creepage No TFC
Resistance to stains:	
Mustard	Very slight (Disappears)
Lipstick	No effect
Tomato juice	No effect
Rubber gasket	No effect
Cigarette smoke	No effect
Burning cigarette	Very slight (Fades)

and outer shells of precoated steel have been on the market for many years. With the high cost of energy and waste disposal, many manufacturers are reevaluating the total coating system cost as compared to coil coating.

Problems which are of concern are welding, raw edges, cost of scrap, and damage repair.

A glass transition forming technique is used where the coating is applied by roll coating, cured, and then formed by heating above the Tg to prevent cracking.[29]

Electrocoating

This process should continue to grow, especially in areas where high corrosion or detergent resistance are required. Cationic electrocoating should continue to be favored in appliance coatings as it has taken over in the automotive field.

Inorganic Coatings

Inorganic coatings which can be applied from water or solvent and baked at temperatures below 450°F offer an interesting alternative to porcelain enamel. Several interesting systems have been studied including silica[30] and polyphosphazene types.[31] These coatings offer greater flexibility than porcelain and can withstand temperatures up to 1000°F and are not derived from hydrocarbons. Some disadvantages of these early systems are high cost, low gloss, and package stability.

Robotics

Appliance coatings will use more robots in the future.[32] Robots provide good reproducibility of coverage and are particularly well suited for coating interior surfaces such as microwave oven cavities tubs or baskets or oven cavities. The problem of blow back in an operator's face is eliminated by using robots. Robots have been tested for coating freezer liners with excellent results.

Surface Analysis

The measurement of electrical properties of coatings as they relate to the substrate has become a useful tool for determining the propensity of steels to corrosion and the degree of protection afforded by the coating.[33,34] Using the EGG Princeton Model 350A characterization of raw steels and of their tendency to corrode has been determined.[35] The value of this instrument in establishing quality control of steel is already obvious.

SUMMARY

This paper reviews the coating of major appliances from early times to the present. In recent years a number of factors: energy, materials, and government have exerted a profound influence on coatings used for appliances. In response to these constraints, new technologies such as high solids, water-borne flow coats, cathodic electrocoating, and powder coatings have provided reasonable solutions.

Future coatings for appliances will involve increased attention to the substrate, lower energy processes, coil coating, robotics, porcelain replacements, and inorganic coatings.

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Evaporation During Sprayout Of a Typical Water-Reducible Paint At Various Humidities

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Solvent balance during sprayout of a water-reducible paint at various humidities and spraygun settings is close to that of a corresponding model system composed of neat solvent blend thickened to the same viscosity as the paint. Using measured degree of evaporation from the model, paint solvent balance can be estimated with a previously developed computer program that predicts evaporation of water and cosolvents at any humidity. During sprayout the concentration of 2-butoxyethanol cosolvent is relatively insensitive to evaporation conditions. Tert-butanol cosolvent is affected less than expected because humidity has opposite effects on evaporation rate and on depletion of volatile cosolvents.

INTRODUCTION

Water-reducible coatings offer the industry a means of reducing organic solvents emissions to comply with pollution control regulations. Though the solvent in these coatings is largely water, organic solvents cannot be avoided completely. One or several must be added to promote resin dispersibility and control rheology. A disadvantage of water/cosolvent blends is that the coatings are very sensitive to evaporation conditions during application and drying. Hill and Brandenburger[1,2] have shown that changes in water/cosolvent balance can have large effects on rheology with important consequences for film quality and acceptability, and Grant[3] has called attention to the lurking danger of immiscibility resulting from solvent imbalance. Thus, loss of a small amount of cosolvent can bring about a sudden viscosity change which may lead to sag or poor leveling. These effects can be minimized by careful selection of cosolvents, but the problem is complicated because the changing water/cosolvent balance during evaporation can be strongly affected by relative humidity. A blend which maintains a satisfactory water/cosolvent balance at a low humidity can lose most of its valuable cosolvent rapidly if the humidity rises. This is an expensive vulnerability. To cope with it adequately requires a good understanding of evaporation behavior under application conditions.

Earlier, in response to emphasis in the industry on water-reducible coatings, Shell had developed a computer program (AQUEVAP) for predicting evaporation of neat multicomponent blends of water and organic cosolvents at any humidity.[4] The program closely predicts the evaporation time and solvent balance that would be observed for the blend evaporating from filter paper under standardized conditions at the specified humidity in the Shell Evaporometer as measured by ASTM D-3539. We wanted to know if it could also predict solvent balance during paint sprayout.

Evaporations from filter paper and during sprayout occur under different conditions, but in one respect they are similar: the evaporation temperatures are not greatly different, as described later. This means that as evaporation proceeds, approximately the same solvent balance could be expected in both cases. Since the computer program calculates solvent balance as a function of degree of evaporation, (as well as of relative humidity), application of the program to predicting solvent balance during sprayout requires that one knows what proportion of the solvent blend is lost in the spray step. If it is

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Table 1—Composition of White Enamel

Component	Total, %w	Solvent, %w
TiO_2 (R-902)[a]	20.99	
Arolon[b] 378 resin	18.92	
Cymel[c] 303 resin	2.64	
Tert-butanol	4.88	8.80
2-Butoxyethanol	4.88	8.80
Dimethylethanolamine	1.16	
Tributyl phosphate	0.86	
Water	45.67	82.40
Total	100.00	100.00

(a) Du Pont.
(b) Spencer Kellogg.
(c) American Cyanamid.

Table 2—Temperature in Spray

RH %	Thick Blend °C	Paint °C
21	11	
37		14
42	15	
74	19	19
87	21	21

known what degree of evaporation to expect at any given spraygun setting and relative humidity, the computer program can then be used to calculate solvent balance. Therefore, an object of this study was to measure degree of evaporation under a variety of sprayout conditions and over a range of humidities. Another object was to measure solvent balance for comparison with the computer predicted values.

We found that the computer program is useful in predicting evaporation trends and in explaining evaporation behavior of a fast and a slow cosolvent over a range of sprayout conditions. Also, we found a close similarity between evaporation from paint and from a simple model system having the same composition as the solvent portion of the paint. Thus, the study sheds light on evaporation during paint sprayout, and describes two useful techniques for simplifying such investigations—use of a model solvent system and application of a computer program.

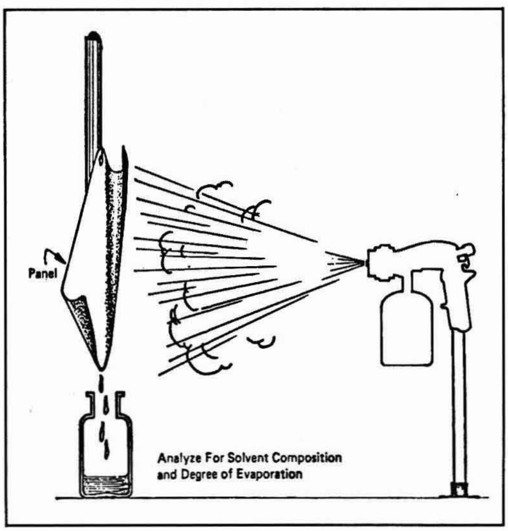

Figure 1—Experimental procedure

BACKGROUND

The literature on evaporation from water-reducible coatings is sparse. There are at least three reasons for this: (1) It is only within the past few years that industrial water-reducible coatings have become important; (2) The physical chemistry of even the simplest formulated aqueous systems is complicated; and (3) Evaporation measurements are difficult to make. Only one experimental study was found that touches on evaporation during sprayout. The two related papers by Hill and Brandenburger[1,2] report solvent balance at various humidities during sprayout and subsequent flashoff of a few water-reducible coatings formulated with water dispersible acrylics and selected aqueous solvent blends, including one composed of water, sec-butanol, and 2-butoxyethanol. In that study, panels were sprayed with a suction-feed gun, the wet films scraped from the panels directly after sprayout and at three five-minute intervals thereafter, then analyzed. Sprayouts were conducted over a range of humidities. Most of the data were obtained with paints formulated with binary blends of water and 2-butoxyethanol. In the one case where they report solvent balance at 60% relative humidity for sprayout of a paint formulated with a blend of 80%w water and 10%w each sec-butanol and 2-butoxyethanol, they found only a minor change in 2-butoxyethanol concentration. This is confirmed by our results, which span a wide range of relative humidity and atomization pressures and which show that concentration of 2-butoxy-

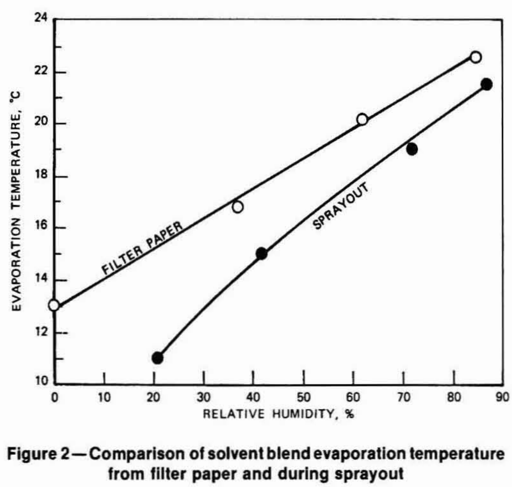

Figure 2—Comparison of solvent blend evaporation temperature from filter paper and during sprayout

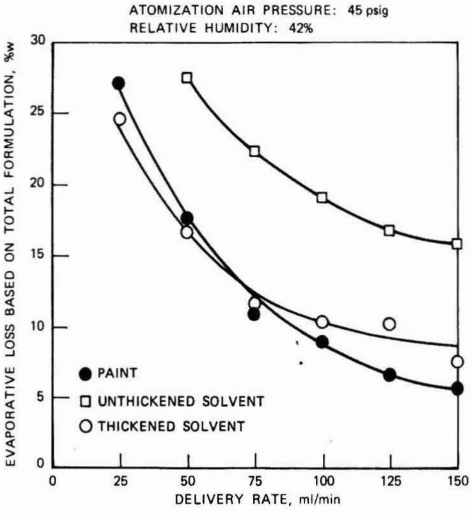

Figure 3—Effect of delivery rate on degree of evaporation during sprayout

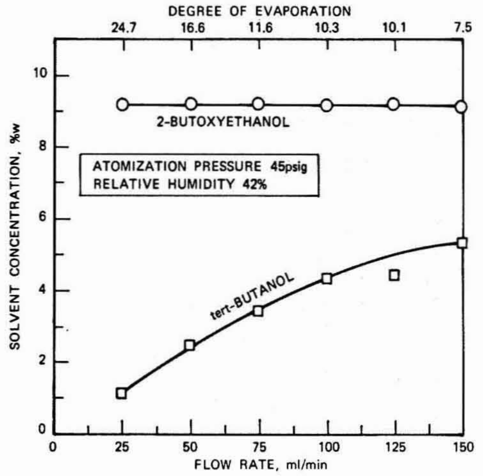

Figure 4—Effect of flow rate on solvent balance during sprayout of thickened solvent blend

ethanol in the sprayed paint is remarkably insensitive to sprayout conditions.

Though Eaton and Willeboordse[5] also deal with "evaporation behavior of organic cosolvents in water-borne formulations," their paper is mostly theoretical. Taking into account diffusion theory, they developed an expression for predicting the absolute evaporation rate of a solvent from a polymer solution, then checked it once by measuring evaporation from a 40%w solution of a poly(ethylene oxide) glycol in water. No experiments were reported with organic solvents. Their pertinent conclusion is that although evaporation is diffusion limited during the later stages of drying, it is rate limited during the initial stages. A similar conclusion was reached by D. A. Sullivan[6] who studied evaporation from latex films. This is encouraging because it suggests that during sprayout, where not much more than 30%w of the solvent is lost, evaporation is rate limited and dependent mostly on concentration, activity coefficient, and pure solvent evaporation rates, and independent of diffusion coefficient in the resin. These are the same factors that are taken into account in Shell's computer program for cal-

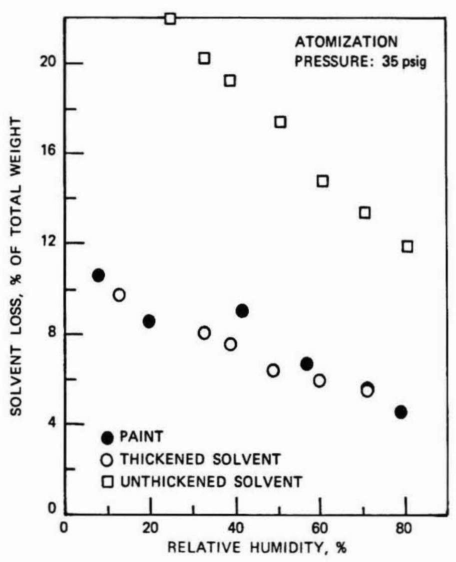

Figure 5—Comparison of degree of evaporation from paint and from neat blends during sprayout at 35 psig

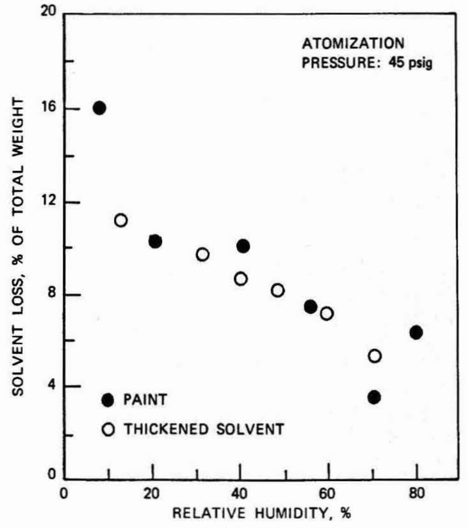

Figure 6—Degree of evaporation during sprayout of paint and thickened blend at 45 psig

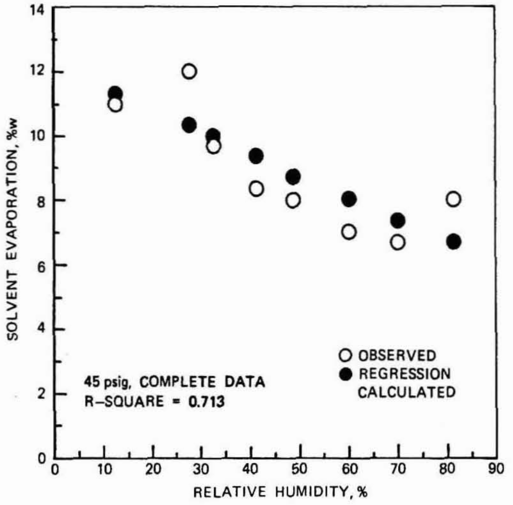

Figure 7—Computer regression analysis for complete set of thickened solvent sprayout data at 45 psig, including points at 27 and 81% RH

culating solvent blend evaporation. This can explain why our study showed that the computer program does a reasonable job of predicting trends on evaporation during sprayout.

METHODOLOGY AND EXPERIMENTAL

Measurement of evaporation during paint sprayout is cumbersome. The paint has to be made fresh daily to ensure uniformity, and the analyses are subject to error because of the complicated composition. Instead of using paint, it would be more convenient if just the solvent portion could be sprayed and the results related to evaporation from the complete formulation. This is not unreasonable. As discussed above, evaporation during sprayout is probably rate limited; also, it is known that with conventional solvent blends, evaporation from the paint is almost the same as from the neat solvent blend up to the point where film formation, or later stage evaporation, begins.

In this study we compared evaporation from paint and from solvent only. Solvent evaporation during sprayout was measured at various humidities, using a commercial water-reducible alkyd having the composition shown in *Table* 1, and a corresponding model system consisting of a neat water/solvent blend having the same composition as the blend used in the paint. To compare paint and neat blend sprayouts under similar conditions, a small amount of thickening agent* was added to the neat blend to adjust its viscosity to that of the paint (40 sec in No. 4 Ford cup). For comparison, some sprayouts were done with unthickened solvent blend.

Our procedure was somewhat different from the method employed by Brandenburger and Hill. Instead of a suction feed gun, we used one with air controlled feed and separately adjusted atomization air pressure. Delivery rates were adjusted and checked before each sprayout. Brandenburger and Hill had relied on ambient conditions for humidity variations, whereas we were able to raise humidity in the spray room by steam injection and control it with a humidistat. Air flow was 125 ft/min and temperature was kept at 25.0°C. Spray from the gun mounted in a fixed position impinged on a panel 10" away, then dripped into a collection bottle, *Figure* 1. Solvent composition of the collected material was determined by gas chromatography on a ⅛ in. by 5 ft. Chromosorb 101 column with TC detector at a helium rate of 30 mL/min and programmed from 75°C to 220°C at 20°/min. The thickened solvent samples were injected directly, but the paint was first diluted with an equal volume of 2-ethoxyethanol to settle the pigment. For the paint, degree of evaporation was calculated from gravimetric total solids measurements before and after sprayout as determined by ASTM D1259-61 (1974), method B. Since this method cannot be used with a neat solvent blend, degree of evaporation was determined from the concentrations of a marker before and after sprayout. Mg^{++} at 1000 ppm was added in the form of magnesium sulfate to the solvent blend before sprayout and analyzed colorimetrically by ASTM D511-76, method B.

*1.0%w Dow Methocel F4M.

Table 3—Regression Line Parameters for Unedited Thickened Solvent Sprayout Data

Atomization Air Psig	Slope	Intercept	R^2
35	−0.06469	10.520	0.739
45	−0.06933	12.129	0.713
55	−0.06917	13.354	0.609
65	−0.09510	15.648	0.662

RESULTS AND COMMENTS

Great care was taken to conduct the sprayouts under controlled conditions, but it soon became evident that deviations could not be avoided. For example, as shown later in *Figure* 7, degree of solvent evaporation at 27% RH and 81% RH is clearly out of line. The deviations are undoubtedly related to the spray gun operation. Though they upset our plan of finding neat relationships between evaporation and application conditions, they certainly cannot be overlooked because they reflect the real world where such behavior is commonplace. This emphasizes the importance of looking for cosolvents with minimum sensitivity to variations in sprayout conditions.

Evaporative Cooling

In calculating solvent activity coefficients, the computer program for predicting evaporation from filter paper takes into account evaporative cooling of the

Table 4—Regression Line Parameters for Edited Thickened Solvent Sprayout Data

Atomization Air Psig	Slope	Intercept	R^2
35	−0.07548	10.547	0.969
45	−0.07931	12.053	0.975
55	−0.06947	12.713	0.981
65	−0.08695	14.532	0.991

blend. These activity coefficients, together with the modification of the standard 25° C solvent evaporation rates, account for the success of the AQUEVAP program in predicting solvent balance during evaporation. Whatever the evaporation conditions, whether from filter paper, quiescent pools, or spray, and regardless of evaporation rate, one could expect the same solvent balance at the same evaporation temperature and relative humidity. Thus, for a given composition the evaporation temperature is a clue as to what the solvent balance will be.

Temperature within the spray drops rapidly to a steady minimum about 6″ from the gun. *Table* 2 lists minimum spray temperatures for paint and thickened blend at several humidities. The two systems have essentially identical spray temperatures. This was encouraging because it offered the strong possibility that solvent balance measurements with thickened blend could be used to predict solvent balance on paint sprayout. *Figure* 2 compares spray temperature with evaporation temperature of the neat solvent blend from filter paper in the Shell Evaporometer. The temperatures certainly differ, but not grossly so. This explains why, as shown later, the computer program for predicting evaporation from filter paper can be applied to predicting evaporation trends on sprayout.

Variables

Control of rheology and film quality depends on how well the rate of evaporation and the solvent balance can be controlled during application and drying. This involves four variables: relative humidity, temperature, paint delivery rate, and degree of atomization. The first two are the ambient conditions. The last two are the spraygun settings.

If humidity cannot be controlled, the effects of its variability have to be compensated by appropriate reformulation and readjustment of the spraygun settings. This study, performed at constant air temperature and confined to a single formulation, explored the effects of varying the degree of atomization over a range of humidities, and looked briefly at the effects of changing delivery rate.

Median spray conditions were those which gave a one mil dry film in one double pass of the automatic spray table with the gun mounted 10″ from the panel, and with paint flow rate adjusted to 75 mL/min and atomization pressure set at 45 psig.

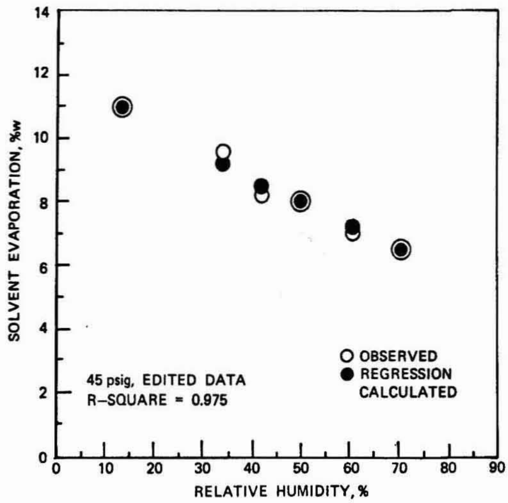

Figure 8—Regression analysis confined to statistically significant data

Flow Rate

With atomization pressure fixed at 45 psig, and relative humidity kept constant at 42%, flow rate was varied from 25 mL/min to 150 mL/min. *Figure* 3, which compares the response of the three systems, paint, thickened solvent, and unthickened solvent, shows that the amount of solvent lost during sprayout varies inversely with liquid flow rate. This is not surprising. The same air flow ought to atomize a small amount of liquid more efficiently than a large amount. Therefore, evaporation should be faster at lower flow rates where atomization is more thorough.

As expected, solvent loss from the low viscosity unthickened neat blend is much greater than from paint or thickened blend, both of which are within experimental error of each other at about median and lower flow rates. To a great extent viscosity controls atomization.

Figure 4 shows the solvent balance when thickened solvent is sprayed at different flow rates. The scale at the top of the figure gives the degree of total evaporation at each flow rate. More than three times the proportion of solvent is lost at the lowest rate than at the highest. It is remarkable that the 2-butoxyethanol concentration remains unchanged throughout this wide range of degree of evaporation. Though this series was done at fixed humidity, other results show similar constancy over a wide range of humidities. This insensitivity to sprayout conditions explains some of the popularity of 2-butoxyethanol as a cosolvent in water-reducible systems. The pattern for tert-butanol is typical of solvents that evaporate faster than water. Depletion increases with increasing degree of evaporation.

These results call attention to one of the consequences of changing flow rate to change film thickness. This can alter degree of evaporation and solvent balance and could, therefore, have a noticeable effect on rheology and film quality.

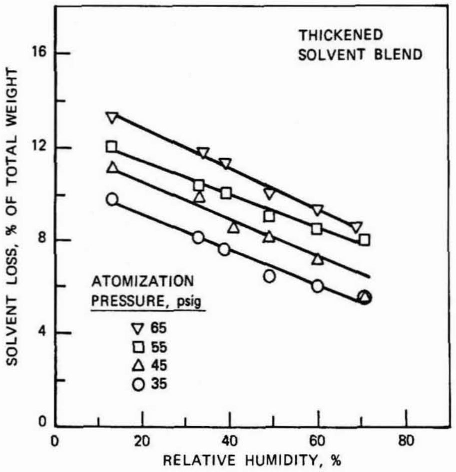

Figure 9—Effect of humidity and atomization pressure on degree of evaporation

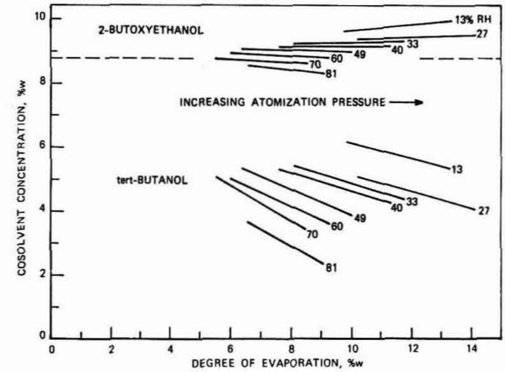

Figure 10—Solvent balance on sprayout of thickened blend

Degree of Evaporation

Unthickened solvent, thickened solvent, and paint were sprayed under a variety of conditions and the sprayed material analyzed for solvent balance and degree of total solvent evaporation. Flow rate was kept constant at 75 mL/min. At each humidity, sprayouts were done at four levels of atomization by adjusting the atomization air pressure to 35, 45, 55, and 65 psig. As shown previously, and as confirmed by *Figure* 5, evaporation from unthickened solvent is in a different range from thickened solvent and paint. Since this would have very little bearing on real paint behavior, nothing further was done with the unthickened solvent data. *Figures* 5 and 6* depict the results for sprayouts at 35 at 45 psig. Paint and thickened solvent have similar response over a wide range of humidities. Comparable results were obtained at 55 and 65 psig. The responses are not identical, but they are close enough to encourage us to look to thickened solvent evaporation data as a guide to paint behavior. As stated above, the reasons for working with thickened solvent instead of paint are that paint is more difficult to formulate, harder to control at the spraygun, and more difficult to analyze for solvents. The differences show up in the data, which are much less scattered for thickened solvent than for paint.

When the computer program predicts solvent balance during evaporation, it computes solvent concentrations as a function of degree of evaporation. On the other hand, a spraygun is not set to a degree of evaporation. It is adjusted to a certain flow rate and atomization pressure, and is used at an ambient or controlled humidity. Therefore, to predict solvent balance during sprayout it is necessary to know what degree of evaporation corresponds to a given set of sprayout conditions. This is where the data on thickened blend sprayout can be useful. Degree of evaporation of thickened blend (as well as paint) as a function of spraygun setting and relative humidity is shown for 35 and 45 psig in *Figures* 5 and 6, but to be usable the discrete, scattered data points have to be fitted to a line. This was done with the thickened solvent data at each atomization pressure (including the points at 27% and 81% RH) using a program that produced computer generated regression lines. *Figure* 7 shows the treatment of the 45 psig data. Points are shown as located on the computer drawn graph. They are not precisely positioned because their placement has to conform to typewriter spacing. *Table* 3 summarizes the exact parameters for each line. The significant parameter is R-square. For a perfect fit this would be unity. Lower values signify the degree of deviation from the regression line. For these lines the fit is poor, but inspection of the data shows that in each case, as in *Figure* 7, the data points at 27 and 81% RH are grossly out of line. Being removed from the others by more than three standard deviations, they comply with the statistical criterion for being discarded. When this is done, the remaining points give excellent straight lines. *Figure* 8 and *Table* 4 show a very close fit.

Figure 9 shows the four regression lines on the same graph. Within experimental error the lines are straight, parallel, and uniformly spaced. It should not be surprising that the lines are straight. The blend is mostly water, whose evaporation rate is a linear function of relative humidity. Also, the total span of evaporation covers the limited range between 5% and 14% solvent loss where any curvature resulting from differential evaporation of the cosolvents would not be noticeable. As for the uniform spacing, it means that a change in atomization pressure will bring about the same change in solvent loss, regardless of relative humidity and initial atomization pressure. The graph tells us what degree of evaporation to expect for a chosen atomization pressure at any humidity. Since solvent balance is a function of degree of evaporation and humidity, it means that we are now in a position to use the computer program for predicting solvent balance.

*Observations with thickened solvent sprayouts at 27% and 81% RH were omitted from these figures because they were not statistically significant (see text).

Solvent Balance

Solvent balance data for the thickened solvent blend are plotted in *Figure* 10. Cosolvent concentrations in the sprayed blend are shown as a function of degree of evaporation. Each line represents a group of sprayouts conducted in sequence over a range of atomization pressures and at fixed humidity. With a few exceptions, the experimental points fell on or close to the straight lines which were drawn in by eye.

Each cosolvent gives rise to a family of lines showing progressively decreasing concentration in the sprayed blend with increasing humidity. But the response of 2-butoxyethanol is greatly different from tert-butanol. The concentration of 2-butoxyethanol hovers close to the initial value of 8.8%w. At low humidities there is minor enrichment, and at high humidities minor depletion, but the overall effect throughout the wide range of humidity and atomization pressure is minimal. Also, at low humidities 2-butoxyethanol enjoys a slight enrichment with increasing atomization pressure, though the effect is reversed as the humidity rises.

On the other hand, tert-butanol concentration is much more sensitive to sprayout conditions. Increasing atomization and increasing humidity both cause significant depletion from the initial 8.8%w concentration.

Figure 10 reflects the displacement noted earlier for the 27% and 81% relative humidity data. Those lines are shifted to the right, showing much higher degrees of evaporation than expected for the given atomization pressures. The reason for this is not certain, but it is probably caused by diminished flow rate which, as shown in *Figure* 3, results in greater atomization and degree of evaporation. Though the 27% and 81% humidity data are far out of line according to spraygun settings, they fit neatly into their respective families of concentration as a function of degree of evaporation. Ultimately, at any humidity it is degree of evaporation that determines solvent balance. This is small comfort to a technologist with a capricious spraygun, but it emphasizes the importance of looking at solvents like 2-butoxyethanol which are minimally affected by application conditions.

Table 5—Calculated Evaporation During Sprayout

Atomization Air psig	Rel Humid %	Evap Wt. Loss[a] % of Total	Solvent Balance[b] tert-Butanol %w	Solvent Balance[b] 2-Butoxyethanol %w
35	13	9.57	4.07	9.27
35	27	8.51	4.25	9.20
35	39	7.60	4.43	9.14
35	49	6.85	4.61	9.08
35	60	6.02	4.85	9.04
35	71	5.19	5.12	8.98
35	81	4.43	5.42	8.95
45	13	11.02	3.43	9.32
45	27	9.91	3.55	9.24
45	33	9.44	3.63	9.20
45	41	8.80	3.73	9.15
45	49	8.17	3.84	9.11
45	60	7.29	4.04	9.05
45	71	6.42	4.27	9.00
45	81	5.63	4.52	8.96
55	13	11.81	3.07	9.34
55	27	10.84	3.12	9.25
55	33	10.42	3.14	9.21
55	39	10.00	3.15	9.19
55	49	9.31	3.21	9.12
55	60	8.54	3.27	9.05
55	71	7.78	3.35	9.00
55	81	7.09	3.44	8.95
65	13	13.40	2.44	9.38
65	27	12.18	2.52	9.27
65	34	11.58	2.56	9.23
65	39	11.14	2.61	9.19
65	49	10.27	2.69	9.13
65	60	9.32	2.82	9.05
65	69	8.53	2.94	9.00
65	81	7.49	3.15	8.53

(a) From regression equation:
%w = (Slope) · (Relative Humidity) + Intercept.
(b) Calculated by AQUEVAP for indicated RH and degree of evaporation.

Application of Computer Program

The computer program AQUEVAP cannot calculate total solvent loss during the fraction of a second that the material is in the spray stream. It can do this only for the system it was designed for, viz., evaporation from filter paper, for which it calculates time required to reach different stages of evaporation. Evaporations from filter paper require at least several minutes to reach the same degree of evaporation achieved almost instantaneously during sprayout.

What the program can do is predict solvent balance at each stage of evaporation. As shown in the previous section, degree of evaporation determines solvent balance. Therefore, to calculate solvent balance during sprayout it is necessary to know what degree of evaporation will be attained under a given set of application conditions. This is already known. As described above, *Figure* 9 and *Table* 4 tell what degree of evaporation can be expected at any given humidity and practical atomization pressure for the thickened 2-butoxyethanol/t-butanol/water system. At each atomization pressure, the appropriate parameters in *Table* 4 were used to calculate degree of evaporation for a series of humidities. The AQUEVAP program was then run at each humidity and the solvent balance for the corresponding degree of evaporation obtained from the computed values. In this way, solvent balance was calculated for each humidity. The figures are listed in *Table* 5.

These calculated values were plotted on the same graphs with the observed solvent balance as a function of humidity for sprayouts of paint and thickened solvent blend. *Figures* 11–14 show certain differences in solvent balance of paint and thickened solvent blend. Though 2-butoxyethanol balance is about the same for both systems, tert-butanol concentration is somewhat higher for thickened blend than for paint. The computer program closely predicts the 2-butoxyethanol response, and is in the same range as paint and thickened blend for the tert-butanol response. The reason the tert-butanol con-

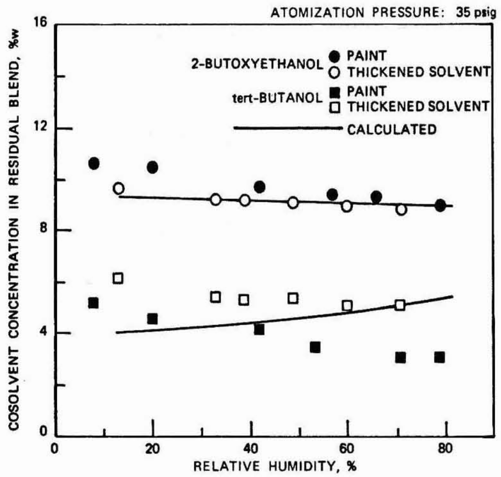

Figure 11—Solvent balance at 35 psig atomization pressure

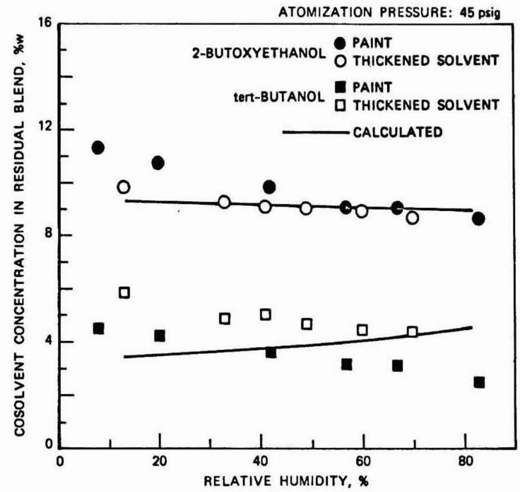

Figure 12—Solvent balance at 45 psig atomization pressure

centration in the sprayed paint is lower than in the neat blend is that the degree of evaporation in the paint is greater than in the blend, and as shown earlier, tert-butanol concentration falls as evaporation proceeds. Paint and blend were sprayed at the same liquid flow rate, but since only about half the paint is solvent it can be seen that the same degree of atomization (as ensured by the same viscosity) would result in a greater proportion of solvent being lost from paint than from thickened blend.

The calculated values in *Figures* 11–14 were based on observed (smoothed) degree of evaporation from thickened solvent blend. As pointed out above, under identical sprayout conditions the paint loses a greater proportion of its solvent than the thickened blend does. One might then expect the solvent balance in the paint to be more closely related to its own degree of evaporation than to that of the thickened blend, but in fact this is not so. The AQUEVAP calculation of solvent balance based on degree of evaporation from thickened solvent blend was much closer to the actual experimental results, especially for 2-butoxyethanol, than was the calculation (not shown) based on actual degree of evaporation from paint.

In view of the pattern shown in *Figure* 10 as well as Evaporometer data and AQUEVAP calculations showing that depletion of tert-butanol increases with rising humidity, it may at first be surprising that *Figures* 11–14 show so little variation in tert-butanol concentration over the complete test range of relative humidity. The answer can be found in *Figure* 15 which shows that increased

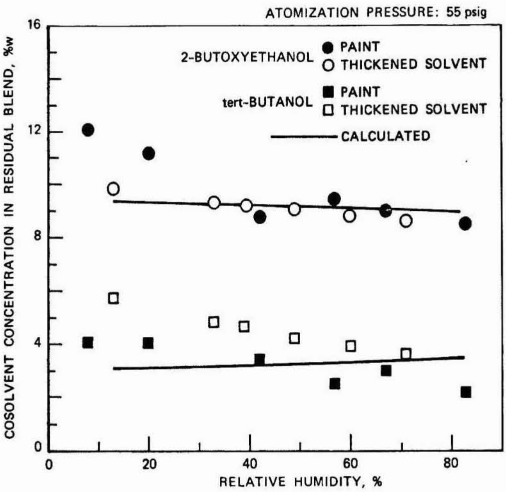

Figure 13—Solvent balance at 55 psig atomization pressure

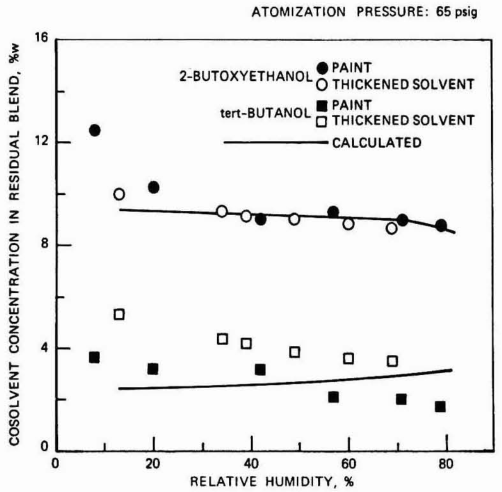

Figure 14—Solvent balance at 65 psig atomization pressure

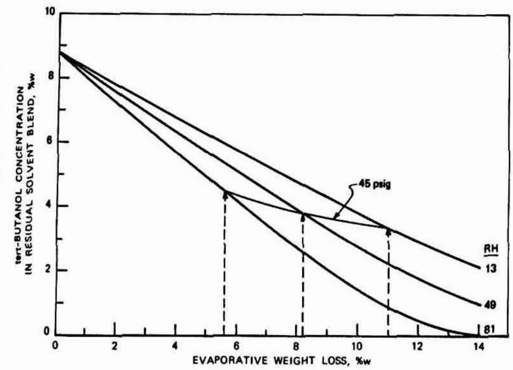

Figure 15—Predicting tert-Butanol concentration during sprayout at different humidities

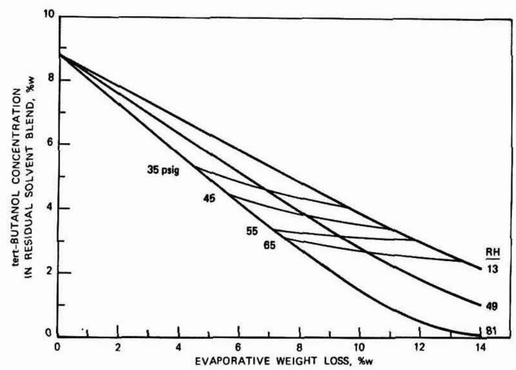

Figure 16—Extending predictions to different atomization pressures

tert-butanol depletion at higher humidity is offset by diminished degree of solvent blend evaporation. The lines designated 13, 49, and 81 show computed values, as calculated by the AQUEVAP program, for tert-butanol concentration as a function of degree of evaporation at the indicated humidity. Suppose sprayouts are conducted at the same atomization pressure at each humidity. In each case, the tert-butanol concentration will depend on the degree of evaporation under those conditions. From *Figure* 9 and *Table* 5 we know, for example, that at an atomization pressure of 45 psig there is an 11.0% evaporative weight loss at a relative humidity of 13%. From the 13% humidity line in *Figure* 15, the tert-butanol concentration at an 11.0% degree of evaporation is 3.4%. But if the sprayout is conducted at a humidity of 49%, the degree of evaporation drops to 8.2%, and the corresponding tert-butanol concentration increases slightly to 3.8%. At 81% humidity, the degree of evaporation goes down to 5.6% and the tert-butanol concentration rises to 4.5%. Response at different atomization pressures is shown in *Figure* 16. The variation at each atomization pressure is fairly small.

These opposing effects explain why, with sensitive cosolvents such as tert-butanol, the variation of solvent balance with humidity is less than expected, and why the insensitivity of 2-butoxyethanol is further enhanced. Increased humidity retards water evaporation to a greater extent than it affects cosolvents. By default, cosolvents should suffer greater depletion, but this effect is partly offset because the whole blend is evaporating more slowly. All the solvents are slowed down (with water more so than others). During the fixed time of the spray step less of the whole blend evaporates, so the cosolvents have less opportunity to become depleted.

SUMMARY

Evaporation during sprayout of a water-reducible paint can be estimated by a technique involving a model solvent system and an evaporation computer program. Evaporation from a corresponding thickened solvent blend model system parallels evaporation from the paint, and can be approximated by a computer program (AQUEVAP) for predicting solvent balance of water/solvent blends at any humidity. Though thickened solvent blend is easier to handle than paint, it is still difficult to control spraygun operation reliably. Despite obvious upsets in gun operation, all the data fit a consistent pattern in which solvent balance is determined only by relative humidity and degree of evaporation.

A single solvent system was chosen because it is in a typical recommended formulation for a commercial paint. This study shows why that system is a fairly good one: The effects of uncontrolled spraygun variations on solvent balance are partly alleviated by the remarkable insensitivity of 2-butoxyethanol to sprayout conditions, and by the opposing effects of humidity and evaporation rate on depletion of tert-butanol. Since the computer evaporation calculations are applicable to paint sprayout, prospective solvent blends can be assessed quickly at the computer terminal for probable evaporation characteristics in the paint. This should speed up detection of clearly unsatisfactory blends and improve the chances of finding blends that qualify.

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Solubility Parameter Concept in the Design Of Polymers for High Performance Coatings

I. Acrylic Copolymers

Anthony J. Tortorello and Mary A. Kinsella
DeSoto, Incorporated

Coatings for aircraft application are required to meet a variety of severe conditions including flexibility over a broad temperature range and resistance to fluids covering the spectrum of polarity from hydrocarbons to water. Upon consideration of all the various film performance requirements, fluid resistance is considered to be the most crucial.

The design of synthetic resins to resist the test fluids began with the characterization of the solubility parameter value for each fluid. A spectrum of fluid solubility parameter values was then constructed and a region corresponding to resistance to the entire body was identified. Acrylic copolymers having the desired solubility parameter as calculated by group contribution theory were synthesized. Both anionic and cationic aqueous dispersions were prepared and evaluated for clear-film performance. The performance was as expected for all fluids except water.

INTRODUCTION

Prior to the enactment of Rule 66 by Los Angeles County, interest in water-based coatings for industrial use was limited primarily to automotive finishes.[1] Since then, additional legislative restrictions[2] and a changing perspective regarding the supply and economic advantages of solvents have led to the onset of technology change.

In the refinishing of its aircraft, the U.S. Air Force is governed by the same restrictions which apply to private industry. Recognizing the needs of a changing technology and compliance with federal emission guidelines, the Air Force has continuously sponsored research to replace its solvent-based epoxy-polyamide primer and urethane topcoat since the early 1970's. This sponsorship has taken the form of several contracts ranging in scope from direct emulsification of primer and topcoat components[3] to development of high solids coatings[4] to development of water-based coatings.[5]

The following report presents in part the results of U.S. Air Force contract F33615-78-C-5096. The study proposes the development of an aqueous resin system intended to function as the pigment binding vehicle for an aircraft topcoat or primer.

Table 1 summarizes the military specification which characterizes the applied film properties of the solvent-based urethane topcoat. The requirements of the primer are similar. And any prospective replacement should display equivalent performance.

The results of a preliminary screening of the commercial marketplace for aqueous resins failed to identify a successful candidate and in addition showed clearly that successful performance could not be predicated on the basis of generic polymer classification.[5] Thus, having essentially excluded the use of a general purpose industrial polymer and thereby establishing the need of a specialty resin, the study proceeded to the design of novel polymers.

The polymers were synthesized in organic solvent, dispersed into aqueous medium, formulated with film aids, and evaluated for clear-film (unpigmented) performance against the criteria as detailed in *Table* 1.

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Table 1—Coating, Urethane, Aliphatic Isocyanates For Aerospace Applications

(Military Specification MIL-C-83286)

5% Salt spray	No blistering, cracking, corrosion, or loss of adhesion after 500 hours of exposure.
100% Relative humidity	No blistering, cracking, softening, or loss of adhesion after 720 hours of exposure.
Accelerated weathering	After 500 hour exposure the coating should exhibit 60% impact flexibility, no more than 10% loss of original gloss, and no color change.
Fluid resistance	A decrease of no more than one pencil hardness unit after immersion in water (4 days, 100° F), lubricating oil (24 hours, 250° F), hydrocarbon fluid (7 days, room temperature), and hydraulic fluid (7 days, room temperature). A decrease of no more than two pencil hardness units after immersion in Skydrol 500B fluid (7 days, room temperature).
Film flexibility	No cracking, crazing, or loss of adhesion of coating when elongated 60% by impacting mandrel.
Low temperature flexibility	No cracking or loss of adhesion when bent around ⅜ in (9.5 mm) diameter cylindrical mandrel after four hours at −65° F (−54° C). (Test immediately after removal from cold box).
High temperature resistance	No loss of adhesion or flexibility after four hours at 300° F (149° C).
60° Gloss	>90

DISCUSSION

In reviewing the applied film properties of military specification C-83286, the combination of fluid resistance and flexibility provide the greatest challenge and constitute the point of failure of most resin candidates. Since chemical resistance is usually achieved by crosslinking and since crosslinking typically results in embrittlement, the cause of failure appears obvious.

Table 2—Energy of Vaporization and Molar Volume Contributions of Some Acrylic Monomers

	ΣΔei (cal/mol)	ΣΔvi (cm³/mol)
n-Butyl acrylate (BA)	10965	114.9
2-Ethylhexyl acrylate (2EHA)	15270	179.6
Ethyl acrylate (EA)	8605	82.7
Methyl acrylate (MA)	7425	66.6
Vinyl acetate (VAc)	7425	66.6
Methyl methacrylate (MMA)	8080	81.9
Styrene (Sty)	9630	86.5
Acrylonitrile (AN)	8100	39.1
Acrylic acid (AA)	8600	43.6
Itaconic acid (Ita)	15910	70.0
Acrylamide (AM)	12000	32.6
Methacrylamide (MAM)	12655	47.9
2-Hydroxyethyl acrylate (HEA)	15780	75.3
2-Hydroxyethyl methacrylate (HEMA)	16435	90.6

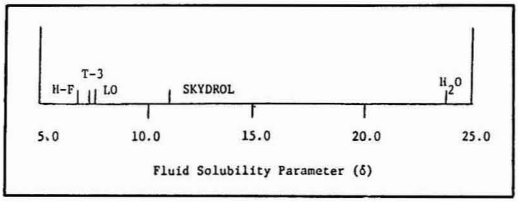


Figure 1—Solubility parameter spectrum of erosive aircraft fluids

In considering the relationship of polymer structure and chemical resistance, literature search inevitably leads to the Flory-Huggins equation [equation (1)].[6]

This equation predicts that crosslinking is not the sole

$$q_m^{5/3} \simeq (V_o/\nu_e)\,(0.5 - \chi_1)/V_1 \qquad (1)$$

answer to achieving chemical resistance. Even network structures are appreciably swollen by solvents having a favorable solvent-polymer interaction parameter (χ_1).

When the inverse relationship between chemical resistance and mechanical flexibility is considered along with the conclusions from the Flory-Huggins equation that crosslinking is no guarantee to complete resistance, it becomes apparent that the nature of the polymer backbone is of paramount importance in achieving desirable performance properties. Any polymer found to display optimum chemical resistance in the thermoplastic (linear) state could achieve the final resistance requirements with minimal crosslinking and hence optimum flexibility. Thus, the problem "reduces" to one of achieving optimum chemical resistance in the linear polymer.

Fluid Resistance And the Solubility Parameter Concept

Perhaps the best known expression dealing with the relationships of solvents and polymers is the solvent-polymer interaction parameter (χ_1) given in equation (1). Unfortunately, this variable is difficult to apply to the design of novel polymers for specialty application.

Alternatively, the same relationship has been expressed in terms of the solubility parameter concept.[7] Hildebrand[8] has shown that for a solution process to occur the solubility parameter value of the solvent must be nearly equal to that of the solute. Conversely, incompatibility is predicted when there is a disparity between the two values. Hence, the design of novel polymers for enhanced fluid resistance can be guided by a broad distinction between the solubility parameter value of the polymer and that of the fluid. Furthermore, this enhanced performance should display no dependence on generic polymer classification. Acrylics should perform as well as urethanes, etc. given the same solubility parameter value.

Acrylic Copolymer Design

The solubility parameter value has been defined according to equation (2) as the square root of the

Table 3—Anionic Acrylic Formulation Properties

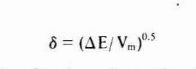
	2722-37	2722-54	2722-70	2722-75	2722-75a	2722-82
Monomer Comp.	BA/MA/AN/AA	2EHA/Sty/AN/AA	EA/HEA/AN/AA	AM/HEA/AN/AA	AM/HEA/AN/AA	BA/VAc/AN/AA
Solubility param. (δ)	11.4	12.0	12.8	13.8	13.8	11.4
Acid value	24.4	21.9	21.9	24.6	24.6	31.9
Tg°C (est)	28	34	57	59	59	41
Aziridine resin[a]	XAMA-7	XAMA-7	XAMA-7	XAMA-7	NONE	XAMA-7
Solids, percent	25.0	31.2	39.5	22.5	18.2	29.9

(a) Cordova Chemical Co.

$$\delta = (\Delta E/V_m)^{0.5} \qquad (2)$$

cohesive energy density, i.e., the ratio of energy of vaporization and molar volume. This definition renders the solubility parameter concept more suitably to novel polymer design than the solvent-polymer interaction parameter. Small,[9] and later Rheineck and Lin,[10] showed that the contribution of each atomic grouping comprising the molecular structure could be totaled to estimate the solubility parameter value. More recently, Fedors[11] has provided an extension to the number of groups available.

SOLUBILITY PARAMETER CALCULATION FOR ACRYLIC MONOMERS. According to Fedors' method the contribution of each atomic group to the molar energy of vaporization and volume is summed over the molecular structure and the square root of the ratio is taken as the solubility parameter value. For n-butyl acrylate the calculation is as follows:



Group	Number	Δe	Δe_i	Δv	Δv_i
CH_3	1	1125	1125	33.5	33.5
CH_2	4	1180	4720	16.1	64.4
CH	1	820	820	−1.0	−1.0
CO_2	1	4300	4300	18.0	18.0
			10965		114.9

$$\delta = (\Sigma\Delta e_i/\Sigma\Delta v_i)^{0.5} = (10965/114.9)^{0.5} = 9.77$$

Table 2 presents the values of the summation of Δe_i and Δv_i terms for some acrylic monomers. These values will be required for the calculation of the solubility parameter of copolymers.

SOLUBILITY PARAMETER CALCULATION FOR COPOLYMERS: In considering the design of copolymers having a preferred solubility parameter value, the entire molecular structure must be viewed. For acrylic copolymers, the molecular structure of the repeating unit is ethylene with varying mole fractions of functionality pendant to the ethylene backbone. The solubility parameter of the copolymer then becomes a function of summation of the energy of vaporization and molar volume terms for each monomer comprising the polymer multiplied by the mole fraction of that monomer. The following example illustrates the calculation:

Monomer	*Mol. Frac. (X)*	$\Sigma\Delta e_i$	$(\Sigma\Delta e_i)(X)$	$\Sigma\Delta v_i$	$(\Sigma\Delta v_i)(X)$
EA	0.6173	8605	5311.9	82.7	51.1
Sty	0.3043	9630	2930.4	86.5	26.3
AN	0.0562	8100	455.2	39.1	2.2
Ita	0.0222	15910	353.2	70.0	1.6
			9050.7		81.2

$$\delta = [(\Sigma\Delta e_i)(X)/(\Sigma\Delta v_i)(X)]^{0.5} = (9050.7/81.2)^{0.5} = 10.56$$

RESULTS

Two series of acrylic copolymers were taken from hypothetical design, through aqueous dispersion, to clear-film evaluation in order to verify the applicability

Table 4—Fluid Resistance of Anionic Acrylic Coatings

Formulation (δ)	Film Thickness, mil	Original Hardness	Lubricating Oil (δ, 8)	Water (δ, 23)	H5606 (δ, 7)	Skydrol 500B (δ, 11)	TT-S-735 (δ, 7.5)
2722-37 (11.4)	1.4–2.4	B, HB	HB	<4B	HB	3B, 4B	B
2722-54 (12.0)	0.5–2.0	HB	HB, F	3B, <4B	HB	HB	HB
2722-70 (12.8)	1.1–2.2	HB	F	<4B	HB, F	F	F
2722-75 (13.8)	0.8–1.0	HB	H, F	<4B	HB, F	HB	HB
2722-75a (13.8)	1.0–1.3	HB	F	DF[a]	HB	HB	HB
2722-82 (11.4)	1.3–2.1	HB	HB	<4B	HB	HB	HB

(a) Film was dissolved by fluid.

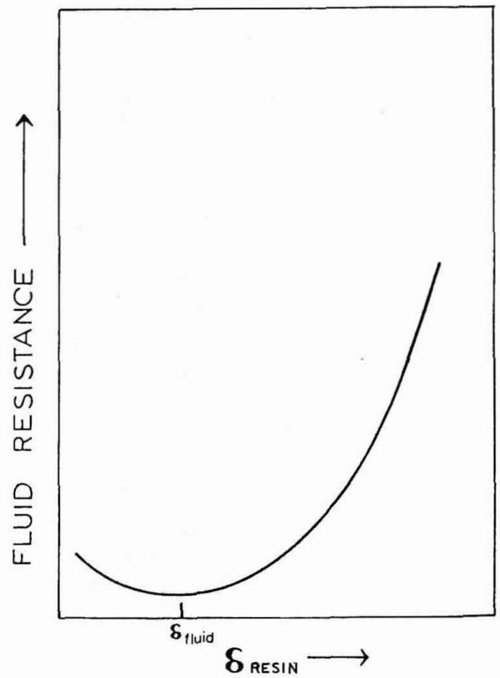


Figure 2—Idealized fluid resistance as a function of polymeric solubility parameter

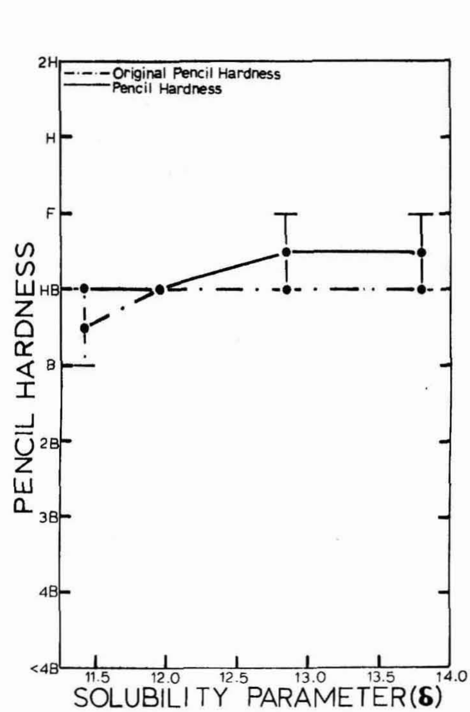


Figure 3—Polymeric solubility parameter effect on resistance to H5606 hydraulic fluid (δ-7)

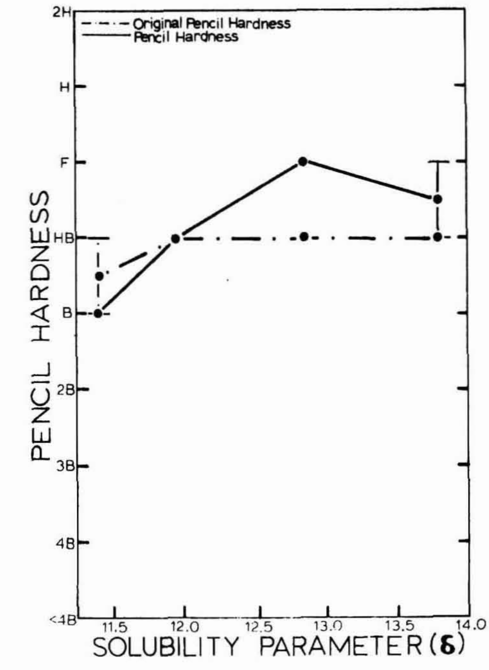


Figure 4—Resin solubility parameter effect on resistance to TT-S-735 type III hydrocarbon (δ-7.5)

of the solubility parameter concept in the design of polymers for high performance coatings.

Aircraft Test Fluids

The design of a polymer for enhanced fluid resistance according to the solubility parameter concept must first begin with a characterization of the solubility parameter value of the fluid. *Table* 1 identifies five fluids which an aircraft coating may contact. These materials are: MIL-TT-S-735 type III hydrocarbon (T-3); diester lubricating oil (LO); MIL-H-5606 hydraulic fluid (H-F); Skydrol 500B hydraulic fluid; and water.

Characterization of the solubility parameter for each fluid was accomplished by boiling point[8] and surface tension[12] techniques. Where possible a comparison to literature reported values[13,14] was made. A spectrum of fluid solubility parameters was then constructed and is displayed in *Figure* 1.

The most striking feature of this spectrum is the extreme gap between Skydrol and water. A resin designed to resist the body of fluids as a whole should have a solubility parameter value falling approximately midway within this gap.

Anionic Acrylic Aqueous Dispersions

A series of acrylic solution polymers varying solely in solubility parameter was designed. Part of the design included carboxylic acid monomers. These carboxy-functional polymers when reacted with volatile amines and mixed with water give rise to colloidal dispersions

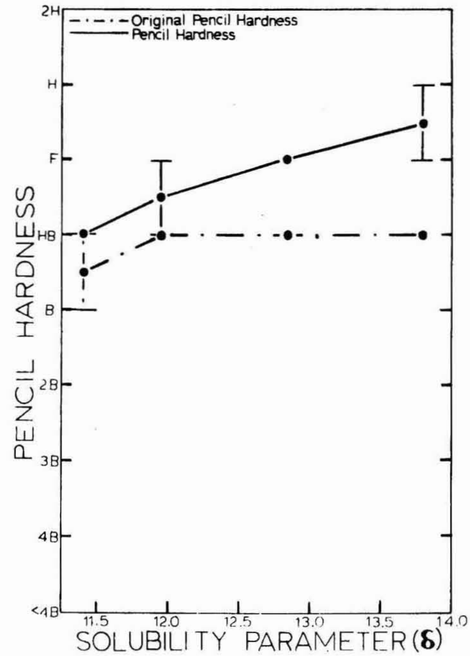


Figure 5—Polymer solubility parameter effect on lubricating oil (δ-8) resistance

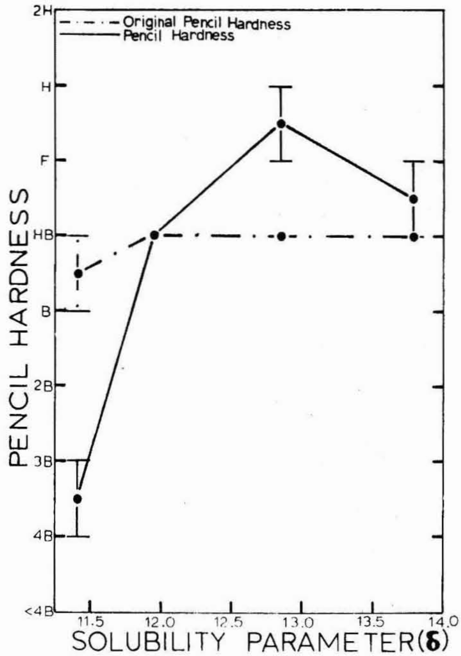
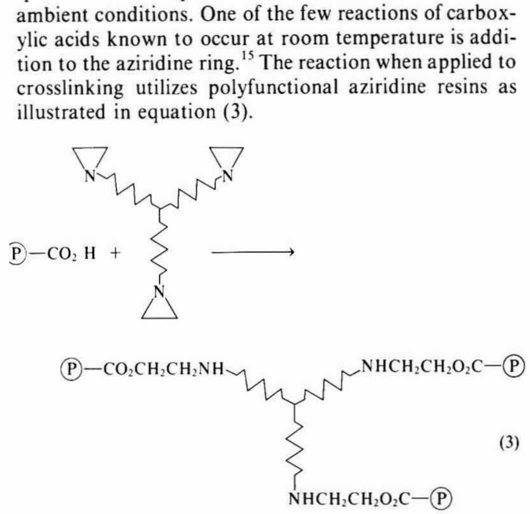


Figure 6—Polymer solubility parameter effect on Skydrol 500B (δ-11) resistance

stabilized by the carboxylate anion. During film formation the amine evaporates along with other volatile components, leaving the free carboxylic acid for subsequent crosslinking chemistry.

Implicit to the other applied film requirements is the specification that performance must be achieved under ambient conditions. One of the few reactions of carboxylic acids known to occur at room temperature is addition to the aziridine ring.[15] The reaction when applied to crosslinking utilizes polyfunctional aziridine resins as illustrated in equation (3).



(3)

ANIONIC DISPERSION PROPERTIES: The series of synthetic acrylic dispersions prepared varied in solubility parameter value from 11 to 14. Attempts to maintain consistent

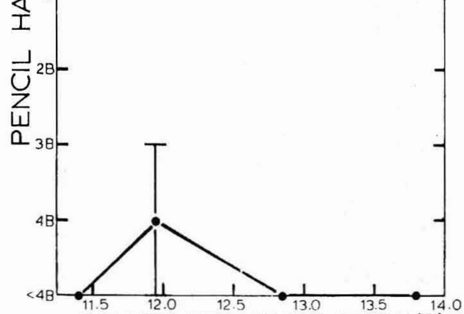


Figure 7—Polymer solubility parameter effect on resistance to deionized water (δ-23)

Table 5—Cationic Acrylic Formulation Properties

	2830-06	2722-198	2830-19	2830-13
Monomer Comp.	BA/MMA/GMA	MA/AN/GMA	BA/AN/GMA	EA/AN/GMA
Solubility param. (δ)	9.7	11.2	12.0	12.4
Amine eq. wt.	1076.5	1047.6	871.6	899.0
Tg°C (est)	30	30	34	59
Epoxy resin[a]	DER 331	DER 331	DER 331	DER 331
Solids, percent	10.2	18.4	9.6	14.7

(a) Dow Chemical Co.

molecular weight and functionality level were made to eliminate any potential effects of these variables on performance. *Table* 3 summarizes the properties of these anionic acrylic formulations.

The formulations were calculated to have stoichiometric amounts of carboxyl and aziridine functionalities. This was to insure consumption of the acid which, if not completely reacted, would provide a site of water sensitivity. Formulation 2722-75a is the only member not utilizing a crosslinking agent. This formulation was prepared to examine the need for crosslinking in the case of specialty resins designed for enhanced chemical resistance.

Formulations 2722-37 and 2722-82 represent an interesting comparison. The polymers are identical with one exception: vinyl acetate (VAc) is substituted directly for methyl acrylate (MA). Since the two monomers are isomeric in atomic structure, group contributions to the total solubility parameter result in the same value for each polymer. The significance lies in the fact that comparative chemical resistance should be achieved with the cost advantage associated with vinyl acetate.

FLUID RESISTANCE PERFORMANCE: The formulations in *Table* 3 were spray applied to treated aluminum substrate, allowed to dry for seven days at constant temperature (23°C) and humidity (50%), and immersed in each test fluid. Fluid resistance was measured in terms of pencil hardness rating. Each coating was given a rating before and after immersion. In order, from hardest to softest, the pencils used are: 4H, 3H, 2H, H, F, HB, B, 2B, 3B, 4B. *Table* 4 describes the fluid resistance performance.

Some entries show two values because all experiments were performed in duplicate. Where different, both values were reported. There appears to be a break-off point in solubility parameter where resistance to Skydrol can be predicted. The break-off occurs somewhere around 12 as evidenced by the performance of 2722-37 ($\delta = 11.4$) and 2722-54 ($\delta = 12.0$). All the resins above solubility parameter 12 display no softening when immersed in Skydrol (or any of the organic fluids). This behavior is consistent with the solubility parameter concept if the value for Skydrol is taken to be as observed around 11 and the others between 7 and 9.

Perhaps the most striking support of this theory is indicated in the performance of 2722-75a. Recall that this formulation was prepared without a crosslinking agent. This resin as a lacquer (not crosslinked) displays resistance to all the organic fluids.

Also worthy of note is the comparative performance of 2722-37 and 2722-82. Both resins have identical solubility parameters but 82 is prepared from less expensive starting materials. The equivalent performance is in agreement with the solubility parameter concept.

The table indicates that all formulations are softened by water. In some cases, such as 2722-75a, this is to be expected. But in most other cases, water softening is unaccountable.

In explaining this anomalous moisture sensitivity, two phenomena may be considered as potential causes. The first phenomenon is incomplete cosolvent evaporation. Since the solubility parameter of the polymers was intentionally higher than conventional acrylics, use of typical water-miscible organic solvents (such as isopropanol and methyl ethyl ketone) for polymer synthesis was precluded. Less conventional (and usually higher boiling) water-miscible cosolvents were required to provide stable aqueous dispersions. As a result, the typical dispersion would be prepared from a polymer solution in which 20% of the solvent would be 2-methyl pyrrolidinone.

Complete evaporation of this high boiling cosolvent is doubtful particularly under room temperature drying conditions. And residual water-miscible solvent in the film may be one cause of moisture sensitivity.

The second phenomenon associated with water softening is incomplete reaction of carboxyl groups. As a system crosslinks, the medium becomes less fluid and the possibility of reactive functional groups approaching each other is reduced. Thus, residual unreacted carboxyl groups can also result in film attack by water.

PREDICTING ANTICIPATED FLUID RESISTANCE: The results of performance as listed in *Table* 4 can be summarized graphically for each fluid. Analysis in this manner enables ready observation of unexpected behavior and simultaneously affords prediction of the solubility parameter required of a resin candidate expected to resist the fluid in question.

Figure 2 represents an idealized curve relating resistance to a particular fluid as a function of resin solubility parameter. As the solubility parameter value of the polymer approaches that of the fluid, softening is expected.

Figures 3 through 7 summarize the results of *Table* 4. Each figure represents the pencil hardness rating after immersion in the indicated fluid as a function of resin solubility parameter. Comparison of this curve to the curve of pencil hardness before fluid immersion indicates the degree of attack by (or resistance to) the test fluid.

In general, performance is as predicted by solubility parameter theory. Water appears to be the only fluid not displaying the expected behavior.

Figure 3 displays the resistance of the series of anionic acrylic aqueous dispersions to MIL-H5606 hydraulic fluid. The curve relates that all members of the series successfully resist this fluid and, in general, that anionic acrylics of solubility parameter greater than 11.5 should resist H5606 hydraulic fluid when formulated with aziridine crosslinking agents.

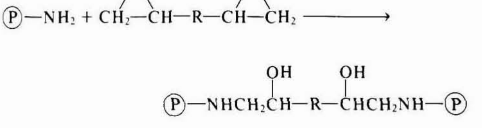
From *Figures* 4 and 5 similar conclusions can be drawn for MIL-TT-S-735 type III hydrocarbon and diester lubricating oil, respectively.

Figure 6 indicates that resistance to Skydrol 500B hydraulic fluid can be anticipated for anionic acrylics with a solubility parameter of at least 12.

Figure 7 relates that all members of the series are attacked by deionized water. As indicated previously, the drastic deviation from expected behavior is believed to be substantially attributed to incomplete consumption of the water sensitive carboxyl functionality in the carboxyl-aziridine reaction.

Cationic Acrylic Aqueous Dispersions

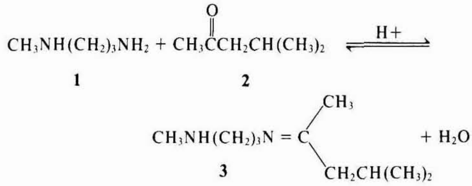
To test the generality of the concept, a series of polymers requiring different crosslinking chemistry was designed. An alternate reaction known to occur at room temperature is the addition of an amine to an epoxide. Amine functionality can be introduced into a polymeric backbone. When reacted with volatile acids, the resultant ammonium cation can stabilize a colloidal dispersion. During film formation, the volatile acid evaporates leaving the free amine for crosslinking chemistry. The crosslinking of polyamines with polyepoxides is shown in equation (4).



(4)

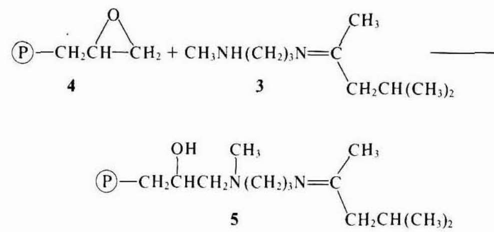
Since the amino group is to react with an epoxy group, primary or secondary amines are preferable to tertiary amines.

Amino-functional Acrylic Copolymers: Acrylic polymers were prepared using glycidyl methacrylate (GMA) to introduce epoxy functionality. The epoxide was then converted to latent amine functionality by addition of a ketimine blocked adduct. This adduct (**3**) was the reaction product of N-methyl-1,3-propanediamine (**1**) and methyl isobutyl ketone (**2**) according to equation (5).

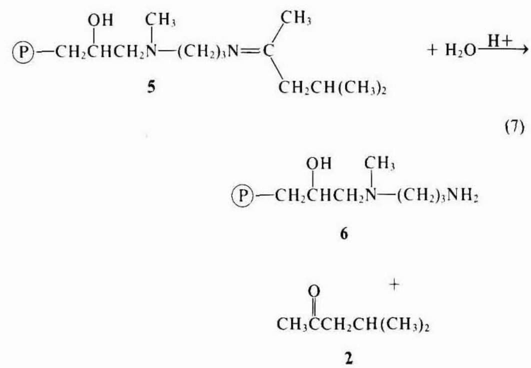


(5)

The sequence of amine addition to the epoxy polymer folowed by ketimine hydrolysis is outlined in equations (6) and (7).



(6)



(7)

Cationic Dispersion Properties: The resultant cationic dispersions generated by the previous sequence were blended with polyfunctional epoxides for crosslinking according to equation (4). The series of synthetic cationic dispersions varied in solubility parameter from 9.5 to 12.5. Attempts were made to maintain molecular weight and functionality levels consistent with those of the anionic acrylic series. *Table* 5 summarizes the properties of these cationic acrylic formulations. The values listed for amine equivalent weight do not appear to be consistent with those of the anionic series. However, upon inspection of the amino-acrylic structure (**6**), two amine groups are found to be present. Since one of these groups is tertiary, it will not participate in direct crosslinking reactions. Thus when adjusted for only the reactive amine, the equivalent weights are consistent.

Fluid Resistance of Cationic Acrylic Formulations: The series of cationic acrylic dispersions was evaluated in a manner identical to that of the anionic acrylics. The dispersions were spray applied to aluminum, dried under constant temperature and humidity, rated for pencil hardness, immersed in the test fluid, and

Table 6—Fluid Resistance of Cationic Acrylic Coatings

Formulation (δ)	Film Thickness, mil	Original Hardness	Lubricating Oil (δ, 8)	Water (δ, 23)	H5606 (δ, 7)	Skydrol 500B (δ, 11)	TT-S-735 (δ, 7.5)
2830-06 (9.7)	0.5–1.0	HB	<4B	<4B	HB	<4B	<4B
2722-198 (11.2)	0.5–0.9	HB	H, 2H	<4B	HB	HB	HB
2830-19 (12.0)	0.7–0.9	HB	F	<4B	HB, F	HB	HB
2830-13 (12.4)	0.5–0.8	F, H	H, 2H	<4B	HB	HB	F

again given a hardness rating. *Table* 6 summarizes the fluid resistance performance of the series of cationic acrylic clear formulations.

The tabulated data indicates that fluid resistance performance for the class of cationic acrylics is as predicted by the solubility parameter concept. Resistance to all fluids except water is achieved with resins having solubility parameter values above approximately 10. Below this value, attack by all fluids except MIL-H5606 hydraulic fluid can be expected.

Although this series does not cover the breadth of solubility parameter values covered in the anionic series, the correlation of performance between the two series appears to be reasonable. For example, Skydrol resistance develops at a value of 12.0 in the anionic series and at a value of 11.2 in the cationic series. This slight deviation may be an artifact of the differences in the nature of the crosslink bond.

PREDICTING THE ONSET OF FLUID RESISTANCE: As was accomplished for the series of anionic acrylics, curves relating fluid resistance in terms of pencil hardness rating to resin solubility parameter were constructed. Comparison of the curves before and after immersion in each fluid can be used to predict the solubility parameter at which resistance is expected. *Figures* 8 through 12 illustrate such curves.

Figure 8 depicts resistance to H5606 hydraulic fluid. An unexpected softening is displayed at 12.4, yet the attack is not very severe (a decrease of about one unit).

Figure 9 indicates expected resistance to TT-S-735 hydrocarbon at around 11. And this curve is generally in agreement with the idealized curve in *Figure* 2.

Resistance to diester lubricating oil can be expected for polymers of solubility parameter above 10.5 as indicated in *Figure* 10.

Figure 11 relating resistance to Skydrol 500B displays

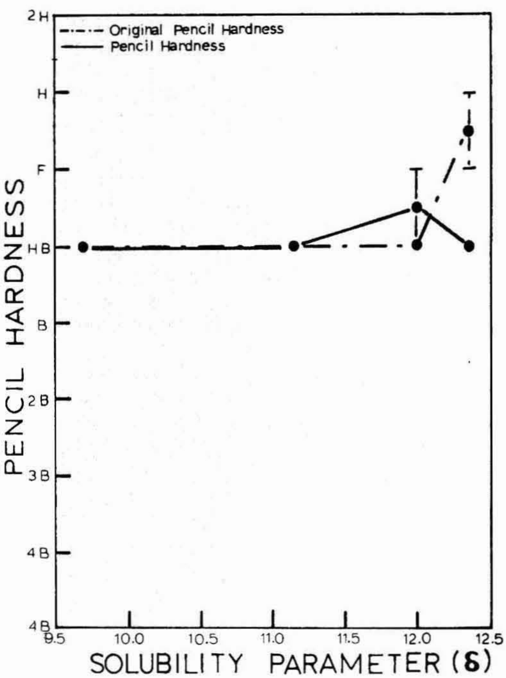


Figure 8—Effect of cationic acrylic solubility parameter on resistance to H5606 hydraulic fluid (δ-7)

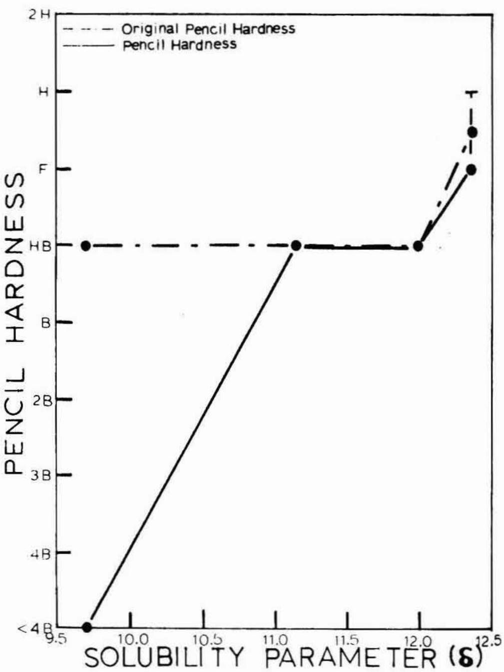


Figure 9—Effect of cationic acrylic solubility parameter on resistance to TT-S-735 type III hydrocarbon (δ-7.5)

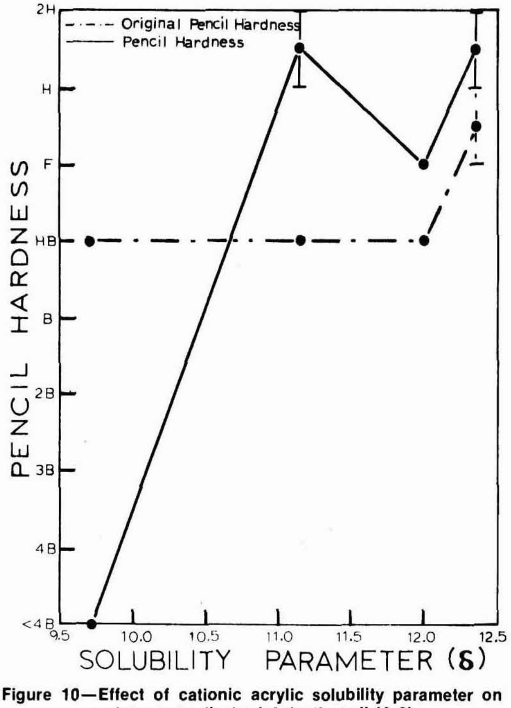


Figure 10—Effect of cationic acrylic solubility parameter on resistance to diester lubricating oil (δ-8)

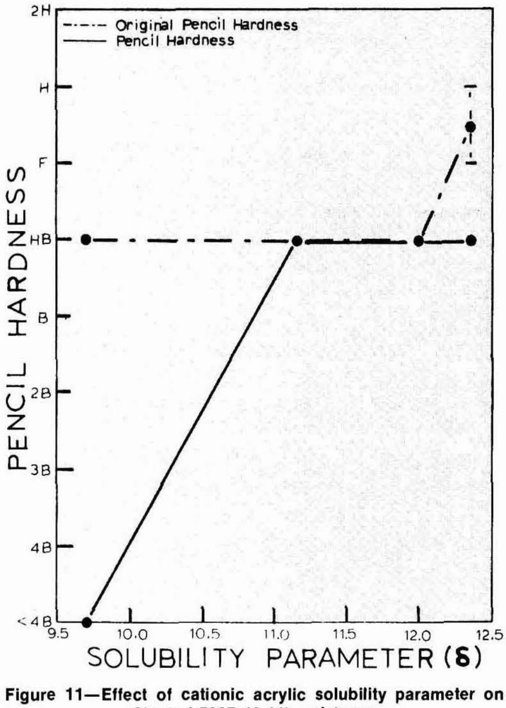


Figure 11—Effect of cationic acrylic solubility parameter on Skydrol 500B (δ-11) resistance

the same unexpected softening at 12.4 as in *Figure* 8 for hydraulic fluid. Other than this anomaly, the curve is similar to ideality and predicts resistance for resins above solubility parameter 11.

Figure 12 indicates that water severely attacks all polymers in the series. As was true for the anionic acrylic series, the case of water evidently does not apply in an assessment of this type.

EXPERIMENTAL

The complete evaluation of the polymers discussed in this report required three distinct processing steps subsequent to design. The polymers were initially synthesized in organic solvent and solution properties (viscosity, concentration, etc.) were recorded. These solutions were then converted to aqueous dispersions and dispersion properties (viscosity, concentration, density, etc.) were recorded. Finally, the dispersions were converted to clear-film formulations by blending with crosslinking agents and film formation aids.

The resulting aqueous formulations were spray applied to aluminum substrate and evaluated as described in the text.

Considering the number of formulations evaluated and the intermediate precursors to each formulation, an extensive experimental section is in order. The data for such a compilation has been included in an annual report released by the U.S. Air Force[5b] which is available through the National Technical Information Service (NTIS). For the sake of brevity, this section will describe the general procedures used in synthesis, dispersion, and formulation.

Synthesis

After design of the hypothetical acrylic copolymers according to solubility parameter considerations, the polymers were synthesized in organic solution. In the case of polymers for cationic dispersion, introduction of amine functionality was accomplished as a separate step by addition of the ketimine precursor **3**.

KETIMINE PRECURSOR (**3**): Into a two-liter single-neck round-bottom flask is weighed 44.1 g of N-methyl-1, 3-propanediamine (**1**, Aldrich Chemical Co.) and 250 mL of anhydrous benzene. To this mixture is then added 55.1 g of urethane grade methyl isobutyl ketone (**2**) and 500 mL of benzene. The solution is then catalyzed with two grams of Dowex® (Dow Chemical Co.) 50W-X8 ion exchange resin.

The flask is then equipped with a Dean-Stark trap and reflux condenser fitted with a drying tube. The solution is then heated to reflux until the stoichiometric amount of water is collected.

The solution is then cooled, filtered, and flash evaporated to a slightly amber colored liquid. The product is stored in an amber bottle under nitrogen atmosphere.

IR (cm^{-1}): 3300 (bd. singlet), N-H; 1655 (sharp singlet), C=N.

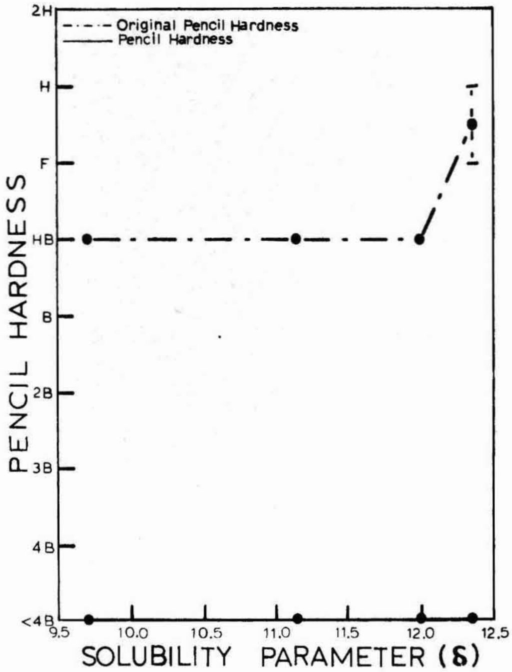


Figure 12—Effect of cationic acrylic solubility parameter on water (δ-23) resistance

CARBOXY-FUNCTIONAL ACRYLIC COPOLYMERS: A four-neck round-bottom flask is equipped with mechanical stirrer, thermometer, reflux condenser and inlet lines for dry nitrogen, monomer feed, and initiator feed. The solvent mixture is then poured into the flask and set under a nitrogen atmosphere. The flask is then immersed in a water bath thermostatically controlled to monitor the internal flask contents. The solvent mixture is then heated to the desired temperature and maintained ± 1°C.

As the desired polymerization temperature is achieved, 10% of the initiator is added to the flask. Addition of monomer is then begun and made to occur at a continuous rate over a three-hour period. The remainder of the initiator is added simultaneously with the monomer but in a separate stream.

The flask contents are held at the desired temperature during addition and a slight positive pressure of nitrogen is maintained.

After addition, the percent conversion of monomer is determined at one-hour intervals adding one gram of initiator until conversion is complete. The polymer solution is then cooled and stored in glass.

AMINE-FUNCTIONAL ACRYLIC COPOLYMERS (**5**): An organic solution of an epoxy-functional acrylic copolymer (**4**) is synthesized by the procedure described above. The epoxy functionality is then verified by titration with perchloric acid in the presence of excess tetraethylammonium bromide.

To the epoxy-functional acrylic solution is then added the stoichiometric amount of ketimine **3**. Addition is made to occur dropwise in 10 minutes under dry nitrogen at 60°C. Periodically, a sample is withdrawn to determine the extent of reaction by titrating the remaining epoxide content. The reaction is terminated by cooling when greater than 90 percent conversion is achieved.

The amine-functional acrylic solution is transferred to glass and stored under a dry nitrogen atmosphere.

Aqueous Dispersion

The acrylic copolymer solutions are converted to aqueous colloidal dispersions by the following general procedure:

The sample is concentrated by flash evaporation under vacuum to increase the nonvolatile content. The sample is then weighed into a tared stainless steel beaker and mixed with a stoichiometric equivalence of neutralizing reagent. For carboxy-acrylics the reagent is triethylamine; for amino-acrylics the reagent is glacial acetic acid.

The solution is mixed under low shear at room temperature using a high speed dispersator until viscosity is consistent. The shear rate is then increased to high speed and water is slowly added in small increments to prevent shock precipitation. Water is added continuously under high speed mixing with increasing viscosity until inversion is indicated by a drastic viscosity reduction. The remainder of the water is added under low speed mixing to the desired nonvolatile concentration.

The dispersion is then filtered through a fine grade paint strainer and stored in glass.

AQUEOUS CLEAR-FILM FORMULATIONS: The aqueous polymer dispersions are converted to clear-film formulations by mixing with crosslinking agents and in some cases film formation aids. The anionic dispersions (carboxy-acrylics) are blended with polyfunctional aziridine resins; the cationic dispersions (amino-acrylics) are blended with polyfunctional epoxy resins.

No special procedure is required for the preparation of these formulations. The materials are merely blended under normal low shear agitation to insure complete mixing. However, since both types of crosslinking agents are slowly hydrolyzed, the final formulation is mixed and filtered immediately prior to spray application.

SUMMARY

Using the method of atomic group contributions, acrylic type polymers of preferred solubility parameter values have been synthesized. A series of carboxy-functional polymers was prepared, dispersed into aqueous medium, and formulated as anionic water-based coatings. Similarly, a series of amine-functional polymers was evaluated as cationic aqueous coatings.

Results indicate that the solubility parameter concept is useful in predicting polymeric resistance to a variety of organic fluids. However, water is apparently a special case. Effects other than solubility may be more significant in predicting resistance to water.

Results also indicate that the solubility parameter concept is useful in identifying alternative choices for polymers serving a particular application.

ACKNOWLEDGMENT

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The study was presented in part at the 182nd Annual Meeting of the American Chemical Society, August 1981. The content is reprinted by permission of the editors from R.B. Seymour and G.A. Stahl, "Solvent-Property Relationships in Polymers," Pergamon Press: Elmsford, New York, 1982.

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OPEN FORUM

Density Method for Determining The CPVC of Flat Latex Paints

Fred B. Stieg

Pigmentech Consulting*

Introduction

It has long been recognized that the CPVC of a paint system may be described as that formula PVC above which air begins to enter the dry paint film due to a deficiency of binder.[1] Various performance characteristics of the dry film are affected to varying degree as the formula PVC passes through this critical area. Among them are tensile strength, stain penetration, water vapor permeability, exterior durability, enamel hold-out, and hiding power. Obviously it is important to know the CPVC, even though its primary use may be that of a reference point—very few practical coatings actually being formulated at the CPVC itself.[2]

Numerous methods have been proposed for identifying the CPVC, most of them employing PVC-ladders to observe the effect of PVC change on one or more of the performance characteristics previously mentioned. Since not all of these characteristics respond to the same threshold level of film porosity, the determination of CPVC by such methods is necessarily imprecise—sufficiently so to lead at least one investigator to postulate that the CPVC concept is not applicable to latex paints.

Although Asbeck and Van Loo's original publication employed the variation of some film characteristics associated with porosity (vapor permeability, blistering, and rusting) for illustrative purposes, the CPVC was defined only in terms of the absence of air in the voids left between pigment particles after the evaporation of all volatile. It would therefore seem that much of the uncertainty resulting from the described PVC-ladder studies might be avoided by the actual determination of air content by film density measurements.

The determination of CPVC from film density measurements is not a new idea, but its appeal has been limited by the fact that the procedures suggested to date have still involved the preparation of PVC ladders.[3] The present paper describes the elimination of this objection through the application of a new graphical technique.

Procedure for Density Measurements

The determination of dry-film density may be performed by several methods, but the author prefers a modification of the technique employed in ASTM D 2805 for the determination of film thickness.

A thick film of paint is applied by drawdown blade to a glass panel and allowed to dry thoroughly. A rectangular metal template, having a minimum area of 20 sq in., is then placed in contact with the dry film and held firmly in position while the surrounding paint film not covered by the template is carefully scraped away with a razor blade. The thickness of the remaining paint film is then measured at random points on all four sides, using an optical microscope, and the results averaged. Finally, the paint film is scraped off the glass into a weighing dish, and weighed on an analytical balance to the nearest 0.1 mg.

This weight, divided by the volume obtained by multiplying the area of the template by the average thickness of the dry film, is the apparent density, D, in gm/mL. The theoretical density, D_t, is obtained by calculating the weight per gallon of the formula nonvolatile content, and multiplying by 0.11983 to convert to gm/mL. The percentage of air in the dry film then may be calculated using the following equation:

$$\%\ \text{air} = \frac{D_t - D}{D_t}$$

Graphical Treatment of Data

If the composition of the dry paint film is represented by a point on a triangular graph, as in *Figure* 1, a number of informative relationships becomes apparent. In this instance, the chosen formulation is an acrylic flat latex paint pigmented at 60 PVC.

On this graph, the composition of the paint will be located somewhere on a line drawn from the "100% Air" apex of the triangle to its pigment/binder base at a point 60% of the distance between "100% Binder" and "100% Pigment". The mathematics are such that any formulation pigmented at 60 PVC must fall upon this same straight line. The specific location of the chosen formulation along this line is established by the percentage of air in the dry film as determined from density

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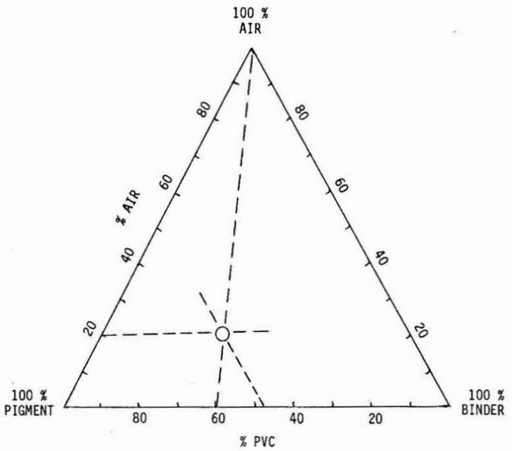

Figure 1—Location of tested dry film

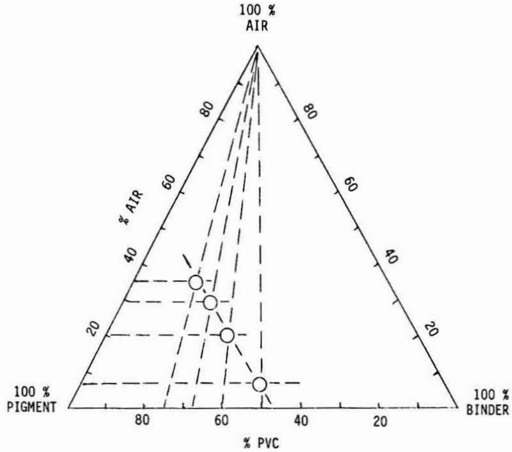

Figure 2—Similarity of CPVC′ for different PVC's

measurements—in this instance, 20% by actual determination.

Since any paint film at the CPVC will, by definition, contain no air, its location on such a graph—regardless of PVC—will fall on the pigment/binder base-line. The CPVC of the chosen formulation may be found by drawing a straight line at constant percent pigment from the point representing its composition to this base-line. The intercept occurs at 48% pigment, which is also the CPVC of this flat latex paint.

Logically this relationship must exist, because the voids left between pigment particles are not altered in volume by the degree to which they are filled or not filled with binder. Air simply replaces binder, or vice versa, as the formula PVC is changed.

To determine whether this will necessarily be true in practice for a particulate binder such as the acrylic latex used in the chosen formulation, additional paints were prepared using the same pigmentation at 50 PVC, 67.5 PVC, and 75 PVC, and the air content of their dry films determined. The results are plotted on the triangular graph of *Figure* 2, the four points forming a reasonably straight line, as predicted, at a constant pigment concentration of 48%, since the CPVC of a paint system is not changed by the PVC at which it is formulated.

Determination of Porosity Index

The porosity index has been defined as the percentage of air in the air/binder mixture which comprises the dispersion medium for the pigment after all volatile has evaporated.[4] The composition of this mixture determines its refractive index, and therefore also determines the amount of high dry-hiding that will be developed by a given amount of titanium dioxide. This factor is of critical importance when attempting to match the hiding power and tinctorial strength of an existing formulation.

For a latex paint system, the porosity index has been assigned the symbol "LP" (for latex porosity), and may be calculated using the following equation if the pigmentation CPVC and the binding power index ("x") are both known:[5]

$$LP = 1 - \frac{CPVC\,(1 - PVC)}{PVC\,(1 - CPVC)}\,x$$

where CPVC = pigmentation CPVC from oil absorption
PVC = formula PVC
LP = latex porosity (% air in medium)
x = binding power index

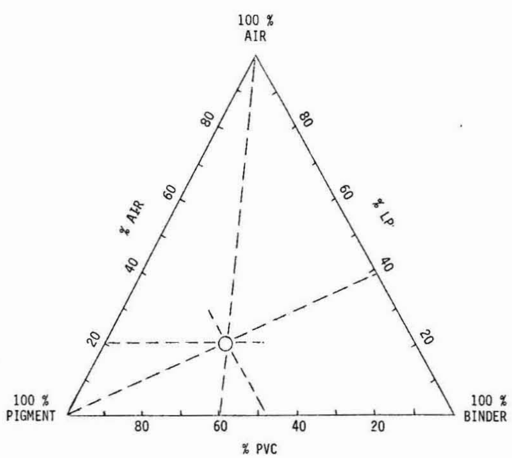

Figure 3—Location of latex porosity (LP)

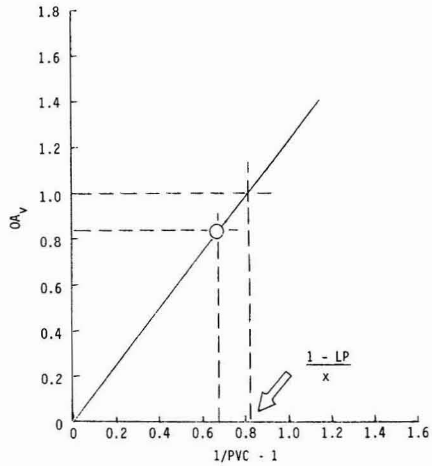

Figure 4—Locus of equal porosity for tested film

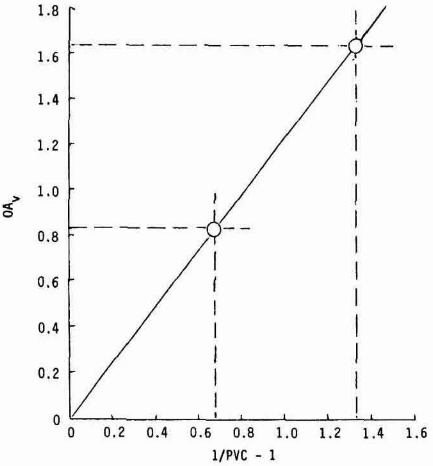

Figure 5—Effect of higher oil absorption on PVC

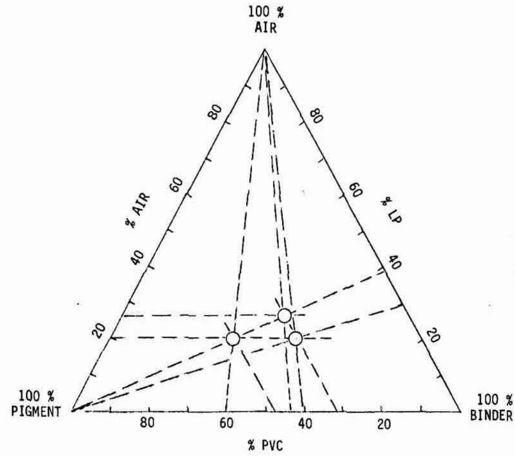

Figure 6—Effect of higher oil absorption on CPVC′ and LP

More often than not, the binding power index is not known for the latex vehicle to be used, and its determination involves the preparation of the same type of PVC-ladder study that the present procedure has been designed to avoid.

If, however, the CPVC of the latex paint system (CPVC′) is known, the term "x" may be eliminated from the equation:

$$LP = 1 - \frac{CPVC' \, (1 - PVC)}{PVC \, (1 - CPVC')}$$

Where CPVC′ = CPVC of latex paint system

Throughout the remainder of this paper, the term "CPVC′" will refer to the CPVC of the latex paint system.

Returning to a plot of the previously described 60 PVC formulation on the triangular graph of *Figure* 3, it will be seen that a straight line drawn through the plotted point from the "100% Pigment" apex of the graph to the opposite side will intersect that side at a point indicating that the nonpigment portion of the dry film contains 38.5% air, 61.5% binder—or in other words, that LP = 0.385.

This may be confirmed using the value of CPVC′ = 0.48 previously read from the graph of *Figure* 1:

$$LP = 1 - \frac{0.48 \, (1 - 0.60)}{0.60 \, (1 - 0.48)}$$

$$= 0.3846$$

Binding Power Index

Berardi[6] defined the "binding power index" as the ratio of the volume of oil required to completely wet and fill the voids of a given amount of pigment, to the volume of emulsion solids required to bind the same amount of pigment.

It is probably unfortunate that the concept of "binding"—with its implication of some relationship to adhesive and cohesive forces—was ever introduced, inasmuch as it seems to have confused some members of the academic community, one of whom has condemned the binding power index as "embodying all that we do not know about the film formation of latex paints," despite its demonstrated usefulness to the paint formulator.

The term "x" may be just as correctly described as a ratio of the volume of oil per unit volume of pigment at the CPVC of an oil-base system to the volume of emulsion solids per unit volume of pigment at the CPVC (CPVC′) of a similarly pigmented latex system—which might be shortened to the ratio of volumetric oil absorption (OA_v) to volumetric "latex absorption".

If the volumetric oil absorption of the pigmentation of the 60 PVC flat latex paint of *Figure* 1 is determined,[2] it is possible to use another graphical method to provide a numerical value for "x" without further testing of the latex.

In *Figure* 4, the determined value of OA_v (0.819) for this pigmentation has been plotted vs 1/PVC − 1 (1/0.60 − 1 = 0.667) and a straight line drawn through the plotted point from the 0-0 origin of the graph. The mathematics are such that all formulations produced with the same latex vehicle and possessing the same optical porosity (LP) will fall upon this "locus of equal porosity", and the value of (1 − LP)/x may be read off the 1/PVC − 1 axis for OA_v = 1.0 − in this instance, a value of 0.814.

Since (1 − LP) = 0.615 from *Figure* 3, 0.615/0.814 = 0.756 = x for the latex used. This may be verified using an equation developed to obtain the value of "x" by Schaller's optical method[7]:

$$x = \frac{PVC_o \, (1 - CPVC)}{CPVC \, (1 - PVC_o)}$$

where CPVC = pigmentation CPVC from oil absorption
PVC_o = CPVC′ for latex system

Since $OA_v = (1 - CPVC)/CPVC$, this equation may be restated as:

$$x = OA_v \frac{CPVC'}{(1 - CPVC')}$$

$$= \frac{0.819 \times 0.48}{0.52}$$

$$= 0.756$$

Optical Porosity vs Total Porosity

While it will be apparent that both optical porosity (LP) and total porosity (% air) are equal to zero at the critical PVC of a latex paint system (CPVC′), the relationships disclosed by the triangular graphs indicate that either one of these factors may be varied while the other remains constant by manipulating pigmentation oil absorption and formula PVC.

If for example, the pigmentation of the 60 PVC flat latex paint is modified so as to increase its volumetric oil absorption (OA_v) to 1.638, the graph of *Figure* 5 shows that the optical porosity of the original formulation may be matched at a formula PVC of approximately 43% (1/PVC − 1 = 1.333).

The location of this modified flat latex paint is found on the triangular graph of *Figure* 6 at the intersection of the 43 PVC line with the 0.385 LP line established by the original 60 PVC formulation in *Figure* 3. Its location shows that although optical porosity has been matched, total porosity (% air) has been increased to 26%—an increase of 30% over the porosity of the original film.

Since the slope of the LP line must always be upward, toward the right-hand side of the graph, for any formulations above the critical PVC, the level of total film porosity required to generate a given level of high dry-hiding (assuming that titanium dioxide content and the dilution factor remain constant) will always be greater at a lower PVC than at a higher. This may at first appear contrary to the common conception of some general relationship between formula PVC and dry-film porosity, but has in fact been verified experimentally, using stain penetration as an index of film porosity (ASTM method D 3258).

It seems logical to expect that the variation of performance characteristics such as stain penetration, vapor permeability, and enamel hold-out will be more closely related to relative total porosity than to relative optical porosity, which suggests that formulations to be matched for overall performance might better be formulated at equal total porosity.

To find the PVC at which the higher-oil-absorption pigmentation will match the total porosity of the original 60 PVC flat latex paint, it is only necessary to drop down its CPVC′ line (approximately 32 PVC) to its intersection with the 20% air line on the graph of *Figure* 6, and then draw a straight line from the "100% Air" apex through this point of intersection to the pigment/binder baseline. For this system, the required PVC is approximately 40%.

For this PVC, a dry film containing 20% air is shown by the graph to develop an optical porosity of only 29%, as compared to the original 38.5%, predicting a loss of high dry-hiding.[8]

This is an extreme example, since the PVC difference that may be tolerated when matching flat latex paints seldom exceeds 10 percentage points, yet the PVC variation between an optical porosity match and a total porosity match is still relatively small (43 PVC vs 40 PVC). Considering the lack of precision in many paint laboratory test procedures, it is not surprising that optical and total porosity may not have been clearly differentiated in the past.

In practice, however, the matching of optical porosity remains the preferred procedure, since tinctorial strength (or white hiding power) is a quality criterion both recognized by the ultimate consumer and of importance to the paint manufacturer concerned with the performance of his product in a color system. The problems most often encountered involve the replacement of high-oil-absorption pigmentations with lower-oil-absorption combinations so that PVC's may be raised to reduce costs, and under these circumstances a tinctorial strength match will be accompanied by a slight improvement in film porosity. If on the other hand, an attempt were made to match total film porosity, the manipulations required to reinstate a hiding power match become somewhat complicated.

Summary

It has been demonstrated that determination of the air content of a dry latex paint film, derived from density measurements, combined with a graphical analysis of the data, will provide numerical values for both the critical PVC of the tested paint system (CPVC′) and its porosity index (LP). The additional determination of the pigmentation's volumetric oil absorption (OA_v) permits calculation of the latex vehicle's "binding power index" (x). The need for PVC-ladder preparations is completely eliminated.

The values obtained by the described graphical methods are quite easily verified mathematically, using the following three equations:

$$CPVC' = PVC\,(1 - \%\,air) \quad (1)$$

$$LP = \frac{\%\,air}{(1 - CPVC')} \quad (2)$$

$$x = \frac{OA_v}{1/CPVC' - 1} \quad (3)$$

The greatest value of the graphical approach is the clear picture that it provides of important volume relationships in a porous latex paint film.

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Society Meetings

BALTIMORE VIRGINIA SECTION — OCT.

"Colorants as Additives"

Dr. Martin Feldman, of Tenneco Chemicals, Inc., discussed "COLORANTS AS ADDITIVES."

Dr. Feldman presented a broad overview of the wide variety of colorants available to the paint industry today. He said that pigments of every kind are dispersed in a wide variety of vehicle types by colorant manufacturers. They offer systems tailored for in-plant addition to any possible coating product, as well as tinting systems available for color tint base systems, which allow in-store tinting of thousands of colors from only three tint bases of various strengths. The precise color and grind tolerances of pigment colorants offer further advantages to paint manufacturers, explained Dr. Feldman.

MICHAEL J. BECKER, *Secretary*

Baltimore Society Officers for 1982–83. (Left to right): Society Representative—James McCormick; President-Elect and Acting Secretary—Joseph Giusto; President—Donald Keegan; Former Secretary—Edward Countryman; and Treasurer—Robert Hopkins

BIRMINGHAM — OCT.

"Election of Officers"

The following officers were elected for 1982–83: President—Raymond B. Tennant, of Carr's Paints Ltd.; President-Elect—Harry J. Griffiths, of Postans Paints Ltd.; Secretary—Don H. Clement, of Holden Surface Coatings Ltd.; and Treasurer—Stan V. Brettell, of Llewellyn Ryland Ltd.

DON H. CLEMENT, *Secretary*

BIRMINGHAM — NOV.

"Coil Coatings"

Michael Foot, of Berger Paints, discussed "COIL COATINGS."

Mr. Foot's talk, illustrated with slides and transparencies, began with a discussion of a variety of finished products shown in situ, illustrating the large amount of deformation required of most coil coatings.

From a start with a venetian blind narrow strip in the United States, the U.S. market has grown by 16–17% per annum. In 1980, 4 million tons of metal was processed in the U.S., compared with 1,200,000 tons in Europe. This latter figure represents 284,000,000 square metres, split 2:1 between steel and aluminum, explained Mr. Foot.

A description of the principal elements of a coil coating line was presented along with a comparison of the properties of the principal resin types: alkyd; acrylic; polyester; vinyl plastisol; silicone polyester; and polyvinylidene fluoride.

According to Mr. Foot, the benefits of coil coatings were energy savings, space savings, low pollution levels, low insurance premiums, capital expenditure savings, and low manpower requirements.

Mr. Foot predicted that plastisols and polyester were the current growth areas, with water-based coatings stronger in the U.S. than in Europe, but with good long term prospects.

Q. What is the state of radiation cured coatings for coils?

A. There is no likelihood of these being used in the short term.

Q. How big is the UK market in £'s?

A. I would guess at £8–10 million.

Q. What proportion of the paint market does British Steel represent?

A. 75–80%.

Q. What happens at potential corrosion sites on the cut edges of coils?

A. They are folded away during manufacture so that they are not exposed.

Q. What happens if a coil blocks solid?

A. You claim from whoever is responsible, and send the coil to be smelted down.

Q. Are the benefits listed really available? For example what if you want grey when British Steel is making blue?

A. The advantages are not available to the small user with his own existing painting facility. The benefits listed are available to the large volume purchaser.

Q. Is the market still growing, and what is its future?

A. The market has been static in Europe, though still growing in the U.S. Growth can be expected to resume when the recession eases.

Q. Is the caravan market usually for one or two coats of paint?

A. Usually one coat in the UK, on an aluminum substrate.

Q. What film thicknesses are usual?

A. For caravans, 25 microns. For cladding, 5–7 microns of primer with 25 microns of PVDF or 50 microns of organosol or 100–250 microns of plastisol.

Q. Why is there such a wide variation in coating weights?

A. This is basically inherent in the

Thomas W. Mitchell (right), of Tenneco Chemicals, Inc., presents traditional Tenneco gavel to Donald Keegan, President of the Baltimore Society, 1982–83

coating types, e.g. it is very difficult to apply less than 100 microns of plastisol, and this is the minimum which can be embossed.

Q. Do you experience problems of color development in polyesters?

A. We have them and have overcome them.

Q. What do you see for the future in high solids coatings and in lower curing times and temperatures?

A. The current route to high solids is via polyesters, with the attendant problems of application, hardness, and flexibility. Water-based coatings or powder dispersions probably hold more promise in the long term. Lower curing is already being achieved as polyesters replace acrylics, but again water-based coatings are probably the longer term solution.

DON H. CLEMENT, *Secretary*

C-D-I-C OCT.

"Grinding and Dispersing Equipment"

A moment of silence was observed in memory of Larry Bing, of Wilson Paint Co. and Paul Marling, the society's oldest retired member.

John B. Deye, of Cincinnati Gas and Electric Co., gave a talk about the William H. Zimmer Nuclear Power Station, Moscow, OH.

Arno Szegvari, of Union Process, Inc., discussed "ATTRITOR GRINDING AND DISPERSING EQUIPMENT."

Mr. Szegvari described the Szegvari Attritor as a most efficient grinding mill with the capability of grinding pigment particles down to two to three microns. The attritor grinding action is achieved, explained Mr. Szegvari, by impact and shear imparted by the vertical rotating shaft, with horizontal arms, which forces the grinding media to tumble randomly through the whole tank volume causing irregular movement.

Grinding media generally used are carbon steel, chrome steel, stainless steel, ceramic, glass, and flint stones, said Mr. Szegvari.

Three types of attritors are available: batch, continuous, and circulation. In the batch attritor, the material is fed into the jacketed tank, ground for a certain length of time until the desired Hegman grind is reached. In the continuous attritor, a premixed slurry is pumped into the bottom of a tall, narrow jacketed tank and discharged at the top, explained Mr. Szegvari. Grids are located at the bottom and the top of the tank to retain the media. The fineness of grind depends on the retention time on the grinding chamber. This "dwell time" is controlled by the pumping rate. In the circulation system, a large holding tank, 10 times the size of the grinding unit, is operated in conjunction with the attritor, said Mr. Szegvari. The contents of the holding tank are passed through the attritor about 10 times per hour until the desired grind is reached.

According to Mr. Szegvari, the attritor is simple and safe to operate. It gives good temperature control, low power, and low maintenance cost.

DAVID C. KINDER, *Secretary*

GOLDEN GATE OCT.

"Specialty Computer Program"

President Robb Holt presented 25-year pins to Dave McGuire, of Cook Paint & Varnish Co., Ed Baker, of Glidden Coatings & Resins, Div. of SCM Corp., Earl Teilman, and Ted Gilbert.

Bob Minucciani reported that the Environmental Committee has been closely monitoring state programs related to our industry. He stated that the meeting with the BAAQMD regarding labelling requirements of architectural coatings resulted in changes that should allow the use of most companies' current labels. Mr. Minucciani also reported on the recent list of Toxic Air Contaminants and Carcinogenic Substances established by the Air Resources Board.

A moment of silence was observed in memory of Harold Brez, of Ishiara Corp., Harry Boerst, and Herb Pratt.

"SPECIALTY COMPUTER PROGRAM AIMED AT SMALL PAINT AND COATINGS MANUFACTURERS" was presented by Fred M. Honeck, of Universal Micro Systems.

Mr. Honeck stated that the advantages of computers are speed and accuracy. Computers do not make mistakes.

The most important part of a computer installation is the software. The advantage of using canned software vs. custom software is that the canned software can be put to immediate use, explained Mr. Honeck. Any changes required in canned software programs can usually be made with a limited effort. Custom software, in addition to taking time to develop, can be very expensive. Use a consultant in selecting both hardware and software, recommended Mr. Honeck. It will save you money in the long run. The cost of setting up the proposed system with micro computer will run $15,000 to $20,000.

ROBERT MILLER, *Secretary*

HOUSTON OCT.

"Driers for Water-Borne Coatings"

Ray Hurley, of Tenneco Chemicals, Inc., presented "DRIERS FOR WATER-BORNE COATINGS."

Mr. Hurley reviewed the basic aspects of drier technology. Metal types were classified as active or auxiliary and the typical drier acids were illustrated. Several slides showed comparable performance between driers containing synthetic acids and naphthenic acid. The main purpose of the acid in the drier is to render the metal soluble in the vehicle, explained Mr. Hurley.

Drier recommendations for three classes of water-borne coatings were presented: alkyd modified latex, water-dispersible alkyds or urethane, and water-soluble alkyds. Although conventional driers give good results in alkyd modified latex, water-dispersible driers and a precomplexed form of cobalt were suggested by Mr. Hurley for water-dispersible or water-soluble alkyds. The use of precomplexed cobalt prevents deactivation by ammonia, primary, or secondary amines. Also, for maximum stability the importance of pH control was stressed.

R.D. BATCHELOR, *Secretary*

KANSAS CITY OCT.

"Chlorinated Solvents"

Steve Collier, of Dow Chemical Co., discussed "CHLORINATED SOLVENTS—THE SOLVENT OPTION FOR LOW VOC COATINGS."

Mr. Collier explained the several ways to meet the VOC (Volatile Organic Compounds) emission guidelines set up by EPA as a result of the Clean Air Act. Included in these are high solids, waterborne, powder, and radiation-curable coatings. The additional option available is the use of compliance chlorinated solvents, 1,1,1-trichloroethane and methylene chloride. These solvents offer many advantages to coatings, according to Mr. Collier. These include:

(1) Fast evaporation rates—can speed dry times of coatings.
(2) Non-flammable—can increase flash point of other solvents.
(3) Can be used with current resins and pigments.
(4) Non-photochemical reactivity—exempt as VOC by EPA and many but not all states.
(5) No indication of carcinogenic, mutagenic, or teratogenic risk.
(6) High OSHA exposure limits—TLV of 350 ppm for 1,1,1-trichloroethane and 500 ppm for methylene chloride.

These solvents can be added to high solids coatings as a reducer with no increase in VOC, explained Mr. Collier. They are used in low solids coatings formulations to get compliance, while the rest of the solvent can be used to adjust dry time for proper application.

The 1,1,1-trichloroethane and methylene chloride solvents should not be used in aluminum equipment, stressed Mr. Collier. Aluminum is a reactive metal which reacts with many things, including chlorinated solvents.

The chlorinated solvents have a very fast evaporation rate which limits their use in brush, roll, and some coil coating operations. These solvents thermally degrade above 400°F to hydrochloric acid and should not be used in welding areas or near open flames.

In conclusion, the reasons chlorinated solvents would benefit coatings formulations are, according to Mr. Collier: (1) exempt in many states; (2) safety; (3) use of current resins with similar performance; (4) faster dry times; (5) minimal or no retraining for application of coatings; and (6) economical when compared to other compliance methods.

Q. What is inhibited 1,1,1-trichloroethane?

A. It is a stabilized or inhibited version of 1,1,1-trichloroethane that will not react with aluminum. Unfortunately, in some formulations, there are ingredients which destabilize these solvents.

Q. Can these solvents be reclaimed?

A. Yes, but unless they are completely segregated, they could only be used for clean-up and not for compliance.

Q. How hazardous is the waste from coatings containing chlorinated solvents?

A. Since the solvents are low in toxicity, do not flash or burn, and they are not carcinogenic, they may not be classed as hazardous waste. This should make disposal a lot easier.

GENE A. WAYENBERG, *Secretary*

LOS ANGELES OCT.

"Computer Program"

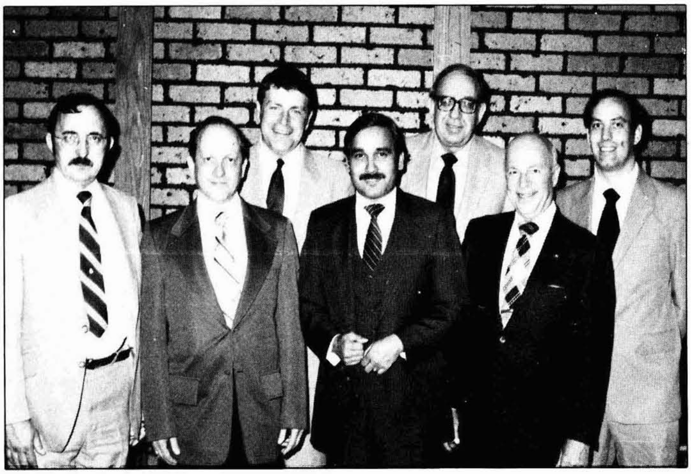
A moment of silence was observed for the passing of Art Fredrick, of Fredrick-Hansen Paint Co., and Jack Kennedy, former President of Amsco.

Ken Morrow discussed that the EPA is sending out survey forms to small generators of hazardous wastes. Also, he announced that a workshop had been scheduled for rule #304.

Frank Belt, of L&B Painting Co., spoke on a Political Action Committee that has been established to help paint contractors and paint manufacturers get favorable legislation.

Fred Honeck, of University Micro Systems, discussed "A COMPUTER PROGRAM AIMED AT THE SMALL PAINT MANUFACTURER."

His program included not only the lab functions, but also the accounting functions. Mr. Honeck discussed that the lab must produce materials and calculate costs to help the sales department, but, the accounting department has the primary function; therefore a computer program should interphase the accounting and lab functions.



1982-83 Officers of the Cleveland Society. (Front row, left to right): Secretary—Raymond Podlewski; Past-President—Carl Knauss; President—Girish Dubey; and President-Elect—Harry Scott. (Back row): Treasurer—Richard Horger; Society Representative—Fred Schwab; and Assistant Treasurer—Robert Thomas

1982-83 Officers of the Detroit Society. Standing (left to right): President—Stephen Vargo and President-Elect—Charles Collinson. Seated (left to right): Secretary—Peter Burnett; Treasurer—William Passeno; and Society Representative—Harry Majcher

Mr. Honeck pointed out that the success of the program would depend on available softwear and mentioned the subdivision of programs operating systems and application systems. To keep the cost within reasonable cost for a small manufacturer, it will be necessary to attempt to find an existing basic softwear, explained Mr. Honeck. The hardware used should be from a manufacturer that is established. Components chosen that are available, can be easily serviced. He pointed out that before buying a system it is very important to ascertain exactly what you need including a consultant that can help you create a specific to cover your exact needs.

Slides showed the various hardware systems, and showed in detail, the type of work done by available software.

Q. What kind of protection do you have in your system to keep the operator from accidently wiping out your files?

A. Each operator has his own password and his own file, and it is set up so that he can only delete his own file but not a common file. Also, a privilege level is set up so that only an operator with a certain level can get into the files at that level.

Q. Have you tested the TP-1 Printer and how did it work out?

A. I did not test this Smith Corona Printer. I did find some 1200 printers that gave letter quality printers.

Q. Can you use your system for color work?

A. The work described are multifunction systems. I feel color work should be dedicated to a complete system by itself.

Q. Approximately what is the minimum amount of data at which point computers will be beneficial?

A. If you handle repetitive calculations in your lab and you have 50 formulas which you use within one month where it is necessary to upgrade costs, then the computer will be in line.

Q. Can a formulator enter the components of a formula, but omit some of the amounts of some ingredients, then ask the computer to finish the formula to a specific nonvolatile content? Can it be used to calculate VOC?

A. No, but a special program can be written to do this.

MICHAEL GILDON, *Secretary*

MONTREAL SEPT.

"Finishing and Spray Equipment"

President John Flack, of International Paints Ltd., introduced the 1982–83 officers: Vice-President—Bert Papenburg, of Canada Colors & Chemicals; Secretary—M. Megelas, of International Paints Ltd.; and Treasurer—D.J. Yokota, of Indusmin Ltd.

J. Coveney, of Graco Canada Inc., discussed "FINISHING AND SPRAY EQUIPMENT USED TODAY."

The evolution of paint application from brushing to electrostatic airless atomization was briefly surveyed. The underlying principles of each application technique were discussed. Both the advantages and the shortcomings of each were analyzed by Mr. Coveney.

The major development occurred in 1944, said Mr. Coveney, when Ransberg used the repulsion forces of similar electrostatic charges in a fluid to produce an extremely fine mist. This was achieved by placing a 100 KU charged wire in the course of the paint stream. The substrate was oppositely charged, whereas atomization was very fine. The range was too short.

Four years later, Ransberg came out with a second invention, according to Mr. Coveney. This time a rotating disc was used to disperse the extremely fine mist and to give it a longer range. Thus, 99% transfer efficiency could be achieved over conventional atomization.

Others followed with improvements, such as the replacement of the disc by a bell, etc., said Mr. Coveney. By late 1950 another significant development arrived on the scene. Airless spray application was invented. Since, better and more powerful pumps were built, according to Mr. Coveney.

Today's equipment can handle such viscous fluids as coal tars and high build systems, said Mr. Coveney. The mixing ratios are now accurate to the point where delicate and critical systems can be applied (up to 16:1). Urethanes and other fast curing paint systems do not present problems anymore. Mixing of the two components is done very close to the nozzle. The use of equipment is thus extended greatly between clean-ups. Only the gun needs to be flushed at work stoppage.

Electrostatic atomization has also been combined with airless applications, said Mr. Coveney.

Two very serious limitations existed, according to Mr. Coveney. The first is Faraday's cage, which made it difficult to coat articles with cavities or with corners and sharp edges. The solution consisted of delaying the electrification of the substrate until the fine mist is evenly distributed around in the cloud chamber, and into the cavities of the article. The second related to the water-based systems. The solution here necessitated the removal of the operator from the vicinity of the gun of the pumping and circulating system. Very high voltages have to be used as the presence of water dissipates the polarity.

Now equipment is made of stainless steel and can handle any type of solvents, thus overcoming the earlier limitations. It also comes in a variety of sprayers; the Ransberg disc which is very efficient on large areas and the bell type or rotating head which is superior for straight line spraying, explained Mr. Coveney. Automated equipment to suit every need is either available or could be made available.

Mr. Coveney made reference to an excellent article in *Coatings* magazine describing the availability and variety of finishing and spraying equipment.

M. MEGELAS, *Secretary*

MONTREAL OCT.

"Sedimentation of Suspensions"

Honored guests included Federation staff members: Executive Vice-President, Frank Borrelle; Director of Field Services, Thomas Kocis; and Director of Meetings, Rosemary Falvey.

Luigi Cutrone, of Tioxide of Canada, Ltd., and Chairman of the Technical Committee, discussed "SEDIMENTATION OF SUSPENSIONS."

Sedimentation, an undesirable phenomenon frequently encountered in surface coatings, is an area in which there is very little knowledge, hence, very difficult to predict, explained Mr. Cutrone. In order to get a better understanding, a method described by P.E. Pierce was investigated. The method utilizes a Brookfield Viscometer, a special measuring procedure, a computer processing of the Brookfield data, and a casson equation to obtain the yield value which is used to predict settling, said Mr. Cutrone.

M.C. MEGELAS, *Secretary*

NEW ENGLAND OCT.

"Colorant Formulation"

President John Fitzwater, Jr. announced that the society had tied for first place for the MMA Award, which recognizes notable achievements by constituent societies of the Federation. The society's achievement was based upon the Coatings Tech Expo '82. Past-President Robert G. Modrak and the Expo '82 Chairman Robert Marderosian were recognized for establishing this program.

Thomas Manning reviewed upcoming new hazardous waste rules effective in 1982–83. Mr. Manning recommended that all companies subscribe to "Waste Management Report" (Massachusetts).

"COLORANT FORMULATION" was discussed by Joseph Kettenacker, of Ciba-Geigy Corp.

A review of pigment selection techniques was presented. Mr. Kettenacker detailed computer color matching for individual color matches, pigment replacement evaluations, and simulation of various proposed formulations. He focused on chromaticity diagrams. Chromaticity coordinates of a pigment in a tint series can be generated, based on stored optical data, and plots of the pigment's behavior can be prepared, according to Mr. Kettenacker. This is a useful tool for assessing replacement potential and for understanding the optical behavior of various pigments, as well as comparing the effects of various dispersion methods.

Mr. Kettenacker discussed spectral curves using the Trilac or Match-Scan. A spectrophotometer curve can be obtained of either reflectance or transmission plotted as a function of wave length, explained Mr. Kettenacker. This is useful for the identification of colorants and potential contaminants in a sample (e.g., small amount of phthalo blue). A plot of log absorbance (Match-Scan) of dyes in solution is extremely useful, stressed Mr. Kettenacker.

The use of the testing tools was discussed, which can, according to Mr. Kettenacker, assist in choosing appropriate pigments. Although these methods are not new, he stressed that they are still very valuable.

Q. How are chromaticity plots based?

A. Chromaticity is based on calibration samples, they are not physically

1982-83 Officers of the Houston Society. (Left to right): Treasurer—Arthur R. McDermott; Secretary—Richard D. Batchelor; President—Klebert D. Jacobson; Vice-President—Donald R. Montgomery; and Society Representative—Willy C.P. Busch

made. I based them on other models. Once a sample is calibrated into the computer, it could be simulated with any other pigments.

CHARLES J. HOAR, *Secretary*

NEW YORK SEPT.

"Powder Coatings"

Immediate Past-President Donald Brody, of Skeist Laboratories, Inc., introduced the 1982-83 officers: President—Theodore Young, of Jesse S. Young Co.; Vice-President—Herbert Ellis, Jr., of D.H. Litter Co., Inc.; Secretary—Mike Iskowitz, of Koppers Co., Inc.; and Treasurer—Ray Gangi, of Woolsey Marine.

Tom Scanlon, of D.H. Litter Co., presented President Young with the Nuodex gavel. Irwin Young, of Jesse S. Young Co., presented President Young with the Roberts Rules of Order, a gift from The Jesse S. Young Co. Past-President Brody received a Past-President's pin and $200 as a token of appreciation.

Jeff Kaye, of the Education Committee, announced the offering of two fall courses: "Understanding the Basic of Coatings" and "Lab Course for Paint Technicians."

Al Sarnotsky announced a workshop on the newest E.P.A. Hazardous Waste Form on October 12 before the regular meeting.

A moment of silence was observed for Merrill Metz, retired President of Empire State Varnish Co., who passed away last spring.

Camilla Zendig, of Ciba-Geigy Corp., spoke on "POWDER COATINGS BECOMING AN IMPORTANT TECHNOLOGY FOR INDUSTRIAL FINISHES."

Ms. Zendig's talk, aided by a slide presentation, covered such matters as powder coatings materials, application, compliance with air quality standards, and the economics of powder coatings.

Materials used are of two major types: (a) thermoplastic and (b) thermosetting, said Ms. Zendig. Thermoplastics include polyethylene, polypropylene, polyvinyl chloride polyester, and fluropolorers. Thermosetting resins include epoxy, polyester, and acrylics.

Uses for epoxy types include exterior and interior gas transmission lines, reinforced steel rods, and oil drilling pipes, said Ms. Zendig. General bake time and temperature would be 250°F for 20-30 minutes.

Problems explained by Ms. Zendig include poor exterior weatherability (such as with liquid epoxies), hence, interior uses are suggested. These include interior refrigerator enamel and interior drier drums.

Epoxy-polyester hybrids are finding more uses such as coating oil filters. One good feature is good overbake resistance and less chalking, said Ms. Zendig. This leads to greater use in the automotive industry.

Polyesters come in two types. The urethane-cured type is one type. This type competes directly with the liquid polyester-urethane as used in aircraft, buses, railroad cars, and many other. Standard cures range from 30 minutes @ 320°F to 10 minutes @ 400°F. The other type is less widely used, has more exterior durability, and is similar to the epoxy-polyester hybrid previously mentioned. The difference is that the epoxy portion is a trifunctional, weatherable type, discussed Ms. Zendig. Recent formulations have typical cures of 20 minutes @ 300°F. This type has excellent mechanical properties at thick film formation as well as good transfer efficiency. Applications include air conditioner cabinets, outdoor furniture, and wrought metal products.

The acrylic type of thermosetting powder coating is acrylic-urethane in nature and has a cure similar to polyester-urethanes. They are somewhat more flexible than liquid acrylics. They have good alkali resistance, said Ms. Zendig.

Equipment used in powder coatings was discussed. The first powder coatings used a fluidized bed process wherein heated parts were passed thru the bed. It is designed for higher film builds. Spray guns were then developed for use with powder coatings. These guns greatly aided in applying those finishes requiring thin films, while still having the ability to apply a thicker film when needed. Both manual and automatic guns are in use. Overspray is reclaimed for reuse.

Economics of powder coatings were explained by Ms. Zendig. While the cost of powder coatings is slightly higher at equal production volumes, savings can be found thru high efficiency, lower labor and maintenance cost, less energy cost, and a lower waste and disposal cost, said Ms. Zendig. Low range economic costs for powder coatings are extremely promising. One promising area is in the job shop market; another is in building products.

Q. What happens with adhesion of rebars to the concrete?

A. The problem is not the adhesion of rebars to the concrete but in rusting of the rebars by the concrete causing eventual cracking. Powder coatings prevent this.

Q. Can powder coatings really be used in refrigerator interiors?

A. Yes, because no VV radiation is present. Thus, it is OK to use.

Q. How do powder coatings compare with other types in cost per sq.ft. of application?

A. Water-borne and high solids are slightly higher.

Q. Could you review to capital expenditures for installing a powder coating system vs. water borne and high solids lines?

A. Water-borne would be $98,000.00; High solids would be $100,000.00; and Powder coatings would be $150,000.00, using 1982 figures.

Q. It is possible to change colors on a powder coating line in one to two minutes?

A. No. Seven to eight minutes is a more reasonable estimate of changeover time.

Q. Are any safety precautions necessary in using powder coating.

A. Yes. Proper air flow must be maintained and proper grounding must be maintained. These are the two main safety precautions.

MICHAEL ISKOWITZ, *Secretary*

NEW YORK OCT.

"Pigment Evaluation"

"PRACTICAL METHODS FOR PIGMENT EVALUATION" was presented by Dan Dixon, of Freeport Kaolin.

Mr. Dixon discussed the problems experienced with wooden exposure racks and explained why they switched to aluminum racks. Exposure periods were for five years.

Mr. Dixon explained how to get results in a lab setting without waiting for five years to expire. According to Mr. Dixon, four criteria were used in determining an appropriate lab method: (1) it had to be quick; (2) verifiable; (3) relatively simple; and (4) it had to be able to be handled by a technician.

The reason a new method was sought was that there were many methods in existence, all of which were too slow and or complex to handle a large number of coatings.

By starting with one pigment (a calcined clay) Mr. Dixon tried to devise this quick method. By looking at drawdowns of this clay at different PVC's, one can see a distinct change in opacity after the CPVC is reached. These were then stained and at the same point the opacity changes, the stain penetrates. Sheen curves of these also matched predicted CPVC range. Also, tinting matched the CPVC loading level. The range was then broken down into finer increments in search of the exact CPVC. The same four criteria (opacity, staining, sheen, and tinting) were used. In this small range opacity plays a lesser role since it is harder to see the changes. Staining was found to be the best indicator of CPVC, according to Mr. Dixon.

To prove out the basic concept of this theory, other pigments were tried, said Mr. Dixon. First other grades of calcined clay then delaminated coarse clays were used. The question arose would this work on pigments other than clay? Trials showed it did, said Mr. Dixon. Pigments tried included talc, carbonates, mica, silica, and titanium dioxide. Combinations of pigments also were found to follow this concept. A practical application of this procedure is determining which combination of pigments can match any given standard paint. It can also show very visibly where CPVC point is.

Q. What influence does the binder have on this method?

A. No time was spent on this point. This was a pigment study not a binder study.

Q. How much blue pigment was added to the pigment under examination so result would be visible?

A. One percent blue pigment was added.

Q. If you change the PVC on TiO_2 from 20 to 30% and add 1% blue are you saying that there is no color range?

A. Yes, because TiO_2 reaches its maximum opacity at a low PVC.

Q. Is there any correlation between exposures and pushing the upper limits of PVC?

A. That is the next step in this program.

MICHAEL ISKOWITZ, *Secretary*

NORTHWESTERN OCT.

"Dispersion of Carbon Black"

James W. Joudrey, of Columbian Chemicals Co., presented a lecture entitled "DISPERSION OF CARBON BLACK IN COATINGS SYSTEMS."

Mr. Joudrey discussed the manufacture, chemistry and structure, characteristics, and dispersion of carbon black. Also included in the discussion were the topics of equipment, dispersants, methods/problems, evaluations, and formulations.

EXTENDERS—THE INORGANIC BACKBONE OF FLATS AND PRIMERS" was presented by Craig J. Stoneback, of Engelhard Minerals and Chemicals Div.

Mr. Stoneback discussed the types of extenders available and the properties of individual extenders.

ROBERT MADY, *Secretary*

PHILADELPHIA OCT.

"Cartridge Filtration"

"THE WHYS AND WHEREFORES OF CARTRIDGE FILTRATION IN THE COATINGS INDUSTRY" was discussed by Charles Lambolot, of AMF, Cuno Div.

Mr. Lambolot's talk centered on the types of cartridges available to the industry. He discussed the many variables that affect filtering and offered suggestions on how to correct by using the proper type. Slides showed the effectiveness of filtration with various media. Mr. Lambolot covered various problems encountered in industry and discussed how to avoid them. Using slides, he explained the types to use when making pigmented and nonpigmented products. The final slide covered in summary what should be done to use filters effectively.

Q. Why should we use ungrooved cartridges?

A. So that bubbles can be released quickly and not be trapped.

WILLIAM GEORGOV, *Secretary*

PHILADELPHIA NOV.

"Use of Ethyl Silicate"

James R. Steinmetz, of Kay-Fries, Inc., spoke on "THE USE OF ETHYL SILICATE IN ZINC RICH PRIMERS."

Mr. Steinmetz stated that without corrosion, paints would not be needed. He briefly described why corrosion occurs and why rust forms.

Kansas City Society Officers for 1982–83. (Left to right): Vice-President—Mike Bauer; President—Melvan Boyer; Treasurer—Dennis Mathes; Secretary—Gene Wayenberg; and Society Representative—Norman Hon

A review of the metals which are active and relatively inactive was presented. Mr. Steinmetz said that metals may retard corrosion or speed up the corrosion rate.

Slides covered several methods of putting zinc in contact with the substrate. Mr. Steinmetz stressed that cost will determine which method to use.

Mr. Steinmetz listed the advantages and disadvantages of organic and inorganic binder systems.

A discussion of the ways of preparing ethyl silicate and ethyl polysilicate was presented. Properties of both silicates were reviewed and Mr. Steinmetz pointed out why each one is used. Several formulas showing how ethyl silicate is used on "one pack" and "two pack" systems were illustrated with slides.

Mr. Steinmetz said that data is available on how to control the rate of hydrolysis.

Q. How do these compare to zinc chromate type?

A. I believe they last longer and are lower in cost.

Q. How do these look in alkaline systems?

A. Formulate using 40% silicate with amine modifier and watch the rate of hydrolysis.

WILLIAM GEORGOV, *Secretary*

PIEDMONT — OCT.

"Uses of Talc and Chlorite Pigment"

William M. Meadows, of Cyprus Industrial Minerals Co., spoke on "THE USES OF TALC AND CHLORITE PIGMENTS IN MODERN COATINGS."

Mr. Meadows highlighted the physical compositions of talc, chlorite, and clay. He showed areas of similarities and differences between these pigments. Chlorite, with its hydrophilic nature, platy character, low oil demand, low flatting efficiency, and a slightly higher MOH hardness than talc, was suggested as a suitable extender pigment for furniture waterbase groundcoats.

Mr. Meadows then discussed a study of the effects of pigmentations on corrosion resistance water-base primer. At threshold PVC of 25% good water-base anti-corrosion primer can be formulated with equal volume of talc and barytes, with or without the aid of inhibitive pigments. These primers have withstood four years—plus actual exposure at a North Sea site. Lastly, chlorite can make equally good anti-corrosion primers and excellent non-chalking exterior enamels as well, said Mr. Meadows.

PHILIP WONG, *Secretary*

ROCKY MOUNTAIN — OCT.

"Computer Programs"

Fred Honeck, of Universal Micro Systems, discussed "SPECIALTY COMPUTER PROGRAMS AIMED AT SMALL PAINT AND COATINGS MANUFACTURING."

LUIS O. GARCIA, *Secretary*

ST. LOUIS — OCT.

"Compliance Coatings"

Steve Collier, of Dow Chemical Corp., discussed "COMPLIANCE COATINGS FORMULATED WITH CHLORINATED SOLVENTS."

The use of compliance chlorinated solvents, 1,1,1-trichloroethane and methylene chloride were discussed by Mr. Collier. The properties, formulating guidelines, and safety of the products were also reviewed.

According to Mr. Collier, as a part of its guidelines of VOC emissions,the EPA has published a list of compounds which have been shown to be of negligible photochemical reactivity (or nonsmog producing) and thus, do not need to be regulated or inventoried as VOC. The exempt compounds are methane, ethane, trichlorotrifluoroethane, 1,1,1-trichloroethane, and methylene chloride. Due to this definition, the solvents—1,1,1-trichloroethane and methylene chloride—may be placed in coating formulations and not increase the VOC emission rate, explained Mr. Collier.

The exemption of these two solvents from air regulations is not present in some states. Following the EPA guidelines, however, over 80% of those states having VOC emissions plans, have exempted 1,1,1-trichloroethane, and over 50% have exempted methylene chloride, said Mr. Collier.

1-1-1-Trichloroethane-based or methylene chloride-based coatings are expected to be slightly higher in cost compared to low solids coatings, explained Mr. Collier. They should be cost competitive with low VOC compliance systems, such as high solids coatings. Also, coatings containing chlorinated solvents should be evaluated for hazardous waste, Mr. Collier stressed.

1-1-1-Trichloroethane and methylene chloride as paint solvents offer industry the ability to comply with air quality regulations. Resin systems, familiar to the end user, can still be utilized providing a proven performance and fast dry times, said Mr. Collier.

WILLIAM A. TRUSZKOWSKI, *Secretary*

Future Society Meetings

Birmingham

(Feb. 3)—"Formaldehyde—Release and Analysis in Amino Resins"—U. Naess, Dyno Industries A.S.

(Mar. 3)—"The Role of the Analytical Laboratory in a Modern Paint Company"—Dr. S. Bryan, Donald MacPherson & Co. Ltd.

(Apr. 14)—"Transport as It Applies to the Paint Industry"—O. Thomas, Freight Transport Assoc.

(May 5)—"Use of Anti-Static Devices in the Paint Industry"—G. Wheatcroft, 3M Co.

Chicago

(Feb. 7)—Federation Officers Visit.

(Mar. 7)—"Custom Computer Systems for Coatings Chemists"—Bruce Banther, East Chester Corp. "Experimental Design and Statistical Analysis of Data—Dr. R.D. Snee, E.I. duPont de Nemours Co.

(Apr. 4)—"Acid Rain Trends in the U.S."—Dr. Gary Stensland, University of Illinois. "Aspects of Rheology in Coatings"—Dr. J.E. Glass, North Dakota State University.

Cleveland

(Jan. 20)—Joint Meeting with CPCA.

(Feb. 15)—"Dispersants: Basic Concepts and Effect on Paint Properties"—Dr. W.K. Asbeck.

(Apr. 19)—"Attritor Grinding and Dispersing Equipment"—Arno Szegvari.

(May 17)—"A Funny Thing Happened on the Way to the Coatings Technical Meeting"—Frank Borrelle, FSCT Executive Vice-President.

Golden Gate

(Jan. 17)—"Water Extendable High Solids Systems. Can Get VOC and Viscosities Down by Extending with Water"—R. Johnson, Cargill Corp.

(Feb. 14)—Joint Meeting with the GGPCA.

(Mar. 14)—"Recent Development in Epoxy Resin"—Dr. Ron Bauer, Shell Development Co.

Houston

(Feb. 12)—"Ladies Night / Valentine's Dance."

(Mar. 9)—Education Committee Symposium. "Security: EDP (Computer), Plant, and Personnel"—Mark Dante, Chairman, Shell Development Co.

Kansas City

(Feb. 10)—"Processes and Properties of Silica Leading to Ideal Flatting Agents"—Jim Gracie, W.R. Grace, Davison Div.

(Mar.)—Ladies Night.

Los Angeles

(Feb. 9)—"Ladies Night."

(Mar. 9)—"Recent Development in Epoxy Resin"—Dr. Ron Bauer, Shell Development Co.

(Apr. 13)—"Chlorinated Solvents in Compliance Coatings"—Hank George, Consultant.

Northwestern

(Feb. 8)—"Technical Presentation—Northwestern Society"—Dan DeChaine, Chairman.

FSCT Membership Anniversaries

50-Year Members

New England

Charles H. Hamilton, Retired.

25-Year Members

Birmingham

R.W. English, Mastermix Engineering.
F. Suddaby, Retired.

Golden Gate

Ed Baker, Glidden Coatings & Resins, Div. SCM Corp.
Ted Gilbert, Consultant.
Dave McGuire, Cook Paint & Varnish Co.
Earl Teilman, Kelly-Moore Paint Co.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD). ED

BIRMINGHAM (First Thursday)—Westbourne Suite, Edgbaston). D. H. CLEMENT, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ, England.

CHICAGO (First Monday—meeting sites in various suburban locations). FRED FOOTE, U.S. Gypsum Co., 700 N. Rte. 45, Libertyville, IL 60048.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). ROBERT A. BURTZLAFF, Potter Paint Co. of Ind., P.O. Box 265, Cambridge City, IN 47327.

CLEVELAND (Third Tuesday—meeting sites vary). RAY PODLEWSKI, Mansfield Paint Co., P.O. Box 998, Mansfield, OH 44901.

DALLAS (Thursday following second Wednesday—Steak & Ale Restaurant). T. LEON EVERETT, Dan-Tex Paint & Ctg. Mfg., Inc., P.O. Box 18045, Dallas, TX 75218.

DETROIT (Fourth Tuesday—meeting sites vary). PETER BURNETT, Wyandotte Paint Products, Inc., 650 Stephenson Hwy., Troy, MI 48084.

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabella's Restaurant on Fisherman's Wharf and the Sea Wolf at Jack London Square, San Francisco). ROBERT MILLER, Frank W. Dunne Co., 1007 41st St., Oakland, CA 94608.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX) RICHARD D. BATCHELOR, Valspar Corp., 2503 W. 11th St., Houston, TX 77008.

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

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). MICHAEL GILDON, Guardsman Chemicals, 9845 Miller Way, Southgate, CA 90280.

LOUISVILLE (Third Wednesday—Howard Johnson's, Louisville, KY). W. JERRY MORRIS, Celanese Plastics & Specialties Co., P.O. Box 99038, Jeffersontown, KY 40299.

MEXICO (Fourth Thursday—meeting sites vary). TERESA SUAREZ, Sherwin-Williams Co., Mexico, D.F.,Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). M. MEGELAS, International Paints Ltd., P.O. Box 190, Outremont, Que., Can., H2V 4M9.

NEW ENGLAND (Third Thursday—Fantasia Restaurant, Cambridge). CHARLES J. HOAR, Union Chemicals Div., 67 Walnut Ave., Clark, NJ 07066.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). MICHAEL ISKOWITZ, Koppers Co., Inc., 480 Frelinghuysen Ave., Newark, NJ 07114.

NORTHWESTERN (Tuesday after first Monday—Boulevard Cafe, Golden Valley, MN). ROBERT MADY, George C. Brandt, Inc., 2975 Long Lake Rd., St. Paul, MN 55113.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). WILLIAM SHACKELFORD, Gaco-Western, Inc., P.O. Box 88698, Seattle, WA 98188.

PHILADELPHIA (Second Thursday—Valle's Steak House). WILLIAM GEORGOV, J.M. Huber Corp., P.O. Box 310, Havre de Grace, MD 21078.

PIEDMONT (Third Wednesday—Howard Johnson's Coliseum, Greensboro, NC). JAMES E. HUSTED, Mobil Chemical Co., P.O. Box 2438, High Point, NC 27261.

PITTSBURGH (First Monday—Skibo Hall, Carnegie Mellon Univ.). CLIFFORD SCHOFF, PPG Industries, Inc., R&D Center, P.O. Box 9, Allison Park, PA 15101.

ROCKY MOUNTAIN (Monday following first Wednesday—Gusthaus Ridgeview, Lakewood, CO). LUIS O. GARCIA, Kelly-Moore Paint Co., 3600 E. 45th Ave., Denver, CO 80216.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). WILLIAM TRUSZKOWSKI, Mozel Chemical Products Co., 4003 Park Ave., St. Louis, MO 63110.

SOUTHERN (Gulf Coast Section—Various Dates; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). S.G. SANFILIPPO, Reichhold Chemicals, Inc., Technical Services Lab., P.O. Box 1610, Tuscaloosa, LA 35401.

TORONTO (Second Monday—Cambridge Motor Hotel). R.H. STEVENSON, Tenneco Chems., Canada Ltd., 235 Orenda Rd., Bramalea, Ont., Can., L6T 1E6.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). DONALD M. KRESSIN, Spencer Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 14225.

(Mar. 8)—"SOCIETY SYMPOSIUM"—H.C. Ting, Chairman.

(Apr. 5)—"EDUCATION NIGHT"—James Lawlor, Chairman.

(May 3)—"MANUFACTURING PROGRAM"—Richard Mundinger, Chairman.

Philadelphia

(Jan. 19)—Joint Meeting with PPCA. "ECONOMIC OUTLOOK FOR 1983 AND BEYOND"—John J. Clutz, Jr., Rohm and Haas Co.

(Feb. 10)—"FUMED SILICA FOR THE RHEOLOGY CONTROL OF HIGH SOLIDS COATINGS"—Dennis G. Miller, Cabot Corp.

(Mar. 10)—FEDERATION VISIT.

(Apr. 15)—AWARDS NIGHT.

(May 12)—"NEWER TECHNOLOGICAL AREAS OF WATER-BORNE RESINS"—Don Hogan, Polyvinyl Chemical Corp.

Piedmont

(Jan. 19)—"ECONOMIC FORECASTING AND TAX ADVANTAGED INVESTMENTS FOR THE INDIVIDUAL"—T. Broadwater, Thomson McKinnon Securities, Inc.

(Feb. 16)—JOINT MEETING WITH PIEDMONT PCA.

(Mar. 16)—FEDERATION OFFICER VISIT.

(Apr. 20)—"PLANT SAFETY-HANDLING SOLVENT AND NITROCELLULOSE"—Speaker from Hercules, Inc.

(May 18)—"SOLVENTS FOR HIGH SOLIDS COATINGS"—R. Readshaw, Union Carbide Corp.

(June 15)—"FINISHING POLYOLEFIN PLASTICS"—T.E. Parsons, Eastman Chemical Products, Inc.

Pittsburgh

(Feb. 7)—"CONCERNING THE QUALITY OF TRADE SALES COATINGS"—Tom Greer, PPG Industries, Inc.

(Mar. 7)—"RELATIONSHIPS BETWEEN PARTICLE SIZE AND OPTICAL PROPERTIES OF IRON OXIDE PIGMENTS"—Dr. Rolf Odenthal, Mobay Chemical Corp.

(Apr. 4)—"CHLORINATED SOLVENTS—AN ALTERNATIVE TECNOLOGY IN COATINGS"—Jed Fulkerson, Dow Chemical Co.

(May 2)—"WHAT IS THE STRUCTURAL STEEL PAINTING COUNCIL?"—John Keane, Mellon Institute.

St. Louis

(Feb. 15)—"LAS VEGAS NIGHT."

(Mar. 16)—"HIGH SOLIDS COATINGS"—Speaker from Freeman Chemical Co.

(Apr. 20)—"EDUCATION NIGHT."

(May 18)—"MANUFACTURING NIGHT."

Meetings/Education

Anne Gorsuch, of EPA, to Deliver Keynote Speech at WCS Symposium

Mrs. Anne Gorsuch, Administrator of the U.S. Environmental Protection Agency, will be the Keynote Speaker at the 16th Biennial Symposium of the Western Coatings Societies, February 23-25. The Symposium is being held at the Embarcadero, Hyatt Regency Hotel, San Francisco.

With a background in legal, legislative, and environmental activities, Mrs. Gorsuch will discuss the subjects currently affecting the coatings industry on a broad scale—both nationally and locally.

Mrs. Gorsuch received her undergraduate degree from the University of Colorado in Boulder, attended the National University of Mexico, and earned a law degree from the University of Colorado Law School. She later spent a year in Jaipur, India as a Fulbright scholar.

Mrs. Gorsuch was first elected to the Colorado House of Representatives in 1976, where she served as vice-chairman of the Judiciary Committee and as a member of the Finance and Appropriations Committee. Re-elected to a second term in 1978, she chaired the House State Affairs Committee and the House-Senate Legal Services Committee. She also served as chairman of the House Interim Committee on Hazardous Waste and was House sponsor of air pollution control inspection-and-maintenance legislation.

Mrs. Gorsuch was nominated to the top EPA post by President Reagan after serving on the new Administration's transition team, and was sworn in as Administrator in May, 1981, following her confirmation by the Senate.

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The technical program will feature over 26 papers during the three-day event, including a seminar on "Computer-Aided Surface Coatings Manufacture." Presentations here will include:

"Improved Operation from Computerization for the Paint and Coatings Industry"—J. Patrick Kennedy, Oil Systems, Inc.

"Computers in the Paint Industry"—Richard Max, Synkote Paint Co.

"The Distributed Approach to Computer-Aided Manufacturing"—Happy Holden, Hewlett-Packard.

"Packaged Software for Controlling Batch Process"—John C. Ward, Setpoint, Inc.

"Computer Control of Batch Resin Reactor"—William S. Armstrong, E.I. duPont de Nemours & Co., Inc.

"Computer Color Systems—How to Maximize Your Investment"—Robert Weaver, Bausch & Lomb, and Patrick Chassaigne, Diano Corp.

Accompanying the Symposium is a show of raw materials and manufacturing equipment. Over 100 booths will be occupied by 70 exhibitors, setting a new record for the event.

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Additional information on the Symposium and the Show may be obtained by writing to: The Western Coatings Symposium, 50 California St., Suite 3110, San Francisco, CA 94111.

'Advances in the Coatings Industry' To Be Sponsored by PRA, May 10–12

The Paint Research Association's Fifth International Conference entitled, "Technological Advances in the Coatings Industry," will be held May 10–12 at the London Penta Hotel, London, England.

The conference will feature 15 papers presented by authors from Denmark, Finland, France, Germany, Holland, Japan, and the UK. Presentations will cover major advances in the last decade—some in established commercial operations, and others just beginning. An overview of recent developments and the state-of-the-art of the technologies will be provided.

The program will cover the following topics: multipurpose dispersants for solvent-based paints; air and polymer extended decorative paints; automated paint production; advances in color control; cathodic electrodeposition; electrophoretic powder coating; microparticles in automotive paints; advances in base coat-clear; self-polishing antifouling paints; can coatings; wood preservation and protection; high-build coatings; wet blasting; advances in anticorrosive paints; underwater painting; and restraints and opportunities for innovation.

For further information, contact the Paint Research Association, Waldegrave Rd., Teddington, Middlesex TW11 8LD, England.

AFP/SME to Hold Coatings Workshops

The Association for Finishing Processes of the Society of Manufacturing Engineers AFP/SME will sponsor two, one-day workshops on "Conversion Coatings as a Substrate for Organic Finishes" on February 1, in Phoenix, AZ, and March 1, in Baltimore, MD.

These workshops have been designed to provide an understanding of various conversion coating processes including iron phosphates, zinc phosphates, and aluminum chromates. Also included will be a study of the bonding mechanisms that occur in painting over these surfaces and on plastic surfaces. Special attention will be given to peripheral portions of the total processes (especially cleaning and rinsing) and trouble shooting. These sessions are intended for engineering and line management personnel in companies using conversion coatings alone or with paint as a product finishing process.

The workshop instructor is Wilfred D. Kennedy, Manufacturing Engineering Consultant based in St. Simons Island, GA.

The workshops will coincide with Phoenix '83 Tool & Manufacturing Engineering Conference and Exposition, February 1–3, Phoenix Civic Plaza and the Baltimore Tool and Manufacturing Engineering Conference and Exposition, March 1–3, Baltimore Convention Center.

For additional information, contact Donna Theisen, Technical Activities Dept., Society of Manufacturing Engineers, One SME Dr., P.O. Box 930, Dearborn, MI 48128.

DuPont Schedules 1983 Statistical Seminars

The DuPont Co. has scheduled spring and summer sessions for three statistical seminars designed for research scientists, engineers, and others engaged in industrial or academic technical work.

The three courses, "Strategy of Experimentation," "Strategy of Formulations Development," and "Focus on Data," will be presented in two and one-half day public sessions in a variety of locations. The $655 registration fee includes coffee breaks, lunches, and course materials. Special sessions can also be scheduled for large groups at client locations.

"Strategy of Experimentation" concentrates on the use of statistical tools for effective designed experiments. It emphasizes the use of proven, immediately applicable methods. Students collect data in workshop sessions using electronic simulators, then learn to analyze the data and draw valid conclusions. The course is ideal for research scientists and engineers. Dates and locations for the session are as follows:

Feb. 8–10	New York, NY
Mar. 8–10	Denver, CO
Apr. 12–14	New Orleans, LA
May 10–12	Wilmington, DE
June 7–9	Chicago, IL
Aug. 2–4	Hershey, PA

"Strategy of Formulations Development" offers a practical introduction to the most efficient methods for the design and analysis of mixture experiments. Statistical models are used to determine the optimum composition of mixtures under study. Techniques covered in the course are particularly useful for research scientists, engineers, and process technicians working on projects involving mixtures. The course schedule is as follows:

Mar. 1–3	Los Angeles, CA
May 3–5	Boston, MA
Aug. 16–18	Mt. Pocono, PA

Designed to teach students elementary statistics, "Focus on Data" concentrating on the three main phases of the data analysis process: exploration, analysis, and communication. Graphical and statistical tools for effective problem solving are presented through a series of lectures, workshops, and class exercises. The seminar is designed for research scientists, quality assurance people, engineers, and anyone who uses data to solve problems, support theories, understand a process, or develop information. The schedule for the session is as follows:

Feb. 22–24	San Francisco, CA
Mar. 15–17	New York, NY
Apr. 19–21	Chicago, IL
May 17–19	Washington, DC
July 19–21	Mt. Pocono, PA

For more information and registration materials, write: DuPont Statistical Seminars, Room X-39699, Wilmington, DE 19898.

Detroit Society Cosponsors Coatings Short Courses

The Detroit Society for Coatings Technology in cooperation with the University of Detroit and the Detroit Paint & Coatings Association has sponsored three coatings short courses this January.

"Fundamentals of Automotive Paint Systems (Part II)," a 12-week course which began January 10, emphasizes the processing of automotive paints. The text used for this session is "Understanding Paint and Painting Processes" by Gerald L. Schneberger. Instructor for the course is Donald Mordis, of the Ford Motor Co.

A seven-week session entitled, "Principles of Color Technology" which began January 10, is an introductory course for those having no previous education in the field. This "hands-on" course deals with color matching and color control. Robert Perchard, of Inmont Corp., is instructor for the session.

"Coatings Laboratory", a seven-week "hands-on" course which covers the use and operation of equipment used in quality control and R&D laboratories, began on January 13. Dr. Daniel Klempner, of the Polymer Institute of the University of Detroit, is instructor for the session.

12th Annual Corrosion Course To Be Held at Lehigh Univ.

The 12th Annual corrosion short course entitled, "Corrosion and Its Control by Protective Coatings," will be held at Lehigh University, Bethlehem, PA, May 23–27.

Corrosion principles and the mechanisms of corrosion beneath paints, metallic coatings, and inorganic coatings will be discussed.

Further information may be obtained from Prof. Henry Leidheiser, Jr., Sinclair Laboratory #7, Lehigh University, Bethlehem, PA 18015.

NPCA Announces 23rd Annual Marine Coatings Conference

The 23rd Annual Marine and Offshore Coatings Conference sponsored by the National Paint & Coatings Association will be held May 11–13 at the Hyatt Regency Hotel, Baltimore, MD.

Conference Chairman, Joseph Harrington, of Farboil Co., stated that the program will feature an in-depth look at antifouling coatings. Presentations on all aspects of this topic from the navy, ship owners, commercial shipyards, and coatings manufacturers are anticipated. Subjects covered will include state-of-the-art, ship owner case histories, health and safety aspects, as well as environmental considerations.

According to Program Chairman, Armand P. Herreras, of Devoe Marine Coatings Co., "An update on advanced antifoulings by manufacturers and two workshops round out the program."

For further details, contact NPCA, 1500 Rhode Island Ave., NW, Washington, DC 20005.

Pacific Northwest Society Issues Call for Papers

The Pacific Northwest Society for Coatings Technology announced the first call for papers for its annual Spring Symposium, May 5–7, at the Thunderbird Inn, Portland, OR.

Abstracts must be submitted to the Symposium Technical Coordinator no later than January 31. Abstracts should include the paper's title, all authors' names and affiliations, as well as a short biographical sketch of each author with mailing address and phone number.

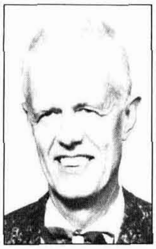
Authors will be notified of the status of their papers by March 1.

Abstracts should be submitted to Roy Blackburn, Technical Coordinator, Imperial Paint Co., 2526 N.W. Yeon, Portland, OR 97210, or, for further information, call (503) 223-5124.

Symposium Chairman is Gerry McKnight, of Lilly Industrial Coatings Inc., Hillsboro, OR.

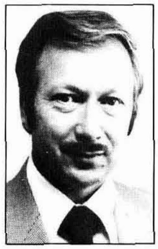
The Pacific Northwest Society includes members from Alaska, British Columbia, Idaho, Oregon, and Washington.

People

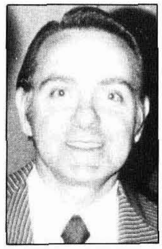


R.S. Hunter

W.C. Jeff



C.C. Tatman



E.B. Countryman

A gift in excess of $500,000 has established the Richard S. Hunter Professorship of Color Science, Appearance and Technology at Rochester, NY Institute of Technology. The endowment by **Mr. and Mrs. Richard S. Hunter,** of Reston, VA, honors Mr. Hunter, founder and Chairman of the Board of Hunter Associates Laboratory, Inc.

The Richard S. Hunter Professorship will enable the Institute to increase its research and educational efforts in the area of color sciences and technology as well as appearance science in order to benefit the industry and science concerned with color.

Mr. Hunter began his career in color and appearance measurement in 1927 at the Colorimetry Section of the U.S. National Bureau of Standards (NBS). While at the bureau in 1942, he developed the Uniform Chromaticity Scale of Hunter, which became the basis of the NBS unit of color difference. In the early 1950's he and his wife founded the Hunter Associates Laboratory, Inc.

Mr. Hunter's extensive knowledge of color and appearance has brought him acclaim. He has received the Testing Division Medal from the Technical Association of Pulp and Paper Industries, the Award of Merit from the American Society for Testing Materials, and the Armin J. Bruning Award in appearance measurement of paints. This past spring, Mr. Hunter was awarded honorary membership in the Inter Society Color Council, a group he served as President in 1972–73. He received the society's Macbeth Award in 1976. Mr. Hunter is also a member of the Baltimore Society.

John L. Armitage & Co., Newark, NJ, has announced the following promotions. **William C. Jeff** has been named Senior Vice-President, responsible for all marketing and technical services. He will be assisted by **Gary E. Lukowitz,** who will serve as National Sales Manager, and by **Thomas Luyster, Jr.,** who has been promoted to Technical Director. Also, **Robert Browing** has been named Technical Services Manager. Messrs. Jeff and Luyster are members of the New York Society.

Dennis Marcantoni has been named Factory Manager of the James B. Day Co. His responsibilities will include heading safety programs, as well as factory operations.

Calvin C. Tatman, of the Glidden Pigments Group in Baltimore, MD, received the 1982 Herman Shuger Memorial Award from the Baltimore Coatings Industry Awards Council on November 18. Mr. Tatman, a Past-President of the Society, was cited for his dedicated and outstanding service to the local coatings manufacturing industry. He was the 26th person to receive the award. At the same meeting, Merit Awards were presented to: **Alex Chasan,** of the U.S. Navy Bureau; **Robert Hopkins,** of Glidden; **Richard D. McCloskey,** of Valspar Corp.; and **C. Herbert Pund III,** of Haskell Chemical Co.

Maurice G. Bradley, President of C-I-L Paints, Inc., was re-elected CPCA President. **Kenneth G.W. Smith,** Manager, Finishes Division, of DuPont Canada, Inc., was re-elected Vice-President (President-Elect) of the Association.

James J. Jordan has been appointed Senior Sales Representative in the Northeast for the Borden Chemical Company's Graphics Div., Specialty Products Group. Mr. Jordan is a member of the New York Society.

The appointment of **Richard L. Cranstoun** as Sales Representative was announced by G.R. O'Shea Co., Westchester, IL. Previously, Mr. Cranstoun was with Tenneco Chemicals, Inc. He is a member of the Chicago Society.

Hal C. Whittemore has been named Executive Vice-President, Operations, for Sun Chemical Corp. Also, **Gerald S. Gutterman** was elected Executive Vice-President for Finance and Administration.

Edward B. Countryman has joined Precision Paint Corp., Atlanta, GA, as Chemist in charge of Technical Service. Mr. Countryman was Secretary of the Baltimore Society prior to his move to Precision.

Robert Athey and **Patricia Shaw** have formed Athey Technologies, a consulting, contract research and product development venture firm in Seal Beach, CA.

Dr. Athey, Education Committee Chairman for the Los Angeles Society, was previously with the General Tire & Rubber Co. and the Mellon Institute in product development and contract research operations.

Ms. Shaw, Los Angeles Society Technical Committee Chairman, developed coatings and adhesives for Dymo Industries and Bostik. Current development work includes a strippable water-based coating and some pigment dispersants.

Daniel J. Haley, Jr., President of Finnaren & Haley, Inc., Ardmore, PA, has been re-elected to a second one-year term as President of Coatings Research Group, Inc. Other officers elected were: Vice-President—**George Gable,** of Perfection Paint & Color Co.; Secretary—**William C. Warlick,** of Warlick Paint Co.; and Treasurer—**Hiram P. Ball,** of Ball Chemical Co. Mr. Ball is a member of the Pittsburgh Society.

James O'Brien has been named Product Manager in Ashland's Chemical Systems Division.

Robert E. Champagne has been named President and Chief Operating Officer of the Porter Paint Co., Louisville, KY. Mr. Champagne joined the company in 1971 and most recently served as Vice-President of their High Performance Coatings Division.

The promotion of **Dr. Richard R. Roesler** to Technical Manager, Resins/Adhesives Research, was announced by Henkel Corp., Minneapolis, MN.

Richard A. Repetto, of the Du Pont Company's Colored Pigment Products Div., Chemicals and Pigments Department, has been named Product Manager responsible for the plastics industry. Since joining the division in 1979, Mr. Repetto has been Product Manager for the Consumer and Industrial Paint Markets. He will retain this responsibility as part of his new assignment.

Linda Messina has joined the Thompson-Hayward Chemical Co. as an Industrial Sales Representative. She will be headquartered at the New Orleans distribution center.

Dennis Deitz was appointed Facility Supervisor of the Everglades Testing Laboratory for DSET Laboratories, Inc. Prior to his recent transfer to this new facility, Mr. Deitz was a Senior Weathering Technician at DSET.

Jack E. Hickey was named Technical Director of Hempel Marine Paints, Inc., United States operations.

Joseph Szulczewski has been appointed Plant Superintendent for Thibaut & Walker Co. He will be responsible for the company's day-to-day operations.

Eastman Chemical Products, Inc. has named **Larry Bernard** to the position of Senior Marketing Representative in the Greenville, SC area for the company's Chemicals Field Marketing Division.

Dr. Paritosh M. Chakrabarti has been named Director of Research and Development for PPG Industries' Chemical Operations, Pittsburgh, PA.

Fred A. Schillinger has been appointed Product Manager for amyl and propyl alcohols and acids in the Solvents & Coatings Materials Div. of Union Carbide Corp., Danbury, CT.

Witco Chemical Corp., New York, NY, has elected **Richard D. Capra** a Vice-President of the firm. Also, **Lawrence B. Moss** was named Product Manager for urethane and acrylic polymers of the company's Organics Division.

Volstatic, Inc. has announced the appointment of James E. Baugh & Co. as their representative for Virginia, West Virginia, North and South Carolina, Eastern Tennessee, and Northern Georgia. **James Baugh** has been active in installing finishing systems in the southeastern U.S. since 1969, offering engineering and design services in the fields of organic finishing, heat treating, induction heating, and cleaning and conveying equipment.

NL Chemicals has named **Michael J. Kenny** Director of U.S. Sales and Marketing.

Irvin Rose, General Manager of General Paint & Chemical Co., a division of Cotter & Co., was presented with the National Distinguished Service Award by the American Jewish Committee, a human relations organization. The award, presented in the Ambassador West Hotel in Chicago, cited Mr. Rose for his "leadership roles in efforts to promote spiritual, cultural, and educational well-being for all people."

Jack Penninga has been appointed Southern Regional Sales Manager for CONAP Div., a Wheelabrator-Frye Co., Olean, NY.

Jack Cole, formerly Vice-President, Marketing of Pall Trinity Micro Corp., has been appointed President of Pall Ultrafine Filtration Corp. Named President of Pall Process Filtration Corp. was **Robert H. Hauslein.**

D.H. Litter Co., Inc., New York, NY, has elected **Fred Holtzman** to the position of President. Mr. Holtzman, a 24-year veteran with the firm, most recently served as Executive Vice-President.

Kurt L. Schoenrade has been elected Vice-President, Manufacturing and Engineering of Day-Glo Color Corp., Cleveland, OH.

International Paint Co., Inc., Union, NJ, has announced the promotions of **James M. Dale** and **Thomas M. Curry** to the position of Vice-President, East Coast and U.S. Gulf Coast, respectively.

In accordance with realignment plans of its corporate structure, McCloskey Varnish Co., Philadelphia, PA, has announced the appointment of **John L. Holmes** to Corporate Vice-President of Marketing and **David M. Setzer** to Corporate Director of Purchasing and Materials Control.

Eric Knauss has been appointed Technical Field Representative for Milliken Chemical, a division of Milliken and Co.

James F. Papenfuss has been appointed Technical Manager—Coil Coatings of Glidden Coatings and Resins, SCM Corp, Strongsville, OH. Mr. Papenfuss previously served as Group Leader and was the 1981 recipient of the Glidden Award for Technical Excellence for his contributions to the development of Aqualure® III water-borne coil coatings.

Donald A. Maki has been named Market Manager—Metal Decorating for SCM Glidden International, Cleveland, OH.

Glenn D. Cassel has been appointed Coatings Plant Manager for Glidden Coatings & Resins Div. of SCM Corp. in Huron, OH.

Applied Color Systems, Inc., Princeton, NJ, has appointed **Donald Walker** as Regional Sales Manager for the Southeastern and Southwestern United States.

Thomas S. Toplisek has been appointed Product Manager, Powder Coatings, for the Chemical Coatings Div., Pratt & Lambert.

William E. Nettles has joined Engelhard Corp., Minerals and Chemicals Div., as Director of Worldwide Sales and Marketing for pigments and extenders.

M. Reid Turner, Jr., has also joined the firm as Senior Production Planner. Mr. Turner was previously with Sandoz Corp.

Gulf & Western Natural Resources Group has announced the appointment of **Don Thornton** as Manager of Chemical Sales for the Group's new Southern Region.

Russell Finex has named **Keith McIntyre** as a Director of the company. He is responsible for sales, including subsidiary companies in the United States and Belgium.

Nalco Chemical Co., Oak Brook, IL, has announced that **Orell T. Collins,** has relinquished his position as President and Chief Executive Officer. He has become Chairman of the Board. **Worley H. Clark** has succeeded Mr. Collins. Present Board Chairman **Robert T. Powers** has become Chairman of the Executive Committee.

Literature

Primers

A new, two-color brochure is available which highlights two ferrous metal primers for structural steel and joists. Data sheets detail performance characteristics and application recommendations. For a copy, contact The Sherwin-Williams Co., Chemical Coatings Div., G.L. Holmberg, 11541 S. Champlain Ave., Chicago, IL 60628.

Microprocessor

A new brochure is available which describes a low cost D25-2 microprocessor which, in combination with a choice of sensors, provides a colorimeter unmatched in versatility and ease with which it can be operated. A description of the microprocessor is provided along with information on the standard and optical features available. For a copy of the D25-2 brochure, contact Hunterlab, 11495 Sunset Hills Rd., Reston, VA 22090.

Latexes

A four-color folder designed as a ready reference to latexes for a wide range of pressure sensitive adhesives has been published. Six water-borne acrylic emulsions are listed with brief descriptions and data on physical and adhesive properties. Applications are also featured. Copies of the folder, "UCAR Latexes for Pressure Sensitive Adhesives," F-48333, can be obtained from Union Carbide Corp., Coatings Materials Div., Dept. K3442, Danbury, CT 06817.

Adhesion Tester

The new Erichsen Model 295 Multi-cross Adhesion Tester, a low cost, practical, and widely used method to evaluate adhesion of dry coatings when applied to any substrate, is featured in recent literature. For more information, contact Frank Rueter, Marketing Dept., Zormco Corp., P.O. Box 4444, Dept. P-31, Cleveland, OH 44125.

Bead Mill

Literature featuring a new 1,000 liter vertical Molinex agitator bead mill for grinding, homogenizing, dispersing, and emulsifying all types of minerals in slurries, has been published. For information, contact Fred Rotar, Netzsch Inc., 119 Pickering Way, Exton, PA 19341.

Vacuum Systems

Custom vacuum packaging systems that remove entrapped air and gasses from inks, epoxies, silicones, and other processed liquids are introduced in new literature. Information is available from Mass-Vac, Inc., Herbert W. Gatti, 11 Esquire Rd., North Billerica, MA 01862.

Pumps

Three new low capacity progressive cavity pumps for use in metering chemicals for fine coated papers and as lab pumps are described in literature. For information, contact Rick Strait, Netzsch, Inc., 119 Pickering Way, Exton, PA 19341.

Pigments

A new brochure has been published featuring pearl lustre pigments for manufacturers of plastics, paints, paper coatings, and printing inks. Included is a visual demonstration of the three-dimensional color printing effects obtainable with these pigments and illustrated is a concept which allows designers great flexibility in achieving unique color effects. For a copy, contact Plastics & Coatings Group, EM Chemicals, 5 Skyline Dr., Hawthorne, NY 10532.

Fire Test Standards

Standards intended for the analysis and assessment of the fire performance of materials, products, and systems within their relevant environment are contained in the "Compilation of Fire Test Standards," recently published by ASTM. The book encompasses 33 standard test methods, specifications, guides, and terminology developed by 17 ASTM committees. Cost of the book is $39 and is available from ASTM Sales Services Dept., 1916 Race St., Philadelphia, PA 19103.

Solvents

A new brochure entitled, "Adhesive Solutions With CHLOROTHENE® SM and AEROTHENE® MM Solvents," contains 32 pages of technical information on specially formulated grades of methylene chloride and 1,1,1-trichloroethane. The physical properties of both solvents—no flash point, optimum and controllable evaporation rate, low residue content, low corrosion, low toxicity, and negligible environmental impact—are discussed. Specific considerations and uses of both solvents are detailed, as are the safety and equipment needs of manufacturers utilizing AEROTHENE MM and CHLOROTHENE SM solvents. For copies of the brochure, Form No. 100-5876-82, write Susan King, Inquiry Correspondent, Inorganic Chemicals, Dow Chemical U.S.A., 1703 South Saginaw Rd., Midland, MI 48640.

Chemical Waste Service

A new brochure from Ashland describing a unique chemical waste service available to the company's chemical customers has been published. Through an unusual distributor agreement with Chemical Waste Management Inc. (CWM), the country's leading chemical waste disposal firm, Ashland's Industrial Chemicals & Solvents (IC&S) Division can now provide a pick-up, transportation and disposal program, safely and legally, throughout the industrial markets it serves. The new service ties together sophisticated treatment and disposal facilities at 18 EPA permitted chemical waste handling sites managed by CWM, with the convenience, truck transport and logistics capabilities of the more than 60 IC&S locations across the U.S. Individual proposals are prepared based on each customer's needs and the types of waste involved. For complete information on this new chemical waste service, request Bulletin 1506 from Ashland Chemical Co., Dept. CW, P.O. Box 2219, Columbus, OH 43216.

Surfactants

A recently published product guide on surfactants for emulsion polymerization is now available. Four surfactant groups are included: ALIPAL ether sulfates; GAFAC phosphate esters; IGEPAL nonionics; and NEKAL sulfonated surfactants. Data on these groups detailed in the product guide include physical form, solids content, surface tension, solubility, and interfacial tension in different monomers. Conformance of surfactants with FDA regulations is also listed. For a copy of the product guide #2302-062, write to GAF Corp., Surfactants Chemicals, 140 W. 51 St., New York, NY 10020.

Monomers

Literature featuring ROCRYL 400 Series of specialty monomers is now available. Bulletin CM-50 discusses the composition and physical properties, chemical reactions, applications, and safety/health aspects of the ROCRYL 400 series. Copies are available from Marketing Services, Advertising Dept., Rohm and Haas Co., Independence Mall West, Philadelphia, PA 19105.

Particle Technology

A monograph introducing particle technology to scientists and engineers concerned with evaluating materials and materials properties is now available. Particle technology, an invaluable tool for research and development and quality control/quality assurance applications, covers topics such as the influence of particle size and range, importance of surface area, effect of pores, and density. Typical application using this quantification technique are also highlighted. The brochure is available from Micromeritics Instrument Corp., Jean Owens, 5680 Goshen Springs Rd., Norcross, GA 30093.

Data Poster

The revised third edition of its full color wall poster giving practical data about key organic pigment raw materials that fall within the scope of the Toxic Substances Control Act is now available from the Pigments Division of Sun Chemical Corp. Two easy-to-read charts are shown: the first providing cross-references between pigment classes and organic pigment raw materials, and the second giving significant technical data about each raw material. The organic pigment inventory chart lists 35 pigment classes with information provided on each class. Forty-seven raw materials are listed in the key organic pigment raw materials chart with technical data such as commercial name, chemical named, empirical formula, and CAS registry number provided. Both charts are color-coded to indicate whether the raw material is amine, coupler, crude of dyestuff, diazotising agent, quinacridone precursor, or salt. For a free copy of the "Toxic Substances Control Act" wall poster, write to Marketing Dept., Sun Chemical Corp., Pigments Div., 411 Sun Ave., Cincinnati, OH 45232.

PRA Paint Industries Review

The National Technical Information Service has announced the acquisition and availability of a comprehensive report from the Paint Research Association entitled, "The World Paint Industries: A Review, 1980-81," by Helma Jotischky, Ph.D, A.L.A. This statistical compendium deals exclusively with the paint market in the U.K. and in 22 other countries. The information contained in this 388-page report is based entirely on published sources obtained from the extensive holdings of the PRA Library and its documentation network. For additional information, contact U.S. Department of Commerce, NTIS, 5285 Port Royal Rd., Springfield, VA 22161.

Color Matching System

A new Color Matching System, the CMS/III, is featured in recent literature. Application uses, outstanding features, and available special standard programs are discussed. For information, contact Color Communications, Macbeth, Div. of Kollmorgen Corp., P.O. Box 950, Newburgh, NY 12550.

Infrared Spectrophotometers

Low cost infrared spectroscopy with ratio recording is the subject of a colorful 12-page brochure describing the performance capabilities of Perkin-Elmer's new Model 1420 and 1430 infrared spectrophotometers. Ratio recording, ordinate scale expansion, automatic gain set, and full compatibility with the Perkin-Elmer infrared data station are a few of the outstanding features of the 1400 Series instruments described. One full page spread illustrates and explains the new touch panel controls. Performance of the 1400 Series is demonstrated showing 10 examples of sample spectra under various operating modes. A sample computer readout of the PSU (possible structural unit) Search program is presented. Specifications for both the Model 1420 and 1430 conclude the brochure. For a free copy, order No. L-727, from the Perkin-Elmer Corp., Main Ave., Mail Station 12, Norwalk, CT 06856.

Polymer Testing Service

Information is available on polymer testing and analysis which enables clients to benefit from such advanced characterization techniques as laser light scattering and thermal analysis. Contact Ms. Marty Sue, Union Carbide Corp., Technical Center, P.O. Box 8631, South Charleston, WV 25303 for additional information.

Plastic Can

A new brochure has been published which features the Poly-Strong plastic can. One part of the literature cites production advantages of the plastic can such as it being dent-resistant, rustproof, and puncture-resistant and compatible with most production lines, Bail-O-Matics, and labelling machines. The second part of the brochure outlines the can's selling features to both retailers and consumers. For more information, contact Armstrong Containers, Inc., 10330 Roosevelt Rd., Westchester, IL 60153.

Measurement of Wet Paint Films

"Techniques of Objective Color Measurement of Wet Paint Films," another in HunterLab's series of *Application Notes,* is available. This issue emphasizes acceptable procedures and techniques for making color measurements of wet paint samples. Information on the use of HunterLab instruments to satisfy these requirements is also included. For a copy or additional information, please contact HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090.

Fused Silica

Detailed technical information on SILTEX brand fused silica, an ultra-high performance extender pigment and filler for the coatings and polymer industries, has been published. Typical physical properties, suggested applications, and benefits are included in the data sheet. Further information can be obtained by contacting Kaopolite, Inc., 511 Westminster Ave., P.O. Box 277, Elizabeth, NJ 07207.

Macerators

Literature is available describing macerators used for grinding, mixing and processing operations as well as waste treatment plants to chop, grind, and prepare solids, entrained in liquids, for pumping and processing. For information, write Rick Strait, Netzsch, Inc., 119 Pickering Way, Exton, PA 19341.

Molded Coatings

Information is available on Polane® Glas-Clad™, a high performance molded coating for plastic components. Featured are the coating's uses, formulas, and benefits. A data sheet is available from The Sherwin-Williams Co., Chemical Coatings Div., 11541 S. Champlain Ave., Chicago, IL 60628.

Mica Coatings

The just-released Supplement No. 2 of the *Wet Ground Mica Coatings Handbook* is available which includes an introduction, a bibliography, and 59 pages of formulas for metal protective paints, exterior and masonry coatings, and coatings for special applications. Accompanying the supplement are 20 pages of reprints from the technical press on applications of wet ground mica in coatings, as well as a technical data sheet and a recommended method for dispersion of 325 mesh wet ground mica.

The formulas are organized in groups of color-coded pages for easy reference to applicable types of paint. The 32-page section on metal protective paints includes formulas currently in use from nine sources of raw materials for coatings. Mixing instructions (where required), sources of raw materials, and supplementary technical information are all included. The 15-page section on exterior coatings is similarly organized, as is the 8-page section on masonry coatings. The miscellaneous section covers applications in swimming pool paints, interior primers, lacquer for plastics, and mastic roof coatings. The entire looseleaf kit in a presentation file cover is available from: The English Mica Co., P.O. Box 709, Kings Mountain, NC 28086.

Resins

Epotuf® epoxy resins and hardeners for chemical coatings are covered in a new bulletin. The bulletin's 36 pages contain information on Epotuf liquid and hard epoxy resins, solutions of hard epoxy resins, epoxy esters, epoxy hardeners, both of the amine and polyamide types, as well as Beckamine® urea-formaldhyde resins and Varcum® phenolic resins. Charts provide the physical specifications on the Epotuf epoxy resin line which allows paint chemists to produce one- or two-component air-drying or baking coatings which exhibit good adhesion, hardness, abrasion, alkali, chemical, and solvent resistance. A general description of epoxy resins, principles of coating formulation, and a number of suggested formulations are also included. The bulletin is available from Reichhold Chemicals, Inc., 525 North Broadway, White Plains, NY 10603.

Coming Events

FEDERATION MEETINGS

(Apr. 26–27)—Federation Seminar on "The Efficient Operation of an Up-to-Date Paint and Coatings Laboratory." Hilton Plaza Inn, Kansas City, MO. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(May 19–20)—Spring Meetings. Society Officers on 19th; Board of Directors on 20th. Terrace Hilton Hotel, Cincinnati, OH. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Oct. 12–14)—61st Annual Meeting and 48th Paint Industries' Show. Place Bonaventure, Montreal, Quebec, Canada. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1984

(May 17–18)—Spring Meetings. Society Officers on 17th; Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Oct. 30–Nov. 2)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

(Feb. 7–9)—10th Annual "Water-Borne and Higher-Solids Coatings" Symposium sponsored by the Southern Society for Coatings Technology and the University of Southern Mississippi. New Orleans, LA. (Dr. Gary C. Wildman, University of Southern Mississippi, Southern Station, Box 5165, Hattiesburg, MS 39406).

(Feb. 23–25)—16th Biennial Western Coatings Societies' Symposium and Show. Hyatt Regency, San Francisco, CA. (Ted Favata, Chairman, Triangle Coatings Co., 2222 Third St., Berkeley, CA 94710).

(Mar. 23–26)—Southern Society Annual Meeting. Peabody Hotel, Memphis, TN. (William E. Early, Piedmont Paint Mfg. Co., P.O. Box 6223, Stn. B, Greenville, SC 29606).

(Apr. 13-15)—Southwestern Paint Convention. Lowe's Anatole Hotel, Dallas, TX.

(Apr. 26–27)—"Advances in Coatings Technology." 26th Annual Technical Conference of the Cleveland Society for Coatings Technology. NASA-Lewis Research Center, Cleveland, OH. (Dr. Richard R. Eley, Glidden Coatings & Resins, P.O. Box 8827, Strongsville, OH 44136).

(May 4)—Detroit Society for Coatings Technology FOCUS —"Corrosion Resistance." Michigan State University Education

Center. (Peter Burnett, Wyandotte Paint Products Co., 650 Stephenson Hwy., Troy, MI 48084).

(May 5-7)—Pacific Northwest Society Symposium. Thunderbird Inn, Portland, OR. (Chairman Gerry McKnight, Lilly Industrial Ctgs. Inc., 619 S.W. Wood St., Hillsboro, OR 97123).

(June 10–11)—Joint meeting of Kansas City and St. Louis Societies. Holiday Inn, Lake of the Ozarks, MO.

OTHER ORGANIZATIONS

(Jan. 17–21)—"Design and Evaluation of Industrial Hygiene Ventilation Systems" Short Course. Rocky Mountain Center for Occupational and Environmental Health, University of Utah, Salt Lake City, UT. (K. Blosch, University of Utah, Bldg. 512, Salt Lake City, UT 84112).

(Jan. 23–24)—ASTM Committee E-13 on Appearance of Materials Meeting. Dutch Inn, Orlando, FL. (Kitty Riley, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 23–27)—Semi-Annual Meeting of the American Society for Testing and Materials Committee D-1 on Paint and Related Coatings and Materials. Dutch Inn, Orlando, FL. (ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 26)—ASTM Committee G-3 on Durability of Nonmetallic Materials Meeting. Dutch Resort Hotel, Orlando, FL. (Phil Lively, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 26)—"New Concepts for Coating Protection of Steel Structures" Symposium sponsored by ASTM Committee D-1 on Paint and Related Coatings and Materials and the Steel Structures Painting Council. Dutch Inn, Orlando, FL. (Cochairman R.F. Wint, Hercules Incorporated, 910 Market St., Wilmington, DE 19899).

(Feb. 1)—"Conversion Coatings as a Substrate for Organic Finishes" Workshop sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Phoenix Civic Plaza, Phoenix, AZ. (Donna Theisen, Technical Activities Dept., SME, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Feb. 3–4)—"Fundamentals of Color" Seminar. Miami, FL. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(Feb. 6–9)—Conference on Color and Illumination sponsored by the Inter-Society Color Council and the Illuminating Engineering Society of North America. Colonial Williamsburg Lodge, Williamsburg, VA. (General Chairmen, Charles W. Jerome and William A. Thorton, Westinghouse Lamp Div., One Westinghouse Plaza, Bloomfield, NJ 07003).

(Feb. 11–13)—Southern Decorating Products Show. Atlanta Apparel Mart, Atlanta, GA. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Feb. 15–17)—"Maintenance Painting" Short Course. Marriott Hotel, Bloomington, MN. (Arts & Sciences Continuing Education, G-7 Humanities-Social Sciences Bldg., University of Missouri-Rolla, Rolla, MO 65401).

(Feb. 19–20)—Fourth Annual Short Course on "Adhesion Theory and Practice" sponsored by The Adhesion Society. Sheraton Savannah Inn, Savannah, GA. (G.F. Hardy, Treasurer, The Adhesion Society, c/o Celanese Research Co., P.O. Box 1000, Summit, NJ 07901).

(Feb. 20–23)—The Adhesion Society's Sixth Annual Meeting. Sheraton Savannah Inn, Savannah, GA. (Prof. James Koutsky, University of Wisconsin, Chemical Engineering Dept., 1415 Johnson Dr., Madison, WI 53706).

(Feb. 22–24)—"Estimating for Painting Contractors and Maintenance Engineers" Short Course. Marriott Hotel, Bloomington, MN. (Arts & Sciences Continuing Education, G-7 Humanities-Social Sciences Bldg., University of Missouri-Rolla, Rolla, MO 65401).

(Feb. 24–25)—"Fundamentals of Color" Seminar. Houston, TX. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(Mar. 1)—"Conversion Coatings as a Substrate for Organic Finishes" Workshop sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Baltimore Convention Center, Baltimore, MD. (Donna Theisen, Technical Activities Dept., SME, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Mar. 1–4)—Fourth International Cadmium Conference. Bayerischer Hof Hotel, Munich, West Germany. (Cadmium Council Inc., 292 Madison Ave., New York, NY 10017).

(Mar. 5–6)—Canadian Decorating Products Show. Skyline Hotel, Toronto, Ont. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Mar. 10–11)—"Fundamentals of Color" Seminar. Birmingham, AL. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(Mar. 24–25)—"Fundamentals of Color" Seminar. Charlotte, NC. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(Mar. 26–27)—Western Decorating Products Show. Disneyland Hotel, Anaheim, CA. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Mar. 28–31)—"Cutting Costs with Computers and Automated Systems"—National Plant Engineering & Maintenance Conference and Exhibition. McCormick Place, Chicago, IL. (Clapp & Poliak, A Cahners Exposition Group Co., 708 Third Ave., New York, NY 10017.)

(Apr. 10–12)—Inter-Society Color Council Annual Meeting. Louisville, KY. (Fred W. Billmeyer, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Apr. 11–12)—23rd Annual Symposium of the Washington Paint Technical Group. Marriott Twin Bridges Motel, Washington, DC. (Mildred A. Post, Publicity Chairperson, WPTG, P.O. Box 12025, Washington, DC 20005).

(Apr. 12–14)—ASTM Committee C-22 on Porcelain Enamel and Related Ceramic-Metal Systems Meeting. ASTM/Philadelphia Centre, Philadelphia, PA. (Drew Azzara, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Apr. 14–15)—"Fundamentals of Color" Seminar. Seattle, WA. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(Apr. 17–20)—National Coil Coaters Association Annual Meeting. Marriott's Marco Beach Hotel, Marco Island, FL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Apr. 18–22)—Corrosion/83 sponsored by the National Association of Corrosion Engineers. Anaheim, CA. (NACE, P.O. Box 218340, Houston, TX 77218).

(Apr. 19–21)—Chemical Coaters Association. "Surface Coating 83." Milwaukee, WI. (Chemical Coaters Association, Box 241, Wheaton, IL 60187).

(Apr. 20–22)—ASTM Committee C-3 on Chemical Resistant Nonmetallic Materials Meeting. Galt House, Louisville, KY. (Jim Dwyer, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Apr. 28–29)—"Fundamentals of Color" Seminar. Don Mills, Ont., Can. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(May 8–12)—74th Annual Meeting of the American Oil Chemists' society. Chicago Marriott Hotel, Chicago, IL. (American Oil Chemists' Society, 508 S. Sixth St., Champaign, IL 61820).

(May 9–11)—RADCURE '83 Conference sponsored by AFP/SME, Palais de Beaulieu, Switzerland. (Susan Buhr, Society of Manufacturing Engineers, One SME Drive, P.O. Box 930, Dearborn, MI 48128).

(May 10–12)—Paint Research Association's Fifth International Conference, "Technological Advances in the Coatings Industry." London Penta Hotel, London, England. (PRA, Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

(May 11–13)—23rd Annual Marine and Offshore Coatings Conference. Hyatt Regency Hotel, Baltimore, MD. (National Paint & Coatings Association, Inc., 1500 Rhode Island Ave., NW, Washington, DC 20005).

(May 12–13)—"Fundamentals of Color" Seminar. Newton Lower Falls, MA. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(May 19-20)—"Fundamentals of Color" Seminar. Cherry Hill, NJ. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(May 23-25)—ASTM D-33 Coatings for Power Generation Facilities Committee Meeting. Galt House, Louisville, KY. (Dean M. Berger, Gilbert/Commonwealth, P.O. Box 1498, Reading, PA 19603).

(May 24-26)—8th Annual Powder and Bulk Solids Conference/Exhibition. World Congress Center, Atlanta, GA. (Cahners Exposition Group, 222 W. Adams St., Chicago, IL 60606).

(June 2-3)—"Fundamentals of Color" Seminar. Rosemont, IL. (Jeanne M. Dolan, Macbeth, Div. of Kollmorgen Corp., Little Britain Rd., P.O. Box 950, Newburgh, NY 12550).

(June 15-18)—Oil & Colour Chemists' Association Biennial Conference on "The Efficient Use of Surface Coatings." Viking Hotel, York, England. (R.H. Hamblin, Director and Secretary, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF, England).

(June 19-22)—Dry Color Manufacturers' Association Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (P.J. Lehr, DCMA, Suite 100, 117 N. 19th St., Arlington, VA 22209).

(June 26-27)—ASTM Committee E-12 on Appearance of Materials Meeting. Hyatt Regency Nashville, TN. (Bob Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103).

(June 26-29)—ASTM Committee D-1 on Paint and Related Coatings and Materials Meeting. Hyatt Regency Nashville, Nashville, TN. (Phil Lively, ASTM, 1916 Race St., Philadelphia, PA 19103).

Advertisers Index

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'Humbug' from Hillman

It was so nice to hear from several of my faithful friends including two new, kind contributors—Maureen Lein and David Lauren (yes—son of our steady faithful, Sid Lauren).

Notes from dear old Dad, Sidney, Howard Jerome, Frank Borelle, Earl Hill, and other one thoughtful friend (whose name I lost) also found their way to Humbug's Nest in Vermont.

Below are pieces from some of the startling and something less than hilarious contributors. The battle to curtail the intellectual development of the JCT goes on—albeit with reduced forces.

Religion again takes over some of our sacred space with:

Church Bulletin Humor

Sometimes the word arrangement in church bulletins is humorous. Below are some samples. All are authentic, taken directly from announcements made in various churches.

- "This afternoon there will be meetings in the South and North ends of the church. Children will be baptized at both ends."
- "Tuesday at 4:00 P.M. there will be an Ice Cream Social. All ladies giving milk, please come early."
- "Wednesday, the Ladies Literary Society will meet Mrs. Johnson will sing 'Put Me in My Little Bed', accompanied by the Pastor."
- "Thursday at 5:00 P.M. there will be a meeting of the Little Mothers Club. All wishing to become Little Mothers will please meet with the minister in his study."
- "This being Easter Sunday we will ask Mrs. Brown to come forward and lay an egg on the Altar."
- "The service will close with 'Little Drops of Water'; one of the men will start quietly and the rest of the congregation will join in."
- "The ladies of the church have cast off clothing of every kind, and they can be seen in the church basement on Friday afternoon."
- "On Sunday a special collection will be taken to defray the expenses of the new carpet. All wishing to do something on the carpet please come forward and get a piece of paper."

Now that foul weather has returned to a considerable portion of the country, perhaps the following from Howard Jerome may be apropos.

Murphy's Laws of Foul Weather Driving

- "If it will snow on a weekday, it will always commence before the rush hour."
- "If there will be stalled automobiles en route, they will be in front of you, not behind, and it will be in your traffic lane."
- "When visibility is critical, the width of the truck in front of you, is directly proportional to the intensity of the snowfall."
- "If you change lanes in heavy traffic, your new lane will immediately cease to move." (This is a variation of Gordon's Law of supermarket checkouts.)
- "Your supply of windshield washer fluid is inversely proportional to the amount of slush on the road."
- "If your wife cooks a really good meal only once or twice a month, those are the days you will get home two hours late due to snow and traffic."
- "Even with well timed departures, you will arrive at any given steep hill before the salt truck."

Frank Borrelle sends us this contribution from *Tradeshow Week*:

Let's Hear It for Paint

Floor Coating Reduces Cleaning Time and Rising Maintenance Bills. A protective painted-on coating is helping crews at the 48-year-old Chicago International Amphitheatre cut cleaning time in half for one of the nation's dirtiest floors. For years, rodeos, circuses, tradeshows and other events exposed the bare concrete arena floor to abnormal wear and dirt, according to Larry Caine, President & General Manager. To reduce clean-up and rising maintenance bills, the arena decided to give the floor a protective coating.

In the summer of 1980, Caine's work crews applied a PPG epoxy-polyamide clear floor sealer and finish to the concrete surface. "Since application, the finish has lost some of its sheen, but we expected that, considering the heavy load of events we schedule." The big performance plus is in cleanup. "Our cleanup time has been halved, and that's extremely important to us with rising maintenance bills. The sealer and finish have made us more efficient and cut our costs while giving us a better looking, durable arena floor."

The PPG product takes the abuse. More than 100 two-gallon kits of the clear floor sealer and finish were used to cover the main arena floor of the Center. Other floors in the complex will be finished with the coating as work schedules permit.

And as another "Humbug from Hillman" winds down to a close, I leave you all to ponder over yet another of Earl Hill's ponderous principles. This time our sage words come from none other than Sherlock Holmes.

It seems my dear Watsonians, that Sherlock was wont to have said at the drop of a clue: "It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts."

—Herb Hillman

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