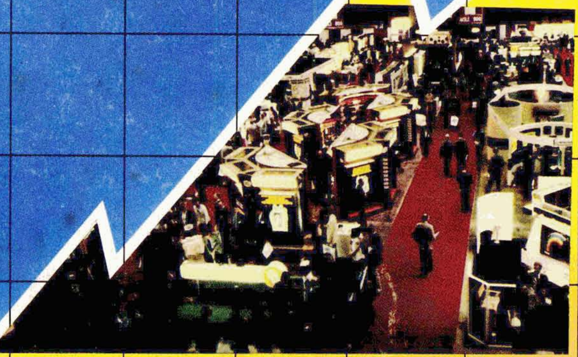
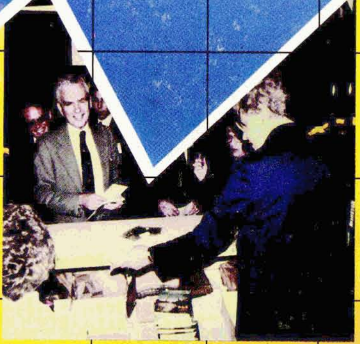
jct JOURNAL OF COATINGS TECHNOLOGY

JCTAX 57 (731) 1-112 (1985)

December 1985

COATINGS R&D TODAY'S INVESTMENT IN TOMORROW





1985 CONVENTION WRAP-UP ST. LOUIS, MISSOURI

Cost
Availability
Safety
Effectiveness

The CASE for ARCOSOLV® solvents keeps getting stronger

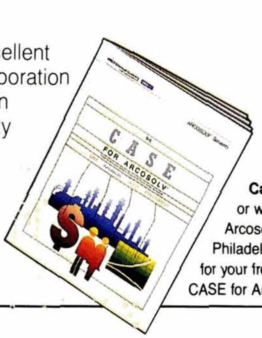
When you need the cost and performance of E-series solvents, but want the safety of P-series, it's an open and shut case—you want Arcosolv solvents from ARCO Chemical Company. Why? Because we produce only P-series solvents. So, we have to make them right—and in the quantities you need, available where you need them. That's why we introduced Arcosolv P-series ethers in 1981, PM acetate in 1983, DPM acetate in 1984; why we have increased terminal locations, and increased our production capacity.

It's a CASE of putting what you need where you need it . . .

Arcosolv P-series ether and acetate production has expanded to more than 125 million pounds per year. It's available from strategically located terminals across the country, and from our network of highly-trained distributors, ready to put the case for Arcosolv solvents to work for you. Today.

. . . with the effectiveness you want.

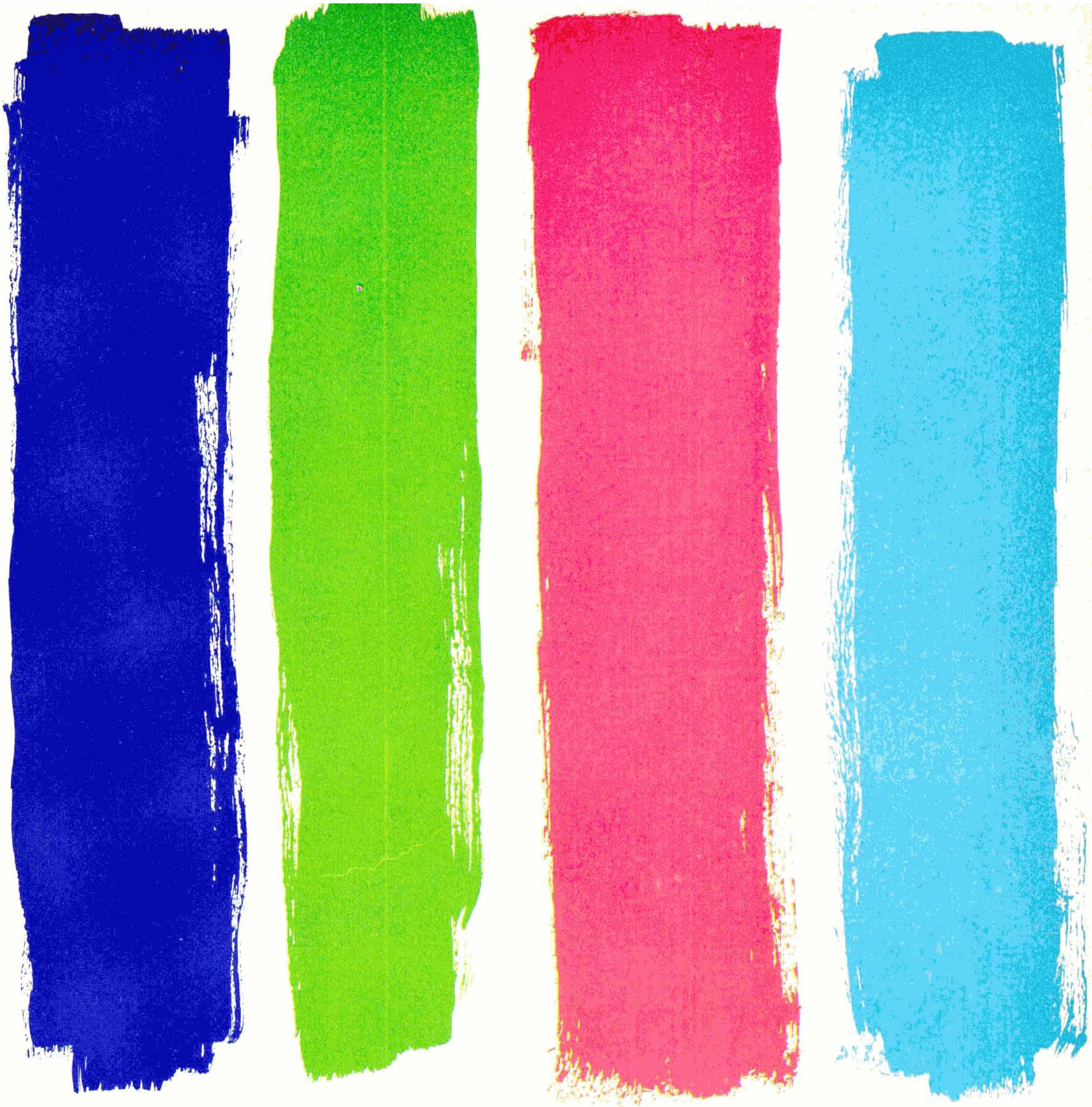
With solvency power for a wide variety of substances, excellent coupling and coalescing ability, and a good range of evaporation rates, Arcosolv solvents are the straightforward formulation choice for everything from automotive coatings to specialty paints, industrial cleaners to electronic chemicals. In many cases Arcosolv solvents have directly replaced E-series. And if you need reformulation assistance, we're ready to help.

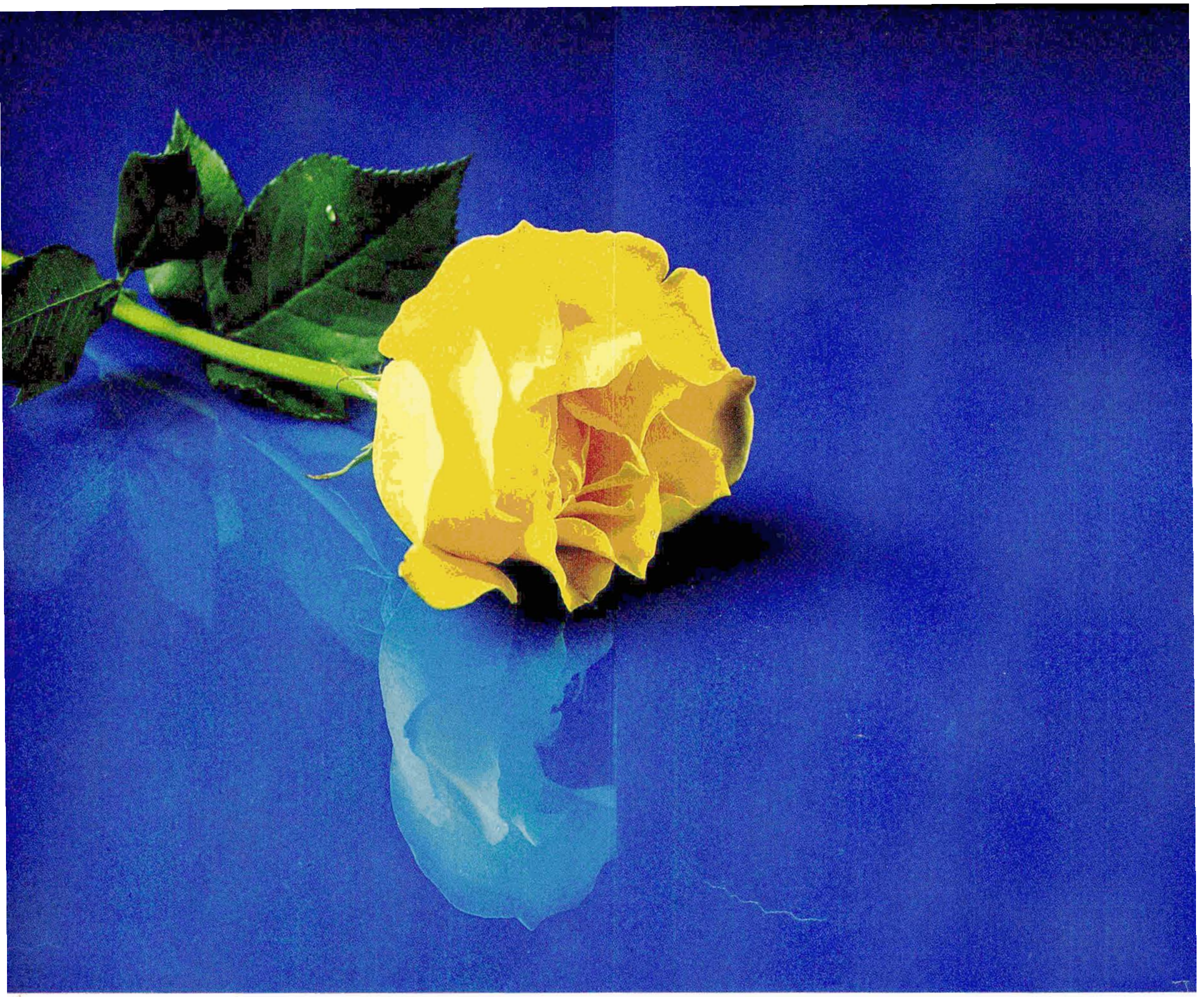


Call Toll-Free 1-800-354-1500, or write to ARCO Chemical Company, Arcosolv Solvents, 1500 Market Street, Philadelphia, PA 19101, for your free copy of "The CASE for Arcosolv Solvents."

ARCO Chemical Company
Division of AtlanticRichfieldCompany

ARCO





DECEMBER 1985

jct JOURNAL OF COATINGS TECHNOLOGY

VOLUME 57 NUMBER 731

Technical Articles

Federation News

Departments

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

Second class postage paid at Philadelphia, PA and at additional mailing offices. POSTMASTER: Send address changes to JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

Subscriptions: U.S. and Canada—1 year, $27; 2 years, $51; 3 years, $73. Europe (Air Mail)—1 year, $50; 2 years, $97; 3 years, $142. Other countries—1 year, $37; 2 years, $71; 3 years, $103.

Any way you handle it,

It's a whole new deal from Rohm and Haas.

Why is this RHOPLEX polymer different from all others? Because it's the proud result of an entirely new technology—one that offers state of the art early handling characteristics, *plus* high performance versatility.

Formulate with RHOPLEX WL-92 polymer whenever products will be stacked, packed or moved soon after paint application. And consider it for coatings used on a diverse range of products and substrates—from plastic molding to metal doors to wood furniture.

RHOPLEX WL-92 polymer delivers sparkling clarity for clear lacquers. Glowing warmth over wood. High gloss for the entire spectrum of color finishes. And, of course, long-term resistance you can depend on.

PERFORMANCE BENEFITS

- **Early and higher stackability, with no sticking**
- **Earlier packing and shipping**
- **More resistance to dust and dirt damage**
- **Fewer rejects and returns due to coating and handling procedures**
- **Long-term protection**
- **The perfect balance of handling, appearance and resistance properties**

New technology comes up aces:

RHOPLEX® WL-92

Waterborne Acrylic Polymer for Air-Dry Lacquers

you win.

FORMULATION BENEFITS

- **Low VOC for environmentally acceptable coatings**
- **The versatility to formulate for many coatings needs and substrates with only one resin, simplifying inventory management**
- **Compatible with corrosion-inhibiting pigments**
- **Ease of formulation**

APPLICATION BENEFITS

- **Extremely versatile—application can be by spray, dip, flow or direct roll**

Deal yourself a perfect hand now.

Don't gamble with handling properties for fresh coated products. With coatings based on RHOPLEX WL-92 polymer, you have a sure thing every time. For more information, literature and evaluation samples, contact your local Rohm and Haas technical representative or write our Marketing Services Department, Independence Mall West, Philadelphia, PA 19105

ROHM AND HAAS
PHILADELPHIA, PA. 19105

JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., PA 19107

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

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

	U.S. and Canada	Europe (Air Mail)	Other Countries
1 Year	$27.00	$ 50.00	$ 37.00
2 Years	$51.00	$ 97.00	$ 71.00
3 Years	$73.00	$142.00	$103.00

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

The JOURNAL OF COATINGS TECHNOLOGY has first rights to the publication of papers presented at the Annual Meeting of the Federation and at local and regional meetings of the Federation's Constituent Societies.

A Guide for Authors is published in each January issue.

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

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

Comment

The Roon Awards: Thirty Years of Competition

Among the highlight presentations at each Federation Annual Meeting are papers entered in the Roon Awards competition. Over the years, the competition has attracted entries from many of the top technical people in the industry, and has done much to advance the knowledge of coatings science and technology.

The Awards were established in 1957 by the late Leo Roon, well-known figure in the coatings industry for many years, and are supported by funds provided through the Roon Foundation. They are presented to the authors of the best technical papers at each Federation Annual Meeting, and the entries are subsequently published in the JCT; top paper in the 1985 competition appears in this issue on pages 49-55.

In addition to the attraction of the monetary reward (winners share a $4,000 purse), entrants in the competition also enjoy the opportunity to make a scientific contribution to the industry, and to derive professional prestige for themselves and their employers.

Entries in the 1986 competition—the 30th Anniversary of the Awards—are now being accepted. Prospective authors should notify the Roon Awards Committee Chairman of their intent *by March 1* (Phillip W. Harbaugh, c/o Reliance Universal, Inc., P.O. Box 37510, Louisville, KY 40232).

Complete information on the Awards is included in the Federation *Year Book,* or may be obtained by contacting FSCT headquarters or Chairman Harbaugh.

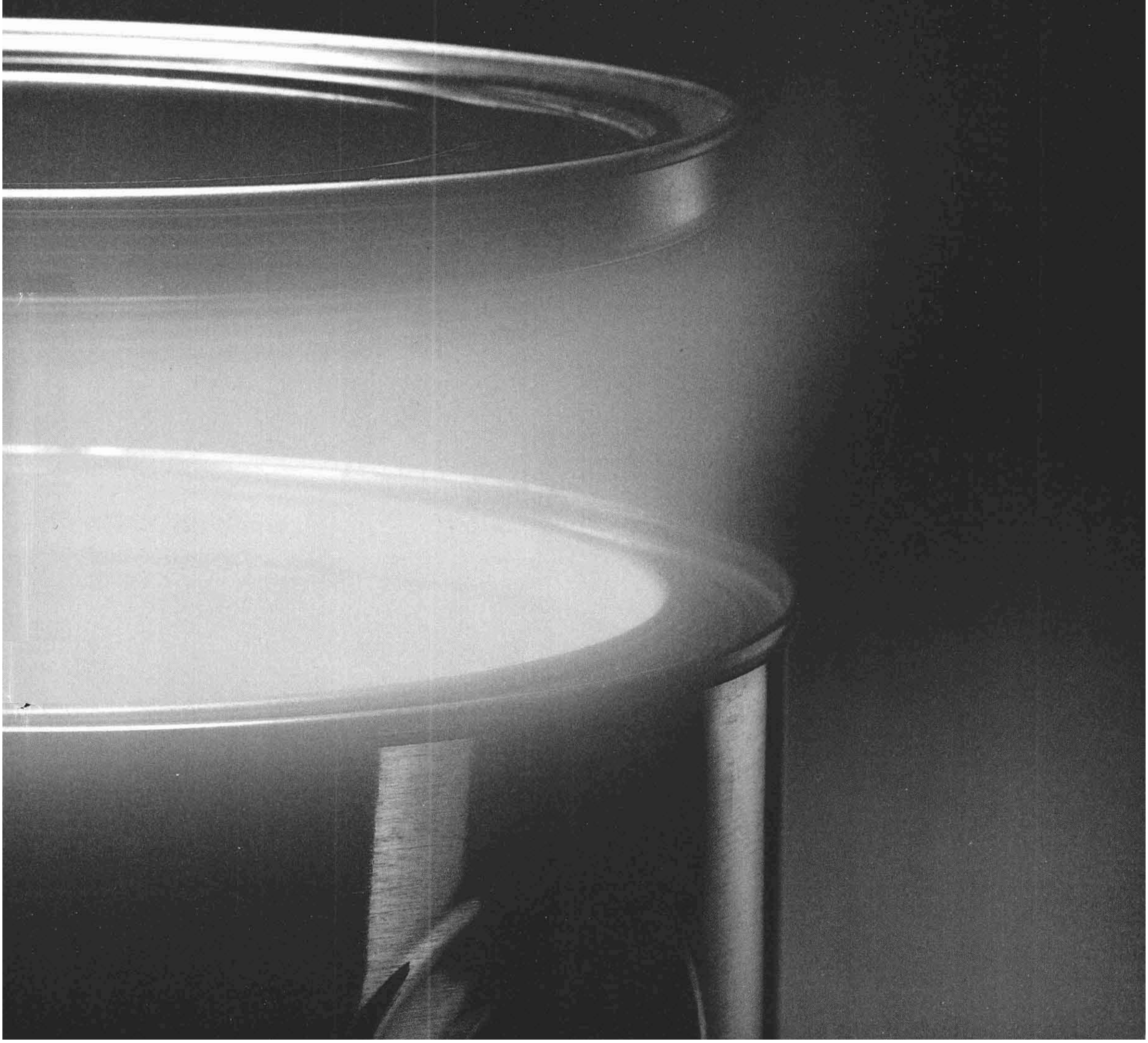
Plan now to get those manuscripts in early and make the anniversary competition for next year's Annual Meeting in Atlanta an outstanding success!

Thomas A. Kocis,
Contributing Editor

WHAT A BRI

Introducing Rhoplex® HG-74 emulsion. The first true high-gloss acrylic latex vehicle.

Suddenly the future of high-gloss paint is looking very bright.
Now, for the first time, you can obtain true high-gloss in a latex paint. Your customers will never have to settle for semi-gloss when high-gloss is what they want. Or compromise with an oil-based paint to get the amount of gloss they need. With Rhoplex HG-74 acrylic emulsion, paint formulations enter a whole new dimension.



Abstracts of Papers in This Issue

EFFECT OF α-METHYL GROUPS ON ROOM TEMPERATURE CROSSLINKING IN ACRYLIC POLYMERS CONTAINING MAGME MONOMERS—H.R. Lucas

Journal of Coatings Technology, 57, No. 731, 49 (Dec. 1985)

Coating formulations, based on MAGME acrylic polymers and aimed at the automotive refinish market, were found to develop a rapid and high degree of cure with multifunctional primary amines at room temperatures. Curing at temperatures some twenty degrees below their glass transitions, these polymers exhibited large differences in their rate of hardness development and solvent resistance. Increasing the amount of α-methyl groups along the backbone of the polymer was found to greatly improve the properties of the coatings. Based on this work, a hypothesis has been proposed and supported by experimental data that these differences are largely due to the amount of inter- or intramolecular crosslinks that occur.

OBSERVATIONS ON MILDEW SUSCEPTIBILITY OF PAINTED SURFACES IN TROPICAL CHAMBER EXPOSURE—M. Greenberger, et al.

Journal of Coatings Technology, 57, No. 731, 59 (Dec. 1985)

Studies were performed to determine methodology requirements for evaluation of the mildew susceptibility of paint coatings in environmental (tropical) test chamber exposure. Paint coatings, formulated to be both susceptible and resistant, were exposed to cycled and uncycled conditions as unsprayed controls and after inoculation with differing combinations of mixed fungal spores and nutrient salts or soil.

A cycled walk-in environmental test chamber, used for microbial screening of diverse Army materiel, provided satisfactory conditions for fungal growth both on unsprayed paint coatings and coatings inoculated or treated with nutrient salts or soil. Specialized test cabinets and inoculation with specific test organisms were not essential requirements for evaluation of mildew susceptibility of paint coatings in environmental test chamber exposure.

FRENCH PROCESS ZINC OXIDE IN PRIMERS FOR HAND-CLEANED STRUCTURAL STEEL—W.C. Johnson

Journal of Coatings Technology, 57, No. 731, 67, (Dec. 1985)

Primers containing lead and chromate compounds as active pigments have provided dependable protection from corrosion for hand-cleaned structural steel. These primers are popular for maintenance painting jobs and in fabricating shops for new structures such as buildings and bridges. The pigments would continue to be the major functional ingredient in many primers were it not for the health and environmental threat they pose. Concern for health and the environment has led to the investigations of zinc oxide concentrations as replacements for lead or chromate pigments in primers for hand-cleaned steel.

On the basis of the evaluation program, including exposure tests of a range of experimental compositions, the following characteristics were found to be in the optimum range in terms of providing corrosion protection: one pound of French process zinc oxide per gallon; pigments minimally contaminated with soluble salts; a ratio of one to one, linseed oil to long oil alkyd; a pigment volume concentration of 30%; and, controlled sag resistance.

Optimum compositions based on the evaluation program were entered in the PACE (Performance of Alternative Coatings in the Environment) Phase I exposure test program conducted by the Steel Structures Painting Council (SSPC). The results were: the primer containing one pound of zinc oxide per gallon protected in a category next to red lead and zinc chromate primer. Because of its successful results in the PACE study and its success as a primer in the fabricating shop of a major industrial concern, the composition was adopted as SSPC Specification Paint 25.

MICROCOMPUTER-CONTROLLED AUTOMATIC WEIGHING-IN MACHINE FOR COMPUTER COLOR MATCHING—Y. Ito

Journal of Coatings Technology, 57, No. 731, 77 (Dec. 1985)

A great variety of colors are presently required in the paint industry and, accordingly, color tolerances are becoming increasingly severe. Because of this, computer color matching (CCM) is gaining an increasingly important role both in the laboratory and in production, and a weighing-in machine, suitable for CCM has been strongly needed.

Described here is a weighing-in machine developed for the CCM user and CCM researcher. This machine features many suitable characteristics, such as high accuracy (error is within ±0.02 g), a reasonable period of weighing-in time, quick and easy operation for exchanging colorants, and successive batch weighing-in.

Relax.
You've got Modaflow® in the mix.

You can rest easy.

Since you add a little Modaflow® resin modifier to all your nonaqueous coatings you don't have to worry about pinholes, craters or orange peel; or any of the other surface imperfections that cause customer dissatisfaction. And since you don't have much control over how your coatings are applied, that's a good feeling.

In addition, Modaflow acts as a defoamer, so it will smooth out your automatic filling operation. And of course, because Modaflow is available in both liquid and powder forms, it fits almost every application, including FDA-regulated applications.

What? You didn't add Modaflow?

Oh my. Well, call Monsanto immediately at 1-800-325-4330 extension 3381 for samples, technical information and price schedules. Just knowing that more information and samples are on the way could help you rest easier.

Remove a lot of worry by adding just a little Modaflow.®

Monsanto

Highlights from the Board of Directors Meeting And Other News from the 1985 AM&PS in St. Louis

Attendance (66)

The attendance included all 36 members of the Board, 16 Past-Presidents (three of whom are on the Board), and 14 other guests. Among the latter were representatives from five other industry associations: NPCA, CPCA, FSPVT, JSCM, and OCCAA.

Amendments to By-Laws/ Standing Rules

The By-Laws proposals lowering dues ($20 to $10) for Society Honorary Members and the revisions in procedures for nominations to Federation Honorary Membership received first reading... The Standing Rule additional guidelines for local technical groups wishing to affiliate with the Federation were passed, with change in the number of Active members (51%) and number of coatings manufacturers (5) required... The Standing Committee proposals re the Planning and Professional Development Committees were tabled.

Actions of Executive Committee

Those from the September 12, 1985 meeting of the Executive Committee were approved. Among them were: That the Southern Society's draft of Consumer Guide to Exterior Flat Latex Paints be referred back to the Society, with thanks for its commendable work...That the Federation respectfully deny a request to financially support the 1986 Gordon Research Conference on Coatings and Films...That (subject to NPCA approval as well) Atlanta be approved as the site for the 1993 AM&PS.

Paint Research Institute/ Coatings Industry Education Fund

After the Board meeting recessed, the PRI Board of Trustees convened and gave final approval to the change in name of PRI to CIEF. Following that, the Stockholders of PRI (the Federation Board) met and approved the proposed changes in the PRI By-Laws (to CIEF). The new Board of Trustees of the Coatings Industry Education Fund is: President—Neil S. Estrada (Chairman of Federation's Investment Committee); Vice-President—Joseph A. Vasta (Chairman of Educational Committee); Secretary-Treasurer—Deryk R. Pawsey (Federation Treasurer); Saul Spindel (Chairman of Technical Advisory Committee); and F. Louis Floyd (Chairman of Professional Development Committee).

Elections

The slate presented in the Spring by the Nominating Committee was elected:

President-Elect—Carlos Dorris, of Dallas Society

Treasurer—Deryk Pawsey, of Pacific Northwest Society

Executive Committee—Dan Toombs, of New England Society (3 years); Kurt Weitz, of Toronto Society (1 year)

Board of Directors—(Members-at-Large)—Richard M. Hille, of Chicago Society (2 years); John Lanning, of Louisville (2 years)

Board of Directors (Past-President)—J.C. Leslie, of Kansas City Society (2 years)

Committee Activities

Environmental Control—Barry Adler, of Golden Gate, and speaking for the four West Coast Societies, moved that the Federation appoint a staff person to serve as communicator/administrator to the Federation's Environmental Control Committee. After considerable discussion, the motion was tabled.

Dick Kiefer, of Philadelphia, presented a resolution asking the Executive Committee to give direct attention to the environmental problems of the California Paint Industry and issue a recommendation by mail to the Board and to the Officers of the Constituent Societies after the Executive Committee meeting of January 31, 1986, as to how the problems may be addressed either independently or in conjunction with NPCA. This was approved.

Professional Development/Educational Committees—Tom Hill, speaking for Western New York, requested that the Federation monitor the work of the Educational and the new Professional Development Committees because the duties of each appear to overlap to a significant degree.

Planning—Chairman Neil Estrada announced that the committee would meet during the Annual Meeting to review—among other things—the Southern Society's proposed Alfred Hendry Memorial Award, for which a $25,000 funding check had already been received at the Federation office.

Professional Development—Chairman Lou Floyd reviewed his report, the highlight of which was the plan to present a three-day short course on Statistical Process Control in the spring, to be repeated three-five times in major population centers within a two-three month period...The survey to determine the makeup of the Federation membership got underway with the distribution of a questionnaire at the AM&PS.

Publications—The report indicated that five manuscripts for the new Series on Coatings Technology are near final approval. Another 17 are in process.

Technical Advisory—Chairman Saul Spindel restated the committee's decision re Consumer Guide to Exterior Flat Latex Paints and referral back to the Southern Society with commendation and compliments for their work...Saul also noted that the first meeting of Society Technical Chairmen, under the new annual fall schedule, would take place on October 29-30, in Madison, WI. To date, he regretted that response from Society Technical Chairmen has been poor.

* * *

Other Business

Past-President J.C. Leslie requested the Executive Committee to establish a permanent policy of offering complimentary registrations and luncheon tickets to 50-year members and spouses who attend the AM&PS.

Dick Kiefer requested that the dates and locations of all Annual Meetings and Paint Shows be included in the *Year Book.*

(continued on page 14)

Highlights from the Board of Directors Meeting (Continued)

Roy Brown announced that the 1986 Seminar (Pittsburgh, May 13-14) would be on "Special Purpose Coatings." Also that the Proficiency Testing Program (which had 71 cooperating labs enrolled in 1985) is ready to commence the second year. And the consolidation of 15 Quality Control Tests (contributed by McWhorter, Inc.) into one VCR tape has been completed by staff and will be available for sale shortly.

The Symposium on Automotive Color Control (SACC) was announced for June 3-6, 1986, at the Michigan Inn, Southfield, MI. The event is sponsored by the Federation, the Detroit Colour Council, the Federation's Detroit Society, and the Manufacturers Council on Color and Appearance. It will acquaint participants with the new SAE Recommended Practice J1545 for determining color match acceptability of automotive components.

1985 Annual Meeting and Paint Show

The Program Sessions were well received and nearly 1,000 were in the room on Monday morning for the "Special Tribute to Paint Show Exhibitors" and the Keynote Address by John McAndrews, Group VP of the DuPont Co. A good crowd also turned out for the Mattiello Lecture by Ruth Johnston-Feller.

The unofficial registration count stands near the 6,000 mark, making St. Louis 1985 either the second or third highest. (Chicago 1984 was tops).

The "Big 50" Paint Show was indeed the biggest ever with 247 exhibitors in 56,000 sf of space. The Cervantes Convention Center is a magnificent facility. Two halls were filled with beautiful and colorfully-creative exhibits, making the Paint Show a wonderfully attractive sight to behold.

The Luncheon Speaker was Jim Valvano, Head Basketball Coach of North Carolina State. His motivational talk was just great and he received a standing ovation as he fled the Sheraton Hotel to catch a plane. Thirteen 50-year members were at the Luncheon and were introduced, along with their spouses.

A display area was provided for Society Commemorative Posters and some were very original and clever.

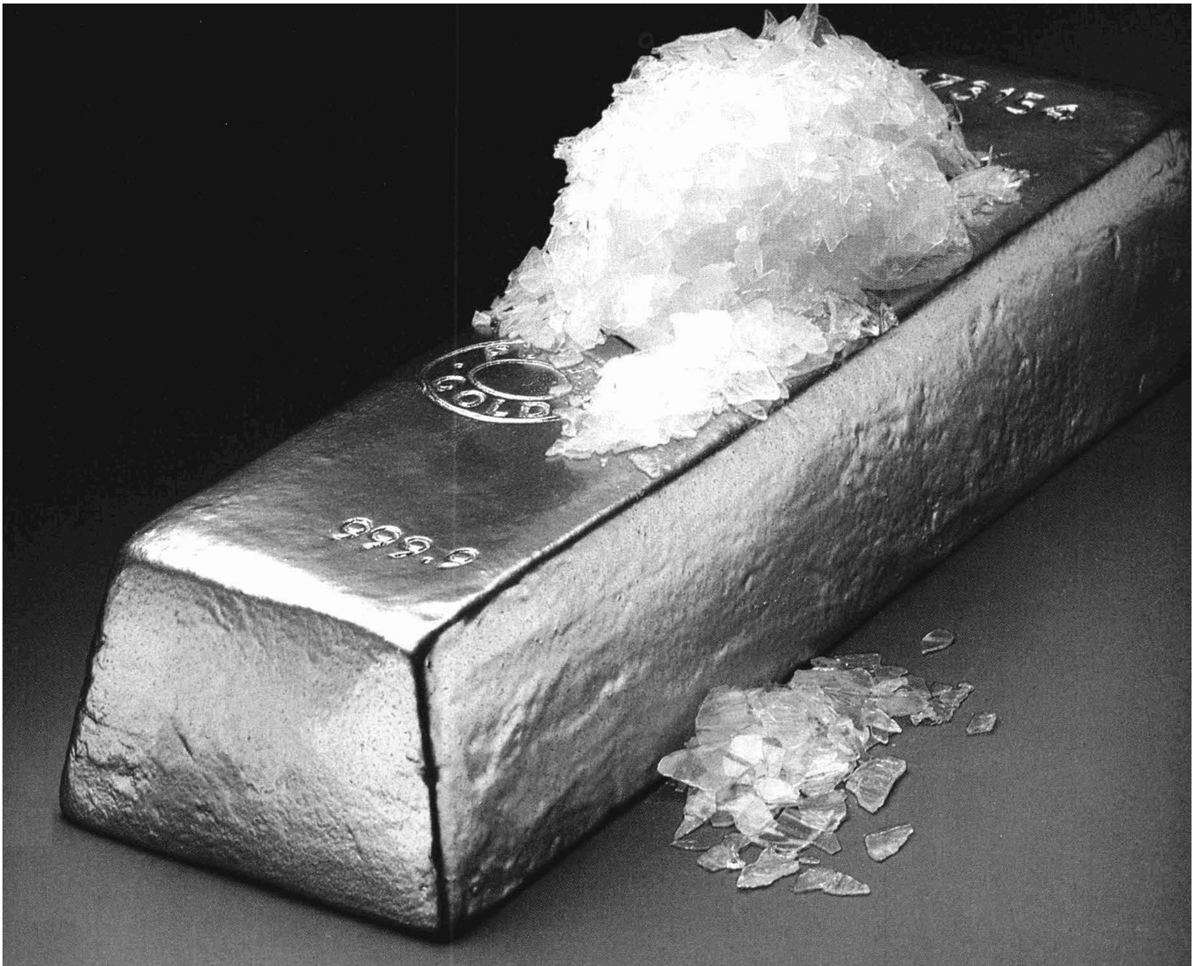
Much praise for a job well done is due: Joe Vasta, Program Chairman, and his committee; John Ballard, Paint Show Chairman, and his committee; and Howard Jerome, Host Chairman and his very cooperative and dedicated group from the St. Louis and Kansas City Societies. Gene Jerome arranged an entertaining Spouses Program.

Paint Research Institute Changes Name To Coatings Industry Education Fund

At its meeting of October 6, 1985, in St. Louis, the Board of Trustees of the Paint Research Institute formally approved By-Laws changes to change the name of PRI to "Coatings Industry Education Fund (CIEF)." The change, also approved by the PRI stockholders (Federation Board of Directors), became effective immediately.

The Board of Trustees of CIEF for 1985-86 are: *President*—Neil S. Estrada, Los Altos Hills, CA (Chairman of FSCT Investment Committee); *Vice-President*—Joseph A. Vasta, E.I. DuPont de Nemours & Co., Inc., Wilmington, DE (Chairman of FSCT Educational Committee); *Secretary-Treasurer*—Deryk R. Pawsey, Rohm and Haas Canada Inc., Vancouver, B.C., (FSCT Treasurer); Saul Spindel, D/L Laboratories, Inc., New York, NY (Chairman of FSCT Technical Advisory Committee); and F. Louis Floyd, Glidden Coatings & Resins, Strongsville, OH (Chairman of FSCT Professional Development Committee).

For highlights of the 1985 Annual Meeting and Paint Industries' Show, see pages 19-46. Coverage includes Awards, Technical Proceedings, and Exhibitor Booth Descriptions.



NOW, A SOLID RESIN THAT'S "SOLID GOLD."

Joncryl 587 solid acrylic polyol.
Versatility and cost savings that add up to great value.

Discover a new world of formulation possibilities with the first solid acrylic polyol—Joncryl 587. This 100% solid flake resin offers you unprecedented versatility to create new acrylic urethane coatings; to find practical answers to challenging coating problems. Plus, save raw material costs in the process.

Joncryl 587 is 100% solid resin. You buy your own solvents. You're not paying for the shipping, handling and mark up on solvents someone else is buying for you.

The results? Potential savings of up to 10% or more on resin costs. That's value and versatility as good as gold.

Joncryl 587 is the latest in a long line of innovative polymers from Johnson Wax. A golden opportunity for you to get a solid handle on your acrylic urethane paint formulations of the future. For a sample of Joncryl 587 call **1-414-631-3121**. . .or write the Specialty Chemicals Group, Worldwide Innochem Operations, Johnson Wax, Racine, WI 53403.

Johnson Wax
SPECIALTY CHEMICALS
Racine, Wisconsin 53403

We do much more than floors.

NPCA Testifies Before CPSC On Methylene Chloride

Informative and instructive labeling, coupled with education, should be used to protect consumers of household paint products containing methylene chloride and other solvents, National Paint and Coatings Association Executive Director Larry Thomas recently told the U.S. Consumer Product Safety Commission. Methylene chloride, a solvent in some aerosol spray paints and paint strippers, has been shown to cause cancer in some laboratory animals, according to a study conducted under the National Toxicology Program.

Testifying before a meeting of CPSC Commissioners, Mr. Thomas said that consumers expect manufacturers to notify them of potential product hazards, but want the right to decide for themselves whether or not to use a product. He also stated that the paint industry's new label-language informs product users not only of hazards resulting from overexposure, but tells them in plain language how to protect themselves against such overexposure. He pointed out that the language tells users how to increase ventilation while using the products, and alerts them to the early symptoms of overexposure. NPCA has been providing labeling guidance to its members for many years, added Mr. Thomas. "The purpose of this guidance is to insure the continued safe use of our products," he said. He added that NPCA would be happy to assist CPSC in developing an overall labeling scheme for chronic hazards, should the Commission embark on a program to require chronic hazard labeling for consumer products.

Methylene chloride is used in paints and strippers primarily because it is an extremely effective solvent and, because it is nonflammable, it reduces the possibility of explosion and fire in the use of consumer products, explained Mr. Thomas. Furthermore, he said, until the NTP study was released this spring, there had been a consensus (including an EPA study issued as recently as summer, 1984) that methylene chloride exhibited no chronic health effects. When the NTP findings became known, NPCA had immediately convened a special work group to undertake a risk assessment of the chemical, emphasized Mr. Thomas. While the group concurred with CPSC findings that consumer exposure, in inadequate ventilation, could exceed the permissible exposure limits established for occupational exposure to methylene chloride, they felt that the potential for adverse consumer exposure can be effectively controlled by proper ventilation, Mr. Thomas said.

In addition to this ongoing labeling program, NPCA's Executive Committee has recently established a national program to better educate the public on how to use paint and coatings safety, by reading and heeding label directions. "This type of program can be as important as label language," Mr. Thomas told the commission. "Education of the consumer should be as broad and meaningful as possible."

NL Expands Pigment Plant

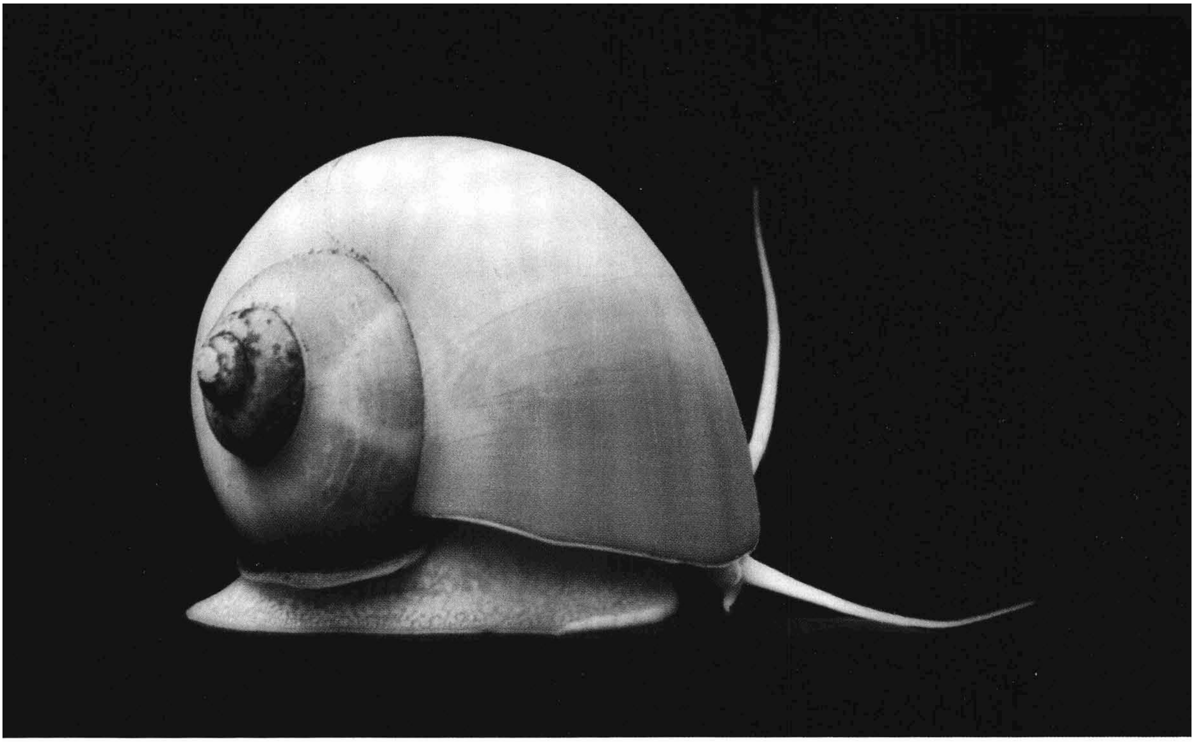
NL Industries, Inc., New York, NY, has embarked on a $50 million expansion project at its NL Chem Canada Inc. titanium dioxide plant located in Varennes, Quebec. Slated for completion in mid-1987, the expansion, which includes construction of a chloride process plant, will double its current output of 40,000 short tons.

Utilizing NL Chemicals' state-of-the-art chloride process technology, the new facility will enable NL Chem Canada to supply a complete range of sulfate and chloride pigments. Approximately 130 jobs will be created as a result of the expansion.

H.B. Fuller Co., St. Paul, Forms Polymer Unit

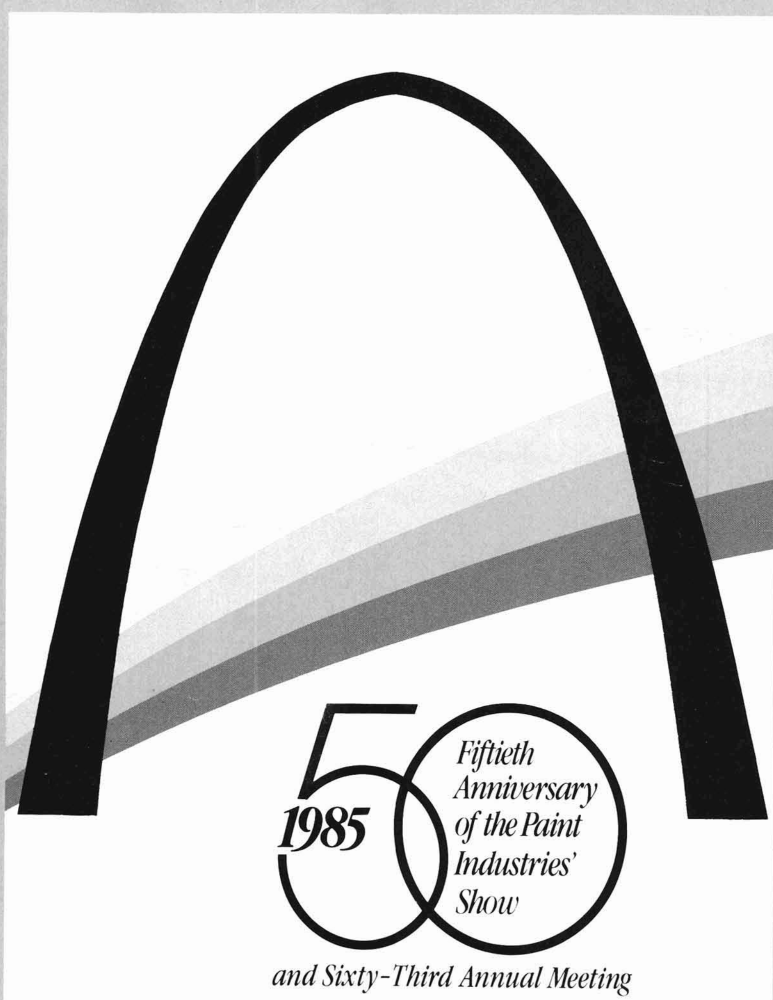
A new polymer business unit has been formed within the Adhesives, Sealants, and Coatings Div. of H.B. Fuller Co., St. Paul, MN. Created to direct product development, marketing, sales, and customer service of the firm's lines of proprietary specialty polymers to industrial customers, the new unit will serve the fiberglass, paint/caulks/adhesives, textiles, nonwoven, and paper industries.

"Our new structure will allow H.B. Fuller Company to focus attention on the specialty polymer applications in each of the identified industries," said Tom Shomion, the newly appointed Polymer Business Unit Manager.



FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

FSCT Annual Meeting and Paint Industries' Show Review



CERVANTES CONVENTION CENTER
ST. LOUIS, MISSOURI OCTOBER 7-9

Over 6200 Registrants Attend Annual Meeting And "Big 50" Paint Industries' Show in St. Louis

A total of 6284 registrants took part in the Federations' 63rd Annual Meeting and 50th Paint Industries' Show, held October 7-9 at the Cervantes Convention Center in St. Louis.

The turnout was the second largest in the history of the AM&PS, and far exceeded the 4691 who registered in 1979, when the event was last held in the Gateway City.

The three days of activities provided those attending with a full schedule of technical presentations keyed to the theme, "Coatings R&D: Today's Investment in Tomorrow," along with the displays of a record number of exhibitors in the Golden Anniversary Paint Show, the largest ever.

The Opening Session set the programming tempo as almost 1,000 attendees crowded the meeting room for the Keynote Address by John P. McAndrews, Group Vice-President, Finishes and Fabricated Products Dept., E. I. du Pont de Nemours & Co., Inc. His presentation, "From Tung Oil to Group Transfer Polymerization," reviewed technological advances over the past half-century and offered some projections for the future. Complementing the Keynote Address was a "Salute to Our Suppliers," by Program Chairman Joseph Vasta, which acknowledged the many significant contributions to coatings science and technology by suppliers to the coatings industry.

Concurrent technical sessions were scheduled all three days, and registrants were treated to a plentiful array of papers on a variety of coating topics. Attendance was excellent throughout, particularly at the R&D Management Symposium, Manufacturing Seminar, Physical Chemistry of Coatings session, and the Symposium on Computer Applications in R&D. A number of free-wheeling question-and-answer sessions marked many of the presentations, underscoring the high interest level of those in attendance.

Highlighting the technical presentations was the Mattiello Lecture by Ruth Johnston-Feller, who spoke on "Reflections on the Phenomenon of Fading."

Meanwhile, in the exhibit hall, traffic was heavy throughout the 2½ days of the Show as registrants toured the aisles to view the displays of 247 supplier firms in 55,600 sq. ft. of exhibit space. Exhibitors were generally enthusiastic with both the number and quality of registrants, and the interest shown in their displays. The "Big 50" Paint Show attracted 55 new exhibitors, with 47 companies returning for over 25 years.

At the Awards Luncheon, on Wednesday, October 9, approximately 400 attendees were on hand to honor the various recipients of Federation awards; included were thirteen 50-year members of the Federation and their spouses. Following the presentations to the prize winners, those attending enjoyed the humorous reminiscences and observations of Jim Valvano, Head Basketball Coach at North Carolina State University.

The many members of the Kansas City and St. Louis Societies who served on the Host Committee under the direction of Chairman Howard Jerome are due much praise and appreciation for contributing their time and effort; special thanks go to Gene Jerome, for her dedicated work on behalf of the Spouses' program. The Federation is indebted to them and to all who helped make the 1985 Annual Meeting and "Big 50" Paint Show such a success.

1986 Annual Meeting and Paint Industries' Show Scheduled for November 5-7 in Atlanta, GA

The 64th Annual Meeting and 51st Paint Industries' Show of the Federation of Societies for Coatings Technology will be held at the Georgia World Congress Center in Atlanta, November 5, 6, 7, 1986.

Chairman of the Program Committee is Dr. Percy E. Pierce, of PPG Industries, Inc., Allison Park, PA.

Members of the Southern Society, under the General Chairmanship of James E. Geiger, of Sun Coatings, Inc., Largo, FL, will serve on the Host Committee.

John Ballard, of Kurfees Coatings, Inc., Louisville, KY will be Chairman of the Paint Show Committee.

Fiftieth Anniversary Paint Show opened with traditional ribbon-cutting ceremony by President and Mrs. Bauer. Shown left to right are: President-Elect William Mirick and wife, Mary; President Joseph Bauer; Treasurer-Designate Deryk Pawsey; Treasurer Carlos Dorris and wife, Karen; Mrs. Bauer; and Executive Vice-President Frank Borrelle and wife, Rose

Herbert E. Hillman (JCT's 'Humbug') Receives 1985 G.B. Heckel Award from FSCT

Other Annual Meeting Awards Presented

Herbert E. Hillman, retired President of F.O. Pierce Co., Long Island City, NY, was honored by the Federation of Societies for Coatings Technology with the 1985 George Baugh Heckel Award for his dedicated service to the Federation. The presentation was made during the FSCT Annual Meeting on October 9 in St. Louis.

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

Mr. Hillman, known to members of the industry as the knowledgeable purveyor of wit as columnist of "Humbug from Hillman," published monthly in the JOURNAL OF COATINGS TECHNOLOGY, retired from F.O. Pierce Co. in 1983. He was also Vice-President of RPM, Inc., Medina, OH.

Herbert Hillman (left) accepts the 1985 George Baugh Heckel Award from Stanley LeSota

Beginning in 1956, Mr. Hillman served two terms as a member of the Federation's Board of Directors. He also served as Chairman of several Federation Committees—Annual Meeting Program (1957) and Host (1959), Mattiello Lecture (1959), and Roon Awards (1965). He also served on the Board of Trustees of the Paint Research Institute (1962-63).

Mr. Hillman's service included membership on the FSCT Technical Advisory, Liaison, and Publications Committees, and on the Editorial Review Board of the JCT.

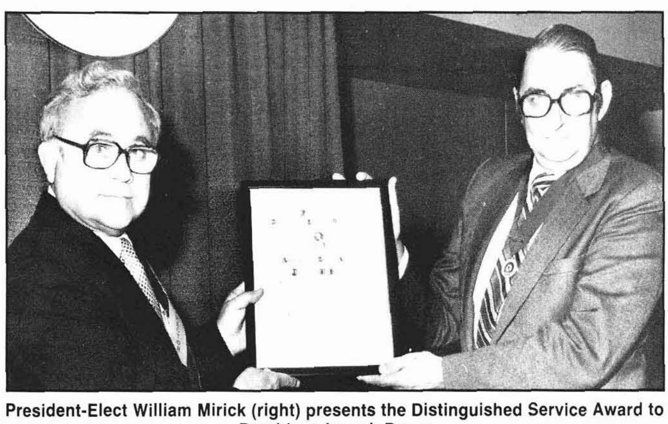
Active in the New York Society, Mr. Hillman served as its President (1952), chairing several of Society committees, including the Technical Committee for many years. He was the recipient of the Society PaVac Award and the Roy H. Kienle Award, and is a Society Honorary Member.

"Humbug," first published as a semi-regular feature in 1980, has become a permanent column in the JCT, and is devoted, as Mr. "Humbug" states, "to the degradation of science and sundry other intellectual pursuits," much to the delight of its many readers.

Mr. Hillman and his wife, Libby, reside in Whitingham, VT.

Distinguished Service Award

This award was presented to Joseph A. Bauer, of the Louisville Society, in grateful recognition of his valuable contributions to the progress of the Federation while serving as President of the Federation in 1984-85. Mr. Bauer is employed with Porter Paint Co., Louisville, KY.



President-Elect William Mirick (right) presents the Distinguished Service Award to President Joseph Bauer

Roon Foundation Awards

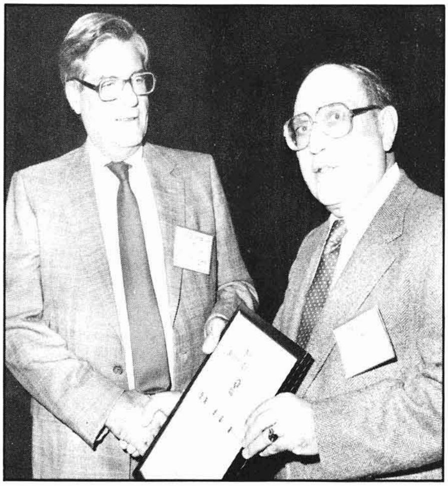
These awards, established by the late Leo Roon, and administrated by the Coatings Industry Education Fund (formerly Paint Research Institute), are for the best technical papers entered in the competition and submitted for presentation at the Federation's Annual Meeting by individuals associated with the organic coatings industry.

FIRST PRIZE ($2,000)—"The Effect of alpha-Methyl Groups on Room Temperature Crosslinking in Acrylic Polymers Containing MAGME Monomers"—Howard R. Lucas, American Cyanamid Co., Stamford, CT.

SECOND PRIZE (tie—$1,000 each)—"An Investigation of Microencapsulated Fungicides for Use in Exterior Trade Sales Paints"—Gerry K. Noren, Mary F. Clifton, and Alex H. Migdal, DeSoto, Inc., Des Plaines, IL; and, "The Role of Azeotropy in Speeding Up Water/Solvent Evaporation in Humid Air"—Albert L. Rocklin, Shell Development Co., Houston, TX.

Ernest T. Trigg Awards

These awards are for the Secretaries of Constituent Societies of the Federation

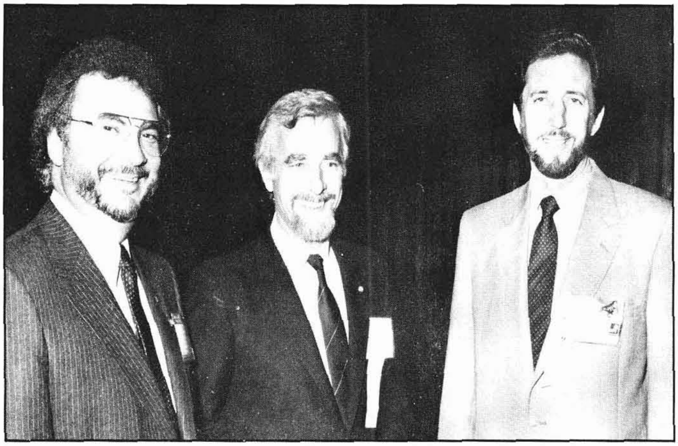


Executive Vice-President Frank Borrelle (right) congratulates publisher A.F. Voss marking the 70th anniversary of APJ's *Convention Daily*

A.F. Voss/*American Paint & Coatings Journal* Award was presented to Joseph Fiocco, of Montreal Society (left) by awards chairman Lloyd Haanstra

President Bauer congratulates Ruth Johnston-Feller on her Mattiello Lecture "Reflections on the Phenomenon of Fading," and presents her with the Federation's certificate of appreciation

Roon Awards Chairman Phil Harbaugh (left) is shown with award winners (from left) Howard R. Lucas (First Prize), and Albert L. Rocklin and Gerry K. Noren (tied for Second Prize)



Trigg Awards Chairman Don Mazzone (left) shown with winners of 1985 Trigg Awards for most interesting reports of Society meetings. Accepting for First Prize winner, Ray DiMaio, Secretary of Los Angeles Society, is LA Society Representative Jan Van Zelm; and Ken Hyde, Secretary of Louisville Society, who won Second Prize

who furnish to the *Journal of Coatings Technology* the most interesting reports of Society meetings and discussions following the presentation of papers at those meetings.

FIRST PRIZE ($100)—Ray DiMaio (Koppers Co., Inc.), Secretary of the Los Angeles Society.

SECOND PRIZE ($50)—Ken Hyde (Reliance Universal, Inc.), Secretary of the Louisville Society.

MMA Awards

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

Class A Competition ($350) was won by the Detroit Society for its sponsorship of the course, "Principles of Color Technology."

Class B Competition ($350) was won by the Golden Gate Society for its Educational Program for the Bay Area Coaters Association.

Class C Competition ($350) was won by the St. Louis Society for its encouragement of technical excellence through the Ralph Gatti Memorial Award program.

Society Speaker Awards

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

FIRST PRIZE ($100)—James D. Hall (Sinclair Paint Co.), Los Angeles Society.

SECOND PRIZE ($50)—Brian J. Addenbrooke (Croda Paints Ltd.), Birmingham Club.

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.

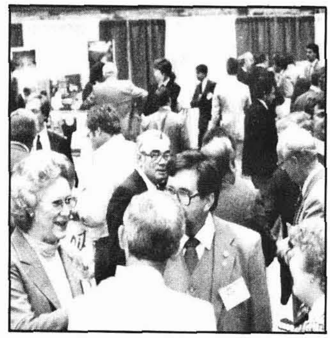
FIRST PRIZE ($200)—"Influence of Rheology Modifiers on Performance Characteristics of Latex Paints"—Montreal Society (John Hall, Tioxide of Canada, Inc., Chairman, Technical Committee).

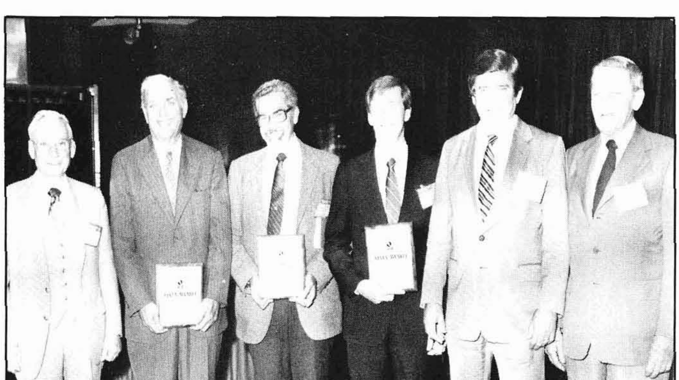
Golden Impeller Award

This award, offered by Morehouse Industries, Inc., for outstanding achievement in dispersion technology, was presented at the Annual Meeting to Webster Edwards, of the DuPont Co., Philadelphia, PA.

Special Award

The Federation presented a special scroll to the American Paint Journal Co. on the occasion of the 70th anniversary of the publication of the *American Paint Journal Convention Daily*.





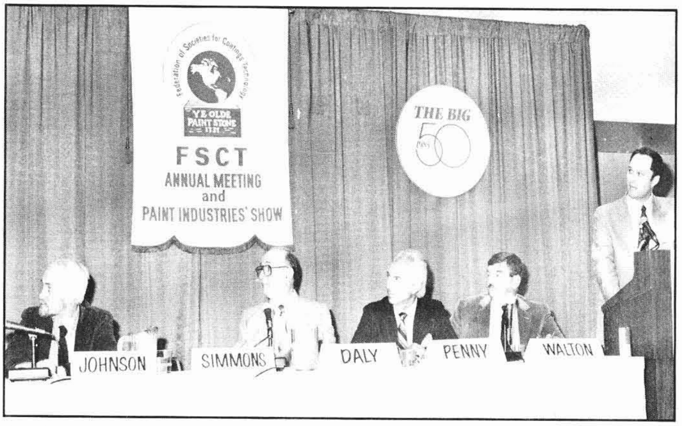
Materials Marketing Associates (MMA) Awards were presented by awards chairman Vic Willis (left) to Al Zanardi, of St. Louis Society, Barry Adler, of Golden Gate Society, and Bob Feisel, of Detroit Society. Assisting with the presentations were MMA President James Boggess and Charles Peterman, of MMA

Program speaker awards were presented by awards chairman John Lanning (left) to James Hall, of Los Angeles Society (First Prize), and Brian Addenbrooke, of Birmingham Club

FSCT Members Celebrate Own 'Big 50' Anniversary

A special group of Federation members were guests of the FSCT at its annual awards luncheon during the Annual Meeting, October 9. In attendance with their spouses at the luncheon were 13 members of the Federation's 50-Year Club.

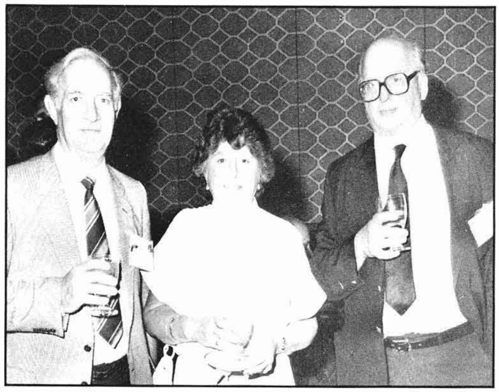
They were: Joseph Cantor, Elmhurst, NY; Joseph Cataldo, Flushing, NY; Michael Catena, Tampa, FL; Richard O. Innes, New York City; Lewis P. Larson, Columbus, OH; Charles H. Levine, Brooklyn, NY; Sidney B. Levinson, Cranbury, NY; Robert W. Matlack, Moorestown, NJ; Loren B. Odell, Houston, TX; Lloyd Owen, Largo, FL; Edward Peterson, Pueblo, CO; G.O. Stephenson, St. Louis, MO; and Edward Wanderman, Brooklyn, NY.



Panel session on "Manufacturing the Next Generation of Coatings" highlighted new technology in coatings formulation

A crowd of about 1,000 attended the Opening Session of the Annual Meeting where John P. McAndrews spoke during his Keynote Address on the advance of coatings technology.

Speakers address the topic of "Effective Use of Computers in R&D"



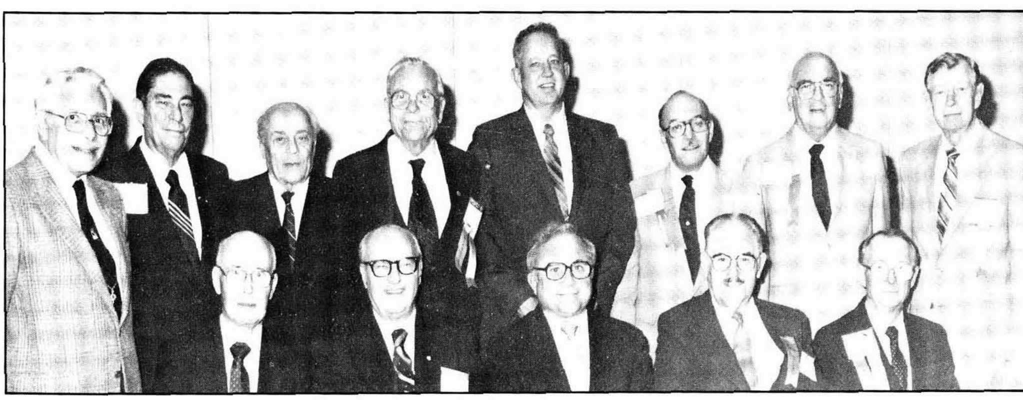
OVERSEAS VISITORS RECEPTION

ICCATCI

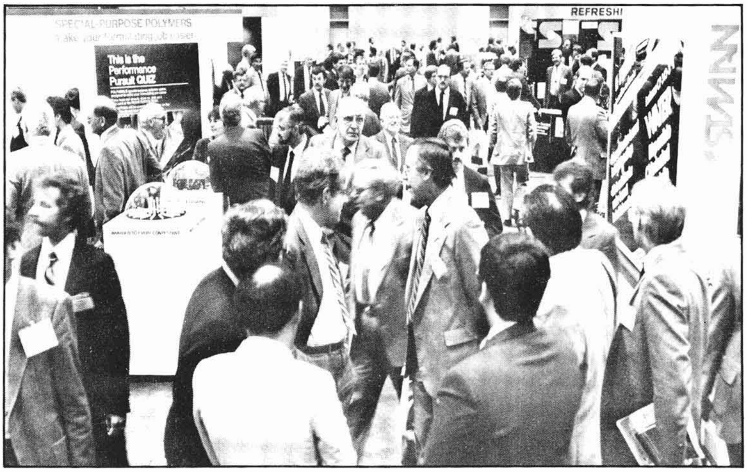
A luncheon for visiting members of the International Committee to Coordinate Activities of Technical Groups in the Coatings Industry (ICCATCI) is sponsored each year by the Federation of Societies for Coatings Technology (FSCT) at its Annual Meeting and Paint Show.

ICCATCI is composed of: FSCT; Federation of Associations of Technicians in the Paint, Varnish, Lacquer, and Printing Ink Industries of Continental Europe (FATIPEC); Oil and Colour Chemists Association (OCCA); Oil and Colour Chemists Association—Australia (OCCAA); Japan Society of Colour Material (JSCM); and Federation of Scandinavian Paint and Varnish Technologists (FSPVT).

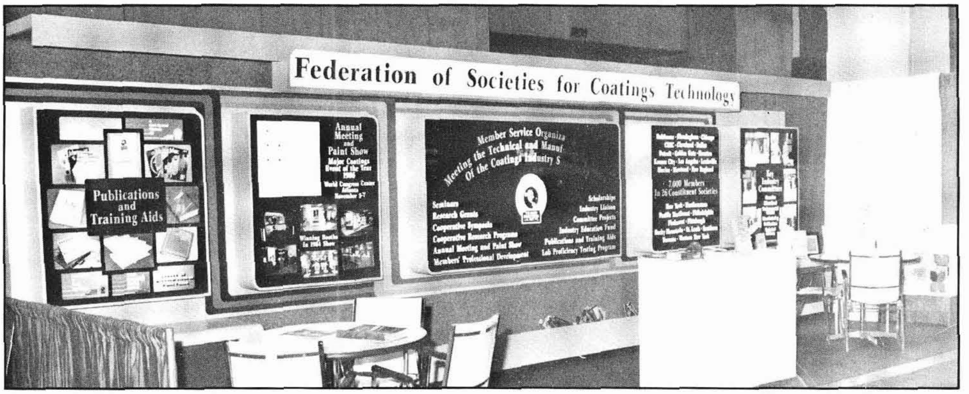
Present at the luncheon, held during the 1985 Annual Meeting and Paint Show of the FSCT in St. Louis, October 8, were: *Standing* (all from the FSCT): Past-President Howard Jerome, Executive Vice-President Frank J. Borrelle; Past-President A. Clarke Boyce; President-Elect William Mirick; Treasurer Carlos E. Dorris; Birmingham Club President Roland Staples; Past-President Terryl Johnson; and Past-President William H. Ellis. *Seated:* OCCAA Past-President Ted Saultry; FATIPEC Past-President Romeo Capanni; OCCA President Frank Redman; FSCT President Joseph A. Bauer; FSPVT Past-President Helge Meyer; and JSCM Vice-President Kenjiro Meguro.



Federation Past-Presidents attending the Annual Meeting included (standing left to right): A. Clarke Boyce (1982-83); J.C. Leslie (1974-75); William Dunn (1975-76); Michael Malaga (1973-74); James McCormick (1978-79); Howard Jerome (1981-82); John Oates (1977-78); and Terryl Johnson (1983-84). Seated: Elder Larson (1979-80); Carroll Scholle (1965-66); Joseph Bauer (1984-85); Eugene Ott (1960-61); and William Ellis (1980-81)


SPECIAL-PURPOSE POLYMERS
This is the Performance Pursuit QUIZ
REFRESHI


MMEMORATIVE
PLAYS
Technical Partner to the Paint and Coatings Industry



Six Exhibitors Win Awards in Federation's 1985 Paint Industries' Show

Atlas Electric Devices Co.; Chicago Boiler Co.; DuPont Co.; DBE Solvents.; Micro Powders, Inc.; Toyo Aluminium K.K.; and Rohm and Haas Co. were recipients of the C. Homer Flynn Awards at the 1985 Paint Industries' Show of the Federation of Societies for Coatings Technology, held October 7-9 at the Cervantes Convention Center, St. Louis, MO.

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

The prizes (engraved plaques) were awarded as follows:

RAW MATERIALS SUPPLIERS:

Single-Booth Exhibit—Toyo Aluminium K.K., Osaka, Japan (1 year in Show).

Double-Booth Exhibit—Micro Powders, Inc., Scarsdale, NY (1 year).

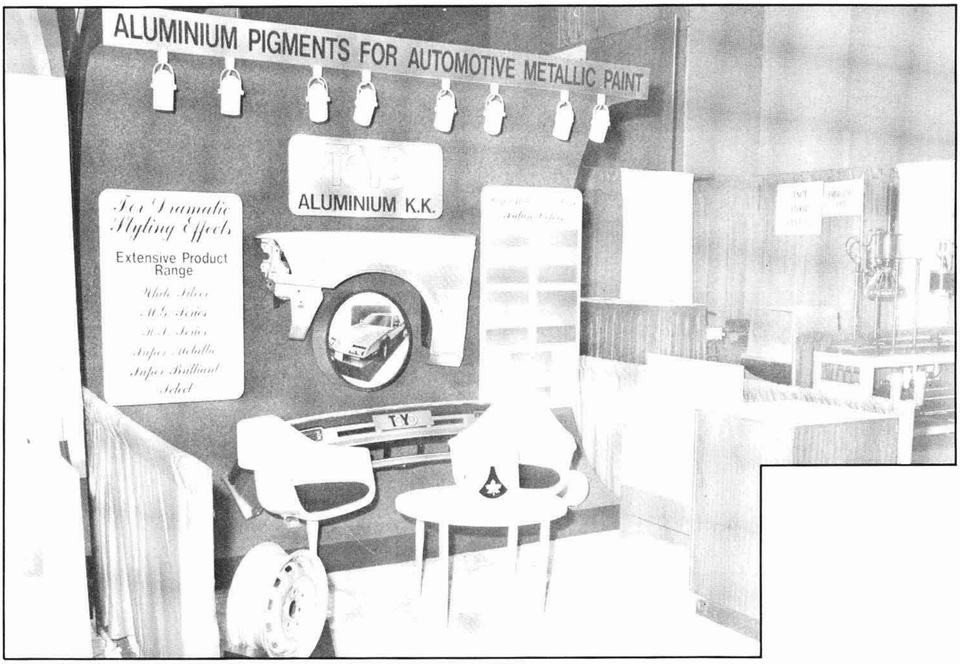
Three-to-Five Booth Exhibit—DuPont Co., DBE Solvents, Wilmington, DE (17 years).

Six-or-More-Booth Exhibit—Rohm and Haas Co., Philadelphia, PA (50 years).

EQUIPMENT MANUFACTURER—Chicago Boiler Co., Chicago, IL (26 years).

SERVICE INDUSTRIES—Atlas Electric Devices Co., Chicago, IL (43 years).

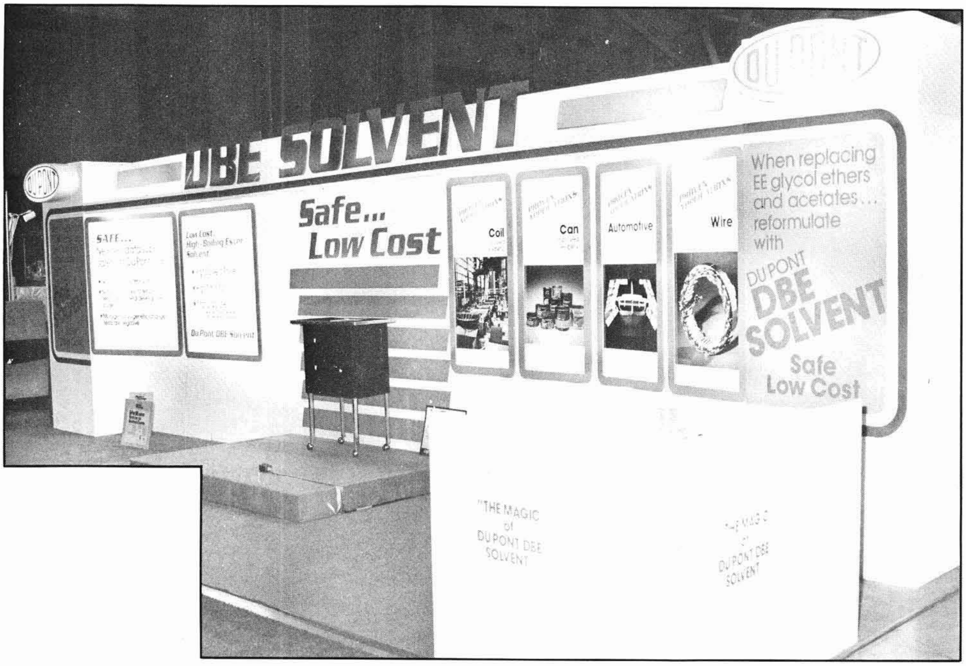
Paint Show Committee Chairman John Ballard (left) is shown with winners of the C. Homer Flynn Awards for outstanding exhibits. Winners (left to right) are: John Scott, Atlas Electric Devices Co.; Paul Jeffrey, Chicago Boiler Co.; Masao Imasu, Toyo Aluminum; James and Phyllis Strauss, Micro Powders, Inc.; Jack Fassnacht, DuPont Co; and Joseph Sullivan, Rohm and Haas Co



19

RAW MATERIA

WINN



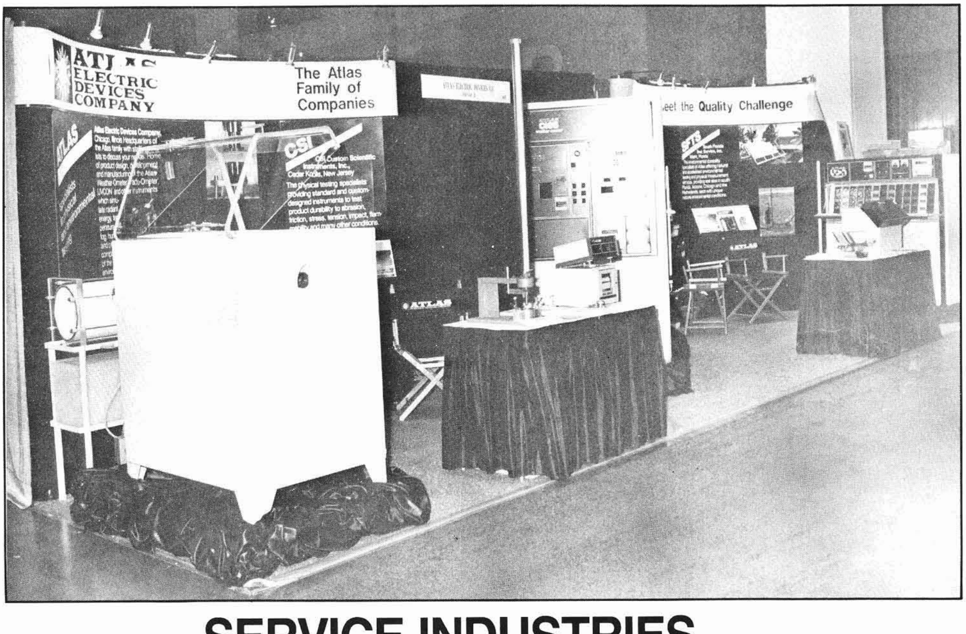
85

_S SUPPLIERS

IERS

1985 WINNERS

EQUIPMENT MANUFACTURERS



SERVICE INDUSTRIES

1985 Paint Show Exhibits

The 1985 Paint Industries' Show of the Federation of Societies for Coatings Technology was held at the Cervantes Convention Center, St. Louis, Missouri, on October 7-9. With 247 exhibitors, it was the 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 inquiries 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, zinc oxide, organotin compounds, anti-skinning agents, electrostatic spray-paint additives, UV photoinitiators, and aziridine-based chemicals.

ADVANCED COATING TECHNOLOGIES, INC.
Hillsdale, MI 49242

Paint test panels—learn what's new in automotive testing. Panels can be phosphated, cathodic electroprimed, spray primed, top coated, or any combination. Special applications—door seams, bimetallic joints, sags and runs, paints, sealants, and adhesives. Special automotive steels. Other industrial applications.

AIR PRODUCTS AND CHEMICALS, INC.
Allentown, PA 18105

Emphasized is the company's broad line of SURFYNOL® nonionic surfactants. Live demonstrations show benefits. Also featured are a line of vinyl acrylic and vinyl acetate-ethylene emulsions, a new caulking compound emulsion, and a line of spray-dried liquid latex powders.

AKZO CHEMIE AMERICA
Interstab Chemicals
New Brunswick, NJ 08903

Featured are 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.

ALCAN POWDERS AND CHEMICALS
Elizabeth, NJ 07207

The exhibit features new specialty aluminum paste and flake pigments for the coatings industry. Technical and marketing specialists are available to discuss product applications and specific end-use requirements.

ALLIED INDUSTRIAL TANK
Los Angeles, CA 90067

The exhibit features portable tank washing systems and portable shipping containers.

C. M. AMBROSE CO.
Redmond, WA 98052

With a renewed emphasis on quality and engineering, C. M. Ambrose Co. also celebrates their Fifty Year Anniversary with the introduction of the NEW Model 571 Inline Twin Fillers with the new "easy clean" cylinders and cone nozzles.

AMF CUNO
General Filter Prod. Div.
Meriden, CT 06450

ANGUS CHEMICAL CO.
Northbrook, IL 60062

The company highlights their complete paints and coatings product line. Featured is AMP-95™ and its contributions to the effectiveness of associative thickeners. Experienced technical representatives answer your questions on the many uses for the company's nitroparaffins and their derivatives and ANGUS biocides.

ANKER LABELERS CORP.
Mt. Laurel, NJ 08054

The new, fully automatic Pail Labeler applies plain paper labels to tapered or straight sided pails and maintains label orientation with respect to the pail. Pails, full or empty, of various sizes and materials can be labeled at up to 25 per minute. Labels up to 25 inches long.

APPLIED COLOR SYSTEMS, INC.
Princeton, NJ 08540

Featured are ACS-3100 multi-user computer color matching system, ACS-1800 IBM-based single user computer color matching system, ACS-1400 color quality control system, and visual color system for matching, creating and communicating color.

ARCO CHEMICAL CO.
Div. of Atlantic Richfield Co.
Philadelphia, PA 19101

Featured is the broad range of high-performance industrial and functional chemicals supplied to the coatings industry. Highlighted are ARCOSOLV® P Series, propylene glycols, and SMA® POLY BD® and high-energy curable monomers and oligomers. Technical representatives are present to introduce new P Series and functional products.

ARIES SOFTWARE CORP.
Louisville, KY 40222

On display are multi-terminal and single-terminal IBM computer systems, featuring the Chem-Pac software system. Chem-Pac is a completely integrated computer software system which includes formula management, formula analysis, MSDS, sales and margin analysis, production, order entry, and all inventory and accounting software.

ASHLAND CHEMICAL CO.
Div. of Ashland Oil, Inc.
Columbus, OH 43216

Industrial Chemicals & Solvents Div. features its solvent line, exempt solvents and specialty chemicals available from over 70 tank farm/warehouse locations across North America, as well as chemical waste disposal services, computerized solvent reformulation and conversion coatings. Drew Industrial Div. displays chemical additives including flow and leveling aids, wetting agents, anticratering agents and a new, low cost, high solids defoamer.

ATLAS ELECTRIC DEVICES CO.
Chicago, IL 60613

Featured are the Ci65 Xenon Arc Weather-Ometer, the UVCON fluorescent ultraviolet exposure system, the LM-3 integrating outdoor light monitoring system, the Color Chex color-matching unit and the Salt Fog exposure cabinet. The subsidiary, Custom Scientific Instruments, Inc., shows its falling weight impact tester designed to test the cracking resistance of coatings.

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

This exhibit includes flexible, semi-bulk material handling containers known as "Super Sacks"®. 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.

BASF WYANDOTTE CORP.
Parsippany, NJ 07054

In addition to having a full color spectrum, our firm's "Color Wheel" encompasses a complete performance range of both organic and inorganic pigments along with dyes, anti-corrosion products and aqueous dispersions. Our new coatings product applications laboratory is ready and adequately staffed to answer your questions.

BATTELLE MEMORIAL INSTITUTE
Columbus Laboratories
Columbus, OH 43201

Examples of technical capabilities, new innovative products, and applied engineering solutions to existing paint industry problems are shown.

BAUSCH & LOMB, INC.
Rochester, NY 14625

See booth description under Milton Roy Co.

BELTRON CORP.
Red Bank, NJ 07701

Exhibits include a working punch filling machine; new five gallon filler and closer with an anti-skinning agent dispenser; "F" style can filler; and an ink jet coder, all using the company's patented and proven ultrasonic fill level detector.

BEROL CHEMICALS, INC.
Westport, CT 06880

The exhibit features the chemically unique Bermocoll line of thickeners. Visit us and find out why Bermocoll is more than just a thickener! Also featured is Inorphil® Mineral Fiber, a safe performance-replacement for asbestos.

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

The company's full line of rotary positive displacement pumps, specially designed for handling emulsions, pastes, resins, oils, and solvents are on display. Flow rates from 2 to 500 gpm, with differential pressures to 500 psi.

BONAR INDUSTRIES, INC.
Macon, GA 31297

On display is the Mulox line of flexible, bulk bags manufactured from light weight, high tensile strength, woven polypropylene. The bags will handle loads up to 4000 pounds while providing a safety factor of 5 to 1. Mulox bags are certified for export shipments. Please visit our display for further details.

BOWERS PROCESS EQUIPMENT INC.
Stratford, Ontario, Canada N5A 6T3

Displayed is a new orbital shaft disperser for very short batch times of pastes and the Russell Finex high speed sieving machine. Information is also available on tank presses, fillers and dispensers.

BPI-BRAIN POWER, INC.
Miami, FL 33155

Featured are mixing/stirring impellers and mandrels and ultrasonic cleaning equipment.

BROCKWAY STANDARD, INC.
Atlanta, GA 30338

The exhibit features "Plastite". . . tomorrow's one gallon plastic paint can for today's water-based paints. Also shown are the firm's complete line of plastic and metal containers used by the paint industry.

BROOKFIELD ENGINEERING LABS., INC.
Stoughton, MA 02072

Bench mounted and in-line viscosity measurement and control instrumentation including the new Digital Viscometer now available with cone/plate measuring system for shear rates from .001 to 1500 Sec^{-1}.

BUCKMAN LABORATORIES, INC.
Memphis, TN 38108

The latest in wood-preservative technology is presented. A comparative evaluation of film-preservatives is on display. Latest literature and papers are available on corrosion control with non-lead, non-chromate inhibitors; stabilization of aqueous coatings and formulating techniques for water-based systems containing reactive pigments.

BUHLER-MIAG, INC.
Minneapolis, MN 55440-9497

Featured is the firm's new BOA 501 Horizontal Bead Mill. With features that can help improve both your product and productivity, including water-cooled pins for high quality and low temperatures and exclusive piston adjustment to optimize results, it is perfect for low and medium viscosities.

BULK LIFT INTERNATIONAL, INC.
Carpentersville, IL 60110

A proven leader in IBC's, the company presents a complete line of woven polypropylene semi-bulk bags for handling capacities from 1,000 to 8,000 pounds of dry flowable material. Included also is information on filling and emptying equipment.

BURGESS PIGMENT CO.
Sandersville, GA 31082

Burgess No. 97 is introduced for maximum gloss and hiding in solvent or water systems. New formulation approaches with Optiwhite P is emphasized. Comparisons are presented vs plastic pigments, with panels available.

BYK-CHEMIE USA
Wallingford, CT 06492

New products presented are Byk 077 and Byk 325, flow additives with defoaming properties; and two non-silicone defoamers, Byk 051 and Byk 053. Additional displays feature Disperbyk 160 for organic pigments, Disperbyk 130 for carbon blacks, anti-sag properties of Anti Terra 202 with Bentone SD-2; and substrate wetting of Byk 341. Instruments displayed are Color Gloss, Multi Gloss M, Gradient Oven, and the new Tri-Gloss.

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

Highlighted is CAB-O-SIL® fumed silica—an effective rheology control agent—offering paint and coatings formulators a unique product which controls viscosity, prevents sagging and anti-settling of heavy pigments. CAB-O-SIL® TS-720 hydrophobic fumed silica (formerly called CAB-O-SIL® N70-TS) for use in epoxy and urethane systems is also featured.

CALGON CORP.
Pittsburgh, PA 15230

On display is a presentation of the company's products and capabilities for the coatings industry. Featured is a new in-can preservative, Biochek 240, as well as Tektamer 38 A.D.

CARGILL, INC.
Minneapolis, MN 55440

Cargill helps you bridge the gap between high-performance coatings and low V.O.C. requirements with a "Helping Hand." The firm brings you new water-borne resins such as a phenolic-alkyd stable with anti-corrosive pigments in primers and black topcoats; a fast-dry acrylic alkyd; a high-gloss alkyd; a high-solids, formaldehyde-free resin for wood coatings, unsaturated polyesters; and a one-component baking system.

CASCHEM, INC.
Bayonne, NJ 07002

Caspol™ 1715 pol-ol for high solids, high performance polyurethane coatings for maintenance, marine and transportation coatings applications is introduced. Technical bulletins and panels coated with formulations using Caspol 1715 are featured.

CATALYST RESOURCES, INC.
Bartlesville, OK 74004

See booth description under Phillips Chemical Co.

CELANESE SPECIALTY RESINS
Louisville, KY 40233

Featured are resins for the high-performance coatings industry with emphasis on water-borne epoxies and acrylics, UV/EB resins, and high solids. Information and technical data are available.

CEM CORP.
Indian Trail, NC 28079

The firm's Moisture/Solids Analyzer provides for rapid and accurate determinations for all types of materials including solids, liquids, and slurries covering a full range of moisture levels. Comparable to standard methods. Modified procedure allows the use of microwave drying solvent-based as well as water-based paints and coatings.

CERTIFIED EQUIPMENT & MFG. CO.
Springfield, IL 62705

The company, manufacturers of both mild steel and stainless steel storage tanks for the petroleum, liquid fertilizer, paint and chemical industries, features above and underground storage tanks.

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 and of policies and activities of the ACS.

CHEMICAL WEEK
New York, NY 10020

Publications on display include: *Chemical Week, Chemical Week Buyer's Guide* and *Coatings '85*.

CHEMTECH INDUSTRIES, INC.
St. Louis, MO 63131

The company is a full line chemical distributor serving the paint and coatings industry for 30 years. Our 4 terminals (3 barge, 1 inland) have tank capacities of over 19 million gallons. Each terminal has an on-site QC lab to assure our customers of high quality products.

CHEVRON—AMERICAN GILSONITE
Salt Lake City, UT 84133

Featured are dark colored and aluminum coatings formulated with Gilsonite, an inexpensive, natural, dark resin. Gilsonite, available in granular or powder form or as a dispersion, can substantially reduce raw material costs of many standard paints and coatings, while giving higher gloss, better weatherability and improved water and chemical resistance.

CHICAGO BOILER CO.
Chicago, IL 60614

This display highlights the company's full line of small media mills for the coating industry—numerous sizes of laboratory through production "Red Head" open vertical mills, sealed horizontal Dyno-Mills, and various grinding media.

CLAWSON TANK CO.
Clarkston, MI 48016

On display are a complete line of portable shipping containers featuring the Jumbo™ Bin and Jumbo™ Drum, as well as accessory items. These containers may be used for storing, transporting, and processing liquid and dry materials.

COLOR CORP. OF AMERICA
Rockford, IL 61101

The firm features their "New Dimensions in Color" industrial maintenance color system, as well as their Customatic Universal Colorants, Tint-Eze aqueous dispersions and "Color Studio" and "Decorator III" color systems.

COLORGEN, INC.
Bedford, MA 01730

The advanced, second generation color matching system—Colorgen DCM 1100—is on display with examples of accurate matches and is available for "hands-on" trial.

COLUMBIAN CHEMICALS CO.
Tulsa, OK 74102

Columbian Chemicals Co., celebrating its 50th year in the Paint Industries Show, features Mapico® synthetic iron oxides, including easy-dispersing reds and yellows, heat-stable tans, blacks, and browns. Full range of industrial carbon blacks including Raven® 5000 for highest quality automotive finishes, lampblack replacements, and general purpose blacks for industrial and trade applications can be seen.

COMMERCIAL FILTERS
Lebanon, IN 46052

On display is a variety of filter housings used throughout the paint and coatings industry. Also featured is a wide selection of filter media (cartridges), including the Fulflo® resin bonded cartridges and the new Fulflo pleated cellulosic cartridge.

CONSOLIDATED PACKAGING MACHINERY/PFAUDLER
Alden, NY 14004

Information on high-speed rotary piston paint fillers with literature and technical person—Mechanical simplicity at its best! Backed by many years of experience!

CONTINENTAL FIBRE DRUM CO.
Stamford, CT 06904

On display are the company's fibre drums for water-based paints and powder coatings. Included are the new Liquipak® drums with linings of LDPE and aluminum foil for high moisture content products. Modified copolymer linings and polyester laminates are also featured.

COOK PAINT AND VARNISH CO.
North Kansas City, MO 64116

The firm's resin technology for the coatings industry is displayed. While the company offers a broad line of resins—special emphasis is given specialty resins which include their additive and microgel lines. Publications regarding these offerings are available.

CORDOVA CHEMICAL CO. OF MICHIGAN
N. Muskegon, MI 49445

See booth description under Virginia Chemical Co.

COSAN CHEMICAL CORP.
Carlstadt, NJ 07072

The exhibit features the organic bactericides Cosan 145 and Cosan 101, offering a broad spectrum of activity against gram positive and gram negative organisms. Personnel are available to discuss the firm's complete line of bactericides, fungicides, specialty chemicals, driers, and catalysts.

CRAY VALLEY PRODUCTS, INC.
East Rutherford, NJ 07073

Three product lines are featured: the Crayvallac range of thixotropic additives including the new SF2; the unique Super Gelkyd thixotropic alkyds based on new chemistry; and two-pack, cold-curing acrylics systems which do not contain isocyanates.

CUSTOM METALCRAFT, INC.
Springfield, MO 65808

Stainless steel TranStore® portable bulk tank (DOT 57) and sanitary process containers are featured.

CYPRUS INDUSTRIAL MINERALS CO.
Englewood, CO 80155

Three new talc products, designed for the coatings industry, highlight our exhibit. Unique properties to make a formulator's life easier. Our continuing study of talc for corrosion control is updated.

DANIEL PRODUCTS CO.
Jersey City, NJ 07304

Featured are: Slip-Ayd® surface conditioners for increased slip and apparent film hardness; Flat-Ayd flatting bases for easy gloss reduction with no dust or hard settling; Tint-Ayd® pigment dispersions for virtually all tinting needs; and Disperse-Ayd grinding aids for faster dispersion, greater strength and improved stability.

DataLogiX FORMULA SYSTEMS, INC.
Hartsdale, NY 10530

A leading supplier of integrated computer-based business management systems for paint companies, the company features a wide range of computers running DataLogiX' CPS, which includes formulation, costing, lot inventory, MSDS, production and accounting software. A new paint lab system is featured.

DEFELSKO CORP.
Ogdensburg, NY 13669

The company exhibits its PosiTest and PosiTector 2000/3000 coating thickness gages. They utilize the latest technology including PosiTest's non-wearing carbide probe tip and the direct digital readouts of PosiTector 2000/3000.

DEGUSSA CORP.
Teterboro, NJ 07608

Featured are OK412 for efficient flatting of clear and pigmented coatings; HK188 especially for coil coatings; TS100, showing highest flatting efficiency; Aerosil 200 for thixotropy and anti-settling of pigments; Aerosil R972 for corrosion-resistant coatings; channel-type Carbon Black FW200 for automotive coatings and Special Black 100.

UNIVERSITY OF DETROIT
Polymer Institute
Detroit, MI 48221

Educational and research programs, contracted research in the area of coatings technology and polymer synthesis at the University of Detroit are featured.

DIAGRAPH CORP.
Herrin, IL 62948

The company is presenting its line of industrial marking supplies, non-contact ink jet printing capable of marking on porous and non-porous surfaces, and electronic label printing for chemical label needs.

DIAMOND SHAMROCK CHEMICALS CO.
Morristown, NJ 07960

On display are the CAPCURE® series of unique epoxy hardeners which, in addition to amines, include mercaptans. They serve as sole hardeners, accelerators or co-curing agents. NOPCOCIDE® N-96 fungicide and NOPCOSPERSE® N-44 pigment dispersant are highlighted along with new rheology modification technology.

DISTI, INCORPORATED
New York, NY 10012

Solvent recovery units to distill contaminated flammable and non-flammable solvents to produce clean solvent are highlighted. Units equipped to incinerate paint sludge, and washing machines for various applications, i.e., tub containers, container bins, and tote tanks, are featured.

D/L LABORATORIES
New York, NY 10003

The booth theme is the diversity of the company's capabilities as "Consultants to the Industry." Featured are examples of services provided to the coatings, caulks, sealants and plastics industries, including formulation, testing and evaluation, corrosion studies, inspection, industry and market surveys and development, preparation of specifications and manuals, personnel training and legal assistance.

DOMINION COLOUR CO.
Div. of Reed, Inc.
Toronto, Ontario, Canada M8W 4X9

Displayed is a broad range of inorganic and organic color pigments. Highlights include non-lead alternatives, new SO_2 resistant grades, bulk handling options, and technical personnel to assist with specific problems and recommendations.

DOW CHEMICAL U.S.A.
Midland, MI 48674

CHLOROTHENE® SM compliance solvent, epoxy resins, bisphenols, hydroxyalkyl acrylate monomers, DOWANOL® P-Series glycol ethers, acetone, vinyl toluene, styrene monomer, PA-2001 paint additive, METHOCEL® cellulose ethers, thickeners for latex paint, DOWICIL® 75 preservatives, vinylidene chloride, and ETHOCEL® ethylcellulose resins are among the products on display. GENERON® Air Separation Systems, a new technology for producing low-cost gaseous nitrogen can be used for blanketing, inerting, sparging, and purging. A system will be displayed in booth #521.

DOW CORNING CORP.
Midland, MI 48686

Technical and sales representatives are available to help formulators and manufacturers learn more about the company's line of silicone paint additives, resins, and new technology to help ensure compliance with VOC regulations.

DRAISWERKE, INC.
Allendale, NJ 07401

Perl mill technology is at the heart of the exhibit. The firm's mills incorporate either a perforated or pinned-disk agitator and are generally 80-90% filled with small grinding beads. Continuous perl mill systems are available. The Drais Star Disperser for low to medium viscosity materials is also presented.

DREW CHEMICAL CORP.
Boonton, NJ 07005

See booth description under Ashland Chemical Co.

DSA CONSULTING, INC.
Mission, KS 66222

The booth has a computer on-site for demonstration of the Formula Design and Manufacturing System. This integrated system includes programs for color, dispersion, gloss, and bulking. Knowledgeable personnel are on hand.

DSET LABORATORIES, INC.
Phoenix, AZ 85029

A full line of outdoor weathering services is displayed. Real-time and accelerated exposures in AZ, FL, CA, and NJ are discussed. The Emmaqua® Test Method is presented in view of ASTM Test Methods E838/D4141/4364. Diagnostic measurement services for evaluating optical/physical property changes as a function of exposure are detailed.

DU PONT CO.
Wilmington, DE 19898

The company's DBE solvent is exhibited. It is a low cost, safe dibasic ester solvent that has high solvent power, low toxicity and high flash point. Proven applications are in automotive and appliance finishes as well as can, coil and wire coatings.

EASTERN MICHIGAN UNIVERSITY
Ypsilanti, MI 48197

Featured is educational information describing programs leading to B.S. and M.S. degrees in polymers and coatings and coatings process technology.

EASTMAN CHEMICAL PRODUCTS, INC.
Kingsport, TN 37662

The exhibit highlights Ektapro™ EEP solvent, an alternate for EE acetate; new cellulosic resins for fast-dry high-solids coatings; chlorinated polyolefins (adhesion promoters for water-base primers and coatings); CAB for urethane wood finishes; and resin intermediates for powder and high-solids coatings.

EBONEX CORP.
Melvindale, MI 48122

Exhibit features specialty bone blacks, and items produced using cosmic black pigment.

EIGER MACHINERY, INC.
Bensenville, IL 60106

Laboratory and production motormills are displayed, including the continuous throughput, dual purpose MINI 50.

ELCOMETER, INC.
Troy, MI 48083

Displayed are mechanical and electronic coatings thickness instruments, featuring the new model 211 "Banana-Type" coatings thickness gage.

ELECTRO-PHYSIK USA, INC.
Virginia Beach, VA 23455

Displayed are precision thickness gages, including the newest digital FD1000.

ELMAR INDUSTRIES, INC.
Depew, NY 14043

High speed rotary piston fillers for gallons, quarts, pints, ½ pints, or aerosol cans of paints and stains, both latex and solvent based, are on display. Latex paints can be filled at speeds up to 180 GPM using the RPE-414G Elmar Filler with guaranteed accuracy of ± ¼ fluid ounce.

EM INDUSTRIES, INC.
Pigment Div.
Hawthorne, NY 10532

This exhibit presents the Afflair® Pearl Lustre line of titanated mica pearl pigments, including new weather-resistant series for automotive finishes and other exterior plastics and coatings applications.

ENGELHARD CORP.
Iselin, NJ 08830

The firm exhibits its specialty kaolin extender pigments and attapulgite-based thickening, stabilizing and suspending products. Details are available on the company's $100 million commitment to the coating industry.

EPWORTH MFG. CO., INC.
South Haven, MI 49090

The revolutionary rotating chamber X-Entri Mill is displayed. This sealed system, small media mill out performs horizontal mills. In addition, the time proven SWMill is displayed along with grinding medias for all mills.

EXXON CORP.
Houston, TX 77001

The company, a major supplier of hydrocarbon and oxygenated solvents designed expressly for the coatings industry, features a new line of Exxate® solvents for electrostatic spray, high solids coatings, urethane and latex systems. High-purity hydrocarbon solvents include ISOPAR® isoparaffins with low surface tensions, NORPAR® normal paraffins with selective solvency and EXXSOL® dearomatized aliphatics.

FAWCETT CO., INC.
Richfield, OH 44286

On display are the company's air-operated mixers, stirrers, and accessories. Also shown are the company's air-driven disperser, new hand held mixers and agitator drum units.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
Philadelphia, PA 19107

Featured is a display of Federation publications and educational and training aids including, the *Journal of Coatings Technology*, "An Infrared Spectroscopy Atlas for the Coatings Industry," "Paint/Coatings Dictionary," and Federation slide/tape training programs. The 1986 Paint Industries' Show floor plan is on display and applications for exhibit space are available.

FILLITE USA, INC.
Huntington, WV 25702

The firm is exhibiting its complete line of ceramic microspheres, (hollow and solid). Ceramic microspheres are currently used in a broad range of paint and coating applications. Available in several densities and particle size distributions.

FILTER SPECIALISTS, INC.
Michigan City, IN 46360

A full line of liquid bag filters, in-line strainers, filter bags and accessories for the process industry are shown. Introduced are new "Polywound" filter cartridges and cartridge housings. Technical personnel are in attendance to discuss applications and processes.

FILTERITE/BRUNSWICK TECHNETICS
Timonium, MD 21093

On display are several products from our broad line of filter cartridges and housings. Hi-V II™ resin bonded cartridges, Duo-Fine® pleated media cartridges and the OMF Redi-clean housings are featured. Sales and application engineers are available to discuss your filtration application.

FLORIDIN CO.
Pittsburgh, PA 15237

See booth description under Pennsylvania Glass Sand Corp.

FRICKE ENTERPRISES
Granite Falls, WA 98252

We're making the future happen now! Stop by our exhibit to see and discuss our new equipment. We set the pace once more with a new 5-gallon Lid Dropper storing over 100 plastic lids and 1-gallon binary "Space-Saver" Filler/Sealer. See it now: the Fricke line of filling and closing systems for the future.

FRYMA, INC.
Middlesex, NJ 08846

Displayed is the Coball Mill, a new concept in fine grinding and dispersing, giving easy and fast clean-up and maintenance, low grinding chamber volume and excellent heat exchange capabilities. Also featured are vacuum deaerators, colloid mills and scraped surface heat exchangers.

GAF CORP.
Wayne, NJ 07470

Specialty chemicals for the coatings industry are highlighted in this exhibit. Featured are V-PYROL®/RC, GAFGARD®, ALIPAL®, BLANCOL®, GAFAC®, GANEX®, IGEPAL®, NEKAL®, Thickener LN, M-PYROL®, THF®, BLO®, and Butanediol.

PAUL N. GARDNER CO., INC.
Pompano Beach, FL 33060

Many new instruments are presented including the new model cross cut tester guide, rolling ball hardness tester, new standard series and mini series Ford cups, dip coater, digital hot plate/stirrer/controller, color logo wet film gages, scrub tester, precision wet film wheel, glossmeters, and more.

GEORGIA KAOLIN CO., INC.
Union, NJ 07083

The company's complete line of calcined, delaminated, and hydrated aluminum silicates is featured along with its newest family member, Illinois Minerals Co., a leading supplier of microcrystalline silica for all types of coatings.

GLOBE TRADING CO.
Detroit, MI 48207

Established in 1942. Distributor of the Norton Chemical Process Products line that includes ball mills, jar mills, grinding media, drum tumblers and rollers. U.S. reps for Peltsman Co. mixers. Sells new and rebuilt equipment for paint and chemical industries.

GOODYEAR TIRE & RUBBER CO.
Akron, OH 44316

The company features two new products . . . Pliolite Maintenance Coatings and Pliolite WR-D. Pliolite is a water system that offers all the advantages of low odor, water cleanability and good adhesion. Pliolite distributors are also featured.

GORMAN-RUPP CO.
Mansfield, OH 44901

The firm features a line of rotary gear pumps available in standard-duty and heavy-duty models. Pumps will deliver up to 480 gpm, pressure to 200 psi, temperature to 500°F, and viscosities to 250,000 SSU.

W. R. GRACE & CO.
Davison Chem. Div.
Baltimore, MD 21203

Visit our booth for the latest information on high-efficiency flatting agents and moisture scavengers for metallic and moisture-sensitive coatings.

GREFCO, INC.
Dicaperl® & Dicalite® Depts.
Torrance, CA 90509

New filler products are featured under both the Dicaperl and Dicalite Trademarks for the first time at a national exhibit. Literature is available on the use of these materials in coatings, spackle, joint compounds, and more.

HAAKE BUCHLER INSTRUMENTS, INC.
Saddle Brook, NJ 07662

Featured is the Rotovisco RV 100 base control unit used to determine the shear stress, viscosity, and elasticity of materials. Computerization of the Rotovisco is also shown.

HALOX PIGMENTS
Pittsburgh, PA 15220

Featured are pigments free of lead and chromate for anti-corrosion coatings and tannin stain blocking. Technical staff are available to suggest ways to maximize performance and cost effectiveness, update your literature, and share case histories.

HARSHAW/FILTROL PARTNERSHIP
Cleveland, OH 44106

Sample our full palette of colors for architectural, OEM and special purpose coatings as well as our spectrum of inorganic and organic dry colors and aqueous, resin and universal dispersions.

HELIOS CONTAINER SYSTEMS
Addison, IL 60101

Displayed are flexible, bulk bags used for shipping dry, flowable solids. Several standard models are available and bags can be customized to your specifications. Bags which have a greater resistance to acids, heat, and static electricity are also featured.

HENKEL CORP.
Polymers Div.
Minneapolis, MN 55435

The company presents G-Cure® acrylic resins for gloss retentive urethane coatings; Versamid® polyamide resins for industrial coatings; Genamid® and amidoamine resins; Versamine® modifed amine curing agents; and Versacure® resin systems.

HERCULES INCORPORATED
Wilmington, DE 19894

Featured are a new low-viscosity grade nitrocellulose; toluene-wet grades; new formulation information. Also: Natrosol® hydroxyethylcellulose; paint-stripper formulations based on Klucel® hydroxypropylcellulose; Pentrex® resins, Pamolyn® and Pamak® fatty acids, Hercules Canada Pigments, Hercoflat® inert texturing agent, ethylcellulose, EHEC, and pentaerythritol polyols—including PE 200-based intumescent paint formulation.

HEUBACH INC.
Newark, NJ 07114

The display illustrates the company's complete pigment color and corrosion inhibiting pigments, including DALAMAR® organic yellows and "Watchung" reds, greens and blues. Special attention is given to the Heucophos and anti-corrosive pigments, and high performance chrome yellows and molybdate oranges. New Heucophthal Blue pigments are introduced.

HILTON DAVIS CHEMICAL CO.
Cincinnati, OH 45222

"Colorants That Offer More"—illustrated is the company's extensive line of colorants from anticorrosives to flushed color. Featured are new high solids universal type colorants and the new volumetric version of SUP-R-CRYL® II for nonaqueous industrial coatings. Technical personnel are available for consultation.

HITOX CORP. OF AMERICA
Corpus Christi, TX 78403

The Hitox exhibit focuses on Hitox buff TiO_2 and the Natural Deep Red Iron Oxide. Photographs of the facility, its personnel, and its product service capabilities are shown. Also available are literature and examples of coatings applications.

HOCKMEYER EQUIPMENT CORP.
Harrison, NJ 07029

Featured is a variable high speed disceperser, a model 2L laboratory disceperser, and a concentric shaft mixer. Various blade styles are available for inspection and discussion.

HOOVER UNIVERSAL, INC.
Bulkdrum
Ann Arbor, MI 48106

Bulkdrum® is a 275 gallon HDPE blowmolded bottle in a galvanized steel shell attached to a wooden pallet. When compared to (5) 55 gallon drums, it saves 24% in floor space, 22-66% in container weight and 80% in handling and filling time.

HOOVER UNIVERSAL, INC.
Tote Products
Beatrice, NE 68310

The new Agitated Tote® Container, plus the Universal Poly 350 Tank, along with the firm's product line of material handling equipment are featured.

HOTPACK CORP.
Philadelphia, PA 19154

Demonstrated is the new SCAB-Corrosion Test Chamber. It meets rigid ASTM standards for SCAB Testing requirements. They have special non-corrosive interiors molded from SB plastic. Technical personnel are on-hand.

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

The Clay Div. is featuring calcined clays, acid washed clays and specialty hydrous clays. The Calcium Carbonate Div. features new fine and ultra-fine particle size calcium carbonate extenders. The Chemicals Div. features new use literature on ZEOTHIX®—flatting and thickening applications. Data is available on new Zeothix 177.

HÜLS AG
New York, NY 10017

See booth description under Nuodex, Inc.

HUNTER ASSOCIATES LABORATORY, INC.
HunterLab
Reston, VA 22090

Introduced is UltraScan™, a sphere-based spectrophotometer which enables the user to achieve unmatched levels of repeatability and reproductivity in the measurement of color and appearance properties. LabScan II, a spectrocolorimeter with a 0°/45° optical sensor and the D25-PC2 colorimeter are also shown.

I.C.I. AMERICAS, INC.
Wilmington, DE 19897

Solsperse® hyperdispersants for nonaqueous industrial and high solids systems; Haloflex® resins-vinylidene chloride containing copolymers; Lumiflon solvent soluble fluoropolymer; antimicrobials; chlorinated rubber; colorants; petrochemicals are featured.

IDEAL MFG. & SALES CORP.
Madison, WI 53704

Information on the company's full line of filling and sealing equipment is available. The exhibit features advanced design of fully pneumatic filling and sealing equipment with capacities from ½ U.S. pints to 5 Imperial gallons. Additional equipment and accessories are displayed.

INDUSTRIAL FINISHING MAGAZINE
Hitchcock Publishing Co.
Wheaton, IL 60188

The October issue of *Industrial Finishing*, the magazine for coatings, manufacturing and applications, is distributed and subscription forms are available. Editorial and business staff members are present.

INOLEX CHEMICAL CO.
Philadelphia, PA 19148

Featured are high-performance polyesters for coil coatings, can coatings, high-solid resins, polyurethane polyols and water-reducible systems. Also shown are surfactants and emulsifiers.

ISC ALLOYS LTD.
Bloxwich, Walsall, England

Delaphos 2 zinc phosphate, a nontoxic, white pigment which has found widespread use as a replacement for the highly toxic lead and chromate based anticorrosive pigments is featured. Delaville zinc dusts are available in grades to suit particular formulae.

ITASCO DIV. AND WELLCO DIV.
I.W.I. Industries, Inc.
Summit, IL 60501

The ITASCO Division is exhibiting its new 375 gallon stainless steel bulk liquid portable shipping tank. WELLCO Products Division features its new high-impact tank cleaning spray nozzles.

JOHNSON WAX
Racine, WI 53403

The exhibit features the company's line of acrylic oligomers for low-VOC product finishing, latices for wood and general product finishing, and polyols for high performance acrylic-urethane coatings.

KAY PUBLISHING CO. LTD.
Oakville, Ontario, Canada L6K 3G5

Featuring *Coatings Magazine*, Canada's only paint industry publication.

KAY-FRIES CHEM. DIV.
Dynamit Nobel of America
Rockleigh, NJ 07647

Featured are saturated polyesters resins and titanates.

KENRICH PETROCHEMICALS, INC.
Bayonne, NJ 07002-0032

Featured are Ken-React titanate and zirconate coupling agents. Kenplast ES-2 (cumylphenyl acetate), a nonmutagenic epoxy-reactive diluent and new neoalkoxy (second generation) titanates are offered. Also featured Kenflex A; Kenplast G; and Kenplast LT plasticizers.

KENT STATE UNIVERSITY
Kent, OH 44242

The booth features description of the coatings education program within the chemistry department, including continuing and cooperative education, undergraduate and graduate research, coatings scholarships, and Ph.D. program.

KINETIC DISPERSION CORP.
Scarborough, ME 04074

The exhibit features the Kady Mill model 20T capable of 75 gallons of latex or alloy base per hour. The 20T eliminates the need for multiple pieces of equipment and premixes. Top entry allows for use of customer's tanks.

KING INDUSTRIES, INC.
Norwalk, CT 06852

Exhibit features NACURE® acid and blocked catalysts, K-FLEX® polyester polyols, K-CRYL® acrylic oligomers, and DISLON® additives for non-aqueous coatings.

KTA-TATOR, INC.
Pittsburgh, PA 15275

Featured are microprocessor controlled dry film thickness gages, a new instrument for measuring adhesion of coatings, and instruments for ambient conditions, surface cleanliness and profile, wet and dry film thickness, adhesion and pinhole. Also highlighted, coatings consulting, failure analysis, lab testing and educational/training services.

LABELETTE CO.
Forest Park, IL 60130

On display is the new and improved F-Style labeler, model F121418 which handles virtually all square containers from ½ pint—1 gallon.

LETICA CORP.
Rochester, MI 48063

Featured is the company's one gallon paint can with the easy peel-off lid. Accompanying the paint can, is the firm's entire product-line, which includes plastic shipping containers in one through six gallon sizes.

LIQUID CONTROLS CORP.
North Chicago, IL 60064

Featured is a unique rotary positive displacement design which permits measurement of liquids with viscosities up to 2,000,000 SSU with low rpm and minimum product shear. On display is an M-7 100 gpm, 150 psi meter and a flowing demonstrator model.

LOGICOM, INC.
Deerfield, IL 60015

CLaM, the Coatings Lab and Manufacturing software system, is presented for hands-on evaluation. Comprehensive lab, production, inventory, and pricing features are combined in an integrated relational data base system.

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

Clears, stains, paints and primer formulations employing the company's JK270 and JK500 resins are shown. Joint cement and caulking compounds are displayed with new formulations based on the company's D054 resin system.

LUBRIZOL CORP.
Diversified Products Group
Wickliffe, OH 44092

The display features Ircogel 905, a unique rheology control additive for pigmented, solvent-based, high-solids paints and coatings. Included in the exhibit are application examples for urethane and high-solids coatings.

MACBETH
Div. of Kollmorgen Corp.
Newburgh, NY 12550-0382

Featured is a fully automated color matching and dispensing station designed by Macbeth and Red Devil, Inc. Also displayed are Series 1500/PLUS Color Measurement System, SpectraLight Color Matching Booth and Munsell Color physical standards and companion products.

MACHINEFABRIEK KLIEVERIK B.V.
Oldenzaal, Holland

Supplier of dosing installations for liquids, the firm features hand-operated to fully automated washing machines in different types for the paint and ink industry.

MAGNESIUM ELEKTRON, INC.
Flemington, NJ 08822

Information on the company's range of zirconium chemical cross-linkers for the coatings industry is available. Improvements in adhesion, heat resistance, and water/solvent resistance are experienced as a result of their use.

MANCHEM LTD.
Manchester, M11 4AT England

The company features Manalox aluminum chemicals which find application as thickeners, gellants and water repellants. New developments in the field of timber protection are presented and staff are on hand to advise on the firm's whole range of coatings products including driers, biocides and pigments.

MANVILLE
Filtration & Minerals
Denver, CO 80217

Learn how our efficient, low-cost flatting agents and extender pigments can help improve your formulation's performance and costs. CELITE® and MICRO-CEL®—used by more than 1000 paint manufacturers worldwide. Also, see our line of fiber-glass filter cartridges.

MARCO SCIENTIFIC, INC.
Sunnyvale, CA 94087

McWHORTER, INC.
Carpentersville, IL 60110

New high solids resins for both air dried and baked coatings are featured, with performance characteristics previously unattainable in high solids systems, plus new emulsions with superior scrub resistance/wet adhesion properties for consumer paints are also exhibited.

THE MEARL CORP.
New York, NY 10017

The Pearl Pigment Div. displays high-luster coatings based on nonmetallic, "metallic-like" pigments, iridescent colors and ultra-bright pearls. Also shown are new weather-resistant grades for long-term exterior exposure. The Franklin Mineral Products Div. displays advantages of high quality, wet-ground mica.

METTLER INSTRUMENT CORP.
Hightstown, NJ 08520

Analytical and precision balances for all applications (formulating, etc.) that require accurate, quick, and reproducible results are displayed. All models can be connected to computers. Also, on-line process control instrumentation for monitoring and controlling the quality of fluid components by means of density measurement.

MICRO POWDERS, INC.
Scarsdale, NY 10583

Special finely micronized waxes for imparting improved properties to all types of paints and coatings are featured. On display is Aquapoly 250 and Aqua Polyfluo 411; specially designed products to improve mar and abrasion resistance in water-reducible paints and coatings.

MICROMERITICS INSTRUMENT CORP.
Norcross, GA 30093-1877

Exhibit includes: particle analysis instruments for fine powders and latices; and surface area and porosimetry instruments which measure surface area by static volumetric or dynamic flow methods and pore structure by automatic physical adsorption or mercury instrusion porosimetry.

MID-STATES ENGINEERING & MFG., INC.
Milton, IA 52570

Featured are portable bulk storage and shipping containers for dry powders and liquids ranging in capacities of 20-150 cubic feet and 150-650 gallons, respectively. They are available in both stainless and mild steel constructions.

MILLER PAINT EQUIPMENT, INC.
Addison, IL 60101

Featured in the exhibit is the company's Accutinter, a computer-controlled tinting machine, and the Model G dual mixer paint shaker. Also displayed is a top load Gyromixer and a colorant dispenser.

MILTON ROY CO.
Analytical Products Div.
Rochester, NY 14625

On display is the COLOR SCAN™ family of color analysis systems, the least expensive true double-beam systems available anywhere, starting at $12,000. Offering research accuracy and production reliability, COLOR SCAN is the system you've been looking for.

THE MILWHITE CO., INC.
Houston, TX 77220-5038

A pictorial display of operational facilities is used to introduce the company to the paint and coatings industry. Product brochures and other information is available on this company which deals with nonmetallic minerals for industry. Featured is Microbarite-1065 mineral extender.

MINERAL PIGMENTS CORP.
Beltsville, MD 20705

Display of uses for inorganic anticorrosive pigments such as zinc phosphate, zinc chromate, strontium chromate and zinc borate. Pictures depicting the use of medium and light chrome yellow and a full line of iron oxides red, yellow and black.

MiniFIBERS, INC.
Johnson City, TN 37615-9220

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 the CR series of tristimulus color difference meters and their new data processor. These are the most compact and lightweight tristimulus color difference meters on the market.

UNIVERSITY OF MISSOURI-ROLLA
Rolla, MO 65401

Featured is a display of the activities of the University of Missouri-Rolla. These include the short course program and outline—Basic Composition, Paint Formulation, Physical Testing, and Microcomputers. Information about the undergraduate and graduate program in polymer and coatings science is available.

MITECH CORP.
Willoughby, OH 44094

The Carri-Med Controlled Stress Rheometer system is displayed. Actual coating rheology data is available that demonstrates the capabilities of this newly-available instrument.

MOBAY CHEMICAL CORP.
Pittsburgh, PA 15205-9741

The exhibit features applications of the company's urethane coatings resins and synthetic iron oxide pigments in trade sales, product finishes, transportation coatings and maintenance coatings. The exhibit also features new product developments in pigments and urethane resins.

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 92633

The exhibit features the new 16-liter horizontal media mill, a 25HP Cowles Dissolver with Polypeller, a 7-15A Vertical Sandmill with quick release screen assembly and a W-12 Lab Dissolver which will be given away in a drawing.

MOZEL CHEMICAL PRODUCTS CO.
St. Louis, MO 63110

A replica of a Mississippi River Steam Boat greets you at the entrance to the Convention Hall. Arrange to meet, or leave and receive messages. Sit down and relax with a complimentary soft drink as you visit with your friends or business associates. A list of popular luncheon and dinner spots is available. To contact the message center, phone 314-342-5586.

MSD SYSTEMS, INC.
Oak Brook, IL 60522-4554

Material Safety Data Sheets "with the touch of a button." The company has the software for your computing needs, whether it's an IBM PC or Burroughs mainframe. The MSDS program runs on 60 makes and models of computers. Meets all OSHA requirements.

MYERS ENGINEERING
Bell, CA 90201

On display is a dual shaft high-speed disperser with two impallers in each shaft that pass over each other in opposite directions. Disperses so fine sandmilling often is not needed. Shafts spread apart for easier loading with less dust. Also displayed is a laboratory-sized disperser. Factory engineers on-hand to answer technical questions.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS
Houston, TX 77084

Information on the use and performance of protective coatings in corrosive environments is featured. The display includes books on corrosion and its control in a wide range of industries.

NATIONAL PAINT & COATINGS ASSOCIATION
Washington, DC 20005

Displayed are the services of the National Paint & Coatings Association and how they support those involved in paint technology.

NETZSCH INCORPORATED
Exton, PA 19341

The grinding and dispersion machinery displayed includes horizontal and vertical small media mills used in the manufacturing of paints, industrial and specialty type coatings, inks, magnetic dispersions and the grinding of coal, minerals, agricultural chemicals, etc. Come and talk with our technical people about our new computerized continuous mixing and feeding systems, as well as the VM staged grinding concept.

NEUPAK, INC.
Burnsville, MN 55337

Demonstrated is an automatic twin-head, high-speed, volumetric filling and capping system capable of filling ½ pint through one gallon containers. An electronic digital weigh filler for 55 gallon drums is also demonstrated.

NEVILLE CHEMICAL CO.
Pittsburgh, PA 15225

The company's wide range of petroleum hydrocarbon resins, Cumar coumarone indene resins, Unichlor chlorinated paraffins and Syntase ultraviolet light absorbers are featured. Technical information on use in coatings and coating systems is available. Technical representatives staff the exhibit.

NJZ COLORS, INC.
Brooklyn, NY 11211

NJZ Colors is showcasing prints of their chrome yellows and molybdate oranges. The excellent properties of their pigments are visual to all. In addition, NJZ demonstrates colors in action for various end uses. Here to stay and growing.

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

Highlighted this year is TITANOX® 2160 titanium dioxide pigment, a high durability, chloride processed pigment used wherever excellent weathering resistance, chalk resistance, gloss retention, and hiding power are required. The BENTONE® SD series of "Super Dispersible" rheological additives and NALZIN® non-lead, non-chrome anticorrosive pigments are also exhibited.

NORTH DAKOTA STATE UNIVERSITY
Polymers and Coatings Dept.
Fargo, ND 58105

Educational and research activities of the department are described. Information on 1986 short courses is available.

NUODEX, INC.
Piscataway, NJ 08854

Hüls AG and Nuodex are exhibiting the Nuodex color system, the high solids colorant dispersions, the aliphatic isocyanates (IPDI/TMDI), the aliphatic epoxy coating systems (IPD/TMD) and their comprehensive line of additives including driers, thickening agents, fungicides, preservatives and special resins to improve adhesion and gloss.

NYCO
Willsboro, NY 12996

Featured is 10 Wollastokup® ES, a new pigment enhancer for primers and barrier coatings. Application information is available for epoxy, urethane and alkyd systems. Product exhibits exceptional blister and corrosion resistance in all industrial systems.

O'BRIEN INDUSTRIAL
San Francisco, CA 94124

In addition to a machine on display, a video presentation shows the compact, Mobile Can Filler and Combination Closer. Rate: 18 1's or 9 5's/minute. Factory people are present to answer questions.

OTTAWA SILICA CO.
Ottawa, IL 61350

Kaolin clays and silicas are displayed with samples available. SNOW*TEX® calcined kaolins are featured along with hydrous kaolins, Sil-Co-Sil® ground silicas, whole-grain silicas for texture and wear-resistant coatings, sand mill media and ASTM Testing Sands.

P.A. INDUSTRIES
Chattanooga, TN 37409

Two new products, Extendospheres® Metalite™-Zinc (zinc-clad hollow microspheres used in conjunction with zinc dust) and Extendospheres® Metalite™-Silver (silver-clad hollow microspheres used for EMI/RFI coatings) are introduced. Also displayed are Metalite™-Copper, Metalite™-Aluminum and Extendospheres® Bubblekup®.

PACIFIC DISPERSIONS, INC.
Cudahy, CA 90201

Pigment dispersions for solvent-borne and water-borne trade sales and industrial paints. Featured are Hi-Tint, AIT, HydroTek AW, and SolvTek SAS lines of dispersions.

PACIFIC MICRO SOFTWARE ENGINEERING
Bell, CA 90201

Featured is BatchMaster software for paint and coatings manufacturers running on IBM PCs. This includes material safety data sheets, production scheduling, batch tickets, cost analysis, physical-properties analysis, inventory, purchasing, and more.

PACIFIC SCIENTIFIC CO.
Silver Spring, MD 20910

A wide selection of quality control testing instruments for the evaluation of color, gloss, viscosity, and other physical parameters are shown. See the Spectrogard Automatch System and the Spectrogard Color System, as well as tristimulus colorimeters.

PAINT & COATINGS INDUSTRY MAGAZINE
Canoga Park, CA 91303

Courtesy copies of the September/October issue of *Paint & Coatings Industry Magazine* are available for all attending the show. Courtesy 1-year subscriptions for all qualified personnel may be ordered free of any charges during the show.

PARALLAX COMPUTER CORP.
Princeton, NJ 08540

The exhibit features computer software specifically designed for the paint industry, including production inventory control and all accounting software demonstrated as an integrated package.

PENN COLOR, INC.
Doylestown, PA 18901

Innovation, advancement, and technical service in pigment-dispersion technology are highlighted. 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.
Floridin Co.
Berkeley Springs, WV 25411

Exhibit features information on 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) as a stabilizing and flow-control agent.

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

Participating in their 33rd Paint Show, the company features a tradition of technical leadership with a display of process control data taken from actual operations in recent years. In addition, a broad line of synthetic and natural iron oxides for the coatings industry is provided.

PHILLIPS CHEMICAL CO.
Bartlesville, OK 74004

Phillips performance-proven products for coatings applications are featured, including high-purity hydrocarbon solvents and propellants. Chemical intermediates as chain transfer agents are exhibited. Catalyst Resources, Inc. are displaying their line of Aztec® Initiators.

PIGMENT DISPERSIONS, INC.
Edison, NJ 08817

Featured in the display are 100% solids color dispersions in polyester, epoxy and low moisture urethanes. These are available in a broad range of standard colors or as custom colors.

PLASTICAN, INC.
Leominster, MA 01453

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

POLY-RESYN, INC.
West Dundee, IL 60118

The exhibit features a pourable rheological anti-settling agent for solvent base paints.

POLYVINYL CHEMICAL INDUSTRIES, INC.
Wilmington, MA 01887

Featured are new products including special-purpose polymers that can be formulated into trade sale varnish, paint, gym floor finish and roof coatings; also a true acrylic-urethane copolymer newly developed for coating housing clapboard and commercial composite board.

PPG INDUSTRIES, INC.
Chemicals Group
Pittsburgh, PA 15272

Lo-Vel® flatting agents for coil coatings, metal furniture finish, aluminum extrusion coatings, and high-solids coatings are featured. Hi-Sil® T-600 synthetic thickener and thixotrope, and new Hi-Sil® T-690 for improved thixotropic and anti-sag action plus coarse pigment suspension are exhibited.

PRA LABORATORIES, INC.
Chicago, IL 60620

Representatives are present to discuss the advantages to you and your company of becoming a member of this association of progressive paint manufacturers. The laboratory provides services in research, analysis, product testing and information exchange.

PREMIER MILL CORP.
New York, NY 10010

On display are 0.25 liter horizontal laboratory Supermill; all stainless steel (inside and outside) 30 liter horizontal Supermill-production size; and explosion-proof laboratory high-speed disperser.

PROGRESSIVE RECOVERY, INC.
St. Louis, MO 63146

On display are the company's LSR Model (Liquid Solvent Recovery) distillation unit and SC Model distillation unit.

PURNELL INTERNATIONAL
Houston, TX 77008

Purnell International is the U.S. Distributor for Mastermix, Ltd., the primary supplier of mixing and dispersing systems in the U.K. On display are the unique PMD-VC-250 mixer disperser and a CH-30 horizontal bead mill. Factory representatives are on hand.

Q-PANEL CO.
Cleveland, OH 44145

On display is the Q-U-V, the world's most widely used weathering tester. The Q-U-V uses fluorescent UV lamps and condensing humidity to reproduce the damaging effects of sunlight, rain, and dew. The Q-U-V gives fast, economical tests in conformance with ASTM G-53. A choice of UV lamps allows for excellent correlation with outdoor weathering.

QUINTEL CORP.
Tempe, AZ 85281

Introduced is the new Benchtop Evaporometer which is accurate, portable, and easy to use for effectively measuring evaporation rates and analyzing profiles of the evaporation processes for paints, coatings, adhesives, and solvents.

RECOVERY FILTRATION PRODUCTS
Orange Park, FL 32067

The exhibit features solvent distillers for hazardous waste.

RED DEVIL, INC.
Union, NJ 07083

A complete line of tint dispensers and paint mixing machinery is on display. Also shown is the new custom color matching system which links the Red Devil Autotint™, fully automatic tint dispenser, to a computer-controlled spectrophotometer, to instantly identify and dispense formulas to match virtually any color example shown to the system.

REECO
Morris Plains, NJ 07950

Displayed is the RE-THERM® thermal oxidation (incineration) system, a most unique, cost and energy efficient pollution control system for the elimination of VOC and odors.

REICHARD-COULSTON INC.
Bethlehem, PA 18018

Irox yellow 207 is featured for use as the ideal extender for organic toners. It reduces cost, increases opacity and retains color durability without causing undue milkiness. Also displayed are pigments for steel primers, including our super strength grades and zinc phosphate "317."

REICHHOLD CHEMICALS, INC.
White Plains, NY 10603

Exhibited are current developments in high-solids polyester, alkyds, chain stopped alkyd and epoxy resins for use in the production of high performance coatings. In addition, the latest developments in emulsion polymer technology covering architectural and industrial finishes, roof mastics, caulks and sealants are displayed.

RHEOMETRICS, INC.
Piscataway, NJ 08854

Featured is a Sir Isaac Newton a/v display. Through the magic of time travel, Professor Newton explains what rheology is all about . . . and that you don't need to be a physicist to make rheology work for you.

ROHM AND HAAS CO.
Philadelphia, PA 19105

Performance characteristics of acrylic vehicles, both aqueous and solvent-borne, and coatings additives are demonstrated to those interested in trade sales paints, industrial finishes, prefinished siding, and marine and maintenance coatings.

ROPER PUMP CO.
Commerce, GA 30529

On display are air-operated double diaphragm pumps, rotary gear pumps and progressing cavity pumps.

RUSSELL FINEX, INC.
Mount Vernon, NY 10550

Featured is the 22 Model A 16350 high speed vibratory strainer, widely used throughout the coatings industry due to its efficiency and high throughput capabilities.

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

Featured is the AIR-PALLET® system, an effective method of handling and shipping powdered products in a completely closed system. The reusable Air-Pallet® container can be discharged by gravity, fed to a pneumatic conveyor or coupled to the Air-Pallet® ejector mixer for direct and rapid pigment dispersions. Systems are also available for filling and batch feeding into process.

SERAC, INC.
Addison, IL 60101

A rotary, fill-by-weight, 6 station paint filler is featured. The filler demonstrates the firm's laminar flow nozzle technology designed for thin solvents and stains as well as thick paints, without drips. The filler is capable of running up to 50 cpm.

SHAMROCK CHEMICALS CORP.
Newark, NJ 07114

Meet the tribologists—specialists in the control of friction and wear! The company provides a wide range of stir-in powder products, primarily utilizing polyethylene and PTFE in grinds to suit your application. Products are designed to provide wear, mar, scuff and abrasion resistance, and other properties.

SHELL CHEMICAL CO.
Houston, TX 77001

Featured are the quality and service associated with EPON® resins, including: availability through its nation-wide network of distributors, and its "1-800-TEC-EPON" direct line for answers to technical resins problems.

SHERWIN-WILLIAMS CHEMICALS
Coffeyville, KS 67337

MOLY-WHITE® corrosion inhibiting pigments are featured. These white, environmentally-safe pigments are available in lower cost modifications specifically designed for both solvent and water based coatings. New easy dispersing products are presented.

SILBERLINE MANUFACTURING CO., INC.
Lansford, PA 18232

Metallic coatings are differentiable. The best are produced with SPARKLE SILVER® and ETERNABRITE®—it's that simple! Come visit the leader in quality, reliability, innovation and technological achievement . . . yesterday, today and tomorrow. Some things never change. Silberline—specialists in aluminum pigments.

SOUTH FLORIDA TEST SERVICE, INC.
Miami, FL 33178

Company representatives are available to discuss the newest exposure methods for both accelerated and natural weathering.

SOUTHERN CLAY PRODUCTS, INC.
an E.C.C. America Co.
Atlanta, GA 30329

Featured is the Claytone series of rheological control additives for solvent paint systems. New is Claytone AF a self-dispersing organoclay for paints.

UNIVERSITY OF SOUTHERN MISSISSIPPI
Hattiesburg, MS 39406-0076

The exhibit offers information concerning undergraduate and graduate programs in polymer science. Emphasis is given to the preparation of undergraduate students for employment in the coatings industry. Coatings research by the Polymer Science Department is also highlighted.

SPARTAN COLOR CORP.
Houston, TX 77087

For small batch manufacture and tinting, the widely-compatible Spartacryl industrial color concentrates in PM acetate are featured. They are excellent for both volumetric and digital weight dispensing systems. A marketing/business multi-user computer application, specifically designed for the coating manufacturer, is also featured.

SPENCER KELLOGG PRODUCTS/NL CHEMICALS
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.

A. E. STALEY MFG. CO.
Chemicals Div.
Decatur, IL 62525

Presenting information on methyl glucoside, a tetra-functional polyol for urethane oils, alkyds and polyesters; polymerizable cellulosics for radiation curable coatings; and new protective colloid for latex systems.

STEEL STRUCTURES PAINTING COUNCIL
Pittsburgh, PA 15213

This technical society demonstrates how it serves the coatings industry through research, membership, publications, and the development of guides and specifications. The exhibit emphasizes the *Journal of Protective Coatings & Linings* and the new SSPC Videotape Training Series on Protective Coatings.

SUN CHEMICAL CORP.
Colors Group
Cincinnati, OH 45232

Exhibit features those products offered by both the Pigments and Dispersions divisions. Emphasis is placed on those pigments targeted specifically at the coatings industry. The theme is the use of organic pigments to meet environmental restrictions. A complete listing of product data is available on all colors.

SYLVACHEM CORP.
Jacksonville, FL 32201

Featured is a new line of epoxy curing agents including Sylvamid™ polyamide resins, Sylvacure™ amidoamine resins and Sylvamine™ modified polyamines. These products fill several major market needs including high solids, high build, improved chemical resistance, high temperature resistance and the need for water based curing agents.

SYNRAY CORP.
Kenilworth, NJ 07033

New resins for high-solids and water-reducible systems, as well as Burnok thixotropic alkyds, are presented. Introducing faster drying long and medium oil alkyds to replace standard type 1 and type 3 resins.

TAMMSCO, INC.
Tamms, IL 62988

The company's complete line of silicas are featured, from a 120 mesh to a 1 micron average particle size. Technical information on all grades is available.

TECHNOLOGY MARKETING CORP.
Norwalk, CT 06851

The world's leading publisher of energy efficient, non-polluting coatings technology news, with over a decade of leadership in this field, features books, buyer's guides, periodicals, and newsletters on the following subjects: radiation curing high-solids coatings, water-borne coatings, and powder coatings.

TEGO CHEMIE SERVICE GmbH
c/o Goldschmidt Chemical Corp.
Hopewell, VA 23860

Tego Chemie service continues its introduction of high performance silicone/silicone polyester resins and a complete line of paint additives. Some exciting new additives are being presented.

TEKMAR CO.
Cincinnati, OH 45222

Introduced is the new Contraves Rheomat 135S Rheometer for the measurement of viscosity, flow behavior, and viscoelasticity. Also shown is the new Covimat 101/105 Process Viscometer, in-line and batch systems and surface tension measuring instruments.

THIELE ENGINEERING CO.
Minneapolis, MN 55435

Thiele Engineering's new 1-5 Gallon Filler-Transfer-Crimper with automatic lid placing and closing for both 1 and 5 gallon lids is featured. Additional equipment is also shown via video tape.

TOYO ALUMINIUM K.K.
Higashi-ku, Osaka 541, Japan

Over 90% of Japanese metallic cars are painted by aluminium pigment produced by the company. Featured is a display of the latest metallic colors for automotives. Color catalogues and company brochures are available. Toyo Aluminium K.K. has the answer to tomorrow's styling challenges.

TROY CHEMICAL CORP.
Newark, NJ 07105

Troysan Polyphase, the low toxicity fungicide proven to be an effective wood preservative and paint film mildewcide, is featured as a most versatile product for these difficult applications. A complete line of defoamers and thixotropes are presented as well.

UNION CAMP CORP.
Wayne, NJ 07470

Featured are UNI-REZ® polyamide resins manufactured especially for coatings used in corrosive marine and industrial applications that require resistance to salt water and various chemicals. UNI-REZ polyamides are derived from a continually renewable resource—the pine tree.

UNION CARBIDE CORP.
Danbury, CT 06817

Featured are materials for industrial finishes and trade paints, with special emphasis on the expanded line of UCAR Solvents for new and conventional coatings applications; UCAR Resins for superior high-performance coatings; and the cost/performance advantages of UCAR Acrylics and Latexes for trade paints and weather barrier coatings. Also featured are the firm's line of TONE products (a caprolactone-based line of polyols, monomers, and diluents), CYRACURE cycloaliphatic expoxides and photoinitiator, cyclohexanone and cycloaliphatic epoxides. The Captain's 20th Putting Contest is being held.

UNION CARBIDE CORP.
Danbury, CT 06817

Visit Union Carbide's information center for literature and technical information.

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

Emulsion polymers (76 RES®), solvents and chemicals are featured in the exhibit. Coating ideas, technical service, and new polymer emulsions for water-resistant membrane coatings are also highlighted. Last year's popular drum roll game returns.

UNION PROCESS, INC.
Akron, OH 44313

Featured is a complete line of fine grinding and dispersing equipment. Included are the Rotomill by Torrance & Sons in England, featuring U.S. electricals and pumps, distributed in North and South America. HSF batch bead mills and attritors in batch, continuous, and circulation systems are also featured.

UNITED CATALYSTS, INC.
Louisville, KY 40232

The full line of Tixogel organoclays, along with York castor-based thixotropes, anti-settling agents, and a full line of castor oils are featured. Specific information on all these Tixogel and York products for a wide variety of coating systems is available from the technical staff.

UNIVERSAL COLOR DISPERSIONS
Lansing, IL 60438

Our booth highlights high solids pigment dispersions for universal application with aqueous and solvent-borne chemical coatings.

UNIVERSAL FILTERS, INC.
Asbury Park, NJ 07712

Metallic/nonmetallic filter vessels; standard/custom filter bags featuring welded seams; oil magnet filters to remove trace oil; and absolute/nominal submicronic filter bags.

U. S. POLYMERS, INC.
St. Louis, MO 63111

Alkyd, dispersion and specialty resins, as well as epoxy esters, polyesters, and oleoresinous varnishes are shown.

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

An expanded line of mineral and chemical additives for the paint industry is featured. Technical advice for all products is highlighted.

VERLAN LIMITED
Washington, DC 20036

Featured are equipment and literature pertaining to fire protection. Insurance information and applications are available.

VIKING PUMP-HOUDAILLE, INC.
Cedar Falls, IA 50613

Viking displays a wide range of positive displacement rotary pumps for abrasive liquids. Featured is the Series 4625 abrasive liquid pump that is four times more efficient than air-operated diaphragm pumps.

VIRGINIA CHEMICAL CO.
Portsmouth, VA 23704

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 available on CORCAT® polyethylenimines and CORFAX™ alkylpolyethylenimine.

VORTI-SIV
Div. of M & M Machine, Inc.
Salem, OH 44460

Displayed is the completely enclosed high-speed stainless steel RBF-15 (15″ screen diam.) sieving and straining machine, for use in pilot plant or small batch production, and the totally enclosed RBF-2 (22″ screen diam.) used for liquid or powder production. All units are available in 15″, 22″, 30″ and 36″ screen diameter and may be screen decked for two to four additional cuts.

WACKER CHEMICAL CO.
Henley & Co., Inc.
New York, NY 10017

Applications for HDK fumed silica are displayed. Dr. J. Doppelberger and other technically capable personnel are available for consultation. A second line of products, including ethyl silicates, solution vinyl resins, and polyvinylbutyrals is also presented.

WARREN RUPP-HOUDAILLE, INC.
Mansfield, OH 44901

The exhibit contains two operating displays of SandPIPER double-diaphragm, air operated 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. TuffRUPP-equipped, corrosion-resistant SandPIPER pumps, plus other models.

WILDEN PUMP & ENGINEERING CO.
Colton, CA 92324

On display are working cutaway models of the company's complete line of air-operated, double-diaphragm, positive displacement pumps designed to handle very thick and very abrasive products. The pumps handle up to 90% solids to over 250 ft heads in permanent, submerged, and self-priming operations.

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

Featured is the firm's series of Witcobond® aqueous urethane dispersions, both anionic and cationic types. They include a unique self-crosslinking single-package urethane dispersion which allows coatings to cure at room temperature without the use of additives. Also exhibited are Witmer® acrylic polymers recommended for emulsion floor polishes and other applications.

ZEELAN INDUSTRIES, INC.
St. Paul, MN 55101

Use of the firm's high strength fine particle size ceramic microspheres as an extender in industrial and maintenance coatings is described. Featured is data on Zeeospheres® ability to increase solids, reduce viscosity and improve such properties as chemical, corrosion, and abrasion resistance.

64th Annual Meeting & 51st Paint Industries' Show

FSCT

1986

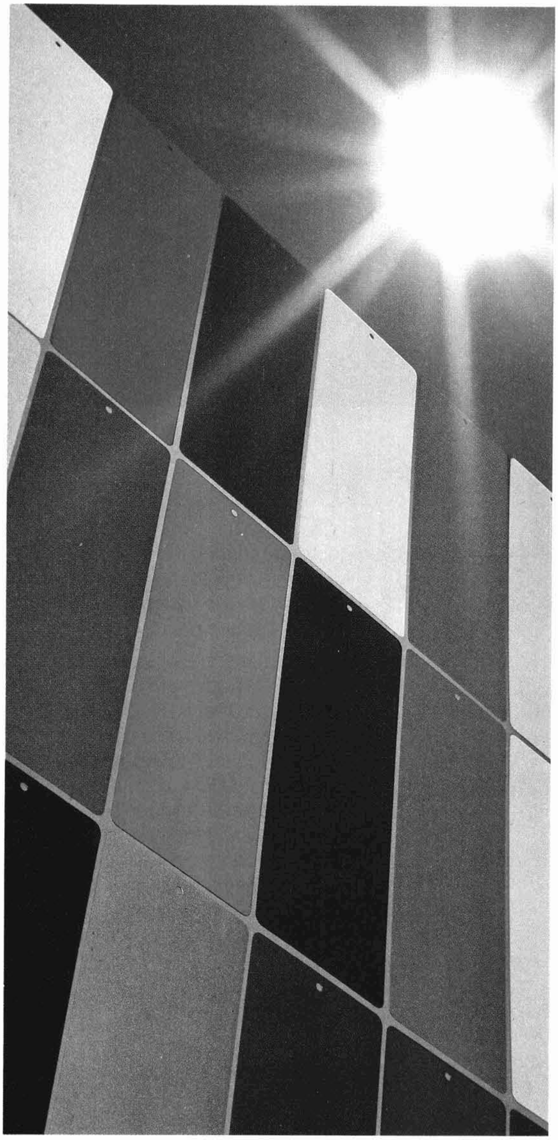
Georgia World Congress Center

• Atlanta •

November 5, 6, 7, 1986

In sunlight, coatings can die in months

With CIBA-GEIGY light stabilizers, they can live for years



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

Cracking, delamination and catastrophic failure often occur in coatings exposed to the sun. Consequently, the service life of both coating and substrate is shortened, and the cost of maintenance goes up.

Commercial use has shown that most types of coatings can be protected against photodegradation by two classes of CIBA-GEIGY light stabilizers.

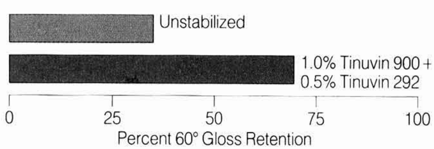
The first class is the hindered amine light stabilizers (HALS), such as Tinuvin® 292, Tinuvin 144 and Tinuvin 079L. They protect gloss and help prevent loss of physical properties that may result in chalking, erosion, water permeability and checking.

Ultraviolet light absorbers (UVA) such as Tinuvin 328, Tinuvin 900 and CGL-1130 are the other class. UVAs prevent UV light from degrading light-sensitive materials, especially primers, mildewcides and pigments. Thus, they protect performance characteristics, such as adhesion between primer and top coats. Depending on the pigment used, a UVA and HALS combination will improve color retention.

While a CIBA-GEIGY UVA or HALS by itself provides good protection for coatings, usage has shown that combinations of the two may give better results. This development is so important that CIBA-GEIGY has four patents* covering the use of HALS and combinations of HALS and UVAs in acrylic, polyester, alkyd and polyurethane coatings.

Percent 60° Gloss Retention After Two Years of Exposure

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



Manufacturers of maintenance, coil and powder coatings can now formulate their products to yield substantially longer service life.

For more information on light stabilization of coatings, call 800 431-1900 (in New York, 914 347-4700). Or write to: Additives Department, CIBA-GEIGY Corporation, Three Skyline Drive, Hawthorne, NY 10532.

CIBA–GEIGY

THIS PAPER WAS AWARDED FIRST PRIZE IN THE 1985 ROON AWARD COMPETITION

Effect of α-Methyl Groups On Room Temperature Crosslinking In Acrylic Polymers Containing MAGME Monomers

Howard R. Lucas
American Cyanamid Company*

Coating formulations, based on MAGME acrylic polymers and aimed at the automotive refinish market, were found to develop a rapid and high degree of cure with multifunctional primary amines at room temperatures. Curing at temperatures some twenty degrees below their glass transitions, these polymers exhibited large differences in their rate of hardness development and solvent resistance. Increasing the amount of α-methyl groups along the backbone of the polymer was found to greatly improve the properties of the coatings. Based on this work, a hypothesis has been proposed and supported by experimental data that these differences are largely due to the amount of inter- or intramolecular crosslinks that occur.

INTRODUCTION

Solvent-borne coatings for the automotive refinish market have traditionally been prepared from air drying alkyds and lacquers. Lacking in durability or chemical resistance, these coatings are giving way to the development of more durable and solvent resistant urethane systems which are capable of rapid cure at ambient temperatures.

To meet the challenge of the urethanes requires new approaches in crosslinking chemistry. One such approach is based on a new monomer, methyl acrylamidoglycolate methyl ether (MAGME)* (see *Figure* 1). Equipped with three reactive sites, the monomer can be incorporated into acrylic copolymers via the double bond functionality using typical free radical polymerization techniques.

Once MAGME is incorporated into a copolymer backbone, crosslinking of the polymer can be accomplished using either the methoxy methylamide group at elevated temperatures (≥100°C) or the activated ester moiety at ambient temperatures. Esters of this type, having two heteroatoms α to the carbonyl, are known to react with amines under mild conditions to form amides.[1-5] MAGME-containing acrylic copolymers, cured with diamines or triamines (see *Figure* 2) for coatings, were described by Ley,[6] but these early coatings fell short of the gloss, durability, speed of cure, and solvent resistance needed to compete with the urethanes. Since that time, work with MAGME acrylics has produced a new concept in polymer design which has increased the performance properties of these systems to a level comparable to those of the urethanes, with indications that further improvements may be obtainable. The purpose of this paper is not only to describe our achievements in the area of low

*Developed by American Cyanamid Resins Products Dept.

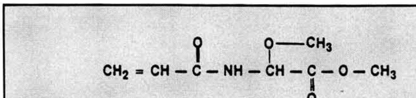


Figure 1—Methyl Acrylamidoglycolate Methyl Ether (MAGME)

Presented at the 63rd Annual Meeting of the Federation of Societies for Coatings Technology in St. Louis, MO, October 8, 1985.
*1937 W. Main St., P.O. Box 60, Stamford, CT 06904.

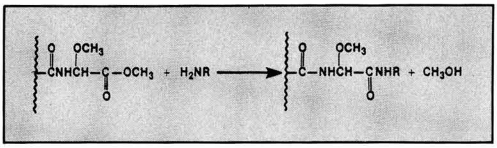


Figure 2—Crosslinking mechanism for MAGME acrylic polymers with primary amines

temperature crosslinker systems, but to shed light on the importance of polymer design, regardless of the crosslinking mechanism.

POLYMER DESIGN

Acrylic polymers, because of their resistance to the effects of weather, offer an ideal building block for coatings, but suffer from poor solvent resistance, an important requirement in today's coatings. However, these deficiencies can be overcome by crosslinking these acrylic systems. In designing crosslinked coatings, however, care must be taken to maximize the use of crosslinkable sites. If left unreacted during the crosslinking stage, these same sites can detract from the potential properties of a coating. To maximize the number of crosslinks in a crosslinkable system, polymers have traditionally been designed such that their glass transition temperatures (Tgs) are below the temperature of cure. This allows for sufficient movement within the polymer for crosslinking to occur. As crosslinking proceeds, the Tg of the polymer increases (see *Figure* 3) until it reaches the cure temperature.[7] Thus it is reasonable to assume that the lower the Tg of the starting polymer, the greater the probability of a larger number of crosslinks.

Our work to improve MAGME acrylic coatings has shown that the Tg of the starting polymer should not be used as the major criterion for the design of these systems. In the course of our studies, we have found that α-methyl groups, located along the polymer's backbone, serve to alter the conformational characteristics in such a way as to improve the crosslinked structure of the coating. Although these groups cause the polymers' Tgs to be

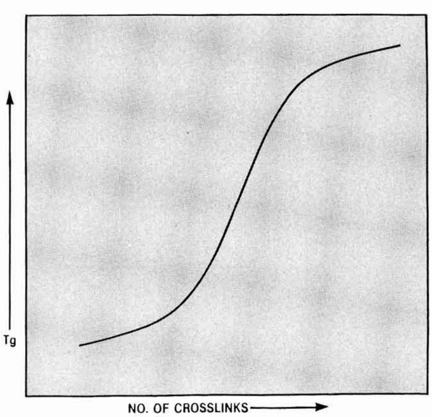


Figure 3—The effect of crosslinking on the glass transition temperature of a polymer

Table 1 — Polymer Compositions of MAGME Acrylic Copolymers

Polymer	Composition and weight %	Tg	Mole % α-Methyl
A	MAGME 25/MMA 30/MA 30/HEA 15	44°C	32.5
B	MAGME 25/MMA 34/MA 20/LMA 6/HEA 10/HEMA 5	44°C	46.5
C	MAGME 25/MMA 35/MA 15/LMA 10/HEA 5/HEMA 10	44°C	56.3
D	MAGME 25/MMA 36/MA 10/LMA 14/HEMA 15	44°C	67.6
E	MAGME 25/MMA 42/LMA 18/HEMA 15	44°C	80.8

MMA = Methyl methacrylate
MA = Methyl acrylate
LMA = Lauryl methacrylate
HEA = Hydroxyethyl acrylate
HEMA = Hydroxyethyl methacrylate

above the cure temperature, they cure to a comparable extent and rate as polymers with Tgs below the cure temperature. Based on infrared, GC, DSC, computer-simulated structural analysis, swelling and hardness development studies, we are now convinced that the improvement of a coating lies in controlling the conformational configurations in which the polymer exists, prior to and during the crosslinking stage. It is the type of crosslink, intra- or intermolecular, formed from these configurations, which affects the property performance of the coating.

RESULTS AND DISCUSSION

Effect of the α-Methyl Group On Cure Response

Solution polymers containing MAGME were prepared with a variety of commercially available acrylic monomers using typical free radical polymerization techniques.

Initial cure studies of the MAGME acrylic coatings, cured at room temperature with a multifunctional primary amine, were run using Fourier Transformed Infrared of films cast on salt plates. By following the increase in absorbance of the -C(=O)-NH- band at 1680 cm^{-1}, the relative rates of the crosslinking reactions were determined. Unexpected results were obtained in this initial study, as can be seen in *Figure* 4. The polymer with an initial Tg of 45°C and cured with 4,7 dioxadecane 1,10 diamine (DODA) crosslinked at a faster rate than a polymer with a Tg of 15°C. This is the opposite of what was expected, since the lower Tg polymer should have allowed for more crosslinking to occur because of its lower initial Tg. The major difference between the two polymers, other than glass transition, was the number of α-methyl groups on the backbone of the polymers (42.3 mole % for Tg = 15°C vs 60.3 mole % α-methyl for Tg = 45°C).

To determine the effect of backbone α-methyl groups on cure response, a series of polymers was prepared, varying the amount of α-methyl from 32.5 to 80.8 mole %, while maintaining a constant Tg of 44°C. This was

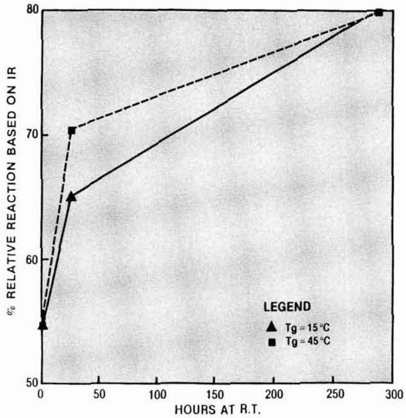


Figure 4—Relative reaction vs time curves obtained from Fourier Transform Infrared Spectrum of MAGME acrylic polymers reacted with DODA by following the increase of the $-\overset{\text{O}}{\overset{\|}{\text{C}}}-\text{NH}-$ group absorbance at 1680 cm^{-1}

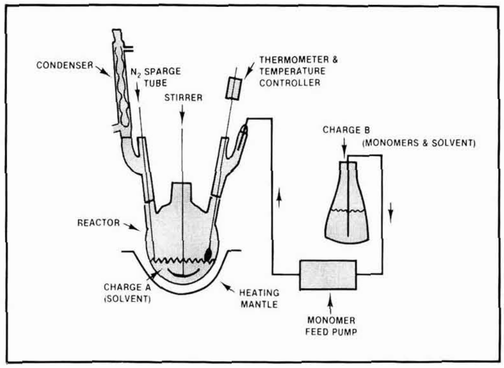


Figure 4A—Polymer reactor flow diagram

accomplished by incorporating small amounts of long chain ester groups from lauryl methacrylate. A list of the polymer compositions is shown in *Table* 1.

The preparation of MAGME-acrylic polymer using a typical monomer charge shown in *Table* 2 is accomplished by feeding a monomer solution (Charge B) to a preheated solvent (Charge A) at 82°C, over a three to five hour period under nitrogen (*Figure* 4A). This procedure produces polymers with a narrow molecular weight range and a random distribution of the monomer units along the polymer chain. Fifty percent solutions of these polymers in a 60/40 (wt/wt) toluene/n-butanol mixture were mixed with 4,7 dioxadecane 1,10 diamine (DODA) on a 1/1 MAGME/NH_2 equivalent basis and cast on steel panels. The coatings were cured at room temperature over 15 days and Knoop hardness values determined at various intervals. A second set of identical coatings was prepared and cured at 100°C for four hours. The hardness values of this latter set of coatings were defined as the "maximum" hardness obtainable for each polymer system. The results (see *Figure* 5) show that each polymer system develops comparable hardness values when cured for four hours at 100°C.

But in the case of the room temperature cured series, hardness development was dependent on the amount of α-methyl groups in the polymers: the higher the amount of α-methyl, the higher the hardness value, suggesting that the degree of crosslinking was a function of the α-methyl content. This explanation was subject to question, however, since all room temperature cured coatings showed an equal resistance to MEK (>200 rubs) and post-curing of these coatings at 100°C for four hours did not increase hardness.

An accurate determination of the degree of crosslinking was obtained by following methanol generation, a by-product of the crosslinking reaction of MAGME's activated ester with a primary amine (see *Figure* 2), using a specially designed reaction chamber maintained at 27°C ± 1°C, coupled to a Perkin-Elmer, Sigma 2 gas chromatograph with a loop type gas sampling valve and a Hewlett-Packard model 3390A computer-recorder (see *Figure* 6). Formulations, based on low (32.5 mole %) and high α-methyl (80.8 mole %) polymers with Tgs of 44°C, were mixed with the amine crosslinker DODA at a MAGME/NH_2 equivalent ratio of 1/1. Coatings were then cast on aluminum foil and placed in the reaction chamber. By monitoring methanol generated over a period of five days at 27 ± 1°C (*Figure* 7), the number of crosslinks

Table 2 — Typical Charge for MAGME — Acrylic Polymer

Charge A	Wt in Grams
n-Butanol	16
Toluene	24
Charge B	
n-Butanol	144
Toluene	216
MAGME	100
Methyl methacrylate	168
Lauryl methacrylate	72
Hydroxyethyl methacrylate	60
Dodecanethiol	6
Tert-butyl peroctoate	8

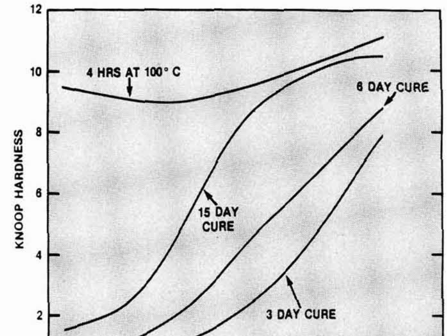


Figure 5—Hardness development plot showing the effects of α-methyl groups when cured with DODA over 15 days at room temperature. Polymer compositions are shown in Table 1

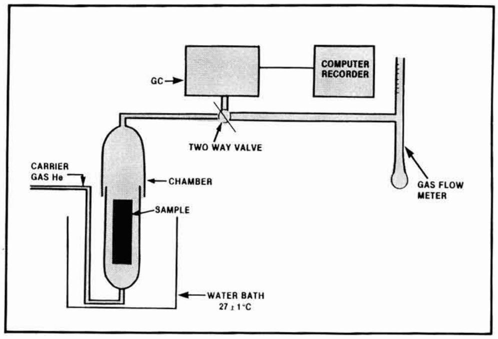


Figure 6—Schematic representation of the instrumentation used to determine the degree of crosslinking of coatings via methanol liberation

and the rate at which they developed were shown to be independent of the number of α-methyl groups contained in the polymer.[8] Also, the differences in hardness between the two room temperature cured polymers could not be attributed to solvent retention, since the majority of the coating's solvents (butanol and toluene) had come off rapidly at an early stage of the reaction and at the same rate, as was shown by the gas chromatograph.

Types of Crosslinking

An explanation of why polymers of equal Tgs and degree of crosslinking develop different degrees of hardness during a room temperature cure lies with the type of crosslinking that occurs, inter- or intramolecular, and the effects of each type of crosslinking on the properties of a crosslinked network.

Stepto and others [9-12] point out that intramolecular crosslinks or loops occur to varying degrees in all crosslinking polymers. These loops act as defects within the polymer network and detract from the physical properties of the system.

These types of crosslinks and how they form can best be described using the schematic representation of network formations from flexible or rigid polymer chains (*Figure* 8).

At the onset of crosslinking and in the presence of a good solvent, both flexible and rigid polymer chains are

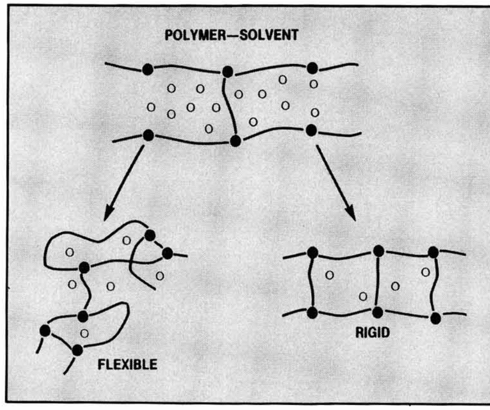


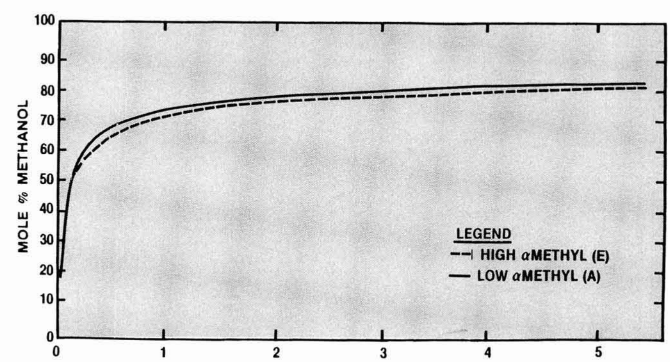
Figure 8—A schematic representation of crosslinking in solvent-borne coatings depicting the formation of intra- and intermolecular crosslinks in a thermosetting polymer

extended and are in continual motion.[3] As solvent evaporates and crosslinking continues, the polymer molecules take on configurations that are influenced by the interactions of groups within the polymer chain, and by the regularity of the chain. Increasing amounts of α-methyl groups located along the backbone, because of their steric influence, serve to increase the rigidity of the chain resulting in more extended chains with larger radii of gyration. This increases the probability of interpenetration of neighboring chains, leading to intermolecular crosslinks. Also, it is well known that, in addition to solvent, heat has the effect of extending polymer chains, thus serving to promote a larger number of intermolecular crosslinks. Such would be the case of the low α-methyl polymer formulation when cured at 100°C for four hours. Chain extension or an open configuration corresponding to a larger radius of gyration will promote a larger number of intermolecular crosslinks while a "collapsed," smaller radius of gyration increases the probability of more intramolecular crosslinks.

Computer Analysis

The greater rigidity and, consequently, greater extension of a polymer due to α-methyl groups, was shown

Figure 7—Mole % methanol vs reaction time as measured by GC. The amount of methanol generated from the reaction of MAGME acrylic polymers A and E with DODA is a direct measurement of the number of crosslinks formed in coatings cured at room temperature



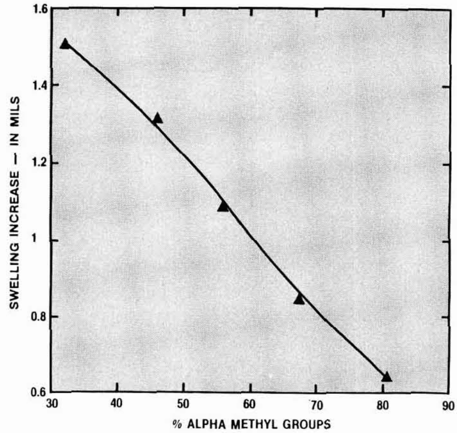


Figure 9 — Effect of α-methyl groups in crosslinked coatings on swelling

using computer calculations of the number of minimum energy states that can exist for dimers of methyl acrylate (MA) and methyl methacrylate (MMA). Using an enhanced version[14] of the computer software program CHEMLAB,[15] analysis showed that because of the α-methyl group in the MMA dimer, the number of possible conformations that could exist was reduced by a factor of 15 compared to MA. The space, or free volume, occupied by these minimized dimers is directly related to the amount of extension of the structure. As can be seen in *Table* 3, the MMA dimer requires a space ~1/3 times greater than the MA structure.

Swelling

As was pointed out earlier, the formation of intramolecular crosslinks in polymer networks serves only to detract from the physical properties of the system. Further evidence of the use of the α-methyl group in reducing these defects was obtained in swelling tests run on 15-day room temperature amine cured coatings, identical to the coatings used in the hardness development test. Using an Elcometer* model 255 coating thickness gauge, coating thicknesses were measured before and after exposure to dimethyl formamide. The coatings, originally 2 mils in thickness, increased to 3.5 mils for the low α-methyl polymer, with swelling decreasing as the α-methyl content of the polymer increased (see *Figure* 9). This result is consistent with higher degrees of intramolecular crosslinking at low levels of α-methyl, since the defects produced by this form of crosslinking should be susceptible to the effects of solvent.

It becomes clear that the hardness development of amine cured, MAGME-acrylics at room temperature is dependent upon the amount of intramolecular crosslinking within the network structure of the coating. However, defects alone are not enough to explain the low hardness values obtained, since the polymers' Tgs of 44°C before crosslinking are well above the temperature of the hardness test (25°C).

The key to the solution of this question lies in the swelling experiments. Since defects in a network are more susceptible to solvent,[11] it stands to reason that they can also be affected by environmental conditions, specifically the effects of moisture, during testing. The 50% relative humidity conditions under which the Knoop hard-

*Product of Elcometer, Inc.

Table 3 — Computer Simulation of Acrylic Dimers Showing the Effects of the α-Methyl Group

Dimer	Min. Energy Conformations	Volume of Dimer[c]	Free Volume[d]
Methyl acrylate[a]	303	160	246
Methyl methacrylate[b]	20	195	321

(a) Contains no α-methyl groups.
(b) Contains 2 α-methyl groups.
(c) Volume of the dimer in cubic angstroms.
(d) Volume of space occupied by the dimer in cubic angstroms.

Table 4 — Properties of a Cured High α-Methyl MAGME-Acrylic Coating

Composition	Tg
MAGME 25/MMA 40/LMA 20/HEMA 15	40°C
Cured with 1 Equivalent of Amine — DODA[a]	

Cure	Dust Free	Tack Free	Tape Resis.	Gasoline Resistance 24 hrs. Before	Gasoline Resistance 24 hrs. After	Gasoline Resistance 48 hrs. Before	Gasoline Resistance 48 hrs. After
RT	<60 Min.	<60 Min.	<16 Hrs.	2B-B	2B-B	HB-F	HB-F

Cure	MEK	Knoop	Gloss 20°	Gloss 60°	QUV>2000 Hrs[e] 20°	QUV>2000 Hrs[e] 60°	QCT[d] 240 Hrs[e] 20°	QCT[d] 240 Hrs[e] 60°
RT[b]	200+	7.0	85	92	94%	98%	98%	100%
100°C[c]	200+	8.3	85	92	94%	98%	98%	99%

(a) DODA = 4,7 Dioxadecane 1,10 Diamine
(b) RT = Cured 14 Days at Room Temperature
(c) 100°C = Cured 20 Min. at 100°C
(d) QCT = 38°C Cleveland Condensation Test
(e) Percent Gloss Retained

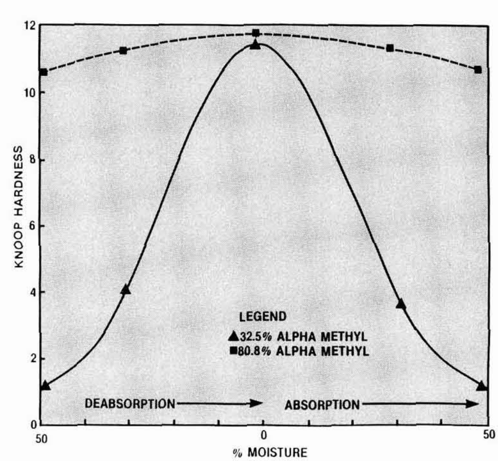


Figure 10—Hardness vs moisture plot showing the effect of moisture on high and low α-methyl polymers cured with DODA

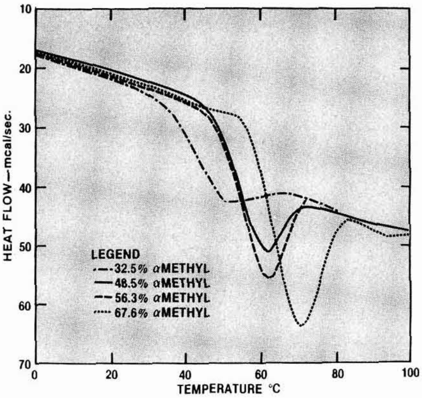


Figure 11—Differential scanning calorimetry curves (DSC) of uncured MAGME acrylic polymers, air dried 17 days at room temperature. Endotherm peak areas are proportional to the mole % of α-methyl in the polymer

ness test is conducted could be sufficient to cause a plasticizing of these defect areas in the network, resulting in an overall decrease in hardness of the coating. The effects of humidity were confirmed with high (80.8 mole %) and low (32.5 mole %) α-methyl polymers cured with DODA. After 15 days of room temperature cure, coatings were tested for hardness before (50% RH) and after exposure to vacuum (0% RH). The low α-methyl system showed a hardness improvement when moisture was removed from the coating and reverted to its original low value after equilibrating at 50% RH, whereas the high α-methyl coating was essentially unaffected by these changes in humidity (see *Figure* 10). Thus the low α-methyl polymer, containing more intramolecular crosslinks, is softened by water, but the high α-methyl polymer is not.

DSC Analysis

DSC analysis, used during the course of our work to determine the polymers' Tgs, showed endothermic peaks directly following the glass transition temperature in all of the uncured polymers used in our experiments (see *Figure* 11). The areas of the endothermic peaks were found to be proportional to the amount of α-methyl contained in the polymers. A second DSC heat cycle, following a quench, showed their Tgs to be unchanged but the endotherms had disappeared. Similar endothermic peaks were observed in the room temperature amine cured (DODA) high α-methyl polymer, but not in the DODA-cured low α-methyl polymer (see *Figure* 12). Calorimetric behavior of this type has been attributed by some workers to local ordering of segments of neighboring polymer chains forming small crystalline areas.[16-19] Tonelli and others argue that the observed endotherms in amorphous polymers are due not to local ordering, but to the dynamic conformational characteristics of the polymer chains and the nonequilibrium of the glass state, and are induced by the thermal history of the polymer.[20,21]

We suggest that the DSC endotherm peaks and obvious differences in peak areas are not due to thermal histories (since all polymers received identical treatment), but are due to extension of polymer chains and that the size of the endotherms are a measure of the degree of extension. We feel that this is a reasonable explanation of our observations, but additional work will be required to verify this suggestion.

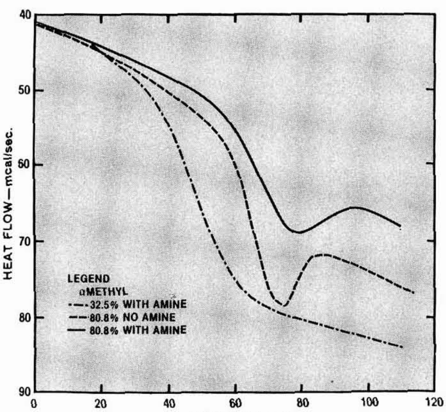


Figure 12—DSC curves showing the effects of amine cured polymers

CONCLUSION

When incorporated into acrylic copolymers, MAGME can be crosslinked with amines at temperatures below the Tg of the polymer. Properties of coatings prepared from these systems are heavily dependent on the type of crosslinking that occurs, intra- or intermolecular. We have found that α-methyl groups, located along the backbone of the polymer chain, play an important part in the development of the type of crosslinking that occurs. The steric interference of these groups serves to prevent a collapse of the polymer chain, resulting in fewer imperfections in the crosslinked network, without diminishing the total number of crosslinked sites.

Application of the polymer design information obtained from these experiments has resulted in coating formulations which develop a rapid cure at room temperature, good solvent resistance to gasoline, high gloss, and outstanding durability to humidity and ultraviolet radiation (see *Table* 4).

ACKNOWLEDGMENTS

The author would like to thank Dr. R. Potenzone and Mr. D. Doherty for their assistance in showing the effects of polymer structuring using computer simulations, and to Mr. W. Mealmaker and Ms. R. Ferrilo for their work on GC and DSC. I would also like to thank Mrs. M. Gromley and Dr. J. Courter for their time and effort in the preparation of this paper.

References

(1) Ogata, N., Hosoda, Y., and Suzuki, G., *Polymer J.*, 5, 412 (1974).

(2) Ogata, N. and Shirmaura, K., *Polymer J.*, 7, 72 (1975).

(3) Ogata, N., Sanui, K., Hosoda, Y., and Nakamura, H., *J. Polymer Sci. 14*, 783 (1976).

(4) Ogata, N., Sanui, K., and Nakamura, H., *Polymer J.*, 10, 499 (1978).

(5) Ogata, N., Sanui, K., Ohtake, T., and Nakamura, H., *Polymer J.*, 11, 827 (1979).

(6) Ley, D.A., American Chemical Society 187th National Meeting, St. Louis, MO. 50, 353-356 (1980).

(7) Aronhime, M.T. and Gillham, J.K., "The Transformation of Liquid to Amorphous Solid," JOURNAL OF COATINGS TECHNOLOGY, *56*, No. 718, 35 (1984).

(8) Mealmaker, W.E., "Methanol Evolution from Films Formed by Room Temperature Curing of α-Methyl Substituted Film of Acrylic Polymers Containing MAGME." (pending publication).

(9) Sanford, J.L. and Stepto, R.F.T., *J. Chem. Soc.*, Faraday Trans. 1, Vol. 71, 1291 (1975).

(10) Stepto, R.F.T., *Polymer*, 20, 1324 (Nov. 1979).

(11) Fasina, A.B. and Stepto, R.F.T., *Makromol. Chem.* 182, 2479 (1981).

(12) Sanford, J.L., Stepto, R.F.T., and Still, R.H., Characterization of Highly Crosslinked Polymer ACS Sympos. No. 243, 1-20, (1984).

(13) Flory, P.J., "Principles of Polymer Chemistry," Chapter X Sec. 3, Cornell University Press, Cornell, NY (1953).

(14) Potenzone, R. and Doherty, D., (Pending Publication).

(15) Distributed by Product of Molecular Design LTD., 1122 B Street, Haywood, CA 94541.

(16) McKinney, P.V. and Foltz, R.C., *J. Appl. Polymer Sci.*, 11, 1189 (1967).

(17) Melia, T.P., Clegg, G.A., and Tyson, A., *Makromol. Chem.*, 112, 84 (1968).

(18) Kashmiri, M.I. and Sheldon, R.P., *J. Polymer Sci.*, Part B, 7, 51 (1969).

(19) Ali, M.S. and Sheldon, R.P., *J. Appl. Polymer Sci.*, 14, 2619 (1970).

(20) Tonelli, A.E., Macromolecules, Vol. 4, No. 5, 653 (Sept.-Oct. 1971).

(21) Karasz, F.E., Blair H.E., and O'Reilly, J.M., *J. Phys. Chem.*, 69, 2657 (1965).

Sound reasons with Du Pont

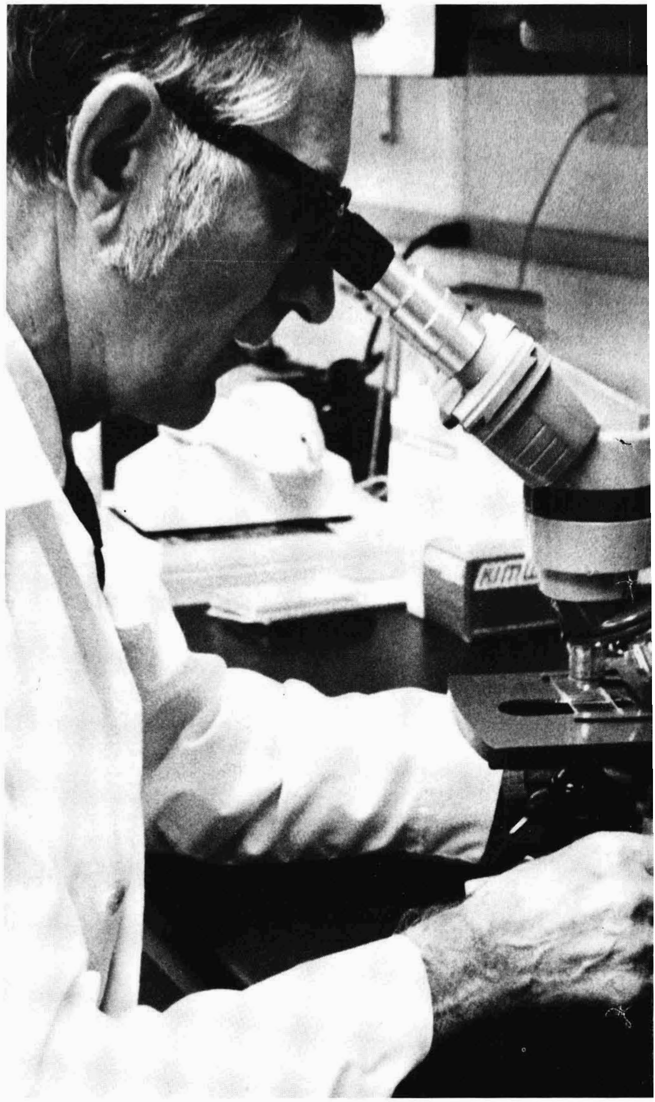
New test data support its safety

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

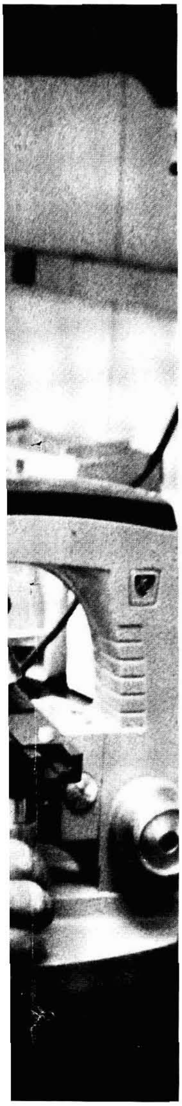
- DuPont DBE solvent has no effect on potency and fertility.
- DuPont DBE is not uniquely toxic to the fetus in teratogenic (fetal development) studies.
- Mutagenicity (genetic change) tests are negative.

Toxicity testing is continuing. Since the introduction of DuPont DBE as a blending solvent more than 10 years ago, no human health problems have been reported.

DuPont DBE cuts costs, too—as you'll see on the facing page.



to reformulate DBE solvent



Cost data underscore its proven economy

Reformulating with blends of Du Pont DBE solvent can be your most cost-effective route to replacing E-series glycol ethers and acetates. The cost table (right) shows that Du Pont DBE is a low-cost high-boiling ester solvent. As a result, you can hold down costs by making Du Pont DBE your retarder solvent when formulating with P-series glycol ethers and acetates. The reformulating chart (below) shows how blends with Du Pont DBE can ease the problem of solvent replacement.

Wide Application. DuPont DBE's solvency for many polymers accounts for its use in a wide range of coatings, both conventional and high-solids. In addition to automotive topcoats and primers, these uses include steel and aluminum coil coatings, interior and exterior can coatings and finishes for appliances and metal furniture.

COMPARISON OF REPRESENTATIVE PRICES OF SLOW ESTER-TYPE SOLVENTS*

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

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

Free sample. Dial (800) 527-2601 for a free sample or help in reformulating with Du Pont DBE solvent.

Use DBE as the slow solvent with PM Acetate and reduce replacement costs

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

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

**Replacement formulas are offered for experimental purposes only.*

DU PONT

REG. U.S. PAT. & TM. OFF.

Observations on Mildew Susceptibility Of Painted Surfaces In Tropical Chamber Exposure

M. Greenberger, A.M. Kaplan, and B.J. Wiley
U.S. Army Natick Research and Development Center*

Studies were performed to determine methodology requirements for evaluation of the mildew susceptibility of paint coatings in environmental (tropical) test chamber exposure. Paint coatings, formulated to be both susceptible and resistant, were exposed to cycled and uncycled conditions as unsprayed controls and after inoculation with differing combinations of mixed fungal spores and nutrient salts or soil.

A cycled walk-in environmental test chamber, used for microbial screening of diverse Army materiel, provided satisfactory conditions for fungal growth both on unsprayed paint coatings and coatings inoculated or treated with nutrient salts or soil. Specialized test cabinets and inoculation with specific test organisms were not essential requirements for evaluation of mildew susceptibility of paint coatings in environmental test chamber exposure.

INTRODUCTION

Laboratory test methodology for the evaluation of the mildew susceptibility of paints has been based mainly on the development of plate test procedures and test cabinet refinements. Advocates of the plate test method have developed and modified simpler procedures into more sophisticated ones to include the effects of important environmental factors.

Extensive work has been performed by ten participating international laboratories on the development of methodology for test cabinets designed for microbial evaluation of paint films, based on the original work of Hendey.[1] Coordination was under the auspices of the Paints Working Group of the International Biodeterioration Research Group (IBRG).[2]

Round robin results from painted glass tubes indicated that reliable mold resistance data could be obtained by visually rating susceptible and resistant paint films inoculated with fungal spores and incubated in humidity test cabinets. Addition of nutrient soil prior to incubation was considered beneficial and the level of condensation on the test films found to be critical to the germination phase. Although most of the data were obtained from painted glass tubes, success with flat panels composed of other materials led to the proposal of an alternative test cabinet method for the evaluation of the mildew susceptibility of paint films.[3] This concept is also the basis for an existing American standard method.[4]

Studies on painted flat surfaces were undertaken in our laboratory to determine whether an environmental (tropical) test chamber routinely being used for studies of fungal deterioration of military materiel could be used instead of specialized test cabinets for the initial screening evaluation of paint coatings. Test variables that were evaluated, in the context of environmental chamber exposure of paint films, included: pre-treatment with mineral salts, nutrients, fungal inoculum, and environmental conditions. Both short-term and long-term incubations were performed on painted surfaces incubated in large, multipurpose environmental test chambers used to evaluate the microbial susceptibility of diverse military materiel. Analyses of the organisms present in the chambers used for these studies confirmed the presence of a wide variety of organisms commonly found in nature.[5] The organisms identified as being present in our test chambers under normal operating conditions include those used in ASTM, Military-Standard, and United Kingdom (UK) fungus testing procedures except that *Scopulariopsis spp.* required

*Science and Advanced Technology Laboratory, Natick, MA 01760-5020.

Table 1—Composition (kg/m³) of Experimental Exterior Vinyl Acrylic Paints

Raw Materials	Control Untreated	Fungicide-Treated
Water	119.8	119.8
Propylene glycol	28.8	28.8
Hydroxyethyl cellulose (thickener)	167.7	167.7
Phenylmercuric acetate (PMA-100)	0	1.8 (0.18%)
Sodium salt of a carboxylic acid (dispersant)	14.4	14.4
Potassium tripolyphosphate	4.8	4.8
Mineral oil-based defoamer	1.2	1.2
Titanium dioxide	299.5	299.5
Calcium carbonate	59.9	59.9
Magnesium silicate (extender)	59.9	59.9
Ester alcohol (solvent)	9.6	9.6
Water	67.1	67.1
Mineral oil-based defoamer	2.4	2.4
Vinyl acrylic latex	431.3	431.3
Dioctyl sodium sulfosuccinate (surfactant)	2.4	2.4

Table 2—Composition of Forest Green Military Specification Paints

Paint	Pigment	Vehicle
MIL-E-52835A Enamel, modified alkyd camouflage, lusterless	Acid insoluble green composed of cobalt, zinc, and chromium oxides, and or chromate yellow, molybdate orange, carbazole dioxazine violet, yellow iron oxide, red iron oxide.	Pure short oil length phthalic alkyd resin baking type, modified with not less than 20% butylated melamine formaldehyde resins of urea formaldehyde or blends of urea/melamine and modifiers, stabilizers, wetting and suspension agents.
MIL-E-52798A Enamel, alkyd camouflage	Same as MIL-E-52835A	Drying oil phthalic alkyd resin in mineral spirits. Driers and Volatile Solvents: Alkyd resin solution Color Phthalic anhydride Drying oil acids Unsaponifiable matter
MIL-C-46168A (MR) Coating, aliphatic polyurethane Chemical agent resistant	Same as MIL-E-52835A	Non volatile: Dicarboxylic Acid Polyols Aliphatic polyisocyanate Volatile: Aromatic compounds Ethyl benzene and toluene Solvents, olefinic or cyclo-olefinic Ethylene glycol monoethyl ether acetate

for UK test procedures was not isolated.[5] No attempt was made to isolate and identify species populating the inoculated and uninoculated test paint films after incubation, but *Aureobasidium pullulans*, the organism most commonly associated with paint mildew, was included in two fungal spore sprays, and has been identified as an inhabitant of our chamber.[5]

EXPERIMENTAL

Sample Preparation

Test samples for environmental test chamber exposure included both paints for application, and prepared painted surfaces. Paints included two sets of similar white vinyl acrylic paints (*Table* 1) and one set of forest green military paints (*Table* 2).[6-8]

Paints were prepared with and without biocides. Untreated paints usually supported growth readily and therefore were considered susceptible as a group. Paints described as marginally resistant or fully resistant were characterized as such by the paint supplier due to the inclusion of biocides. Paints formulated with biocides supported slower growth of fungi, particularly with the effective fungicides, over a given period of time.

All paints were applied by dipping 153 × 19 × 1.8 mm polished gumwood or hardwood tongue depressors into each paint and then allowing the coated surfaces to drip-dry and harden overnight.

Painted surfaces prepared by other laboratories included 102 × 305 × 1.1 mm steel panels coated with the three military specification paint formulations and 100 × 75 × 10 mm flat panels of either wood or plaster. Wood panels were select specimens of straight-grained sapwood of Scots pine (*Pinus sylvestris*). Plaster panels were formulated from a 3:2 hemi-hydrate plaster to distilled water mix. Wood and plaster panels were conditioned at 20 ± 2°C and 65 ± 5% RH prior to painting. Wood panels were coated with seven paints* but plaster panels only with alkyd gloss and alkyd modified acrylic on plaster. Two coats were applied to each panel. Twenty-four hrs

*Linseed oil, alkyd gloss, alkyd semigloss, polyvinyl acetate (PVA) emulsion, alkyd modified acrylic, alkyd modified acrylic plus 1% tetramethyl thiuram disulphide (TMTD), or acrylic emulsion.

Table 3—Composition of IBRG Nutrient Soil

Nutrient Salts	(g/60 mL)
$CaH_4(PO_4)_2 \cdot H_2O$	0.44 g
$Ca_3(PO_4)_2$	0.90 g
$CaCO_3$	0.20 g
K_2SO_4	0.11 g
$(NH_4)_2SO_4$	0.51 g
NH_4NO_3	1.37 g
Trace Elements	**(g/100 mL)**
$FeCl_3 \cdot 5H_2O$	1.46 g
$CuSO_4 \cdot 5H_2O$	1.18 g
$ZnSO_4 \cdot 7H_2O$	1.32 g
$(NH_4)_6MO_7O_{24}$	0.01 g
$MnSO_4 \cdot 4H_2O$	0.20 g

were allowed as drying time between coats of oil-based paints, and one hr between coats of emulsion paints.

Two of each set of four IBRG wood and plaster panels were weathered on one side for 242 hrs with a water spray in a twin carbon arc Weather-Ometer®.[9]

All painted surfaces were incubated in the dark in one or both of the following tropical environments:

(1) An uncycled chamber, 3.3 × 3.3 × 2.6 m, operated continually at 30°C ± 1°C and 95% RH.
(2) A cycled chamber, 6.9 × 7.5 × 3.6 m, operated continually for 20 hr at 30°C ± 1°C and 95% RH followed by 4 hr at 25°C ± 1°C and 100% RH. Cycle conditions were in accordance with Method 508.1 (MIL-STD-810C).[10]

Susceptibility Tests

Prior to incubation, painted surfaces were sprayed with fungal spores and/or nutrient salts or left unsprayed. Spore mixtures and nutrient salts were prepared in accordance with the following procedures: (1) ASTM D3273-76[4]; (2) IBRG test procedure[2]; and (3) Method 508.1 (Fungus) of MIL-STD-810C.[10]

IBRG nutrient soil was prepared in our laboratory from a nutrient salts/starch paste containing trace elements (*Table* 3).[2] Method 508.1 (ASTM G21-70) nutrient salts medium was prepared from the salts listed in *Table* 4. The various fungal spore inocula are listed in *Table* 5.

Wood and plaster panels were inoculated only on the front weathered or unweathered surface (back surfaces were not weathered or inoculated). One inoculated panel of each type was coated with nutrient soil.

Only the painted metal panels were cleaned (70% ethanol) 72 hours prior to inoculation. After inoculation, painted surfaces were incubated in walk-in environmental test chambers operated at either cycled or uncycled conditions. Mold growth was rated at weekly intervals for at least four weeks, based on the rating scale used by Barry, et al.[2]

RESULTS

Vinyl Acrylic Paints on Wood Exposed in Cycled and Uncycled Environmental Conditions

Wood specimens were coated with vinyl acrylic paints, inoculated, and then incubated in the cycled or uncycled environmental chamber (*Figure* 1). Paints without phenylmercuric acetate (PMA) supported about the same growth, particularly during early uncycled chamber exposure. During cycled chamber incubation, inoculated paints without PMA supported more growth after exposure for seven days, but uninoculated paints supported equally heavy growth after exposure for 28 days. By contrast, all sets of PMA-containing paints supported only trace to sparse growth over the 28 days of exposure. In a repeat cycled chamber test on paints without PMA, nutrients salts alone were sprayed onto one set of specimens. Again, inoculated specimens supported more initial growth than other categories, but after 28 days all supported equally heavy growth. There was negligible growth difference between control specimens and specimens sprayed with nutrient salts throughout the incubation period.

Weather-Ometer is a registered tradename of Atlas Electric Devices Co., Chicago, IL.

Table 4—Composition of Method 508.1 Nutrient Salts

Nutrient Salts	(g/L)
KH_2PO_4	0.7 g
K_2HPO_4	0.7 g
$MgSO_4 \cdot 7H_2O$	0.7 g
NH_4NO_3	1.0 g
NaCl	0.005 g
$FeSO_4 \cdot 7H_2O$	0.002 g
$ZnSO_4 \cdot 7H_2O$	0.002 g
$MnSO_4 \cdot H_2O$	0.001 g

Oil- and Water-based Paints on Wood and Plaster Exposed With or Without Fungal Inoculum And/or Nutrient Soil

Wood and plaster specimens similar to those used in the IBRG collaborative study[11] were inoculated, and then incubated in the cycled chamber (*Figure* 2). Spraying with IBRG fungal spore mixture generally resulted in more initial growth on both wood and plaster substrates, and the inclusion of nutrient soil, in some cases, produced even greater initial growth. However, growth differences between paint sets tended to narrow by the end of the 28-day incubation period. On the average, weathered painted wood was slightly more susceptible than unweathered painted wood containing the same coatings, but differences between groups were generally small relative to the standard deviations of the groups. Growth ratings of weathered painted wood were increased by prior fungal inoculation with or without inclusion of nutrient soil. Plaster, as substrate, without prior spraying

Table 5—Test Organisms

Test Method		Fungal Spore Inocula
ASTM D3273-76	QM 458	*Aspergillus niger*
	QM 1226	*Penicillium citrinum*
	QM 3090	*Aureobasidium pullulans*
IBRG test procedure	IMI 17,454	*Aspergillus niger*
	IMI 45,533	*Aureobasidium pullulans*
	IMI 45,554	*Aspergillus versicolor*
	IMI 49,948ii	*Phoma violacea*
	IMI 79,906	*Ulocladium atrum*
	IMI 82,021	*Stachybotrys atra*
	IMI 178,517	*Cladosporium cladosporioides*
	IMI 178,519	*Penicillium purpurogenum*
Method 508.1	QM 380	*Aspergillus flavus*
	QM 386	*Aspergillus niger*
	QM 432	*Aspergillus versicolor*
	QM 459	*Chaetomium globosum*
	QM 474	*Penicillium funiculosum*

with nutrients or fungi supported trace to sparse growth after incubation for 28 days.

A comparison between plaster and wood specimens containing the same coatings indicated that growth ratings were nearly identical during early exposure, but on extended incubation painted wood, on average, supported slightly more growth.

Military Specification Paints on Wood and Steel Exposed With or Without Fungal Inoculum And/or Nutrient Salts

Wood and steel specimens were coated with military paints, inoculated, and then incubated in the cycled chamber (*Figure* 3). All three paints on wood supported substantial growth. MIL-E-52798A enamel, alkyd, camouflage paint on steel supported growth more readily than the others under all conditions of pretreatment and was judged to be the most microbially susceptible of the three coatings. In general, spraying with fungal spores and nutrient salts had little impact on growth ratings of military paints on steel except for a few isolated instances of enhanced growth.

Vinyl Acrylic Paints on Wood Exposed With or Without Fungal Inoculum And/or Nutrient Salts

Wood specimens were again coated with vinyl acrylic paints, inoculated, and then incubated in the cycled chamber (*Figure* 4). After 42 days of incubation, mechanical problems necessitated conversion of the chamber from cycled to uncycled operation to maintain sufficient ambient humidity. The control paint, when sprayed with Method 508.1 inoculum, initially supported moderate growth, but all categories including unsprayed specimens supported moderate to heavy growth after incubation for 14 days. Method 508.1 salts *per se* had a negligible effect on growth enhancement. Control paint coated with nutrient soil, on average, supported more initial growth than others in the IBRG set, but again all unprotected coatings supported moderate to heavy growth after 14 days.

Coatings treated to be marginally resistant to fungal growth (0.5% PMA) supported trace to sparse growth after incubation for 42 days with negligible differences between categories of pretreatment, and after 56 days all categories supported moderate to heavy growth. Of the

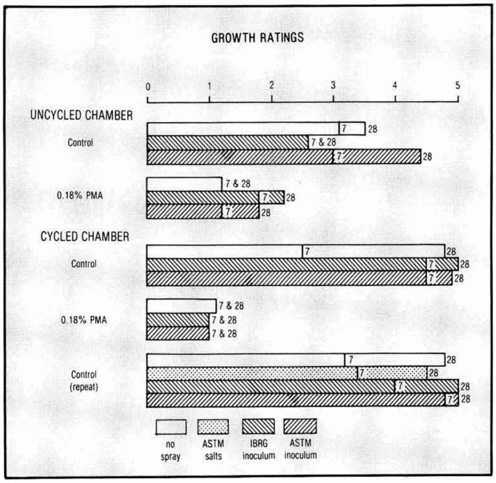


Figure 1— Growth ratings after incubation periods of 7 and 28 days for vinyl acrylic paints on wood. Rating scale as follows: 0 = no growth; 1 = trace growth; 2 = 1% – 10% coverage of test surface (sparse); 3 = 10% – 30% coverage (light); 4 = 30% – 70% coverage (moderate); and 5 = 70% – 100% coverage (heavy). Ratings represent the average of four specimens

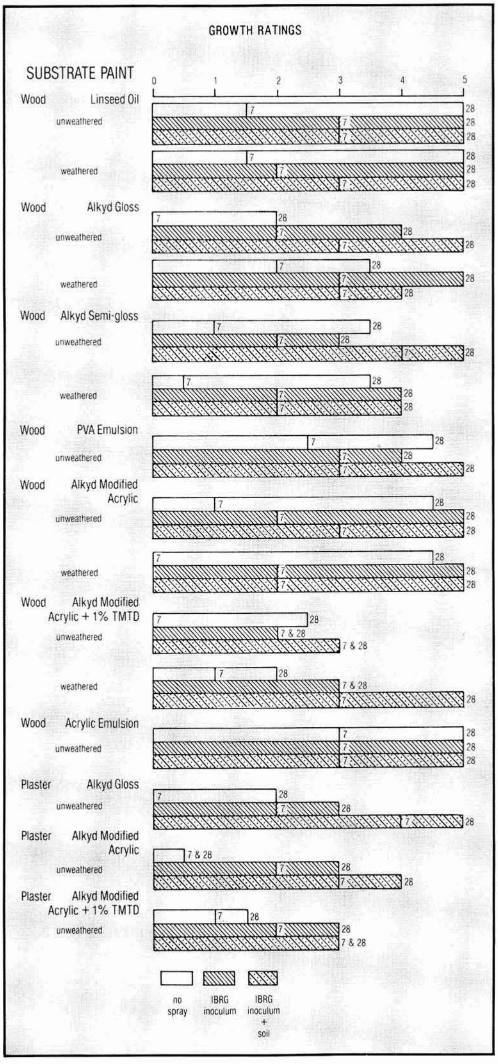


Figure 2—Growth ratings after incubation periods of 7 and 28 days for IBRG panels inoculated with IBRG fungal spore mixture and nutrient soil. Rating scale as follows: 0 = no growth; 1 = trace growth; 2 = sparse; 3 = light; 4 = moderate; and 5 = heavy. Ratings represent single measurements except for controls which are the average of two measurements

coatings treated to be fully resistant (2.0% PMA), specimens inoculated with IBRG nutrient soil, or IBRG soil plus IBRG fungal spore mixture, were first to support growth after incubation for 56 days, and all categories supported moderate to heavy growth after incubation for 196 days.

DISCUSSION

Results obtained from incubation of paint coated specimens indicate that walk-in environmental test chambers are suitable for the initial screening evaluation of paint films provided that test conditions are optimized to be conducive to fungal growth. Variations in environmental conditions, substrate, fungal inoculum, and nutrient salts or soil, affect results obtained.

Good fungal growth was obtained on painted wood specimens incubated in the cycled tropical environment. This environment supplies a daily variation in temperature that is conducive to surface condensation. The importance of surface moisture for satisfactory growth has been discussed in the literature.[11,12] Our data indicate that the cycled environmental chamber provided a better environment for fungal growth than the uncycled chamber.

Coatings on wood panels supported more growth after environmental chamber incubation than the same coatings on plaster or steel. This difference can be attributed to extraneous nutrients supplied by the wood. Our work supports the thoughts of Zabel,[13,14] that choice of substrate is an important parameter in determining the susceptibility of the coating. In this case, wood provides additional nutrients for fungal growth supplementing those in the paint. Such supplementary nutrients, of course, are not present in the case of plaster or metal substrates. The mildew susceptibility of paint coatings on wood was, in general, slightly increased by artificial weathering as reported in the literature.[11,13]

Inoculation with mixed fungal spores assured rapid, uniform fungal growth in the cycled chamber on susceptible painted wood specimens. *Aureobasidium pullulans*, considered to be the most ubiquitous paint mildew organism, was included in two fungal spore inocula but not in Method 508.1 fungal spore spray. All three fungal sprays resulted in satisfactory growth when painted wood was incubated on our environmental test chamber environment.

The environmental chamber permits selection from an extensively diverse population of fungal organisms.[5] Therefore inoculation with fungal inoculum, though beneficial, is not strictly essential for mildew screening of paint coatings in an environmental chamber operated under cycled tropical conditions. Our data indicate that uninoculated painted wood controls supported satisfactory growth in a 28-day test, but uninoculated susceptible coatings on steel may require environmental chamber incubation extended beyond 28 days.

The length of environmental chamber incubation must be sufficient to characterize the mildew susceptibility of the materials. Though susceptible coatings on wood were usually detected early within the framework of a 28-day test, relatively resistant coating-substrate pairings required incubation in excess of 28 days to determine rankings. Therefore, we advocate adoption of a standard 90-day test period for mildew tests performed in a general purpose, environmental test chamber. The 90-day incubation period should be sufficient to produce a satisfactory test even for uninoculated coatings on steel.

Nutrient salts alone did not induce improved growth response, presumably because trace mineral requirements of the fungi are already satisfied by nutrients from the

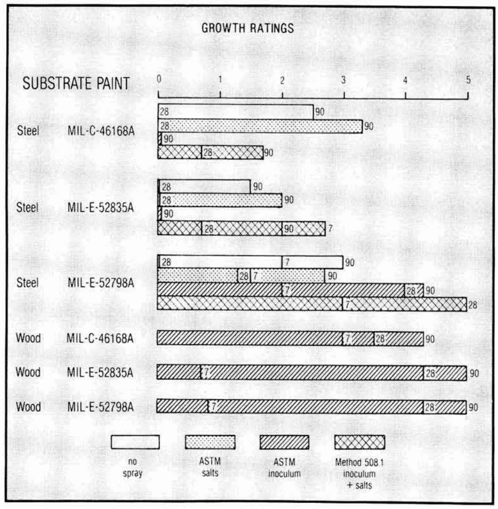


Figure 3—Growth ratings after incubation periods of 7, 28 and 90 days for military paints. Rating scale as follows: 0 = no growth; 1 = trace growth; 2 = sparse; 3 = light; 4 = moderate; and 5 = heavy. Ratings represent the average of three specimens

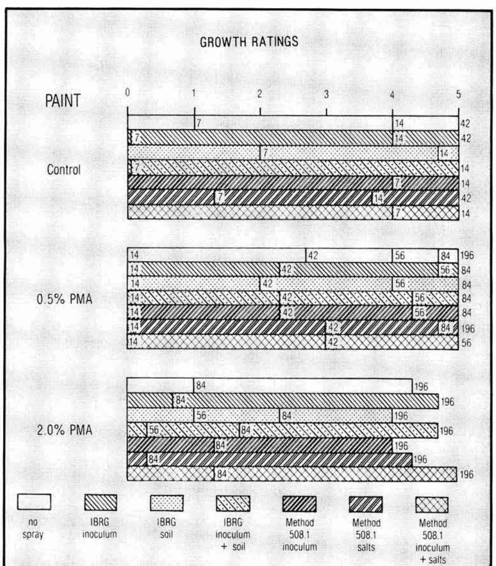


Figure 4—Growth ratings after incubation periods of 7 through 196 days for vinyl acrylic paints on wood. The rating scale is the same as for *Figure* 3

paint, the substrate, or contaminants from the environmental chambers. The data suggest that, although nutrient salts may help to insure a satisfactory fungus test, they are not strictly essential for the testing of paint coatings in a large environmental test chamber.

Pretreatment with nutrient soil, in some cases, induced more growth response than could be attributed to nutrient salts alone. Nutrient soil functions both as a retention aid for the inoculum and as an exogenous carbon source to stimulate germination and growth.[11] Zabel and Terracina[13] speculate that as preconditions for latex paint films to support microbial growth, the films must reach critical moisture levels and accumulate exogenous carbon sources. If so, carbon sources should be available during the fungus test of latex films to simulate the effect of natural environmental contaminants accumulating during indoor and outdoor exposures.

Our studies indicate that the differently pretreated coatings on wood supported nearly the same amounts of fungal growth near the end of the incubation period; so that for wood, as substrate, inclusion of an exogenous carbon source into the pretreatment was not essential for fungal testing in an environmental chamber. Painted plaster and steel were more difficult to colonize than wood substrates. However, the same coatings on wood and plaster supported nearly the same amounts of fungal growth during the course of a 28-day environmental chamber test when both coatings were pretreated with IBRG fungal spore mixture plus nutrient soil. This observation supports the contention of Bravery, et al.[11] that flat panels made from different substrates with appropriate pretreatment can produce comparable data.

It cannot be determined from the limited scope of these environmental chamber studies whether the data obtained from inclusion or exclusion of nutrients in the artificial soil most closely reflects natural deterioration processes. However, availability of contaminants from various decaying materials in the environmental test chamber would appear to lessen the necessity of adding nutrients in simulation of natural contamination of painted surfaces. The fact that coatings on plaster and steel without nutrient soil did support growth during chamber incubation indicates that the environmental test chamber met minimal fungal growth requirements without the necessity of added nutrients.

SUMMARY

A cycled walk-in environmental test chamber used for microbial screening of various Army materiel induced satisfactory fungal growth on flat painted surfaces of varying fungal susceptibilities. The ready availability, in this environment, of many representative organisms common in nature permits natural organism selection processes to occur in simulation of outdoor paint exposure.

Inoculation with fungal spore mixtures encouraged an early and uniform growth. Although prior inoculation was not strictly essential for the screening of susceptible coatings on wood in the environmental chambers, it was helpful for more resistant (or inert) substrates such as plaster and steel. Addition of nutrient soil containing starch to the inoculated surface, in some instances, enhanced growth attributable to both the presence of an exogenous carbon source and better retention of the inoculum. The enhanced growth resulted in comparable susceptibilities of the same coatings on plaster and wood. Mineral salts *per se* assured that nutritional requirements were met but did not appear to substantially promote growth.

To sufficiently characterize the mildew susceptibility of resistant paint coatings, the incubation period for environmental chamber exposure should be extended beyond 28 days. If environmental chamber testing is extended for 90 days to screen biocidal treatments, the need for prior inoculation and addition of nutrient soil to resistant substrates may be unnecessary.

The data suggest that wood is a useful substrate, requiring no pretreatment with inoculum or nutrient soil, for the screening of paint films and biocides in an environmental test chamber. They also suggest that other substrates, if pretreated with inoculum and nutrient soil, will give results more comparable to wood. Specialized test cabinets with specific test organisms do not appear to be strictly essential for evaluation of paint coatings. The data suggest that environmental chambers operated under cycled tropical conditions can also satisfactorily rank the relative mildew susceptibilities of paint coatings.

ACKNOWLEDGMENTS

These studies were made possible by personnel from other laboratories who assisted by supplying us with paints and painted panels for our evaluation. Mr. Milton Goll, Cosan Chemical Corporation, Clifton, NJ, supplied vinyl acrylic paints, both with and without phenylmercuric acetate. Mr. W. R. Springle, Paint Research Association, Teddington, UK, provided IBRG test organisms and IBRG prepared wood and plaster panels on behalf of IBRG. Ms. Sarah Rosen, U.S. Army Electronics Research and Development Command (ERADCOM), Ft. Monmouth, NJ, supplied all paints conforming to military specifications and all metal panels treated with military paints.

We also thank Dr. David L. Kaplan, of our laboratory, for his guidance in preparation of the manuscript. Ms. Cynthia A. Harrington and Ms. Kyle A. Wallace participated in the early experimentation.

References

(1) Hendey, N.I. Lecture given to the Southern Branch of the London Section, on Fungus and Paint, *J.Oil & Colour Chemists' Assoc.*, *45*, 343 (1962).

(2) Barry, S. Bravery, A.F., and Coleman, L.J., "A Method for Testing the Mould Resistance of Paint Films," *Int. Biodeterior. Bull.*, *13*, No. 2, 51-57 (1977).

(3) Bravery, A.F., Barry, S., and Worley, W., "An Alternative Method for Testing the Mould Resistance of Paint Films," *J. Oil & Colour Chemists' Assoc.*, *66*, 39-43 (1983).

(4) American Society for Testing and Materials. Standard Test Method for Resistance to Growth of Mould on the Surface of Interior Coatings in an Environmental Chamber, ASTM D3273-76. Annual Book of ASTM Standards, Philadelphia, PA, Part 27. 1982.

(5) Wiley, B.J., Hebert, R.L., Armstrong, J., and Kaplan, A.M., "The Aerobiology of an Environmental Test Chamber," *Mycoligia.*, *74*, No. 6, 886-893 (1982).

(6) United States Department of the Army. Military Specification. Enamel, Alkyd, Camouflage. MIL-E-52798A(ME). U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA (1976).

(7) United States Department of the Army. Military Specification. Enamel, Modified Alkyd, Camouflage, Lusterless. MIL-E-52835A(ME). U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA (1976).

(8) United States Department of the Army. Military Specification. Coating, Aliphatic Polyurethane, Chemical Agent Resistant. MIL-C-46168A(MR). U.S. Army Materials and Mechanics Research Center, Watertown, MA (1978).

(9) United States Government Printing Office. Weathering Resistance of Cloth; Accelerated Weathering Method, Method 5804, Federal Standard for Textile Test Methods, FED TEST METHOD STD. No. 191A, Washington, D.C. (1978).

(10) United States Department of the Air Force. Military Standard, Environmental Test Methods. MIL-STD-810C. Wright-Patterson Air Force Base, OH (1975).

(11) Bravery, A.F., Barry, S., and Coleman, L.J. "Collaborative Experiments on Testing the Mould Resistance of Paint Films," *Int. Biodeterior. Bull.*, *14*, No. 1, 1-10 (1978).

(12) Zabel, R.A. and Terracina, F., "Nutrition of Saprobic Fungi and Control Strategies for Paint Mildew Caused by *Aureobasidium pullulans*," JOURNAL OF COATINGS TECHNOLOGY, *50*, No. 639, 43-47 (1978).

(13) Zabel, R.A. and Terracina, F., "The Role of *Aureobasidium pullulans* in the Disfigurement of Latex Paint Films," *Develop. Ind. Microbiol.*, *21*, 179-190 (1980).

(14) Zabel, R.A. and Horner, W.E., "An Accelerated Laboratory Procedure for Growing *Aureobasidium pullulans* on Fresh Latex Paint Films," JOURNAL OF COATINGS TECHNOLOGY, *53*, No. 675, 33-37 (1981).

Errata

The labels under the two specimens in *Figure* 5 of the article, "Physical and Chemical Considerations on Copper Phthalocyanine," by Calvin Wanser (JCT, October 1985, p. 60), should be reversed. **A** shows the dispersed form prior to flocculation and **B** shows the form after flocculation.

Figure 3 of the same article should appear as:

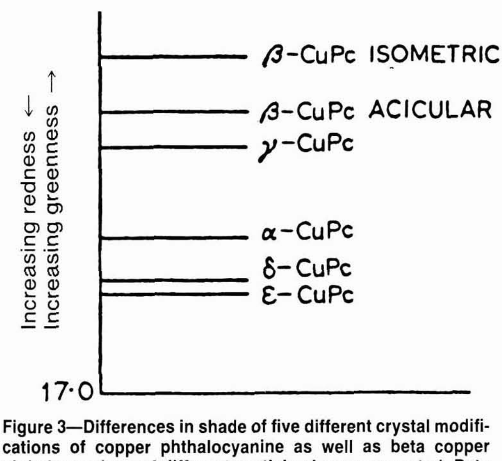


Figure 3—Differences in shade of five different crystal modifications of copper phthalocyanine as well as beta copper phthalocyanines of different particle shapes are noted. Beta copper phthalocyanine (isometric particles) are greener than beta copper phthalocyanine (acicular particles). Redness of shade is maximum at epsilon copper phthalocyanine. (Sappok, 1978)

IT DOESN'T TAKE MUCH.

It takes less. In fact, with UCAR Methyl n-Amyl Ketone, a little goes a long way. Which makes it the solvent of choice for today's new high solids coatings.

It provides lower viscosities than most other oxygenated solvents at equivalent solids levels. And UCAR MAK offers the added advantages of strong solvency, low density, and slow-to-medium evaporation rate when used as the primary solvent in higher solids coatings.

UCAR is a registered trademark of Union Carbide Corporation.

It takes very little to find out more about UCAR MAK. Call your local Union Carbide Sales Representative, contact one of our many distributors, or write us at Dept. K3442, Danbury, CT 06817.

You'll find you can be very happy with less.

UNION CARBIDE

UCAR Solvents

French Process Zinc Oxide in Primers For Hand-Cleaned Structural Steel

William C. Johnson
Consultant*

Primers containing lead and chromate compounds as active pigments have provided dependable protection from corrosion for hand-cleaned structural steel. These primers are popular for maintenance painting jobs and in fabricating shops for new structures such as buildings and bridges. The pigments would continue to be the major functional ingredient in many primers were it not for the health and environmental threat they pose. Concern for health and the environment has led to the investigations of zinc oxide concentrations as replacements for lead or chromate pigments in primers for hand-cleaned steel.

On the basis of the evaluation program, including exposure tests of a range of experimental compositions, the following characteristics were found to be in the optimum range in terms of providing corrosion protection: one pound of French process zinc oxide per gallon; pigments minimally contaminated with soluble salts; a ratio of one to one, linseed oil to long oil alkyd; a pigment volume concentration of 30%; and, controlled sag resistance.

Optimum compositions based on the evaluation program were entered in the PACE (Performance of Alternative Coatings in the Environment) Phase I exposure test program conducted by the Steel Structures Painting Council (SSPC). The results were: the primer containing one pound of zinc oxide per gallon protected in a category next to red lead and zinc chromate primer. Because of its successful results in the PACE study and its success as a primer in the fabricating shop of a major industrial concern, the composition was adopted as SSPC Specification Paint 25.

INTRODUCTION

During the past century, primers containing red lead as the active pigment have been used in the protection of hand-cleaned structural steel surfaces painted in fabricating shops and for maintenance. Trade and engineering journals have reported that bridge owners and others prefer primers containing lead compounds; however, the use of toxic compounds is being limited by health and environmental policies. The concern for health and the environment motivated some companies to work toward developing effective primers for hand-cleaned steel that are free of lead or chromate. A French process zinc oxide was tested in a primer as an active pigment, in concentrations ranging from four pounds per gallon, which was anticipated to be higher than optimum, down to zero pounds per gallon.

Presented at the Western Coatings Society Technical Symposium, Anaheim, CA, Feb. 26-Mar. 1, 1985.

*1522 State Ave., Corapolis, PA 15108.

CORROSION SUPPRESSION MECHANISM OF RED LEAD AND ZINC OXIDE

In the Alternative Primer Pigment Study of the PACE (Performance of Alternate Coatings in the Environment) program, a project of the SSPC, (Steel Structures Painting Council), zinc oxide primers were compared with red lead primers in one accelerated and three atmospheric environments. For each primer test, panels representing five surfaces were included: blast cleaned, fresh mill scale, totally prerusted, partially prerusted in a moderately industrial environment, and partially prerusted in a severe industrial environment. The prerusted panels were prepared in accordance with SSPC-SP 2, "Hand Tool Cleaning." Fifty-six formulations were studied, includ-

Table 1—Corrosion-Suppression Mechanisms

	Red Lead or Litharge	Zinc Oxide
Buffers pH[a]	Yes	Yes
Renders water alkaline[a]	Yes	Yes
Neutralizes fatty acids[b]	Yes	Yes
Its reaction product with linseed oil fatty acid renders water noncorrosive[c]	Yes	Yes
Insolubilizes chlorides & sulfates	Yes	No

(a) Passivation.
(b) Improves barrier properties.
(c) Reinforces air formed film.

ing 40 alternative compositions along with 16 well-known and widely used standard specification paints. Six-year data on atmospheric results from this study were reported by Bruno and Appleman[1] and 16-month data were reported by Keane, et al.[2]

After six years, the one-pound-per-gallon French process zinc oxide primer and topcoats (System #52 in the Alternative Primer Study—later adopted as SSPC-Paint 25) ranked eleventh in the composite weighted average for all environmental tests. This coating system of primer and topcoat ranked fourth in resistance to undercutting at the scribe behind only lead or zinc chromate systems. It ranked seventh in rust resistance, again only behind lead and chromate systems.

Two primer compositions, a red using one pound of zinc oxide per gallon and a gray using two pounds zinc oxide per gallon, were entered into the PACE exposure test program. The former protected marginally better than the latter, and its formula is included as *Appendix* B.

In an earlier study[3] than PACE, where 60 primers including red lead and zinc yellow controls were compared over a period of 30 months, French process zinc oxide primer (now SSPC-Paint 26, "Slow-Drying Linseed Oil Black Maintenance Primer") ranked third overall. Only one red lead and one zinc dust primer ranked higher.

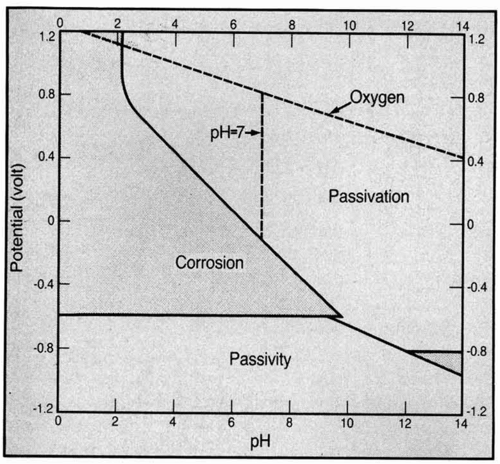


Figure 1—Pourbaix diagram

Since red lead and zinc oxide suppress corrosion by similar mechanisms, the functions of these two pigments may be compared. *Table* 1 summarizes the corrosion-suppression mechanisms of red lead and zinc oxide.

Zinc oxide is an acid neutralizer and has a pH of approximately 7. Lohr and Barry[4] stated: "While the pigment (zinc oxide) is not considered in the same category as red lead or zinc dust as a corrosion inhibiting pigment, it does contribute to retardation of the corrosion process as a result of its slightly alkaline nature."

In applications of electrochemical thermodynamics, Dr. Pourbaix[5] has constructed an equilibrium diagram of oxidation-reduction potentials plotted against pH for the water-iron system (*Figure* 1). Dr. Pourbaix found zones representing three conditions: (1) corrosion, (2) passivation, and (3) passivity. The Pourbaix diagram is helpful in visualizing the relationship of passivation to pH and oxidation-reduction potentials. (Dashed lines have been inserted to show an approximation of the line for atmospheric oxygen and the portion of the line for pH between the corrosion boundary line and atmospheric oxygen line. Air formed films which Dr. Mayne[6] discussed occur in the region below the atmospheric oxygen line.) Pourbaix cautioned that the extent of the region of corrosion can be increased considerably by chlorides.

The neutralizing action of zinc oxide is an essential function. H.B. Stephenson[7] explained the role of the zinc oxide in a primer composition as follows: "Zinc oxide reacts with these (fatty) acids, thus preventing further catalyzed binder degradation."

Red lead and zinc oxide will both buffer acidity to a neutral or slightly alkaline pH. J.E.O. Mayne[6] stated: "It has been found that red lead, litharge, and certain grades of lead powder render water alkaline and inhibitive." He also pointed out: "It was found that water became non-corrosive after contact with the lead, zinc, barium, strontium, and calcium soaps of the linseed oil fatty acids."

In addition to these four corrosion mechanisms, red lead indirectly suppresses corrosion by reducing the solubility of chloride and sulfate ions, present either in pigments or with the rust or scale. This action reduces the osmotic pressures that these ions might otherwise exert and also substantially prevents them from lowering the pH.[8]

When edges of painted steel are observed on metallurgical cross sections under low magnification, coatings are seen tapered to a thin neck. In extreme cases, a primer with too much flow and too low a viscosity will taper down at an edge to one-half of the thickness on adjacent plane surfaces. Corrosion commonly begins at such thin films on edges. Tator[9] recognized that prominences such as edges or weld spatter were susceptible to corrosion. Suggitt and Graft[10] reported that coatings provide only 40% as long service life on edges as on planes. Coatings with sag resistance show much less flow back from an edge or from the peak of weld spatter. Thus, primers need sag resistance to cover edges and protuberances while retaining sufficient flow that avoids ropiness of brush marks. Sag resistance is controlled with Federal Test

Method Standard No. 141, Method 4494, "Sag Test (Multinotch Blade)."

PRIMER INGREDIENTS

The main ingredients of alkyd/linseed oil primers for hand-cleaned steel are chemically active pigments, auxiliary pigments such as colored pigments and extenders, and the binder (linseed oil, alkyd resins). The proportions of ingredients also give a primer some of its properties. These proportions are expressed in terms of pigment volume concentration (PVC) and oil/resin ratio.

Zinc Oxide

Zinc oxide, a chemically active and relatively nontoxic white pigment, is made by one of two processes: directly from ore in the American process, or after being refined to metal in the French process. Because the French process zinc oxide is made from special high grade metal, it has a higher purity than the American process zinc oxide. French process grades are also available in minute particle sizes which are more active than the larger particle sizes of the American process, due to the greater surface area. Characteristics of the French process zinc oxide pigment are given along with those of an average American process zinc oxide in *Table* 2.

The result of a simple test led to the selection of the French process zinc oxide in preference to the American process material. When a clean, cold-rolled steel panel was dipped into an aqueous slurry of material from each process and hung up to dry, the panel dipped into the American process slurry rusted visibly but the other did not. This rusting was attributed to soluble salts in the American process pigment. These soluble salts co-fumed with the American process would draw water into the film by means of osmotic pressure. In solution next to the steel, salt would promote corrosion.

Nodular zinc oxide was used for this study, although in the fine sizes and in the low concentrations, acicular may work as well.

Zinc oxide has been overlooked as an active pigment because, in the past, adverse results were obtained when high concentrations and the wrong kind of zinc oxide were used. Excessive quantities of zinc oxide may gel the binder; too many fatty acids in the vehicle cause livering or gelation when they react with the zinc oxide. French process zinc oxide has been used at low concentrations that do not gel as readily. Moreover, with modern resin technology, the acid-number can be accurately controlled at low levels, avoiding gelation.

Payne[11] reported that during the storage of paints seeding can result from three causes. One of these, an agglomeration of soaps within the paint, applies to active pigments. The cause is the overpolymerization during processing of the resin which results in the formation of gel particles in the resin. Consequently, such gels can be controlled by avoiding overpolymerization during processing.

When zinc oxide is incorporated at excessively high concentrations, it hardens and embrittles the film, causing flaking and producing poor intercoat adhesion. Werthan[12] found that large quantities of zinc oxide caused the paint film to harden. Bunce[13] and Elm[14] showed that the tensile strength and resulting excessive hardness of paint films increased with the concentration of zinc oxide.

French process zinc oxide may therefore be considered a practical pigment when incorporated in the proper concentrations. Stephenson[7] notes, "Many coatings designed for protection of metal against corrosion contain zinc oxide together with zinc dust, zinc chromate, red lead, or other pigments. Zinc oxide is helpful in providing an overall durable paint film."

In an exposure study of red lead pigment concentrations, fine particle red lead pigment was shown[15] to be more effective at low rather than high concentrations in primers for hand-cleaned steel, obtaining efficiency from the larger surface area per pound of minute particles. In fact, red lead was superior at the very low concentration of one pound per gallon. This red lead primer composition subsequently did very well in the SSPC-PACE exposure program. Similarly, primers containing low concentrations of fine particle zinc oxide have proven successful.[3,16]

Thus, the success of the red lead study prompted the testing of low concentrations ranging from zero to four pounds per gallon French process zinc oxide. Lower concentrations do reduce activity; however, greater surface area compensates for the lower concentration.

Auxiliary Pigments

Although chemically inert in the primer, colorants and extenders can nevertheless act physically to add to the primer's protective properties.

COLORANTS: Zinc oxide primers can be manufactured in a wide range of colors for application where whites or light grays are required. However, the addition of a dark pigment, such as iron oxide, is usually incorporated in primers. Iron oxides which have low cost, high hiding, and resistance to chalking (by blocking ultraviolet light radiation) have earned acceptance.

EXTENDERS: Mica and some talcs are plate-like pigments that restrict the permeation of water through the film by blocking its path. Preston[17] explained how flakes of mica orient themselves parallel to the painted surface, retarding moisture penetration. Singleton and Johnson[18]

Table 2—Zinc Oxides

	French Process	American Process
Particle size, microns	0.1	0.6
Surface area sq. m/g	10	4
Water soluble salts %	0.06	0.50[a]
Starting material	High purity metal	Ore

(a) One grade of American process zinc oxide is specially refined to lower the soluble salts concentration, resulting in a higher purity American zinc oxide.

Table 3—Chemically Inert Pigments

	Iron Oxide	Titanium Dioxide	Talc	Mica
Specification	ASTM D3722	ASTM D476 Type II	ASTM D605	ASTM D607
Purpose	Color and hiding	Color and hiding	Extender	Moisture Block
Oil absorption, gm oil/100 gm pigment	11	21	25-29	50-54
Color	Metallic brown	White	White	White
Specific gravity	4.8	4	2.8	2.5
Fineness, % through 325	99.99	99.99	99.00	94.00
pH	7.20	6.5	8.0	8.5
Soluble salts, ohms/cm[a]	5,000	5,400	2,800	17,000

(a) Soluble salts are expressed as ohm/cm electrolytic resistance of filtrate from a 10% slurry in deionized water per ASTM 2448.

reported that talc reduced permeability to a minimum in the 30% to 50% PVC range. Mica is considered more effective in reducing permeability of the film because it has a higher percentage of large plate-like particles, but in high concentrations it interferes with application and is more costly. Mica is normally incorporated as 10% of the pigment, a level which is considered to be optimum (Werthan,[19]). Talc extenders (Patton,[20]) also contribute to settling resistance, sag resistance, bonding properties, and film toughness. They fortify the film structure and lower the cost.

Soluble chlorides and soluble sulfates are detrimental to protection.[8] Pigments having low concentrations of soluble salts have been developed for automobile and appliance enamels. It is logical to utilize these pigments in primers for hand-cleaned steel.

Various properties, supplier specifications, and characteristics of inert pigments used are listed in *Table* 3.

Binders

Formulators have long recognized that in primers for hand-cleaned steel it is advisable that at least half of the binder be linseed oil in order to facilitate the wetting and the penetration of the rust and scale. Linseed oil is seldom used at 100% concentration because it dries too slowly and forms too soft a film. To shorten the drying time, harden the film, and reduce the permeability to water, the oil is blended with varnishes or resins (usually alkyds). Because short drying time is commercially so important, as much resin as possible is incorporated into the formula.

In reviewing the chemistry of linseed oil during the drying and film decomposition, Elm[21] contended that drying and film decomposition are not two reactions chronologically, but occur concurrently from the moment the first traces of oxygen have been absorbed. (Oxygen is absorbed at the double bonds of fatty acids which are present in linseed oil and alkyd finishes.) Numerous attempts have been made to unravel the complex reactions of oxidative decomposition by determining the chemical compositions of aged drying oil films. Some work was done by identifying the compounds of relatively low molecular weight. D'Ans[22] was one of these investigators. His data show the oxygen consumption and the gaseous products that are released at laboratory temperatures, and those that are driven off at 130°C (266°F). Each mole of linseed oil was found to take 11.5 moles of oxygen. The total quantity of gaseous products obtained was 36% of the oil. Among these products, 10.4% were volatile acids expressed as formic acid. Seventy percent of these (volatile acids) was actually formic acid. The volatile products were as follows:

Water	12.30%
Volatile acids	10.40
Carbon dioxide	11.75
Aldehydes	0.80
Carbon monoxide	1.06
	36.31%

Merzbacher[23] reported the analysis for linseed oil after three weeks of drying and nine months of aging in a closed vial.

Dried Three Months and Aged Nine Months

Ash	0.4%
Moisture	9.6
Glycerol	9.0
Formic acid	1.0
Propionic acid	1.0
Caproic acid	0.3
Pelargonic	1.6
Azelaic acid	9.0
Saturated higher fatty acids	9.5
Unsaturated higher fatty acids (soluble in petroleum ether)	9.6
Water insoluble oxidized acids	26.0
Water soluble oxidized acids	8.0
Water soluble organic material not identified	3.0
Loss (including carbon dioxide)	12.6
Total	100.0%

The composition of mixed fatty acids in linseed oil was given by Lucas[24] as:

Palmitic	9%
Oleic	5%
Linoleic	62%
Linolenic	24%
Total	100%

Table 4—Zinc Oxide Concentration Ladder—Blasted Steel Substrate ASTM D-610 Rust Ratings After 13 Months' Exposure In an Industrial Environment

Pounds/gallon	Zinc Oxide PVC	Talc and Mica PVC	ASTM Rust Rating Oil/Alkyd Ratio 50/50	67/33
4	14	13	8.5	7.5
2	7	20	9	8.5
1	3.5	23.5	9	8
0.85	3	24	8	8
0.70	2.5	24.5	7.5	7.5
0.57	2.0	25	7	7.5
0.28	1.0	26	6	6.5
0	0	27	3	1

Merzbacher reported increases in acid number as linseed oil films aged to acid numbers of 73 after 60 days, and 191 after two years. He reported that volatile acids, formic and propionic, would be present to contribute to the acid number. Hartshorn[25] reported that acids are formed during the drying and degradation of alkyds.

TEST PROGRAM

Specimens*

STEEL SHAPES: For the exposure tests on rusted surfaces, one-foot-long specimens cut from mill lengths of 4″ × 4″ × 3/8″ thick low-carbon ASTM A-36 hot-rolled automatically straightened structural angles were used. The hot-rolled surface was covered with mill scale, a black oxide that forms on the steel surface when steel is rolled at red heat into structural shapes. Angles rather than flat bars were chosen because the mill scale on shapes such as angles is broken and blistered at the various contours.

Each primer was tested on both rusted angles and a blast-descaled flat bar, 4″ × 12″ × 3/8″ thick. Blasted steel is an ideal surface for painting, and many primers that last a long time on blast descaled surfaces fail on hand-cleaned steel. The blasted surface was particularly valuable for determining the ultimate durability and confirming the minimum concentration level for an active pigment.

PRERUSTING OF MILL SCALE-BEARING SURFACES: In the test procedures, care was taken to make the surfaces simulate rusted structural steel. Prior to priming, the mill scale-bearing surface was rusted in a representative natural environment subject to acid rain, since this simulates what actually occurs in practice. However, any natural environment is variable: long periods of foggy nights with fallout of moisture high in chlorides and sulfates would be expected to result in a higher surface concentration of these electrolytes than would a long period of cleansing rain. Therefore, only specimens having identical prerusting histories were compared in any given evaluation of primers.

*Details on the preparation and exposure of steel specimens are covered because no standards exist, and much special effort was taken to control variables while simulating actual conditions and practices.

Table 5—Zinc Oxide Concentration Ladder—Moderate Prerust ASTM D-610 Rust Ratings After 13 Months' Exposure In an Industrial Environment

Pounds/gallon	Zinc Oxide PVC	Talc and Mica PVC	ASTM Rust Rating Oil/Alkyd Ratio 50/50		67/33	
4	14	13	7.5	7	7	7
2	7	20	8.5	8	8	7.5
1	3.5	23.5	8.5	8	7	6.5
0.85	3	24	6.5	6.5	7	7
0.70	2.5	24.5	7	7	7	7.5
0.57	2.0	25	7	7.5	7	7
0.28	1.0	26	7	7	7	7
0	0	27	7	6.5	6.5	6.5

Table 6—Zinc Oxide Concentrate Ladder — Severe Prerust ASTM D-610 Rust Rating After 2 Months' Exposure In an Industrial Environment

Pounds/gallon	Zinc Oxide PVC	Talc and Mica PVC	ASTM Rust Rating Oil/Alkyd Ratio 50/50	67/33
4	14	13	8	8
2	7	20	8	8
1	3.5	23.5	7	8
0.85	3	24	6	7
0.70	2.5	24.5	7	7
0.57	2.0	25	8	6
0.28	1.0	26	7.5	6.5
0	0	27	7	6

The variable nature of rusted mill scale necessitated testing on more than one specimen. Duplicates of moderately prerusted panels were used in some phases of the zinc oxide concentration study, and quadruplicates were used in the pigment volume study.

For uncoated steel, different exposure times result in different surface conditions. Therefore, both two- and eight-week exposures were used. Experience has shown that about 20% of the scale rusts away during a two-week exposure, whereas about 80% rusts away during an eight-week period. These two surface conditions are termed "moderate" prerust and "severe" prerust, respectively.

SURFACE PREPARATION: Prior to painting, the rusted angle specimens were hand-wire brushed in accordance with Steel Structures Painting Council specification SSPC-SP 2, "Hand Tool Cleaning," to remove the loose rust and scale. The blasted panel was prepared to a cleanliness of SSPC-SP 5, "White Metal Blast."

CONTROLS: Because data on the amount of zinc incorporated was of primary importance, a conventional lead or chromate control was not included in the zinc oxide concentration ladder comparison; a control, SSPC-Paint 11, a zinc yellow (chromate) primer, was part of the pigment volume study.

COMPOSITIONS: Primer compositions were varied in two separate experiments. In the experiment studying zinc oxide concentrations, two ratios of linseed oil to long oil alkyd were included. A separate study was made of pigment volume.

Zinc Oxide Concentration Ladder

In *Tables* 4, 5, and 6 the amounts of zinc oxide, mica, and talc for the experimental compositions are expressed in terms of pounds per gallon of zinc oxide as well as pigment volume concentrations. Titanium dioxide was 8% PVC throughout. Thus the four-pound-per-gallon zinc oxide composition was 14% PVC of zinc oxide, 13% PVC of talc and mica, 8% PVC of titanium dioxide, making the total pigment volume 35%.

In preparing the experimental zinc oxide primers for each ladder, two master compositions, identical in all ingredients except zinc oxide and talc, were made up at 35% PVC. The binder, 65% of the volume solids, was 50/50 oil/alkyd in one ladder and 67/33 oil/alkyd ratio

Table 7 — Pigment Volume Concentration Ladder

	30% PVC	37% PVC	44% PVC
Zinc oxide	2.0%	2.0%	2.0%
Titanium dioxide	9.4%	9.4%	9.4%
Talc	18.6%	25.6%	32.6%
Binder volume	70.0%	63.0%	56.0%

in another ladder. One master composition, the first on the Table, contained a high concentration level (14% PVC zinc oxide); the other master composition, last on the Table, (0% PVC zinc oxide) contained additional talc replacing the zinc oxide. These were then blended together to make six primers at intermediate concentrations of zinc oxide (1%, 2%, 2.5%, 3%, 3.5%, and 7% PVC). The first two steps were 1% increases of zinc oxide expressed in pigment volume; the next three steps were closer together at 0.5% increases in pigment volume. (This was a more generous distribution of points in the range considered critical.) The last two were widely apart—doubled in pigment volume.

Pigment Volume

Pigment volumes were compared in another study which used a gray primer containing a zinc oxide/titanium dioxide/talc pigmentation. Only the talc and the binder were varied to change the pigment volume. Primers were prepared at 30%, 37%, and 44% PVC. The volumes of the individual pigments, as shown in *Table* 7, are: zinc oxide—2%; titanium dioxide—9.4%; and talc—18.6% for the 30% PVC total, the remaining 70% being binder, which was a 75/25 mixture of linseed oil and long oil alkyd. *Table* 7 also lists the corresponding values for the 37% PVC and the 44% PVC primers with the remaining percentage being the same binder.

Oil/Alkyd Ratio

Two commonly used binders, 67/33 oil/alkyd and 50/50 oil/alkyd, were compared at the eight concentrations in the zinc oxide ladder study. The binder for the three pigment volume variations consisted of 75% linseed oil and 25% alkyd.

Paint Application

The paint was applied by air spray with a mechanically operated gun holder controlling the paint thickness. Dry film thickness was kept at 2 mils ± 0.2 mils measured by a magnetic film thickness gauge on a companion cold-rolled steel panel sprayed at the same conditions as the test panel.

RESULTS

Evaluation Standards

Results were noted as the rust rating determined by visual comparison with ASTM-D-610-68 photographic standards after a given period of exposure. The photographic standards are graded from 10, representing no visible rust, down to 1, representing 50% rust. A rating of 8 is often considered the repaint stage.

Experimental Exposure Tests

ZINC OXIDE CONCENTRATION LADDER: The results of the zinc oxide concentration ladder for the blast-descaled surface are listed in *Table* 4 and are plotted in *Figure* 2. After a 13-month exposure period, the rust ratings for all zinc oxide primers are dramatically better than the no-zinc-oxide control. Rust ratings of the zinc oxide primers at a binder ratio of 50/50 ranged from 6 to 9 compared to the no-zinc-oxide control which rusted to a rating of 3. As little as 0.28 pounds per gallon of zinc oxide protected to a rating of 6 after 13 months. One and two pounds of zinc oxide per gallon protected best with ratings of 9 after 13 months.

In the case of the 67/33 binder ratio primers, the results for no-zinc-oxide are even more disparate. After 13 months with zinc oxide primers ranging from 6.5 to 8.5, the no-zinc-oxide control had failed completely with a rust rating of 1. Two pounds of zinc oxide per gallon rated the best.

Figure 2 shows a curve of the ratings versus the concentration with maximum protection occurring in the zinc concentration ranges of one and two pounds per gallon for the 50/50 binder ratio and the two pounds per gallon for the 67/33 binder ratio.

Compared to the outcome on the blasted surfaces, the ratings over moderately prerusted surfaces fall in a range from 6.5 units to 8.5 units. Considering that on rusty surfaces paints are expected to fail rapidly, these no-zinc oxide readings are not as bad (6.5 and 7) after 13 months on moderately prerusted steel as the corresponding readings of 1 and 3 on blasted metal. The concentrations of one and two pounds of zinc oxide per gallon showed the least rust break-through in the 50/50 binder ratio compositions. In the 67/33 binder ratio compositions, the two pounds of zinc oxide per gallon primer performed the best.

The life of primers on severely prerusted steel is an order of magnitude shorter than the life on moderately prerusted or blasted steel. The severity of the substrate shortened the life and dominated the results, narrowing the ratings between 6 and 8 units after two months' exposure. This is illustrated in *Table* 6.

PIGMENT VOLUME: In the comparison of experimental primers containing a ladder of pigment volumes, the primer with a PVC of 44% failed early, a PVC of 37% protected well, and a PVC of 30% gave even better protection. These did not perform as well as the SSPC control, a dependable primer based on zinc yellow used as the standard in this test. The results also suggest that a plateau or maximum of protective properties has been reached at 30% PVC. Results are given in *Table* 8.

OIL/ALKYD RATIO: Results of eight compositions for each binder ratio are listed in *Tables* 4, 5, and 6 for blasted surfaces, moderate prerust, and for severe prerust, respectively. The 50/50 oil/alkyd binder ratio shows a slight advantage for the blasted surface and the moderate prerust. The 67/33 oil/alkyd shows a slight advantage for the severe prerust.

DISCUSSION

The results support a reassessment of the corrosion protection mechanisms of active pigments in oil/alkyd primers. Several functions of primer ingredients contribute to the overall performance, but the neutralization of film acids stands out in the data. The protection provided is related to the concentration of zinc oxide. The poor protective properties at low concentrations of zinc oxide on blasted steel indicate that an insufficient stoichiometric quantity of zinc oxide was present to neutralize the film acids.

A stoichiometric calculation shows that the one-pound-per-gallon of zinc oxide is roughly two equivalents to each equivalent of the chemically combined starting fatty acids of both oil and alkyd.

The 10.4% of acids that D'Ans found amount to an estimated 2.1 equivalents of acid per mole of linseed oil. He reported the 10.4% to be 70% formic, the remaining 30% being less volatile acids.

Merzbacher found 9% of azelaic acid in the aged dry film. Azelaic acid, which is dibasic, boils at 360°C (680°F). Thus it represents an additional increase in acid because it should not have appeared in substantial quantities in either of D'Ans' volatile acid categories. At least one of the carboxyl (acid) groups on each azelaic molecule would have been formed during the drying and degradation process because dibasic acids are not present in linseed oil. This second carboxyl group on azelaic acid would account for an estimated 0.6 equivalent of acid formed per mole of linseed oil. Thus the volatile acids, together with the second carboxyl group on azelaic, total 2.7 equivalents of acid per mole of linseed oil, making a ratio of 0.9 equivalents of acid corresponding with the two equivalents of zinc oxide that are present.

Merzbacher's data on acid number shows that three equivalents of free acid per mole of linseed oil are in the film after two years. This is a ratio of one equivalent of acid per two moles of zinc oxide. This does not take into account volatile acids which could also enter corrosion reactions.

In this stoichiometric estimation of a material balance, assumptions were made that no changes in acid formation and neutralization would occur due to the following differences:

(1) Zinc oxide, an ultraviolet light absorber, and other ingredients were present.

(2) Acidity of the film would be lower because acids would be neutralized, which should suppress degradation.

(3) Temperatures could be high during drying and aging.

(4) Utilization of even fine particle sized zinc oxide may be incomplete.

(5) Topcoating would restrict sunlight, moisture, and oxygen.

(6) Fatty acids in the alkyd may degrade less than oil.

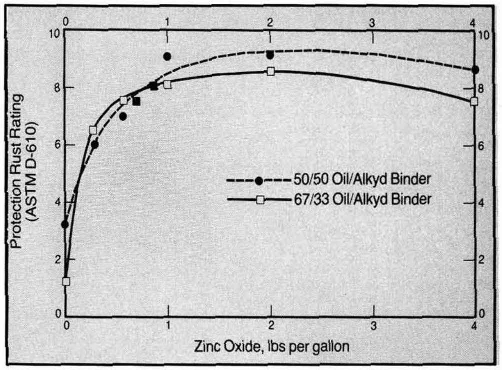


Figure 2—Zinc oxide concentration ladder vs rust rating

However, changes in acid formation and neutralization probably do occur.

The slope of the curve in *Figure* 2 ascends steeply, showing the benefit of neutralization with zinc oxide in increasing amounts up to the concentration range where the curve reverses the slope and declines due to an excess of zinc oxide. Excess zinc oxide causes the film to harden and to embrittle. The excess zinc oxide will also dissolve in acid rain, leaving voids in the film.

Zinc oxide maintains a neutral or alkaline pH at the interface. The pH level of zinc oxide, 7.2, appears in the passivation zone on the Pourbaix diagram.

The failure after two months of the severely rusted steel is attributed to salt present on the severely prerusted panels; lead primers would be expected to perform better because lead pigments would insolubilize sulfates and chlorides. Zinc oxide does not insolubilize sulfates and chlorides.

Zinc salts may be kept from harming the corrosion resistance indicated above by incorporating only sufficient concentration to be reacted with fatty acids. The soaps will not react to form zinc chloride or sulfate. Statistical calculations of the data are covered in *Appendix* A, "Statistical Evaluation of Exposure Results."

These estimations show that sufficient acids can form during the drying and degradation of the one-pound-per-gallon linseed oil/alkyd films (of this study) to consume a substantial portion of one pound of zinc oxide. Thus this supports the hypothesis that neutralization of free acids,

Table 8—Pigment Volume Concentration Rust Ratings, ASTM D-610T After 6 Months, In an Industrial Environment

PVC Percent	Moderate Prerust[a]	Severe Prerust[a]	Blasted Steel
44	4.75	5.50	7.25
37	8.25	8.00	9.00
30	8.50	8.00	9.25
SSPC-Paint 11 PVC 30% (Control)	9.25	8.75	9.25

(a) Prerusting history is not the same as in *Tables* 5 and 6, respectively.

which form during drying and degradation, is a major function of active pigments.

Future studies using modern technology, for example, x-ray diffraction analysis of the depletion rate for the zinc oxide concentration, could reveal the rate and extent of acid formation and retardation of acid formation by zinc oxide during drying and decomposition.

At the origin, the curve for 50/50 oil/alkyd ratio binder ascends more steeply and peaks at lower concentrations than the curve for 67/33, indicating that the binder with the higher alkyd concentration releases fewer fatty acids. Thus, binders having higher concentrations such as 100% of alkyd should need less zinc oxide, and latexes, which do not release fatty acids on curing, would be expected to need only a minimum of zinc oxide for alkalinity to provide anti-corrosion properties.

Where panels were "moderately" prerusted, most (80%) of the surface was intact scale which provides extra protection to the steel, even from formic acid. The corrosion attack occurred where 20% of the surface was covered with rust. However, the failure was judged on the total panel area. The no-zinc oxide primers benefited disproportionately from the extra protection of the mill scale. In contrast, on the 20% rust covered steel areas, the salts and pits stimulate the breakout of corrosion on all panels. The advantages for the zinc oxide compositions appears in *Table* 5.

On severely prerusted steel, failure came early (after two months), reflecting the condition of the· salts, corrosion product, and mill scale present. This failure came before the embrittlement which would have detracted from the performance of the highest zinc oxide concentration.

SUMMARY

On the basis of the evaluation program, including exposure tests of a range of experimental compositions, the following characteristics were found to be optimum in terms of providing corrosion protection: one pound of French process zinc oxide per gallon; a ratio of 1 to 1, linseed oil to long oil alkyd; a pigment volume of 30%. Pigments minimally contaminated with soluble salts were selected, and sag resistance in terms of paint thickness was more than conventional paints.

Primer compositions were entered in the PACE exposure test program conducted by the SSPC.[2] As a result of the successful performance there and the favorable experience as a primer in the fabricating shop of a major industrial concern, the composition, based on one pound of zinc oxide per gallon, was adopted as SSPC Specification Paint 25.

References

(1) Bruno, J.A. Jr., and Appleman, B.R., "Developing and Evaluating Environmentally Acceptable Coatings: Part I," *J. Protective Coatings & Linings*, Vol. I, No. 6, 24-33, 1984.

(2) Keane, J.D., Bruno, J.A. Jr., and Weaver, R.E.F., *Performance of Alternate Coatings in the Environment (PACE)*. Steel Structures Painting Council, Pittsburgh, PA, August 20, 1979.

(3) Keane, J.D., *Painting of Hand Cleaned Structural Steel*. Steel Structures Painting Council, Pittsburgh, PA, August, 1962.

(4) Lohr, R.F. and Barry, H. "Pigmentation of Coatings—Marine and Ship Service," *Pigments Handbook*, Vol. II (II-A-b-3), pp. 29-37.

(5) Pourbaix, M. *Corrosion*. National Association of Corrosion Engineers, Vol. VI, 1950, pp. 395-404.

(6) Mayne, J.E.O., "Pigment Electrochemistry," *Pigments Handbook*. Vol. III (III-G-a), pp. 457-464.

(7) Stephenson, H.B., "Zinc Oxide and Leaded Zinc Oxide," *Pigments Handbook*, Vol. I (I-A-b-1), pp. 37-49.

(8) Johnson, W.C., "Detrimental Materials at the Steel/Paint Interface," New Concepts for Coatings Protection of Steel Structures, ASTM STP 841, D.M. Berger and R.F. Wint, ed., American Society for Testing and Materials, 1984, pp. 28-43.

(9) Tator, K., *Chemical Engineering*. October, 1951, pp. 14, 141, 142.

(10) Suggitt, J.W. and Graft, C.M., "Ten Years Experience in Evaluation of Coatings for Underwater Steel Structures," Journal of Paint Technology, *38*, No. 494, 150 (1966).

(11) Payne, H.F., *Organic Coating Technology*. John Wiley & Sons, Inc., New York, 1954.

(12) Werthan, S., "Outside Paints", *Official Digest*, No. 143, 73-74, 1935.

(13) Bunce, E.H., *Paint, Oil, Chem. Rev*. Vol. LXXXIV, pp. 12-13, December 1, 1927.

(14) Elm, A.C., "Some Mechanical Properties of Paint Films," *Official Digest*, No. 340, 751, 1953.

(15) Johnson, W.C., U.S. Patent No. 4,094,837.

(16) Johnson, W.C., U.S. Patent No. 2,858,285.

(17) Preston, J.B., *Pigments Handbook*. Vol. I. (I-B-C-7), pp. 249-263.

(18) Singleton, F. and Johnson, W.C., *Ind. Eng. Chem*. Vol. XLI, April, 1949, pp. 749-753.

(19) Werthan, S., "Wet Ground Mica Promises Added Years of Protection in the Battle Against Corrosion," *Paint Varnish Production*. 57 (8), August, 1962.

(20) Patton, C., "Magnesium Silicate, Talc," *Pigments Handbook*. Vol. I (I-B-C-5), pp. 233-242.

(21) Elm, A.C., *Ind. Eng. Chem*. Vol. XLI, No. 2, February, 1949, pp. 319-324.

(22) D'Ans, J., *Chemishe Umschau*, Vol. XXXIV, pp. 281-291, 1927, Zeitschrift fur angewandte Chemie, Vol. XLI, pp. 1193-1212.

(23) Merzbacher., *Chemishe Umschay*, Vol. XXXV, pp. 173-176, 1928, and Vol. XXXVI, pp. 339-345.

(24) Lucas, H.J., *Organic Chemistry*, American Book Company, New York, 1935, p. 21.

(25) Hartshorn, J.H., "Time-Lapse Spectroscopic Investigation of Alkyd and Linseed Oil Cure," Journal of Coatings Technology, *54*, No. 687, 53. (1982).

APPENDIX A

Statistical Evaluation of Exposure Results

Blasted Steel Surfaces: A straight line corresponding to the steeply rising beginning of each curve in *Figure* 2 and another corresponding to the tail lines, were calculated by the method of least squares.

These lines represent, respectively, the beginning portion dominated by the benefit of neutralization of film acids, and the tail, diminished in protection by the embrittlement along with the leaching of excess zinc oxide by acid rain.

Visually, from *Figure* 2, the portion of the curve for the six primers with the lowest zinc oxide concentrations ascends steeply with very little change in direction except at the origin. The intercept and slope of the least squares straight line for this portion of the 50/50 oil alkyd binder data were respectively 3.65 (rust rating) and 5.5 (rust rating units per pound of zinc oxide per gallon of primer). A calculated correlation coefficient of 0.96 relates to the linearity of this section of the curve. The data

Table A-1

Data	Intercept[a]	Slope[b]	Correlation Coefficient
50/50 Binder	9.25	−0.18	0.87
67/33 Binder	8.50	−0.21	0.86
Combined	8.60	−0.20	0.89

(a) Rust rating
(b) Rust rating units per pound of zinc oxide

for the 67/33 binder ratio was treated similarly giving a positive slope of 6.3, an intercept of 2.8 and a coefficient of 0.96.

For the tail of the curves, lines of least squares were calculated from the three highest concentrations of zinc oxide for each binder ratio and for the combined binder ratio data. Characteristics of the lines are given in *Table* A-1.

Moderately Prerusted Steel: Results on moderately prerusted steel, where specimens were duplicated, were analyzed by calculation of the variances.

In designing the study on moderately prerusted surfaces, duplicate specimens were included to obtain reasonable statistical confidence. Moreover, variables associated with prerusting history were carefully controlled to minimize the error (standard deviation).

Table A-2—Analysis of Variance

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio	Confidence
Binder	1	0.5	0.50	0.5	>90%
ZnO concentration	7	5.4	0.77	5.5	>99%
Error	23	3.3	0.14	—	—
Total	31	9.2	—	—	—

The data from results in *Table* 5 were compared by analysis of variances. Components of the variation are shown in *Table* A-2.

The difference in results on the binder ratios is significant at the 90% confidence level. Differences in the comparisons of zinc oxide concentrations are significant at the 99% confidence level. The standard deviation is 0.38 rust rating units.

Data for the various zinc oxide concentrations were subjected to the student's t test. For use in this t test a best estimate of the population variance was made by applying Bessel's correction to the sample variance. The t test indicates that the difference of mean for duplicate panels, which is significant at the 90% confidence level, is 0.8 rust rating units. Thus, rust ratings for the one and two pound per gallon compositions are better than any of the other concentrations at a confidence level of 90%.

Severely Prerusted Steel: Replicates were not exposed and no calculations were made. From the very short life-span, a better cleaning method is indicated for this surface.

APPENDIX B

100-Gallon Formula
Red Zinc Oxide Primer for Hand-Cleaned Steel

Ingredients	Pounds per 100 Gallons
Zinc oxide, ASTM D-79, Type I	100
Iron oxide, ASTM D-3722	240
Talc, ASTM D-605	200
Mica 221, ASTM D-607	68
Raw linseed oil	172
Alkyd resin TT-R-266, Type II, Class B	245
24% Lead naphthenate	15
6% Cobalt naphthenate	2
Butyraldoxime	3
Mineral spirits	155
	1,200

Viscosity 80 K.U. ± 5 K.U.
Gallon weight 12.05 Pounds per gallon

Microcomputer-Controlled Automatic Weighing-in Machine For Computer Color Matching

Yoshito Ito
Nippon Paint Co., Ltd.*

A great variety of colors are presently required in the paint industry and, accordingly, color tolerances are becoming increasingly severe. Because of this, computer color matching (CCM) is gaining an increasingly important role both in the laboratory and in production, and a weighing-in machine, suitable for CCM has been strongly needed.

Described here is a weighing-in machine developed for the CCM user and CCM researcher. This machine features many suitable characteristics, such as high accuracy (error is within ±0.02 g), a reasonable period of weighing-in time, quick and easy operation for exchanging colorants, and successive batch weighing-in.

Introduction

Computer color matching (CCM) is a very useful and effective tool in the color industry. A detailed investigation of the process of visual color matching at Japanese factories indicates that there is no effective tool in color matching without CCM. Although CCM is widely utilized in the paint industries in the USA and Europe, it isn't used in Japan. Why?

There are several reasons, one of them being the problem of weighing-in. Weighing-in means filling a container with a colorant on a balance until the desired weight (target weight) is reached. In CCM, colorants must be weighed-in with required accuracy within specified tolerances. Visual color matchers have not been able to be used to produce accurate weighing-in. Moreover, an excessive amount of colorant is nearly impossible to remove from the container. Therefore, when a color matcher uses CCM, he must be especially alert during the weighing-in process.

Our company produces many kinds of finish paints for cars and coil coating. The color tolerances of these paints are very severe, and CCM demonstrates its high performance in these narrow tolerances. Therefore, we developed an automatic weighing-in machine which can be used with very narrow color tolerances. In addition, when using this automatic weighing-in machine many colorants can be easily changed.

Important Points of the Automatic Weighing-in Machine

The automatic weighing-in machine described was designed for laboratory or sample use, with batch sizes between 100 g and 800 g. In addition, several requirements were necessary: A wide range of weights of colorants and varnishes, such as from a few tenths of a milligram to several hundred grams, had to be weighed precisely in a short time; colorants on the machine had to be quickly changed to other colorants; and several batches had to be continuously weighed-in.

To satisfy the first two requirements, we used the valve shown in *Figure* 1. The slide member of *Figure* 1, as shown in *Figures* 2 and 3, is held down by a leaf-spring end attached to a pair of roller bearings. A pair of coil springs pull the slide member to the outlet port. Therefore, unless the valve operating rod is pushed down, the outlet port of the reservoir is completely closed. The valve is built on the lid of the reservoir and the lid can be removed from the reservoir in a few seconds, allowing the colorant to be poured into the reservoir. Later, the lid with the valve is replaced and quickly tightened.

To pour the colorant, the reservoir with the valve is laid on its side, then the operating rod is pushed down manually or by some other mechanical force. The slide member is moved to the left, as shown by the arrow marked A in *Figures* 1-3, in parallel with the surface of the valve seat. Thus, the colorant flows down from the outlet port. The degree to which the outlet port is opened is easily adjusted according to the force strength at C in *Figure* 1. The shape of the valve seat is shown in *Figure* 3.

This article was originally published in *Coatings Technology*, August 1984, p. 17-23 under the title, "An Auto-weighing Machine Linked by CCM," by the Japan Society of Coatings Technology.

*Technical Center, 4-1-15, Minamishinagawa Shinagawa-ku, Tokyo 140, Japan.

Proportionally, as the degree of opening decreases, the colorant flow diminishes progressively from a stronger to a weaker state, until the flow reaches the thread state. As soon as the valve is closed, the flow ceases. Thus, even one drop can be produced by the delicate and sophisticated movement of the slide member under control of the microcomputer. The weight of one drop is usually 0.02-0.03 g, and droplet formation indicates the weighing-in can be accomplished within an error of ±0.02 g. If the slide member is opened to the maximum, approximately 1 kg of colorant (weight depends on its viscosity and specific gravity) flows out per minute. Therefore, the first requirement is satisfied.

The built-in lid valve is inexpensive and an ordinary commercially available quart can be used for the reservoir, which allows many reservoirs with valves containing colorant to be stocked on shelves at reasonable cost. To change the colorant, one can easily exchange the reservoir on the weighing machine to the desired colorant off the shelf. Each reservoir is equipped with an agitating blade to prevent mixing of the colorant with the sediment. Thus, the second requirement is satisfied.

As for the third requirement, a designed weighing machine, as described later, is continuously able to weigh-in five batches.

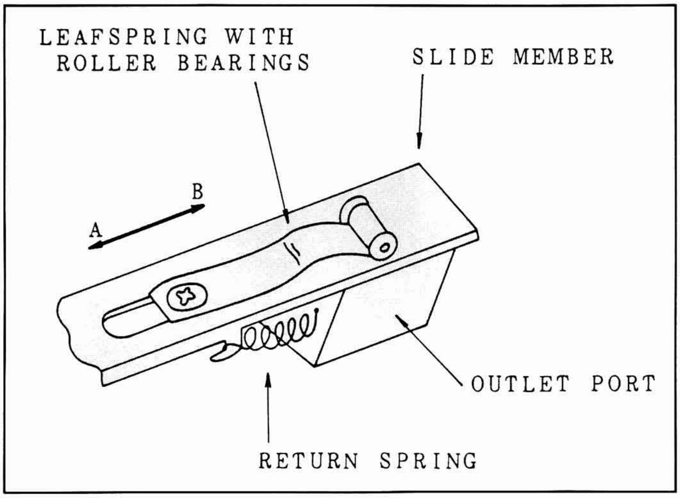


Figure 2—Valve

Method of Automatic Weighing

To easily explain the method of automatic weighing-in of predetermined quantities of colorant, *Figure* 4 shows the necessary minimum equipment. *Figure* 4 schematic shows a fixed reservoir of colorant being weighed inside a fixed container. Components of the automatic weighing equipment, as shown in *Figure* 4 include: a fixed reservoir with a control valve; a cam for moving the valve; a pulse motor for driving the cam; a container in which the colorant will be weighed; a balance (e.g., weighing range 4,000 g, readability 0.01 g), which is connected to a microcomputer; a microcomputer which reads the balance data and controls the driving operation of the pulse motor; and a terminal, for computer input and output.

In the following example, (Steps 1-5), the colorant weight for weighing-in is 100.00 g.

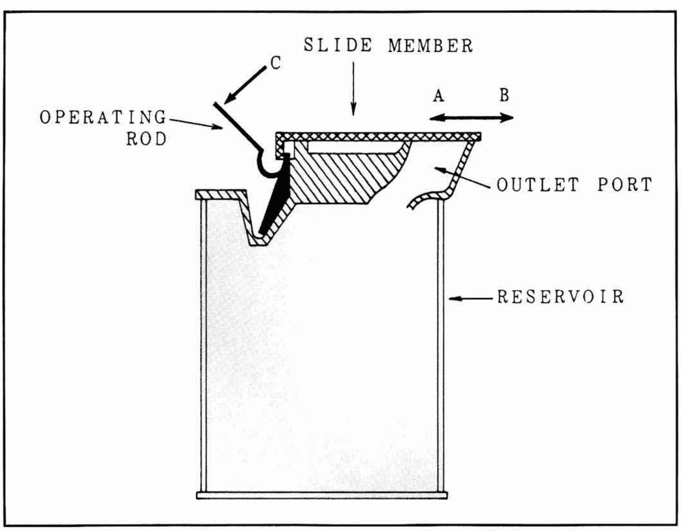


Figure 1—Built-in lid valve of reservoir

STEP 1: Initially, the figure of 100.00 g is put into the microcomputer through the terminal, the microcomputer instructs the balance to reset to zero after a container has been placed on the pan.

STEP 2: The pulse motor is set in motion by receiving the controller signal, thereby permitting the starting portion of the cam surface to engage with the operating rod. The slide member is then moved slightly upward by the motion of the operating rod, and a droplet of liquid colorant flows out of the port. At this instant, zero point adjustment has been completed.

STEP 3: The next step of the zero point adjustment is the first metering control stage in which the degree of the valve opening is reduced in steps. In *Figure* 4, the cam is rotated about the shaft in a clockwise direction by a signal from the controller, thereby pushing the rod upward until the slide member reaches the fully open position. Next, the cam is rotated gradually about the shaft in a counterclockwise direction in proportion to the signal from the controller so that the slide member moves downward in steps. Thus, the degree of port opening is reduced in steps. In this first metering con-

Table 1 — Relationship Between the Weight Collected and the Opening Degree of the Valve

Weight Collected (g)	Opening Degree of Valve
40.0 and over	fully open
20.0–39.9	1/2
10.0–19.9	1/4
5.0– 9.9	1/8
2.5– 4.9	1/16

Table 2 — Relationship Between the Weight Collected and the Number of Drops in a Specified Time (sec)

Weight Collected (g)	Number of Drops
0.20–0.40	3–4
0.10–0.19	2
0.01–0.09	1

trol state, interrelations between the weight of the collected point and the degree of the opening of the valve are shown in *Table* 1.

During the first metering control stage, all of the colorant flowing out of the port is collected in the container located below. When the balance indicates the weight of 97.5 g, the first metering control stage is succeeded by a second metering control stage in which the degree of valve opening is gradually adjusted.

STEP 4: In the second metering control stage, the microcomputer detects the indication of the balance and adjusts the position of the cam so as to move the slide member to the direction of either up or down, thereby permitting a weight increment per second of time. For example, 0.02-0.05 g of colorant flow out per 0.1 second. Thus, a weight from 0.4-2.5 g is metered. When the balance indicates the weight of 99.6 g, the second metering control stage is succeeded by a third metering control stage in which the port of the valve is intermittently closed so that the proper amount of the liquid colorant is discharged dropwise.

STEP 5: In this step, during the third metering control stage, the remaining 0.4 g or less is metered and collected. The cam can be gradually rotated about the shaft in a clockwise direction or in the counterclockwise direction via microcomputer signal, whereby the slide member reciprocates by moving up and down and intermittently closing the port. During the intermittent closing operation, colorant is discharged in drops. Relationships between the paint weight to be collected and the number of drops during a specified time period are

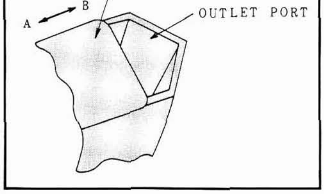


Figure 3—Shape of the outlet port

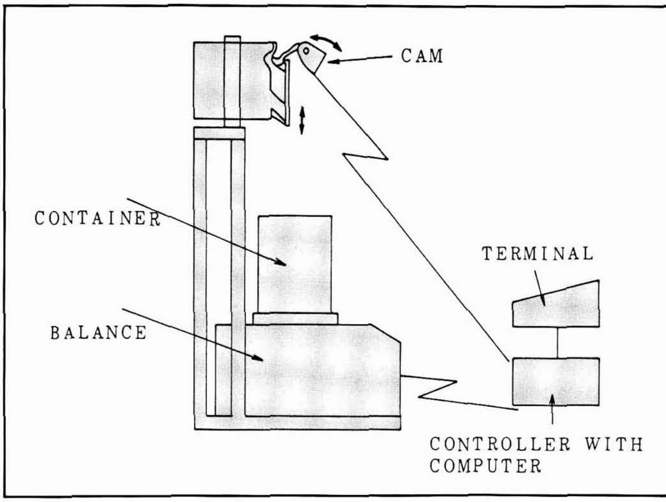


Figure 4—Basic configuration of automatic weighing-in machine

shown in *Table* 2. Accordingly, after the third metering control stage, the balance indicates the weight of 100.00 ± 0.02 g.

If the colorant weight to be collected is more than 2.5 g, the first, second, and third metering control stages proceed successively to meter the target weight. If the weight to be collected is between 0.4 and 2.5 g, only the second and third metering control stages operate. If the weight to be collected is less than 0.4 g, the third metering control stage operates. Therefore, each stage is selected by the microcomputer depending upon the target weight of the colorant collected.

Thus the weight of the colorant flowing into the container is monitored at all times by the microcomputer by means of the balance. The weight of one droplet (approx. 0.02-0.03 g, depending on the viscosity, surface tension, and specific gravity of the colorant) is also monitored and controlled. Accordingly, the most appropriate stages are selected to be utilized in achieving the automatic weighing-in of predetermined quantities of the colorant, so that a high-performance metering process is obtained with considerable accuracy (predetermined weight ±0.02 g). *Table* 3 shows the weighing-in accuracy.

To shorten the weighing-in time, it is possible to omit the third metering control and terminate the weighing-in process at the second metering control stage. In such case, the metering accuracy of ±0.1 g is obtained.

Continuously Working Automatic Weighing-in Machine

How a fixed, specified colorant is weighed-in to a fixed container on the pan of the balance was noted previously. To continuously weigh-in the specified amount of specified colorants in several formula into specified containers, however, the appropriate equipment must be designed. Such equipment can be easily devised, once the method of the automatic weighing-in is known. In using the equipment, it is necessary that the specified reservoirs with a control valve are set on the location shown in *Figure* 4 one by one in specified order under computer control. It is also required that the specified containers are set on the pan of the balance one by one in the specified order under computer control. Many laboratories and factories must handle many types of paint and each type has between 10 and 40 colorants. Therefore, the colorants should be easily and quickly interchangeable.

Although there were several types of equipment devised to satisfy the above

Table 3 — Specified Weight And the Result

Specified Weight (g)	Result (g)	Error (g)
500.00	499.98	−0.02
200.00	200.01	0.01
100.00	100.00	0.00
50.00	44.99	−0.01
25.00	24.98	−0.02
10.00	10.00	0.00
5.00	5.01	+0.01
2.00	2.00	0.00
1.00	0.99	−0.01
0.50	0.50	0.00
0.20	0.22	+0.02
0.10	0.11	+0.01

requirements, *Figure* 5 shows one of the recommended models. Our designed model has the same configuration as that shown. Of course, a computer for control and an input-output unit must be added to this configuration. There are many reservoirs with a control valve (10-20 reservoirs are desirable, but in *Figure* 5, there are 10 reservoirs) on the turning table. The reservoirs are easily connected into the receiving seats (*Figure* 5 shows 10 seats for 10 reservoirs) on the turn table by using a detachable fastener. Therefore, an operator can very easily exchange a reservoir within a few seconds.

We purposely designed a compact configuration and the equipment in *Figure* 5 has the dimensions of 66 cm in width and 118 cm in length (26 × 46.5″). In the above dimension, the content of the reservoir is about 1000 cc (1 quart) and the various containers, such as the 2000 cc (2 quarts), 1000 cc (1 quart) and 500 cc (1 pint) can, are set on the rail shown in *Figure* 5. If larger reservoirs are desired, the 4000 cc (gallon) can is available. We are now producing such a machine which has four receiving seats for 4000 cc reservoirs and six receiving seats for 1000 cc reservoirs.

The concrete weighing-in process is shown in the following example.

PROCESS 1: Required containers are placed on the rail, as shown in *Figure* 5.

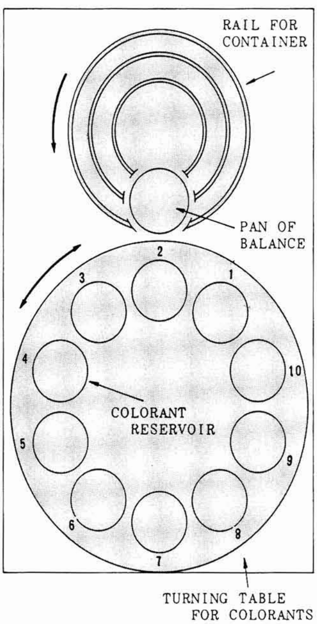


Figure 5—Outline of automatic weighing-in machine for successive five batches

```
NAME: A-2
    COLORANT NO    (INPUT)(g)   (RESULT)(g)
         1              1.00          0.99
         2             10.00          9.98
         3            100.00         99.99
         4            200.00        199.98
    ---------------------------------------
      TOTAL           311.00        310.94

                          (%)           (%)
         1              0.32          0.32
         2              3.22          3.21
         3             32.15         32.16
         4             64.31         64.31
    ---------------------   ---------------
      TOTAL           100.0         100.00
```

Figure 6—Output of first weighing-in

Our machine accommodates five containers at once. The containers are sent automatically to the pan of the balance by the bar unit controlled by the microcomputer at the required time and are moved to the right side of the pan on the rail at the required time. In this example, two containers are positioned. It is then necessary to check if the reservoirs with a control valve filled with the specified colorant are already set on the seat of the turn table. If not, the reservoirs with the required colorants should be set.

PROCESS 2: An operator gives an instruction to the microcomputer by typing the specified figure. In the following example, the sentences on the left side of the mark ">>" are the questions from the microcomputer, and the figures on the right side of the mark ">>" are the input answers submitted by the operator. The mark "↓" means typing of the carriage return and this mark informs the microcomputer of the termination of the input for the batch.

The number of batches? >>2
(Batch 1) Seat No., Colorant No. and weight (g) ? >>1, 1, 100.
(Batch 1) Seat No., Colorant No. and weight (g) ? >>2, 2, 200.
(Batch 1) Seat No., Colorant No. and weight (g) ? >>3, 3, 300.
(Batch 1) Seat No., Colorant No. and weight (g) ? >>4, 4, 400.
(Batch 2) Seat No., Colorant No. and weight (g) ? >> ↓
(Batch 2) Seat No., Colorant No. and weight (g) ? >>4, 4, 40.
(Batch 2) Seat No., Colorant No. and weight (g) ? >>5, 5, 50.
(Batch 2) Seat No., Colorant No. and weight (g) ? >> ↓

PROCESS 3: The first container for batch 1 is sent to the pan of the balance by the bar unit connected to the motor shaft under the control of the microcomputer.

PROCESS 4: The turn table turns to the right or left depending on the distance between the present location and the weighing position (the weighing position is the No. 2 location in *Figure* 5). To shorten the time, the table turns to the shorter side for the required colorant to achieve the weighing position. In this example, the first specified colorant is No. 1. The turn table turns to the left, and a sensor detects when colorant No. 1 is properly located at the weighing position, the table stops at the exact position where there is a tilting device and a fixing device. The reservoir storing colorant No. 1 is tilted and fixed by these devices just as in the position of the reservoir shown in *Figure* 4. The operating rod rotates the cam, which is connected to the computer-controlled pulse motor. Thus, the degree of opening of the outlet port is computer-controlled.

PROCESS 5: On computer instruction, the balance is reset to zero, then as previously mentioned, 100.00 ±0.02 g of No. 1 colorant is weighed-in.

PROCESS 6: After weighing-in, the No. 1 reservoir returns to the table.

PROCESS 7: No. 2, No. 3 and No. 4 colorants are weighed-in according to processes 4-6.

PROCESS 8: The first batch is thus completed, the second batch is next. The first batch container slides from the pan to the rail, successively the second batch container slides to the pan and processes 4-7 are repeated.

The weighing-in time is dependent on the precision needed, but approximately five minutes per batch is sufficient for CCM on the condition that each batch is composed of four colorants. The weighing-in time is not affected by batch size, so that five containers can be placed on the rail at a time. All the specified colorants for the five batches are put on the table and all specified colorant numbers and the figures

```
NAME: A-2
    COLORANT NO    (INPUT)(g)   (RESULT)(g)
         4              2.00          1.99
    ---------------------------------------
      TOTAL             2.00          1.99

                          (%)           (%)
         4            100.00        100.00
    ---------------------------------------
      TOTAL           100.00        100.00

      [SUM]
                                        (g)
       (1) 1                          0.99
       (1) 2                          9.98
       (1) 3                         99.99
       (2) 4                        201.97
    ---------------------------------------
    GRAND TOTAL                     312.93

                                        (%)
         1                            0.32
         2                            3.19
         3                           31.95
         4                           64.54
    ---------------------------------------
    GRAND TOTAL                     100.00
```

Figure 7—Output of second weighing-in (first correction). The figures in the parentheses equal the weighing-in number

of the specified weights are typed at the terminal. Then, after, about 25 min, all five containers on the rail are filled with specified weights of specified colorants.

Examples of a computer output are shown in *Figures* 6 and 7. Since all weighing-in results are stored in the computer memory, when the batches are weighed-in at the second or third time for correction of the color, the weighing-in results are summed and the summed results are typed out as noted in *Figure* 7.

The microcomputer used in this example is the SBC 11/21 (Digital Equipment Corp.) with 16K bytes of software written using assembler language. The microcomputer can communicate with a minicomputer which performs the CCM calculations.

Conclusion

As noted, development of the automatic weighing-in machine for laboratory use has worked as expected. We have also developed a machine equipped with two kinds of balances for both laboratory and production use with reservoirs of about 20 liters = (5.3 gal) and the valve apertures are about four times larger than for the 1000 cc reservoir. As one of the balances has a maximum range of 2,200 g with a readability of 0.01 g, the maximum range of the other balance is 24,000 g. The available batch sizes are 100 g to 23,000 g.

Using the above weighing-in machine with our developed CCM software, 20 batches on average with color tolerances within 0.3 CIELAB can be produced daily by two inexperienced color matchers. The more the computerized area in color matching is enlarged, the more evident the superior performance of CCM. In the very near future, the CCM system will be an indispensable tool in all paint factories in Japan.

JOURNAL OF COATINGS TECHNOLOGY

Annual Index

Volume 57
Numbers 720–731
January—December, 1985

Journal of Coatings Technology 1985 Annual Index

Keyword Subject Index

Prepared by Technical Information Systems Committee

Interfacial Phenomena

Manufacturing Operations and Plant

Mathematical Models

Pigments and Extenders

Polymers and Resins

Research and Development

Solvents and Plasticizers

Statistical Methods

Substrates or Surfaces to Be Coated

Alphabetical Listing of Papers

R

S

U

V

W

Author Index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

Constituent Society Papers

Society Meetings

BALTIMORE............. SEPT.

"MSDS"

Ken Zacharias, of the National Paint and Coatings Association, spoke on "MATERIAL SAFETY DATA SHEETS."

Mr. Zacharias introduced his presentation with a brief history of OSHA. He detailed their main purpose, scope, and methods of implementation. In addition to discussing the preparation of Material Safety Data Sheets (MSDS), Mr. Zacharias spoke on trade secrets, hazards determination, hazard communication programs, and labeling. He concluded with a description of the types and amounts of raw materials which must be reported in the MSDS.

ED COUNTRYMAN, *Secretary*

CLEVELAND............. SEPT.

"Manufacture of Colored Organic Pigments"

A moment of silence was observed in memory of George Grossman, who passed away in August.

A Past-President's pin was presented to Robert Thomas, with appreciation, by incoming President, Scott Rickert, of Case Western Reserve University. Mr. Rickert and his fellow officers for 1985-86 were introduced and installed by Society Representative, Fred Schwab, of Coatings Research Group, Inc. The other officer positions are held by the following individuals: President-Elect—Madelyn Harding, of Sherwin-Williams Co.; Secretary—Richard R. Eley, of Glidden Coatings & Resins Div.; and Treasurer—R. Edward Bish, of Jamestown Paint & Varnish Co.

"MANUFACTURE OF COLORED ORGANIC PIGMENTS," was the title of the technical presentation given by Peter Lewis, of Sun Chemical Corp.

Dr. Lewis began by describing the four forms in which pigments are commonly available. They are: "dry color," which has negligible water content and is difficult to disperse; "presscake," water-wetted and readily dispersible; "flush," pre-dispersed in oleoresinous vehicle; and as a dispersion in water. In purchasing pigments, Dr. Lewis advises that the pigment appropriate to the end use in terms of durability required and expected life of the product be selected.

Dr. Lewis discussed the manufacture of azo pigments. The pigments are highly explosive when isolated, but are safe under normal conditions of handling. One of the first azo pigments specifically aimed at coatings was toluidine red, or pigment red 3, he said. It contains no metal ions nor any ionizable groups, and has enhanced stability toward acid compared to other azos.

Dr. Lewis stated some of the drawbacks of organic pigments. They have a higher oil absorption and must be used in lower amounts or else viscosity becomes unmanageable. In the manufacture of organic pigments, there is a persistant problem of uniformity.

Lastly, Dr. Lewis discussed pigment performance. He stated that a pigment does not perform the same in all systems. Expect a pigment formula to transfer to a different generic system and display unchanged properties, he warned.

RICHARD R. ELEY, *Secretary*

LOS ANGELES........... SEPT.

"Aluminum Pigments: Past, Present, and Future"

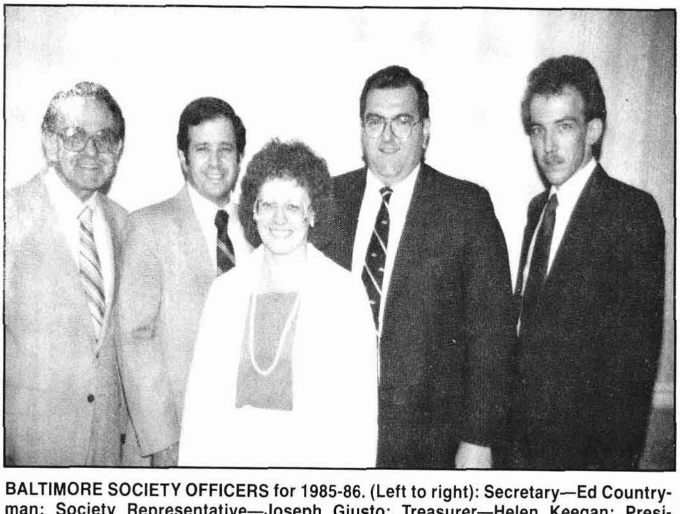
A moment of silence was observed in memory of Harold J. McKibben and William C. Metcalf, both of whom recently died.

Lloyd Haanstra, Society Past-President, installed the officers for 1985-86. The new slate includes: President—Mike Gildon, Guardsman Chemicals; Vice-President—Henry J. Kirsch, Trans Western Chemicals, Inc.; Treasurer—Ray DiMaio, Koppers Co., Inc.; Secretary—Melinda Rutledge, Allo Chemicals; and Society Representative—Jan Van Zelm, Byk Chemie.

Robert Backlin, of Nuodex, Inc., presented the Nuodex gavel to Mr. Gildon.

An Environmental Committee report was given by Lloyd Haanstra. Mr. Haanstra discussed the Public Hearing held on August 2, 1985, at the Southern California Air Quality Management Department office where the following decisions transpired: the 380 rule on non-flats will be extended for four more years; and a one-year extension was granted for maintenance coatings. Mr. Haanstra said that the 380 extension comes up for vote in San Diego next month. In the Bay Area, the rule expires in 1986. Mr. Haanstra then told of the next Architectural Coating Task Force meeting.

Don Curl, Past-President of the SCPCA, gave a report on EL RAP (Environmental Legislative and Regulatory Advocacy Pro-



BALTIMORE SOCIETY OFFICERS for 1985-86. (Left to right): Secretary—Ed Countryman; Society Representative—Joseph Giusto; Treasurer—Helen Keegan; President—Frank Gerhardt; and President-Elect—C. Ted Grumbine

LOUISVILLE SOCIETY OFFICERS for 1985-86. (Left to right): Alternate Society Representative—Phil Harbaugh; President-Elect—Howard Ramsay; Society Representative—Jim Hoeck; President—Joyce Specht-St. Clair; Treasurer—Ken Hyde; and Secretary—Larry Pitchford

gram). He stated that the Legislative Committee had met throughout the summer.

The California Prison System is considering making paint at some of the prisons, mentioned Mr. Curl. They would like to make highway and bridge paint, as well as other coating materials. The prison board will vote on this decision at a meeting on November 2, 1985, reported Mr. Curl. He also discussed Right-to-Know legislation.

Later in the meeting, Bert Osen, of John K. Bice Co., stated that there are about a dozen counties in California that are not affected by the extension given to South Coast. These counties must comply to the 250 VOC rule which takes effect, explained Mr. Osen. Paint companies in L.A. cannot sell paint legally unless they comply to the 250 rule. Mr. Haanstra responded by explaining that the Architectural Coatings Task Force has tried for state-wide uniformity. However, because each district is autonomous in rule-making, this is difficult. Mr. Haanstra also stated that many of the districts who have 250 on their books, are not enforcing it. Mr. Van Zelm added that in Kern County, the 250 rule is in effect yet many of the companies are not aware of the rule and are selling paint illegally. Mr. Haanstra explained that in Kern County, the rule is not being enforced because of the lack of paint companies and the small number of paint stores. In the South Coast, San Diego, Bay Area, and Ventura districts, the regulations are being enforced, Mr. Haanstra emphasized. The Air Resources Board periodically updates a list of current VOC rules for each district. This publication can be requested by anyone, added Mr. Haanstra.

Frank Peters, of Dunn-Edwards Corp., gave a report on the 1985-86 Paint Technology course which is being held at Cal-State L.A. He then awarded certificates to the graduates of last year's class. Of the 26 graduates, those receiving honors included top student—John Wahlquist, and "A" students—John Gilbert, Yong Han Kim, and Dan Noyes.

Russ Ferguson, of Silberline Mfg. Co., spoke on "Aluminum Pigments: Past, Present, and Future."

Melinda K. Rutledge, *Secretary*

NEW YORK.............SEPT.

"Microbial Spoilage of Latex Paint"

President Raymond Gangi, of International Paint Co., introduced the slate of officers: President-Elect—Kenneth J. DePaul, Whittaker, Clark & Daniels, Inc.; Secretary—John W. Burlage, Pacific Anchor Chemical; Treasurer—David Penichter, D.H. Litter Co., Inc.; and Society Representative—Saul Spindel, D/L Laboratories.

Michael Granito, of D.H. Litter Co., presented Mr. Gangi with the Nuodex gavel and Irwin Young presented him with "Robert's Rules of Order" from the Jesse S. Young Co. Outgoing President Mike Iskowitz was presented with a Past-President's pin by Mr. Gangi.

William Woods, of Nuodex, Inc., spoke on "Prevention of the Microbial Spoilage of Latex Paint."

Dr. Woods addressed the various ways in which organisms come into contact with the ingredients used in latex paint. He stressed that good housekeeping was a necessity. A sloppy transfer of emulsions, exposure of cellulosic thickness to the atmosphere, and inadequate cleaning of mixing vessels all contribute to the growth of bacteria, he concluded.

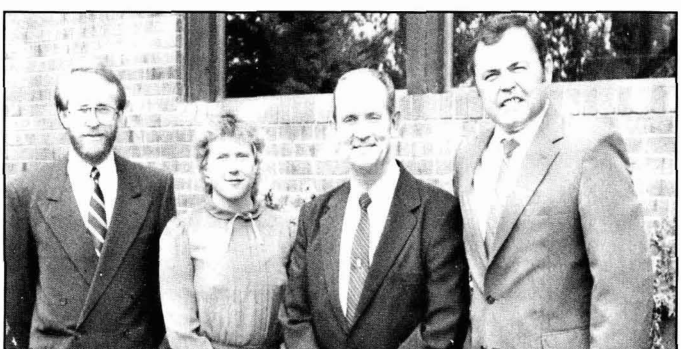
John W. Burlage, *Secretary*

NORTHWESTERN........SEPT.

"History of Drier Usage" and "Hazardous Waste Management"

Past-President Richard Johnson presented the Nuodex gavel to incoming President Al Yokubonis.

Technical Committee Chairman, Ed Ferlauto, reported that the project entitled, "To Determine Why Measured VOC Differs from Theoretical Values," was on schedule. The resin has been selected and the coatings made. He stated that Dr. Frank N. Jones, of North Dakota State, has of-



ROCKY MOUNTAIN SOCIETY OFFICERS for 1985-86. (Left to right): Treasurer—Jeffrey B. Johnson; Secretary—Marcy S. Baugh; President—Carwin C. Beardall; and Vice-President—Craig R. Hansen

fered his assistance. Mr. Ferlauto added that he would like to start a second project and needs volunteers.

Society Representative, Richard Fricker, announced the proposed changes to the by-laws to be presented at the Annual Meeting in St. Louis. They include: change of dues for Society Honorary members from $20 to $10; more clearly defined guidelines for technical groups to establish a Society; establishment of a Professional Development Committee to assist the Educational Committees and a Planning Committee to work on future plans for the Societies; and a tightening of requirements for Federation Honorary Membership. A motion was made, seconded, and passed that Mr. Fricker approve these changes.

Educational Committee Chairperson, Susan Walgrave, reported that she will be contacting schools and universities to generate interest in the field of coatings. She is looking for volunteers.

The first speaker of the evening was Sam Bellettiere, of Nuodex, Inc. He spoke on the "HISTORY OF DRIER USAGE."

Mr. Bellettiere's presentation covered the history of drier usage in coatings, metal types, and acids. He also discussed the theory of oxidation. New technology in water-borne, complexed metals, and lead replacement was also covered.

Andy Datko, of Minnesota Waste Management Board, delivered the second presentation, entitled "HAZARDOUS WASTE MANAGEMENT."

Mr. Datko began by providing a background of the Minnesota Waste Management Board. The Board was established in 1980 to provide incentives, set policy in Minnesota, and provide solutions for the problem of solid and hazardous waste management. It is not a regulatory agency, he emphasized. Mr. Datko then described the four-tier hazardous waste management system drafted by the Board. It includes a 30% reduction of hazardous waste generated; recycling; treatment; and disposal or long term storage. According to Mr. Datko, the coatings market has not been strong enough to attract private investors so the Board initiated programs to encourage companies to develop facilities.

JOAN B. LAMBERG, *Secretary*

PHILADELPHIA .... SEPT.

"Synthetic Amorphous Silicas in Coatings"

Honorary Director, J. Richard Kiefer, Jr., installed the new officers for the 1985-86 year. The slate includes: President—Philip Reitano, Inolex Chemical Co.; President-Elect—Donald F. Denny, E.W. Kauffman Co.; Secretary—Thomas L. Peta, C.J. Osborn Chemicals, Inc.; Treasurer—Larry Kelly, Peltz/Rowley Chemical Co.; and Society Representative—Carl Fuller, Reichard-Coulston Inc.

Frank Gaffney presented the Nuodex gavel to Philip Reitano. Mr. Reitano presented William Georgov with a Past-President's pin and thanked him for a job well done.

"SYNTHETIC AMORPHOUS SILICAS IN COATINGS" was the title of a slide presentation and discussion given by Robert Thomas, of PPG Industries, Inc.

Mr. Thomas began be examining three types of synthetic silicas. They include: pyrogenic, formed by oxidation in flame or electric arc of gaseous silica; silica gels, formed in an aqueous system and dried by the removal or displacement of water followed by evaporation of solvent; and precipitated silicas, made from a soluble silicate and acid. The agglomerate strength of synthetic silicas increases from pyrogenic to precipitated to gels.

The particle size of silicas was then addressed by Mr. Thomas. The pyrogenic type has a small particle size, the gels have a range of sizes, and the precipitated have the largest particle size. The ultimate particle size in silicas is usually very small, said Mr. Thomas. These ultimate particles agglomerate in grape-like clusters and therefore have a larger dimension, he explained.

Next, Mr. Thomas elaborated on the subject of flatting. "The degree of flatting efficiency will depend on how many agglomerates are of the proper size for interrupting the incident angle of elimination," stated Mr. Thomas. A single silica may work very well at 60° gloss reduction, but may not at 85° gloss reduction. Silica flatting agents are very active hydrogen-bonding molecules; therefore, silica agglomerates will settle to the bottom of the container and form a hard cake, said Mr. Thomas. The strength of this cake derives from the many hydrogen bonds that effectively crosslink the particles together, he added.

In conclusion, Mr. Thomas discussed thickening and thixotropy effectiveness.

THOMAS L. PETA, *Secretary*

PITTSBURGH............SEPT.

"Hyperdispersants"

The Nuodex gavel was presented to Society President Joseph L. Mascia by Allan Zoller. Outgoing President Clifford Schoff was presented with a Past-President's pin in recognition of his fine leadership and service to the Society.

A discussion on "HYPERDISPERSANTS—A NEW TECHNOLOGY FOR THE COATINGS INDUSTRY," was delivered by James Hampton, of ICI Americas Corp.

Mr. Hampton began his presentation by describing three main factors essential to good dispersion: wetting of the pigment, agglomerate size reduction, and stabilization of the reduced agglomerates. He then mentioned that hyperdispersants were developed as agents to effectively enhance those dispersion characteristics.

In order to realize the full potential and effectiveness of the pigment, the agglomerates must be kept apart in the dispersion process. There are two mechanisms which can be used to accomplish this, said Mr. Hampton. They are charge stabilization and steric stabilization. Hyperdispersants work under the steric stabilization method, he added. By anchoring the hyperdispersants to the agglomerates, a chain is formed through which a steric barrier encircles the pigment particles and prevents re-agglomeration of the already broken particles, explained Mr. Hampton.

Three mechanisms by which the hyperdispersants are anchored to the pigment particles were then enumerated by Mr. Hampton. Comprising this list are: single mechanism, for inorganic materials; multiple anchoring, effective when there are relatively weak polar groups on the surface of the particle; and the use of a pigment synergist, for non-polar surfaces.

Mr. Hampton also discussed functional advantages of the hyperdispersants. He mentioned increased solids loading of a dispersion, stability in a resin-free media, multipurpose compatibility, and improved physical properties.

The presentation concluded with a discussion of new areas where continued development is occurring.

Q. Can more than one hyperdispersant system be used in a dispersion at the same time and, if so, should they and can they be dispersed together?

A. Yes, more than one system can be used. ICI has seen no difference in dispersing more than one system at a time, but a manufacturer should proceed based on whatever is best for their particular pigment processing procedure.

MARK D. TROUTMAN, *Secretary*

Future Society Meetings

Chicago

(Jan. 6)—"SOLVENT SELECTION: COPING WITH TOXICITY DEVELOPMENTS"—Richard C. Wise, Union Carbide Corp.

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

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

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

(May 9)—AWARDS NIGHT BANQUET.

Cleveland

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

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

(Mar. 18)—"COMPUTER CONTROL FOR THE MODERN PAINT PLANT"—James De Groff, Applied Color Systems, Inc.

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

(May 20)—"AFTERMARKET AUTOMOTIVE COATINGS: HISTORY AND TECHNOLOGY"—Milton I. Hardt, Sherwin-Williams Co.

Detroit

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

(May 14)—JOINT MEETING WITH DPCA.

Kansas City

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

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

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

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

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

Louisville

(Jan. 15)—PAST PRESIDENTS' NIGHT.

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

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

Constituent Society Meetings and Secretaries

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

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

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

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

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

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

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

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

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

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

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

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

MEXICO (Fourth Thursday—meeting sites vary).

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

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

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

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

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

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

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

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

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

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

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

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

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

New England

(Jan. 16)—JOINT MEETING WITH NEPCA.

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

(Mar. 20)—FEDERATION NIGHT.

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

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

New York

(Jan. 14)—"INERTING FOR SAFETY IN COATINGS PLANT"—Terry A. Holpern, Neutronics, Inc.

(Feb. 6)—"JOINT NYSCT/NYPCA LEGISLATIVE UPDATE"—Charles D. Reeder, Du Pont Co.

(Mar. 11)—"FIVE KEYS TO LOSS PREVENTION IN THE PAINT AND COATINGS OPERATION"—Jeffrey Flemington, Hercules Inc.

(Apr. 8)—"FUTURE NEW COATINGS"—William E. Wellman, Exxon Chemical.

(May 9)—"COMPOSITE VS SINGLE DISTERANTS"—Michael C. Frantz, Daniel Products Co.

Pacific Northwest

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

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

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

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

Piedmont

(Jan. 15)—"COMPUTER MODELING FOR SOLVENT SELECTION IN AIR DRY COATINGS"—Phil Kalina, Dow Chemical Co.

(Mar. 19)—"SOLVENTS POINT THE WAY TO HIGH QUALITY COMPLYING ACRYLIC COATINGS"—Jay Reynolds, Exxon Corp.

(Apr. 16)—"SURFACE MODIFIERS IN COATINGS"—Speaker from Cavedon Chemical Co.

(May 21)—"ADVANCES IN WATERBORNE EPOXY TECHNOLOGY FOR COATINGS"—Clifford Dukes, Celanese Specialty Resins.

St. Louis

(Jan. 21)—JOINT MEETING WITH SLPCA.

(Feb. 18)—SPOUSES' NIGHT.

(Mar. 18)—TECHNICAL SPEAKER FROM APPLIED COLOR SYSTEMS.

(Apr. 15)—EDUCATION NIGHT.

(May 20)—MANUFACTURING SEMINAR.

People

John Bowman, President of Bowman Design Center, has joined the C.M. Ambrose Co., Redmond, WA, as a principal. **C.M. Ambrose, Jr.** remains President and CEO of the firm and Mr. Bowman becomes Vice-President and General Manager.

Stephen M. Delich, Jr. has joined Silberline Manufacturing Co., Lansford, PA, as a Technical Research and Product Applications Representative. A member of the Philadelphia Society, Mr. Delich will be stationed in the firm's new R&D center located in Hometown, PA.

Fayez Hanna, a member of the technical staff at Thibaut & Walker, Newark, NJ, since 1979, has been promoted to Quality Control Manager.

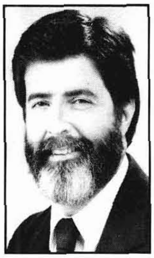
In addition, the firm has announced the appointments of **Ram Hulyalkar** to the position of Technical Director—latex and **Rick Busch** to Technical Director—alkyd resins. Mr. Hulyalkar is a member of the Western New York Society.

Assuming the position of Senior Vice-President of Operations at Pennsylvania Glass Sand Corp., Berkeley Springs, WV, is **Steven S. Stillar.** Prior to joining PGS, Mr. Stillar served as Mineral Concentration Manager for Anaconda Minerals Co.

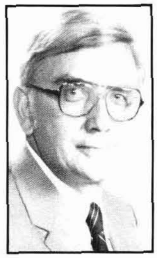
Midland Division of the Dexter Corp., Waukegan, IL, announced the following promotions: **William A. Bartz**—Quality Programs and Administrative Services Manager; **Steven Morris**—Regulatory and Legal Affairs Manager; **Louis Sharp**—Polymer and Analytical Chemistry Manager; **Kenneth W. Shorkey**—Market Development Manager, Coil Coatings; and **Joseph Stupar**—Development Chemist in Polymer Chemistry.

Norman F. Lippucci, Vice-President and General Manager of the Industrial Products division at Midland, has been appointed President and Chief Operating Officer of Evodex, a new joint venture company formed by Midland and Postans P.L.C., a division of Evode Group in the U.K.

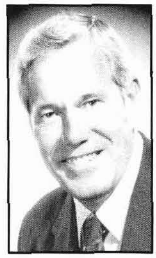
Morehouse Industries, Inc., Fullerton, CA, has named **Hedayat Abedi** to the position of Engineering Manager. Dr. Abedi brings extensive engineering, consulting, and management experience in the chemical processing industries to his new post.



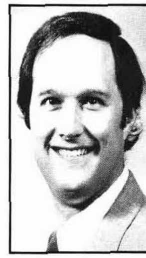
J. Bowman



S.M. Delich, Jr.



H.A. Bennett



R.W. Simmons

Harold A. Bennett has accepted the position of Vice-President and General Manager with Automotive Finishes, Inc., Dearborn, MI. A member of the Detroit Society, Mr. Bennett previously served as General Manager of Atech Chemical Coatings, Toledo, OH.

The A-C® Polyethylene business of Allied Corp., Morristown, NJ, has promoted **Garry M. Nichols** to Marketing Manager of the inks, coatings, and floor finishes industries. Mr. Nichols has served with Allied for 20 years and most recently held the post of Manager of International Marketing and Sales for the Industrial Chemicals division. Advancing to the position of Account Executive at Allied is **Stanley Dudek, Jr.** Covering the northeast territory, Mr. Dudek will specialize in sales to the inks, coatings, and polish industries.

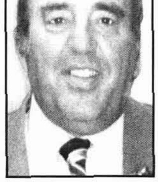
Dow Chemical Co., Midland, MI, has named **Robert W. Simmons** to Industry Marketing Manager for the firm's coatings, inks, and adhesives products in the Specialty Solvents group. Previously a research and development Project Leader, Mr. Simmons now directs the marketing activities.

Spencer Kellogg Products/NL Chemicals, Buffalo, NY, has appointed **Robert Neu** to the position of Accounts Representative in the Cincinnati, Ohio, sales area. He will be responsible for sales of the company's full range of resins, pigments, and rheological additives.

Joining the sales force of Croda Inks Corp., Niles, IL, as a Sales/Technical Representative is **Terry C. Bryant.** He brings over 20 years of marketing experience to the position.

Obituary

George Grossman, founder and President of the Q-Panel Co., Cleveland, OH, died on August 28 at the age of 61.



Mr. Grossman started Q-Panel in 1956, after hearing some paint chemists complain about the impossibility of getting standard steel for their paint tests. In 1965, he commercialized the Cleveland Condensation Tester and in 1970, he developed the Q-U-V Weathering Tester.

A member of the Cleveland Society, Mr. Grossman's research into steel surfaces won him the 1959 Roon Award from the Federation of Societies for Paint Technology. Mr. Grossman was also active in ASTM, chairing two subcommittees: D.01.27 on Water Resistance Tests for Paint, and G.03.03 on Accelerated Weathering Tests.

Frank G. Lombardi, Technical Manager of Coatings and Adhesives for AZS Corp., Atlanta, GA, died on August 26. He was 48 years old.

Unsaturated Polyesters

Recently released literature details a series of highly pigmented dispersions in an unsaturated polyester vehicle system. The products are available in a variety of colors and can be color-blended and formulated to customized specifications. For more information, contact CDI Dispersions, 27 Haynes Ave., Newark, NJ 07114.

Extender

A two-color brochure which describes fillers and extenders for paints, coatings, glass, rubber, and plastics, is now available. Physical properties, chemical analyses, and information on the manufacturer's quality control process are included. For copies, contact The Milwhite Company, P.O. Box 15038, Houston, TX 77020.

Acrylic Emulsion

A new modified-acrylic emulsion designed for formulation into top-quality exterior paints is the subject of a recently published product bulletin. Properties of the emulsion include wet adhesion to glossy alkyds, wet and dry adhesion to chalky substrates, and early development of water resistance. For more details, contact Union Carbide Corp., UCAR Emulsion Systems, Dept. K3442, 39 Old Ridgebury Rd., Danbury, CT 06817.

Stabilizer

A cost effective accelerator and stabilizer, designed to achieve rapid rates of dry in difficult applications, is described in literature. The new product acts synergistically with metallic driers, especially cobalt and manganese, in both solvent and water reducible coatings. For more details, contact Mooney Chemicals, Inc., 2301 Scranton Rd., Cleveland, OH 44113.

Spectrophotometer

A new model fluorescence spectrophotometer is described in a two-page, color data bulletin. Instrument sensitivity and ease of operation are featured as two important benefits. For a free copy of the bulletin, request Order Number B-469, the Perkin-Elmer Corporation, 761 Main Ave., Norwalk, CT 06859.

Filter Cartridge

Filter cartridges which offer a broad range of chemical compatibility are introduced in literature. Available in a variety of configurations, the cartridges are suited for use in chemical, plating, printed circuits, paint and ink, and photographic industries. Additional details may be obtained from Thomas A. Herrmann, AMF Cuno, 400 Research Parkway, Meriden, CT 06450.

Acrylic Polymer

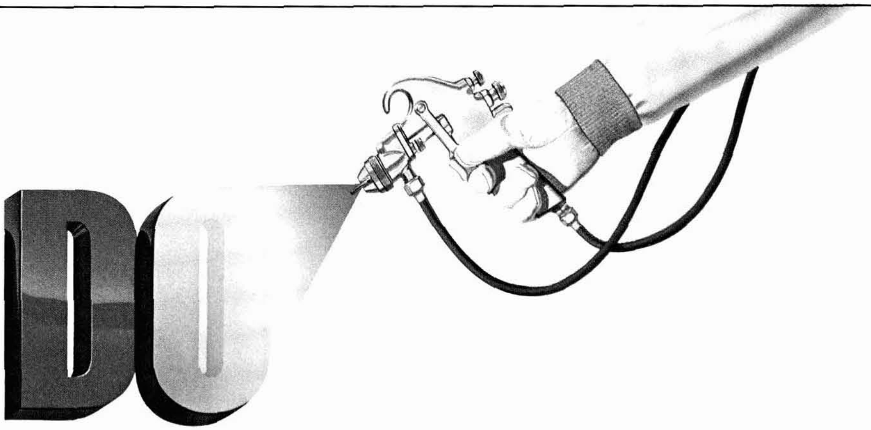
A water-borne acrylic polymer for lacquers is the subject of a leaflet. The 42% solids thermoplastic acrylic polymer is designed to be formulated into clear and pigmented water-borne lacquers for state-of-the-art block resistance and hot print resistance. For literature and samples, contact Rohm and Haas Co., Marketing Services Dept., Independence Mall West, Philadelphia, PA 19105.

P-Series Ethers

A two-page information bulletin outlines the substitutability of propylene-based glycol ethers and acetates for ethylene based products. Also covered are chemical and physical property comparisons including solvent parameters, dilution ratios, and viscosities. Copies of the bulletin are available from the Marketing Communications Dept., Arco Chemical Co., 1500 Market St., Philadelphia, PA 19101.

Computer Color Matching

A low cost second generation computer color matching system is the subject of a new product bulletin. For specifications, prices, and additional information, contact Colorgen, Inc., One Oak Park Dr., Bedford, MA 01730.



Microbiocide

Liquid microbiocide for use in formulating wood-protective coatings is featured in a full-color brochure. Results of independently conducted tests are included in the publication. For copies, contact Buckman Laboratories, 1256 N. McLean Blvd., Memphis, TN 38108.

Powder Coating Guide

The Society of Manufacturing Engineers (SME) has published a *User's Guide to Powder Coating*, an up-to-date evaluation of the powder coating process for manufacturing engineers. The 168-page book contains over 50 charts, tables, and diagrams. Chapters cover economic considerations, applications, materials, advantages, surface preparation, quality assurance and control, maintenance, and troubleshooting. Priced at $18 for members and $22.50 for nonmembers, the Guide may be ordered from SME's Publication Sales Dept., One SME Drive, P.O. Box 930, Dearborn, MI 48121.

ASTM Publications Catalog

The *1986 ASTM Publications Catalog* describes 66 volumes of the *Annual Book of ASTM Standards* as well as a variety of ASTM technical publications, compilations, data series, and standard adjuncts. Copies of the free catalog can be obtained from Jacqueline Nolden, ASTM, Marketing & Promotions Services, 1916 Race St., Philadelphia, PA 19103.

Intumescent Coating

Literature has been published on a new type of fire retardant coating. This intumescent coating offers one-coat application with no reinforcement and is designed to protect steel storage tanks, structural columns, and bulk heads from heat of fires in the range of 2000°F. Further details can be obtained from Fiber Materials, Inc., Biddeford Industrial Park, Biddeford, MA 04005.

Color System

A new series of color systems for color matching of paint by retail dealers is detailed in a product bulletin. The system features color sensors mated with an IBM PC and software designed by Applied Color Systems. For performance specifications, write to Hunter Associates Laboratory, Inc., 11495 Sunset Hills Rd., Reston, VA 22090.

On-Line Instruments

A product bulletin describing a range of on-line monitoring instruments has been published. There are systems for collecting color data, measuring reflected light, and analyzing powder, ground materials, liquids, slurries, web, and sheet material. For complete details, write to Pacific Scientific, Gardner/Neotec Div., 2431 Linden Lane, Silver Spring, MD 20910.

Color Formulation System

The features of a computerized color formulation and batch system are discussed in a new brochure. The recently developed system reportedly performs a wide variety of functions including: color matching under all light conditions; quality control measurements; and inventory control. Contact Macbeth, Div. of Kollmorgen Corp., P.O. Box 230, Newburgh, NY 12550-0382, for complete details.

Additives

Additives reported to improve flow and leveling of powder coatings, inks, sealants, and other products are detailed in literature. Information on the free-flowing powders are offered from Robert F. Baker, King Industries, Inc., Science Rd., Norwalk, CT 06852.

Radiation Curable Study

Literature is offered on the results of a radiation curing study. Entitled "Radiation Curing II" the multi-client techno-economic study examines coatings, inks, and adhesives cured by various types of radiation: ultraviolet, electron beam, and visible light. For a free brochure and table of contents, write to Skeist Laboratories, Inc., 112 Naylon Ave., Livingston, NJ 07039.

Emulsion Technology

Recently published is the *Encyclopedia of•Emulsion Technology*, edited by Paul Becker. The three volume set is directed to researchers in the coatings, petroleum, cosmetics, pharmaceuticals, and food industries as well as students in graduate-level colloid science courses. Contact Marcel Dekker, Inc., 270 Madison Ave., New York, NY 10016, for order inquiries.

Viscosity Cups

Brochures describing the features of a complete line of viscosity cups have been released. A two-color pamphlet covers the improved design of Zahn Signature Series cups and a 14-page booklet highlights Standard Ford cups. Copies of each are available from Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061-0688.

Solvents

A six-page booklet describes a wide range of solvents—alcohols, glycol ethers, esters and ketones—used in the formulation of water-borne coatings. The booklet discusses the use of organic cosolvents as additives to improve the performance of water-borne coatings. Copies of (F-45623B) "UCAR Solvents for Water-Borne Coatings," are available from Union Carbide Corp., Solvents and Coatings Materials Div., Dept. K3442, 39 Old Ridgebury Rd., Danbury, CT 06817.

Method for Predicting Dissolving Power of Solvents Challenged; Authors Respond with a Defense Of Their Polymer Treatment

TO THE EDITOR:

A new method for predicting the dissolving power of solvents has been proposed in "Dissolving Power of Solvents and Solvent Blends for Polymers," JOURNAL OF COATINGS TECHNOLOGY, Vol. 57, No. 724, p. 57, which claims to be superior to "the three dimensional solubility parameter" method of Hansen and to be more profoundly based on theoretical grounds. I should like to make a few comments on these two claims:

The theoretical basis of the new method as presented in the JCT seems obscure on several points.

First, the criteria stated for phase separation, that the change in solute chemical potential must be greater than zero when brought into solution, is thermodynamically wrong. The correct criteria is that the chemical potential passes through a maximum. This *criteria* in the Flory-Hildebrand theory leads to the following stability requirement:

$$\frac{\overline{V}_1 \times (\delta_1 - \delta_2)^2}{RT} \leqq 0.5 \times \left(1 + \sqrt{\frac{\overline{V}_1}{\overline{V}_2}}\right)^2$$

This basic equation is the starting point of the Hansen method, but apparently not in the new method.

Secondly, the new method claims to account for the entropic effects encountered in polymer solutions through a separate term. The origin of this term, however, is not revealed, and it is not in accord with the fundamental theories of polymer solutions.

Thirdly, the new method introduces a term accounting for "the necessity of fluidizing the polymer, before bringing it into the solution." The physical significance of this term is by no means indicated. In modern theories on polymer solutions it is common to include a so-called "free volume" term into the expressions for the thermodynamic quantities, but this term is derived from fundamental physical properties of the substances (thermal expansivities and pressure coefficients).

The criteria for cosolvency of the new method is thermodynamically wrong, as was the criteria for mono-solvency. The effect of cosolvency (where two non-solvents in appropriate mixtures dissolve a polymer) is caused by the mutual dislike of the two solvents. This effect is qualitatively correctly represented in the Hansen approach.

The new method claims to give superior predictions as compared to the Hansen method, with the SAME NUMBER OF PARAMETERS.

This statement may be challenged. The hydrogen-bonding parameter is *not* a pure component characteristic in the new model, as it is in the Hansen model, but depends on the hydrogen-bonding *solvent*. Extensions of the method to other hydrogen-bonding solvents than those considered in the article (chloroform, water, and alcohols) therefore require new and more parameters. Extentions of the method to polymers capable of forming hydrogen bonds with themselves further demand more parameters. In addition, the parameters of the Hansen method are related to fundamental properties of the pure components: the dipole-moment, the number of hydrogen-bonding sites, and the energy of vaporization. In the new method the parameters are all fitting parameters; they are necessarily much more mutually correlated. This will seriously reduce the generalization of the method to other systems than those treated in the article.

In conclusion, it appears that the new method is an empiricism, neither founded on the basic theories of polymer solutions, nor the laws of solution thermodynamics. The method must be considered as a purely empirical exercise in data fitting.

JOHN HOLTEN-ANDERSEN
SPPIRI, Denmark

* * *

TO THE EDITOR:

In the equation cited by Mr. Holten-Andersen, $\bar{V}_1$ is the molar volume of the whole polymeric molecule and $\bar{V}_2$ the molar volume of the solvent. As $\bar{V}_1$ is much larger than $\bar{V}_2$, this equation may be written to a good approximation as

$$(\delta_1 - \delta_2)^2 \leq \frac{0.5\,RT}{\bar{V}_2}\left(1 + 2\sqrt{\frac{\bar{V}_2}{\bar{V}_1}}\right)$$

(where $2\sqrt{\bar{V}_2/\bar{V}_1}$ is much smaller than one). A first remark is that the method of Hansen does not take into account the molar volume of the solvent appearing in the denominator. (This would make the radius of the "solubility sphere" not constant but depending on the molar volume of the solvent).

Our method does not derive from this equation, which is based in fact on three assumptions:

(1) When phase separation exists, solvent molecules can come in both phases into contact with *each* polymer segment, the relative occurrence of such contacts being governed by a random mixing relation. The equation therefore does not apply in general to partially crystalline polymers.

(2) At the exception of the combinatorial entropy, calculated from the Flory-Huggins expression, all the deviations from ideality are energetic in nature.

(3) The cohesion energy per unit volume C_{ms} for segment-solvent contacts is the geometric mean of those C_{mm} and C_{ss} for segment-segment and solvent-solvent contacts.

As explained in our article, the last assumption cannot be made in the case of hydrogen bonds. Furthermore, when H-bonds are present, entropy factors different than deriving from the combinatorial entropy must be taken into account. This is done in our method in the terms containing the stability constant K and K_{pp}, terms that involve also entropic contributions. The effect of solvent-solvent hydrogen bonds on the solubility is even in general chiefly entropic in nature. The theoretical derivation of the equations leading to our β-term will soon appear in the *Journal of Molecular Liquids*.

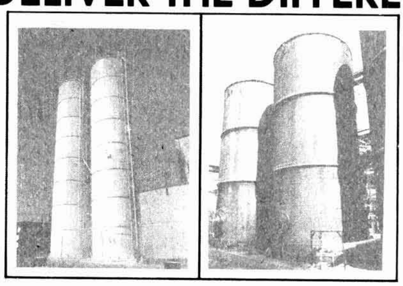
We first tried to modify the Flory-Hildebrand equation to account for these additional entropy effects. But it turned out that, even in the absence of H-bonds, the experimental cloud-points were better predictable if the Flory criterion were abandoned and if, for phase separation, the amorphous polymers below their glass transition temperature were treated in the same way as crystalline polymers.

For the latter, the thermodynamic treatment necessitates the introduction of a solvent-independent term that accounts for the melting of the crystalline parts, just as it is the case when dissolving low molecular crystals. Thus, we came to the conclusion that it was useful for the predictions to preserve a similar "fluidization" term (although smaller in absolute value) for polymers where no crystallization is detected at all. This solvent-independent term seemed to depend, among others, on the molecular weight of the polymer, tending to a maximal limiting value upon increasing M_w.

What may be the origin of this term in amorphous polymers? A possible explanation is the following: Dispersion forces between two segments originate from electric temporary dipoles, related to the motion of the electrons, that oscillate in phase in both segments, leading to a permanent attraction. If we now consider two sequences lying along each other and containing similar segments, the cohesion energy between the two sequences will be larger than that corresponding to the sum of the individual contacts. In effect, because of the spatial regularity, the various oscillating dipoles along a sequence can become in phase, extending the attractive effect further than the nearest segment. This coordination effect can lead to the formation of domains of "coordinated" segments where the local order is higher, where the cohesion forces exhibit a collegial character and where, as a consequence, the density is higher and the individual mobility of the segments strongly reduced.

Such coordination does not necessarily imply crystallization because the latter supposes the phenomenon to occur in three dimensions leading to the formation of a geometric lattice.

Solvent molecules can only penetrate in a coordinated domain if the chemical potential of the segments brought into solution is lower than in the coordinated do-



DOWANOL

P-SERIES GLYCOL ETHERS

DOWANOL* PM and PMA glycol ether and acetate. The solvents that provide the fastest evaporation rates and reduced drying times for maintenance coatings.

DOW*

main. It may happen that this is already the case for some domains and not for others. In such cases the polymer brought into contact with the solvent will only "swell." The *A* factor of our equation can be explained in this way as the price to be paid to de-coordinate all possible domains.

In contrast to the theory of Flory which refers to the formation of two liquid phases with random mixing, where the thermodynamic criterion of phase separation at a critical concentration is indeed the presence of a maximum in the chemical potential as a function of ϕ_P, our treatment considers phase separation for polymers as resulting from the formation of coordinated domains where the chemical potential of the segments is lower than in the remaining. In such case the thermodynamic criterion of phase separation becomes that given in our article.

Our treatment remains valid for the polymers that are partially crystalline, the *A*-constant being only larger. At higher temperatures where the *A*-constant becomes very small or vanishes, our treatment no longer holds.

It is our intention to publish the details of the thermodynamic derivation of our equations in a near future, but these details fall out of the scope of the JOURNAL OF COATINGS TECHNOLOGY.

The validity of the somewhat "alchemical" sentence of Mr. Holten-Andersen "The effect of cosolvency is caused by the mutual dislike of the two solvents," the correctness of the Hansen approach and the wrongness of our own thermodynamic criteria can at best be evaluated considering the data of *Table* 6 of our article.

In using our method for polymers with O-H groups (which were not yet considered in the article) it is clear that the determination of the K constants for categories of solvents other than the alcohols and water becomes necessary. However, as to a first approximation the same constant can be used for all the solvents belonging to the same category, the number of determinations remains limited. The effect of segment-segment H-bonds is then included in the determination of the sum $(A + C)$ which, together with δ'_P, can in principle be obtained from two cloud-points, preferably in solvents which do not form H-bonds with the polymer. Each constant K can be obtained in principle from one additional cloud-point determination.

At last, those who are not convinced by the precedent arguments can make these determinations, considering them only as "a purely empirical exercise of data fitting." Subsidiarily this exercise can perhaps give some information about the dissolving power of other solvents for this polymer.

P. HUYSKENS,
M.C. HAULAIT-PIRSON,
and X. VAN DER BORGHT

Meetings/Education

'Colors of History' Is Subject of ISCC Conference In Williamsburg, VA in February

The Inter-Society Color Council will hold its 1986 Annual Conference at The Lodge, in Colonial Williamsburg, VA, February 9-12. The topic of the conference is "Colors of History: Identification, Re-Creation, Preservation."

The theme reflects the ever-growing interest in the restoration of the interiors and exteriors of historic houses and in the reproduction of the textiles and wallpapers contemporary with them. The conference will review the latest knowledge and techniques of experts and answer questions concerning the identification and reproduction of the colors of paints, pigments, and dyes used in times past.

Technical presentations will address the following topics: interior and exterior architecture; wallpaper and textile sampling and reproduction; all types of transportation; identification of ancient and modern colorants; metamerism, fading, and enhancement.

Among the invited speakers and topics are:

"18th Century Coatings"—Nathan Stolow, Colonial Williamsburg.

"House Paints"—Morgan Phillips, New England Antiquities.

"Wallpapers"—Andrea Gilmore, Charlestown Navy Yard.

"Textiles"—Margaret Fikirois, Winterthur.

"Ancient Dyes"—Max Saltzman, Consultant.

"Pigment Identification"—Elizabeth FitzHugh, Freer Gallery.

"Historic Colorants"—Robert L. Feller, Mellon Institute.

"Illumination"—W.A. Thornton, Prime-Color.

"Image Enhancement"—John Asmus, USC.

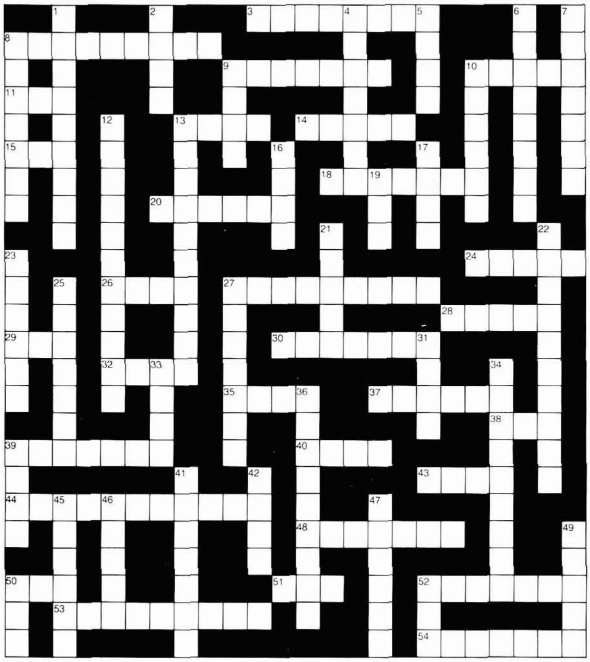
The technical program is organized by Dr. Robert L. Feller, of Carnegie-Mellon University's Research Center on the Materials of the Artist and Conservator, Pittsburgh, PA, and Dr. Danny C. Rich, of Applied Color Systems, Inc., Princeton, NJ.

The conference fee of $570 includes registration, accommodations at The Lodge, all meals (American plan), and visiting privileges to Colonial Williamsburg.

To register, or to obtain further information, contact Norman W. Burningham, 357 True Hickory Dr., Rochester, NY 14615.

CroSSLinkS

by Earl Hill



Solution to be published in January issue.

No. 9

ACROSS

3. Red sulfidic pigment
8. Glass beads
9. Syn. for cinder (British)
10. Refined rapeseed oil
11. Return on ____. Financial term (Abr.)
13. Wainscot
14. Wood direction
15. Chemical prefix, ___mer
18. Toxic aromatic solvent
20. Drier metal
24. Type of lacquer
25. To color lightly
27. Type of polymer
28. Result of distilling No. 50 down
29. Thickening agent (Abr.)
30. Minute film defect
32. Indian oil
35. Mill media
37. Aromatic solvent $C_6H_4(CH_3)_2$
38. Helps cool the factory
39. To thicken
40. To convert
43. Chemical specialties association (Abr.)
44. To stick together
48. ___ brightener
50. Light yellowish brown
51. Thermal analytical technique (Chem.)
52. Soft natural wax
53. Glue size
54. Derivative of 37 Across

DOWN

1. Porcelain decoration
2. Alkyd reactant
4. Salt of CH_3 COOH
5. R___ of reaction
6. Imparts color
7. A novel finish
8. To block out
9. Batch c___
10. Useful metal. Preservatives, pigments
12. To carry (Electrocoating)
13. To put on (Electrocoating)
16. To join together
17. Diethyl amino ___ (amine)
19. Isocyanate radical
21. Color difference
22. Cycloparaffinic hydrocarbon solvent
23. Hardness test
25. Bluish red dyestuff
27. Purple red
31. Financial color
33. A class of numbers (Math.)
34. Cut the bubbles (Pl.)
36. D___ (Optical property)
39. Aluminum silicate
41. Small fissure (film defect)
42. Building tier
45. A type of 28 Across
46. Earthy iron ore pigment
47. Syn. for coating
49. Alkyl radical C_6
50. Black bituminous substance
52. Holds paint cans

Coming Events

FEDERATION MEETINGS

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

1986

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

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

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

1987

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

SPECIAL SOCIETY MEETINGS

1986

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

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

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

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

(Apr. 29-May 1)—"Advances in Coatings Technology" Conference sponsored by the Cleveland Society for Coatings Technology.

NASA, Lewis Research Center, Cleveland, OH. (Dr. Rosemary Loza, Standard Oil Co. (Ohio), 4440 Warrensville Center Rd., Cleveland, OH 44128).

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

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

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

1987

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

OTHER ORGANIZATIONS

1986

(Jan. 12-13)—ASTM Committee E-12 on Appearance of Materials Meeting. Sheraton New Orleans, New Orleans, LA. (Robert Morgan, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 12-15)—ASTM Committee D-1 on Paint and Related Coatings and Materials Meeting. Sheraton New Orleans, New Orleans, LA. (Brent Backus, ASTM, 1916 Race St., Philadelphia, PA 19103).

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

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

(Feb. 9-12)—Inter-Society Color Council. "Colors of History: Identification, Re-creation, Preservation." The Lodge, Colonial Williamsburg, VA. (ISCC, N.W. Burningham, 357 True Hickory Dr., Rochester, NY 14615).

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

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

(Mar. 4-7)—Painting and Decorating Contractors of America. 102nd National Convention. Honolulu, HI. (PDCA, 7223 Lee Hwy., Fall Church, VA 22046).

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

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

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

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

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

(Apr. 6-11)—"Advances in Size-Exclusion Chromatography" Symposium. Sponsored by ACS Div. of Polymeric Materials: Science and Technology. New York, NY. (Theodore Provder, Glidden Coatings & Resins, Div. of SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 7-11)—"Paint Formulation" Introductory Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(Apr. 9-16)—"Surface Treatment '86" sponsored by the World Center for Industrial Technology. Hannover Fairgrounds, Hannover, West Germany. (Hannover Fairs USA Inc., P.O. Box 7066, 103 Carnegie Center, Princeton, NJ 08540).

(Apr. 14-15)—ASTM Symposium on "Testing of Metallic and Inorganic Coatings," Chicago, IL. (Teri Carroll, ASTM Standards Development Div., 1916 Race St., Philadelphia, PA 19103).

(Apr. 22-24)—PaintCon '86. O'Hare Expo Center, Chicago, IL. (PaintCon, Suite 205, 2400 E. Devon Ave., Des Plaines, IL 60018).

(Apr. 28-May 2)—"Applied Rheology for Industrial Chemists" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 5-9)—"Physical Testing of Paints and Coatings" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(May 12-16)—"Adhesion Principles and Practices for Coatings and Polymer Scientists" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 13-15)—11th Annual Powder & Bulk Solids Conference/Exhibition. O'Hare Exposition Center, Rosemont, IL. (Patricia Dickinson, Show Manager, c/o Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017).

(May 14-15)—Surfex '86. Oil and Colour Chemists' Association. Harrogate Exhibition Centre, Yorkshire, England. (Robert H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HAO 2SF).

(May 19-22)—"Basic Microcomputer Programs for Coatings" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(June 2-6)—"Dispersion of Pigments and Resins in Fluid Media" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(June 10-16)—CHINAPLAS 86. International Exhibition Centre, Beijing, China. (Kallman Associates, 5 Maple Court, Ridgewood, NJ 07450).

(June 15-18)—60th Colloid and Surface Symposium. Georgia Institute of Technology, Atlanta, GA. (Symposium Chairman, M.J. Matteson, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332).

(June 16-18)—Inter-Society Color Council and Canadian Society for Color. Joint Meeting. Ryerson Polytechnic Institute, Toronto, Ont., Canada.

(July 3-6)—Oil and Colour Chemists' Association Australia. 28th Annual Convention. The Estate, McLaren Vale, South Australia. (OCCAA, 6 Wilson Ave., Felixstow, South Australia 5090, Australia).

(Sept. 7-12)—Symposium on High Solids Coatings. Sponsored by the ACS Div. of Polymeric Materials: Science and Engineering. Anaheim, CA. (George R. Pilcher, Hanna Chemical Coatings Corp., P.O. Box 147, Columbus, OH 43216).

(Sept. 8-13)—190th National Meeting. American Chemical Society. Chicago, IL. (ACS, A.T. Winstead, 1155 16th St. N.W., Washington, D.C. 20036).

(Sept. 9-11)—RadCure '86—Association for Finishing Processes of the Society of Manufacturing Engineers Conference and Exposition. Baltimore Convention Center, Baltimore, MD. (AFP/SME Public Relations, Society of Manufacturing Engineers, One SME Dr., Dearborn, MI 48121).

(Sept. 15-17)—13th International Naval Stores Meeting. Waldorf-Astoria, New York, NY. (Douglas E. Campbell, Executive Director, Pulp Chemicals Assn., 60 E. 42nd St., New York, NY).

(Sept. 21-26)—XVIIIth Congress of FATIPEC. (Federation of Associations of Technicians in the Paint, Varnish, and Printing Ink Industries of Continental Europe). Venice, Italy. (C. Bourgery, Secretary General of FATIPEC, 76 Blvd. Pereire, 75017 Paris, France-or-Amleto Poluzzi, AITIVA, Piazzale R. Morandi 2,20121 Milano, Italy).

(Sept. 22-25)—"Your Chosen Finish." FINSTRAT Conference and Exposition sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Long Beach, CA. (Gerri Andrews, SME, Public Relations Dept., One SME Dr., P.O. Box 930, Dearborn, MI 48121).

(Nov. 3-5)—Paint Research Association. Sixth International Conference, Sheraton Hotel, Brussels, Belgium. (D. Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

Advertisers Index

'Humbug' from Hillman

Years ago, Thomas Wolfe wrote, "You Can't Go Home Again." My trip to the recent convention in St. Louis belied Wolfe's flat statement. After three years of absence, I was home again at the Federation Annual Meeting and Paint Show. The joy of seeing old friends and the opportunity to whet my somewhat faded technical appetites again were stimulating and exciting.

In truth, however, I arrived at Convention Hall with sharpened pencil, quite prepared to expose the blunders and vexations that crop up at most conventions. Humbug was ready to go on a critical rampage. Woe is me—disappointment is mine!!! Even the hotel elevators seemed to run efficiently and I didn't once get lost in the spacious aisles of the Paint Show. I even managed to get in to the coffee shop for breakfast before lunch hour.

I did observe that communications at the booths in the Paint Show would have been easier and more complete if I had been Japanese and spoke a fluent German as well. It would be no surprise if a not too distant Federation Convention were held in Frankfurt or Tokyo. It probably would be more convenient for a majority of the exhibitors.

I did notice that the most active and best attended technical booths featured golf, football and billiards. The well stacked and interestingly attired attendants also seemed to hold the attention of many of our erudite scientists. Far be it from me to suggest that the conventioneers should be denied the technical uplift that those exhibits bring to the show.

So to Frank Borrelle, wherever he may be hiding—"You can come out now!! All your past sins have been forgiven by those who like a well-run convention but from me, FOOEY!!!!".

Past-President Howard Jerome, who was one of the busiest bees flying around the convention was kind enough to write me about—

YOU CAN TELL IT'S GOING TO BE A ROTTEN DAY WHEN...

You see a "60 Minutes" news team waiting in your office.

Your birthday cake collapses from the weight of the candles.

You turn on the news and they are showing emergency routes out of the city.

Your car horn goes off accidentally and remains stuck as you follow a group of Hell's Angels on the freeway.

Your boss tells you not to bother to take your hat off.

The bird singing outside your window is a buzzard.

Your blind date turns out to be your ex-wife.

Your income tax check bounces.

You put both contact lenses in the same eye.

Your pet rock snaps at you.

Your wife says, "Good morning, Bill" and your name is George.

You call your answering service and they tell you it's none of your business.

You want to put on the clothes you wore home from the party and there aren't any.

You call Suicide Prevention and they put you on hold.

Always alert, Howard also sent some of the following observations of the passing scene.

- Old bowlers never die, they just end up in the gutter.
- I can't be overdrawn, I still have some checks.
- 'Tis better to divorce than murder.
- Fishing is not a matter of life or death—it's much more important than that.
- Golf is a beautiful walk spoiled by a small white ball.

Among the nice things that happened at the Convention—meeting some of our faithful readers and contributors. One of the nicest, Maureen Lein, sent in the following some time ago from the National Safety Council Brochure.

- Some people know a lot more than they tell. Unfortunately, the reverse is also true.
- The walls of motel rooms are a problem. They're thick when you're trying to listen and thin when you're trying to sleep.
- A sure-fire diet is just to stop eating. Nothing dentured, nothing gained.
- That increase in your utility bill is just part of the old rate race.

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


"CREATIVE COLORSHIP FOR OVER A CENTURY"
COLORSHIP is COMMITMENT
In 1852 the American Clipper-ship "Comet" encountered a severe hurricane off the coast of Bermuda. A lesser ship would not have survived that storm. Through know-how and COMMITMENT, Pfizer has been successfully weathering similar storms in American industry for over a century. Despite the challenges of recession, inflation, regulation and shortages, Pfizer has maintained its COMMITMENT to leadership in Pigment Technology. Through unsettling times, Pfizer has:
• Expanded and modernized its three major manufacturing facilities
• Introduced new innovative products such as Pferrisperse™ Slurry, RO-2097 Light Shade Kroma® Red Oxide, Easy Dispersing Red and Yellow Pigments, and others
• Added new technical service personnel and laboratories
• Supplemented its direct sales force with a highly responsive LTL distributor network
No one knows what future economic storms may be on the horizon. However, no matter what the climate, Pfizer is committed to meeting the needs of its Pigment customers. Creative Colorship For Over a Century represents the continuous pursuit of excellence in Pigment Technology. It takes total COMMITMENT. But at Pfizer, there is no other way.
Pfizer
MINERALS, PIGMENTS & METALS DIVISION
Dept. 3C-1
235 E. 42nd Street, New York, N.Y. 10017