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**JOURNAL OF
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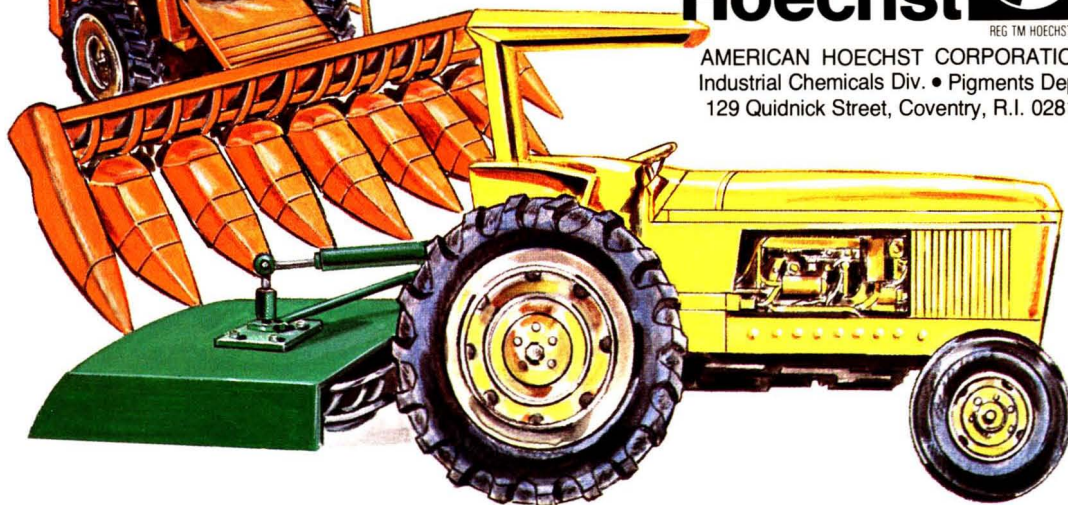
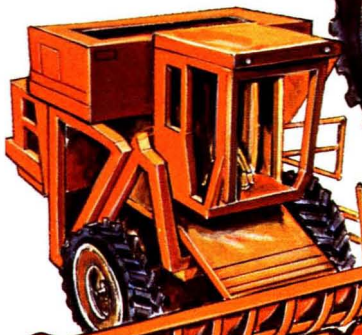
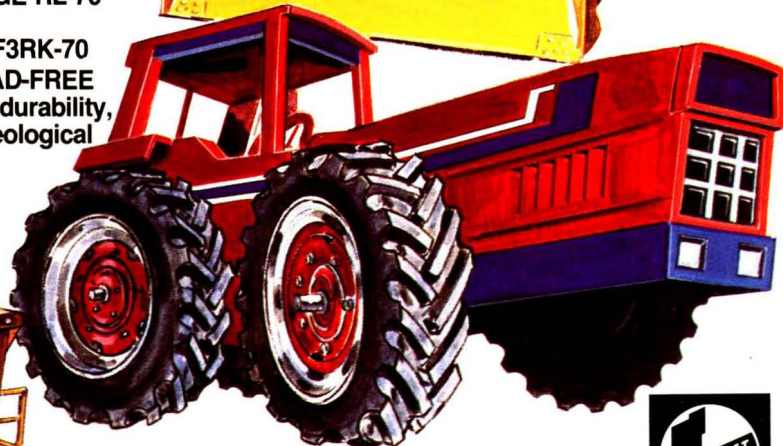
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JOURNAL OF
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Volume 52 Number 671

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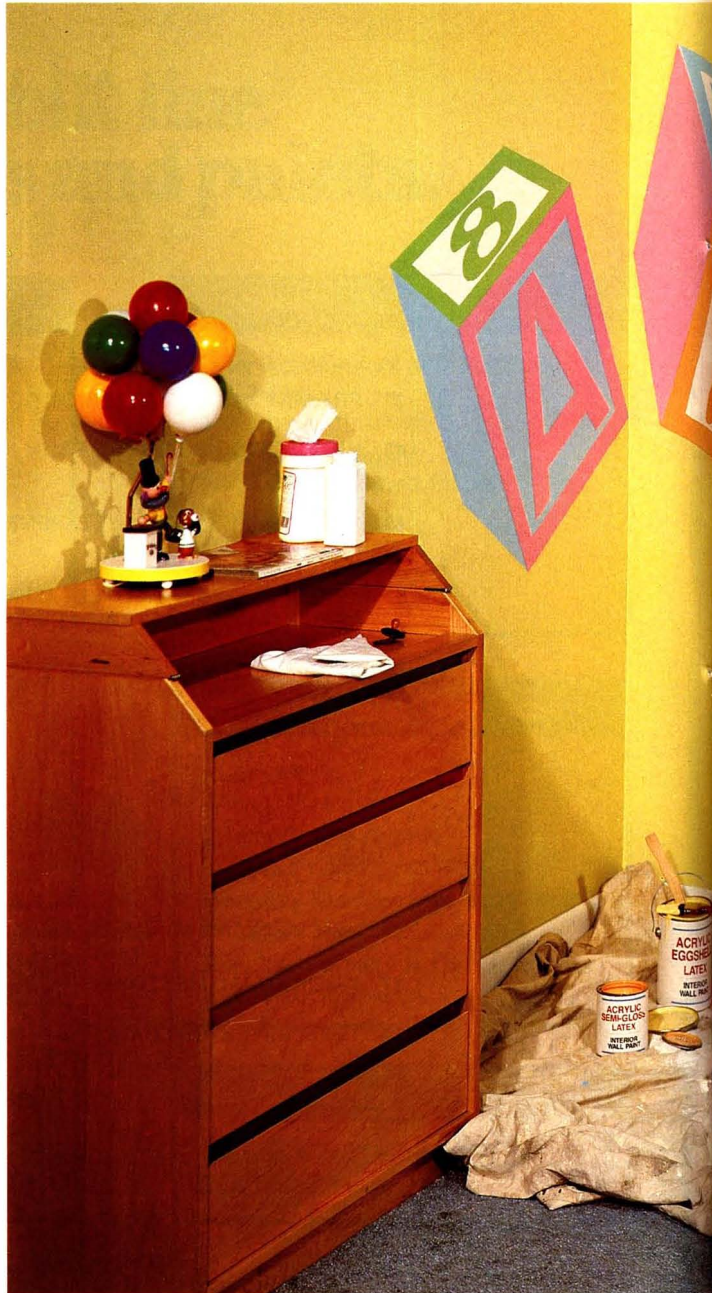
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During the 20-year period from 1960 through 1979, the Technical Committees of the Federation's Constituent Societies authored and presented 159 papers at the Annual Meetings.

Those projects consumed thousands of hours of volunteer work and dedication by hundreds of members who not only made an important contribution to the industry but gained for themselves a valuable learning experience as well.

The Societies which produced ten or more papers were: New York—21; Philadelphia—17; Northwestern—13; Houston—12; and CDIC—10.

The fine record of all the Societies stands as a challenge to present and future Technical Committees and we are confident that they will top the performance of their predecessors.

The Technical—and the Corrosion, Educational, Environmental, Manufacturing—Committees are the true strengths of the Federation and Societies and represent what the 27 organizations are really all about.—FJB.

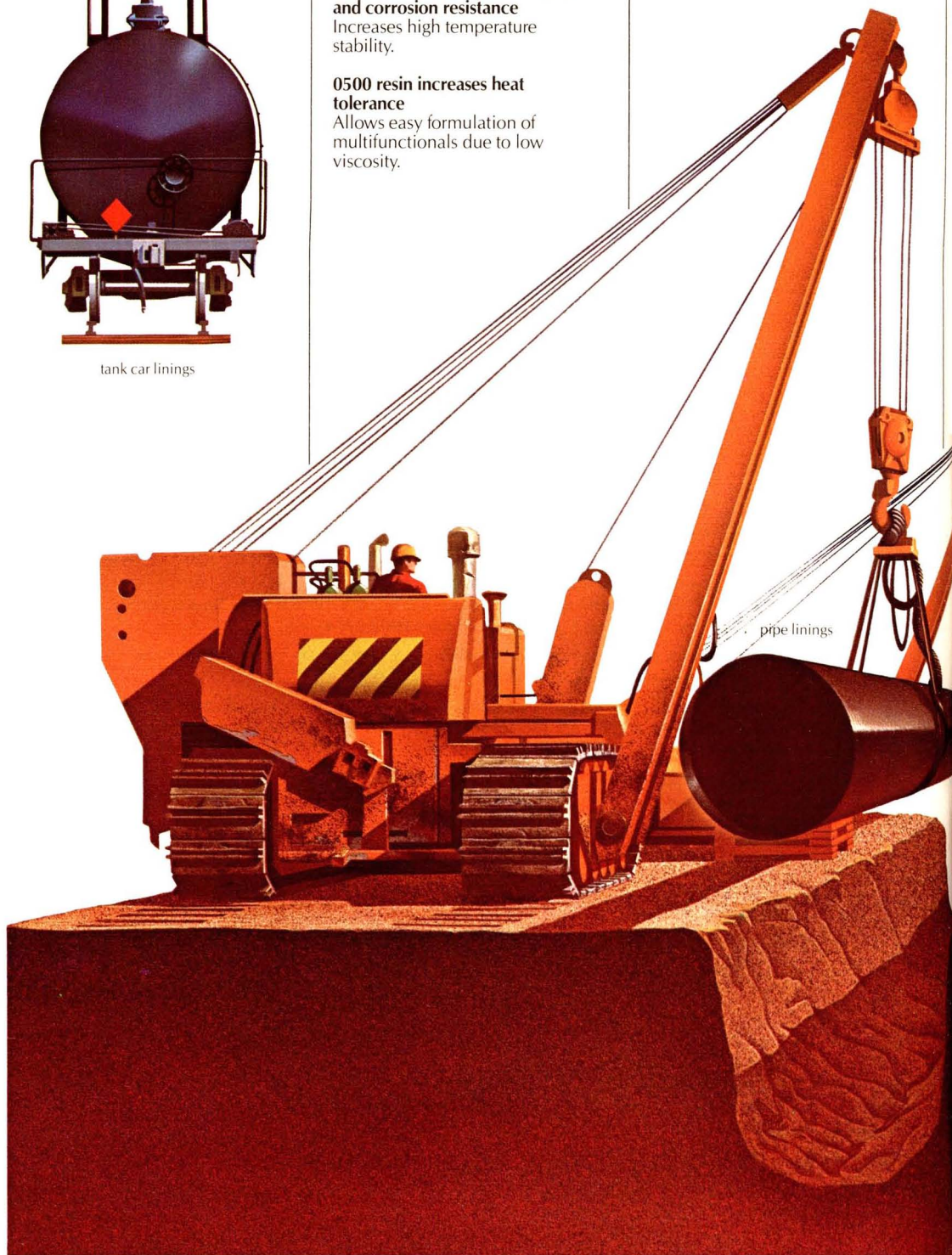
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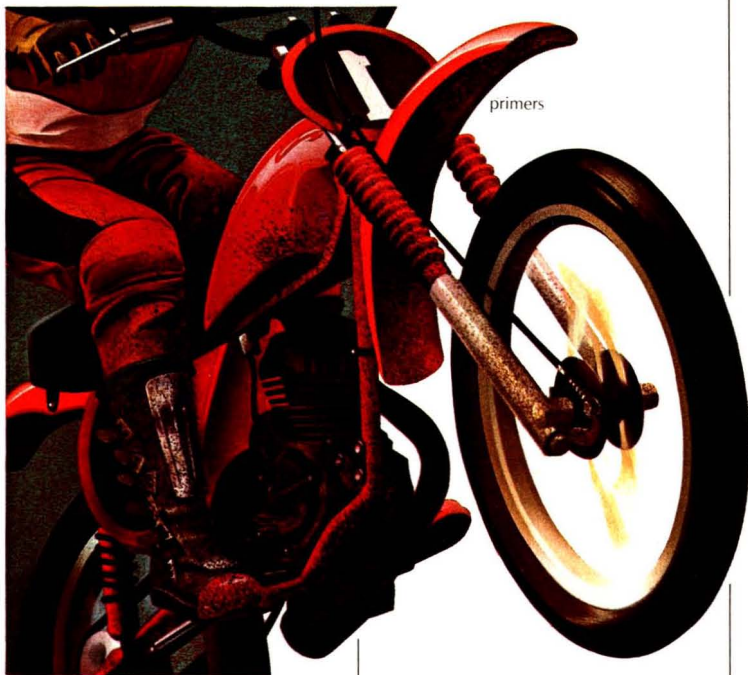
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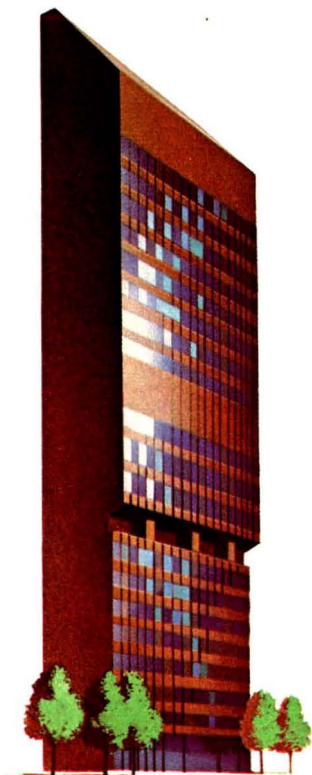


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Abstracts of Papers in This Issue

PRIMARY AMINE ZWITTERION COPOLYMERS—Z.W. Wicks, Jr. and C.-W. Koay

Journal of Coatings Technology, 52, No. 671, 37 (Dec. 1980)

A copolymer of the vinyl ester of trimellitic acid anhydride and butyl acrylate was reacted with 2-amino-2-methyl-1-propanol to give a zwitterion copolymer with pendant half esters of 2-amino-2-methyl-1-propanol. The copolymer is soluble in 2-butoxyethanol. When diluted with water, it generally behaves in a similar manner to that resulting when amine salts of "water-soluble" acrylic resins in cosolvent are diluted with water. Films of the copolymer with pTSA catalyst crosslink, when cured for 30 min at 150-175°C, give solvent rub resistance and hardness comparable to a conventional water soluble acrylic with hexamethoxymelamine, without emission of amine or formaldehyde.

HIGH SOLIDS COATINGS FROM NEW ORGANOPHOSPHORUS RESINS—M.S. Chattha

Journal of Coatings Technology, 52, No. 671, 43 (Dec. 1980)

The reaction of alkyl acid phosphates with aliphatic diepoxy resins has been found to be rather facile for producing oligomeric hydroxy phosphates of molecular weight (M_n) in the range of 1800 to 2500. Progress of the reaction has been followed by infrared spectra and titration of the reaction mixture; less than stoichiometric amount of the acid ester is needed for complete consumption of the epoxy functionality. When stoichiometric amounts of the alkyl acid phosphates and the epoxy resin were reacted in solution, the acid concentration, as evidenced from alkali titration, decreased rapidly in the initial reaction stages to a nearly constant value. The hydroxy phosphates thus prepared can be crosslinked with aliphatic isocyanates in two-component high solids coatings formulations. The coatings, cured at 100°C for 20 min on primed panels, exhibit excellent gloss, hardness, solvent resistance, impact strength, and adhesion. Their weatherability, however, in QUV Weathering Tester and in Cleveland Humidity Chamber, is inferior to acrylic-urethane high solids coatings.

COPOLYMERS OF POLYSTYRENE GLYCOL AND LINSEED OIL ALKYD—S. Chandra and S. Pasari

Journal of Coatings Technology, 52, No. 671, 49 (Dec. 1980)

A new approach for the synthesis of alkyds containing a polystyrene chain has been described. These copolymers can be closely related to the styrenated alkyds already known in the surface coating field.

Polystyrene glycol was synthesized first, followed by glyceryl phthalate resins. Polystyrene glycol replaced part of the glycerol in its esterification reaction with phthalic anhydride. The products obtained from this approach were found to exhibit better physical and chemical properties when compared with those of conventional styrenated alkyds.

N-DODECYL-SUBSTITUTED AMINOPYRIMIDINIUM SALT DERIVATIVES AS PAINT FILM ANTIFUNGAL AGENTS—N. Grier, et al.

Journal of Coatings Technology, 52, No. 671, 57 (Dec. 1980)

A paint film antifungal agent was sought from among 49 aminopyrimidinium salt derivatives which have in common an exo- or ring-nitrogen n-dodecyl substituent. Structure-activity studies with the destructive *Aureobasidium pullulans* indicated electron-withdrawing bromo or trifluoromethyl ring substitution reduced potency, whereas electron donor methyl and amino (in resonance) enhanced or maintained efficiency. A balanced hydrophilic-lipophilic partitioning capability appeared essential; more polar substituents caused compound removal from films by water leach, and excessive lipoidal modifications decreased fungitoxicity. Eleven derivatives were evaluated in an acrylic paint, at a 0.5% (w/w) compound loading, as a two coat self-primed system on pine wood panels exposed outdoors. Only 4-(n-dodecylamino)-1-methylpyrimidinium acetate matched the reference inhibitor, tetrachloroisophthalonitrile, in the first six months but then failed within the year.

SKID RESISTANT COATINGS FOR AIRCRAFT CARRIER DECKS—S.H. Davang and H. Dear

Journal of Coatings Technology, 52, No. 671, 65 (Dec. 1980)

Skid resistant deck coatings for Navy aircraft carriers are covered by performance type specifications. To develop a new specification for a high performance coating which can be applied by ships' crews, six proprietary coatings were examined and tested for film thickness, weight, friction and wear properties. In comparison to sprayed deckings, the test coatings applied by roller showed greater variance in properties. Two of the six coatings would pass a friction retention requirement more stringent than the sprayed decking specification while four would fail the specification. In the wear test, the high friction coatings show greater wear than the lower friction coatings.

L.W. Keller and D.W. Smith Win 1980 NPCA Heckel Award

Lawrence W. Keller, Manager of Industry Hygiene and Product Safety and Director of the Industrial Hygiene Laboratory at PPG Industries, Inc., Coatings and Resins Div., Springdale, PA, and Donald W. Smith, Manager of Safety and Environmental Affairs, Pratt & Lambert, Inc., Buffalo, NY, were named the 1980 winners of the George Baugh Heckel Award by the National Paint and Coatings Association at its 93rd Annual Meeting, held in Atlanta on October 27-29.

The Award recognizes outstanding contributions to the industry and commemorates George B. Heckel, the founder of *Paint Industry Magazine* and an active member of NPCA and other industry organizations.

Mr. Smith worked for Bell Aerospace and the Carborundum Co. before joining Pratt & Lambert. He serves on many task forces within NPCA. A member of the Government Relations Committee of the Adhesives and Sealants Council, Mr. Smith is Chairman of the Occupational Safety and Health Committee of the Buffalo area Chamber of Commerce. He also holds membership on the Hazardous Materials Transportation task force of the Buffalo Common Council, the Occupational Health Committee of the Western New York Chapter of the American Lung Association, and the Industrial Advisory Committee of the Buffalo Sewer Authority. Mr. Smith participates on the Occupational Safety and Health Committee of the Canadian Paint & Coatings Association and is

Director of the Western New York Safety Conference.

Mr. Keller, a Certified Industrial Hygienist and Safety Professional, is a Consultant to the World Health Organization and the University of Pittsburgh, in addition to his responsibilities at PPG Industries. He is also an Assistant Professor of Industrial Hygiene at the University of Pittsburgh.

A Diplomat in the American Academy of Industrial Hygiene, Mr. Keller is a member of the American Industrial Hygiene Association, the Systems Safety Society, and the Air Pollution Control Association. He has been Manager of NPCA's Product Safety Task Force and a member of the Toxic Substances and Occupational Health Task Force.

NPCA Presents Industry Statesman Awards at 93rd Annual Meeting

The National Paint and Coatings Association honored five men with long and illustrious careers in the U.S. paint and coatings industry at its 93rd Annual Meeting in Atlanta.

Receiving the Association's Industry Statesman Award for "long and unheralded service to the paint industry" were: Robert S. McKay II, retired President and Treasurer of the Dean & Barry Co., Columbus, OH, and consultant to the RPM Company, Medina, OH; Neil S. Estrada, Vice-President and General Manager of the Pacific Central Div. of Reichhold Chemicals, Inc., San Francisco, CA; William E. Hood, Chairman of the Board of Indurall Coatings, Inc., Birmingham, AL; John Armitage, President of John L. Armitage & Co., Newark, NJ; and Alfred J. Knapp, founder of the Napko Corp., Houston, TX, which was recently acquired by the Fuller O'Brien Corporation.

The Industry Statesman Award is one of the highest honors presented by the paint industry. It is given to individuals who have made substantial contributions to the betterment of the industry and to their communities over a number of years. The awards were first presented in 1964.

Neil Estrada joined Reichhold Chemicals in 1950, after working with several paint companies as a Naval Weather Officer, and for the National Bureau of

Standards. At Reichhold, he progressed from a position in the South San Francisco Laboratory to his present post.

Robert McKay retired from the Dean & Barry Company in 1979, and now is a consultant to the RPM Company. He joined Dean & Barry in 1945 in the retail stores and subsequently progressed to become the third-generation of his family to head the company. In 1975, he received the NPCA George Baugh Heckel Award. In addition, he has been and continues to be extensively involved in Coatings Research Group, Inc.

Alfred Knapp migrated from New York to Houston in 1940 to join Ed D. Konken in founding the Napko Corporation. Until 1979, when Napko was acquired by Fuller O'Brien, Mr. Knapp had an executive role in guiding the corporation.

William E. Hood was graduated in 1931 from the University of Alabama with a B.S. Degree in Mechanical Engineering. He went to work for the Alabama Paint Co. and was with that company until 1947, when he launched his own paint manufacturing business. A Past-President of the NPCA, Mr. Hood served on the NPCA Board of Directors and the Executive Committee. In addition to his Association activities, Mr. Hood has continually participated in the affairs of the Southern Society for Coat-

(Continued on page 13)

Estrada Wins NPCA Industry Statesman Award

Neil S. Estrada, Vice-President and General Manager of the Pacific Central Div. of Reichhold Chemicals, San Francisco, was named one of the five winners of the National Paint and Coatings Association's 1980 Industry Statesman



Neil S. Estrada

Award at its 93rd Annual Meeting, held in Atlanta, October 27-29, (See accompanying story.)

Mr. Estrada began his career with Reichhold in their South San Francisco Laboratory and advanced to his present position. His long record of service to the paint industry includes the authorship of numerous technical papers on chemical coatings and plastics. Past-President of the Federation, as well as the Golden Gate Society, he is currently a member of the Federation Board of Directors. He is also active in industry activities regarding California air pollution regulations.

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Dr. C. Robert Hiles is Elected President of NPCA

Dr. C. Robert Hiles, President of Lilly Industrial Coatings, Inc., Indianapolis, IN, was elected President and Chief Executive Officer of the National Paint and Coatings Association (NPCA) at its 93rd Annual Meeting, held in Atlanta. Also elected were: James H. Davis, Porter Paint Company, Inc., Louisville, KY, as Vice-President, and William D. Kinsell, Jr., Glidden Coatings & Resins, Div. of SCM Corp., Cleveland, OH, as Treasurer.

Regional Vice-Presidents were chosen from seven geographical zones: New England—Joseph S. Parker, Sterling-Clark-Lurton Corp., Malden, MA; Eastern—Stanley Eysmann, Cellofilm Corp., Woodridge, NJ; East Central—Merritt E. Marcus, Edward H. Marcus Paint Co., Louisville, KY; West Central—Roland Gianneschi, Standard T. Chemical Co., Inc., Chicago, IL; Southern—Paul Pope, AZS Corporation, Inc., Atlanta, GA; Southwestern—Richard Williamson, Trinity Coatings Co., Fort Worth, TX; Western—William B. Manuel, Pacific Coast Chemicals Co., Berkeley, CA.

Elected to the Board of Directors for a one-year term was: W.F. Rhoades, Standard T. Chemical Co., Chicago, IL. The following were elected for three-year terms: George E. Batzel, Midland Division of Dexter Corp., Waukegan, IL; W.A. Bours III, E. I. duPont de Nemours & Co., Inc., Wilmington, DE; John G. Breen, The Sherwin-Williams Company, Cleveland, OH; D. Patrick Curran, Cook

Paint & Varnish Co., Kansas City, MO; Robert Glick, Martin Paint & Chemicals Corp., Jamaica, NY; Milton M. Golden, Major Paint & Varnish Co., Div. of Standard Brands Paints Co., Inc., Torrance, CA; Larry Hecht, Southern Protective Products Co., Atlanta, GA; Roland V. McPherson, Armstrong Containers, Inc., Westchester, IL; F.W. Montanari, NL Chemicals/NL Industries, Inc., Hightstown, NJ; Arnold R. Wolff, The Enterprise Companies, Div. of Insilco Corp., Wheeling, IL; C. Angus Wurtele, The Valspar Corp., Minneapolis, MN; Rockford G. Yapp, Shell Chemical Co., Houston, TX.

Industry Statesman Awards Presented at Annual Meeting

(Continued from page 11)

ings Technology, and served as its President in 1950.

John Armitage became Chairman of the Board of John L. Armitage & Co. in January 1980 after completing over 40 years in the paint industry. Mr. Armitage's coatings industry activities began shortly after he became President of his company in 1949. Due to a change of the Chief Executive Title at NPCA, Mr. Armitage is the only individual to have served as both NPCA President (1975) and Chairman of the Board (1976).

Chicago Society Seeks Help For Project Work On Biocidal Polymerization

The Technical Committee of the Chicago Society for Coatings Technology has announced that its Biocidal Polymerization Subcommittee has expanded its area of activity to include the search for *natural* fungicides which are effective against fungal attacks on coatings. This search is twofold:

- (1) Bacteria—which produce either enzymes or toxins which will inhibit, or destroy, the fungi which infect coatings.
- (2) Natural Fungicides or Fungistats—Products of plant life which will resist fungal attack.

The potential for this effort is such that the Subcommittee solicits the participation of Federation members from other Societies.

Persons interested in assisting in this project are requested to contact either: Chairman of the Technical Committee—Joseph H. Boatwright, Premier Paint & Varnish Co., Inc., 2250 Arthur Ave., Elk Grove Village, Ill. 60007 (312) 439-4200; or Subcommittee Chairman—Jonathan C. Landwer, U.S. Gypsum Co., 1000 E. Northwest Highway, Des Plaines, Ill. 60016 (312) 299-3381.

Roon Awards Competition Offers \$1,750 in Prizes For Winning Technical Papers Presented in 1981

The Roon Foundation Awards, established in 1957, will be continued at the Federation's 1981 Annual Meeting in Detroit, MI, where the best technical papers offered for presentation will be eligible for up to \$1,750 in cash prizes donated by Leo Roon, former President of Nuodex Products Co., and a Director of the Roon Foundation.

Martin R. Hastings, Chairman of the Federation's 1981 Roon Awards Committee, stated that the papers submitted in competition for the Awards must: (1) Be of such caliber that they will reflect

a step forward in real scientific contribution to the coatings industry; (2) Be directly related to the protective coatings industry; and (3) Shall describe original work not previously published or presented.

At present, the schedule of prizes is as follows: First—\$800; Second—\$450; Third—\$300; and Fourth—\$200.

The 1981 Annual Meeting of the Federation will be held in Detroit from October 28 to 30, and the deadline for receipt of papers is June 1.

Principles Governing the Roon Awards

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

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

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

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

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

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

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

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

(6) The submitted papers may be presented at the Annual Meeting with the consent of the President of the Federa-

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

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

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

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

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

(11) The Awards will be open to anyone involved in study of or engaged in work related to the protective coatings industries, including paint, varnish and lacquer manufacturers, raw material suppliers, research laboratories and universities. (The committee, however, will not accept papers which involve raw

1980 AWARDS

FIRST PRIZE (\$800)—"Kinetic Parameter Considerations for Maximizing Stability and Minimizing Cure Temperature of Thermosetting Coatings. Sulfonium Salts as Latent Thermal Initiators for Cationic Polymerization."—S. Peter Pappas, of North Dakota State University, Fargo, ND, and Loren W. Hill, of Monsanto Co., Indian Orchard, MA.

SECOND PRIZE (\$450)—"Computer Method for Predicting Evaporation of Multicomponent Aqueous Solvent Blends at Any Humidity"—Albert L. Rocklin, of Shell Development Co., Houston, TX, and David C. Bonner, of Shell Oil Co., Houston, TX.

THIRD PRIZE (\$300)—"Primary Amine Zwitterion Copolymers"—Zeno W. Wicks, Jr. and Chiew-Wah Koay, of North Dakota State University, Fargo, ND.

FOURTH PRIZE (\$200)—"Synthesis of Blocked MDI Adducts, Their DSC Evaluation and Effect of Pigmentation"—Taki J. Anagnostou, of Wyandotte Paint Products, Inc., Troy, MI, and Ernest Jaul, of Union Carbide Corp., S. Charleston, WV.

material sales promotion or are self-serving in regard to exploiting a proprietary product.)

(12) The Committee may award three or four prizes, the total of which is not to exceed \$1,750. Maximum for first prize is \$1,000.

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

(14) Those planning to submit a paper in 1981 must let the Chairman (Martin R. Hastings, Midland Div., Dexter Corp., P.O. Box 620, Waukegan, IL 60085) know by March 1. He must have seven publication manuscripts by June 1.

(15) The 1981 Awards, and accompanying certificates, will be presented during the Annual Meeting in Detroit.



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FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

1980
ANNUAL MEETING
AND
PAINT SHOW
REVIEW

ATLANTA, GA OCTOBER 29-31

Annual Meeting and Paint Show Draw 5200 Registrants to Atlanta

The Federation Annual Meeting and Paint Industries' Show returned to Atlanta, Ga., October 29-31, and drew a total of 5207 registrants to the Civic Center for the three days of technical sessions and exhibits.

Included in the attendance were 479 registrants from the National Paint and Coatings Association Annual Meeting, held October 27-29 at the Atlanta Hilton. The back-to-back events attracted a total registration in excess of 6500 persons for Paint Industry Week 1980 in Atlanta.

Chairman Hugh Lowrey and his Program Steering Committee scheduled concurrent sessions all three days on a wide range of theoretical and practical topics, and from the Keynote Address by Harvey George, of the Gravure Research Institute, on through the Mattiello Lecture by Dr. Percy Pierce, of PPG Industries, Inc., and the closing session on Waste Management, registrants were treated to a plentiful array of papers on coatings research and technology.

The presentations were well attended throughout and generated a number of spirited question-and-answer sessions.

Meanwhile, in the exhibit hall, the largest Paint Show in Federation history featured the exhibits of 140 supplier companies,

who displayed the latest in their lineup of products, equipment, and services.

Traffic was heavy in the hall all three days and many registrants returned to the Show several times to be sure they covered all the exhibits.

Exhibitors were very pleased with both the attendance and the interest expressed in the displays. And registrants were impressed with the number and quality of the exhibit booths—the latter again presenting the judging committee with difficult choices for selecting the outstanding exhibits (see Awards story).

At the luncheon on Friday, October 31, business formalities were kept to a minimum, and the more than 400 registrants in attendance were entertained by comments by Dr. Kenneth McFarland, Dean of America's Public Speakers.

The many members of the Southern Society who served on the Host Committee under the direction of Berger Justen deserve much praise and appreciation for their invaluable assistance. To them, and to all the dedicated members who contributed their time, talents, and efforts on behalf of the 1980 Annual Meeting and Show, the Federation is deeply indebted.



President Elder Larson and wife, Margaret (center), opened the 1980 Paint Show with traditional ribbon-cutting ceremony. Looking on are (left to right): Treasurer Howard Jerome and his wife, Gene; Rose Borrelle; Executive Vice-President Frank Borrelle; Treasurer-Elect A. Clarke Boyce; Marjorie Boyce; Bea Ellis; and President-Elect William H. Ellis

Thomas J. Miranda, of Whirlpool Corp., Wins 1980 Heckel Award

Dr. Thomas J. Miranda, Staff Scientist at the Whirlpool Corp. Research Center, Benton Harbor, MI, was honored by the Federation of Societies for Coatings Technology with the 1980 George Baugh Heckel Award for his nine years of service to the Federation as Chairman of the Publications Committee and Editorial Review Board, and Technical Editor of the *JOURNAL OF COATINGS TECHNOLOGY*. The presentation was made at the FSCT Annual Meeting luncheon on October 31, in Atlanta, GA.

The 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.

In addition to serving as Chairman of the previously mentioned committees, Dr. Miranda was a member of the Federation's Board of Directors (1978-80) and Chairman of the Trigg Awards (1966) and Mattiello Lecture (1980) Committees. As Vice-Chairman of the 1980 Program Committee, he will be the Program Chairman in 1981.

A Past-President of the Chicago Society for Coatings Technology, he is a recipient of their Outstanding Service Award.

Other awards presented during the Annual Meeting honored those who have made outstanding contributions to the Federation and the coatings industry.

Union Carbide Award

Established in 1979 by the Union Carbide Corp., the 1980 Award was presented to the Chicago Society for Coatings Technology for its distinguished effort in compiling the *Infrared Spectroscopy Atlas for the Coatings Industry*. In 1976, the Chicago Society established the Infrared Spectroscopy Committee to revise and update the previously published volume (1969). *Infrared Spectroscopy—Its Use in the Coatings Industry*. Working under the chairmanship of John J. Vandenberg, the committee compiled over 1400 infrared spectra of materials used in the industry. These, together with a complete bibliography, and material on theory, practice, and instrumentation, were published by the Federation in January 1980.

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

Distinguished Service Award

This award was presented to Elder C. Larson, of the Houston Society for Coatings Technology, in grateful acknowledgment of his valuable contributions to the progress of the industry and the Federation while serving as President of the Federation in 1979-80. Mr. Larson is a Senior Research Chemist at Shell Development Co., Houston, TX.

Roon Foundation Awards

These awards, established by Leo Roon, Director of the Roon Foundation, 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.

Winners in the 1980 Competition were:

FIRST PRIZE (\$800)—"Kinetic Parameter Considerations for Maximizing Stability and Minimizing Cure Temperature of Thermosetting Coatings. Sulfonium Salts as Latent Thermal Initiators for Cationic Polymerization"—S. Peter Pappas and Loren W. Hill, North Dakota State University, Fargo, ND.

SECOND PRIZE (\$450)—"A Computer Method for Predicting Evaporation of Multicomponent Aqueous Solvent Blends at Any Humidity"—Albert L. Rocklin, Shell Development Co., and

David C. Bonner, Shell Oil Co., Houston, TX.

THIRD PRIZE (\$300)—"Primary Amine Zwitterion Copolymers"—Zeno W. Wicks, Jr. and Chiew-Wah Koay, North Dakota State University.

FOURTH PRIZE (\$200)—"Synthesis of Blocked MDI Adducts, Their DSC Evaluation and Effect of Pigmentation"—Taki J. Anagnostou, Wyandotte Paint Products Co., Troy, MI, and Ernest Jaul, Union Carbide Corp., South Charleston, WV.

Ernest T. Trigg Awards

Presented annually, these awards are for the two Secretaries of Constituent Societies of the Federation who furnish to the *JOURNAL OF COATINGS TECHNOLOGY* the most interesting reports of Society meetings and discussions following the presentations of papers at those meetings. Consideration is given in the judging to general reporting and reader interest, reporting of technical papers and discussions, completeness of coverage and promptness.

Winners for 1980 were:

FIRST PRIZE (\$100)—Romer E. Johnson (Dorsett & Jackson, Inc.), Secretary of the Los Angeles Society.

SECOND PRIZE (\$50)—R. H. Kuhnen (Tioxide, Inc.), Secretary of the Montreal Society.

Program Theme Announced and Papers Invited For 1981 FSCT Annual Meeting in Detroit

The 1981 Annual Meeting of the Federation of Societies for Coatings Technology will have as its theme, "Challenge, Change and Opportunity," it was announced by Program Chairman Thomas J. Miranda, of Whirlpool Corp.

The Annual Meeting will be held in conjunction with the Paint Industries' Show at Cobo Hall, Detroit, Mich., on October 28, 29, and 30.

The theme reflects a positive viewpoint of the coatings industry future in the decade of the 80's, and program sessions will focus on such topics as innovations in research, meeting the challenges of regulatory compliance and hazardous waste disposal, and analyzing and responding to causes of industrial and trade sales coatings failures (particularly, coatings failures on steel and wood substrates).

Prospective speakers are invited to present original papers on the many and varied aspects of the theme, and are requested to submit abstracts for review to Dr. Thomas J. Miranda, FSCT Program Chairman, c/o Elisha Gray II R&E Center, Whirlpool Corp., Monte Rd., Benton Harbor, Mich. 49022. *Deadline for receipt of abstracts is March 1.*

Assisting Chairman Miranda in developing the program is Steering Committee composed of: John C. Ballard (Vice-Chairman), Kurefs Coatings, Inc., Louisville, Ky.; Darlene Brezinski, DeSoto, Inc., Des Plaines, Ill.; Peter Hiscocks, Canadian Industries Ltd., Toronto, Canada; Percy E. Pierce, PPG Industries, Inc., Allison Park, Pa.; Theodore Provder, Glidden Coatings & Resins Div., SCM Corp., Strongsville, Ohio; and Walter Stuecken, Grow Group, Inc., Troy, Mich.



Thomas J. Miranda (right) accepts the 1980 George Baugh Heckel Award from Stanley LeSota, Chairman of the Heckel Award Committee



Union Carbide Award was presented to the Chicago Society for its efforts in compiling the *Infrared Spectroscopy Atlas*. Accepting the award from President Larson are John T. Vandeberg (left), Chairman of the Atlas Subcommittee, and Wally Krason, also of the Chicago Society

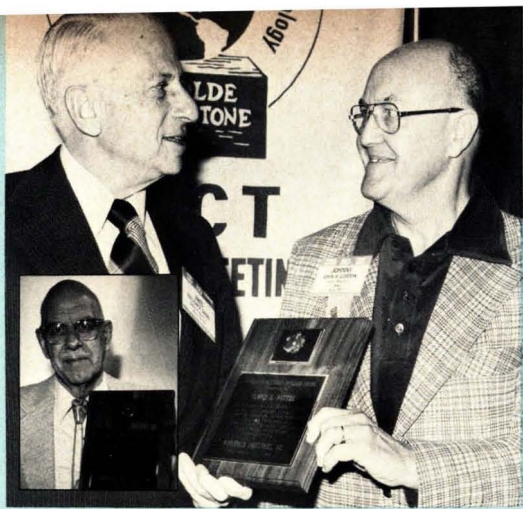
Umberto Ancona (right), Chairman of the 1980 Roon Awards Committee, presented the awards to the winners (left to right): Loren Hill (co-author with S. Peter Pappas, First Prize); Albert L. Rocklin (co-author with David C. Bonner, Second Prize); and Zeno W. Wicks, Jr. (co-author with Chiew-Wah Koay, Third Prize). Not present were Taki J. Anagnostou and Ernest Jaul, Fourth Prize



Incoming Federation President William Ellis (left) presents the Distinguished Service Award to Elder Larson for his "valuable contributions while serving as President during 1979-80"



President Larson presents 1980 Mattiello Memorial Lecturer Percy Pierce with a certificate of appreciation for his presentation, "Physical Chemistry of Cathodic Electrodeposition"



Temple C. Patton was the recipient of Morehouse Industries' 'Golden Impeller Award'. Accepting the award from Selection Committee Chairman John Gordon (right), is Fred Daniel, who subsequently presented the award to Mr. Patton at his home in New Jersey (see inset)



Program Awards for best presentation of Society papers were presented by Gordon Allison (left), Chairman of Program Awards Committee, to Patricia Shaw, of Golden Gate Society, and Charles Aaronson, accepting for Maureen Lein, of New England Society



Horace Phillip (left), Chairman of the A.F. Voss/American Paint Journal Awards Committee, with winners: T. Kirk Hay, accepting for Chicago Society; Patricia Shaw, accepting for Golden Gate Society; and Charles Aaronson, accepting for New England Society



Albert Seneker (right), Chairman of the 1980 Trigg Awards Committee, presented certificates and checks for the best Society reports to Romer E. Johnson, Secretary of Los Angeles Society (First Prize); and Rob H. Kuhnen, Secretary of Montreal Society (Second Prize)



President Larson presents Federation Honorary Member certificates to Howard Sholl (center) and Carroll Scholle (right), who were elected to that status during the Annual Meeting

MMA Awards

Established in 1975 by Materials Marketing Associates, these \$350 cash awards and plaques are for notable achievements by Constituent Societies of the Federation, other than Society papers presented at the Federation Annual Meeting.

Winners of the 1980 competition were:

Chicago Society, for the compilation of the *Infrared Spectroscopy Atlas for the Coatings Industry*.

Louisville Society, for the excellence of its educational programs.

Birmingham Club, for its preparation of audio-visual presentations on "The Setaflash Tester" and "An Introduction to the Paint Industry;" sponsoring the seminar, "Effects of Current Legislation in the U.K. upon the Industry;" and for developing procedures to serve as agents in the U.K. for marketing Federation literature and slide/tape programs.

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, develop-



Material Marketing Associates Awards were presented by MMA Awards Committee Chairman Tom Cochran (right) and MMA Executive Director John Paul Taylor (left) to winners (left to right): John Vandenberg, for the Chicago Society; John Bauer, for the Louisville Society; and John Hitchin, for the Birmingham Club

ment, manufacture, or application of the industry's products, or of the raw materials entering into their fabrication. The awards also commemorate the name of A.F. Voss, President of the American Paint Journal Co. from 1931 through 1969.

Winners in the 1980 competition were:

FIRST PRIZE (\$200)—"Renewable Resources for the Coatings Industry"—Chicago Society for Coatings Technology. (T. Kirk Hay, of The Sherwin-Williams Co., Chairman of the Committee).

SECOND PRIZE (\$175)—"Flash Rust Inhibitors: Some Amines and Organic Acid Salts"—New England Society for Coatings Technology. (N. Bradford Brakke, Lilly Chemical Products, Chairman of the Technical Committee).

THIRD PRIZE (\$125)—"Corrosion Inhibitive Performance of Some Commercial, Water-Reducible, Nontoxic Primers"—Golden Gate Society for Coatings Technology. (Patricia Shaw, Esselte Pendaflex Corp., Chairman of the Technical Committee).

Six Companies Share C. Homer Flynn Awards

Byk-Mallinckrodt Chem. Prod. GmbH, Filter Specialists, Inc., Macbeth Div., Kollmorgen Corp., Rohm and Haas Co., 3M/Chemical Resources Div., and Troy Chemical Corp. were recipients of the C. Homer Flynn Awards at the 1980 Paint Industries' Show of the Federation of Societies for Coatings Technology, held October 29-31 at the Civic Center, Atlanta, GA.

These annual awards are for outstanding exhibits in the Show on the basis of technical excellence, educational value, attractiveness, and novelty. In a departure from previous years, the awards were 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 Material Suppliers

SINGLE-BOOTH EXHIBITS: 3M/Chemical Resources Div., St. Paul, MN (2 years in the Show).

DOUBLE-BOOTH EXHIBITS: Troy Chemical Corp., Newark, NJ (27 years).

THREE-TO-FIVE-BOOTH EXHIBITS: Byk-Mallinckrodt Chem. Prod. GmbH, Melville, NY (16 years).

SIX-OR-MORE-BOOTH EXHIBITS: Rohm and Haas Co., Philadelphia, PA (45 years).

EQUIPMENT MANUFACTURERS: Filter Specialists, Inc., Michigan City, IN (8 years).

SERVICE INDUSTRIES: Macbeth Div., Kollmorgen Corp., Newburgh, NY (26 years).

Program Committee Awards

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

Winners for 1980 were:

FIRST PRIZE (\$100)—Maureen Lein (Polyvinyl Chemical Industries), New England Society.

SECOND PRIZE (\$50)—Patricia Shaw (Esselte Pendaflex Corp.), Golden Gate Society.



Paint Show Manager Frank Borrelle and Deryk Pawsey, Chairman of the Paint Show Committee, presented C. Homer Flynn Awards to six companies for the best exhibits in the Paint Show. Shown left to right are: Mr. Borrelle; Mr. Pawsey; Joseph Sullivan, of Rohm and Haas Co.; Wolfgang Zinnert, of Byk-Mallinckrodt Chem. Prod.; Daryl Smith, of Troy Chemical Corp.; E.L. Mainen, of Chemical Resources Div. of 3M Company; Ken Crombie, of Filter Specialists, Inc.; and Larry Sheets, of Macbeth, Div. of Kollmorgen Corp.

Peter V. Robinson Elected President of PRI For 1980-81

Peter V. Robinson, of Glidden Coatings and Resins Div., of SMC Corp., Strongsville, OH, was elected President of the Paint Research Institute of the Federation of Societies for Coatings Technology for 1980-81, at the Federation's Annual Meeting in Atlanta, GA.

Other officers elected to serve are: Vice-President—C. Malcolm Hendry, O'Brien Corp., Houston, TX; Secretary—Charles Kumins, Sherwin-Williams Co., Cleveland, OH; and Treasurer—A. Clarke Boyce, Nacan Products Ltd., Toronto, Ont., Canada.

The remaining Trustees are: Dr. Darlene Brezinski, DeSoto, Inc., Des Plaines, IL; Royal A. Brown, National Paint and Coatings Association, Washington, D.C.; Dr. Philip Heiberger, duPont Co., Wilmington, DE; Ruth Johnston-Feller, Consultant, Pittsburgh, PA; Dr. Orin C. Keplinger, Valspar Corp., Minneapolis, MN; Garmond G. Schurr, Sherwin-Williams Co., Chicago, IL; and Marco Wismer, PPG Industries, Inc., Pittsburgh, PA.

Dr. Raymond R. Myers, University Professor at Kent State University, Kent, OH, continues as Research Director of PRI.



The Federation sponsored a luncheon of the International Coordinating Committee during the Annual Meeting. Federation President Elder C. Larson (second from left) is shown with representatives of overseas groups. From left to right: Jacques Roire, a Past-President of FATIPEC, from Puteaux, France; Gert K. Thompsen, President of the Scandinavian Association, from Soborg, Denmark; David A. Kalwig, a Past-President of OCCA-Australia, from Victoria; and John Hitchin, President of the Federation's Birmingham (England) Club



The Manufacturing Committee's Seminar on Safety in the Paint Plant was one of the most popular sessions during the Annual Meeting. Panel members included Moderator Gilbert Cain, of Hercules, Inc.; Nelson W. Lamb, of Hercules, Inc.; Gabriel Malkin, of Jesse S. Young Co.; and Francis Gaugush, of Sherwin-Williams Co.

Executive Committee of the Federation for 1980-81. Top row (left to right): William Mirick, of Battelle Memorial Laboratories, Columbus, OH; Fred G. Schwab, of Coatings Research Group, Inc., Cleveland, OH; Joseph A. Bauer, of Porter Paint Co., Louisville, KY; and Immediate Past President Elder C. Larson, of Shell Development Co., Houston, TX. Bottom row (left to right): President-Elect Howard Jerome, of Spatz Paint Industries, Inc., St. Louis, MO; President William H. Ellis, of Chevron Research Co., El Segundo, CA; and Treasurer A. Clarke Boyce, of Nacan Products Ltd., Toronto, Ont., Canada



1980 Paint Show Exhibits

The 1980 Paint Industries' Show of the Federation of Societies for Coatings Technology was held at the Atlanta Civic Center, Atlanta, Georgia, October 29-31. With 141 exhibitors in 319 exhibit spaces, 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). We will forward all inquiries.—Ed.

ACETO CHEMICAL CO., INC. Flushing, NY 11368

The company is offering a wide range of Aziridine-based chemicals which offer significant advantages as adhesion promoters and as low-energy crosslinking agents. In addition, the exhibit features a variety of coatings raw materials. These include: titanium dioxide, organotin compounds, anti-skinning agents, electrostatic spray paint additives, and UV photoinitiators.

AIR PRODUCTS AND CHEMICALS, INC. Allentown, PA 18105

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

ALCAN INGOT AND POWDERS Union, NJ 07083

The company is featuring their water-dispersible aluminum pigments. Also being exhibited are non-leafing aluminum pigments for beautiful metallescent finishes. The economical use of aluminum pastes for roof coatings are on display. The firm's new Copper Flake Pigments for aerosols and marine boat bottom paints are also featured.

ALPINE AMERICAN CORP. Natick, MA 01760

The booth features the company's wide range of size reduction, air classification, and sieving equipment. Special emphasis is on the Circoplex ZPS Air Classifying Mill capable of grinding product 97% finer than 5 microns. Mikroplex MPVI Spiral Air Classifier, a self-contained unit which separates coarse and fines internally with a cut point from 200 down to eight microns, and Model AJS-200 Laboratory Air-Jet Sieve for sieving down to ten microns with precisely repeatable results are also displayed.

ALUMINUM CO. OF AMERICA Pittsburgh, PA 15219

The exhibit features aluminum pigmented roof coatings, maintenance paints, and automotive finishes. Specification and product data is available for all of the company's powder and flake grades.

C. M. AMBROSE CO. Redmond, WA 98052

Equipment on display includes the Model 322-F, a four-posted closer unit which can be supplied to seal both five-gallon plastic pails and metal lug lid containers, and the Model 315, a light liquid product filler for F-style containers. Also exhibited is one of the company's new light product filler sealers.

AMERICAN HOECHST CORP. Somerville, NJ 08876

The display emphasizes the use of opaque organic pigments for automotive, industrial, and trade sales coatings. A rainbow of colors has been created using Colanyl and Flexonyl water dispersions. The line of resins and additives is also on display, with emphasis on water-reducible and electro-deposition systems. Information on surfactants and thickeners is also available.

AMERICAN NEPHELINE CORP. Columbus, OH 43214

Comparative exterior exposures demonstrating the exterior durability characteristics of Minex nepheline syenite, Lawson-United feldspar and competitive extenders are featured.

APPLIED COLOR SYSTEMS, INC. Princeton, NJ 08540

The company is demonstrating the new ACS-550M color control system and the LABCAL/Production Control Software Package for the coatings industry. Designed for manufacturing operations requiring system access from multiple terminals, the 550M enables users to execute color control and auxiliary programs simultaneously.

ARMSTRONG CONTAINERS, INC. Westchester, IL 60153

The exhibit features the company's line of tin paint cans ranging in size from ¼ pint through 5 quart, and introduces their new, one-gallon plastic paint container, the "PAIL."

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

On display is a complete line of solvents, exempt solvents, and specialty chemicals for paint formulation. Information about the company's computerized reformulation service for paint manufacturers and 59 bulk plants located in major market centers around the country is also available.

ATLAS ELECTRIC DEVICES CO. Chicago, IL 60613

The exhibit features the all new CXW Solid State Sunshine Carbon Arc Weather-Ometer along with the Uvcon Fluorescent UV/Condensation Device, the UV2 mini version of the Uvcon, the Color-Chex Color Matching Booth and Panel-Rak display.

B.A.G. CORP. Dallas, TX 75228

The exhibit includes flexible semi-bulk material handling systems for storing and transporting dry, flowable solids. Featured are "Super Sack" containers.

BASF WYANDOTTE CORP. Holland, MI 49423

Organic yellows is the main theme of this booth. Two major areas are emphasized. The first is a presentation of the division's high performance pigments available to the producers of automotive, farm implement, and general industrial coatings where excellent opacity, durability and performance are required. The second major area exhibits the division's broad range of organic yellows for all types of trade sales coatings.

BELTRON CORP. Farmingdale, NJ 07727

Booth display introduces a new, automatic paint and stain filling machine with electronic, ultrasonic fill height control, providing high sustained accuracy and operational simplicity. This new generation filling system has only one wearing part, can be run by an inexperienced operator, and cleans up in less than two minutes in a can using minimum solvent.

BENNETT'S COLORANT DIV.
Salt Lake City, UT 84110

This exhibit features the new high-strength Decorator III Color System and Merchandising Aids plus Deltasperse, in-plant tinting colorants.

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

Products exhibited include the company's XLW Abrasive Liquids pump. This pump has been manufactured with wear-resistant parts and has been designed to handle abrasive liquids such as paints and inks. Other pumps for solvents, resins, and varnishes are also on display.

BRINKMANN INSTRUMENTS
Div. Sybron
Westbury, NY 11590

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

BROOKFIELD ENGINEERING LABORATORIES, INC.
Stoughton, MA 02072

The company is exhibiting a complete line of instrumentation for the measurement and control of viscosity. Featured is a cone and plate viscometer for the measurement of paint and paint products at defined shear rates less than 1 Sec⁻¹.

BUCKMAN LABORATORIES, INC.
Memphis, TN 38108

Featured are three new microbicides (Busan 85, Busan 42 and Busan 44) and a new, low cost dispersant (Busperse 203). As in years past, the usefulness of Busan 11-M1 in a variety of coatings is demonstrated. Buckman Laboratories is a manufacturer of microbicides, corrosion inhibitors, dispersants, defoamers, tannin stain blocking agents, a flame retardant and a UV light stabilizer for use in coatings formulations.

BURGESS PIGMENT CO.
Sandersville, GA 31082

Optiwhite, Optiwhite P and Tisyn are presented as functional pigments capable of reducing TiO₂ levels upward of 75 lb/100 gal without loss in wet or dry opacity. Cost savings are demonstrated to be substantial, while physical properties are improved. Key application areas covered include interior/exterior latex coatings.

BYK-MALLINCKRODT CHEM. PROD. GmbH
Melville, NY 11747

Byk VP-155, a unique, polymeric dispersant with properties like nonfoaming, impairing higher gloss and superior stability, is featured. For amine-neutralized, water-soluble systems, defoamer, Byk VP-020, is displayed. A new wetting and dispersing agent, Anti Terra VP-202 with anti-sag properties, is also shown. The display of instruments includes the Dynamometer as well as a line of gloss meters, including the new Pocket Gloss.

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

The thixotropic properties of Cab-O-Sil along with its unique flattening effect in water-reducible systems is illustrated. Technical papers on Cab-O-Sperse, a nonionic fumed silica dispersion, and a report on Cab-O-Sil thixated water-reducible alkyd enamels are available.

CARBORUNDUM CO.
Niagara Falls, NY 14305

The exhibit features the new Fulflo® Resin Bonded Filter Cartridge in grooved and ungrooved models in 10, 20, 30 and 40" lengths. Exhibit also includes displays of wound depth cartridges, disposable filter bags and Fulflo line of filter vessels.

CARGILL, INC.
Minneapolis, MN 55440

The newer high-solids, water-borne, powder, and UV-cure coatings are highlighted. Actual application, performance and cost comparisons and advantages are shown between the conventional and these newer coating technologies. A paint formulary is available to complement the "helping hand" theme that is offered to coating customers. New resins introduced are air-dry, high solids; urethane, silicone modified alkyd, baking polyesters, and polymeric melamine water bornes; and high-hardness powder resins.

CDI DISPERSIONS
Newark, NJ 07114

The exhibit includes information on a complete line of pigmented dispersions in a variety of vehicle systems. Carbon-black compounds and custom dispersions are a specialty and are tailored to customer's needs. Industries served include coatings, printing inks, plastics, textiles, foams, paper, building materials, and other areas of specialized applications.

CELANESE CHEMICAL CO., INC.
Dallas, TX 75247

514-516-518-520

New products and application technology for ultra violet and electron-beam cured systems for adhesives, inks, and coatings are displayed. Emphasis is given to the use of multifunctional acrylates, monomers, and esters in high solids and water-borne systems as possible solutions to energy conservation and environmental problems.

CELANESE POLYMERS & SPECIALTIES CO.
Louisville, KY 40208

515-517-519-521

While the exhibit features a broad line of coatings polymers, particular emphasis is given to water-reducible epoxies and curing agents for marine and industrial maintenance coatings, water-reducible acrylates for industrial baking and maintenance finishes and acrylated epoxies, acrylates and urethanes for UV/EB curing applications. Displays, highlighting specific performance characteristics of these various resins, are also featured.

CHICAGO BOILER CO.
Chicago, IL 60614

The exhibit features the horizontal Dyno-Mills and the "Red Head" small media mills. The various grinding media used with these mills are also displayed.

CLAWSON TANK CO.
Clarkston, MI 48016

Exhibit includes 50—50,000 gallon tanks and semi-portable Jumbo Bins and Drums.

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

On display is the popular Color Studio Trade Sales Program as well as an expanded Industrial Tinting System which offers a wide range of colors applicable to both trade and architectural applications.

COLUMBIAN CHEMICALS CO.
Tulsa, OK 74102

The company manufactures and markets complete lines of Raven® industrial furnace carbon blacks and Mapico® synthetic iron oxides. Highlighted this year are specialty pigments for industrial and trade sales applications, including a new electrically-conductive carbon, Conductex® 975 beads.

CORDOVA CHEMICAL CO.
Sacramento, CA 95813

This booth features polyfunctional aziridines, XAMA®-2 and XAMA®-7, for use as low-energy crosslinkers, adhesion promoters and polymer modifiers for coatings systems. Also featured are CORCAT® and the company's line of polyethylenimines.

COSAN CHEMICAL CORP.
Carlstadt, NJ 07072

The booth features C-Flocs—a group of cationic polymers for the primary treatment of latex wash waters. Personnel are available to discuss applications and equipment needed in order to obtain a total recycle process by use of C-Floc. Personnel are also available to discuss the firm's bactericides, fungicides, chemical specialties and catalysts and their application to your specific needs.

CUSTOM CHEMICALS CO.
Elmwood Park, NJ 07407

Mikrolour® AC, the newest addition to the line of Mikrolour pigment dispersions is highlighted. This aqueous dispersible color concentrate is available in micropulverized, nondusting powder, and custom particle forms. Pigment concentrations range from 30 to 65%. Mikrolour AC dispersions can produce opaque or transparent coatings of fine quality and appearance, as represented in the exhibit. The standard line of Mikrolour AC is augmented by a variety of custom formulas designed to meet customers' specific requirements.

DANIEL PRODUCTS CO.
Jersey City, NJ 07304

The latest Dapro Foam Suppressor, DF 1181, is featured. It provides both quick bubble release and suppression of foam buildup in water-soluble alkyd, acrylic, and polyester dip and flow coatings. Also, examples of the effectiveness of several additive lines are illustrated, including Slip-Ayd Surface Conditioners for improved resistance to marring and metal marking; Disperse-Ayd pigment dispersing agents for improved color development and increased compatibility; and Dapro Interfacial Tension Modifiers for reduction of cratering and crawling.

DEGUSSA CORP.
Teterboro, NJ 07608

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

DESERT MINERAL PRODUCTS CORP.
Ontario, CA 91762

Desertalc is displayed. Qualified technical and marketing personnel are on hand to answer any questions.

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

Two new products—ultraviolet (UV) curing agents and Capcure® accelerators for epoxy systems—are displayed along with the company's full line of performance dispersants, defoamers, wetting agents and fungicides. A live dramatization, coordinated with an audio-visual presentation, features Nopcosperse® N-44, the new universal pigment dispersant; Nopocide® N-96, a superb nonmercurial fungicide; and the Foamaster® series of anti-foaming agents. All demonstrate the division's problem-solving capabilities in coatings technology.

DIANO CORP.
Woburn, MA 01801

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

D/L LABORATORIES
New York, NY 10003

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

DOW CHEMICAL USA
Midland, MI 48640

This exhibit features chlorinated solvents, with emphasis on Chlorothene® and Methylene Chloride®. These nonflammable solvents are used to make nonflammable paints and coatings.

DRAISWERKE, INC.
Ramsey, NJ 07466

The company, a German manufacturer of wet milling and dispersing machinery, presents its newest additions to its product line. These additions include continuous agitation Bead Mills (Perl Mills) for heat sensitive and highly viscous products, as well as a Direct Dispersion Mill which completely eliminates all pre-mixing and pre-dispersing. The highlight of the exhibit is a newly designed Perl Mill which promises to increase versatility and simplicity of mill operation.

DRESSER MINERALS, INC.
Houston, TX 77005

EASTMAN CHEMICAL PRODUCTS, INC.
Kingsport, TN 37662

The exhibit features the new Ektasolve® EP solvents for water-borne coatings, as well as glycols for high-performance coatings, CAB for automotive sanding sealers and fast-dry wood coatings, CPO for water-resistant polyolefin coatings, and CAP for printing inks.

EBONEX CORP.
Melvindale, MI 48122

The company is displaying drawdowns and samples of a new series of water-dispersible, high-tint black pigments. Also shown is a line of black cement colors surpassing in both tint and temperature stability the historically used black iron oxides. Samples of test blocks using these pigments are available for examination.

ELCOMETER, INC.
Birmingham, MI 48012

The exhibit features the company's new 250 range of digital electronic gages; an improved version of the 150 Minitec analog gage; a new portable Ultrasonic gage, along with the well-liked Inspector and Elcometer gages. In addition, the several new models of thickness gages and adhesion testers that the company is introducing to the market are available to demonstrate.

ELEKTRO-PHYSIK, INC.
Virginia Beach, VA 23455

This company is well-known as a manufacturer of portable non-destructive instruments for the measurement of coating thickness on metals. The entire range of instruments is on display, including the Mikrotest, the electronic Minitest and Elektrotest, and the new budget-priced Certotest for paint measurement.

ENCAPSULAIR, INC.
Wheeling, IL 60090

The booth features an exciting breakthrough in paint technology that permits raw material cost reductions of up to 20% in latex flat paints. The company, a division of the Insilco Corp., Meridan, CT, is the exclusive U.S. distributor of Spindrift® beads, a licensed product of Dulux Australia Ltd. Spindrift® beads, used successfully in Australia for four years, are pigmented microvoid-containing beads that permit titanium dioxide (TiO₂), latex and extender pigment replacement for raw material cost reductions and improved product performance.

ENGELHARD MINERALS & CHEMICALS DIV.
Menlo Park, NJ 08817

The company's technical staff is available to answer questions and provide information about applications for its products: Attapulgit® Clays, often referred to as attapulgit, crystalline magnesium aluminum silicates with unusual colloidal and sorptive properties (used for thickening, stabilizing, suspending and flattening); Emtal® Talcs, hydrous magnesium silicates exhibiting soft tone and low abrasion (platy in character and processed in several grades to improve the application properties of trade sales paints, metal and industrial primers and enamels); and kaolins.

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

This exhibit features a new, laboratory, small-batch, media mill along with a cross-sectioned, production-size SWMill, designed to disperse hard to grind pigment and vehicle systems in an hour or less. Experts are on hand to discuss a full line of ball mills, mixers, sand mills, and media types.

FAWCETT CO.
Macedonia, OH 44056

On display are the company's air-driven stirrers and mixed flow impellers.

FEDERATED METALS CORP.
Subsidiary of ASARCO, Inc.
New York, NY 10271

Practical advice on application, handling, and storage of zinc dust is featured. Information on all of the various grades of zinc dust produced by the company is available.

FEDERATION OF SOCIETIES FOR COATINGS TECH.
Philadelphia, PA 19107

Featured is the revised book "An Infrared Spectroscopy Atlas for the Coatings Industry," authored by members of the Chicago Society. This 896-page volume contains over 1400 spectra and has a bibliography of over 1500 references. Also featured is the "Paint/Coatings Dictionary" and the new edition of "Pictorial Standards of Coatings Defects." The Federation slide/tape training programs are displayed along with various publications including the Journal of Coatings Technology, 27 units in the Federation Series on Coatings Technology, Color-matching Aptitude Test Set, and the 1980 Membership Directory (Year Book).

FILTER SPECIALISTS, INC.
Michigan City, IN 46360

Liquid bag-type filters are on display. Sizes range from miniature models to models with 3000 GPM capacity. Filter bags are available from 1 to 800 microns in a wide variety of shapes and sizes. Technical personnel are in attendance to help with any filtration applications or problems.

FRICKE ENTERPRISES CO.
Granite Falls, WA 98252

A new semi-automatic binary paint filling and closing machine, capable of filling and closing one gallon through one-half pint containers, is on display, as well as a new automatic five gallon labeling machine which labels five gallon containers prior to or after filling.

GAF CORP.
New York, NY

GARDNER LABORATORY DIV.
Bethesda, MD 20014

Come by and take a close look at the XL-805 Tristimulus Colorimeter utilizing proven optics and advanced microprocessor technology, as well as the Glossgard II Glossmeter, completely portable and self-contained, and the critical color-matching Colorgard Light Booth. A wide selection of equipment for precise measurement and assessment of appearance and color properties as well as physical testing, viscosity, and laboratory apparatus are displayed.

GEORGIA KAOLIN CO.
Elizabeth, NJ 07207

The company offers the largest selection of calcined, delaminated, and hydrated aluminum silicate extender pigments for use in the paint industry. The exhibit features a cost savings approach to formulating quality paints and coatings.

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

The exhibit features a new family of high efficiency, easy to disperse Syloid® flattening agents.

GRACO, INC.
Minneapolis, MN 55440

Featured are the Auto Tint 2000 automatic colorant dispenser and the Auto Spense 2000 high-speed paint mixer. The Auto Tint provides accurate repeatable tinting and enables the user to increase productivity, with a minimum of operator training. The Auto Spense mixes most trade paints in 15-30 seconds, quietly and efficiently.

HALOX PIGMENTS
Pittsburgh, PA 15220

Booth "program" includes demonstrations of nonlead pigment functionality as corrosion inhibitor, results of field exposure of primers and paint systems, and test results of pigments specific to tannin-stain blocking. Two new pigments are offered which give formulators greater range of use and easier balancing of composition in solvent-thinnable as well as water-emulsifiable and water-reducible systems. Improved stability and compatibility with a variety of vehicles is stressed.

HARSHAW CHEMICAL CO.
Cleveland, OH 44106

The exhibit features the company's full color palette for architectural, OEM and special purpose coatings. Highlights include the Color Concept Universal Colorant System; Aurasperse aqueous dispersions; Sun, Meteor, and Cadmium colorants; thermoplastic dispersions; and organic and inorganic colors. Visitors are invited to participate in a Color Clinic for confidential technical discussions.

HENKEL CORP.
Minneapolis, MN 55435

The Resins Div. exhibit segment (booths 624-626) presents G-CURE® acrylic resins for gloss retentive urethanes; Versamid® polyamide resins, the industry standards for industrial and maintenance coatings; Genamid® amidoamine resins for higher solids, higher build coatings; and Waterpoxy® resin systems, for CARB compliance in high-performance, water-borne and water-reducible coatings. The Chemical Specialties Div. portion of the exhibit (booth 628) features the numerous coating additives offered by the company.

HERCULES INCORPORATED
Wilmington, DE 19899

This exhibit demonstrates improved ways of using the company's products for coatings and ink industry applications. Emphasis on regulatory compliance appears in several displays featuring water-borne coatings based on nitrocellulose, pentaerythritol, Pamolyn® fatty acids, and Piccono® resin dispersions. Technology update information on specific coating materials such as rosin ester resins, hydrocarbon resins, Pulpex® synthetic pulp, Di-Cup® dicumyl peroxides, Natrosol® hydroxyethylcellulose, and Parlon® chlorinated rubber is also featured.

HILTON-DAVIS CHEMICAL CO. DIV.
Cincinnati, OH 45237

The theme of the exhibit is "New Waves in Colorants." Displayed is a broad spectrum of colorants for the coatings industry, including new and innovative concepts for water-based finishes of the future that offer the paint formulator *Choice with Consistency*. Highlighted are new and improved lead-free organic yellows and Trans-Oxide® Black.

HOCKMEYER EQUIPMENT CORP.
Harrison, NJ 07029

Featured is a demonstration showing the mixing action of a high-speed disperser and a Series 2000 agitator drive. The effects of baffles and variable speeds are also demonstrated.

HOOKER CHEMICAL CORP.
Niagara Falls, NY 14302

Ferrophos[®], an enhancer for zinc-rich protective coatings that improves improved weldability and topcoat ability, while retaining full corrosion resistance, is featured. This enhancer was developed as a partial substitute for zinc dust in zinc-rich primers.

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

Featured are low cost, amorphous, precipitated silica pigments. Information on reducing your TiO₂ cost with Zeolex[®] 80 functional spacer silicate, used in trade sales, latex, and solvent paints, is available. Data is featured on Zeothix[®] 265 precipitated silica in epoxy, polyesters, stains, and adhesives, for thickening applications; and for flattening applications, industrials, lacquers, urethanes, coil coatings, and water-borne systems, universal Zeothix[®] 95 precipitated silica produces excellent results.

HUNTER ASSOCIATES LABORATORY, INC.
Reston, VA 22090

The company exhibits their line of instrumentation which is directly related to the measurement of color and gloss of paints. This includes the D54P-5 Spectrophotometer, the D25-9 Microprocessor Colorimeter, and the D48 and D52 Glossmeters. Being introduced this year is the D25-9 Batch Correction System which is designed especially for the paint industry. It is programmed to determine what corrections should be made to a production batch in order to bring it within tolerance of a target color. The HunterLab D25-9 Tristimulus Colorimeter with batch correction programs stored on floppy diskettes offers the paint industry the means of quality improvement and cost reduction.

IDEAL MANUFACTURING & SALES CORP.
Madison, WI 53704

The company, a builder of filling and sealing equipment, has on display the semi-automatic SA 120 filling and sealing machine with simplified valving. Also on display are some options which are available for Ideal filler/sealers.

INTERNATIONAL MINERALS & CHEM. CORP.
NP & Industrial Chemicals Div.
Des Plaines, IL 60016
McWhorter Resins
Carpentersville, IL 60110

The display highlights the company's full line of "Chemicals for Coatings," including NiPar S-30[®] to lower formulation costs while providing superior film integrity; AMP-95, the all-purpose additive for coatings; BIOBAN[®] CS-1135, the nonmercurial in-can paint preservative; DMPA[®] for superior film properties in water-reducible alkyd resins; and TRIMET[®] for high gloss, durability, and gloss retention in alkyd resins. McWhorter Resins, the source of superior resins used in high solids, water solubles, and emulsions are also featured.

INTERSTAB CHEMICALS, INC.
New Brunswick, NJ 08903

Go one step beyond. Take a look at your future with the new world of Interstab, a manufacturer of a complete line of additives for the paint and coatings industry since 1931. See what we can do for you in the future. Interstab is a wholly owned subsidiary of Akzo Chemie, Amersfoort, The Netherlands.

IWI INDUSTRIES
Itasco Div.
Summit, IL 60501

The Itasco Div. displays one of its new, bulk-liquid, portable shipping tanks used for transporting various finished and raw materials to paint company customers. The Welleo Products Div. displays its new, high-impact, tank-cleaning, spray nozzle and its automatic, tank-washing equipment. Information relating to paint-stripping compounds is also available.

JAYGO, INC.
Hawthorne, NJ 07506

The exhibit includes equipment such as liquid strainers; drum and tub cleaning equipment; new, special inflation-fighting, high-speed dispersers, and multi-media mills; batch and continuous mixers/homogenizers; conical screw blender; and double-arm mixer/extruder mixer.

JOHNS-MANVILLE
Denver, CO 80217

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

KENRICH PETROCHEMICALS, INC.
Bayonne, NJ 07002

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

KTA-TATOR ASSOCIATES, INC.
Coraopolis, PA 15108

The company is exhibiting a comprehensive line of field coating inspection instruments. Included are equipment for ambient conditions, surface cleanliness and profile, wet and dry film thickness, adhesion, pinhole, and holiday detection. KTA coatings consulting, failure analysis and laboratory testing services are also presented.

LABELLETTE CO.
Forest Park, IL 60130

Featured in the exhibit are semi-automatic labeling machines for round and F-style containers from ounces to 5-gallon pails.

LIQUID CONTROLS CORP.
North Chicago, IL 60064

In addition to a series of positive displacement meters, the booth features the series 1000 Electronic Liquid Batch Controller. The LC series 1000 Batch Controller is designed for interfacing with LC positive displacement meters and control valves to provide a remote electrically controlled, accurate, reliable and (when desired) repeating batching system. Its design flexibility enables the Liquid Batch Controller to be incorporated in most all meter systems regardless of origin.

LORCON RESINS
Doral, Quebec, Canada

The booth illustrates the use of JK 270 resin, "the resin of the 80's." Typical sample drawdowns of alkyd, latex formulations and samples of alkyd paints to meet CARB rulings are displayed. JK 270 cuts RMC's, makes tougher, more resistant paints, and promotes better adhesion on a wide variety of surfaces. After ten years of development, JK 270 is now in volume use in the United States and Canada and is available through distributors everywhere.

3M CO.
Chemical Resources Div.
St. Paul, MN 55144

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

MACBETH DIV.
Kollmorgen Corp.
Newburgh, NY 12550

The company is exhibiting its new generation of high-speed, color-measurement instrumentation, the 1500 Series, with both colorimetric and spectrophotometric capabilities. The 1500 has the ability to make noncontact measurements, particularly useful for measuring material not yet completely dry, such as paint. Also exhibited are the SpectraLight Color Matching Booth and Munsell color standards and tolerances for visual color control, color vision testing, and color educational materials.

MANCHEM, INC.
Princeton Junction, NJ 08550

The exhibit features the role of metal organic compounds for the new coatings technologies for the '80s. New data is available about stable, cost effective curing of high-solids, water-reducible, and solvent coatings conforming to "CARB." Also noteworthy is information about new products to replace cobalt.

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

Featured are high quality zinc dust pigments produced at the company's West Virginia smelter. Included is its low micron, high metallic zinc dust. The company is a producer of zinc oxide. Zinc oxide specification sheets are also available at the booth.

MERCK & CO., CHEMICAL DIV.
Rahway, NJ 07065

Visit the booth and learn about the many Merck biocides and the know-how and lab services available for both formulation development and biocide effectiveness testing. Experts are also current on applicable government biocide regulations.

MGI INTERNATIONAL, INC.
Morris Plains, NJ 07950

The exhibit includes brochures and flyers featuring the newest A-PAR Model, the A-PAR MARK IV, designed to handle pollutants ranging in size from long strips down to particles of fibers, with a variety of applications: in newspaper pressrooms for folder dust, paint industry for picking up pigments, textile industry to handle various dust particles; and the pharmaceutical industry to pick up powder and dust of various types.

MILLER PAINT EQUIPMENT, INC.
Addison, IL 60101

The new AccuTinter Computerized Colorant Dispenser is demonstrated. It shows speed, accuracy, and ease-of-operation, and has electronic programming of formulas—one shot dispensing, and push-button operation for automatic tinting of fives, gallons, or quarts. High speed Gyromixers complete tinting and mixing operations within one minute. Various models of Gyromixers are demonstrated.

MiniFIBERS, INC.
Weber City, VA 24251

The company portrays a patriotic theme, complete with colors and election-year campaign, to promote its three newest members of the SHORT STUFF® family for use where bridging, viscosity, and increased thixotropy are needed. These new grades are shoo-ins for replacing mineral shorts.

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 Palmerton Publishing Co.

MOREHOUSE INDUSTRIES, INC.
Fullerton, CA 92633

Two divisions of the company are exhibiting. The Fullerton Div. features a 25 hp variable-speed dissolver, a new dual-shaft laboratory dissolver, and a variable-speed Pressure Sandmill. A new media cleaner is introduced. The Zeks Air Drier Div. is exhibiting three air driers of various designs and will feature its new heat sink unit with reduced energy requirements and anti-freeze design.

MYERS ENGINEERING
Bell, CA 90201

On display is a new four-motor disperser/mixer for extra high viscosity products. In addition to high-speed blades and a slow-speed sweep impeller, a medium-speed gate blade has been added to provide better intermixing throughout the batch. Also shown is a medium-size single-shaft disperser. Factory engineers are present to discuss dispersion or mixing problems.

NETZSCH INCORPORATED
Lionville, PA 19353

The exhibit features the company's newest horizontal convertible grinding mill. Media activation can either be accomplished by the Molinex eccentric ring agitation or, in the case of high viscosity, high solids and hard to grind materials, by the peg or John agitation systems. The 0.2 mm wide rotating ring slot type media separator permits the use of grinding media as fine as 0.8 mm in diameter. The isolation of the cassette-type, double-action mechanical seal provides for a very effective grinding process at relatively high pressures, resulting in higher gloss, increased color strength and maximum transparency.

NEVILLE CHEMICAL CO.
Pittsburgh, PA 15225

This exhibit encompasses the company's wide range of petroleum hydrocarbon resins, CUMAR® coumarone-indene resins and UN-ICHLOR® chlorinated paraffins. Of particular interest is technical information on the utilization of the firm's resins and chlorinated paraffins in coating systems and exempt solvents. Featured this year is a new, comprehensive products catalog. Technical representatives are on hand to discuss the company's capabilities and products for the coatings industry.

NL CHEMICALS
NL Industries, Inc.
Hightstown, NJ 08520

The exhibit features both new products and the versatility of current products. New Pourable MPA® a high performance easily incorporated thixotropic anti-settling agent is highlighted. The greater versatility of Rheolate® 1 liquid thickener in a wide range of coatings is shown. Improved corrosion resistance of coatings by using Nalzin® SC1 lead and chromate free corrosion inhibition pigment is demonstrated. The entire line of rheological additives, titanium dioxide pigments, and corrosion inhibitive pigments is shown and supported by an experienced staff of technical experts, demonstrating how to obtain economy through quality.

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

The company is exhibiting data on NYAD® wollastonite (calcium metasilicate) and Wollastokup® surface modified wollastonite. Technical data emphasizes wollastonite as pH buffer in acrylic and PVA systems; in zinc oxide-containing exterior house paints to prevent gelation; and in water-borne metal coatings aiding blister prevention. New data is available on surface modified wollastonite to aid corrosion resistance in industrial primers. Technical staff is present for discussion.

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

The company is exhibiting its universal filler, set up for five gallon filling with a new combination pail crimper and plastic lid press.

OMYA, INC.
Proctor, VT 05765

Featured are the Omycarb® series of fine and ultra-fine wet ground calcium carbonates for application in gloss, semi-gloss and flat trade sales and industrial finishes. The company also displays specially treated carbonates—WS and Albarex; Omycarb dry ground carbonates produced in California, and Vertal platy tales, from Vermont.

PAINT RESEARCH INSTITUTE
Philadelphia, PA 19107

A section of the Federation booth devoted to the Paint Research Institute features a sound, color film loop describing the use of an in-pedometer monitoring the liquid-to-solid conversion of coatings.

PENN COLOR, INC.
Doylestown, PA 18901

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

PENNSYLVANIA GLASS SAND CORP.
Pittsburgh, PA 15235

The exhibit features information documenting the benefits of using both Min-U-Sil (micron-sized silica) and Supersil (custom-ground silica) in both conventional and powder coatings.

THE PFAUDLER CO.
Rochester, NY 14603

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

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

A full line of inorganic color pigments and minerals for the paint industry are featured. PfferrisperseTM, a new cost-saving iron oxide slurry, is introduced.

PHOTOMARKER CORP.
Hawthorne, CA 90250

Products being displayed consist of three models of color analysis instruments, to meet the needs of varied industrial color quality control applications. All units are micro-computer based, providing full automatic operation, and operation by unskilled personnel. They are capable of evaluating all types of materials with assured accuracy and reliability. Instruments are lightweight and portable, for use in any type environment or location. The model PM 600, which incorporates a fiber optics sensor, and can measure samples as small as 2 millimeters, is introduced.

POLYCHROME CORP.
Yonkers, NY 10702

The Industrial Chemical Div. comprises Cellofilm Corp., Fayette Chemical Corp., and Cellomer Corp. Cellofilm and Fayette offer industrial grade nitrocellulose and nitrocellulose solutions. Featured are CellovacTM plasticizers for fingernail lacquer formulations. Plants are located in Wood-Ridge, NJ and Chicago. Cellomer manufactures coating vehicles, principally alkyd resins, in Newark, NJ. Featured are new high-solids resins for industrial coatings along with UvimerTM resins for radiation-curable coatings, inks, and adhesives.

POLYVINYL CHEMICAL INDUSTRIES
Wilmington, MA 01887

Featured are proven performance polymers: Neocryl A-600 series water-borne acrylics meet the diverse performance requirements for multiple substrates; Neorez R-9000 series water-borne urethanes offer flexible, yet hard, films with superior exterior durability properties in both aliphatics and aromatics; and Neocryl A-623, a new water-borne polymer that has the unique combination of solvent, water and humidity resistance with superior hardness development for coating metal and plastic.

PPG INDUSTRIES, INC.
Pittsburgh, PA 15222

Lo-Vel[®] flattening agents for coil coatings, lacquers, clear finishes, textured finishes, vinyl, and furniture are featured. Also shown is Hi-Sil[®] 422 silica paint pigment for flat and semi-gloss latex interior paints, latex exterior paints, oil-based house paints, and traffic paints. Hi-Sil[®] T600 synthetic thickener and thixotrope provides anti-sag action on vertical walls and keeps coarse particles in suspension in paints.

PREMIER MILL CORP.
New York, NY 10001

The newly updated Supermill, a horizontal media mill with a unique automatic wash/flush system for easy product changeover and new electrical control logic for automated operation, is displayed. A new 1.5 liter horizontal pilot plant/lab unit is also featured. Current models of vertical pressure sealed media mills are shown, as well as colloid mills and dispersators with all accessories.

Q-PANEL CO.
Cleveland, OH 44135

On display is a new sample frame which doubles the test capacity of the QCT Cleveland Condensation Tester. The new design retains the compactness, low maintenance, and fast corrosion testing of the QCT—and it can be retrofitted to existing cabinets. Also displayed is the QUV Weathering Tester which simulates rain or dew by the same condensation system as the QCT, and in addition simulates the damaging effects of sunlight with fluorescent UV lamps.

QUACKENBUSH CO.
Arlington Heights, IL 60004

A latex pump that produces no shear and uses no air is the first of two new products exhibited. The other is a line of complete filtration equipment for paints and resins.

REICHARD-COULSTON, INC.
New York, NY 10010

In addition to the company's full line of natural and synthetic iron oxide pigments, the display features the new Super Strength Iron Oxides. There is also an exhibit of "317" Zinc Phosphate, a nontoxic, anti-corrosive pigment, and "316" Miox[®], a lamellar-structured iron oxide used for the protection of steel subjected to heavy corrosive atmospheres.

REICHOLD CHEMICALS, INC.
White Plains, NY 10603

The booth features a conference center where Reichhold Chemicals representatives, and representatives from Reichhold Limited of Canada, are ready to discuss the latest developments in RCI's full line of chemical coatings, emulsions, and colors. The display features important additions in water-reducible resins and emulsions, epoxy resins and hardeners, and Varecum[®] metal coating resins.

ROHM AND HAAS CO.
Philadelphia, PA 19105

This exhibit is of interest to those involved with industrial, trade sales, and maintenance coatings. Displays demonstrate the performance of high solids and aqueous vehicles which can be air-dried or baked. Rhoplex AC-64 acrylic emulsion for multi-purpose use, as well as Rhoplex AC-417 for interior gloss and egg shell and Rhoplex MV-23 for stain blocking are shown. Exposure panels with paints at various RMC levels are used to compare 100% acrylic vehicles with other types. New products introduced include high gloss and acrylic epoxy vehicles.

SCHOLD MACHINE CO.
St. Petersburg, FL 33702

This display features the F-600 variable high-speed pressurized media mill with new screen assembly and the VHS 20 HP variable high speed disperser with a range of 6 to 1.

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

The exhibit introduces the Air-Pallet System, an effective new method of packaging, handling, and shipping such powdered products as pigments, clays, carbon blacks, calcium carbonate, resins, silicas, and other materials. The Air-Pallet is a reusable container comprising heavy-duty PVC coated fabric, and incorporating a unique pallet with built-in fluidizing floor and discharge port. Since filling and unloading operations are completely enclosed, highly effective dust control is achieved at point of origin and destination.

SHAMROCK CHEMICALS CORP.
Newark, NJ 07114

This company specializes in the accurate control of fine particle size to provide easily dispersible wax, polyethylene, and PTFE powders for improvement of mar and abrasion resistance in industrial finishes and printing ink. Technical people are on hand in the booth to discuss product application.

SHELL CHEMICAL CO.
Houston, TX 77002

"Partners for Success" is the company's theme in the exhibit which features highlights of Epon® related epoxy resins and a full line of coatings solvents. Featured are powder coatings, water-borne coatings and new computer technology which takes advantage of the company's depth of knowledge in solution theory. A new computer program is demonstrated (live) which calculates evaporation of solvent blends of up to 10 cosolvents, taking into account effects of humidity on aqueous and other humidity sensitive organic blends.

SILBERLINE MANUFACTURING CO., INC.
Lansford, PA 18232

The display presents aluminum pigments to enhance coatings—featuring the pinnacles of quality technology, EternaBrite leafing grades and Sparkle Silver nonleafing grades. The 1980 EternaBrite story is related through comparative panels and technical data. Coatings formulated with Sparkle Silver grades display their different and appealing aesthetics. Panels and data on all Silberline aluminum pigments are available. Technical personnel to discuss any facet of metallic coatings formulation are present.

SOLEM INDUSTRIES, INC.
MetalGlas Products Div.
Atlanta, GA 30340

The MetalGlas Products Div. features information on their complete line of 275 to 850-gallon high shear mix systems and holding tanks. The company's resin tote bins and storage vessels reduce resin costs through bulk purchasing. Solem Industries supplies information on alumina trihydrates, for a new look at flame retarding and smoke suppression in resin systems.

SOUTH FLORIDA TEST SERVICE
Miami, FL 33178

A technical representative of the company is available to discuss the latest exposure procedures and experimental test methods being employed by its facilities in Florida and Arizona, and to report on the status of current correlation studies involving programmed environmental testing.

SOUTHERN CLAY PRODUCTS, INC.
Gonzales, TX 78629

The exhibit presents organophilic clays for the coatings industry, featuring Claytone 34 and Claytone 40, new organo clays.

SPENCER KELLOGG DIV.
Textron, Inc.
Buffalo, NY 14240

The theme, "We'll see you through with Resinvision," stresses the company's philosophy of working with the customer on every aspect of resin needs. The new, water-dispersible urethane line, along with other WD's, high solids, and two-component systems, is illustrated in the exhibit. Technical service people for each product group are on hand to discuss applications and "... see you through with Resinvision."

SUN CHEMICAL CORP.
Pigments Div.
Cincinnati, OH 45232

A pictorial display highlighting the company's commitment to "research, regulation, and resources," and the changing needs of the '80s is exhibited. Panels featuring a complete line of organic pigments for many types of coatings are on display. Literature on specific pigments systems and uses, as well as current environmental information, is available.

SWECO, INC.
Los Angeles, CA 90051

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

TENNECO CHEMICALS, INC.
Piscataway, NJ 08854

The exhibit features the introduction of a new, industrial color system in addition to illustrative information and display material on all the company's colorants for industrial, trade sales, and on-the-job tinting along with chemical additives for the coatings industry.

THIBAUT-WALKER CO.
Newark, NJ 07101

New applications for the company's recently expanded line of 100% acrylic emulsions are displayed, representing the firm's dedication to the "Three R's for the Eighties." Also on hand are examples of the company's alkyds, polyurethanes, polyvinyl acrylics, and specialty products which have made possible one century of successfully dedicated service to the coatings industry.

THIELE ENGINEERING CO.
Minneapolis, MN 55435

The Neumo Twin Head Automatic Filler (AF-2) for half pint through gallons, with lid-handling equipment, is demonstrated. The versatile Semi-Automatic Filler (SAF) is shown along with an Automatic Closing Machine (AC-9) for half pint through gallon, and a Closing Machine (AC-1C) for five-gallon pails.

TOKHEIM CORP.
Meter Div.
Ft Wayne, IN 46801

The exhibit features industrial liquid meters. Designed for paint products and related chemical liquids, meter sizes are available for flow rates from 0.2 GPM to 750 GPM. Accessories available include automatic temperature compensators, pulsers, flow rate indicators, flow control valves, direct or remote mounted preset control units, ticket printers, and air eliminators and strainers.

TROY CHEMICAL CORP., INC.
Newark, NJ 07105

Biocides which are featured include: CMP Acetate; nonmercurial preservatives Troysan 174 and 192, Troy's premium liquid nonmercurial fungicide, Polyphase Anti-Mildew, and sanitizing agent Troysan 364. Also featured are problem-solving additives, including bodying agent 42-BA, a single-component liquid post add for alkyd systems; Perma Dry, an effective lead-free loss-of-dry inhibitor; and the company's full line of defoamers and anti-cratering agents for water-based industrial and trade sales paints. Technical personnel are available to discuss specific problems.

UNION CAMP CORP.
Wayne, NJ 07470

The exhibit features UNI-REZ polyamide resins, tailor-made for high solids and for weatherable epoxy coatings. UNI-REZ polyamide resins are derived from trees—the renewable, natural resource grown in the U.S.A.

UNION CARBIDE CORP.
New York, NY 10017

The exhibit features materials for conventional coatings, industrial finishes, and trade paints. New opportunities for coil, wood, and product finishes are presented. Special emphasis is given to cost/performance opportunities of Ucar Acrylics for trade paints. The Captain's 15th Annual Putting Contest is being held—with golf pro Johnny Pott giving tips on Wednesday.

UNION CHEMICALS DIV.
Union Oil Co. of Calif.
Schaumburg, IL 60196

Vinyl-acrylic latex polymers are featured, along with the research and development and manufacturing capabilities of the company. Dart contests are being held, with prizes offered to the winners.

UNION PROCESS INC.
Akron, OH 44313

Exhibited are various types of equipment for dispersing and grinding: batch, continuous, and circulation processing. The ultimate grinding, dispersing, and mixing is obtained in attritors. Processing equipment is available for applications from laboratory experiments to large scale production.

UNIROYAL CHEMICAL CO.
Naugatuck, CT 06770

Polywet® dispersants, a tool for solving production bottlenecks, color acceptance, cratering, foaming, and low gloss problems, are featured. Polywet emulsifiers, for nonfoaming, highly stable paint latexes, are also exhibited.

UNITED CATALYSTS INC.
Louisville, KY 20232

The exhibit includes information on Tixogel, organophilic clays for solvent and water-based coatings. The booth features the company's new plant at Louisville and information on sales representatives throughout the U.S. and Canada.

UNIVERSAL COLOR DISPERSIONS
Lansing, IL 60438

The exhibit introduces the company's new V-line (volumetric) colorant for use in industrial, marine, and heavy maintenance coatings where liquid volume dispensing is required. Colorants are rigidly controlled for color, strength, and viscosity to insure excellent reproducibility. A flattening base plus 14 colorants are offered. High loading of colorant permits simplification of inventory, as only a clear base and/or one white base are necessary to obtain the range of colors usually offered by manufacturers.

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

The exhibit features Vantale 6H a recently introduced high fineness, high oil absorption magnesium silicate extender pigment. Also on display is a slide presentation illustrating the mining and manufacturing facilities for products offered to the coatings industry.

VIKING PUMP DIV.
Houdaille Industries, Inc.
Cedar Falls, IA 50613

On display are cutaway models of internal and external gear pumps which show the company's total problem-solving approach for industry. The 624 series is especially developed for handling paints, inks, solvents, and abrasive liquids.

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

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

WACKER CHEMICAL CO.
New York, NY 10017

On exhibit is a visual display of applications for H.D.K. fumed silicas, with particular emphasis toward the paint industry. Technical literature and staff are available.

THE WARREN RUPP CO.
Mansfield, OH 44905

The booth contains operating displays of air-powered, double-diaphragm pumps featuring the VIP Model with Teflon diaphragms, ball valves, and gaskets for corrosive or volatile products which are self-priming and explosion-proof.

WILDEN PUMP & ENGINEERING CO.
Colton, CA 92324

On exhibit are cut-away working models of unique air-operated double diaphragm, positive displacement pumps. The four sizes of pumps on display are submersible, self-priming, and designed to handle very thick and abrasive, as well as highly shear-sensitive, products. They are available in optional alloys and elastomers to handle most erosive and corrosive applications. The company is also featuring models of the M-2, M-4, and M-8 teflon diaphragms. In addition to a powder pump display, the revolutionary Sentry I surge suppressor is shown.

ZORELCO LTD.
Cleveland, OH 44125

This display features a new product line of inexpensive measuring and testing instruments, a new wet film thickness micrometer, a new single contact magnetic coating thickness gage, a new porosity detector, a new high voltage holiday detector, plus other digital, analog, and magnetic coating thickness gages.

**UCAR[®]
ACRYLICS.
OUT OF
THE RED
AND INTO
THE BLACK.**

Ask your local Union Carbide Sales Representative to show you how the Acrylics of the Future can put profit making back into paint making.



Because no single polymer can meet all your formulating needs, we offer...



NEOCRYL solid resins are acrylic copolymers supplied in a dry, free-flowing form. Dissolved in appropriate solvents such as aliphatic or aromatic hydrocarbons, alcohols, esters and ketones, they provide the base for formulating high-performance

lacquers, inks, adhesives and specialty coatings. The beads are available in a number of grades with varying hardness, flexibility and solubility characteristics. They have wide compatibility with

Here's what our NEOCRYL acrylic polymers offer:

B-700 Medium-hard resin with solubility in a wide range of solvents including weak aliphatics and alcohols. Compatible with nitrocellulose and cellulose acetate butyrate. Used in adhesives and coatings for plastics sensitive to strong solvents.

B-705 Harder (than B-700) resin, soluble in mineral spirits with high solids at application viscosity. Used in top coatings for plastics and wood parquet floor dressings.

B-723 Tough, flexible resin with superior adhesion to bare and treated metals. Compatible with nitrocellulose and vinyl. Used in top coatings on aluminum, brass, chrome and steel.

B-725 Fast-dissolving general purpose resin with rapid solvent release, excellent print resistance and exterior durability. Compatible with cellulose, vinyl and chlorinated rubber. Used in industrial lacquers, aerosols and inks.

B-728 Hard, chemical resistant resin compatible with nitrocellulose, vinyl and silicone. High hardness and excellent color. Blended with vinyls for barrier top coatings on vinyl fabrics.

B-734 Blending resin having wide compatibility with short and medium oil alkyds for faster dry times and improved exterior durability. Excellent pigment wetting properties.

the NEOCRYL series of free-flowing solid acrylic resins for solvent applied coatings.



other resins and plasticizers, permitting further modification to achieve the exact properties desired. Lacquers based on NEOCRYL solid beads can be used as clears or easily pigmented to

achieve high gloss durable finishes. As a class, they offer outstanding abrasion resistance and excellent resistance to water, alcohol, acids and chemical fumes.

B-735 Fast-dissolving general purpose resin with good solvent and gasoline resistance and quick solvent release. Used in automotive and industrial lacquers, aerosols, inks and coatings for plastics.

B-745 Tough resin with high solids at application viscosity, outstanding adhesion to metals. Compatible with cellulose and vinyl. Used for heavy duty machinery and transportation lacquers.

B-750 Fast-dissolving resin with extremely quick solvent release and high alcohol tolerance. Compatible with cellulose, chlorinated rubber and vinyl. Used in overprint varnishes and flexographic inks.

B-1000 Clear, tough resin with excellent nitrocellulose compatibility. Used in extending nitrocellulose and upgrading gloss of pigmented lacquers.

B-1041 Tough, high-molecular-weight resin for top coatings on vinyl fabrics where barrier and dielectric heat sealing properties are required. Excellent abrasion and block resistance.

B-1042 Flexible, tough, medium-molecular-weight resin with excellent adhesion. Used for heat seal lacquers on treated aluminium foil and flexible plastic substrates.

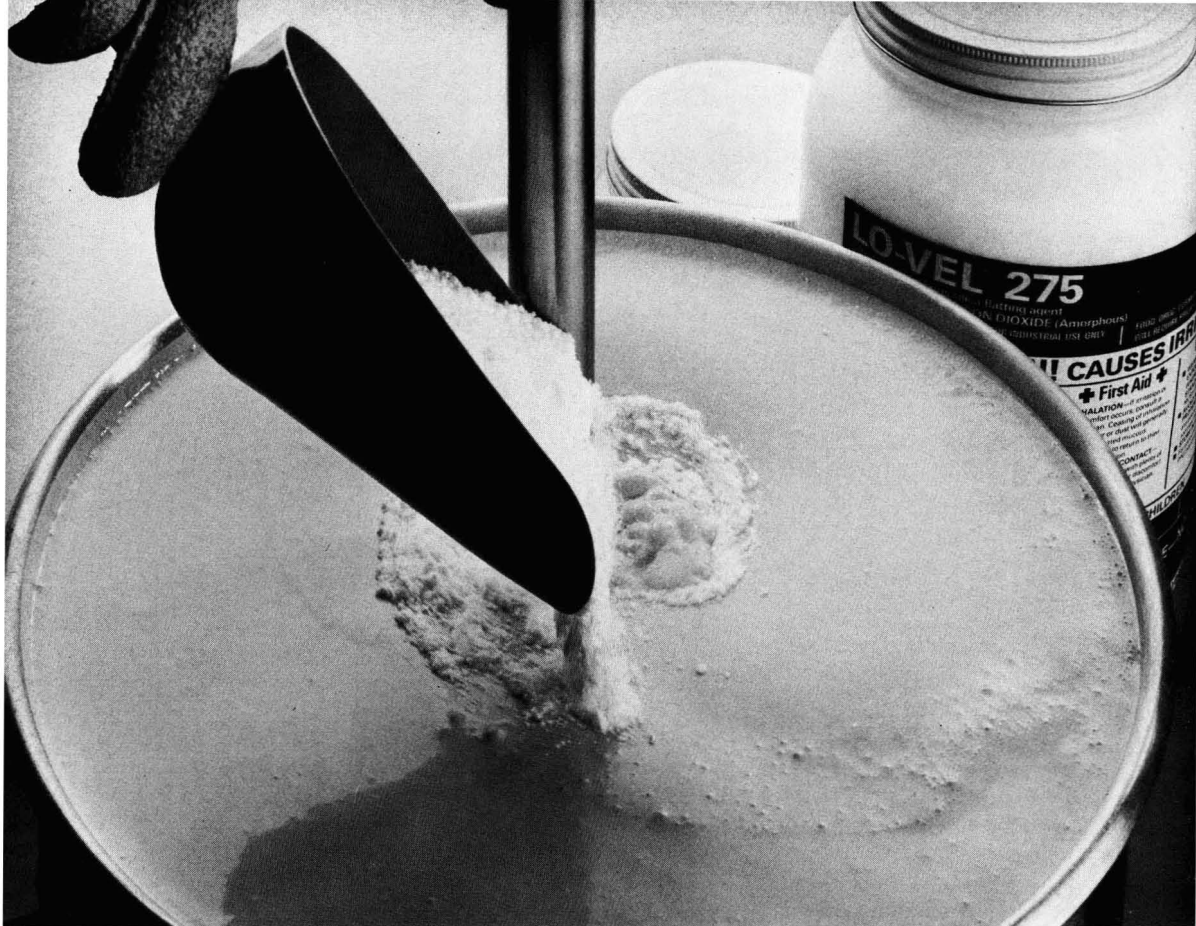
Write for more detailed information. Let us help you select the best NEOCRYL solid resin to meet your formulating needs.

Polyvinyl Chemical Industries

Dept. SR-3, 730 Main Street, Wilmington, Mass. 01887
Telephone: (617) 658-6600



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And the most versatile, too. You can use it to formulate Hegman 6 coil coatings or any of a wide range of other coatings requiring an exceptional flattening agent.

Lo-Vel 275 is so efficient that a two-thirds loading can reduce gloss just as well as the full amount of silica hydrogel you use now.

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Add that kind of efficiency to the reduced initial cost of Lo-Vel 275, and the result is a substantial

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PPG: a Concern for the Future

Chemicals 
INDUSTRIES

Primary Amine Zwitterion Copolymers

Zeno W. Wicks, Jr. and Chiew-Wah Koay
North Dakota State University*

A copolymer of the vinyl ester of trimellitic acid anhydride and butyl acrylate was reacted with 2-amino-2-methyl-1-propanol to give a zwitterion copolymer with pendant half esters of 2-amino-2-methyl-1-propanol. The copolymer is soluble in 2-butoxyethanol. When diluted with water, it generally behaves in a similar manner to that resulting when amine salts of "water-soluble" acrylic resins in cosolvent are diluted with water. Films of the copolymer with pTSA catalyst crosslink, when cured for 30 min at 150-175°C, give solvent rub resistance and hardness comparable to a conventional water soluble acrylic with hexamethoxymelamine, without emission of amine or formaldehyde.

INTRODUCTION

Increasingly stringent limitations on the emission of volatile organic compounds (VOC) into the atmosphere have led to the development of "water soluble" industrial baking enamels. Typically, the vehicle in such a system is an acrylic or polyester resin with pendant hydroxyl and carboxylic acid groups. The resins are generally prepared as high solids solutions in a cosolvent (an ether-alcohol or an alcohol) and partially neutralized with an amine such as 2-N,N-dimethylaminoethanol (DMAE) or 2-amino-2-methyl-1-propanol (AMP). Usually a melamineformaldehyde resin, such as hexamethoxymethylmelamine (HMMM), is used as a crosslinking agent. The system is diluted to application viscosity with water. During cure at least part of the amine is volatilized and crosslinking between HMMM and the resin occurs.

During the HMMM crosslinking reactions, methanol and formaldehyde are evolved.¹

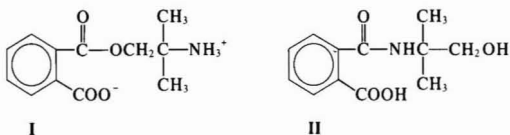
It would be desirable to have a similar system in which amine would not be volatilized during cure. Any volatile amine must be included in calculation of VOC content of the coating. If none volatilized, more cosolvent could be used (or lower VOC's might be possible). Also it has been reported that secondary and tertiary amines undergo photochemical reactions under atmospheric conditions to yield nitrosamines and nitramines.²

A possible approach to attaining "solubility" without use of a volatile amine could be to make a "zwitterion" type copolymer in which both the amine and the carboxylic acid are attached to the resin by covalent bonds. Van Westrenen reported the synthesis of such a polymer by reacting a maleated epoxy ester with DMAE.³ While the resin was water soluble, it did not cure sufficiently with melamine resin due to the retarding influence of the (tertiary) amine group. Earlier research studied the relationship between amine solubilizer structure and cure of water soluble acrylic-HMMM systems.⁴ It was found that when a primary amino-alcohol (AMP) was used as a solubilizer, crosslinking increased. In fact, there was some crosslinking even without HMMM. Presumably, this resulted from reaction of the alcohol group with the acrylic resin to give an ester and of the primary amine group with another molecule of acrylic resin to give an amide or imide. Woods also has reported a greater degree of cure when AMP is used as a solubilizer for water soluble coatings in comparison with DMAE.⁵ It, therefore, seemed possible that a zwitterion polymer containing an ester of AMP and free carboxylic acid might provide a water soluble polymer which would crosslink during cure without emission of amine or formaldehyde.

In other studies, it was found that phthalic anhydride reacts with AMP at 80-120°C to yield the aminoester zwitterion I rather than the half amide II.⁶ Therefore, it

Presented by Dr. Wicks at the 58th Annual Meeting of the Federation of Societies for Coatings Technology in Atlanta, GA, October 31, 1980.
* Dept. of Polymers and Coatings, Fargo, ND 58102.

was decided to synthesize a resin with a structure like I attached to the copolymer backbone.



EXPERIMENTAL

Vinyl Ester of Trimellitic Acid Anhydride (VTMA)

The procedures reported in the literature^{7,8} were modified for convenience. A mixture of 249.5 g (1.8 mole) of trimellitic acid anhydride (TMA) and 990 g (11.5 mole) of freshly distilled vinyl acetate was stirred and heated at reflux for 3 hr. After cooling to 55°C, 7.62 g of mercuric acetate was added and 20 min later 0.72 ml of conc. H₂SO₄ was added dropwise. The reaction mixture was then heated for 30 hr at 55°C with a slow sweep of N₂. Then, 4.2 g of sodium acetate trihydrate was added and the solution was filtered. After standing at room temperature overnight, 20 g of unreacted TMA crystallized out and was removed by filtration. When the filtrate was cooled in a dry ice-acetone bath, VTMA crystallized out and was recovered by filtration. The yield of crude VTMA was 314 g (80% of theory) and it had a melting point of 118–123°C. The crude VTMA was recrystallized three times from a mixture of chloroform and benzene. The yield was 239 g (61%) of product with mp 127–129.5°C (lit⁹ 129.5°C). The anhydride equivalent weight, as determined by reacting with excess morpholine⁵ at 25°C for 0.5 hr in methanol, was 221 (calcd 219).

Copolymerization of VTMA and Butyl Acrylate (BA)

Solutions were prepared of 799 g (6.2 mole) of freshly vacuum distilled BA in 230 ml of acetonitrile and 340 g (1.56 mole) of VTMA, and 51.2 g (4.5% of total monomers) of azobisisobutyronitrile in 850 ml of acetonitrile. About 5% of each solution was charged into a flask and while stirring was heated to reflux (85°C). After refluxing for 30 min, addition of the BA and VTMA-initiator solutions from separate dropping funnels was started. The two solutions were added, in proportion to their volumes, over a period of 6 hr while maintaining the reaction at reflux temperature (approx 85°C). Heating was continued for an additional 16 hr. In order to separate the polymer from unreacted monomers, 500 ml of n-heptane was added. A viscous yellowish layer separated. After decanting off the supernatant layer, the polymer phase was washed with three 500 ml portions of hot n-heptane. After removing solvent under vacuum, the yield of polymer was 950 g (80%). The presence of anhydride groups was confirmed by IR absorption at 1850 and 1775 cm⁻¹. The acid number was 125 mg of KOH/g of polymer solids (expressed as acid equivalent weight, 446) and the anhydride equivalent weight was 898 based on polymer solids. Thus, within experimental error, all of the acid was present as anhydride. Based on the equivalent weight, the mole ratio of VTMA/BA in

the copolymer was 1/5.3, whereas the starting monomer ratio was 1/4. Gel permeation chromatography showed a single fairly broad peak, \bar{M}_w , 24,200; \bar{M}_n , 7,700; \bar{M}_w/\bar{M}_n , 3.1 (based on polystyrene standards).

Reaction of VTMA/BA Copolymer with AMP

A solution of equal equivalent amounts of VTMA/BA copolymer (113 g, 0.126 equiv) and AMP (11.2 g, 0.126 equiv) in 120 ml freshly dried and distilled acetonitrile was refluxed at 80°C for 2 hr. The product precipitated as a yellowish solid and was recovered by filtering the hot reaction mixture. After washing with ether, the polymer was dried, yield 106 g (85%). It was then dissolved in 2-butoxyethanol with gentle warming to give a 61% solids solution. The acid number was 63.5 mg of KOH/g of polymer solids (equivalent weight 884) as determined by titration with aqueous NaOH. The amine equivalent weight was 1081 based on polymer solids as determined by nonaqueous titration.¹⁰ Based on these titrations, 83% of the anhydride had been converted to the ester zwitterion comparable to I and 17% had been converted to the amide comparable to II. The ratio of NH₂/COOH was 0.818. For convenience, hereafter, this zwitterion polymer is referred to as ZIP.

Reaction of VTMA/BA Copolymer with Methanol

A solution of 56.6 g (0.063 equiv) of VTMA/BA copolymer in 20 ml (0.5 mole) of freshly distilled methanol was refluxed for 8 hr. Excess methanol was removed by vacuum distillation, yield of polymer 55 g (94%). Sufficient 2-butoxyethanol was added to give a 61% solids solution. The acid number of the resin was 70.2 mg of KOH/g of polymer solids (equivalent weight 779). If the anhydride had been fully converted to half ester, the equivalent weight would have been 898. Therefore, approximately 89% had been converted to half methyl ester. For convenience, this half ester copolymer is designated as HEP.

Dilution Studies

Samples of ZIP were diluted with water. Viscosities were determined with a Ferranti-Shirley cone and plate viscometer at a shear rate of 346 sec⁻¹. Also, the pH of several of the diluted samples was determined with a Corning Model 5 pH meter with a calomel reference electrode. For comparison purposes, HEP was neutralized with 81.8% of the theoretical amount of AMP and the solids (including AMP as part of the solids) was adjusted to 61% with 2-butoxyethanol. For convenience, this material is designated HEP-AMP. The viscosities and pH's of the solutions when diluted with water were determined as above.

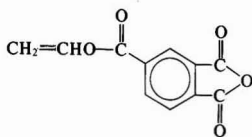
Curing Studies

ZIP and HEP-AMP was diluted with water to a viscosity of 3 poises (21.5% solids) and drawn down on unprimed steel panels to give approximately 30 μm dry film thickness. After flashing off for about 10 min, they

were baked for 30 min at 175, 150, and 125°C. Most panels showed some craters; no attempt was made in this preliminary study to eliminate this problem. Methyl ethyl ketone (MEK) rub resistance, Tukon hardness, conical mandrel flexibility, reverse impact resistance, and cross hatch adhesion tests were run. Panels were also exposed on a Cleveland Condensing Humidity Cabinet, water vapor temperature 38°C. Tests were also made on the effect of adding 0.21% pTSA (based on copolymer solids). The effect of addition of Cymel® 303 (21.5% of copolymer solids; approximately 3 equivalents of COOH per mole of HMMM), plus 1.0% pTSA (based on HMMM) was also evaluated. The amount of pTSA in this case is also 0.21% based on copolymer. For comparison purposes, HEP was also 81.8% neutralized with DMAE (HEP-DMAE), diluted with water, drawn down on a steel panel and baked for 30 min at 175°C. Also films were prepared of a methyl methacrylate, butyl acrylate, hydroxyethyl methacrylate, acrylic acid (MMA/BA/HEMA/AA) copolymer with a weight ratio of 40.8/40.8/10.0/8.4, 61% solids in propoxypropanol, with acid number of 62 mg of KOH/g of polymer solids, neutralized to 81.8% with AMP, with Cymel 303 (17.2% of copolymer solids) and 1.0% pTSA (based on HMMM), then diluted with water to 3 poises. The films were also baked 30 min at 175°C. This is the same resin studied earlier by Wicks and Chen.⁴

RESULTS AND DISCUSSION

While homopolymerization^{7,8} of the vinyl ester of trimellitic acid anhydride (VTMA) (III) and copolymerization with acrylonitrile¹¹ have been reported, copolymerization with methacrylic or acrylic esters has not been reported. Initially, copolymerization of VTMA with butyl methacrylate (BMA) was tried; very little VTMA



was incorporated in the copolymer. This may be due to a very large difference in r_1 - r_2 values for VTMA and BMA. These r_1 and r_2 values have not been reported but the r_1 - r_2 values for vinyl acetate-butyl methacrylate show a very large difference.¹² Since the r_1 - r_2 values for vinyl acetate-butyl acrylate (BA) are less different, copolymerization of VTMA with BA was attempted. It was found that VTMA copolymerized reasonably satisfactorily with BA. The copolymer was precipitated and washed with solvent to remove unreacted monomer. Formation of a copolymer rather than a mixture of homopolymers was indicated by a smooth GPC elution curve with a single peak. The VTMA/BA mole ratio (1/5.3) in the copolymer was lower than the initial monomer ratio

(1/4). No attempt was made in this feasibility study to improve the incorporation of VTMA or to determine sequence distribution.

The VTMA/BA copolymer was reacted with AMP by refluxing equal equivalents as a solution in acetonitrile. These are conditions which had been shown to give substantially complete conversion of phthalic anhydride to ester zwitterion I.⁶ Based on acid and amine equivalent weights, approximately 83% of anhydride groups were converted to ester zwitterion and the remaining 17% were converted to half amide. The copolymer was insoluble in acetonitrile but dissolved with gentle warming in 2-butoxyethanol to give a 61% solids solution. Hereafter, this copolymer is designated ZIP.

For control purposes, a sample of the same batch of VTMA/BA copolymer was reacted with methanol to make the half methylester. Based on titration, approximately 89% of the anhydride was converted to half ester and 11% was converted to dibasic acid. The resulting polymer was neutralized with 81.8% of the theoretical amount of AMP (the same ratio of NH₂/COOH as in ZIP). Sufficient 2-butoxyethanol was added to give a 61% solids solution (including the AMP as part of the solids). Hereafter, this copolymer is designated HEP-AMP.

Viscosity Changes During Water Dilution

Water dilution studies were done with both copolymers. When sufficient water had been added to dilute the concentration to about 35%, some turbidity developed. Turbidity increased with further additions of water until the "solutions" were opaque. No separation into layers was observed even after allowing 20% solids systems to stand for more than 2 weeks. This behavior is comparable to the behavior of many water soluble acrylic polymer systems.¹³⁻¹⁵

Figure 1 shows the log viscosity as a function of polymer concentration for ZIP and HEP-AMP when diluted with water. The viscosities were all measured at 346 sec⁻¹. The initial viscosity of ZIP (600,000 cps) was substantially higher than that of HEP-AMP (215,000 cps) with both at 61% in 2-butoxyethanol. This probably results from ion pair formation between amine groups and carboxylic acid groups on different polymer molecules of ZIP, rather than just association of ion pairs which probably occurs with HEP-AMP. The change in viscosity on dilution is comparable in a general way with viscosity-dilution curves of water soluble polymer systems.¹³⁻¹⁵ In line with the explanation of such behavior proposed by Hill,¹⁴ we propose that the initial rapid drop on addition of water results not only from dilution but also by reduction of association of ion pairs. As dilution proceeds further, the increasing polarity of the cosolvent/water mixture leads to aggregation of polymer molecules by association of the nonpolar butyl groups. Crowding from formation of aggregates leads to an increase in viscosity which is offset by the concomitant reduction in concentration. The balance of these two effects, in this case, leads to a plateau effect in the viscosity-dilution curve. As dilution continues, the viscosity drops precipitously. It is proposed that the

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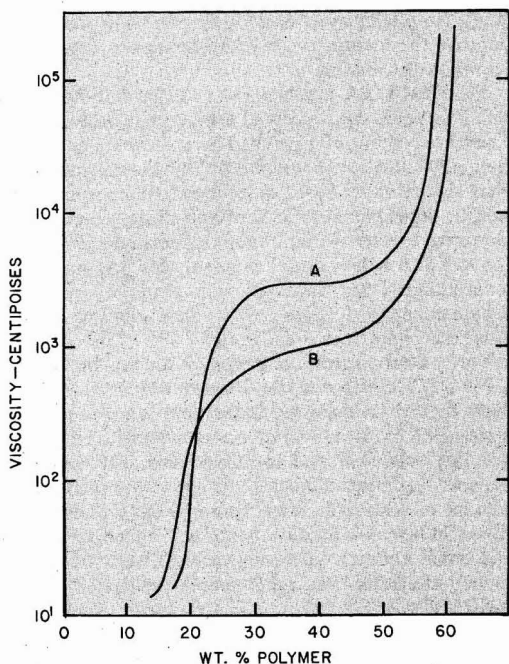


Figure 1—Log viscosity as a function of polymer concentration during dilution with water. Curve A-ZIP, Curve B-HEP-AMP. Both dilutions started with solutions at 61% solids in 2-butoxyethanol

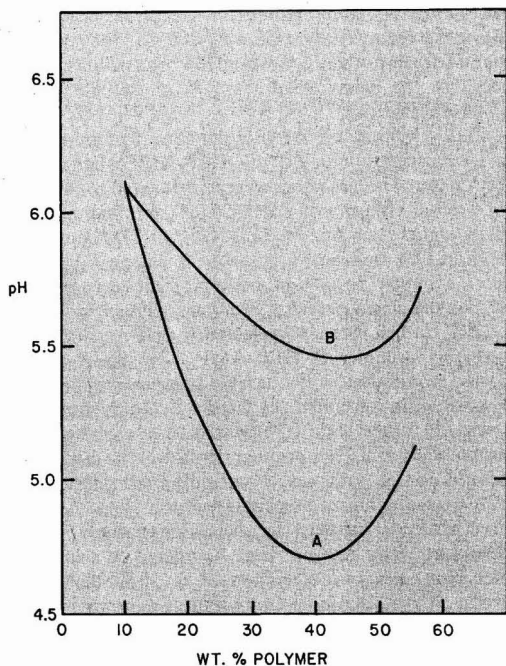


Figure 2—pH as a function of polymer concentration during dilution with water. Curve A-ZIP, Curve B-HEP-AMP. Both dilutions started with solutions at 61% solids in 2-butoxyethanol

major reason for this drop is that on further dilution, there is sufficient continuous phase to separate the aggregates. Hence, crowding is reduced and viscosity drops rapidly. The drop occurs in a range of concentration of 18–25% instead of the 50–70% range typical of systems like latexes. This is thought to be due to swelling of the aggregate with cosolvent and water. The volume of internal phase may thus be roughly comparable to that in an unswollen latex system.

Hill and Richards¹⁴ have shown that amine salts of butyl methacrylate (BMA)/acrylic acid (AA) copolymers with different acrylic acid contents give different curve shapes on water dilution of cosolvent solutions. Low acid number copolymers show a peak in the dilution curve, moderate acid number copolymers show a plateau and high acid number ones show only an inflection point. Data with AA copolymers having the same acid number, extent neutralization, cosolvent composition, and cosolvent/water ratios as ZIP are not available. However, the dilution curve of a BMA/AA copolymer with an acid number of 82.5, at 100% neutralization with DMAE, and starting with a 54% solution in tertiary butanol shows a peak. In contrast, ZIP with an acid number of 63.5, and extent neutralization of 81.8%, and starting with a 61% solution in 2-butoxyethanol gives a plateau region rather than a peak. HEP-AMP also gives a viscosity-dilution curve without a peak. Since the lower acid number, lower extent neutralization and lower cosolvent/water ratio all would be predicted to give a higher peak in the dilution curve, VTMA derivative copolymers give quite different results than AA copolymers. Three factors may account for this difference. In the VTMA derivative copolymers, the COOH groups are on a bulky side chain instead of directly on the polymer backbone as in an AA copolymer. This may lead to more loosely packed aggregates. There may be zwitterion groups trapped inside the aggregates which could lead to increased water absorption by the aggregates increasing their volume. Also, the VTMA derivatives have their COOH groups on an aromatic ring in contrast to the aliphatic carboxylic acid on the BMA/AA. Aromatic acids are stronger acids than aliphatic ones. Therefore, one would expect a greater extent of salt formation (see below for pH comparisons). A greater extent of salt formation would be expected to lead to a greater degree of swelling of aggregates with water as well as cosolvent. More swollen polymer aggregates would be more easily distorted by shear, hence, less likely to show a peaking of viscosity. It would also be expected to shift the concentration of precipitous decline of viscosity to lower concentrations; as is the case, in comparing with the BMA/AA copolymer systems.

The viscosities of the ZIP system are higher than the HEP-AMP system in the range of 21–61% concentration. While the ZIP dilution curve exhibits a level plateau region, in the HEP-AMP curve the plateau definitely slopes down. As noted earlier, the initially higher viscosity of ZIP solutions may result from intermolecular salt formation. This would also be expected to increase viscosity not only of the “true solution” but of the internal phase after aggregate formation. Thus, at a given rate of shear, the internal phase would be less easily distorted

and the overall viscosity would be higher. Also as noted earlier, entrapment of zwitterion groups within aggregates of the ZIP system may lead to greater water absorption, hence, higher internal phase volume and viscosity.

pH Changes During Water Dilution

The pH-dilution curves for ZIP and HEP-AMP are shown in Figure 2. While pH's of comparatively viscous systems in cosolvent-water mixtures are of doubtful absolute significance, relative comparisons may be useful. Above 20% concentration, the pH of the ZIP system is significantly lower than the HEP-AMP system. The pH's, however, are all below 7 in contrast to conventional water soluble polymer systems. When water-cosolvent solutions of BMA/AA copolymers with acid numbers in the same range as these copolymers are titrated with amines, the pH rises above 7 when as little as 40% of the theoretical equivalents of amine have been added.¹⁵ With ZIP and HEP-AMP at 81.8% neutralization equivalents, all the pH's are below 7. The high pH of BMA/AA copolymer solutions, even when substantially less than equivalent amounts of amine are present, has been attributed to entrapment of some carboxylic acid groups in the inside of aggregates.¹⁵ Since these COOH groups would not be accessible to amine molecules, the ratio of amine molecules to carboxylic acid groups at or near the surface of aggregates could be greater than 1, even when the ratio of amine to total COOH is substantially less than 1. Thus, the pH of such a system can be as high as 8.5. In the case of ZIP, since the amine is bound to the polymer molecule, such a gross segregation cannot take place. The excess COOH, therefore, leads to an acidic pH. The initial drop in pH, when water is added, may reflect the effect of changing polarity of the cosolvent/water mixture parallel to that reported with small molecule systems.¹⁶ However, as the water ratio increases further, it is possible that the less polar COOH groups and their neighboring butyl ester groups are increasingly attracted to the less polar interior of the aggregates, while the more polar zwitterion salt groups are increasingly attracted to the outer surface of the aggregates. Such a change fits in with the observed increase in pH on further dilution. The minimum pH is observed at concentrations where the viscosity-dilution curves indicate significant aggregation. HEP-AMP systems showed higher pH's than ZIP systems. This would be expected on the basis of the proposed morphology. It is surprising, however, that in this case also the pH's are below 7 in contrast to BMA/AA copolymers. It may be, as mentioned earlier in the discussion of the viscosity-dilution curves, that this is due to the greater acidity of aromatic acids and to the bulkiness of the side chain on which the COOH's are located.

Crosslinking

Clear coatings of ZIP on steel panels baked at 175°C for 30 min showed a significant degree of crosslinking. The cured films withstood 150 double MEK rubs and 600 double rubs with water, had a Tukon hardness of 8.7, showed no blistering after 1500 hr exposure in a

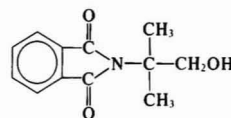
Table 1—Properties of Films Cured for 30 Min at 175°C

Film Description	MEK Double Rubs to Failure	Tukon Hardness	CCHC Hours to Blister
ZIP	150	8.7	>1,500
HEP-AMP	12	5.9	>1,500
HEP-DMAE	1	Too soft to measure	< 4
ZIP + pTSA	290	18	>1,500
HEP-AMP + pTSA	70	15	>1,500
ZIP + pTSA + HMMM	>600	51	(a)
HEP-AMP + pTSA + HMMM ..	230	50	900
MMA/BA/HEMA/AA + AMP + pTSA + HMMM	300	40	>1,500

(a) Some milkiness at 1,000 hr. No blisters at 1,500 hr.

Cleveland Condensing Humidity Cabinet (CCHC), had excellent flexibility (no failure in a reverse impact test at 80 in.-lb, and no failure in a conical mandrel test) and excellent adhesion. Crosslinking was catalyzed by addition of pTSA; MEK resistance increased from 150 to 290 rubs. Comparisons with a series of systems were run as shown in Table 1. The effects of changes in cure temperature of some of the systems were determined as shown in Table 2.

There are two possible reaction pathways for the crosslinking reaction: formation of an amide by reaction of the amine with an ester to form an amide (possibly reaction with COOH), or by conversion of the aminoester to a 2-hydroxyalkylimide followed by esterification of the hydroxyl group. While no direct evidence is available, the first reaction pathway seems more probable. Aminolysis of esters is a relatively facile reaction and it has been reported that such reactions are acid catalyzed.¹⁷ It is known that ester zwitterion I and half amide II can both be converted to imide IV by heating.⁶ However, as can be seen in Table 2, crosslinking occurs not only at 175°C but



IV

also at 150°C and to some extent at 125°C. This is below the temperature at which I is rapidly converted to imide.

Table 2—Effect of Cure Temperature on MEK Rub Resistance (30 Min Cures)

Temperature	ZIP	ZIP-pTSA	HEP-AMP	HEP-AMP-pTSA
175°C	150	290	12	70
150°C	150	290	12	70
125°C	18 ^a	60	12 ^b	30

(a) Blisters in CCHC after 552 hr.

(b) Blisters in CCHC after 408 hr.

Table 3—MEK Double Rub Resistance of Films Made From "Solutions" Which Had Been Stored At Room Temperature Before Coating (All Films Baked 30 Min at 175°C)

Time of Storage	ZIP	ZIP-pTSA	HEP-AMP	HEP-AMP-pTSA
None	150	290	12	70
1 day	150	—	12	—
10 days	140	290	12	70
30 days	140	290	12	70

Lomax and Swift¹⁸ have shown that 2-hydroxyalkylamides undergo esterifications readily. However, they report that the esterifications are not acid catalyzed. Furthermore, other work in our laboratories¹⁹ has shown that in contrast to 2-hydroxyalkyl amides, 2-hydroxyalkyl imides esterify very slowly. Therefore, we conclude that the most probable crosslink structure is the esteramide of AMP.

The degree of crosslinking was substantially greater with ZIP films than with HEP-AMP films, as can be seen in Tables 1 and 2. This is not surprising since in ZIP the ester end of the crosslink had already formed and also the AMP could not be lost by volatilization. The development of a partially crosslinked film from HEP-AMP is consistent with our previous observation of partial crosslinking of an MMA/BA/HEMA/AA copolymer solubilized with AMP.⁴ In contrast, HEP 81.8% neutralized with DMAE (HEP-DMAE) showed no crosslinking when cured at 175°C for 30 min. In this case, the tertiary amine cannot react to form an amide.

Resistance to MEK of both ZIP and HEP-AMP cured 30 min at 175°C was further increased by addition of HMMM (Table 1). The resistance of the ZIP system with HMMM was still superior to that of the HEP-AMP with HMMM. In fact, ZIP-pTSA was more resistant than HEP-AMP-HMMM-pTSA. A comparison was also made at 175°C with a MMA/BA/HEMA/AA-HMMM-pTSA coating previously studied.⁴ The MEK rub resistance of the ZIP-pTSA film was essentially the same as the conventional acrylic with HMMM and pTSA.

Stability

It is well known that half esters of phthalic acid are readily hydrolyzed due to the anchimeric effect of the adjacent carboxylic acid.^{20,21} It, therefore, seemed possible that the ZIP solution diluted with water might be very susceptible to hydrolysis. The pH of the solutions remained unchanged over a period of three weeks. However, this may be a poor indication of hydrolytic stability. Since the second carboxylic acid group of a phthalic acid, which would be formed by hydrolysis, is such a weak acid relative to the acid strength of the half ester, the pH before and after hydrolysis might be unchanged. Therefore, the MEK rub resistance was determined on films prepared from solutions which had been stored for various times after dilution with water. Up to at least 30 days, no significant change in the MEK resistance was

observed (Table 3). For comparison purposes, films were prepared with ZIP diluted with t-butanol rather than water. No difference in MEK rub resistance of cured films was noted. Further studies of hydrolytic stability are required.

SUMMARY

It has been shown that a primary amine zwitterion solubilized polymer can be prepared and give crosslinked films when cured for 30 min at 150–175°C. Such systems offer the potential of curing without emission of amine or formaldehyde into the atmosphere. This research should be considered as a feasibility study. Substantial additional work would be required to make practical coating systems. Examples of further studies needed include other means of preparing primary amine zwitterion polymer, effect of zwitterion content, other monomer combinations, effect of catalyst concentrations, and stability.

ACKNOWLEDGMENT

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High Solids Coatings From New Organophosphorus Resins

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The reaction of alkyl acid phosphates with aliphatic diepoxy resins has been found to be rather facile for producing oligomeric hydroxy phosphates of molecular weight (M_n) in the range of 1800 to 2500. Progress of the reaction has been followed by infrared spectra and titration of the reaction mixture; less than stoichiometric amount of the acid ester is needed for complete consumption of the epoxy functionality. When stoichiometric amounts of the alkyl acid phosphates and the epoxy resin were reacted in solution, the acid concentration, as evidenced from alkali titration, decreased rapidly in the initial reaction stages to a nearly constant value. The hydroxy phosphates thus prepared can be crosslinked with aliphatic isocyanates in two-component high solids coatings formulations. The coatings, cured at 100°C for 20 min on primed panels, exhibit excellent gloss, hardness, solvent resistance, impact strength, and adhesion. Their weatherability, however, in QUV Weathering Tester and in Cleveland Humidity Chamber, is inferior to acrylic-urethane high solids coatings.

INTRODUCTION

Acrylic polymers and polyesters comprise the major resin components in automotive topcoats and primers. Replacement of a $-\text{CH}(\text{CH}_3)-$ by $-\text{P}(\text{CH}_3)-$ or $-(\text{CH}_3)\text{P}(\text{O})-$ in these acrylics and polyesters does not change the general physical properties; however, flammability is significantly reduced.^{1,2} In addition to increased polarity and nonflammability, special effects can be assigned to the various organophosphorus functional groups. For example, incorporation of all organophosphorus esters ($\text{P}-\text{O}-\text{alkyl}$, $\text{P}-\text{O}-\text{aryl}$), both in the main chain of the polymer and in the pendent groups,

leads to pronounced internal plasticization, which is accompanied by a lower softening temperature, an increase in impact strength, and a higher elongation at rupture. In addition to some of these desirable properties, organophosphorus esters have been reported to be radiation stabilizers and antioxidants.³

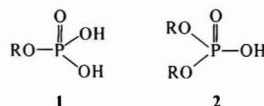
A versatile synthesis of a new class of hydroxy organophosphorus oligomeric esters has been developed. These oligomers, when crosslinked with trifunctional aliphatic isocyanates, afford high solids low-bake coatings with excellent hardness, adhesion, impact strength, elongation, and durability.

EXPERIMENTAL

Infrared spectra were recorded on a Perkin Elmer 453 spectrophotometer and the molecular weights of the oligomers were determined by Gel Permeation Chromatography. The coatings were sprayed with a suction gun and were baked in an air flow oven. The weathering of the coatings was examined in Cleveland Humidity Chamber and in a QUV® Cyclic Weathering Tester.

Materials

Alkyd acid phosphates* which consisted of approximately equimolar quantities of monoalkyl and dialkyl phosphates **1** and **2**, respectively, were used.



a: R = n-butyl
b: R = 2-ethylhexyl

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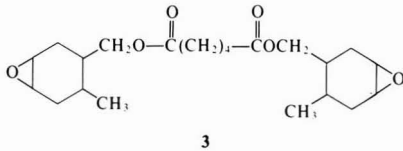
QUV is a registered trademark of the Q-Panel Co.
*Obtained from Hooker Chemical Co.

Table 1—Preparation of Hydroxyphosphate Oligomers from Araldite CY178

Product	Amounts of Reactants & Solvent (grams)				Mol. wt. (GPC)
	Epoxy	Phosphate	Butyl Acetate	Epoxy Acid	
5a (R=n-butyl)	315	119	108	1.5	1795
5b (R=2-ethyl-hexyl)	315	160	118	1.4	1950

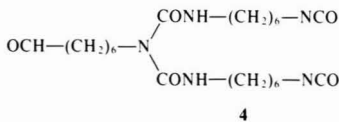
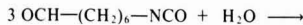
The acid equivalent weight (NaOH titration) of butyl phosphate was 120 and 2-ethylhexyl phosphate was 150.

A cycloaliphatic liquid epoxy resin, Araldite CY178,[®] bis-(3,4-epoxy-6-methylcyclohexylmethyl) adipate (**3**) was employed in this investigation without purification.



The viscosity of **3** was 830 cps at 25°C, and its epoxy equivalent weight was 210 (theoretical 197).

The crosslinking agent employed, a biuret containing polyisocyanate **4**,* was the reaction product of three moles of hexamethylene diisocyanate and one mole of water.



The isocyanate equivalent of **4** was found to be 195.

Reagent grade butyl acetate† was dried over #4A molecular sieves and titanium dioxide** was dried over-

[®]Araldite is a registered trademark of CIBA-GEIGY Corp.

* Desmodur N-100, Experimental Product L2291, obtained from Mobay Chemical Corp.

† Obtained from J. T. Baker Chemical Co.

** R-902, obtained from E. I. duPont de Nemours & Co.

Figure 2—Infrared spectrum of bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3**)**

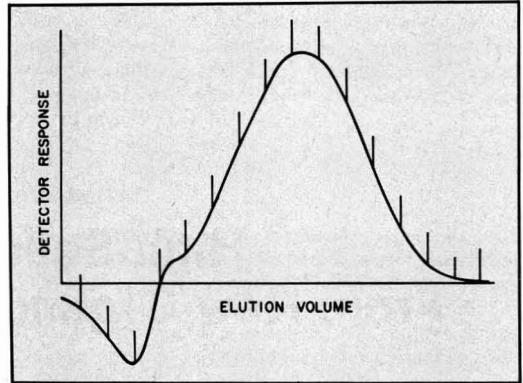
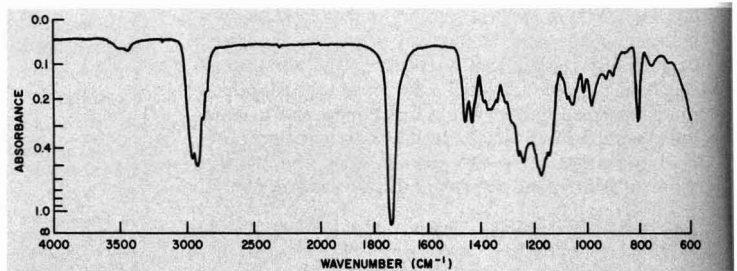


Figure 1—Gel Permeation Chromatogram of 1:1.5 adduct (5a) butyl acid phosphate (1a + 2a) and bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3**)**

night in a 130°C oven. The catalyst used was dibutyltin dilaurate and was used as received.

Preparation of Hydroxyphosphate Oligomers **5a** and **5b**

In a four-necked round bottom flash equipped with a dropping funnel, a stirrer and a thermometer, a solution of Araldite CY178 in butyl acetate (*Table 1*) was placed under nitrogen. Alkyl acid phosphate, 1 or 2, was taken up in the dropping funnel and was added dropwise with continuous stirring. An exothermic reaction occurred; the temperature was allowed to rise to 60°C and then the addition was regulated to maintain this temperature. After the addition was complete, the reaction mixture was stirred for one hour while the temperature was maintained at 60°C. The molecular weight of the product was determined by Gel Permeation Chromatography (*Figure 1*). Infrared spectra of the starting resin **3** (*Figure 2*) and that of the product (*Figure 3*) were recorded. A test portion of the product was titrated with standard sodium hydroxide solution to determine the extent of the acid-epoxy reaction.

Paint Formulation and Film Properties

By the use of hydroxyphosphates **5a** and **5b**, three different paint formulations were prepared. The NCO:OH ratio in these formulations is 1:2.

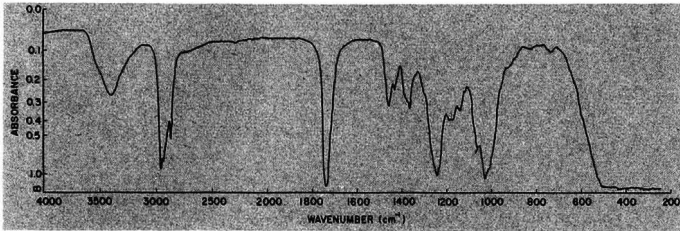
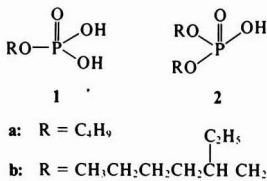


Figure 3—Infrared spectrum of butyl acid phosphate (1a + 2a) and cycloaliphatic epoxy (Araldite CY 178) adduct (1:1.5) 5a

All three formulations were applied by spraying with a suction gun to primed (ester-epoxy primer) steel panels in three coat applications; intermediate flash time was one minute and the final flash was five minutes. The panels were baked at 100°C for 20 min; the properties are listed in Table 2.

RESULTS AND DISCUSSION

Alkyl acid phosphates, which have been employed in this investigation, are mixtures of monoalkyl and dialkyl phosphates 1a, b and 2a, b



The diacids 1a, b react with diepoxies to produce hydroxy polymers such as 5a, b.

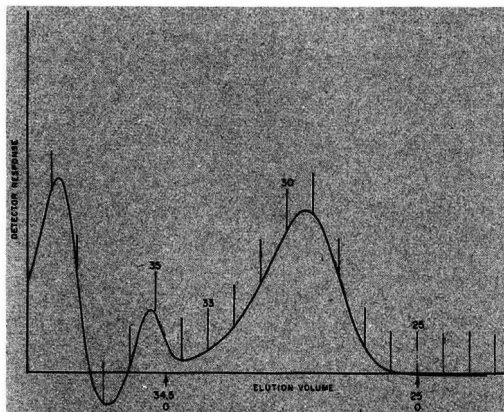
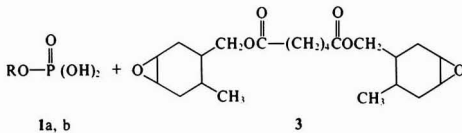
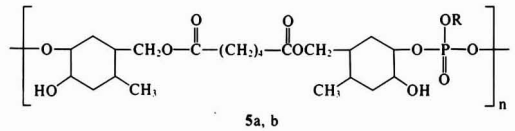


Figure 4—Gel Permeation Chromatogram of the reaction product butyl acid phosphate (1a + 2a) and bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3) (1:1.1)



a: R = C₄H₉

b: R = C₂H₅, CH(CH₃)CH₂

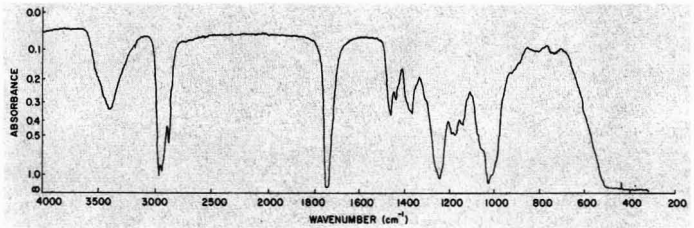
Phosphates 2a, b, being monofunctional acids, would react with 3 to produce low molecular weight adducts and, thus, would act as chain terminators for the reaction products of 1a, b and 3. In spite of this, chains terminating by 2a, b, relatively high molecular weight ($M_n \approx 2000$) oligomeric products were formed when one equivalent of butyl phosphate (1a + 2a) was reacted with 1.1 equivalents of diepoxy 3. The molecular weight distribution was determined by Gel Permeation Chromatography and is shown in Figure 4. The infrared spectrum (NaCl plates) of this reaction product (1:1.1) of butyl phosphate (1a + 2a) and epoxy 3 shows complete disappearance of the epoxy absorption band at 810 cm⁻¹ (Figure 5). Similarly, infrared spectrum of 1:1.5 acid-epoxy adduct shows complete reaction of the epoxy functionality (Figure 3). Since, in the synthesis of these acid-epoxy adducts (1:1.1 and 1:1.5) less than stoichiometric

Paint Formulations

Formulation A	Wt. Grams
Hydroxyphosphate 5a	70.00
Desmodur L2291	45.00
Dibutyltin dilaurate	0.51
n-Butyl acetate	45.00
Formulation B	Wt. Grams
Hydroxyphosphate 5a	32.80
White millbase*	48.00
Desmodur L2291	26.00
n-Butyl acetate	20.00
Methyl amyl ketone	19.00
Dibutyltin dilaurate	0.38
Formulation C	Wt. Grams
Hydroxyphosphate 5b	52.00
Desmodur L2291	26.00
Dibutyltin dilaurate	0.29
Methyl amyl ketone	39.00

*One hundred and five grams of the adduct 5a were dissolved in 140 g of methyl amyl ketone and 455 g of titanium dioxide were added under agitation to this solution. The resulting mixture was whipped with a Cowi's blade (6300 RPM) for 15 min to obtain a Hegman grind fineness of 7.5. The resulting mill base was filtered through a coarse filtering cloth.

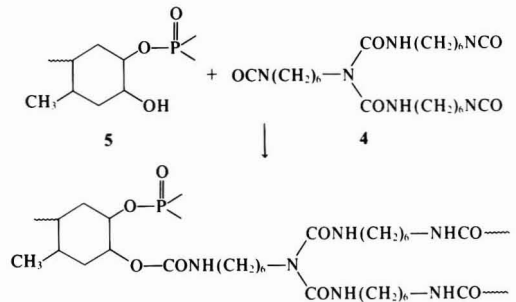
Figure 5—Infrared spectrum of butyl acid phosphate (1a + 2a) and bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3) adduct (1:1.1)



metric amount of the acid was used, an excess of epoxy should have been left unreacted if addition of the acid to the epoxy was the only chemical reaction taking place. However, some acid remains unreacted, even after prolonged heating at 60°C, as determined by titration of the reaction mixture. Initially a rather rapid reaction takes place and then the acid concentration reaches an almost constant level (Figure 6). Even when the acid epoxy ratio was 1:1.5, the epoxy was completely consumed as evidenced by the absence of the epoxy absorption band at 810 cm⁻¹ in the infrared spectrum of the product (Figure 3). Since an excess of epoxy is being consumed, it may be doing so through acid catalyzed self-condensation to produce hydroxy-ether phosphates.⁴ However, the presence of ether linkage could not be confirmed from the infrared spectra of the acid-epoxy adducts (Figures 3 and 5). The excess acid may then be resulting from hydrolysis of the adduct by ambient moisture. This has been shown by following the increase in acid content when acid-epoxy adduct (1:1.1) was dissolved in excess ethanol and mixed with excess water (Figure 7).

When three molar excess of epoxy 3 was treated with the acid esters (1a + 2a), significant amount of epoxy was found to be unreacted as seen from the epoxy absorption (810 cm⁻¹) in the infrared spectrum of the reaction mixture (Figure 8). This shows that the self-condensation of the epoxy takes place under these reaction conditions to an insignificant extent.

In the curing of these acid-epoxy adducts, isocyanate groups react readily with hydroxy moieties to produce well crosslinked networks.



This condensation of the hydroxy groups with isocyanates is rather facile, as evidenced by the complete disappearance of the isocyanate absorption band (2290 cm⁻¹) in the infrared spectrum of the clear coating formulation.

Any unreacted acid would react with isocyanate to afford additional crosslinking,⁵ as shown below.

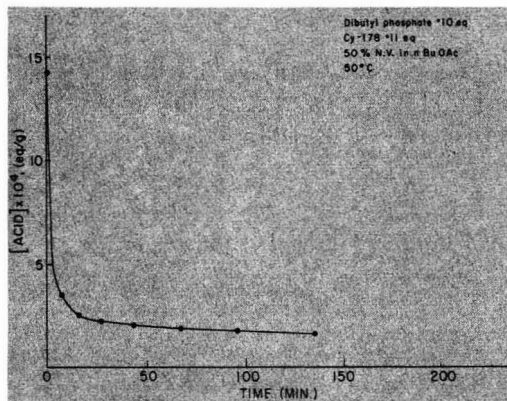
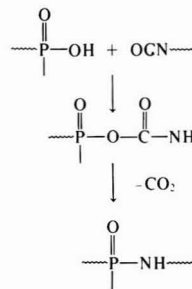


Figure 6—Consumption of acid in the reaction of butyl acid phosphate (1a + 2a) with cycloaliphatic epoxy 3.

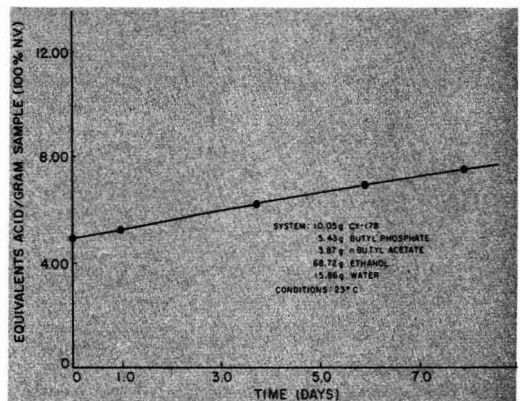


Figure 7—Hydrolysis of 1:1.1 butyl acid phosphate (1a + 2a) and bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3) adduct

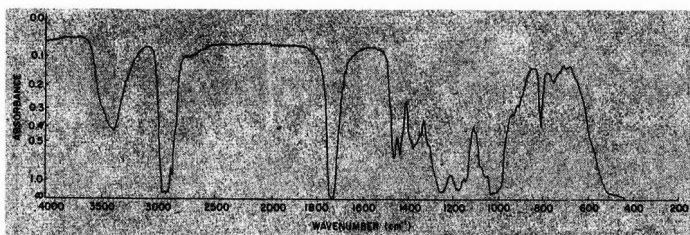


Figure 8—Infrared spectrum of butyl acid phosphate (1a + 2a) and bis-(3,4-epoxy-6-methylcyclohexyl methyl) adipate (3) adduct (1:3)

Additional crosslinking may also be produced by reaction of epoxy with isocyanate to yield oxazolidone type structures;⁶ however, due to rather low concentrations of acid and epoxy functionalities in the acid-epoxy 1:1.5 adduct, no evidence for the above two types of linkages could be obtained.

Coatings Formulation and Film Properties

Physical properties of coatings A, B, and C (Table 2) show that with the use of adducts 5a, b, both clear and pigmented coatings with excellent physical properties can be obtained. In addition to an adequate hardness of these coatings, their excellent impact strength and elongation are probably due to trialkyl phosphate moieties which act as internal plasticizers for the coatings. All these coatings exhibit this enhanced flexibility even at -30°C (Table 2). The increased low-temperature flexibility of coating C (Table 2) as compared with A, is

probably due to a greater plasticization of the coating by the ethylhexyl group as compared with the butyl group. Loss of gloss in QUV Weathering Tester and lack of performance in Cleveland Humidity Chamber may be because of photolytic and hydrolytic instability of the ester linkages in the oligomeric hydroxy phosphate resins.

CONCLUSIONS

Alkyl acid phosphates react very rapidly with aliphatic epoxy resins to produce hydroxy-phosphate oligomers. These hydroxy-phosphate oligomers can be crosslinked with polyisocyanates in two-component high solids coatings with desirable physical properties. These coatings have an excellent combination of hardness, adhesion, flexibility, gloss, and solvent resistance; however, their weatherability is inferior to acrylic-urethane high solids coatings.

Table 2—Paint Properties

	Formulation		
	A	B	C
Viscosity, #4 Ford cup, sec	23	17	24
Solids, weight %	63	61	58
Gloss/20°	84	82	85
Thickness, μ	1.5	1.6	1.6
Xylene resistance, 1 min spot	Excellent	Excellent	Excellent
Methyl ethyl ketone resistance (50 double rubs)	Excellent	Excellent	Excellent
Impact, in.-lb direct	Pass 70	Pass 110	Pass 55
Hardness, pencil	B	B	B
knop	8.7	10.0	9.9
Mandrel bend, crack (22°C)	$\frac{5''}{8}$	0	$\frac{1''}{8}$
% elongation (22°C)	15.5	30	30
% elongation (-30°C)	6	15	14
Adhesion, tape	Pass	Pass	Pass
knife	Pass	Pass	Pass
QUV, 330 hr, ^a gloss	74	46	79
Cleveland Humidity Chamber 14 days	Slight discoloration, no other change	No change	No change

(a) QUV cycles, 8 hr light at 60°C , followed by 4 hr darkness and humidity at 50°C .

SUMMARY

Oligomeric hydroxyphosphates were prepared by the reaction of alkyl acid phosphates with aliphatic diepoxies. The hydroxy phosphates thus prepared can be crosslinked with aliphatic isocyanates in two component high solids coatings formulations. The coatings, cured at 100°C for 20 min on primed panels, exhibit excellent gloss, impact strength, elongation, adhesion and weathering properties. These coatings are promising for flexible substrates and "universal automotive topcoats."

ACKNOWLEDGMENT

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Copolymers of Polystyrene Glycol And Linseed Oil Alkyd

Sushil Chandra and Suman Pasari
Harcourt Butler Technological Institute*

A new approach for the synthesis of alkyds containing a polystyrene chain has been described. These copolymers can be closely related to the styrenated alkyds already known in the surface coating field.

Polystyrene glycol was synthesized first, followed by glyceryl phthalate resins. Polystyrene glycol replaced part of the glycerol in its esterification reaction with phthalic anhydride. The products obtained from this approach were found to exhibit better physical and chemical properties when compared with those of conventional styrenated alkyds.

INTRODUCTION

In surface coatings, since no single resin possesses all the desired properties, various resins are used which are generally modified by other resins and polymers. For example, alkyds (oil modified glyceryl phthalate resins) are considered to have good color, color retention, and durability in exterior finishes, but their water, alkali, and chemical resistance is relatively inferior to many film formers. Numerous attempts to modify alkyds have been carried out by using various oils,¹⁻⁴ incorporating various synthetic resins and polymers, such as vinyls,^{5,6} acrylics,⁷ silicone,⁸ phenolics,⁸ amino resins,⁹ chlorinated rubber,^{9,10} polycarbonate,^{11,12} etc. Styrene has also been incorporated into alkyds by first styrenating fatty acids,¹³ oils,¹⁴⁻¹⁶ or monoglyceride¹⁰ (i.e., pre-styrenation) or styrenation after the preparation of alkyds¹⁷ (i.e., post-styrenation).

A different approach was investigated by the authors for the incorporation of a polystyrene moiety into alkyds. Polystyrene was functionalized by adding hydroxyl

groups at the end of a polystyrene chain,¹⁸ thus yielding polystyrene glycol. This approach closely resembles the preparation of polyacrylate modified water-borne alkyds¹⁹ in which low molecular weight acrylic polymers with both hydroxyl and carboxyl functionalities were prepared and charged to the alkyd reactor with the conventional alkyd components.

The reactivity of the polystyrene glycol as prepared was tested by its esterification reactions with phthalic anhydride, linseed fatty acids,²⁰ and rosin.²¹ A study on the blends of polystyrene glycol and alkyds was also made.^{22,23} Copolymers were prepared with niger seed and castor oils representing semi-drying and non-drying oils, respectively.²⁴

In the present work, polystyrene glycol was used to replace glycerol in the preparation of linseed oil alkyds, thus yielding a copolymer similar to a graft copolymer. Film properties of these copolymers were compared with those of a conventional styrenated alkyd,¹⁰ prepared from a linseed oil-dehydrated castor oil (DCO) mixture, because it is essential to incorporate a conjugated oil (e.g., dehydrated castor oil) along with linseed oil in the preparation of styrenated alkyds.

EXPERIMENTAL

Materials

Phthalic anhydride, LR grade of glycerol, and alkali refined linseed oil were used for the preparation of alkyds of 50% oil length. Monomeric DCO, having an acid value of six and viscosity of two poise was used along with linseed oil for preparing a control sample of conventional styrenated alkyd. Calcium oxide was used as catalyst for monoglyceride formation. Lead and cobalt naphthenates were used as driers. Xylene, LR grade was used as solvent.

Polystyrene glycol¹⁸ was prepared by free radical polymerization of styrene using benzoyl peroxide as the

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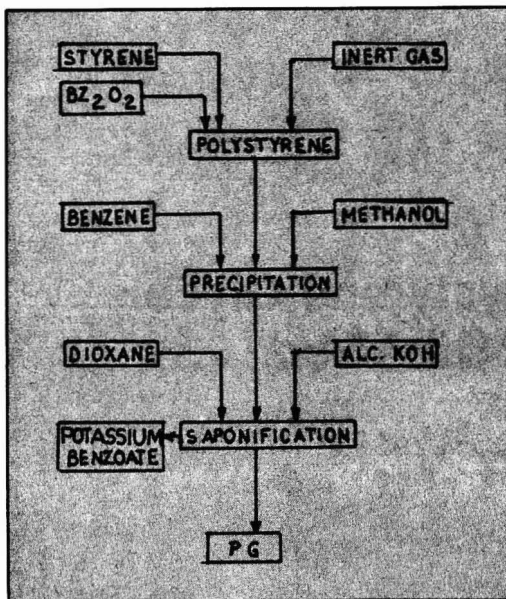


Figure 1—Synthesis of polystyrene glycol

initiator, followed by hydrolysis of the benzoate end groups, as shown in Figure 1. The sample had an hydroxyl value of 39.8 and molecular weight of 2742. The IR spectrum (KBr) of polystyrene glycol also exhibited the presence of a hydroxyl group which appeared as a broad vibration in the region 3450 cm^{-1} , as shown in Figure 2. Presence of hydroxyl groups was reconfirmed by the reaction of polystyrene glycol with monobasic acids (linseed fatty acids and rosin) and dibasic acid anhydride (phthalic anhydride).

Preparation of Copolymers

The maximum amount of polystyrene glycol which rendered a clear product in the synthesis of a copolymer was investigated. In addition, three samples having lower amounts of polystyrene glycol were also prepared. Thus, four samples of copolymers of polystyrene glycol and linseed oil modified glyceryl phthalate resin containing 34, 29, 24, and 17% polystyrene glycol were prepared by

the monoglyceride process. The preferred formulating technique was to replace a portion of the glycerol with the amount of reactive polystyrene glycol essential on the basis of hydroxyl value. The amounts of ingredients required in each sample are shown in Table 1. A typical preparatory method, as shown in Figure 3, is as follows:

Linseed oil and glycerol were taken in a three neck flask fitted with a stirrer, thermometer, and Dean and Stark water separator. The mixture was heated to 180°C . Calcium oxide (0.2% by weight of oil) was added and the temperature was raised to 230°C . Formation of monoglyceride was checked at a regular interval of 15 min by dissolving one part of sample in three parts of methanol. Monoglyceride formed in an hour. The mixture was cooled to 180°C and phthalic anhydride and polystyrene glycol were added. The temperature was raised to 230°C . Heating was continued for about six hours. The acid value of the final product, a clear viscous liquid, was determined and is shown in Table 1.

Preparation of the Control Sample Of Styrenated Alkyd

The reactivity of styrene monomer with oils or fatty acids is very poor and a high molar excess of styrene is required.¹³ This allows the formation of a large amount of homopolymer (polystyrene) which is not compatible with the alkyd and, thus, clear products cannot be obtained. Therefore, only a limited amount of styrene can be copolymerized, maintaining a homogenous product. In preparing the control sample of styrenated alkyd, equal weights of oil and styrene monomer¹⁴ were taken, corresponding to a three molar excess of styrene monomer. This amount of styrene is also equivalent to that of polystyrene glycol in the copolymer containing maximum compatible polystyrene glycol, i.e., copolymer 4. The sample was prepared by the solvent method¹⁴ which is supposed to allow more styrene in the copolymerized form. The amount of ingredients used is shown in Table 1. A systematic scheme of its preparation is shown in Figure 4.

The mixture of oils was converted into monoglycerides as previously described. Half of the styrene, benzoyl peroxide (3g) and xylene (100 g) were added to the monoglycerides and the mixture was heated to 160°C . Reflux was maintained and remaining styrene was added over a

Table 1—Composition and Physical Characteristics

Sample	Parts by Weight			Polystyrene Glycol	% Polystyrene Glycol in Copolymer ^a	Acid Value	Drying Time		Scratch Hardness g
	Linseed Oil	Phthalic Anhydride	Glycerol				Surface Dry min	Hard Dry hr	
Styrenated alkyd	Linseed + DCO 37.0 + 13.0	38.0	18.0	Styrene	Styrene	12	30	Within 6	3,600
Copolymer 1	50.0	38.0	17.6	20.0	17	10	15	Within 4	3,700
Copolymer 2	50.0	38.0	17.4	30.0	24	12	15	Within 4	3,750
Copolymer 3	50.0	38.0	17.1	40.0	29	11	10	Within 4	3,900
Copolymer 4	50.0	38.0	16.9	50.0	34	13	10	Within 4	4,250

(a) Calculated

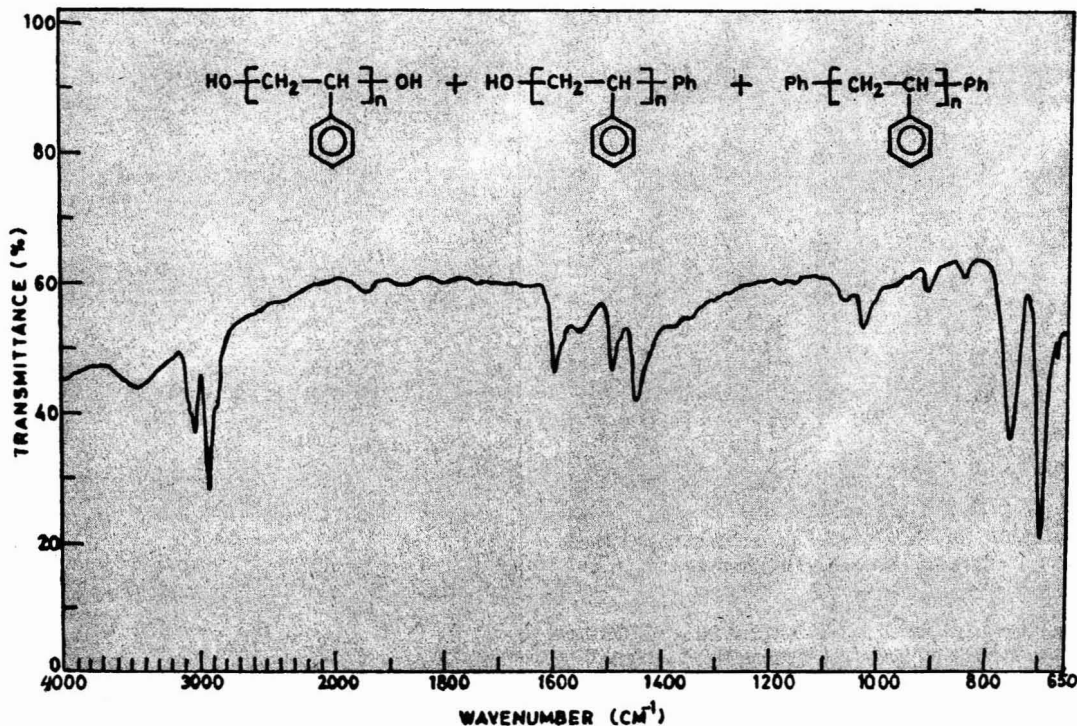


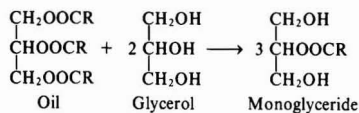
Figure 2—IR spectrum of the polystyrene glycol sample

three hour period. Then, temperature was raised to 210° C. Total time for styrenation was 24 hr. Xylene was removed through the Dean and Stark apparatus. Phthalic anhydride and remaining glycerol were added and heated at 215°-230° C for about three hours. The product was slightly hazy, as expected. Its acid value is also shown in Table 1.

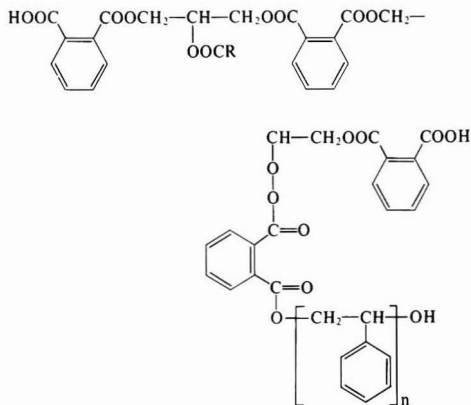
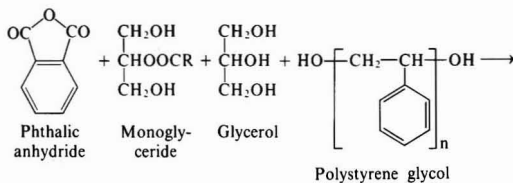
RESULTS AND DISCUSSION

Chemical Structure of Copolymers

The first step in the synthesis of the copolymer is alcoholysis of the oil forming monoglyceride, as follows:



Monoglycerides, along with polystyrene glycol and glycerol, react with phthalic anhydride and yield the copolymer as follows:



In fact, the polystyrene glycol used is not exclusively a diol. It also contains a mono-ol (polystyrene chains having an hydroxyl group at one end and phenyl at the other), plus a nonreactive polystyrene chain having phenyl groups at both ends.¹⁸ The mono-ol will also take part in the esterification reaction, yielding copolymer. The nonreactive polystyrene homopolymer is, however, found to be compatible with the copolymer and it does not affect the clarity of the product.

A big advantage of this process is that the presence of conjugation in the oil or fatty acid is not necessary. Here, polystyrene glycol easily reacts with phthalic anhydride

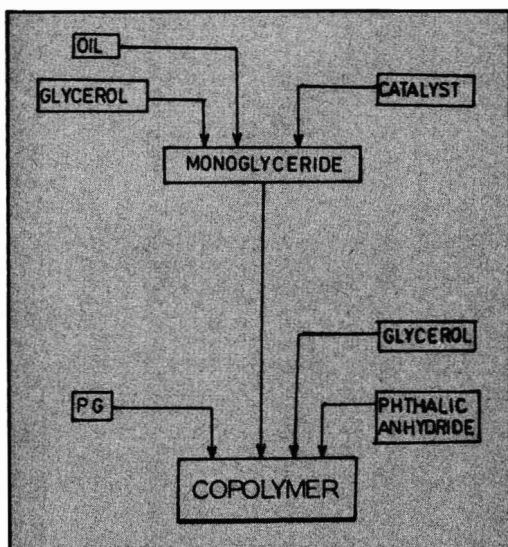


Figure 3—Synthesis of the copolymers

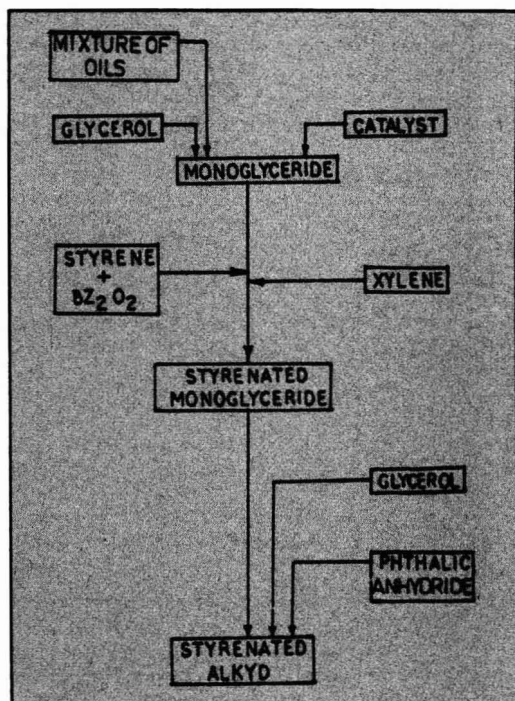


Figure 4—Synthesis of styrenated alkyd

and becomes a part of the glyceryl phthalate resin. On the other hand, in the case of conventional styrenated alkyds, styrene reacts at a conjugated double bond in the fatty acids via the Diels-Alder reaction.

Another advantage is that more polystyrene chains are chemically linked with alkyd in the copolymers prepared through polystyrene glycol than those in the conventional styrenated alkyd, because the copolymer sample containing maximum polystyrene glycol (i.e., 34%) was a clear product, while the control sample of styrenated alkyd containing the same amount of styrene was a hazy product.

The copolymers formed may be referred to as graft copolymers because one polymer (glyceryl phthalate) has been synthesized in the presence of presynthesized polystyrene glycol. From the chemical structure previously shown, glyceryl phthalate resin may be regarded as the backbone, with polystyrene as the side chains.

In an investigation of the utility of the copolymers of polystyrene glycol and oil modified glyceryl phthalate

resin, their film properties were studied and compared with those of conventional styrenated alkyds. For this, an adequate amount of driers was added to all the samples prior to thinning with xylene to a brushable consistency. Films were applied on 6 × 2 in. glass and tin panels and were air dried.

Films of the copolymers and the control sample of styrenated alkyd were tested for drying characteristics, flexibility and adhesion, scratch hardness (Table 1) and resistance to water, acid, alkali, and solvent (Table 2).

Drying Characteristics

Films of all samples were air dried. Surface dry and hard dry times are recorded in Table 1. It was observed

Table 2—Resistance of Styrenated Alkyd and Copolymers to Water, Acid, Alkali and Solvent

Sample	Condition of the Film Immersed						
	Distilled Water 30 days	Hydrochloric Acid 30 days	Sulfuric Acid 45 days	Nitric Acid 15 days	Sodium Carbonate 4 days	Sodium Hydroxide 2 hr	Xylene 60 days
Styrenated alkyd	0 ^a	1	2	1	0	0	0
Copolymer 1	1	3	3	2	1	1	5
Copolymer 2	2	4	4	3	2	1	5
Copolymer 3	3	4	4	3	3	2	5
Copolymer 4	4	5	5	4	5	3	5

(a) Legend: 5 = practically unaffected; 4 = slight loss in gloss; 3 = loss in gloss and change in color; 2 = partially cracked; 1 = cracked and partially removed; and 0 = completely removed.

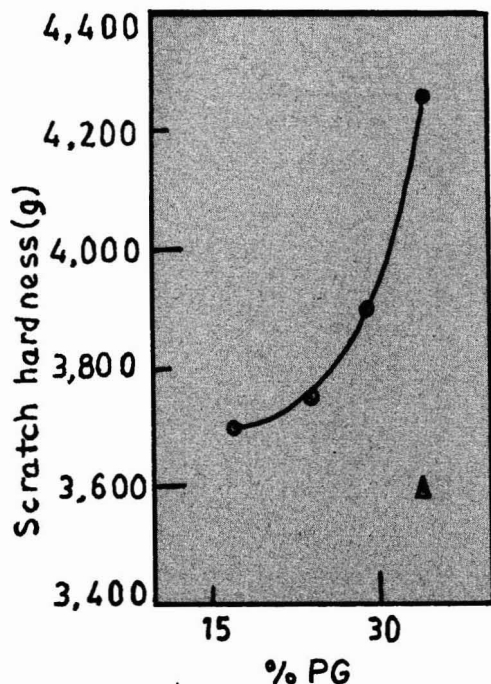


Figure 5—Scratch hardness of the copolymers and the styrenated alkyd control. Δ —percent styrene in the control sample

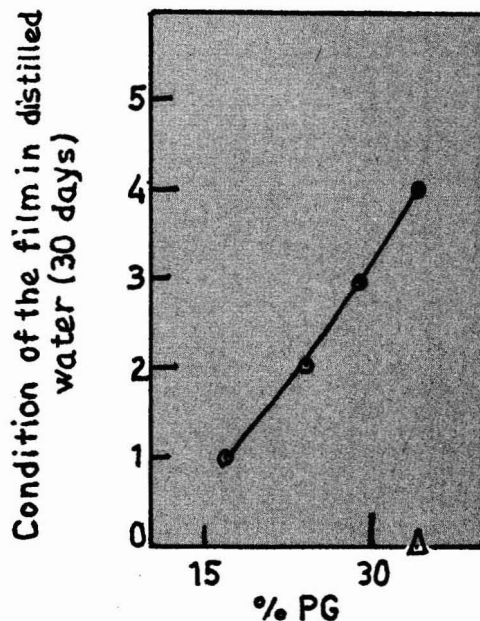


Figure 6—Water resistance of the copolymers and the styrenated alkyd control. Legend: Δ —percent styrene in the control sample; 0—completely removed; 1—cracked and partially removed; 2—partially cracked; 3—loss in gloss and change in color; 4—slight loss in gloss; 5—unaffected

that drying times of copolymers were lower than those of a styrenated alkyd. While in the copolymers more of the polystyrene is chemically linked with the alkyd, in the

styrenated alkyd, polystyrene is present as a physical blend. Therefore, copolymers have improved drying characteristics.

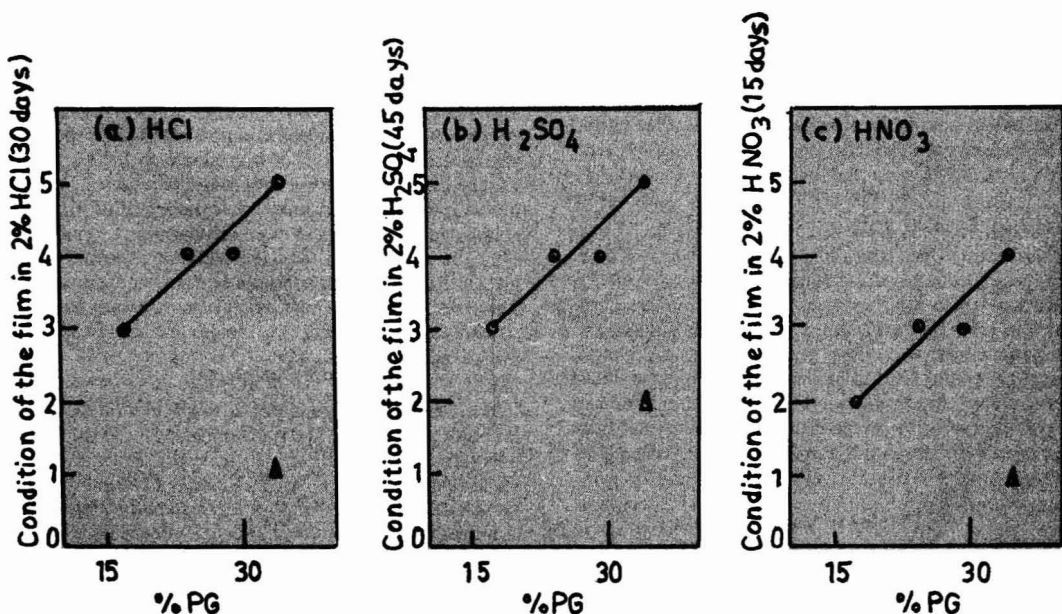


Figure 7—Acid resistance of the copolymers and the styrenated alkyd control: (a) hydrochloric; (b) sulfuric; and (c) nitric. Legend: see Figure 6

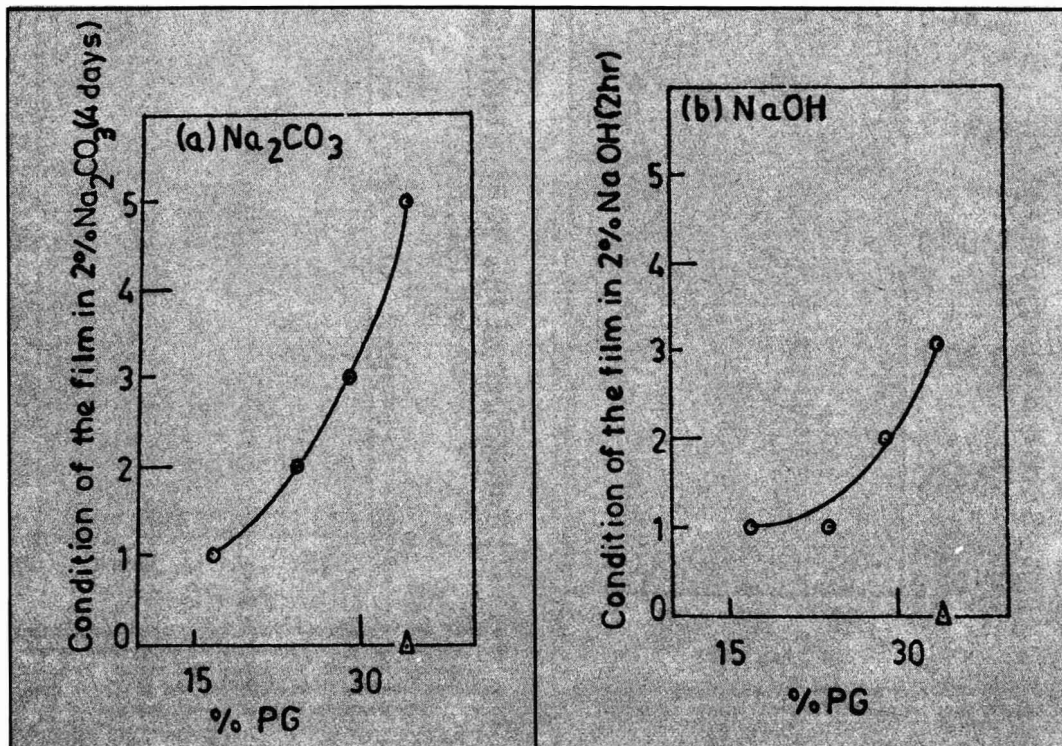


Figure 8—Alkali resistance of the copolymers and the styrenated alkyd control: (a) sodium carbonate and (b) sodium hydroxide. Legend: see Figure 6

Flexibility and Adhesion

Flexibility and adhesion of the dried film were tested on tin panels with a $\frac{1}{4}$ in. mandrel. No detachment of the film from the substrate or visible cracks in the film were observed in any of the samples, indicating that all the samples had good flexibility.

Scratch Hardness

Scratch hardness of the dried film was measured on tin panels with a mechanically operated "Sheen" scratch hardness tester by placing an increasing load over a hardened needle which moves on the film. Scratch hardness (in grams) of all samples is shown in Table 1 and plotted against polystyrene glycol content in Figure 5. From the results, it is clear that these copolymers have better scratch hardness than the conventional styrenated alkyd. Further, it was also found that scratch hardness increases with increasing amount of polystyrene glycol in the copolymers.

Water Resistance

All the samples were allowed to air dry in a horizontal position for 48 hr. The sides of the glass panels were protected by wax before this test was performed and were immersed in distilled water at room temperature (about 25°C). The dipped portion of the film was examined for

appearance, i.e., loss in gloss, change in color, and for other visible damages. After 30 days, slight loss in gloss was observed in the film of the sample having 34% polystyrene glycol. Loss in gloss and change in color was observed in the film of the sample having 29% polystyrene glycol. The film of the sample having 24% showed partial cracks. The film of the sample with 17% polystyrene glycol cracked and was partially removed. These observations are illustrated in Figure 6. The film of styrenated alkyd was, however, completely removed. These results suggest that the reaction of polystyrene glycol with alkyd yields a copolymer which has better water resistance than that of styrenated alkyds synthesized by copolymerizing fatty acids.

Acid Resistance

For this test also, glass panels of all the samples were prepared as described and were immersed in 2% solutions of hydrochloric, sulfuric, and nitric acids separately at room temperature. Panels were checked for any loss in gloss, change in color, and for any sign of disintegration at a regular five day interval. Figure 7 describes the acid resistance of all the samples. It was observed that acid resistance of the samples having polystyrene glycol was excellent and far superior to that of the styrenated alkyd. The effect of nitric acid was more pronounced than that of hydrochloric and sulfuric acids as deterioration in the

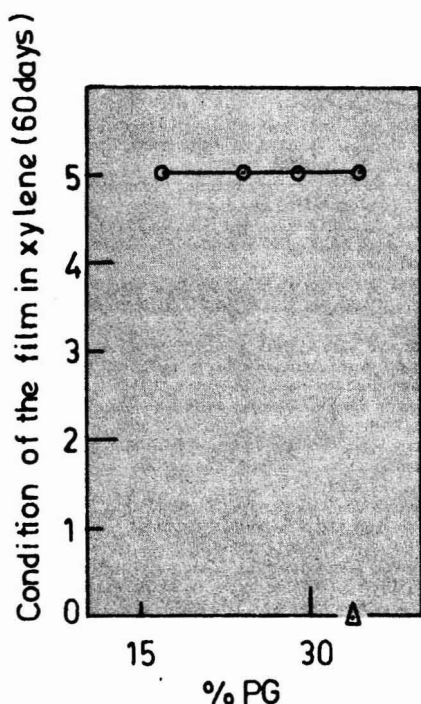


Figure 9—Solvent resistance of the copolymers and the styrenated alkyd control. Legend: see Figure 6

condition of the film was observed within 15 days in nitric acid.

Alkali Resistance

Glass panels of all samples were prepared as before and were immersed in separate 2% solutions of sodium carbonate and sodium hydroxide at room temperature. Panels dipped in sodium carbonate solution were taken out at regular intervals of 24 hr, washed in running fresh water, dried, and examined for any visible damages. Films in sodium hydroxide were checked every 2 hr.

It was found that after four days immersion in sodium carbonate, films of the sample having 34% polystyrene glycol were practically unaffected; those having 29% showed gloss loss and color change. Partial cracks and cracks with partial removal of film were observed in the cases of samples having 24% and 17% polystyrene glycol, respectively. The film of the styrenated alkyd was completely removed when immersed for four days. Results of immersion in 2% sodium hydroxide also revealed that films of the samples with polystyrene glycol gave better alkali resistance. The results as shown in Figure 8 also reveal that alkali resistance increases with increasing amount of polystyrene glycol in the copolymer.

Solvent Resistance

Glass panels were prepared as described earlier and were dipped in xylene at room temperature. Film condition was observed at regular intervals of five days. For

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this, panels were removed, allowed to stand in a vertical position for 5 min and then rubbed with cotton wool soaked in xylene. It was observed that film of samples having polystyrene glycol was practically unaffected up to 60 days of immersion, as shown in Figure 9, whereas the film of the styrenated alkyd was completely removed in nine days. It was interesting to note that polystyrene glycol, having a linear chain and being soluble in xylene, was not affected by xylene. In the copolymers prepared, polystyrene glycol reacts chemically with phthalic anhydride and is incorporated into the compact structure of the glyceryl phthalate resin. In the case of the styrenated alkyd, homopolymerization of styrene cannot be avoided. Therefore, little styrene is copolymerized with the fatty acids.¹⁶ The polystyrene homopolymer formed is sensitive to xylene, whereas in the preparation of polystyrene glycol, polystyrene homopolymer formation is negligible and, hence, the copolymer possesses excellent solvent resistance.

SUMMARY

Polystyrene glycol used in place of glycerol during the preparation of alkyds provides a new approach for synthesis of alkyds with a polystyrene moiety. In other words, polystyrene glycol serves a two-fold function. First, it can replace a part of the glycerol in the preparation of alkyds and, second, a long chain of polystyrene can be incorporated into an alkyd. The product so obtained has better physical and chemical resistance than those of conventional styrenated alkyds. These results suggest that the products may find application in high class finishes.

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United Kingdom Orders of FSCT Educational Literature

Mr. Ray Tennant, of the Birmingham Society, will act as a source of Federation educational literature (Color-matching Aptitude Test Set; Infrared Spectroscopy; Paint/Coatings Dictionary) for United Kingdom customers. Anyone interested in receiving these items is urged to contact Mr. Tennant. His address is: Carrs Paints Limited, Westminster Works, Alvechurch Road, Birmingham B31 3PG, England.

n-Dodecyl-substituted Aminopyrimidinium Salt Derivatives As Paint Film Antifungal Agents

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A paint film antifungal agent was sought from among 49 aminopyrimidinium salt derivatives which have in common an exo- or ring-nitrogen n-dodecyl substituent. Structure-activity studies with the destructive *Aureobasidium pullulans* indicated electron-withdrawing bromo or trifluoromethyl ring substitution reduced potency, whereas electron donor methyl and amino (in resonance) enhanced or maintained efficiency. A balanced hydrophilic-lipophilic partitioning capability appeared essential; more polar substituents caused compound removal from films by water leach, and excessive lipoidal modifications decreased fungitoxicity. Eleven derivatives were evaluated in an acrylic paint, at a 0.5% (w/w) compound loading, as a two coat self-primed system on pine wood panels exposed outdoors. Only 4-(n-dodecylamino)-1-methylpyrimidinium acetate matched the reference inhibitor, tetrachloroisophthalonitrile, in the first six months but then failed within the year.

INTRODUCTION

The need to protect paint films, which may be exposed exteriorly or subjected to high humidity interior conditions, against premature failure caused by fungal attack is well recognized in the industry.¹ Phenylmercury salts were among the predominant antimicrobial coating additives, but the search continues for a more environmentally acceptable non-metallic replacement. The Environmental Protection Agency has acknowledged inade-

quacies of presently available substitutes by permitting limited usage of the mercurials in water-borne outdoor paints.

Heterocyclic compounds have been widely employed as industrial and agricultural biocides,² with ring nitrogen-containing types serving as preservatives for aqueous systems, paint film protectants, fungitoxicants against phytopathogens, and other applications.³ This paper is part of a study to find similar outlets for a group of aminopyrimidinium salt derivatives which have in common an n-dodecyl substituent to increase microbial cell wall biophase solubility. All of the compounds (49) were initially screened in a nutrient medium against the fungus most commonly encountered on coated surfaces, *Aureobasidium pullulans*,⁴ and in acrylic paint films which were subjected to laboratory simulated weathering.⁵ Eleven representative examples of varied structure from among the better performers were then submitted to outdoor wood panel tests in northwestern New Jersey and southern Louisiana. Two commercial fungicides, tetrachloroisophthalonitrile and phenylmercuric propionate, served as comparison standards.

MATERIALS AND PROCEDURES

Preparation

All of the aminopyrimidinium salt derivatives (see Tables 1-4) were synthesized by known methods in which (a) nucleophilic halogen displacement of 2-, 4- or sequentially, of 2,4-di-chloropyrimidines with ammonia or amines provided requisite intermediates and (b) reaction with organic halide produced alkylated halide salt end-

* Merck & Co., Inc., Rahway, NJ 07065.

products. Acetate salts were obtained by metathesis with silver acetate. A comprehensive review of the different procedures has been reported,^{6a,b} and the following preparations illustrate generally applicable conditions. Structures have been reported as pyrimidinamines, although the tautomeric 2(1H) or 4(1H) pyrimidinines may be present as well. Ring nitrogen quaternization upon alkylation was given preference over exo-ring amine substitution.⁷ Endproducts were characterized by elemental analysis; purities were checked by thin layer chromatography on Analtech, Inc. precoated silica gel GF glass plates (250 μ m) with development by mixtures of chloroform, methanol, and ammonium hydroxide. Some molecular weights were confirmed by mass spectra analysis.

Typical Syntheses

4-(*n*-DODECYLAMINO)-2-(2-HYDROXYETHYLAMINO)-1-METHYLPYRIMIDINIUM IODIDE, 13:

2-Chloro-4-(*n*-dodecylamino)pyrimidine—*n*-Dodecylamine (67.2 g, 0.36 mol) was added to a well-stirred slurry of 2,4-dichloropyrimidine (27 g, 0.18 mol) in *n*-butanol (150 ml) and water (150 ml). The clear solution which resulted shortly after addition gradually deposited the product. The mixture was stirred 40 hr and the precipitate was removed by suction filtration. The solids were washed several times with water and then air-dried. A yield of 29.2 g (64%) was obtained: mp 80–82°C. Anal. calculated for C₁₆H₂₈N₃Cl: C, 64.51; H, 9.47; N, 14.11; Cl, 11.91. Found: C, 64.26; H, 9.51; N, 14.18; Cl, 12.02.

9.47; N, 14.11; Cl, 11.91. Found: C, 64.26; H, 9.51; N, 14.18; Cl, 12.02.

4-(*n*-Dodecylamino)-2-(2-hydroxyethylamino)pyrimidine—A mixture of 2-chloro-4-(*n*-dodecylamino)pyrimidine (6.0 g, 0.02 mol), ethanolamine (12.2 g, 0.2 mol), ethanol (70 ml) and water (20 ml) was stirred and heated at reflux until no unconverted chloro compound remained, 20 hr (tlc, silica gel; 10 parts chloroform, 0.2 part methanol, and 0.05 part conc. ammonium hydroxide). The ethanol was removed by distillation *in vacuo* and the residue was extracted with methylene chloride, the aqueous phase was re-extracted with methylene chloride, the combined organic layers were washed well with water, dried (Na₂SO₄) and concentrated *in vacuo* to a residual oil which gradually solidified. A yield of 6.3 g (98%) was obtained. The intermediate was used for the quaternization reaction without further purification and showed essentially a single spot on thin layer chromatography.

4-(*n*-Dodecylamino)-2-(2-hydroxyethylamino)-1-methylpyrimidinium Iodide, 13—Methyl iodide (0.8 ml, 0.012 mol) was added to a stirred solution of 4-(*n*-dodecylamino)-2-(2-hydroxyethylamino)pyrimidine (3.2 g, 0.01 mol) in anhydrous dimethylformamide (25 ml) and the stoppered solution was stirred 16 hr. Anhydrous ether (180 ml) was added slowly in small portions and the resultant precipitate was slurried one hour. The mixture was suction-filtered, the solids washed with ether and dried. Yield, 3.4 g (76%): mp 118–119°C. Anal. calculated for C₁₉H₃₇N₄OI: C, 49.13; H, 8.03; N, 12.06; I, 27.33. Found: C, 48.98; H, 7.99; N, 11.88; I, 27.42.

1-(4-CHLOROPHENYLMETHYL)-4-(*n*-DODECYLAMINO)PYRIMIDINIUM CHLORIDE, 26:

4-*n*-Dodecylaminopyrimidine (mp 75–75.5°C, 1.3 g, 0.005 mol) was suspended in a mixture of anhydrous dimethylformamide (5 ml) and ether (10 ml). 4-Chlorophenylmethyl chloride (1.0 g, 0.006 mol) was added, and the reaction mixture was stirred at 20°C for 96 hr until all of the amine was quaternized. Ether was added to precipitate the product, with cooling to 0–5°C. The solids were removed by suction filtration, washed with ether and dried at 40°C. Yield, 0.55 g (26%): mp 85–88°C. Thin layer chromatography on silica gel and development with CHCl₃:NH₄OH:CH₃OH (75:5:20 by volume) indicated an R_f 0.4. For analysis, a sample was dried at 60°C/0.1 mm. Anal. calculated for C₂₃H₃₅N₃Cl₂: C, 65.08; H, 8.31; N, 9.90; Cl, 16.32. Found: C, 64.76; H, 8.60; N, 9.97; Cl, 16.36.

4-AMINO-2-(*n*-DODECYLAMINO)-1-(3-HYDROXYPROPYL)PYRIMIDINIUM BROMIDE, 49:

4-Amino-2-(*n*-dodecylamino)pyrimidine—4-Chloro-2-(*n*-dodecylamino)pyrimidine (5.96 g, 0.02 mol), obtained from the filtrate of 13 (a) as a byproduct, was added to a solution of anhydrous ammonia (1.02 g, 0.06 mol) in ethyl alcohol 2BA (50 ml), placed in a sealed glass tube and heated at 180°C for 5 hr. After cooling to 20°C, the precipitated ammonium chloride was filtered and the filtrate concentrated *in vacuo*. The residue was dissolved in water, made basic with the addition of 2.5N

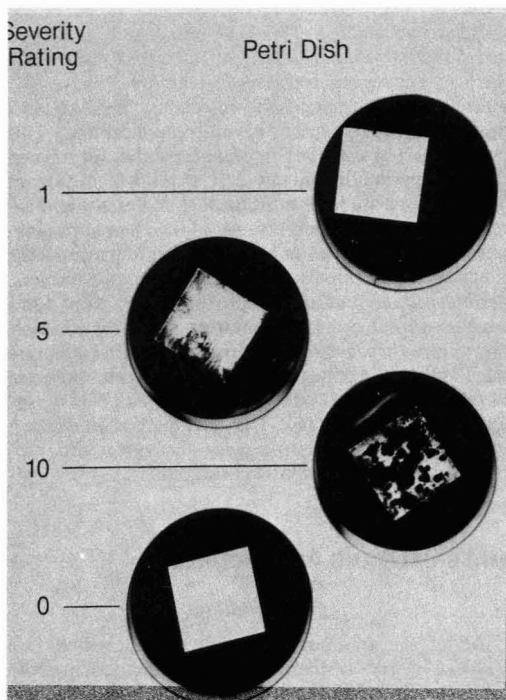


Figure 1—Visual approximation of *Aureobasidium pullulans* for the evaluation of potential chemical inhibitors. Outdoor-exposed pine panel tests were graded accordingly for mildew intensities

sodium hydroxide and extracted with several portions of ether. The ether layers were combined, dried over anhydrous sodium sulfate and the solvent then evaporated. The remaining colorless crystalline solid was of near analytical purity, 4.8 g (86%): mp 46–50°C. Anal. calculated for $C_{16}H_{30}N_4$: C, 69.02; H, 10.86; N, 20.12. Found: C, 69.62; H, 10.67; N, 19.51.

4-Amino-2-(n-dodecylamino)-1-(3-hydroxypropyl)pyrimidinium Bromide, 49—4-Amino-2-(n-dodecylamino)pyrimidine (1.1 g, 0.004 mol) and 3-bromo-1-propyl alcohol (0.61 g, 0.0044 mol) in anhydrous dimethylformamide (10 ml) was stirred at 45–50°C for 72 hr. The solvent was removed under reduced pressure and the residual solid was washed several times with ether. Upon crystallization from acetone, 0.55 g (33%) was obtained: mp 70–73°C. TLC on SiO_2 ($CHCl_3:NH_4OH:CH_3OH$, 75:5:20) R_f 0.26. Anal. calculated for $C_{19}H_{37}N_4OBr$: C, 54.66; H, 8.94; N, 13.42; Br, 19.15. Found: C, 54.66; H, 8.46; N, 12.99; Br, 18.98.

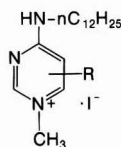
Fungal Inhibitor Assays

IN MEDICATED AGAR MEDIUM: Stock solutions of the test compounds in dimethyl sulfoxide were diluted with hot, sterile Sabouraud maltose agar (Difco) to provide concentrations of 100, 80, 60, 40, 20, 10, 5, and 1 $\mu g/ml$.

Ten ml of the medicated agar was poured into petri plates, allowed to solidify, and the surface streaked with cells of *Aureobasidium pullulans* ATCC 9348 using a sterile cotton swab. This inoculum was grown for seven days at 28°C. The test petri plates were incubated for four days at 28°C. The minimum inhibitory concentration (MIC) was that at which there was no visible growth. A culture medium with the maximum concentration of 1% dimethyl sulfoxide as the solvent control was non-inhibitory. All tests were run in duplicate.

IN PAINT FILM-PETRI PLATE: The pyrimidinium salt derivatives were mixed into the acrylic paint (see *Formulation*) to provide a loading of 0.5% by wt. Samples were brushed out two coats on Whatman No. 1 filter paper substrate. A 24-hour dry time was allowed before the second coat of paint was applied, followed by seven days aging after the top coat.⁵ Specimens, 1.5 in. square, were cut from the paper; the unweathered group was used as is. Simulated weathering was obtained by heating specimens at 65°C for 24 hr. After cooling to room temperature, the squares were leached in cold, running tap water for 24 hr. The unweathered and heat-leached coated squares were placed on the surface of Sabouraud maltose agar petri plates and inoculated with a spore suspension of *Aureobasidium pullulans* ATCC 9348. The plates were incubated at 28–30°C and 90–95%

Table 1—Antifungal Activity of Substituted 4-n-Dodecylamino-1-methylpyrimidinium Iodide Salts



Substituent R	<i>Aureobasidium pullulans</i> Minimal Inhibitory Concn. parts per million ^a	Fungal Growth on Paint Film ^b	
		Unweathered	Heat-leached
(1) — ^c	10	0	0
(2) — (bromide salt)	5	0	0
(3) — (acetate salt)	5	0	0
(4) 2-CH ₃	5	0	0
(5) 6-CH ₃	5	0	1
(6) 2,6-diCH ₃	5	0	1
(7) 2-CH ₃ , 6-CF ₃	40	8	10
(8) 5-Br	100	1	5
(9) 2-NH ₂	5	0	0
(10) 2-NHCH ₃	5	0	0
(11) 2-NH ₂ , 6-CH ₃	5	1	1
(12) 2-NHCH ₂ -CCH ₃ =CH ₂	20	1	1
(13) 2-NHCH ₂ CH ₂ OH	10	1	2
(14) 2-NHCH ₂ CHOHCH ₂ OH	5	1	4
(15) 2-NHCH ₂ CHOHCH ₂ NH ₂	40	10	10
(16) 2-NHCH ₂ CH ₂ OH, 6-CH ₃	20	0	1
Tetrachloroisophthalonitrile	10	1	1
Phenylmercuric propionate ^d	1	0	0
Control Paint ^e		10	10

(a) Concentration of compound, w/w, in test medium, petri plate.

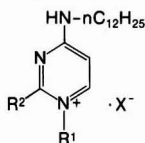
(b) Concentration of compound in acrylic paint, 0.5% by wt: 0 = no growth; 1–9 = increasing levels of growth; 10 = heavy growth.

(c) R = H for unsubstituted positions.

(d) Loading in acrylic paint, 0.17% by wt.

(e) Acrylic paint with no mildewicide added.

Table 2—Antifungal Activity of Substituted 4-n-Dodecylaminopyrimidinium Halide Salts



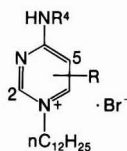
Substituents			X	<i>Aureobasidium pullulans</i> Minimal Inhibitory Conc. parts per million ^a	Fungal Growth on Paint Film ^b	
R ¹	R ²	Unweathered			Heat-leached	
(17)	CH ₂ COCH ₂	— ^c	Cl	20	0	3
(18)	CH ₂ CH ₂ OCH ₃	—	Br	10	0	1
(19)	CH ₂ CH ₂ OOCCH ₃	—	Br	5	1	5
(20)	CH ₂ CH ₂ CH ₂ OH	—	Br	10	0	1
(21)	CH ₂ CH ₂ CH ₂ OH	NHCH ₂ CH ₂ OH	Br	10	0	4
(22)	CH ₂ CCH ₃ = CH ₂	—	Cl	5	0	0
(23)	CH ₂ CCH ₃ = CH ₂	NHCH ₂ CH ₂ OH	Cl	20	0	0
(24)	CH ₂ CH(OC ₂ H ₅) ₂	—	Br	5	1	3
(25)	CH ₂ CH ₂ c-C ₆ H ₁₁ ^d	—	Br	20	10	8
(26)	CH ₂ C ₆ H ₄ -4-Cl	—	Cl	100	2	5

(a) Concentration of compound, w/w, in test medium, petri plate.

(b) Concentration of compound in acrylic paint, 0.5% by wt: 0 = no growth; 1-9 = increasing levels of growth; 10 = heavy growth.

(c) R² = H.(d) c-C₆H₁₁ = cyclohexyl.

Table 3—Antifungal Activity of Substituted 4-Amino-1-n-dodecylpyrimidinium Bromide Salts



Substituents			X	<i>Aureobasidium pullulans</i> Minimal Inhibitory Conc. parts per million ^a	Fungal Growth on Paint Film ^b	
R ¹	R ²	Unweathered			Heat-leached	
(27)	— ^c	— ^d	—	5	0	3
(28)	2,5-diCH ₃	—	—	5	0	5
(29)	2-CH ₃ , 5-CH ₂ OH	—	—	5	0	4
(30)	2-CH ₃ , 5-CH ₂ OCH ₃	—	—	25 (60)	2	9
(31)	2-nC ₃ H ₇ , 5-CH ₂ OCH ₃	—	—	100	0	3
(32)	2-NH ₂	—	—	5	0	1
(33)	2-NHCH ₂ CH ₂ OH	—	—	10	3	10
(34)	5-NH ₂	—	—	5	3	7
(35)	—	CH ₃	—	—	0	0
(36)	—	nC ₃ H ₇	—	10	0	2
(37)	—	CHCH ₃ CH ₂ CH ₃	—	5	1	1
(38)	—	C(CH ₃) ₃	—	10	1	5
(39)	—	CH ₂ cC ₆ H ₁₁ ^e	—	60	10	10
(40)	—	CH ₂ C ₆ H ₇ O ^f	—	10	5	9
(41)	—	CH ₂ CH ₂ OCH ₃	—	10	1	3
(42)	H	CH ₂ CHOHCH ₃	—	10	4	9
(43)	H	CH ₂ CH ₂ OCH ₂ CH ₂ OH	—	20	6	10
(44)	H	HCO	—	60	0	8
(45)	H	CH ₃ CO	—	10	1	8

(a) Concentration of compound, w/w, in test medium, petri plate.

(b) Concentration of compound in acrylic paint, 0.5% by wt: 0 = no growth; 1-9 = increasing levels of growth; 10 = heavy growth.

(c) R = H.

(d) R¹ = H.

(e) Cyclohexylmethyl.

(f) Tetrahydrofuran-2-ylmethyl.

relative humidity for four weeks. All tests were run in duplicate, and the plates were scored visually as indicated in Table 1, footnote (b), and in Figure 1.

FIELD PANEL EXPOSURE TEST

Acrylic paints (see Formulation) which contained six pounds of a pyrimidinium salt derivative or tetrachloroisophthalonitrile per 100 gal (0.5% by wt), or two pounds of phenylmercuric propionate per 100 gal (0.17% by wt) were applied two coats self-primed on 6 in. x 36 in. Northern white pine beveled siding. A 24-hr air dry was allowed between coats. Each panel surface was divided into thirds as follows: (1) Blank paint—no mildewcide; (2) Treated paint—experimental compound added; and (3) Control paint—isophthalonitrile derivative added.

The phenylmercuric propionate paints were run on separate panels, one-half the area was coated with the blank paint. All panels were run in duplicate. The New Jersey series was terminated after three months, and the Louisiana series after six months; panels with compound 3 were continued for one year. Visual ratings were made for mold growth (see Table 4 footnote b, and Figure 1).

RESULTS OF LABORATORY ANTIFUNGAL EVALUATIONS

The majority of 4-n-dodecylamino-1-methylpyrimidinium salt derivatives (Table 1) appeared comparable to the reference commercial product, tetrachloroisophthalonitrile, in the minimal inhibitory concentration assay and for the protection of paint films subjected to an *Aureobasidium pullulans* challenge after simulated weathering. Some substituent variation among the 19 compounds altered efficiency significantly.

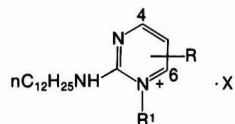
The introduction of an electronegative 6-trifluoromethyl group, as in compound 7, for the electron-donating 6-methyl group of compound 6, or the replacement of hydrogen at pyrimidine ring-five position of compound 1 with an electron-withdrawing bromine, as

Material	Pounds per 100 Gallons
Natrosol® 250 HR* (2% solution)	100
Water	65
Tamol® 850 (30%)	6
Potassium tripolyphosphate	0.5
Igepal® CO-610 ^a	4
Colloid® 691 ^c	2
Ethylene glycol	25
Texanol®	8
TiPure® R-966 ^d titanium dioxide	250
Nyral® 300 ^e talc	125
Natrosol 250 HR* (2% solution)	125
Water	60
Colloid 691 ^c	1
MERBAC-35® ^a	1
Rhoplex® AC-388 ^b	364
NH ₄ OH	1
% Pigment volume content	40.0
% Solids, weight	50.1

(a) Hercules, Inc.	(e) Eastman Chemical Products, Inc.
(b) Rohm and Haas Company	(f) E.I. Dupont de Nemours
(c) General Aniline & Film Corp.	(g) R. T. Vanderbilt Co.
(d) Colloids, Inc.	(h) Benzyl bromoacetate, Calgon Corp.

in compound 8, caused a sharp loss evidenced in both antifungal test systems. Decreased basicity would be an expected consequence of such changes. The presence of a 2-amino group, as in compound 9, had no influence; its electron-releasing resonance potential possibly dominated. However, increasingly polar modifications of the same group which culminated in the 2-(3-amino-2-hydroxypropyl)amino substituted compound 15 produced complete ineffectiveness in the paint film. This

Table 4—Antifungal Activity of Substituted 2-n-Dodecylaminopyrimidinium Halide Salts



Substituents	R ¹	R	X	Aureobasidium Pullulans	Fungal Growth	
				Minimal Inhibitory Conc.	On Paint Film ^b	
				parts per million ^a	Unweathered	Heat-leached
(46) CH ₃		6-CH ₃	I	5	1	3
(47) CH ₃		4-NH ₂	I	5	0	0
(48) CH ₃		4-NHCH ₂ CH ₂ CH ₂ OH	I	5	0	1
(49) CH ₂ CH ₂ CH ₂ OH		4-NH ₂	Br	5	2	2

(a) Concentration of compound, w/w, in test medium, petri plate.

(b) Concentration of compound in acrylic paint, 0.5% by wt: 0 = no growth; 1-9 = increasing levels of growth; 10 = heavy growth.

may not reflect toxicant removal by the heat-leach treatment, for the unweathered film also failed. No significant performance differences were observed for anion salt variations between halides and acetate in the limited series of compounds 1, 2, and 3.

In a second series (Table 2), replacement of the 1-methyl quaternary group in the 4-n-dodecylaminopyrimidinium salt derivatives with an oxygen-containing alkyl, an alicycloalkyl, an aralkyl, or with a 2-methyl-2-propenyl group indicated only compounds 22 and 23 protected weathered films completely. Related compounds of increased hydrophilicity, for example compound 21, wherein a 1-(3-hydroxypropyl) group replaced the 1-(2-methyl-2-propenyl) group of 23, appeared vulnerable to water leach, for full inhibitory properties were retained in unstressed specimen films. The relatively greater lipophilicity of the 1-substituents in compounds 25 and 26, as compared to that of 22, proved detrimental. The need for a balanced partition capability of antimicrobial agents between water and lipid has been previously reported.⁸

A shift of the n-dodecyl substituent from the 4-amino group to the N¹ quaternary moiety provided 19 compounds (Table 3), 14 of which approximated the MIC assay for the isophthalonitrile. However, only 32, 33, and 37 maintained peak efficiency in the weathered film.

Some of the factors which appeared to affect activity and performance in the two prior series were also found among these derivatives. The 2-amino group, as of 32, was without influence; relatively polar oxygen-containing substituents reduced resistance to heat-leach for about half of the otherwise superior compounds, and linear lower alkyl amino-modifying groups favorably imparted sufficient lipid-like properties, for example, to compounds 35, 36, and 37. Interestingly, a 5-amino substituent vicinal to the 4-amino group as in compound 34, provoked a loss in efficiency to weathering.

The 2-n-dodecylamino derivatives of the final series (Table 4) were potent antifungals in the nutrient medium. Of the four, compound 47 retained highest activity in the film under all conditions similar to its position isomer, 9, and represented a confirmation of the role of an amino group. The other three compounds appeared to rank practically equivalent to their isomer counterparts in the 4-n-dodecylamino series.

OUTDOOR TESTS

The compounds selected for exterior paint panel exposure (Table 5) represented the three n-dodecyl types of pyrimidine substitution; namely, as an alkylamino group attached to the 2- or 4-ring carbon, or as the N¹ quaternary alkyl salt. All but two displayed relatively high antifungal action in the laboratory weathered films; the potentially fair, 17, and poor, 30, inhibitors were included as additional controls. Only compound 3, 4-n-dodecylamino-1-methylpyrimidinium acetate, of the 11, suppressed panel mold growth at both test sites and approximated the ratings for the two commercial products in the three and six months periods. It also failed within the following six months. The predominant fungus was identified as *Aureobasidium pullulans* in association with some *Alternaria* sp., a colonization similar to that previously reported by others.⁹

There were factors omitted in the laboratory procedure which could be responsible in part for the poor field trial correlations, although in prior years similar tests with phenylmercury salts and various relatively stable non-metallic inhibitors proved productive.¹⁰ For example, aminopyrimidinium salts may be oxidized or undergo dimer and oligomer formation mediated by ultraviolet light.¹¹ The heterocyclic ring is susceptible to hydrolytic instability; accelerated degradation may result in the film at elevated temperatures of exposure assisted by high concentrations of compound in water at the surface microenvironment of pigments and extenders. An examination of test coatings after six months of in-the-can shelf aging indicated samples containing compounds 20, 23, and 47 lost about one-third of their initial potency. Other differences between the field and laboratory include the wood substrate and probable film attack by a succession of mixed microbial flora¹² in contrast to the filter paper base and a single pure fungal culture challenge. Further studies are required to assess the utility of some of these variants in the development of an accelerated screen method for more vulnerable compounds.

SUMMARY

n-Dodecyl-substituted aminopyrimidinium salt derivatives appeared to be potent inhibitors of paint film-destructive *Aureobasidium pullulans* in medicated agar assay and acrylic paint subjected to simulated weathering. Their useful properties could be modulated by additional substituents: electron-withdrawing or donor groups affected fungitoxicity, and hydrophilic or lipophilic modifications influenced antifungal efficiency and

Table 5—Field Test of Two Coat Self-primed Acrylic Paint^a on White Pine Panels

Compound No.	Fungal Growth Severity Rating ^b	
	N. New Jersey	S. Louisiana
	3 months	4 months
1	6	7 ^d
3	2	4 ^d
12	6	9
16	5	8
17	6	8
18	4	6 ^d
20	5	8
23	6	9
30	6	9
36	5	5 ^d
47	6	8
Tetrachloroisophthalonitrile ^c	3	3 ^d
Phenylmercuric propionate ^c	0	2 ^d
Control Paint ^d	10	10

(a) Compound loading — 6 lb in 100 gal of acrylic paint; 0 lb in control paint;

(b) 0 = No growth; 1-9 = increasing mold; 10 = completely overgrown.

(c) 2 lb in 100 gal of acrylic paint.

(d) Reading after 6 months.

permanence of compounds in the film. Outdoor tests of selected derivatives in an acrylic coating on self-primed painted pine wood panels, indicated only the 4-n-dodecylamino-1-methyl quaternary acetate salt provided mold growth inhibition comparable to the reference tetrachloroisophthalonitrile additive for the first six months and then failed.

ACKNOWLEDGMENT

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Skid Resistant Coatings For Aircraft Carrier Decks

S.H. Davang* and H. Dear
Tracor, Incorporated†

Skid resistant deck coatings for Navy aircraft carriers are covered by performance type specifications. To develop a new specification for a high performance coating which can be applied by ships' crews, six proprietary coatings were examined and tested for film thickness, weight, friction and wear properties. In comparison to sprayed deckings, the test coatings applied by roller showed greater variance in properties. Two of the six coatings would pass a friction retention requirement more stringent than the sprayed decking specification while four would fail the specification. In the wear test, the high friction coatings show greater wear than the lower friction coatings.

INTRODUCTION

Deck coatings used on aircraft carrier flight and hanger decks must have skid resistant properties and also protect decks from corrosion. Skidding of heavy equipment can cause serious accidents, particularly during heavy seas or "scramble" situations. A high performance "non-skid" deck coating is available to the Navy, but its application requires professional spraymen and equipment. For a more utilitarian coating, the Navy is proceeding with a project to develop a new performance specification for a deck coating that can be applied by a ship's crew or professional painters. As a minimum, the coating must be capable of providing an effective service life of two years with little maintenance and repairs.

STATE OF THE ART

There are presently excellent proprietary deck coatings available for ship use. Development of these skid resistant coatings has been previously reported in U.S., British, and Australian naval laboratory papers.¹⁻³ These coatings are usually high performance two-component epoxy or urethane type paints with an added aggregate to create the skid resistant properties. The aggregate used in these coatings is hard material such as aluminum oxide, silicon carbide or furnace slag. For a less abrasive coating, which is needed in the carrier flight deck landing area to prevent abrasion damage to the steel arresting cables, softer particles such as aluminum granules are used. The Navy has designated as Types I and II those materials for use in nonlanding areas and landing areas, respectively.

Deck coatings are applied either by troweling, spraying, brushing, or rolling, with the last being one of the most productive methods for nonprofessional applicators. Coatings are usually applied by the ship's crew when their ship is in port. Maintenance of the deck is accomplished both in port and during deployment at sea. When these and all the other possible ship situations are analyzed, it was reasoned that rolling would be the most universal method of application. Therefore, the primary emphasis in the specification development would be a rollable coating.

The Navy is currently using two nonskid deck covering specifications, Military Specification MIL-D-23003 and MIL-D-24483A.^{4,5} The former, and earlier, specification covers a coating that can be applied by the aforementioned four methods, while the latter covers an improved material applicable by spraying only. These two specifications will be used as the guidelines in the development of a new rollable coating specification. In

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Table 1—General Information on the Six Proprietary Skid Resistant Deck Coatings

Coating	Type of Resin in Coating	No. of Components	Mixing Ratio of Components (By Weight)	Type of Aggregate in Coating
A	Epoxy	2	9 to 1	Aluminum oxide 24 mesh
B	Epoxy	2	13.6 to 1	Aluminum oxide 24 mesh
C	Epoxy	2	100 to 6.5	Silicon carbide 20–30 mesh (75%) aluminum oxide 20–30 mesh (25%)
D	Urethane	3	17 to 100 to 182	Aluminum oxide 14–28 mesh
E	Epoxy	2	100 to 10.5	Furnace slag plus aluminum oxide 36 mesh
F	Epoxy	2	7.36 to 1	Aluminum oxide 20 mesh

this paper, only the first part of the specification development work is reported. This part consists of testing six Type I candidate commercial materials for the most critical properties, such as the coefficient of friction in dry

condition, resistance to wear, and applicability. Other important properties, such as the coefficient of friction in wet and oily conditions, resistance to impact, fire retardancy, corrosion resistance, and stability will be the subject of another report.

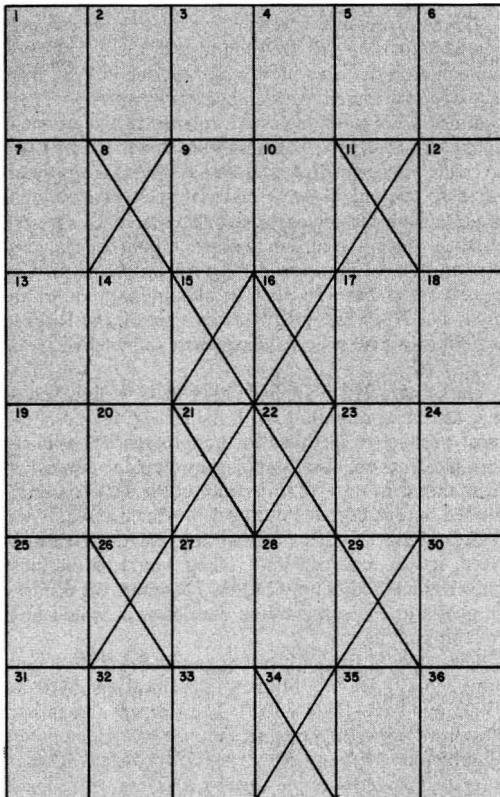


Figure 1—Diagram of scheme for selecting nine wear test panels from an array of 36 panels

MATERIALS

Six proprietary deck coatings were obtained from six manufacturers for testing. The number of components in each coating and their mixing ratios are given in Table 1. The generic type of resin, as well as the type and size of the aggregate in each coating, are also given in the table.

METHOD OF TEST

The test methods were patterned after the tests in Military Specification MIL-D-24483A. The testing procedure consists of preparing panels; measuring the static friction, weight, and thickness of coating; wearing the coating in the Tinius Olsen wear machine; and remeasuring the static friction, weight and loss of thickness of coating. These measurements were repeated after every 50 revolutions of the wear machine rotating disc. Inspection and photographs were made after each of these 50 cycles. Details of the tests are given in the following sections.

Panel Preparation

Sandblasted 1/16 × 2.0 × 3.0 in. (0.16 × 5.1 × 7.6 cm) mild steel plates were used as test panels. Thirty-six of these panels were butted together in a 6 × 6 array to form a 12.0 × 18.0 in. (20.5 × 45.7 cm) surface for the test application of each deck coating.

The 36-panel arrays were first coated with Navy Formula No. 150 primer.⁶ After drying, the primed panels were separated, weighed to establish a tare weight, and examined for film thickness. The array was reassembled on a plywood board for the deck coating application.

Table 2—Average Coating Weight, As Applied, Of Six Proprietary Deck Coatings

Coating	Weight in oz/ft ²
A	6.91
B	6.02
C	4.32
D	4.29
E	3.61
F	4.98

Each deck coating was applied onto a separate 6 × 6 array of primed panels. The roller used was a smooth plain phenolic core without any textile covering. The six deck coatings were each mixed according to manufacturers' instructions before the application.

After 96 hr of drying, the individual panels in the arrays were separated and excess coating material scraped off panel edges. Cleaned panels were reassembled in the original array arrangement and photographed to show the surface texture and pattern of the coating.

To measure the applied coating weight, each individual panel was weighed. The weight of each coating was computed from the difference between the weight of the 36 primed panels and the same panels fully coated. The average applied weights obtained are given in Table 2 in ounces per square foot.

Test Panel Sampling

For the friction and wear tests, a certain number of representative panels were selected from the 36 in each array. From the 36 panels of coatings A, B and C, nine were selected from their arrays using a selection scheme diagrammed in Figure 1. For coatings D, E and F, which were considered less likely to perform to proposed specification requirements, only three were selected from each array. This latter selection was made first, by taking the nine according to Figure 1 scheme, and second, by taking only three of the nine.

All of the selected panels were mounted on wooden blocks to become wear test specimens. The weight and thickness of each specimen were determined. In the thickness determination, the specimens were measured at 12

Table 3—Percent Weight Losses of Six Proprietary Deck Coatings After Wear Tests

Coating	Percent Weight Loss of Coating After Wear Tests	
	225 Revolutions of Wear Disc	350 Revolutions of Wear Disc
A	28.2%	45.5%
B	28.9%	45.0%
C	37.0%	59.9%
D	22.8%	30.9%
E	33.0%	37.2%
F	30.2%	39.9%

Table 4—Coefficient of Static Friction^a of Six Proprietary Deck Coatings (Dry Surface) Before and After Wear Tests

Wear Test in No. of Revolutions of Wear Test Machine Disc	Coefficient of Friction Coating					
	A	B	C	D	E	F
0	1.21	1.18	1.14	1.10	0.97	1.12
50	1.15	1.09	1.09	0.91	0.90	1.08
100	1.12	1.07	1.07	0.92	0.91	0.98
150	1.09	1.00	1.07	0.89	0.92	0.96
200	1.09	0.96	1.06	0.90	0.90	0.96
225	1.11	0.97	1.07	0.89	0.92	0.96
250	1.02	0.98	1.05	0.88	0.96	0.96
300	1.03	0.98	1.09	0.87	0.95	0.95
350	1.00	0.93	1.08	0.87	0.93	0.92

(a) The coefficient of friction of 1.0 is considered high enough for aircraft carrier deck use.

separate points predetermined by a template. These first measurements gave the initial weight and thickness of the specimens.

Friction Test

The initial static friction of the specimens was determined with an Olson slipmeter,^{7,8} which measures the tension required to pull the meter across a surface. This instrument had a set of three removable 0.75 in. (1.9 cm) diameter feet, each fitted with a shoe of vulcanized neoprene rubber having a Shore "A" hardness range of 85 ± 5 durometer. This is a harder rubber than shoes of Shore "A" hardness of 75 ± 5 durometer used in Military Specification MIL-D-24483A. Three specimens are required for friction measurement. The three panels were arranged so that each foot of the slipmeter contacted the coating surface of a separate panel. Six readings were made. For the first three readings, the three

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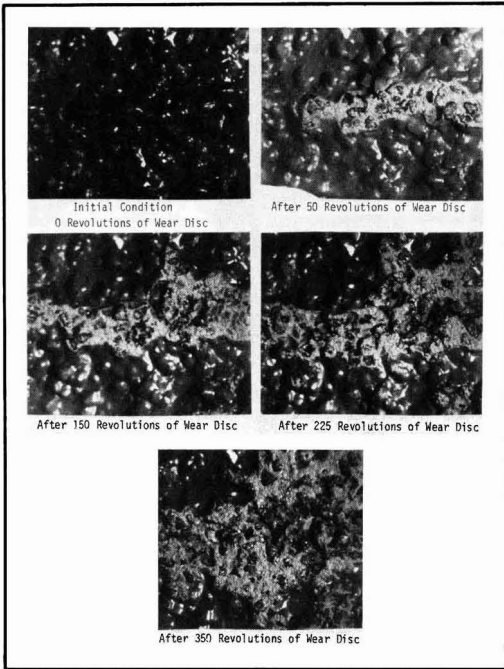


Figure 2—Progressive wear of Coating A surface in wear tests (7X)

panel surfaces supported a different foot of the slipmeter during the test pulls. The panels were then rotated 180° and pulls repeated for three additional readings. The six readings of each coating were averaged. The coefficient of friction was obtained from conversion curves, which converted the tension readings to coefficient of friction.

Wear Test

Each specimen was given a wear test with 50 revolutions of the wear disc of the Tinius Olsen machine. This apparatus is fully described in specifications.^{4,5} Essentially, the deck coating is abraided with aluminum oxide particles scattered on a flat rotating disc. After this wearing, the specimens were remeasured to determine their weight, thickness, and coefficient of friction. Representative specimens were photographed.

The test continued with another wearing in 50 revolutions of the wear disc for each specimen followed with another remeasurement. This cycle of wearing and measuring was conducted seven times, to the final completion of 350 disc rotations. This procedure gave eight points of change for each type of measurement. An additional point was obtained at the end of 225 revolutions of the disc so as to gather data for comparison with the 225 revolution requirement of Military Specification MIL-D-24483A.

Photomicrographs were taken of representative specimens after each wear test. Figure 2 shows five of these photomicrographs taken of coating A illustrating the progressive changes of the coating surface in the wear

tests. A thorough inspection of the specimens was made at the end of the last test.

RESULTS

The wear testing of the six proprietary deck coatings revealed the comparative durability of the materials. The average weight losses of the six coatings after each run in the wear machine were calculated and converted into percent accumulated losses. The highlight of this data is the losses after 225 and 350 revolutions of the wear disc, which are given in Table 3. It is seen that coatings C and D gave the highest and lowest percent losses by weight respectively.

The average losses in coating thickness after each wear cycle is shown graphically in Figure 3. Loss in coating thickness rather than weight is generally considered as

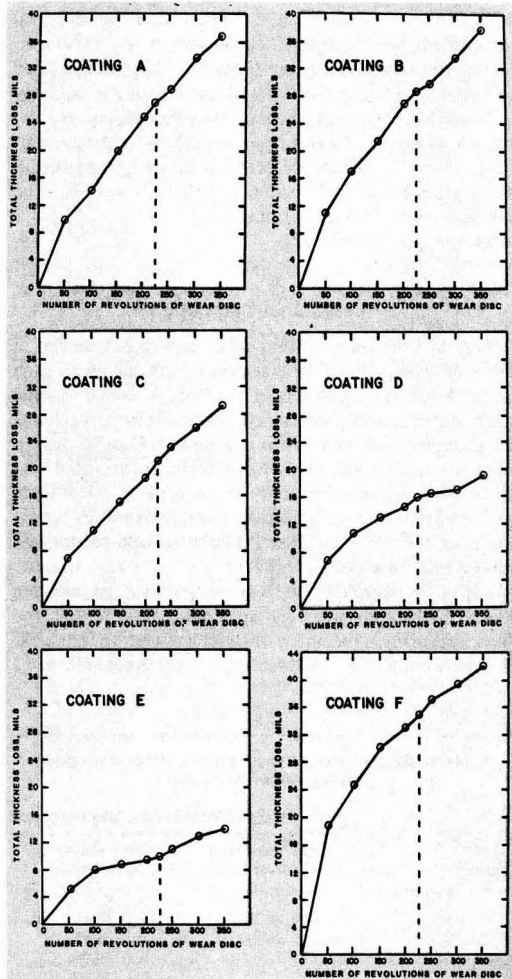


Figure 3—Loss of film thickness of six proprietary deck coatings in the wear test. (Dotted line indicates thickness loss at 225 revolutions of disc)

the criteria of wear resistance. Coating F and E, in this case, are seen as the least and most wear resistant, respectively.

The change in the coefficient of static friction after each wear cycle is shown in *Table 4*. From these results, the ranking from best to worse can best be listed as: A, C, B, F, E, D.

DISCUSSION

Perhaps the most important property of deck coating is the retention of a high coefficient of friction in service. As indicated, coating A is superior in this regard, followed by coatings C, B, F, E, and D, in descending order. With the method of friction measurement used in this work, a value of 1.0 is accepted by the Navy as being high enough for aircraft flight deck use, although the initial value of 1.1 is required by Military Specifications MIL-D-24483A. Only coatings A and C retained a friction value of over 1.0 at the end of the test even though five of the six coatings had a satisfactory 1.5 initial coefficient. For the first approximation, the initial friction of 1.1 minimum and of 1.0 minimum after 350 disc revolutions should be incorporated in the new specification.

The next property to be considered is wear resistance. In examining *Table 3* and *Figure 3*, it is found that coating D has the lowest loss of weight and coating E the lowest loss of thickness. However, these two coatings were the poorest in initial friction retention. It is axiomatic that harder substances become more polished with wear than softer substances. Therefore, if coatings D and E are resistant to wear (harder) they tend to be polished more than the less resistant (softer), thus dropping in coefficient of friction somewhat faster. On the other side of the coin, too rapid wearing is also undesirable. The best trade-off would be low wear rate with a steady retention of acceptable friction, as found in coatings C and A.

The weights of the six coatings, as applied, varied by nearly a factor of two. The highest was 6.91 oz/ft² (2.10 kg/m²) for coating A and the lowest was 3.61 oz/ft² (1.10 kg/m²) for coating E. These are above and below, respectively, the weight requirement in existing government specifications. The case of the weight of coating A seems to open the consideration of allowing a higher

weight limit, since coating A performed well in the test. On the other hand, the low weight of 3.61 for E has only poor connotations as the light weight coating had poor performance and a very poor amount of deposition per application. It appears that a coating weight of 4.0 oz/ft² (1.1 kg/m²) minimum and 6.0-7.0 oz/ft² (1.8-2.1 kg/m²) maximum could become criteria for weight, although too heavy a coating presents problems in drying, impact resistance, and fire resistance.

CONCLUSION

Among the six proprietary roller applied skid resistant coatings tested, several have initial coefficients of friction and retentions of friction equal to sprayed typed coatings of MIL-D-24483A. The weights and thicknesses of the six rolled coatings were varied, and some of the values would be outside the specifications limits of MIL-D-24483A. New criteria will be incorporated in a new specification for roller-applied coatings based on this work.

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STANDISH, J.V. and BOERIO, F.J.—Anodic Electrodeposition of Paint for Coil Coatings Galvanized Steel, Apr., p. 29.
STOY, W.S.—See Brown, T.G.

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- TECHNICAL INFORMATION SYSTEMS COMMITTEE—Technical Computer Applications in the Coatings Industry. A Bibliography—1967-79, Nov., p. 69.
TSUBOUCHI, K.—See Imai, T.

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- UEDA, Y.—See Ashida, M.

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- WALKER, P.—Organo-Silanes as Adhesion Promoters for Organic Coatings, Nov., p. 49.
WERNER, H.M.—An Overview of Quality Assurance, Oct., p. 53.
WICKS, Z.W. and KOAY, C.-W.—Primary Amine Zwitterion Copolymers, Dec., p. 37.
WILDMAN, G.C.—See Crews, G.M.
WILLEBOORDSE, F.G.—See Eaton, R.F.
WILLIAMS, M.M.—See Irwin, V.L.
WINTERS, H.—Use of Amines to Inhibit Viscosity Loss in Latex Paints Caused by the Presence of Oxidants and Reductants, May, p. 71.

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- YASEEN, M.—See Jayasri, A.

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- ZINC INSTITUTE, INC.—Zinc Oxide Stability in Exterior Latex Paints, Sept., p. 79.

Proceedings Of the Paint Research Institute

- No. 138—Research Director's Report, July, p. 65.
No. 139—Application of Hydrodynamic Volume and Swelling Theory to the Crosslinking of Latex Particles, Oct., p. 33.

Society Meetings

Chicago

Oct. 6

Education Committee Chairman, James Manier, announced that three \$1,000 scholarships have been awarded to North Dakota State University, the University of Missouri-Rolla, and Elmhurst College.

Larry Leonard, of the Commonwealth Edison Co., spoke on "ENERGY PROSPECTS FOR THE 1980's."

A presentation was given by T.K. Hay, of the Sherwin-Williams Co., on the subject of "RENEWABLE RESOURCES."

L.F. KINNEY, *Secretary*

Cleveland

Sept. 23

The following officers for 1980-81 were introduced: President—Jack S. Malaga, of Body Brothers, Inc.; President-Elect—Thomas D. Tuckerman, of Akron Paint & Varnish Co.; Secretary—Carl J. Knauss, of Kent State University; Treasurer—Girish C. Dubey, of Cambridge Coatings, Inc.; and Society Representative—Fred G. Schwab, of Coatings Research Group, Inc.

The Tenneco Gavel was presented to President Malaga by C. Sisk, of Tenneco Chemicals.

Paul Houck, of Morgan Adhesives Co., was presented with a Past-President's pin, in appreciation for his service to the Society.

John Bax, of Pacific Scott Bader, spoke on "NEW CONCEPTS IN THE FORMULATION OF GLOSS LATEX COATINGS."

After defining alkali-soluble acrylics, Mr. Bax explained that, of the four types used in coatings, those of lower molecular weight and acid value than the conventional pigment dispersing agents give high gloss retention and increased efficiency of the pigment in terms of opacity and CPVC.

He described how water-soluble acrylics work, relating that the surface charges on the acrylics are such that the polymer can coalesce, but prevent the pigment particles from coalescing by forming a physical barrier on the pigment surfaces, thus preventing flocculation.

The alkali-soluble acrylic gives a greater pigment-free surface to a film and therefore improves the gloss, he continued. To aid in his presentation, Mr. Bax demonstrated some electron micrographs. He concluded his lecture with some exterior exposure studies.

CARL J. KNAUSS, *Secretary*



St. Louis Society Officers for the year 1980-81. Left to right: Society Representative—Herman Lanson, Lanchem Corp.; President-Elect—John Kemper, Sterling Lacquer Mfg. Corp.; President—Floyd Thomas, Thomas & English, Inc.; Secretary—Joseph Wrobel, Ciba-Gelgy Corp.; and Treasurer—Robert J. Glery, Sinnett Lacquer Mfg. Co.

Cleveland

Oct. 21

Ronald H. Rowland, of Omya, Inc., spoke on "NEW CONCEPTS IN CALCIUM CARBONATE IN THE 1980's."

Mr. Rowland focused on ultra-fine wet ground calcium carbonates, placing emphasis on trade sales use. He spoke on the theory of spacing extenders and pigment particle packing and described advances in grinding technology which provide calcium carbonates with a new capability in this respect. He discussed specific end applications and described the benefits attained through using this ultra-fine product.

The titanium dioxide pigments have an average particle size of 0.3 which gives the paint film its whiteness, brightness,

and opacity by the scattering of light which does not increase in direct proportion with increasing concentration of titanium dioxide, he said. The titanium dioxide should be spaced in the paint film in an edge-to-edge distance of at least one half the wavelength of light if it is to be effective as a light scattering source for the particles.

Experimental results on contrast ratio and brightness between clay and calcium carbonate were presented. Generally, brighter paints are at a disadvantage when compared on the basis of contrast ratio alone, Mr. Bax stated. Brightness must be made equivalent for true comparison of hiding power in terms of coverage.

CARL J. KNAUSS, *Secretary*



Golden Gate Society Officers for 1980-81. Left to right: Secretary—Wayne Cochran, Tenneco Chemicals, Inc.; Vice-President—E. "Bud" Harmon, Borden Chemicals Co.; President—Sharon Vadnais, E.T. Horn Co.; and Treasurer—Don Mazzone, Fuller O'Brien Corp. Not shown: Board Representative—A. Gordon Rook, Fuller O'Brien Corp. Recently, Mr. Cochran resigned his position and was replaced as Secretary by F. Robb Holt, Sherwin-Williams Co.

Dallas

Oct. 16

Daniel O. Adrien, of Burgess Pigment Co., spoke on "EFFICIENT FORMULATING TECHNIQUES FOR THE 80's."

Presenting principles which related to industrial as well as trade sales paints, Mr. Adrien stated that, of the two methods utilized in drying clays, spray drying requires less energy than a rotary kiln. It is likely that all clays will be manufactured by spray drying in the future, he predicted.

Mr. Adrien said that it is preferable to calcine clay with the clay in a dust state, since this will control particle size. This method also yields pigments containing pores that cannot be wet out. This gives light scattering ability and, consequently, hiding.

Continuing the presentation, Mr.

Adrien explained how the product allows the formulator to reduce the titanium dioxide content of a coating without reducing the quality of the film. He concluded with a description of a method of formulating with titanium dioxide.

W.A. WENTWORTH, *Secretary*

Golden Gate

Oct. 13

Chairman of the Educational Committee, Ted Favata, of Triangle Paint Co., announced that the first session of the basic coatings course sponsored by the Society was completed by 34 students.

George McTavey, of Cosan Chemical Corp., spoke on "PRETREATMENT OF WASTE WATER."

W. WAYNE COCHRAN, JR., *Secretary*

Houston

Sept. 10

Society President, James Hunter, of Napko Corp., announced that the Society will contribute a check of \$500 to the Paint Research Institute.

V.R. Pedersen, of Tioxide Canada Inc., spoke on "TITANIUM DIOXIDE—PRINCIPLES, PROPERTIES, AND PERFORMANCE."

K.D. JACOBSON, *Secretary*

Houston

Oct. 8

Daniel Adrien, of Burgess Pigment Co. spoke on "EFFICIENT FORMULATING TECHNIQUES FOR THE 80's."

Mr. Adrien explained that one key to efficiency is to improve the opacity of paints through the proper choice of clay extender pigments. There are several types available to the paint industry, namely, air floated, delaminated and calcined. The calcined is perhaps the most popular to the paint trade as in some flat paints, as much as 45 pounds of titanium out of 200 pounds per 100 gallons can be replaced with clay, he maintained.

Other benefits of using clay extenders which he described were improved scrub resistance and better enamel holdout. In certain primers, the hiding pigment can be completely replaced with calcined clay at no loss of hiding, he concluded.

K.D. JACOBSON, *Secretary*

Kansas City

Oct. 9

Ray Hurley, of Tenneco Chemicals, spoke on "DRIERS FOR WATER-REDUCIBLE COATINGS."

MIKE BAUER, *Secretary*

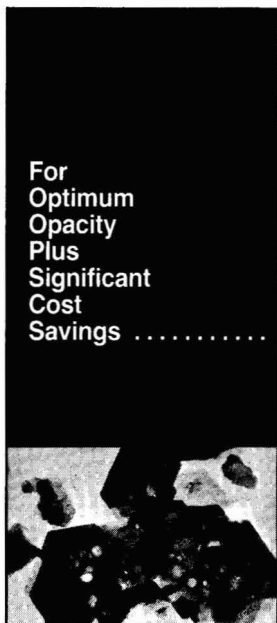
Los Angeles

Oct. 8

Society President, Donald Jordan, of Cargill, Inc., announced that the new scholarship program will consist of one annual scholarship award of \$2000. The following qualifications were cited: candidates must be related to a member of the paint industry; they should be interested in entering the coatings industry after completion of the course; they must pursue a study in the field of science; and they should carry a 3.0 or better grade point average.

George McTavey, of Cosan Chemical Corp., spoke on "PRETREATMENT OF LATEX WASH WATER."

L. LLOYD HAANSTRA, *Secretary*



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Montreal

Sept. 10

A moment of silence was observed in memory of Hy Kredentser, Past-President of the Society, who died recently.

Dr. F. K. Daniels, of Daniels Products Co., spoke on "FACTORS GOVERNING TINTER PERFORMANCE."

Incorporating slides into his presentation, Dr. Daniels provided illustrations of acrylic, long medium, and short oil alkyds. He explained that the belief that better color acceptance can be achieved by dispersing the color pigment in the same resin system is false.

R. KUHNEN, Secretary



New York Society Officers for 1980-81. Left to right: Treasurer—Herbert Ellis, Jr., D.H. Litter Co., Inc.; President—Marvin J. Schnall, Troy Chemical Corp.; Vice-President—Donald E. Brody, Skelst Laboratories, Inc.; and Secretary—Theodore Young, Jesse S. Young Co. Not shown: FSCT Board Representative—S. Leonard Davidson, N L Industries, Inc.

Montreal

Oct. 1

A moment of silence was observed in memory of Art Eastman, Past-President of the Society, who died recently.

Honored guests in attendance included Federation President, William H. Ellis.

Mrs. Ruth Johnston-Feller, Consultant to Ciba-Geigy Corp., spoke on "THE EXPOSURE OF ALIZARIN IN COMBINATION WITH TiO₂."

Mrs. Johnston-Feller defined Alizarin as an organic pigment which occurs in the root of the madder plant. This pigment,

often used by famous painters because of its brilliant transparent red color, was also the first synthetic colorant, she explained.

Mrs. Johnston-Feller showed exposure data ΔE vs. hours in a fade-ometer, of 25%, 18%, and 50% Alizarin-containing coatings. Color change was expressed by the amount of yellow necessary to add to the standard in order to match the

faded sample, because Alizarin changes from a red to yellow color on exposure. These studies revealed that, with different Alizarin concentrations compounded with TiO₂ using a PVA polymer as the binder, this pigment initially becomes more brilliant (chroma) on exposure, followed by a color change to yellow.

The same study was performed using an acrylic binder, she continued. In this

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system, the lower Alizarin-containing systems faded faster than the higher ones. The acrylic systems exhibited faster fading than the PVA coatings. In both systems, Alizarin increased in chroma prior to fading, she said.

According to Mrs. Johnston-Feller, exposure programs should be conducted in a manner which leads to an understanding of the basics, rather than simply a comparison of millions of exposure data. She predicted that this will eventually result in significant cost savings.

R.H. KUHNEN, *Secretary*

New England

Oct. 23

Ms. Maureen Lein, of Davidson Rubber Co., spoke on "FLASH RUST INHIBITORS: AN EVALUATION OF SOME AMINES AND ORGANIC SALTS."

With the advent of water-thinned coatings for industrial and maintenance application, special problems have become apparent when using ferrous substrates. Ms. Lein defined flash rusting as the corrosion of a ferrous substrate that occurs during the drying process of an aqueous coating. Air drying a waterborne acrylic emulsion on steel under high humidity conditions can cause flash rusting, she said. Small amounts of certain chemicals can retard this rusting.

The chemicals, though present only in small amounts, can affect the water sensitivity of the dried film, Ms. Lein continued. Therefore, their effect of the film should be tested prior to incorporation in a finished formulation as a flash rust inhibitor.

FRAN KOEBERT, *Secretary*

New York

Oct. 14

A moment of silence was observed in memory of Gustave Taube, Dr. Marcus Thau, Alexander C. Haber, and Edward Mone who died recently.

Society President, Sidney J. Rubin, of Empire State Varnish Co., presented Gabriel Malkin, Consultant, with a certificate commemorating his election to Honorary Member.

Dr. Gordon P. Bierwagen, of Sherwin-Williams Co., spoke on "LATEX PAINT FILM FORMATION."

Dr. Bierwagen discussed the various origins of mud cracking. Following a description of pigment packing in formulation, he emphasized the importance of generating new ideas in product improvement. Through the use of slides, he presented schematics on the forces that cause film formation in latex coatings—surface forces and pigment packing.

TED YOUNG, *Secretary*

Piedmont

Oct. 15

Dean Arlidge, of the Pfaunder Company, spoke on "SOLVENT RECOVERY SYSTEMS BASED ON A WIPED FILM EVAPORATOR."

In his presentation, Mr. Arlidge mentioned that the use of wiped film evaporators to process heat sensitive, viscous materials in the chemical, pharmaceutical, and food processing industries has been known over the past 25 years. Currently, application has expanded to recover solvents from paint slurries, industrial oils, and other washes.

Slides were used by Mr. Arlidge to show the mechanical structure of the wiped film evaporator, with important components' functionality explained. Certain physical conditions, such as feed temperature were pointed out as criteria to proper efficiency of the unit.

Mr. Arlidge stressed the necessity of a pilot plant run that would simulate actual conditions required.

Q. What effect will oxidative film-formers have on the evaporator? Will the high temperatures cause polymerization? Is there a limitation level?

A. Short residence time in the unit is important. The viscosity limitation is approximately 100,000 cps. The unit may not be able to handle certain systems. However, high viscosity food products are able to be moved through.

SARA M. ROBINSON, *Secretary*

Philadelphia

Oct. 9

James W. White, of Hockmeyer Equipment Corp., spoke on "HIGH SPEED MIXING AND DISPERSING."

Mr. White introduced his presentation with a discussion of those forces which bind agglomerates and aggregates together—molecular attraction, matrix bonding, gas layer, and liquid layer.

Mr. White then offered proven parameters to be followed in order to de-agglomerate. Among those mentioned were horsepower required, blade to tank ratios, blade speeds, blade design, tank design, and millbase viscosity and composition.

Q. Does temperature generated during the dispersion process affect dispersion?

A. Yes. Too high a temperature can reduce the viscosity of the millbase, thereby reducing the shearing action.

Q. Should you be able to see the entire blade inside the vortex when dispersing?

A. No. This indicates that no work is being done on the millbase.

WAYNE A. KRAUS, *Secretary*

Pittsburgh

Oct. 6

Robert Price, of Spencer Kellogg, spoke on "CONSERVATION ORIENTED COATING SYSTEMS."

Mr. Price spoke of the need for the coatings industry to produce high quality coatings, while conserving energy and controlling pollution of the environment. He focused on high solids coatings, defined as coatings with at least 80% volume solids using exempt solvents. Several formulations detailing the properties of high solids coatings were given.

WILLIAM CIBULAS, *Secretary*

Rocky Mountain

Oct. 6

George McTavey, of Cosan Chemical Co., spoke on "PRETREATMENT OF LATEX WASTE WATER."

DONALD R. BAGGE, *Secretary*

St. Louis

Oct. 21

Ronald Eritland, of Mobay Chemical Corp., spoke on "NEW DEVELOPMENTS IN URETHANE COATINGS."

Mr. Eritland reported on several urethane systems employed by his company. He emphasized the use of the three coat system consisting of a primer, mid-coat, and top-coat to a dry film build of seven to nine mils.

In a slide presentation, three Pittsburg bridges were professionally prepared and brush painted by unskilled labor using urethane systems from four to five coatings manufacturers. The coatings are in good shape after eight years and are expected to last over 20 years.

Slides were presented showing the systems superior to most other resin systems. Chlorinated rubber had excellent corrosion resistance and acrylics have better gloss retention. It was pointed out that urethanes have good impact resistance.

Q. Do these systems work on a variety of surfaces?

A. Yes.

Q. Can you roll or spray these systems?

A. Yes, but the best results in getting the correct film build everywhere is done by brushing.

Q. How does the system prevent corrosion?

A. By forming an ideal vapor barrier.

Q. Can the primer be thinned?

A. No. Any dilution of the system reduces its anti-corrosion effectiveness.

JOSEPH J. WRABEL, JR., *Secretary*

Future Society Meetings

Baltimore

(Jan. 15)—FSCT SLIDE PRESENTATION—Federation Officers.

(Feb. 13)—LADIES' NIGHT.

(Mar. 12)—Manufacturing Committee program.

(Mar. 13)—MINITRADE SHOW. Pikesville Hilton.

(Apr. 16)—Education Committee program.

(May 21)—Technical Steering Committee program on PAINT APPLICATION METHODS.

Birmingham

(Jan. 8)—"AN UPDATE ON DRYING SYSTEMS"—K. Lakin, Manchem Ltd.

(Feb. 5)—"STATIC ELECTRICITY"—Dr. R.J. Loveland, H.M. Electrical Inspector of Factories.

(Mar. 5)—"MARKETING IN THE EIGHTIES"—P. Harland, Croda Paints Ltd.

(Apr. 2)—"SOME ASPECTS OF AMINO RESINS"—J.E. Sreeves, B.I.P. Ltd, Chemical Div.

(May 7)—"COATING WINDOW FRAMES"—G.W. Rothwell, Building Research Establishment.

Chicago

(Jan. 5)—"SOLVENT ALKYD REPLACEMENT"—Dr. Andrew Mercurio, Rohm and Haas Co.; "ENZYMATIC RESINS"—Edward Glass, North Dakota State Univ.

(Feb. 2)—"LATEX PARTICLE INTERACTIONS"—C.T. Havens, Sherwin-Williams Co.; "NEW WATER-REDUCIBLE POLYMERS"—Henry Kasprzak, Spencer Kellogg Div.

(Mar. 2)—"HARD LATEX POLYMER MODIFICATION OF WATER-SOLUBLE ALKYDS"—Nick Roman, Rohm and Haas Co.; "FSCT CORRESPONDENCE COURSE"—John Gordon, Univ. of Missouri—Rolla.

(Apr. 6)—FSCT SLIDE SHOW—Federation Officers; "MULTI-FUNCTIONAL EPOXIDES"—M. Gaschke, CIBA-Geigy Corp.

(May 9)—AWARDS NIGHT. Installation of 1981-82 Officers.

C-D-I-C

(Jan. 12)—"FORMULATION & APPLICATION OF INDUSTRIAL LOW SOLVENT FOR THE 80's"—Jim Larson, Cargill, Inc.

(Feb. 9)—"WASH SOLVENT RECLAMATION"—Larry Durr, DCI Corp.

(Mar. 9)—FSCT SLIDE SHOW, Federation Officers.

(Apr. 13)—PLANT TOUR of Battelle Memorial Institute.

(May 11)—"PIGMENT DISPERSION AND MILLING IN THE PAINT AND RELATED INDUSTRIES"—Edward Carter, Morehouse Industries, Inc.

Detroit

(Feb. 17)—"SAFETY PRACTICES IN THE PAINT INDUSTRY"—Gilbert Cain, Hercules, Inc.

Houston

(Jan. 14)—Education Committee Symposium.

(Mar. 11)—PAST-PRESIDENTS' NIGHT (Apr. 8)—"CHLORITE: A NEW FAMILY OF PAINT EXTENDERS"—William Meadows, Cyprus Industrial Minerals.

Los Angeles

(Jan. 14)—"EXTENDERS, THE INORGANIC BACKBONE OF FLATS AND PRIMERS"—Thomas G. Brown, Engelhard Minerals & Chemical Corp.

(Mar. 11)—"SHORT TIME EVALUATION TECHNIQUE FOR LIQUID AND PARTICLE BEHAVIOR IN COATINGS SYSTEMS"—Frank Zurlo, Byk Mallinckrodt, Chem Prod. GmbH.

(Apr. 8)—"POLYMERIC ORGANIC DISPERSANTS FOR PIGMENTS: PRINCIPLES AND PRACTICES"—Robert D. Athey, Jr., Swedlow, Inc.

(May 12)—"PLANT DESIGN: BUILD NEW—REDESIGN OLD"—Jim White, Hockmeyer Equipment Corp.

Montreal

(Jan. 7)—"OBSERVATIONS ON THE EXPERIMENTAL DETERMINATION OF CPVC"—Peter Hiscocks, CIL Paints Inc.

(Feb. 4)—Manufacturing Committee program.

(Mar. 4)—"SELLING TECHNIQUES"—Graham Oliver, McGill Univ.

(May 7)—PAST-PRESIDENTS' NIGHT (May 9)—50TH ANNIVERSARY BALL. Ritz Carlton Hotel

New York

(Jan. 13)—"VENTILATION IN A PAINT PLANT"—Gabe Malkin, Jesse S. Young Co.

(Feb. 5)—"LEGISLATIVE UPDATE"; JOINT MEETING with New York PCA.

(Mar. 10)—MINIWORKSHOPS ON "ZERO EFFLUENCE"; "TYPES AND FUNCTIONS OF ADDITIVES"; "ADHESION OF LATEX PAINTS"; SALES AND MANAGEMENT TOPIC; and "COMPUTER AS A TOOL IN PRODUCTION."

(Apr. 14)—"DISPERSION EQUIPMENT"—Panel Discussion.

(May 12)—PAVAC AWARD NIGHT.

New England

(Jan. 15)—JOINT MEETING with New England PCA; "EFFECTIVE R&D MANAGEMENT/PRODUCT EVALUATION"—E. Bruce Euchner, Glidden Coatings & Resins.

(Feb. 19)—"AMINO CROSSLINKERS: RELATIONSHIP OF STRUCTURE TO COATINGS PROPERTIES AND PERFORMANCE"—Dennis E. Erickson, Monsanto Plastics & Resins; "THE USE OF TITANATE COUPLING AGENTS IN COATINGS"—David Busker, Kenrich Petrochemicals. (Mar. 19)—JOINT INDUSTRY MEETING.

(Mar. 24)—JOINT MEETING with Society of Plastic Engineers; "MICROBIOLOGICAL DETERIORATION OF PLASTIC AND COATINGS"—Susan Tamborini, Ventron.

Philadelphia

Technical Committee Meetings

(Jan. 15)—"CEMENTITIOUS COATINGS"—Dr. Joseph Lavelle, Rohm and Haas Co.

(Feb. 5)—"CONVERSION ENAMELS-ENERGY SAVERS"—Paul W. McCurdy, Reichhold Chemicals, Inc.

(Mar. 5)—"NEW GENERATION COATINGS—APPLICATION WORKSHOP: PART I—WATER-BORNE AND HIGH SOLIDS"—speakers from Cargill Chemical Products Div. and Nordson Corp.

(Apr. 2)—"NEW GENERATION COATINGS—APPLICATION WORKSHOP: PART II—TWO COMPONENT AND POWDER"—speakers from Mobay Chemical, Polymer Corp., and Nordson Corp.

(May)—Society Technical Committee Seminar on "INTERFACES REVISITED."

Pittsburgh

(Jan. 5)—JOINT MEETING with Pittsburgh PCA.

(Feb. 2)—"INDUSTRIAL HYGIENE AND URETHANE COATINGS"—Paul D. Ziegler, Mobay Chemical.

(Mar. 2)—"PIGMENT DISPERSION—WHAT DOES IT MEAN?"—James D. Easton, Harshaw Chemical Co.

(Apr. 6)—"KNOW YOUR ENEMY—THE WEATHER"—George W. Grossman, The Q-Panel Co.

(June 1)—"ART AND ALCHEMY"—John C. Pavlik, Fisher Scientific Co.

Elections

CHICAGO

Active

ADKINS, EDWARD—Whittaker Corp., Batavia, IL
ANDERSON, GILBERT J.—Midland Div., Dexter Corp., Waukegan, IL
BRANDAN, ALAN H.—DeSoto, Inc., Des Plaines, IL
BRINKMAN, RANDALL D.—DeSoto, Inc., Des Plaines.
BROGAN, KERN W.—DeSoto, Inc., Des Plaines.
BUTLER, JAMES M.—DeSoto, Inc., Des Plaines.
CRAIG, CAROLYN—DeSoto, Inc., Des Plaines.
DALY, THOMAS M.—Midland Div., Dexter Corp., Waukegan.
DEBEERS, FRANKLIN M., JR.—Midland Div., Dexter Corp., Waukegan.
ELLIS, KENNETH A.—Valspar Corp., Chicago, IL
ERNST, JOHN J.—Dupli-Color Prods. Co., Elk Grove Village, IL
ESSIGMANN, MARTIN L.—DeSoto, Inc., Des Plaines.
FIEDER, DONALD W.—DeSoto, Inc., Des Plaines.
GREENGARD, RICHARD—S. C. Johnson & Son, Inc., Racine, WI
GRZANICH, WILLIAM J.—Midland Div., Dexter Corp., Waukegan.
HOECK, RICHARD—DeSoto, Inc., Des Plaines.
ICELIC, L. LINDA—Midland Div., Dexter Corp., Waukegan.
JAHNKE, STEVEN R.—U.S. Steel Supply Div., Chicago, IL
JONES, DAVID R.—Standard T Chemical Co. Inc., Chicago Heights, IL
KERSTEN, MARK A.—DeSoto, Inc., Des Plaines.
KONANUR, NANDA K.—Midland Div., Dexter Corp., Waukegan.
KORTYE, FRED J.—Hentzen Chemical Ctg. Inc., Milwaukee, WI
MCGILL, GEORGE T.—Coatings & Chemicals, Chicago.
MCWILLIAMS, DEBORAH A.—DeSoto, Inc., Des Plaines.
MELIK, ABDULLAH M.—Aqua Day International, Carpentersville, IL
MILLAR, RONALD L.—Hanco Coatings Inc., Broadview, IL
NIX, VERNON G.—Mortell Co., Kankakee, IL
PALMER, CHRISTINE M.—DeSoto, Inc., Des Plaines.
PERKINS, RICHARD E.—O'Brien Corp., South Bend, IN
ROTA, LEONARD A.—Valspar Corp., Chicago.
SCHROEDER, WILLIAM F.—DeSoto, Inc., Des Plaines.
SMITH, RONLYN—Valspar Corp., Chicago.
SUTLIFF, THOMAS M.—Borg Warner Chemicals, Des Plaines.
TAUBMAN, CHARLES M.—Technical Coatings, Melrose Park, IL
WITCZAK, GRACE A.—DeSoto, Inc., Des Plaines.

Associate

ABELS, WILLIAM H.—Omya Inc., Des Plaines, IL
BELOTE, STEPHEN N.—Eastman Chemical Prods., Kingsport, TN
CROCO, EDWARD G.—Glidden Pigments, Naperville, IL
EQUI, ROBERT J.—Rohm and Haas Co., Niles, IL
FETTE, C. JOSEPH—IMC, NP Div., Des Plaines.
GALLAS, RICHARD M.—BASF Wyandotte Corp., Holland, MI
KLATT, ROBERT W.—American Chemet, Deerfield, IL
KRUMMEL, KEVIN—Calcium Carbonate Co., Quincy, IL
KUNZ, ROSEMARY J.—Rohm and Haas Co., Niles, IL
LEU, DENNIS T.—IMC Chemical Group, Des Plaines.
MAGERS, THOMAS A.—Ames Co., Miles Laboratories, Inc., Elkhart, IN
MARSH, F. JOSEPH—Ferro Corp., Hoffman Estates, IL
NG, EDWARD W.—American Cyanamid Co., Rosemont, IL
PIET, PAUL—Strauch Chemical, Chicago, IL
STRAUCH, MARVIN J., JR.—Strauch Chemical, Chicago.
VERLOTT, PATRICIA A.—Color Communications, Inc., Chicago.

DALLAS

Active

EVERETT, LARRY—Dan-Tex Paint & Ctg. Mfg., Dallas, TX
HALMESS, CHUCK—Texstar Plastics, Grand Prairie, TX
MURPHY, BUD—Murco Wall Products, Ft. Worth, TX
PLACKE, HENRY L.—Dal Worth Paint Mfg. Co., Mesquite, TX
PRUETT, DOUGLAS—DeSoto, Inc., Garland, TX
RHODES, MARK D.—DeSoto, Inc., Garland.
SAXTON, ROBERT L.—Delta Solv. & Chem. Co., Dallas.
SMITH, MARVIN D.—Koppers Co., Irving, TX

Associate

ADAMS, ARTHUR W.—Delta Solv. & Chemicals Co., Dallas, TX
ARCHER CARL D.—Glidden Pigments, Bedford, TX
HEILEMANN KENNETH R.—Spencer Kellogg Div., Houston, TX
PARASILITI, ANTHONY—Crozier-Nelson Chemicals, Dallas.
SPEER, RANDALL J.—E.I. duPont de Nemours, Houston.
WILLIAMS, JAMES R.—Eastman Chemical Prods., Inc., Richardson, TX.

CLEVELAND

Active

ABBEY, KIRK J.—Glidden Div., SCM Corp., Cleveland, OH
BARRICK, JAMES G.—Consultant, Fairview Park, OH
BARTLETT, JANICE—Sherwin-Williams Co., Cleveland.
BLANKSCHAEN, ELIZABETH—Sherwin-Williams Co., Cleveland.
CASAREGOLA, JOSEPH L.—Sherwin-Williams Co., Cleveland.
HOFFMAN, PAUL—Harrison Paint Corp., Canton, OH
KROTINE, F. THOMAS—Sherwin-Williams Co., Cleveland.
LOEHNING, RALPH H.—Morgan Adhesives, Stow, OH
MC EWEN, WILLIAM J., JR.—Morgan Adhesives, Stow.
PHILLIPS, JOHN—Harrison Paint Corp., Canton.
PODLEWSKI, RAYMOND—Mansfield Paint Co., Mansfield, OH
SOOS, JAMES L.—J. C. Whitlam Mfg. Co., Wadsworth, OH
STRUGER, DANIEL—RPM, Inc., Medina, OH
TUCKERMAN, THOMAS D.—Akron Paint & Varnish Co., Akron, OH
TURNBULL, STEPHAN C.—Sherwin-Williams Co., Cleveland.
WHITE, JOHN—Foseco Inc., Cleveland.
WOLF, DOUGLAS B.—Sherwin-Williams Co., Cleveland.

GOLDEN GATE

Active

ALLEN, MARK R.—Fuller-O'Brien Corp., South San Francisco, CA.
DAVIS, KAREN J.—Cal-Resins & Chems., Vallejo, CA.

LOUISVILLE

Active

HANSON, MARTIN—Ceramicrome, Stanford, KY
LYNCH, DONALD L.—Porter Paint Co., Louisville, KY
STORMES, KEITH E.—Porter Paint Co., Louisville.
SUMMER, ARTHUR—Porter Paint Co., Louisville.

Associate

BOGGESS, JAMES D.—Wm. B. Tabler Co., Inc., Louisville, KY
BUYTENDORP, FRANS—Chemcentral/Louisville, Louisville.
HODGSON, JEAN S.—Hilton-Davis Chemical Co., Cincinnati, OH
KING, NOBAL E.—Hercules Incorporated, Cincinnati.
LYNE, JEFFREY S.—Columbian Chemicals, St. Louis, MO
O'DONOGHUE, M. ELAINE—Union Carbide Corp., Cincinnati.

NEW ENGLAND

Active

BRIEFF, PHILIP—Shibley Co., Inc., Newton, MA
CHARPENTIER, LINDA J.—W. R. Grace & Co., Lexington, MA
CHEYNE, ROBERT H., III—Porex Corp., Loren Div., Lawrence, MA
HILL, LOREN W.—Monsanto Co., Indian Orchard, MA
KORETSKY, DIANA R.—Bixby International, Haverhill, MA
LAYTON, STAN—International Coatings, Westport, CT
SULLIVAN, TIMOTHY F.—Coatings Systems, Inc., Nashua, NH
WARREN, ROBERT V.—Sagamore Industrial Finish, Amesbury, MA
WOOD, FREMONT E.—Nu Brite Chemical Co., Taunton, MA

Associate

CONNOLLY, STEPHEN J.—Union Chemicals Div., Melrose, MA
DOERING, THEODORE J.—American Hoechst Corp., Coventry, RI
ROLBIN, PHILIP—Hunter Lab., Chestnut Hill, MA
WIDRIG, LISA M.—3M Co., Needham Heights, MA

PIEDMONT

Active

MATEJKA, ROBERT C.—Reliance Universal, Inc., High Point, NC
THOMAS, JAMES E.—Rexham Corp., Matthews, NC

Associate

HANSON, CAROLYN J.—Union Chemicals Div., Union Oil Co., Charlotte, NC
MAYURNIK, KATHLEEN L.—Dow Chemical USA, Charlotte.
MIXON, DANIEL L.—Chemcentral, Jamestown, NC
TUCKER, JANICE L.—Union Carbide Corp., Charlotte.

PITTSBURGH

Active

DUKOVICH, EDWARD—PPG Industries, Inc., Springdale, PA
ESLINGER, DELANO—PPG Industries, Inc., Springdale.

WESTERN NEW YORK

Active

KAUFMAN, MICHAEL C.—Bisonite Co., Inc., Tonawanda, NY
KROCZYNSKI, NANCY J.—Bisonite Co., Inc., Tonawanda.

Associate

MATZEK, CHARLES H.—Remet Corp., Chadwicks, NY
ZUSMAN, RALPH H.—Remet Corp., Chadwicks.

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Meetings/Education

Color Conference to be Held in Williamsburg, Feb. 8-11

The Inter-Society Color Council and the Canadian Society for Color will jointly sponsor a color conference focusing on "Creativity—The Common Denominator: Artist and Scientist Working Together" in Williamsburg, VA, on February 8-11, 1981.

The following presentations have been announced:

"Color in Signs and Graphics"—P. Arthur, of Newton, Rank, Arthur, Inc.

"Color in Early Glass"—R.E. Brill, of Corning Museum of Glass.

"The Dependence of Color Systems on Technology"—J.S. Davenport, of DeSoto, Inc.

"Clichés and Trends in Graphic Design"—K. Fink, of Karl Fink & Associates.

"China—Its Influence on Western Color"—Y. and F. Forman, of Yale Forman Designs Inc.

"The Interaction of Art and Tech-

nology in TV"—P. Garneau, of Canadian Broadcasting Corp.

"Application of Scientific Knowledge to the Fine Arts"—J.T. Luke, of Studio 231.

"Liquid Crystals—A New Material for Artists"—D. Makow, of National Research Council (Canada).

"Who Invented the Color Wheel?"—C. Parkhurst, of the National Gallery of Art (USA).

"Identification of Dyes in Archaeological Textiles"—Max Saltzman, of University of California and Rensselaer Polytechnic Institute.

"Color in Colonial Williamsburg"—A. Smith, Colonial Williamsburg Foundation.

"Art and the Analytical Laboratory"—J.M. Taylor, of Canadian Conservation Institute.

For additional information, contact E.L. Cairns, General Chairman, E.I. Du Pont Co., C&P Dept. B-6268, Wilmington, DE 19898.

CALL FOR PAPERS

International Symposium On Physicochemical Aspects Of Polymer Surfaces New York, NY August 23-28, 1981

The purpose of the symposium is to provide a forum for the discussion of polymer surfaces and the dissemination of the latest ideas and information. The technical program will contain both invited overviews and contributed original research papers.

Papers dealing with any aspect of polymer surfaces are solicited. Inquiries should be sent to Dr. K.L. Mittal, Symposium Chairman, IBM Corp., Bldg. 300-40E, Hopewell Junction, NY 12533.

Analysis of Emulsion Paints—A New IUPAC Project

The International Union of Pure and Applied Chemistry (IUPAC)-Supported Polymer Films Group has initiated a project on the analysis of emulsion paints. Samples of three paints will be sent to those who wish to test their analytical capabilities by comparison of their results with the results of others. The following items have been selected for analysis:

Pigment-Binder-Ratio; Binder composition including molecular weight distribution and particle size distribution; Pigments; Cosolvents; Amines; and Coalescing agents, thickeners, dispersing agents, surfactants, foaming agents, residual monomers, biostats, emulsifiers, and other additives.

In the course of the cooperative work, some of the analytical methods should be common for a larger number of laboratories while special laboratories could contribute methods where they have special equipment and special abilities.

Interested parties may request samples from Dr. Charles M. Hansen, Scandinavian Paint and Printing Ink Research Institute, 3 Agern Alle-DK 2970 Horsholm, Denmark.

Federation Delegates to IUPAC Supported Polymer Films Group are: Milton A. Glaser, Midland Div., Dexter Corp., Waukegan, IL; and Percy E. Pierce, PPG Industries, Inc., Allison Park, PA.

"Introduction to Resin Operations" Added to A/V Series

"Introduction to Resin Operations," prepared by the Manufacturing Committee of the Toronto Society for Coatings Technology, has been added to the Federation library of audio-visual presentations.

The program, which runs approximately 12 minutes, has been developed to assist in the selection and training of resin plant opera-

tors, and focuses on basic concepts of manufacture and the role of a resin operator.

The cassette tape, 58 slides, and accompanying script, are packaged in an attractive vinyl album.

Inquiries should be addressed to Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107.

Southern Society/USM to Host 8th Annual Water-Borne Symposium

The 8th Annual Water-Borne and Higher-Solids Coatings Symposium will be held on February 25-27, 1981, at the Hyatt Regency Hotel in New Orleans. The symposium will be jointly sponsored by the Southern Society and the Department of Polymer Science at the University of Southern Mississippi.

For additional information, contact the Department of Polymer Science, University of Southern Mississippi, Southern Station, Box 10076, Hattiesburg, MS 39401.

Kent State to Host Short Courses in May and June

The Rheology and Coatings Laboratory of Kent State University will present three short courses designed for specialists in coatings and polymers. The first course, "Dispersion of Pigments and Resins in Fluid Media," will be held May 18-22. From June 8-12, a course on "Adhesion Principles and Practice for Coatings and Polymer Scientists" will be offered. "Applied Rheology for Industrial Chemists" is the topic of the third course, scheduled from June 15-19.

Additional information on these programs can be obtained from Carl J. Knauss, Chemistry Department, Kent State University, Kent, OH 44242.

People

Union Carbide Corp., Danbury, CT, has promoted **Peter F. Decker** to Account Manager for the Southeast sales region of its Coatings Materials Div. A member of the Southern Society, Mr. Decker will serve as the 1980-81 Chairman of the Federation's Public Relations Committee.

Dr. Richard A. Greengard has been appointed Product Research Chemist for Johnson Wax Specialty Chemicals. A member of the Piedmont Society, Dr. Greengard will work on developing polymer products for the water-borne industrial finish markets.

In addition, **Dr. Vincent G. Calder** has joined the Research and Development Staff of the company as an Industry Specialist/Graphic Arts. He will direct technical service support of marketing and sales activities with the company's line of polymer products for the graphic arts industry.

Richard D. Rhinesmith has been appointed Sales Manager for the Middle East and Africa for the Industrial Chemicals Div. of Drew Ameroid International, Boonton, NJ. He will be responsible for the expansion and development of the division's distributor network in these areas.

Sun Chemical Corp., New York, has elected **John C. Allwarden** to the position of Corporate Vice-President. Until his election, Mr. Allwarden served as Divisional Vice-President in charge of marketing for the firm's Kollsman Instrument Div.

Joseph T. Dooley has been promoted to the newly created post of Eastern Regional Sales Manager for Interstab Chemicals, Inc., New Brunswick, NJ. He will be responsible for the sale of additives for both coatings and plastics on the eastern seaboard.

Ray Erickson has been named Sales Representative for the Industrial Coatings Department of H.B. Fuller Co., St. Paul, MN. In this capacity, he will assume responsibility for the sale of the firm's epoxy and polyester powder coatings in North and South Carolina, Tennessee, Georgia, Alabama, and Florida.

Glenn J. Jackson has been appointed Plant Engineer for the new Mobile plant of M&T Chemicals Inc. Before joining M&T, he was Plant Engineer for Frito Lay, Inc., in Jackson, MS.



P. Decker



R.A. Greengard



S.C. Holland



H.W. Lowrey

Steven C. Holland has been named Vice-President of Thibaut & Walker Co. Inc., Newark, NJ. In this new position, Mr. Holland will be responsible for directing operations for T&W, as well as managing the marketing effort for the firm's product lines. He is a member of the New York Society.

Polychrome Corp., Yonkers, NY, has announced a change in status for **Gregory Halpern** from Chairman of the Board and Chief Executive Officer. Mr. Halpern, who founded the company in 1936, has been designated Chairman Emeritus and he will continue as a Director and Consultant for the firm. **Enrique Levy**, President of Polychrome, has been named Chief Executive Officer.

Dr. Stephen L. Buchwalter and **Dr. Thomas C. Moriarity** have been promoted to the positions of Research Associates in the Research and Development Laboratory of PPG Industries, Allison Park, PA. Prior to his association with PPG Industries, Dr. Buchwalter was employed by the University of Chicago. Dr. Moriarity was formerly associated with Celanese Coatings Co., Louisville, KY.

Tony Rumpfola, President of TCR Industries, Carson, CA, has announced the following appointments: **Thomas D. Donahoe** to Vice-President and Sales Manager; **H. Don Smith** to Sales Representative for southern California; and **Scotty Wimer** to Sales Representative for northern California. Messrs. Donahoe and Rumpfola are members of the Los Angeles Society.

Dr. Ronald W. Kreis has been named Product Manager for specialty monomers for Alcolac, Inc., Baltimore, MD. He most recently served as Manager of polymer and monomer research for the firm.

Hugh W. Lowrey has been named Technical Director of The Perry & Derrick Co., Cincinnati. For the past 20 years, he has been associated with Indurall Coatings as Vice-President and Technical Director. Mr. Lowrey is a Past-President of the Southern Society.

Bernard A. Yemc, Jr. has been appointed Technical Sales Representative in the Polymers, Resins and Monomers North America operation of Rohm and Haas Co., Philadelphia. In this position, he will be responsible for the sale of the company's products used in the coatings, paper, nonwovens, floor polishes, adhesives, caulks, sealants and cement modifier industries in Maine, New Hampshire and Massachusetts.

Meanwhile, **Eileen M. McDevitt** has joined the research laboratories of the firm. In her new position as Scientist, she will be working in the Industrial Coatings Department.

Frank V. Allen has been appointed Vice-President and General Manager of the newly formed Specialty Chemicals Div. of Ashland Chemical Co., Columbus, OH.

Also announced by the company were the following assignments: **Robert M. Tomino**—Business Manager of the Electronics and Reagents Group; **K. Alan Manougian**—Business Manager of the Globrite brand Industrial Cleaners Group; **William B. Tarver**—Business Manager of the Consumer Products Group; and **Andrew M. Sova**—Administrative Manager of the Specialty Chemicals Div.

U.S. Paint Div., Grow Group, Inc., of St. Louis, MO, has appointed **Danforth G. Padgett** to the newly created position of Central Region Sales Manager of Industrial Coatings. Mr. Padgett most recently served as Manager of the Distribution Marketing Group of Pierce and Stevens Chemical Corp., Buffalo, NY.

Dr. J. Paul Hogan has been named recipient of the Outstanding Achievement Award presented annually by the Thermoplastic Materials and Foams Div. of the Society of Plastics Engineers, Inc. Dr. Hogan is Senior Research Associate for Research and Development, Phillips Petroleum Co., Bartlesville, OK. In addition to being coinventor of the chromium oxide catalyst for high density polyethylene, Dr. Hogan and members of his research team have developed and discovered many other breakthroughs.

Joseph A. Budash has been named Technical Director of the Sarasota operations of Scott Paint Corp. In this capacity, he will manage efforts in new product development, while maintaining the quality of existing products.

In recognition of his outstanding contributions to the advancement of the protective coatings industry, **Wayne A. Kraus** has been named recipient of the Liberty Bell Award of the Philadelphia Society for Coatings Technology. A Past-President of the Philadelphia Society, Mr. Kraus currently serves as Secretary. He is employed as Technical Director of the Lawrence-McFadden Co.

Recipients of the Society's Technical Award were **Stanley LeSota**, of Rohm and Haas Co., and **Robert Toothill**, of United Gilsonite Laboratories.

Robert G. Schwartz has been elected to the Board of Directors of NL Industries, Inc., New York. He currently serves as Vice-Chairman of the Board of Directors for Metropolitan Life Insurance Co.

In a series of executive appointments, Tenneco Chemicals, Inc., Saddle Brook, NJ, has promoted **Dr. Paul A. Lobo** to the position of Vice-President of Planning; **Don C. Coldiron** to Vice-President of Engineering; and **Dr. Wayne R. Sorenson** to Vice-President of Research and Development.

McCloskey Varnish Co., Los Angeles, has appointed **Dodwell De Silva** to the position of Senior Chemist. Most recently, he served as Manager of the Technical Department and supervised research and development for Flecto Coatings Ltd., British Columbia, Canada.

Gregory L. Daum has joined Witco Chemical Corp. as Manager for Personnel Safety. He will be based at corporate headquarters in New York and will report to **Lester J. Gilbert**, Director of Safety, Health and Environmental Affairs for the firm.

Robert W. Lippert, Jr. has been named Product Manager of Surfactants for the Organic Chemicals Div. of The Richardson Co., Des Plaines, IL. Immediately prior to joining Richardson, he represented Agrimenica, Inc. as a Marketing Consultant.

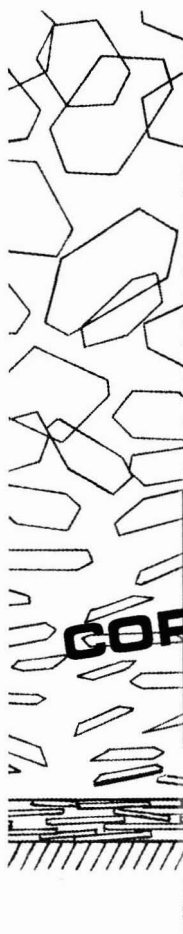
American Cyanamid Co. has appointed **Robert S. Berger** to the position of Marketing Manager, Molding Compounds and Resins Department. He will be located at the headquarters of the firm's Industrial Products Div. in Wayne, NJ.

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Obituary

Alwin C. Eide, 87, of American Zinc Co., died on October 14, 1980. A graduate of the University of Illinois in the field of Chemical Engineering, Mr. Eide began his association with the coatings industry as a Chemist with the Patton Paint Co., in Milwaukee. In 1916, he was employed by American Zinc Co., from which he retired as Vice-President and member of the Board of Directors in 1961.

A member of the Federation, Mr. Eide was a pioneer in the development of zinc pigments and he was largely responsible for the development and use of acicular zinc oxides in the paint industry. He is also credited with the introduction of de-aerated zinc oxides.

Literature

Ketone Research

Information has been released detailing a new research project which examines the toxicological aspects of several industrial chemicals widely used as solvents and intermediates in the manufacture of other chemicals and synthetic fibers. For details, write the Chemical Manufacturers Association, 1825 Connecticut Ave. NW., Washington, D.C. 20009.

Color Monitor

A new color transducer is described in recently issued literature. For complete details, write Reva I. Goldman, Advertising and Sales Promotion, Gardner Laboratory Div., Pacific Scientific Co., Bethesda, MD 20014.

Atomic Spectroscopy

A 20-page color brochure which details the techniques and applications of atomic spectroscopy has been published. Included are a summary of reprints dealing with the technique and listings of various instruments and accessories available. For a free copy of Order No. L-655, write the Perkin-Elmer Corp., Main Ave., Mail Station 12, Norwalk, CT 06856.

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Acrylic Acid Information

The safety and handling of acrylic acid have been summarized in a 20-page booklet. This booklet contains a table of properties and characteristics, which includes physical data and such safety information as flammable limits, reactivity, and NFPA and NFC classifications. Copies of "Acrylic Acid—A Summary of Safety and Handling" can be obtained from Coatings Materials Div., Dept. K3442, Union Carbide Corp., Old Ridgebury Rd., Danbury, CT 06817.

Polyester Resins

A four-page bulletin which details the physical properties and technical data of a new series of polyester resins has been published. These resins are recommended for fiberglass-reinforced plastic applications ranging from ducts, hoods, blowers, and fans to stacks and similar fume handling equipment at temperatures up to 200-250° F. For information, write the Polyester Div., Ashland Chemical Co., Dept. NT, P.O. Box 2219, Columbus, OH 43216.



**ANNUAL MEETING AND
PAINT INDUSTRIES SHOW
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Coming Events

FEDERATION MEETINGS

(Mar. 24-26)—"Symposium on Color and Appearance Instrumentation." Executive West, Louisville, KY. Jointly sponsored by Federation of Societies for Coatings Technology, Manufacturers Council on Color and Appearance, and Inter-Society Color Council. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107).

(May 14-15)—Spring Meetings. Society Officers on 14th; Board of Directors on 15th. Hilton Hotel, Denver, CO. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Oct. 28-30)—59th Annual Meeting and 46th Paint Industries' Show. Cobo Hall, Detroit, MI. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1982

(Apr. 29-30)—Spring Meetings. Society Officers on 29th; Board of Directors on 30th. Boston, MA. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Nov. 3-5)—60th Annual Meeting and 47th Paint Industries' Show. Sheraton Washington Hotel, Washington, D.C. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

PAINT RESEARCH INSTITUTE MEETING

(May 4-5)—Paint Research Institute Symposium on "Stability and Stabilization of Coatings Systems," Battelle Memorial Institute, Columbus, Ohio. (Dr. Raymond R. Myers, Chemistry Dept., Kent State University, Kent, Ohio 44242).

SPECIAL SOCIETY MEETINGS

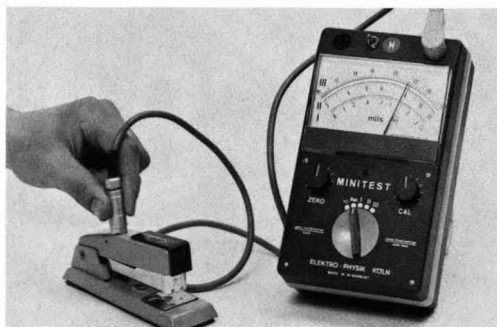
(Feb. 25-27)—Eighth Annual Water-Borne and Higher-Solids Coatings Symposium Hyatt Regency Hotel, New Orleans, LA. Sponsored by Southern Society and University of Southern Mississippi. (Dept. of Polymer Science, Univ. of Southern Mississippi, Southern Station, Box 10076, Hattiesburg, MS 39401).

(Mar. 4-6)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA. (Richard C. Sutherland, E.T. Horn, Co., 16141 Heron Ave., La Mirada, CA 90638.)

(Mar. 11-13)—Southern Society. 45th Annual Meeting. Birmingham Hilton Inn and Conference Center, Birmingham, AL (Peter F. Decker, Union Carbide Corp., 17 Executive Park Drive, N.E. Atlanta, GA 30359).

(Mar. 24-25)—Cleveland Society 24th Annual Conference, "Advances in Coatings Technology," Baldwin-Wallace College, Berea, OH. (George R. Pilcher, Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113.)

(May 1-2)—Pacific Northwest Society. Annual Symposium. Washington Plaza Hotel, Seattle, WA.



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(May 9)—Montreal Society. Fiftieth Anniversary dinner-dance, Montreal, Que.

(June 15)—Golden Gate Society Seminar, "Safety and Government Regulations." (Louie Sanguinetti, Jasco Chemical Corp., P.O. Drawer J, Mountain View, CA 94042).

1982

(Mar. 10-12)—Southern Society Annual Meeting. Savannah, Ga.

(Apr. 22-24)—Southwestern Paint Convention. Shamrock Hilton Hotel, Houston, TX.

(May 6-8)—Pacific Northwest Society. Annual Symposium. Vancouver, B.C.

OTHER ORGANIZATIONS

(Jan. 14-16)—Hunterlab Workshop, "Appearance Properties of Materials." Hunterlab, Reston, VA. (Hunter Associates Laboratory, Inc., 11495 Sunset Hills Rd., Reston, VA 22090).

(Jan. 18-22)—ASTM Committee D-1 Winter Meeting. Dutch Inn, Orlando, FL. (American Society for Testing & Materials, 1916 Race St., Philadelphia, PA 19103).

(Jan. 21)—ASTM Symposium, "Regimens for Predicting Permanence of Decorative and Protective Surfaces." Orlando, FL. (Symposium Chairman Garmond Schurr, Sherwin-Williams Co., 10909 S. Cottage Grove Ave., Chicago, IL 60628).

(Feb. 3-May 12)—"Polymer Chemistry" Course. St. James Campus, George Brown College, Toronto, Ont. (Mr. P. Rodak, Mathematics and Science Div., George Brown College, P.O. Box 1015, Station B, Toronto, Ont. M5T 2T9).

(Feb. 4-May 13)—"Coatings Laboratory" Course. St. James Campus, George Brown College, Toronto, Ont. (Mr. P. Rodak, Mathematics and Science Div., George Brown College, P.O. Box 1015, Station B, Toronto, Ont. M5T 2T9).

(Feb. 8-11)—Inter-Society Color Council. Williamsburg Conference, Williamsburg, VA. (Dr. Fred W. Billmeyer, Secretary, ISCC, Rensselaer Polytechnic Institute, Troy, NY 12181.)

(Mar. 2-4)—"Adhesion Science and Technology" Short Course. The Center for Professional Advancement, Central NJ. (The Center for Professional Advancement, P.O. Box H, East Brunswick, NJ 08816).

(Mar. 25-26)—Air Pollution Control Association, Ninth Government Affairs Seminar. Sheraton Washington Hotel, Washington, D.C. (Public Relations Dept., Air Pollution Control Association, P.O. Box 2861, Pittsburgh, PA 15230).

(Apr. 6-10)—National Association of Corrosion Engineers "Corrosion/81." Sheraton-Centre and Hotel Toronto, Toronto, Ontario, Canada. (Conference Coordinator, NACE, P.O. Box 218340, Houston, TX 77218).

(Apr. 7-8)—NACE T6 Symposium on Underfilm Corrosion. Sheraton Centre Hotel, Toronto, Canada. (National Association of Corrosion Engineers, 1440 South Creek, Houston, TX 77084.)

(Apr. 27-28)—Inter-Society Color Council Annual Meeting. Roosevelt Hotel, NY. (Dr. Fred W. Billmeyer, Secretary, ISCC, Rensselaer Polytechnic Institute, Troy, NY 12181.)

(Apr. 28-30)—OCCA-32. Oil and Colour Chemists' Association 32nd Annual Technical Exhibition. Cunard International Hotel, London, England. (The Director and Secretary, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex HA0 2SF, England.)

(May 17-21)—American Oil Chemists' Society 72nd Annual Meeting. Fairmont Hotel, New Orleans, LA. (American Oil Chemists' Society, 508 S. Sixth St., Champaign, IL 61820).

(June 14-17)—Dry Color Manufacturers' Association Annual Meeting. The Greenbriar, White Sulphur Springs, WV. (P.L. Lehr, DCMA, Suite 100, 1117 North 19th St., Arlington, (Rosslyn) VA 22209.)

(June 17-20)—Oil and Colour Chemists' Association Conference, "Alternative Technologies in Coatings." Beaufort Hotel, Bath, England. (The Director and Secretary, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex HA0 2SF, England.)

(June 21-26)—Air Pollution Control Association 74th Annual Meeting & Exhibition. Philadelphia Civic Center, Philadelphia, PA (Public Relations Dept., Air Pollution Control Association, P.O. Box 2861, Pittsburgh, PA 15230).

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'Kumbug' from Hillman

Welcome to the back of the book! I was flattered to hear from those eleven people who made the September issue to the last page, and generously offered to share the possibility of public opprobrium ("something that brings disgrace"—now you know!) with me. Those brave souls will be exposed to public censure as we determine whose contributions are suitable to be rated "PG."

I was pleased to note that most of the comments were kind, especially—"the best thing in the Journal" from a person whose observations I have to respect—my wife! So—there is a possibility that this column for some better and mostly worse is officially launched. I cannot promise that we will appear every month because of missed deadlines or more probably—horrified censorship by the Editor.

Here follows a few of the gems received recently. Others will follow on future pages, unless the Editor receives more than his usual quota of threatening letters. You will note that I throw full responsibility on the humourless folks who sent them to me. I have a nice contribution from someone in Baltimore who was clever enough to remain anonymous.—Herb Hillman
(P.S. Thanks also to Frank Borrelle, Jim Flanagan and Royal Brown.)

Quotables

"Pity costs nothing, and ain't worth nothing."—Josh Billings.

"If it ain't broke—don't fix it."

"Physical Chemist: A blind man in a dark room looking for a black object that isn't there."

—Tom Miranda

Six stages of any project

- (1) Enthusiasm
- (2) Disillusionment
- (3) Panic
- (4) Hunt for the guilty
- (5) Punishment of the innocent
- (6) Reward for those who had nothing to do with it

—Peter Marr

O.K., But who mows the grass?

An honest-to-goodness quotation in a report from an insurance company loss prevention consultant after a visit to the McCloskey Varnish Co. plant in Portland, Oregon—

"At the time of the survey you were in process of cleaning up the ash fall from the volcano in your outside yard...."

We never really appreciated the size of our "outside yard" before!

—Dick Kiefer

On the job training

A *Chemist* is said to be a man who knows a great deal about very little and who goes along knowing more and more about less and less until finally he knows practically everything about nothing; whereas—

A *Salesman* is a man who knows a very little about a great deal and keeps knowing less and less about more and more until he knows practically nothing about everything; however—

A *Purchasing Agent* starts out knowing practically everything about everything, but ends up knowing nothing about anything due to his association with chemists and salesmen.

—Milt Goll

'By the time I get to Phoenix . . .'

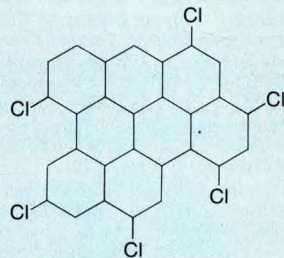
After his first day on the job, a man hired to paint yellow lines down the middle of the road reported to his foreman that he had painted a three-mile line. The foreman was impressed. Usually a good day is only two and a half miles.

The second day, the man reported to his foreman that he had added only two miles to the line. "Well," said the foreman, "you have good days and bad days."

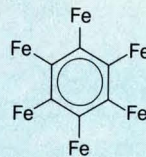
But the next day, the worker told the foreman he had added only one mile to the line. "I'm sorry," said the foreman, "but each day you paint less and less. We're going to have to let you go."

The man turned to the foreman and yelled, "Well, it's not my fault. Each day I get further from the paint can."

Structural Damage



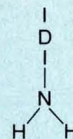
chlorinated chicken wire



ferrous wheel



mercedes benzene



Idi Amine



paramedic

—Anon.

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