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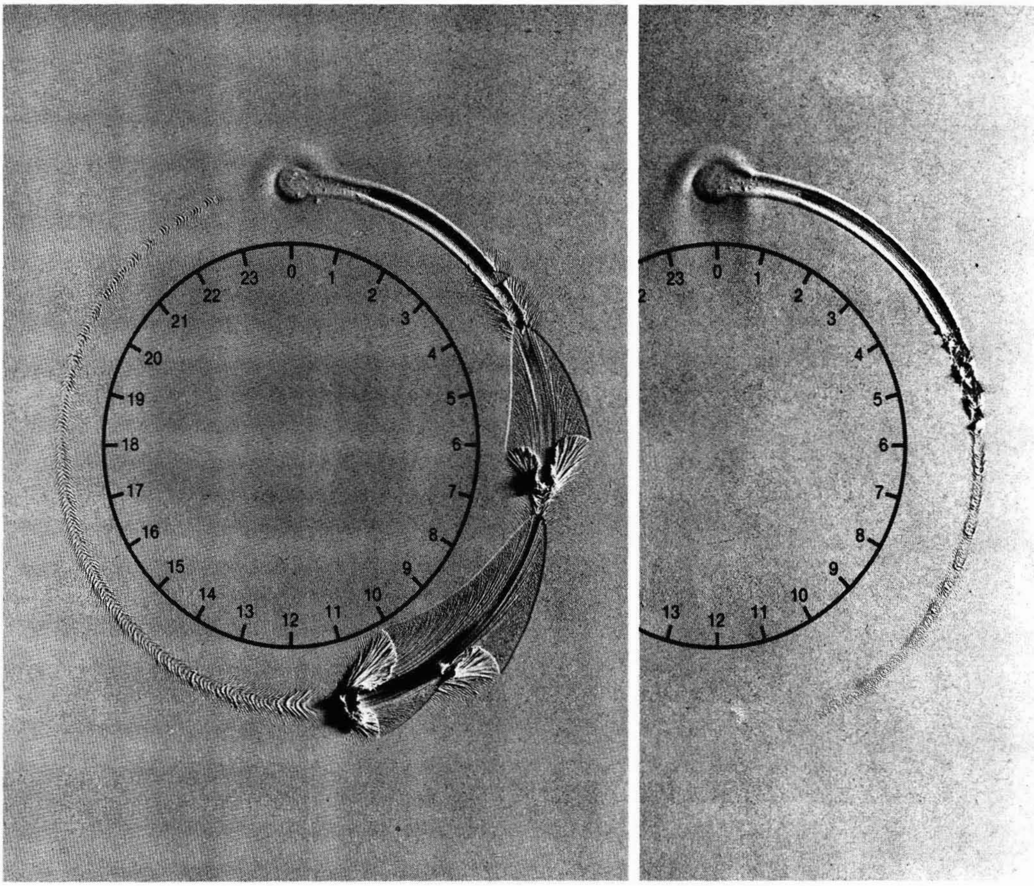
jct JOURNAL OF COATINGS TECHNOLOGY

DECEMBER 1983

"Knowledge Applied Profitably"

1983 Montreal Convention Wrap-Up



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INDUSTRIAL MINERALS AND CHEMICALS

DECEMBER 1983

jct JOURNAL OF COATINGS TECHNOLOGY

VOLUME 55 NUMBER 707

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1315 Walnut St., Phila., Pa. 19107

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

Comment

Merci Beaucoup

The Federation's first Annual Meeting and Paint Show in Canada has come and gone. But happy memories of that first venture outside the U.S. will long remain.

Many of those who attended the October 12–14, 1983 convention in Montreal said it was one of the best—if not the best—ever staged by the Federation.

All of the necessary ingredients for success were present:

(1) The largest Paint Show in spacious, bright, and colorfully decorated Place Bonaventure Exhibit Hall. And the exhibits themselves were equally attractive. The Manager of the Hall commented that the Paint Show was among the most beautiful ever in that building. Thanks to the exhibitors and their creative designers, the Paint Show continues to rank high as a first-class industry exhibit.

(2) A timely and informative assortment of technical program sessions—the top of which was the Mattiello Lecture by Fred Daniel.

(3) A large attendance—over 5,600 (10% were spouses).

(4) Hotel accommodations in Montreal's finest.

(5) Courteous, efficient, and friendly service personnel in the exhibit hall, hotels, and restaurants.

(6) A hard-working Host Committee composed of dedicated members of the Montreal and Toronto Societies.

(7) A beautiful and clean city.

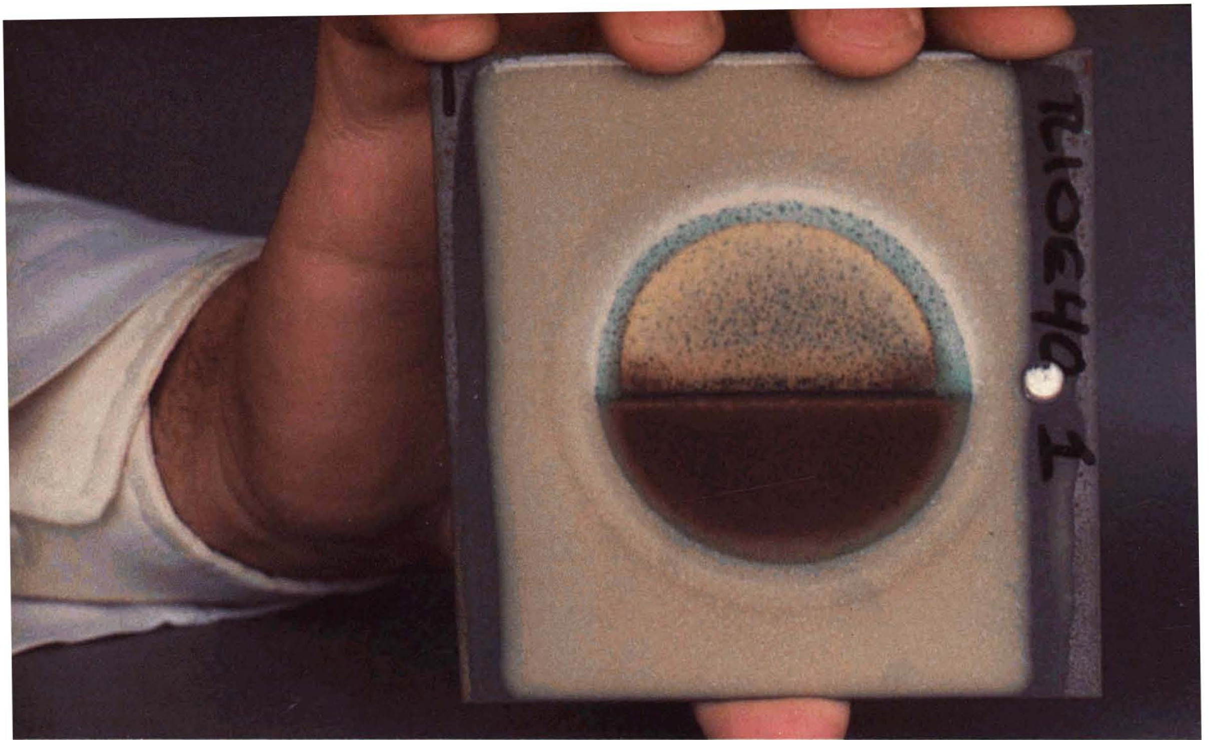
(8) Pleasant weather.

When the Montreal event was announced eight years ago, the pessimists came out of the woodwork and predicted that any attempt to take the AM&PS outside the U.S. would result in failure.

Now that they have been proven wrong—and the ice has been broken successfully—it is certain that the Federation will return to Canada again someday.

Until then, we can happily reflect upon October 1983 and, with appreciation, say—Thank you, Canada—Merci Beaucoup, Montreal.

Frank J. Borrelle,
Executive Vice-President



CIBA-GEIGY epoxy hardeners vs. the toughest applications around.

Encapsulated in our XU 252 and XU 264 system, this strip of steel was immersed in a 50% sulfuric acid bath for two hours at room temperature then, without rinsing, put into a 350° oven for 30 minutes. This was followed by quenching in sulfuric acid. After 10 such cycles, there was slight surface charring—but no penetration.

You can now formulate practical, durable coatings for such difficult applications as pollution control equipment.

Conditions are so hostile inside a coal-burning utility's flue gas desulfurization unit that, until today, no completely satisfactory coating has existed. Traditional coatings for carbon steel have been too brittle. And exotic alloys have been too costly.

Now, however, there is an answer. An answer that, for the first time, allows you to formulate an organic coating with the characteristics you need to meet the demands of this particularly difficult application.

In 14 days of continuous exposure in an Atlas Cell, refluxing 50% sulfuric acid had virtually no effect on the combination of our XU 252 epoxy resin and XU 264 epoxy hardener. After only four days, however, a conventional system was completely destroyed.

Start with a high performance resin.

Our system begins with XU 252, a high performance epoxy resin that has already proven its worth against chlorinated solvents, ethanol, methanol, aromatic amines, acids, caustic and ammonia— and proved it under a wide range of service temperatures.

But you require more than a high performance resin to formulate a superior coating. You also need a high technology hardener that can produce the desired physical qualities in the cured system.

Combine with a high technology hardener.

Today, CIBA-GEIGY offers two highly versatile hardeners that you can combine with XU 252 to formulate coating systems with the high level of resistance and durability you require.

The first, XU 264, is a toughened aromatic amine-based epoxy hardener that is particularly suitable for high temperature service. It provides good flexibility, superior toughness, and excellent resistance to sulfuric acid—properties that make it the ideal hardener for use in high performance coatings for the scrubbers, ducts and stacks in flue gas desulfurization units.

The second of these new products, XU 265, is a liquid hardener that cures epoxy resins into coatings that are highly resistant to acid, alkali, solvents and chemicals. In combination with XU 252, it produces a coating system that is widely used, for example, in tanks, processing plants and transmission pipes.

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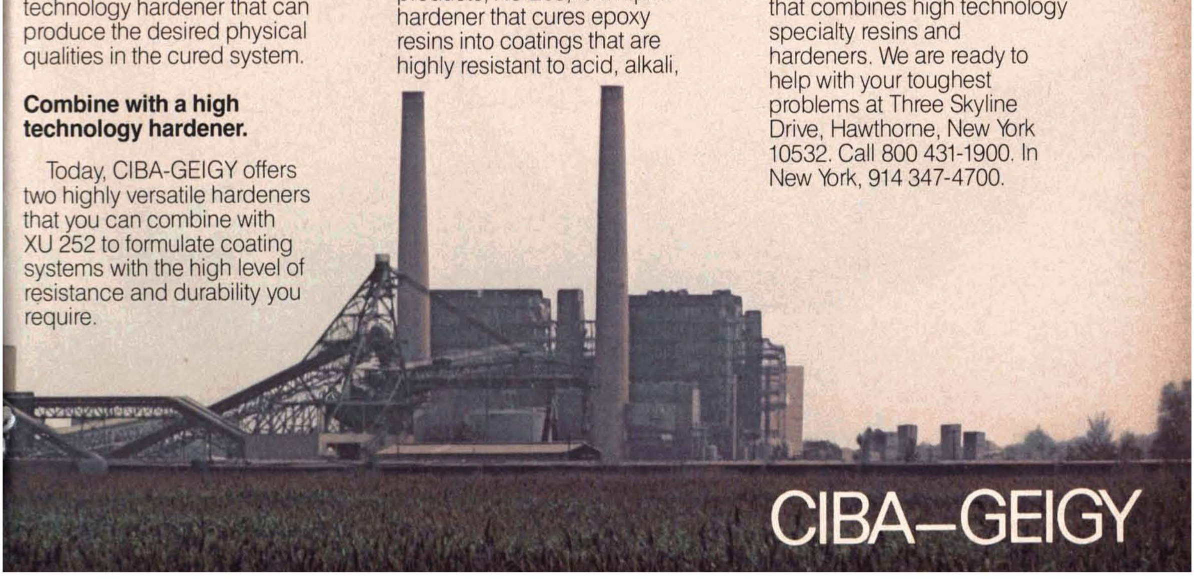

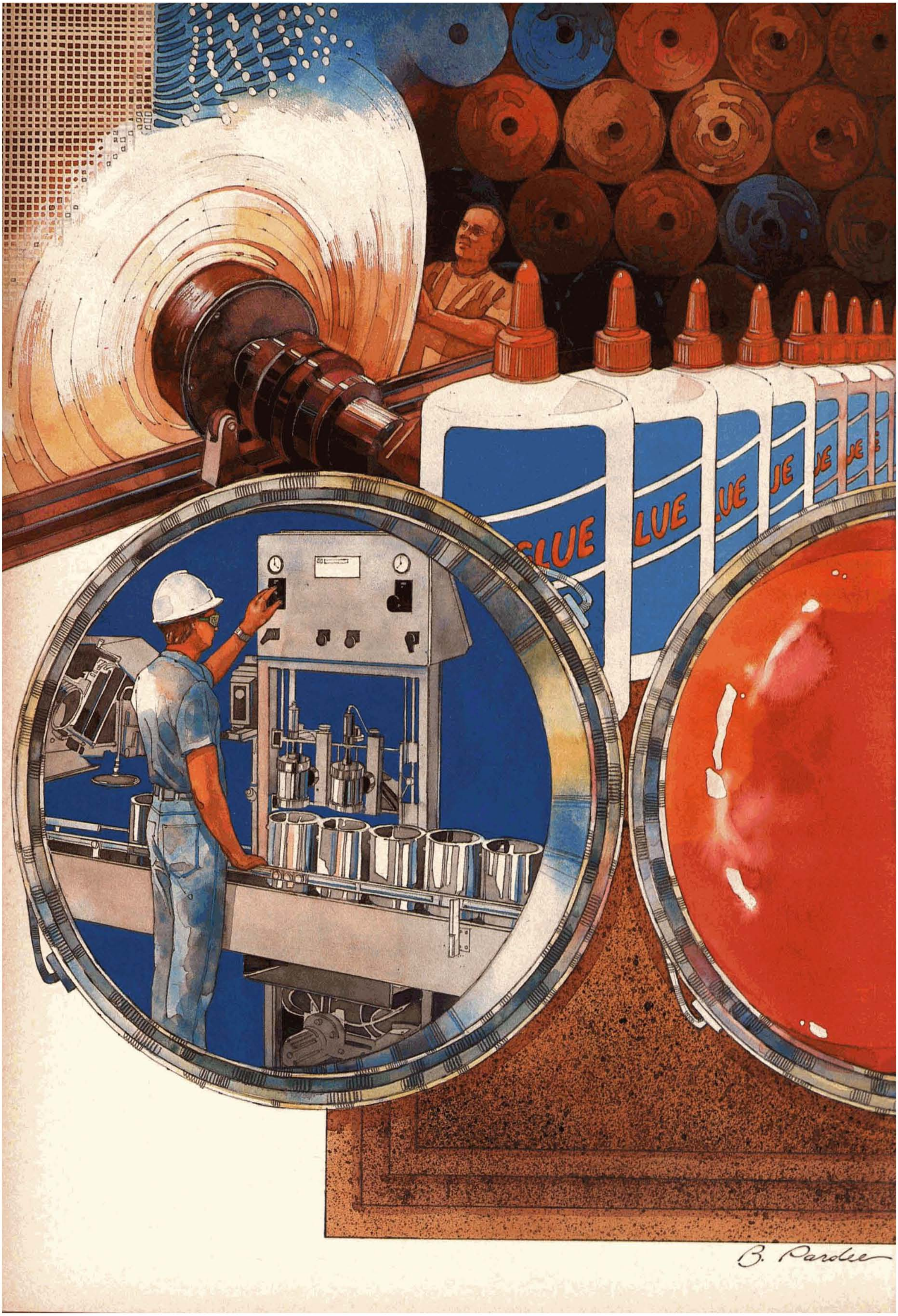
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B. Pardee

Abstracts of Papers in This Issue

SURFACE CHARACTERISTICS THAT CONTROL THE PHOSPHATABILITY OF COLD-ROLLED STEEL SHEET—S. Maeda

Journal of Coatings Technology, 55, No. 707, 43 (Dec. 1983)

The factors that control phosphatability were investigated using various cold-rolled steel sheets with different manufacturing conditions. The contributing factors to the phosphatability were studied by Auger electron spectroscopy and secondary ion mass spectrometry from the view point of adsorption of nucleating agents (Ti-colloid and Ni^{2+} ion, both generally used in a commercial phosphate treatment) because the adsorption of the nucleators substantially controls the grain size of the phosphate coatings. A high steel surface carbon level leads to a coarse grain size of the zinc phosphate coating, resulting in poor paint performance. This result is attributed to a reduction of titanium adsorption. On the other hand, the surface manganese improves the phosphatability because, unlike the carbon, it increases nickel adsorption by increasing the activity of ferric oxide films on steel sheets. The effects of manufacturing conditions such as annealing on surface compositions are also discussed.

PARTICLE PACKING ANALYSIS OF COATINGS ABOVE THE CRITICAL PIGMENT VOLUME CONCENTRATION—R.C. Castells, et al.

Journal of Coatings Technology, 55, No. 707, 53 (Dec. 1983)

Dry film densities are determined by hydrostatic weighing; the method is rapid, precise, and can be applied on real films. The experimental data for films constituted by zinc, zinc oxide, or aluminum as pigment, and a mixture of chlorinated rubber plus chlorinated paraffin as binder are reported and interpreted by a packing model. This model predicts the existence of two characteristic points in the plots of film properties against PVC: the CPVC, defined in 1949 by Asbeck and Van Loo, and a point of maximum film porosity designated CPVC*. There is a nonlinear decrease in film density between the two points. A method for their location is proposed.

THE ACCOMPLISHMENTS OF THE MILDEW CONSORTIUM—C.C. Yeager

Journal of Coatings Technology, 55, No. 707, 61 (Dec. 1983)

The Paint Research Institute, the research arm of the Federation of Societies for Coatings Technology, is charged with organizing and supporting fundamental research on problems related to the coatings industry. Findings of the research are made available to the public, and no patents are issued. Individuals and companies may use the information to develop their own proprietary products.

This report summarizes a research program authorized by the Paint Research Institute and supported and directed by a consortium of organizations interested in the control of defacement of painted surfaces by mildew. The research was conducted mainly in university laboratories. The supporting organizations helped with advice and assistance in their laboratories.

The Trustees of PRI, believing that sufficient information and techniques are now available to make proprietary research attractive, has discontinued their association with the consortium. The published papers are given in the Bibliography.

VISUAL COLOR TECHNOLOGY DEVELOPMENT IN THE COATINGS INDUSTRY—J.T. DeGroff

Journal of Coatings Technology, 55, No. 707, 67 (Dec. 1983)

There has been a need for a visual method of generating a color without preparing a paint standard or finished product. In the majority of visual approaches, a color chip or other reference has been used as a guide, which must then be matched with coating materials on a manual basis. Even in the utilization of an automated color system, the visual appearance of many materials cannot be fully duplicated until the actual coating materials are available. A mechanical/electrical approach could supply many of the answers to solve this need.

A device, based on the basic Maxwell spinning disk concept, was developed. It is a solid-state, fully integrated system that creates visual color simulations that duplicate a wide range of typical coatings finishes. By adding visual modifications to the disks, the operator can create steps at various loadings of white or create a metallic "look" to simulate metal loadings of several of the metal sizes available. He can then take the data output results of this visual capability and convert them into paint formulas on a fully automated basis. This same data can be used to communicate colors from one location to another, making it possible to see those colors in the second location. The coatings industry may also be able to use such a device as a merchandising aid to help the customer to visualize the finished coating surface.

Now there's a water-borne acrylic coating polymer that really bonds to plastics.

NeoCryl® A-655-based coatings thoroughly wet the surface of plastics to achieve real bonding to materials such as Noryl®, ABS, polycarbonate, polystyrene and other plastic substrates. With A-655, films bond so strongly they maintain adhesion even when subjected to tough physical and environmental tests.

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PAINT INDUSTRIES' SHOW

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1983 CONVENTION WRAP-UP

1983 Annual Meeting and Paint Industries' Show Attracts over 5600 Registrants to Montreal

The first-ever Federation Annual Meeting and Paint Industries' Show outside the U.S., held in Montreal on October 12–14, attracted a near-record total of 5686 registrants, who were treated to three days of technical sessions and exhibits and the opportunity to savor the many charms of one of North America's most attractive cities.

The solid upbeat tone for the event was set at the Opening Session, when registrants crowded the ballroom of the Hotel Bonaventure to enjoy the music of the Royal Canadian Artillery Band and a dynamic Keynote Address by motivational speaker Jean-Marc Chaput. The subsequent technical presentations, developed by Peter Hiscocks and his Program Committee, covered a variety of topics keyed to the theme of "Knowledge Applied Profitably," and were well attended throughout, with the Mattiello Lecture by Consultant Fred Daniel drawing a standing-room only crowd. And the high level of interest among the attendees was reflected by the lively discussions that followed many of the presentations.

Meanwhile, in the exhibit area of Place Bonaventure, registrants toured the record-sized Paint Show to view the displays of 176 exhibiting firms and chat with their technical personnel. Many made repeat trips through the hall to be sure they took in all the attractions, and aisle traffic was heavy well into the final day. For their part, exhibitors generally expressed enthusiasm for the Show and were pleased with both the attendance and the interest shown in their displays.

There was also a goodly crowd at the Federation Luncheon, where more than 500 registrants were on hand for the presentation of Awards (see Awards story) and to enjoy the humorous comments of comedian and satirist David Broadfoot, "Canada's Bob Hope."

By all accounts, the 1983 event will be a tough act to follow, and the Federation is indebted to all who contributed. Particular thanks are due the many members of the Montreal and Toronto Societies who served on the Host Committee, under the direction of Chairman Horace Philipp, and devoted much time and effort to assure the success of the Federation's first Canadian venture.

1984 Annual Meeting and Paint Industries' Show Scheduled for October 24-26 in Chicago, IL

The 62nd Annual Meeting and 49th Paint Industries' Show of the Federation of Societies for Coatings Technology will be held at the Conrad Hilton Hotel in Chicago, IL, October 24–26, 1984.

Chairman of the Program Committee is Dr. Darlene Brezinski, of DeSoto, Inc., Des Plaines, IL. Members of the Chicago Society, under the chairmanship of Richard M. Hille, of General Paint & Chemical Co., Cary, IL, will serve on the Host Committee.

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

The National Paint and Coatings Association will also be in Chicago during the same week: October 22–24, at the Palmer House.

President Clarke Boyce and wife, Marjorie (right center), open the 1983 Paint Show with traditional ribbon-cutting ceremony. Looking on are (left to right): Treasurer-Elect William Mirick; Treasurer Joseph Bauer and wife, Dorothy; President-Elect Terryl Johnson and wife, Bonnie; Rose Borrelle; Executive Vice-President Frank Borrelle; and Roland Roy, General Manager of Bonaventure Hall

Dr. Darlene Brezinski, of DeSoto, Inc., Receives 1983 George Baugh Heckel Award from FSCT

Dr. Darlene Brezinski, Manager of the Analytical and Computer Application Research Department at DeSoto, Inc., Des Plaines, IL, was honored by the Federation of Societies for Coatings Technology with the 1983 George Baugh Heckel Award for her dedicated service to the Federation. The presentation was made at the FSCT Annual Luncheon on October 14, in Montreal, Quebec, Canada.

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

Dr. Brezinski is Vice-President of the Federation's Paint Research Institute. She chaired the Federation's Roon Awards Committee for two years and her work revitalized the awards competition. She is also a member of the Mattiello Lecture Committee, the Federation Publications Committee, the *Journal of Coatings Technology* Editorial Review Board, and the Federation Series Advisory Board. Dr. Brezinski will chair the 1984 Annual Meeting Program Committee.

Dr. Brezinski, the first woman to receive this prestigious award, is a member of the Chicago Society, the American Chemical Society, and is active in the American Society for Testing and Materials.

Distinguished Service Award

This award was presented to A. Clarke Boyce, of the Toronto Society, in grateful acknowledgment of his valuable contributions to the progress of the industry and the Federation while serving as President of the Federation in 1982–83. Mr. Boyce is Technical Service Manager of the Resins Div. of Nacan Products Ltd., Toronto, Ont., Canada

Roon Foundation Awards

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

First Prize ($1,500)—"The Transformation of Liquid to Amorphous Solid: Effect of Reaction Mechanism on the Time to Vitrify for Linear and Network Polymerization"—Marc T. Aronhime and John K. Gillham, Princeton University, Princeton, NJ.

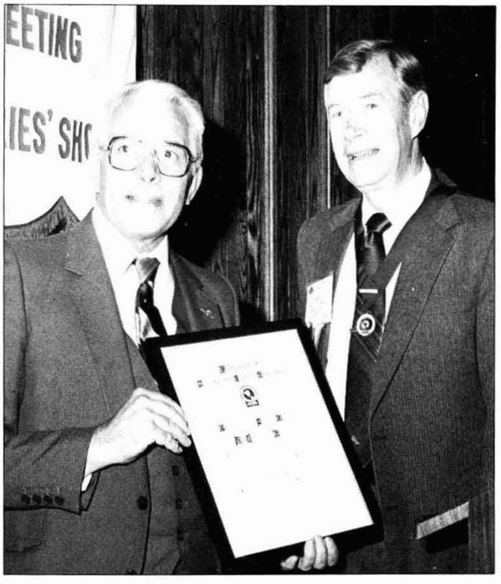
Second Prize ($1,000)—"Protection of Mildewcides and the Fungicides from Ultraviolet Light Induced Photo-oxidation"—Peter D. Gabriele and Robert M. Iannucci, Ciba-Geigy Corp., Ardsley, NY.

Third Prize ($750)—"Pigment Volume Concentrations and an Interpretation of the Oil Absorption of Pigments"—H.H. Huisman, PD Magnetics B.V., Oosterhout, The Netherlands.

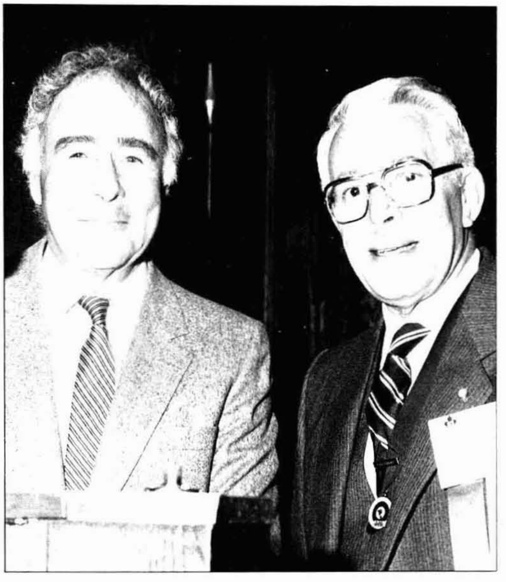
Dr. Darlene Brezinski (right) accepts the 1983 George Baugh Heckel Award from Heckel Award Committee Chairman Stanley LeSota

President Boyce presents 1983 Mattiello Memorial Lecturer, Frederick K. Daniel, with certificate of appreciation for his presentation, "The Obstacle Course from Mill Base to Finish Coating"

Roon Awards Chairman Darlene Brezinski presents awards to winners (right to left): Marc T. Aronhime, First Prize (co-author John K. Gillham, not present); Robert Iannucci and Peter Gabriele, Second Prize; and H.F. Huisman, Third Prize

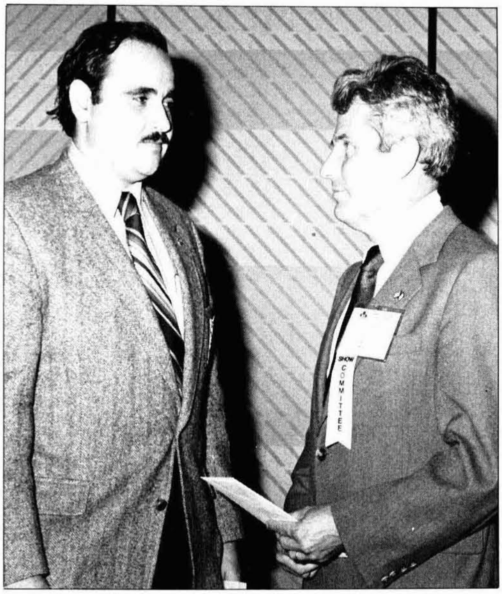


President-Elect Terryl Johnson (right) presents the Distinguished Service Award to President Clarke Boyce



President Clarke Boyce (right) greets motivational speaker, Jean-Marc Chaput, Annual Meeting Keynoter

Marketing Material Associate Awards were presented by Committee Chairman Al Heitkamp (left) and Howard McCollough, of McCollough and Benton, (left to right): Fred Foote, for Chicago Society; Gordon Rook, for Golden Gate Society; and Bob Matejka, for Piedmont Society



Winners of the Trigg Award for the most interesting reports of Society meetings and discussions were Clifford Schoff, of Pittsburgh Society (First Prize), and Michael Gildon, of Los Angeles Society (Second Prize). Honorable Mention went to Michael Iskowitz, of New York Society. Above, Barry Oppenheim, Trigg Awards Committee Chairman, presents check to Lloyd Haanstra, accepting for Mr. Gildon

Paint Show aisles were crowded and exhibits busy during the three-day event

Ernest T. Trigg Awards

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

FIRST PRIZE ($100)—Clifford Schoff (PPG Industries, Inc.), Secretary of Pittsburgh Society.

SECOND PRIZE ($50)—Michael Gildon (Guardsman Chemicals, Inc.), Secretary of Los Angeles Society.

HONORABLE MENTION—Michael Iskowitz (International Paint Co., Inc.), Secretary of New York Society.

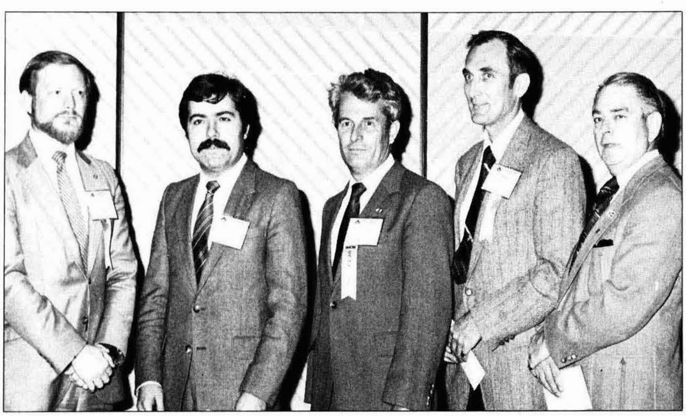
MMA Awards

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

Class A Competition ($350) was won by the Chicago Society for its Educational Program Series, SYMCO '83, "E.T.—Emerging Technologies: A Closer Encounter."

Class B Competition ($350) was won by the Golden Gate Society for hosting the 1983 Biennial Western Coatings Societies Symposium and Show.

Program Chairman Peter Hiscocks (left) presented the A.F. Voss/*American Paint & Coatings Journal* Awards to (left to right): Luigi Cutrone, accepting for Montreal Society; Lloyd Haanstra, accepting for Los Angeles Society; Norman Hon, accepting for Kansas City Society; and Andy Jones, accepting for Toronto Society



Canadian comedian Dave Broadfoot received roaring approval from the audience at Friday's Federation Luncheon

Bernie Orwig (right) accepts Morehouse Industries' Golden Impeller Award from Dale Morehouse

Class C Competition ($350) was won by the Piedmont Society for the funding of, and participation in, a credited academic polymers course offered at the University of North Carolina-Greensboro.

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

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

FIRST PRIZE (tie—$150 each)—"Water-Based Aerosols"—Los Angeles Society (Dodwell P. DeSilva, Lawson Chemical Products Co., Chairman, Technical Committee); "Sedimentation of Suspensions"—Montreal Society (Luigi Cutrone, Tioxide Canada Inc., Chairman, Technical Committee).

THIRD PRIZE (tie—$100 each)—"Performance Comparison of Exterior Flat Finishes on Hardboard Siding"—Kansas City Society (Roger Haines, Farmland Industries, Inc., Technical Committee); "Oxidative Dry Retention of Water-Soluble Alkyds in the Presence of Glycol Ethers"—Toronto Society (Andy Jones, Degussa Canada Ltd., Chairman, Technical Committee).

Program Committee Awards

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

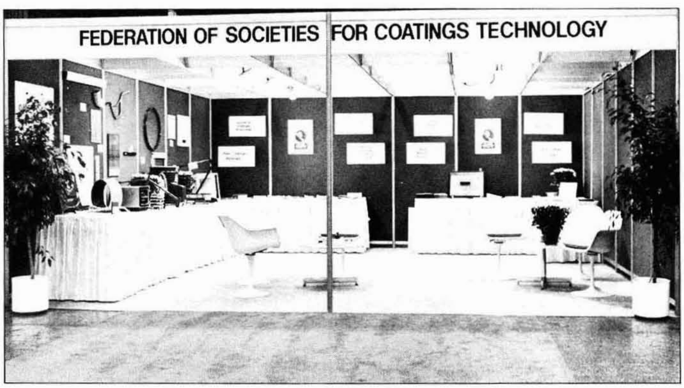
FIRST PRIZE ($100)—Roger Haines (Farmland Industries, Inc.), Kansas City Society.

Golden Impeller Award

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

This year's award was presented to Bernie Orwig, retired from Sherwin-Williams Co., for his extensive contributions to high shear dispersion technology, as well as to small media milling (sandmill) technology, for which he holds two patents.

Retired in 1978 after 42 years with Sherwin-Williams, Mr. Orwig is a past member of the Chicago Society and the Federation.



An added touch to the Federation's booth was the "Wonderful World of Coatings," a display of coated objects donated from manufacturers across the broad spectrum of industry

President Boyce officially begins the 1983 Annual Meeting at Opening Session ceremonies

Members of the Federation Executive Committee for 1983-84. Front row (left to right): President-Elect—Joseph Bauer, Porter Paint Co., Louisville, KY; President—Terryl F. Johnson, Cook Paint & Varnish Co., Kansas City, MO; and Treasurer—William Mirick, Battelle Memorial Institute, Columbus, OH. Back row: Horace Philipp, Sherwin-Williams Co., Montreal, Que.; Deryk R. Pawsey, Rohm and Haas Canada Ltd., Vancouver, B.C.; Immediate Past-President—A. Clarke Boyce, Nacan Products Ltd., Toronto, Ont., Also shown is Executive Vice-President Frank J. Borrelle. Member John Vandeberg, DeSoto, Inc., Des Plaines, IL, was not present when photo was taken

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

Deryk R. Pawsey, Chairman of the Paint Show Committee, presented awards for outstanding exhibits to (left to right): Norm Uress, of Applied Color Systems, Inc.; Myron Segal, of Premier Mill Corp.; James Flynn, of EM Chemicals; Judy Forbes, of Manville Products Corp.; Armetta Parker, of Dow Chemical USA; and Joseph Sullivan, of Rohm and Haas Co.

Six Exhibitors Win Awards in 1983 Paint Industries' Show

Applied Color Systems, Inc., Dow Chemical U.S.A., EM Chemicals, Manville Products Corp.—Filtration and Minerals Div., Premier Mill Corp., and the Rohm and Haas Co. were recipients of the C. Homer Flynn Awards at the 1983 Paint Industries' Show of the Federation of Societies for Coatings Technology, held October 12–14 at the Place Bonaventure in Montreal, Quebec, Canada.

These awards are for outstanding exhibits in the Show on the basis of technical excellence, educational value, attractiveness, and novelty. The awards are divided into three categories: Raw Material 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 Exhibit—EM Chemicals, Hawthorne, NY. (2 years in Show).

Double-Booth Exhibit—Manville Products-Filtration and Minerals Div., Denver, CO. (34 years).

Three-to-Five-Booth Exhibit—Dow Chemical U.S.A., Midland, MI. (30 years).

Six-or-More-Booth Exhibit—Rohm and Haas Co., Philadelphia, PA. (48 years).

EQUIPMENT MANUFACTURER: Premier Mill Corp., New York, NY. (16 years).

SERVICE INDUSTRIES: Applied Color Systems, Inc., Princeton, NJ. (14 years).

Successful Annual Meeting program included the Manufacturing Committee Seminar, "Improved Profitability Through Efficient Cleaning, Recycling, and Reclamation Techniques"

Award-Winning Exhibitors in the 1983 Paint Industries' Show

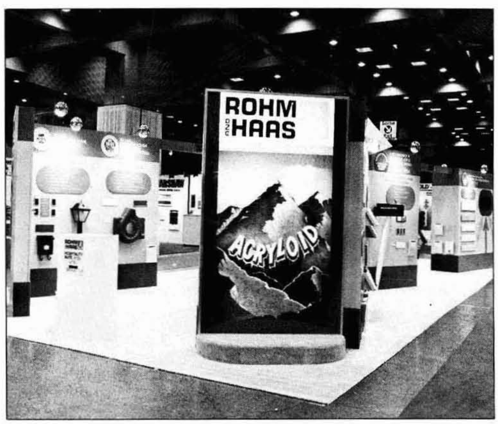
Applied Color Systems, Inc., a 14-year exhibitor, won in the Service Industries category

Dow Chemical U.S.A., 30 years in the Paint Show, won as a raw material supplier in the three-to-five booth category

The winner in the single-booth exhibit for raw material suppliers was EM Chemicals, a two-year exhibitor

Manville Products—Filtration and Minerals Div., exhibiting for 34 years, won in the Raw Materials Supplier category

A 16-year exhibitor, Premier Mill Corp., was cited in the Equipment Manufacturer category



Rohm and Haas Co., a 48-year exhibitor, was awarded for its six-or-more-booth exhibit in the Raw Materials Supplier category

Paint Research Institute

Thomas J. Miranda, of Whirlpool, Re-elected President of PRI for 1983-84

Dr. Thomas J. Miranda, Staff Scientist at Whirlpool Corporation's Elisha Gray II Research and Engineering Center, Benton Harbor, MI, was re-elected President of the Paint Research Institute of the Federation of Societies for Coatings Technology for 1983-1984.

Other officers elected to serve are: Vice-President—Dr. Darlene Brezinski, of DeSoto, Inc., Des Plaines, IL; Secretary—Dr. Howard Bender, of General Motors Research Laboratories, Warren, MI; and Treasurer—William A. Mirick of Battelle Memorial Institute, Columbus, OH.

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

Dr. Seymore Hochberg will continue as Executive Director of PRI.

Outstanding programming drew high attendance for the 1983 event

1983 Paint Show Exhibits

The 1983 Paint Industries' Show of the Federation of Societies for Coatings Technology was held at Place Bonaventure, Montreal, Canada, October 12–14. With 176 exhibitors, it was the largest show in Federation history.

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

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

ACETO CHEMICAL CO., INC.
Flushing, NY 11368

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

AIR PRODUCTS AND CHEMICALS, INC.
Allentown, PA 18105

Emphasized is the company's broad line of Surfynol nonionic surfactants. Live demonstrations show benefits to coatings formulations, including excellent coverage over oily surfaces and defoaming. Also featured is a line of vinyl acrylic emulsions.

ALCAN INGOT AND POWDERS
Elizabeth, NJ 07207

The exhibit features a wide variety of standard and high quality specialty aluminum paste and flake pigments for paints, ink and roof coating applications.

ALUMINUM CO. OF AMERICA
Pittsburgh, PA 15219

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

C. M. AMBROSE CO.
Redmond, WA 98052

This year's exhibit features our PF9 One Gallon Filler/Sealer with five-station indexing conveyor, new adjustable size lid dropper, and Micro Adjusted Measuring Cylinder for quick adjusting "during" operation and an accurate fill. Details on saving money, time and energy, with figures to prove it!

ANGUS CHEMICAL CO.
Northbrook, IL 60062

This 30-foot display highlights our full line of chemicals, including NiPar S-30™, to protect solvent coatings systems from weather, water, and corrosion, and AMP-95, the multi-functional additive for coatings. Technical representatives are on hand.

APPLIED COLOR SYSTEMS, INC.
Princeton, NJ 08540

Featured is the new line of computer-based color control products. Also displayed is the Visual Color System and Low Volume Dispensing System.

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

Featured is the broad range of high performance industrial and functional chemicals that the company offers the coatings industry. Highlighted are low toxicity ARCOSOLV™ PG ethers and acetate, propylene glycols, and SMA®, Poly BD®, and UV-cured resins. Technical representatives introduce new product literature.

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

On display is a complete line of solvents, exempt solvents and specialty chemicals, available from 68 tank farm/warehouse locations across North America. Information is available about our chemical waste disposal service, computerized solvent reformulation, specialty cleaners and conversion coatings for paint manufacturers.

ASHLAND CHEMICALS CANADA
Div. of Valvoline Oil & Chemicals Ltd.
Mississauga, Ontario, Canada L5J 4E7

On display are solvents, specialty chemicals, cleaners and conversion coatings. Information is available on our line (only available in Canada) of coatings and specialty resins including alkyds, high solids, silicone modifiedes, oil-free, vinyl toluene, styrenated alkyd copolymers, water solubles, and acrylic emulsions.

ATLAS ELECTRIC DEVICES CO.
Chicago, IL 60613

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

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

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

BASF WYANDOTTE CORP.
Parsippany, NJ 07054

Heliogen® phthalocyanine blue and green pigments have demands for special coloristic and technical properties which have developed into an extensive range. Paliotol® organic pigments of differing chemical types have very good fastness properties which carry out the theme of the display.

BAUSCH & LOMB, INC.
Rochester, NY 14625

The company is displaying the latest in color formulation systems based on the Match-Scan II spectrophotometer, including custom Match-Pak software, the only color formulation software that thinks like a colorist.

BEROL CHEMICALS, INC.
Westport, CT 06880

Ingemar, the champ, delivers a technical knockout. He and his colleagues inform you of the success story of Bermocoll thickeners. A display of their unique performance in water-based paints is featured.

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

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

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

High speed dispersers; horizontal mixers; ribbon blenders; agitators; Russell Finex sieving machines; Winkworth Sigma blade mixers; Torrance milling equipment; ultrasonic homogenizers; coding machines; stainless, carbon and aluminum stor bins, mix tanks, reactors, storage tanks are displayed.

BROOKFIELD ENGINEERING LABORATORIES, INC.
Stoughton, MA 02072

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

BUCKMAN LABORATORIES, INC
Memphis, TN 38108

The latest in wood preservatives, dispersants, non-lead/non-chromate corrosion inhibitors and non-mercurial fungicides are featured at this year's show. Other applications presented include flame retardants, tannin stain blockers, UV light stabilizers, defoamers and flash rust inhibitors.

BURGESS PIGMENT CO.
Sandersville, GA 31082

In addition to the savings and quality available with Optiwhite and Optiwhite P, hydrous clays including the new Burgess 17, with a GE brightness of 90-92 and stir in Hegman grinds of 6.5-7.0, are presented. Panels depict formulation techniques and performance vs current commercial standards.

BYK-MALLINCKRODT USA, INC.
Wallingford, CT 06492

Panels display performance benefits of the new wetting agent for organic pigments, Byk® LP-5064; and for carbon black, Disperbyk® 130; Byk Defoamer 080; co-use of effective latex dispersant/defoamer, Byk 156 and Byk 035; dispersion and anti-sag properties using Anti Terra® 202 with Bentone® SD-1; and the blocked pTSA catalyst, Byk Catalyst 450. Two new instrumentation items featured are Color Gloss and Multi Gloss B, in addition to Gradient Oven, Byk-O-Stor, and Blocking Tester.

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

The company has provided the paint industry with 25 continuous years of fumed silica chemistry. Highlighted is Cab-O-Sil® N70-TS hydrophobic fumed silica, developed in our fully-equipped technical service laboratory.

CANADA COLORS & CHEMICALS LTD
Montreal, Quebec, Canada H4T 1T9

As one of Canada's largest chemical distributors, representing over 100 suppliers, we display some of the speciality products we have for the coatings industry.

CANADA TALC INDUSTRIES LTD.
Madoc, Ontario, Canada K0K 2K0

On display is a sample of our white ore, as well as samples of our new micronized products Cantal MB 95-20 (5+ Hegman) and Cantal MB 95-10 (6+ Hegman).

CANADIAN PAINT AND COATINGS ASSOCIATION
Montreal, Quebec, Canada H3B 1B4

A number of association technical, environmental and health and safety programs are displayed. Literature describing these programs and their availability is also distributed.

CARGILL, INC.
Minneapolis, MN 55440

Four industrial coating systems are featured: Contemporary powder, high solids, water extendible high solids, and water-reducible coatings. Architectural coatings, Agrisource™ resins and 7352 for water-thinned penetrating stains are shown. Our famous "Helping Hand" outreaches to give a commitment for your future.

CDI DISPERSIONS
Newark, NJ 07114

High strength blacks, phthalo blues, phthalo greens, etc. in alkyd, aqueous, and universal type vehicles are featured. Standard and custom designed pigmented dispersions in polymer systems are specialties.

CELANESE CHEMICAL CO., INC.
Dallas, TX 75247

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

CELANESE SPECIALTY RESINS
Louisville, KY 40233

Featured are resins for the high performance coatings industry with emphasis on (1) waterborne expoxies and acrylics, (2) UV/EB resins, and (3) high solids. Information and technical data are available.

CEM CORP.
Indian Trail, NC 28079

The company is exhibiting its systems for moisture/solids analysis. Utilizing unique microwave technology, these systems rapidly and accurately measure the percent moisture/solids in all types of materials including solids, liquids and slurries covering a full range of moisture levels. Accuracy and precision are comparable to standard methods.

CERTIFIED EQUIPMENT & MFG. CO.
Springfield, IL 62705

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

CHEMICAL AND ENGINEERING NEWS
American Chemical Society
Washington, DC 20036

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

CHEMISCHE WERKE HÜLS
D-4370 Marl, West Germany

Featured are aliphatic isocyanates (IPDI/TMDI), aliphatic epoxy coating systems (IPD/IMD), Nylon 12 coating powders and special resins to improve adhesion and gloss of lacquers and printing inks. Examples of uses as well as technical advice and brochures are available.

CHICAGO BOILER CO.
Chicago, IL 60614

This 20-foot display highlights the company's full line of small media mills for the coating industry—numerous sizes of laboratory through production "Red Head" open vertical mills, sealed horizontal Dyno-Mills and also various grinding medias.

CHROMALLOY INDUSTRIAL MINERALS
Houston, TX 77042

In addition to the white barytes, Bartex 30 and Bartex 65, two new products, Bartex T and Bartex Industrial, are featured. Bartex T is an off white grade barytes with a 6+ grind. Bartex Industrial is our inexpensive grade off-white barytes.

CLAWSON TANK CO.
Clarkston, MI 48016

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

CLOUGH INC.
St. Jean, Quebec, Canada J3B 7B5

The company is exhibiting management information and totally integrated business operations systems software on microcomputer which is especially designed for the paint and chemical specialty industries.

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

Featured this year is the "New Dimensions in Color" system for 1984. It incorporates features and innovations never before offered, including the latest pigment technology and a unique merchandising program. The Color Studio and Decorator III systems are also exhibited.

COLUMBIAN CHEMICALS CO.
Tulsa, OK 74102

Featured are the Mapico® and Raven® lines of timeless, permanent synthetic iron oxides and industrial carbon blacks. Used in trade sales, industrial sales, specialty, and colorant applications, these pigments include easy-dispersing reds and yellows.

CONTINENTAL FIBRE DRUM CO.
Stamford, CT 06904

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

CORDOVA CHEMICAL CO. OF MICHIGAN
North Muskegon, MI 49445

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

COSAN CHEMICAL CORP.
Carlstadt, NJ 07072

A new liquid biocide, Cosan 145, is introduced. It has good solubility in water, low odor, and a broad spectrum of activity against gram positive and negative organisms. Personnel will discuss 145 and the other organic bactericides, Cosan 101 and 265, as well as our complete line of fungicides, bactericides, driers, specialty chemicals and catalysts.

DANIEL PRODUCTS CO.
Jersey City, NJ 07304

New this year are Tint-Ayd® "ST" pigment dispersions for all solvent-thinned, high-performance coatings and Slip-Ayd® ultra-fine surface conditioners for mar and abrasion resistance with no loss of gloss or clarity in thin film coatings. Complete information is available on these and other colorants and additives.

DEGUSSA CORP.
Teterboro, NJ 07608

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

FRANK E. DEMPSEY & SONS LTD.
Toronto, Ontario, Canada M4M 2A9

Featured are our services available for those who seek a Canadian agent to handle their product's sale & distribution in the Canadian marketplace. Also featured is our wholly owned subsidiary, Cra-Vac Industries Inc., and the Crayvallac series of products as well as the products of those principals whom we already represent.

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

Displayed are the company's fungicides N-96 and N-40-D, a new rheology modified PA-605, and a new emulsifier for polymerization LF-40. Nopcosperse-44 is featured as the primary dispersant.

DISTI, INC.
New York, NY 10012

In-house solvent recovery and washing machines are displayed, featuring equipment in various sizes to recover contaminated solvent (wash-up solvent). Washing machines for buckets and containers and a washing process with solvent, which again can be recovered, are also highlighted.

D/L LABORATORIES
New York, NY 10003

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

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

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

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

Aerothene™ MM and Chlorothene™ SM solvents (exempt from state implementation plans in most states), epoxy resins, acrylate monomers, PM-acetate, P-Series glycol ethers, isocyanatoethyl methacrylate, Methocel™ cellulose ethers thickeners for latex paint, and Dowicil™ 75 preservatives are among the products on display.

DOW CORNING CORP.
Midland, MI 48640

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

DRAISWERKE, INC.
Allendale, NJ 07401

Presented is a continuous vacuum perl mill for grinding, dispersing, and de-aerating highly viscous, hard to grind, and heat sensitive products, and a direct dispersion system. Highlighted are the re-designed modular agitated bead mills.

DREW CHEMICAL CORP.
Boonton, NJ 07005

Innovative technology in foam control agents, dispersants, specialty surfactants and biocides is featured. Also on display is the new technical identification system for our Drewplus™ foam control agents. This system takes the guesswork out of defoamer evaluations.

DSET LABORATORIES, INC.
Phoenix, AZ 85029

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

DUPONT CANADA INC.
Toronto, Ontario, Canada M5K 1B6

Exhibited is DBE, a low cost solvent that has high solvent power, low toxicity and high flash point. Proven applications are can, coil and wire coating as well as appliance and automotive finishes.

EASTMAN CHEMICAL PRODUCTS, INC.
Kingsport, TN 37662

Base coat-clear coat, clear powder on color base, OEM and refinish automotive finishes, oil-free alkyds, CAB in curing type wood finishes, chlorinated polyolefin resins for finishing polypropylene, alcohols, esters, ketones, glycol ethers and esters, Texanol® solvent are shown.

EBONEX CORP.
Melvindale, MI 48122

The exhibit features specialty bone blacks, and introduces jet black for use in coatings intended for food contact applications.

EIGER MACHINERY, INC.
Bensenville, IL 60106

A full range of direct drive horizontal motor mills is exhibited, including the Mini 50 and Mini 250 ml self-contained mills and the dual-purpose (interchangeable .75L and 1.25L) used for formulation and small batch production. Production motor mills are available from 5 to 150L chamber capacity, with a 20 liter unit displayed.

ELEKTRO-PHYSIK, INC.
Virginia Beach, VA 23455

The manufacturers of precision surface testing instruments for more than 30 years and the original Mikrotest gage, to which no other copy can compare, have on display the Pentest, Mikrotest® Certotest®, Minitest®, analog and digital, Elektrotest, Porotest, and the Galvanotest.

EM CHEMICALS
Hawthorne, NY 10532

This exhibit presents the Afflair® pear lustre line of titanited mica pearl pigments. Available, also, are the Iriodin® line of lead carbonate products and Darocur® photoinitiators. The company's Canadian subsidiary, BDH Chemicals Canada Ltd., of Toronto, is also represented.

ENGELHARD CORP.
Minerals & Chemicals Div.
Edison, NJ 08818

Specific formulas, drawdowns, and performance properties are featured. Our extender pigments can be used in a wide variety of high-solids, or water-reducible systems, maintain or improve film appearance and optical characteristics without sacrificing application or durability properties, and reduce production costs.

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

The company's new X-Entri Mill is presented. It offers high-efficiency grinding, with lower horsepower, higher thru put, closed system and temperature controlled grinding for smaller investment cost. The Proto-Lab SWMill is also displayed, designed for batch operation for finished product within an hour.

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

The exhibit features computer software designed and implemented especially for the paint and coatings industry. The software provides for formula maintenance, formula analysis, formula costing, RM requirements, batch ticket, batch tracking, production variance reports, RM & FG inventory, purchasing aides, order analysis, etc.

FAWCETT CO., INC.
Richfield, OH 44286

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

FEDERATION OF SOCIETIES FOR COATINGS TECH.
Philadelphia, PA 19107

Featured is a display of Federation publications and educational and training aids. Publications on display include "An Infrared Spectroscopy Atlas for the Coatings Industry," "Paint/Coatings Dictionary," and the *Journal of Coatings Technology*. Federation slide/tape training programs for the coatings industry are also shown.

FELCO INDUSTRIES LTD.
Concord, Ontario, Canada L4K 2H3

Manufacturer of wedge-wire wound filter elements, ideal for back-washing. Manufacturing of bag type filter system and high pressure sock type filter for high viscous liquids. Capable of withstanding over 900 psig differential pressure.

FILTER SPECIALISTS, INC.
Michigan City, IN 46360

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

FREEPORT KAOLIN CO.
Gordon, GA 31031

Discover your friends at the Freeport Kaolin Message Center. We, the innovators of the Kaolin industry, hope that you enjoy and benefit from the Federation convention. The telephone number in the message center is 514-395-6110.

FRICKE ENTERPRISES
Granite Falls, WA 98252

The Model 1-P with various support equipment is displayed. You are invited to visit the exhibit to discuss simple ways to increase your productivity.

GAF CORP.
New York, NY 10020

Specialty chemicals for the coatings industry are highlighted in this exhibit. Featured are V-Pyrol®/RC, Gafgard™, Alipal®, Blanco®, Gafac®, Ganex®, Igepal®, Nekal®, Thickener LN®, M-Pyrol®, THF®, BLO®, and Butanediol.

GEORGIA KAOLIN CO., INC.
Elizabeth, NJ 07207

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

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

Visit this booth for up-to-date information on the company's high-efficiency flatting agents and moisture scavengers for metallic and moisture sensitive coatings.

GRACO, INC.
Minneapolis, MN 55440

Introduced is the new Auto Tint 8000 automatic colorant dispenser. Also featured is the MT80 manual colorant dispenser, the Colormatic semi-automatic dispenser, and the Auto Sperse high-speed paint mixer. Tinting equipment for accurate, repeatable dispensing is shown.

GRANCO PUMP
Div. Challenge Mfg. Co., Inc. of LA

The exhibit features positive displacement rotary ball pumps. Viscosity application ranges from 30 to one million ssu. Two, four, and six port models in threaded sizes 1½ through 3" are available.

GREGORY, INC.
Clifton, NJ 07014

Explosion proof, UL approved, rider and pedestrian operated lift trucks for use in Class I, Group D, Division I and Class II, Group G, Division I locations are featured. Latest developments in construction and features are demonstrated in the EX unit on display.

HALOX PIGMENTS
Pittsburgh, PA 15220

Featured are pigments which are free of lead and chromates for anti-corrosion coatings and tannin stain blocking. Technical staff provide guidance and recommendations for maximum performance and best utilization of this family of pigments.

HARSHAW CHEMICAL CO.
Cleveland, OH 44106

Watch artist Stephen Farkas create original acrylic paintings and register to win one of the paintings created during the show. Sample our full palette of colors for architectural, OEM and special purpose coatings as well as our spectrum of inorganic and organic dry colors and aqueous, resin and universal dispersions.

HENKEL CORP.
Chemical Specialties Div.
Maywood, NJ 07607

This booth features the company's line of additives for the coatings industry. These additives include anti-settling agents, dispersing agents, flow agents and defoamers.

HENKEL CORP.
Polymers Div.
Minneapolis, MN 55435

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

HERCULES INCORPORATED
Wilmington, DE 19899

Featured are nitrocellulose, Natrosol® hydroxycellulose, Parlon® chlorinated rubber and Hercules Canada Pigments. A new form of nitrocellulose for urethane lacquers appears. New resins and Pulpex® synthetic pulp are displayed, as well as pentaerythritols, Pamolyn® fatty acids, Hercoflat® texturing and flattening agent, Di-Cup® dicumylperoxide, Vul-Cup® vulcanizing agent, ethylcellulose and EHEC.

DR. HANS HEUBACH GmbH & CO. KG
Langelsheim 1, West Germany

The display illustrates the company's complete pigment color and corrosion inhibiting pigments, including Heucotron high performance inorganic pigments, Heucophos ZPO & ZPA, phthalochrome high performance colors and the new high-speed dispersible phthalo blues.

HILTON-DAVIS CHEMICAL CO.
Cincinnati, OH 45237

"The Colorful Way"—for water-borne and solvent-based coatings. Featured are flushings and dispersions for high-solids coating systems. Technical literature and technical personnel are in attendance.

HOCKMEYER EQUIPMENT CORP.
Harrison, NJ 07029

Featured is a demonstration of high-speed dispersion as it compares to low-speed agitation. All blade styles are available for inspection and discussion. Also featured is the improved design 2L, 2 horsepower laboratory variable-speed disceperser.

HOOKER INDUSTRIAL & SPECIALTY CHEMICALS
Occidental Chemical Corp.
Niagara Falls, NY 14302

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

HOOVER UNIVERSAL, INC.
Memphis, TN 38119

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

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

New amorphous precipitated silica and silicate pigments. ZEOLEX® spacing pigments to reduce RMC in trade sales. Low cost flatting pigment. Cost-effective silica thixotrope. Clay Division featuring new mica pigment. Calcined clays and water-washed Kaolin clays including new acid clays.

HUNTER ASSOCIATES LABORATORY, INC.
Reston, VA 22090

The new LabScan II™ Spectrocolorimeter, which combines a personal computer with 0°/45° or sphere geometry, is introduced. It provides spectral data, measures color difference, detects metamerism and offers ease of operation. The LabScan™, D25-9 tristimulas colorimeter, D48-7 gloss meter and Dorigon® are also shown.

ICI AMERICAS, INC.
Wilmington, DE 19897

The company supplies Haloflex 202 latex, a vinyl acrylic copolymer for production of water-based, air drying primers that outperform conventional latex paints. Information is available on the company's other products, notably the new Solsperse hyperdispersants.

IDEAL MFG. & SALES CORP.
Madison, WI 53704

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

INDUSMIN LTD.
Toronto, Ontario, Canada M4W 3L4

Both the Minex nepheline syenite and Lawson-United feldspar lines of paint extenders are featured in a variety of exterior exposures. Special emphasis is placed on Minex 10.

INTERNATIONAL MINERALS & CHEMICAL CORP.
Mundelein, IL 60060

Apex paint extender is an anhydrous sodium potassium aluminum silicate which can be used for both exterior and interior applications, in alkyd, latex and oil systems. It can also be used in street and road applications and in a wide range of priming paints.

INTERSTAB CHEMICALS, INC.
New Brunswick, NJ 08903

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

ISC ALLOYS LTD.
Bloxwich, Walsall, England

Exhibited are Delaphos 2 zinc orthophosphate, a nontoxic white anticorrosive pigment designed for ease of dispersion and widely used in solvent and water-based primers, and Delaville zinc dusts, available in many grades. Advanced processing and blending techniques allow for individually tailored product requirements.

JOHNSON WAX
Racine, WI 53403

Exhibit features the company's polymer products for the formulation of clear and pigmented industrial coatings. Included are solid resins, oligomers, and emulsions which enable the coatings' producer to develop and manufacture low VOC coatings.

KAY-FRIES, INC.
Chemical Div. of Dynamit Nobel
Rockleigh, NJ 07647

The company's full line of polyester resins, ethyl silicates, silanes, and titanates are featured. Thirty polyester resins are available for all your metal, wood, and plastic coating requirements.

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

Featuring *Coatings* Magazine, Canada's only paint industry publication, and *Corrosion Control*, the new magazine for management.

KENRICH PETROCHEMICALS, INC.
Bayonne, NJ 07002

Featured are 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; promote adhesion; and lower bake temperatures. Kenplast ES-2 (cumylphenyl acetate), a nonmutagenic epoxy reactive diluent, is offered.

LAPORTE (UNITED STATES) INC.
Hackensack, NJ 07601

Titanium dioxide pigments produced by the company are highlighted together with colored and anti-corrosive pigments for the paint industry. Also on display are the Laponite range of synthetic colloids and the Sheen range of laboratory testing equipment.

LENETA CO.
Ho-Ho-Kus, NJ 07423

The company is exhibiting its complete line of paint test charts and test equipment, including such ASTM-approved devices as their Anti-Sag Meter and Leveling Test Blade. Its Catalog No. 4, containing detailed test procedures, is available for distribution.

LIQUID CONTROLS CORP.
North Chicago, IL 60064

On display are series of positive displacement liquid meters, including an M-7-NX 100 GPM, 150 PSI electric demonstrator model, an MS-7 spherical steel case 100 GPM, 150 PSI model, and a liquid batch controller. Positive displacement meters feature no metal-to-metal contact of measurement chamber element and extreme accuracy.

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

The use of the company's JK 270 in a variety of applications is shown. Emulsion systems, alkyd applications, clears, stains, primers, and joint sealing compounds are on display.

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

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

MACBETH
Div. of Kollmorgen Corp.
Newburgh, NY 12550

The company introduces its MatchMaker entry-level color system. Its CMS/III computerized color matching system, Series 1500/Plus color measurement system with non-volatile memory, SpectraLight color matching booth, and Munsell Book of Color, color vision tests, color standards and tolerances are also exhibited.

MANVILLE PRODUCTS CORP.
Filtration & Minerals
Denver, CO 80217

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

MCCLOSKEY VARNISH CO.
Philadelphia, PA 19136

Description of company products manufactured at three locations, Los Angeles, Philadelphia, and Portland, are highlighted. Products include alkyds, polyurethanes, copolymers, silicone alkyds, polyesters, epoxyesters, varnishes, PVA's acrylics, water-soluble and high-solids resins.

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

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

MEARL CORP.
New York, NY 10017

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

MERCK & CO., INC.
Calgon Corp.
Teterboro, NJ 07608

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

MILLER PAINT EQUIPMENT, INC.
Addison, IL 60101

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

MINERAL PIGMENTS CORP.
Beltsville, MD 20705

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

MiniFIBERS, INC.
Weber City, VA 24251

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

MINOLTA CORP.
Ramsey, NJ 07446

The company is announcing the Chroma Meter II Reflectance for measuring reflected subject color. This highly accurate meter is the most compact and lightweight tristimulus color analyzer on the market.

MOBAY CHEMICAL CORP.
Pittsburgh, PA 15205

Complete line of inorganic color pigments for paints and coatings, including Bayferrox synthetic iron oxide pigments and lightfast mixed metal oxide pigments.

MODERN PAINT AND COATINGS
Atlanta, GA 30328

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

MOREHOUSE INDUSTRIES, INC.
Fullerton, CA 92633

The exhibit features a new pressurized lab sandmill and a new laboratory dissolver. Displayed is a pneumatic vari speed system, a M-4 7-15 pressure sandmill, and sandmill media cleaner.

MYERS ENGINEERING
Bell, California 90201

A multi shaft disperser for processing the most viscous products is being shown. Also on display is a 15 horsepower, single shaft disperser for less viscous material. Factory representatives will answer any questions concerning mixing or dispersion.

NETZSCH INCORPORATED
Exton, PA 19341-1393

Grinding and dispersion machinery displayed in the booth include both horizontal and vertical type small media mills used in the manufacture of paints, coatings, inks, magnetic dispersions and the grinding of coal, minerals and agricultural chemicals, etc. Featured are our newest lab bench size convertible continuous mini-mill and our one-gallon attrition type batch mill.

NALCO CHEMICAL CO.
Oak Brook, IL 60521

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

NATIONAL ASSOCIATION OF CORROSION ENGINEERS
Houston, TX 77084

On display is information concerning the use and performance of protective coatings in corrosive environments.

NEVILLE CHEMICAL CO.
Pittsburgh, PA 15225

The company's wide range of petroleum hydrocarbon resins, Cumar coumarone-indene resins and Unichlor chlorinated paraffins are featured. Of interest is technical information of the utilization of the firm's resins and chlorinated paraffins in coating systems. Technical representatives are on hand.

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

Featured is Bentone SD-2. The newest member of the "super-dispersible" organoclay family, it is a rheological agent for paints, plastics, certain cosmetics and other products; used with paints incorporating polar activators, it is expected to be a substitute for the more expensive fumed silica.

NORTHERN PIGMENT
Toronto, Ontario, Canada M8V 3S5

The company, a producer of iron oxide pigments, is featuring their new Micronized Yellow Oxide.

NUODEX INC.
Piscataway, NJ 08854

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

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

The exhibit contains information on wollastonite, mica, calcium carbonate, PMF fiber and barytes; information is also available on surface modified versions. Technical data emphasizes the use of 10 Wollastokup ES in an epoxy polyamide primer study. Data on alkyds study is available. Technical staff is present.

THE ORE & CHEMICAL CORP.
New York, NY 10022

Featured is Blanc Fixe Micro, the revolutionary new micronised white extender, which reduces cost and increases gloss, as well as our new concept for cutting raw material cost in latex paints. Also displayed is the entire line of white pigments and extenders for the coating industry produced by Sachtleben Chemie, Duisburg, West Germany.

OTTAWA SILICA CO.
Ottawa, IL 61350

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

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

A wide selection of quality control testing instruments for the evaluation of color, glass, viscosity, and other physical parameters of color are shown. See the new Spectrogard Automatch System and the Spectrogard Color System, an easy to use spectrocolorimeter.

PAINT RESEARCH INSTITUTE
Philadelphia, PA 19107

Reprints of PRI Research Proceedings on mildew and corrosion prevention are available.

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, the company also features the latest advancements in water-borne and radiation-curable pigment dispersions.

PENNYSLVANIA GLASS SAND CORP.
Pittsburgh, PA 15237

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

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

The exhibit features a full line of inorganic pigments for the coatings industry, including several new products and formulations utilizing lead-free traffic and implement enamel pigments.

PLASTICAN, INC.
Leominster, MA 01453

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

POLYVINYL CHEMICAL INDUSTRIES, INC.
Wilmington, MA 01887

A special display allows you to select polymers and starting formulations for desired end uses from the best of over 30 water-borne and solvent-borne acrylic and urethane polymers. Starting formulations are printed from a computerized library. Test panels of different substrates demonstrate the performance of various polymers.

PPG INDUSTRIES, INC.
Pittsburgh, PA 15272

Lo-Vel® flatting agents for coil coatings, metal furniture finish, aluminum extrusion coatings, and high-solids coatings are featured. Hi-Sil® T-600 synthetic thickener and thixotrope, which provides anti-sag action on vertical walls and keeps course particles in suspension in paints, is also exhibited.

PREMIER MILL CORP.
New York, NY 10010

On display is a horizontal pressurized media mill equipped with unique microprocessor controls including an improved wash flush system for easy product changeover; a laboratory, table top version of the horizontal media (1.5 liter); a colloid mill; an homogenizer; and dispersers.

PURITY ZINC METALS CO. LTD.
Stoney Creek, Ontario, Canada, L8G 3X9

Information is available on the various grades of ultra pure zinc dusts produced by the company which offer the ultimate performance in the coatings field.

Q-PANEL CO.
Cleveland, OH 44145

Displayed is the QUV Accelerated Weathering Tester which simulates the damage caused by sunlight, rain, and dew. Sunlight is simulated by fluorescent UV lamps and dew is simulated by direct condensation. Advantages include fast, low cost tests, conformance with ASTM practice, and comparability with over 1500 QUVs world wide.

REICHARD-COULSTON, INC.
Bethlehem, PA 18018

Featured are 207 Irox cost cutters for organic pigments, as well as 1475 Super Strength primer oxide for high-quality primers, Super Strength easy dispersing umbers, reds, and maroons, and 317 Zop for quality nontoxic conventional and water-reducible anti-corrosive primer systems.

REICHHOLD CHEMICALS, INC.
White Plains, NY 10603

The latest developments in the area of environmental resins, including water-reducible and high-solids systems, are featured. Also of interest is a wide range of products including alkyds, thermoset polyesters, uralkyds, copolymers, amino resins and hardeners, emulsions (acrylics, vinyl acetate acrylics, vinyl acetate ethylenes, styrene butadienes) and phenolics.

REICHHOLD LTD.
Islington, Ontario, Canada M9B 4B1

The exhibit shows the predominance of the company in the Canadian paint industry as a supplier of solvent and water-based resins and emulsions. Various plant locations, industries served, and products produced are mentioned with a focus on the industrial paint market.

RELIANCE PRODUCTS LTD.
Winnipeg, Manitoba, Canada R3H 0H3

On display are 4 litre plastic paint pails.

ROHM AND HAAS CO.
Philadelphia, PA 19105

The latest developments in acrylic emulsion technology are shown. Displayed are a new exterior latex vehicle with outstanding film build and adhesion to chalky surfaces, a new latex vehicle for interior and exterior high-gloss enamels. Ropaque™ OP-42 hiding additive, an aqueous lacquer vehicle that gives superior adhesion to engineering plastics, and water-borne and high-solids vehicles for coil, board and general product finishing.

RUSSELL FINEX, INC.
Mount Vernon, NY 10550

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

SANDOZ COLORS & CHEMICALS
Charlotte, NC 28205

Sanduvor 3206, a new multi-system compatible liquid UV absorber is emphasized. In the area of colorants, Sandorin Orange 5RLT, a new transparent pigment, and Sandorin Orange 6RL, a new opaque pigment, are displayed. Lead-free shades produced with Sandorin Yellow 6GL and Yellow G demonstrate the economics of substitution for C.I. pigment yellow 151 products.

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

Featured is the Air-Pallet System, an effective method of handling and shipping powdered products in a completely closed system. The Air-Pallet container, the heart of the system, is reusable. Systems are also available for automatic batch feeding directly into process or storage.

SHAMROCK CHEMICALS CORP.
Newark, NJ 07114

Special emphasis is on our new line of silicone solutions called Versa-Flow. It is used as an additive for surface imperfections as well as slip. Also introduced are the encapsulated versions of polymers for water wettability, ie.; polyethylene, PTFE.

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

Featured is a plastic one-gallon container compatible with all existing equipment in paint plants today. Also shown are metal containers.

SILBERLINE MANUFACTURING CO., INC.
Lansford, PA 18232

For the inside story on metallic coatings, speak to our technical people at the booth. From the quality-assured regular grades to the superior leafing of EternaBrite® and the glamorous "whiteness" offered by Sparkle Silver® grades, the company's innovative aluminum pigments represent the highest levels of technological achievement.

SOUTH FLORIDA TEST SERVICE, INC.
Miami, FL 33178

Company representatives are available to discuss the newest exposure methods for both accelerated and natural weathering. Exposure sites and equipment are featured in a continuous slide presentation.

SOUTHERN CLAY PRODUCTS, INC.
ECC America
Atlanta, GA 30329

Featured at the display is the Claytone series of rheological control additives. A variety of Claytones are offered for use in a wide variety of solvent systems.

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

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

STANDARD CONTAINER CO.
Fairfield, NJ 07006

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

SUN CHEMICAL CORP.
Pigments Div.
Cincinnati, OH 45232

Illustrated is the company's extensive line of organic pigments, with emphasis on Quinacridone, Monoarylide Yellows, Phthalocyanine Blues and Greens. The Dispersions Div. is also featured. Technical literature on the company's complete line of pigments is available, including environmental data and system specific information for the coatings industry.

SYNRAY CORP.
Kenilworth, NJ 07033

New resins for high-solids and water-reducible systems as well as Burnok thixotropic alkyds are presented. Oil-free alkyds which can be cross-linked with isocyanates meet requirements for MIL spec. (chemical agent) and "skydrol" resistance and flexibility. "No Frills" alkyds are also introduced.

TECHNOLOGY MARKETING CORP.
Norwalk, CT 06851

The exhibit includes the company's books, Buyer's Guides, periodicals and newsletters on the following subjects: radiation curing, high solids coatings, water borne coatings, and powder coatings. Technology Marketing Corp. is the leading publisher of energy efficient, non-polluting technology publishing with over a decade of leadership.

THIBAUT & WALKER CO., INC.
Newark, NJ 07101

Introduced is a new superior PVA with wet adhesion, which has been added to the line of Parco® vinyl acrylic copolymer emulsions. Information is also available on ParCryl® 100% acrylics, Super Alkyds®, Super Thanes® (oil modified urethanes), concentrated varnish stains, and other specialty products.

THIELE ENGINEERING CO.
Minneapolis, MN 55435

Examples of semi-automatic and fully-automatic filling machines are featured. Units are complete with lid placing and lid pressing systems.

TIOXIDE CANADA, INC.
Sorel, Quebec, Canada J3P 5P8

The exhibit features superdurable Tioxide R-CR60, superversatile Tioxide R-CR40, TiINFO system, and Tiotainer bag system. Technical displays illustrate millbase formulation for best dispersion, use of scanning electron microscopy for examining weathering, quantitative measurement of pigment flocculation, and computer-aided prediction of paint properties.

TRIANGLE IMEX LTD.
Montreal, Quebec, Canada H9P 1E9

The company is an established Canadian supplier with 30 years' experience, and the exclusive Canadian distributor for such DSM products as ammonium sulphate, benzoic acid, benzyl alcohol, melamine and methyl ethyl ketoxime.

TROY CHEMICAL CORP.
Newark, NJ 07105

A complete line of biocides is featured, along with other specialty products such as defoamers, wetting agents, dispersants, and rheology modifiers. Troysan Polyphase is presented as the leading product for wood preservation in both industrial and consumer formulations.

UNION CAMP CORP.
Wayne, NJ 07470

UNI-REZ polyamides are made especially for coatings used in corrosive marine and industrial applications, requiring resistance to salt water and various chemicals. UNI-REZ polyamides are derived from pine trees—a renewable resource.

UNION CARBIDE CORP.
Danbury, CT 06817

Featured are materials for conventional coatings, industrial finishes, and trade paints, with emphasis on UCAR Resins for high performance coatings; UCAR Acrylic 518 for semi-gloss paints; UCAR Latex 376; and the overall cost/performance advantages of UCAR Acrylics. Solvents for electrostatic spray and high-solids coatings; TONE polyols, reactive diluents, and monomers; and cycloaliphatic epoxides for UV coatings are also featured. The Captain's 18th Annual Putting Contest is being held.

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

Emulsion polymers (76 RES®), solvents and chemicals are featured in the exhibit. New coatings ideas, starter formulations and technical advice are also highlighted. Last year's popular drum roll game returns.

UNION PROCESS, INC.
Akron, OH 44313

Featured is fine grinding and dispersion equipment. This includes attritors and HSF bead mills for batch, continuous, and circulation processing. Also featured, are new models with nonmetal parts for metal contamination free products.

UNITED CATALYSTS, INC.
Clays and Minerals Div.
Louisville, KY 40232

The exhibit features the Tixogel line of organo clays and activated bentonites. The exhibit provides information on the application of the products to a variety of coating systems and also includes literature on the products for solvent, water-borne and emulsion systems.

UNIVERSAL COLOR DISPERSIONS
Lansing, IL 60438

In our all new exhibit is displayed our universal A, N, and Q lines along with the Super V line, the latest most widely compatible volumetric industrial dispersion line in the market today. Also featured is our newly developed family of acrylic resins.

UNIVERSITY OF DETROIT
Detroit, MI 48221

Educational and research programs in the area of coatings technology and polymers at the University of Detroit are featured.

UNIVERSITY OF MISSOURI—ROLLA
Rolla, MO 65401

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

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

Mineral and chemical additives for the paint industry are featured.

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

Introducing the new enclosed gyratory sieving and straining lab or pilot plant 15" model RBF-15. Also displayed is our enclosed gyratory action Robot Vorti-Siv. All models are produced with American Standard nuts, bolts, and threads, and can be produced in metric or BSF systems. The company carries a complete stock of parts for all older models including the 1950 Lehamnn.

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

Applications for HDK fumed silica are displayed. Dr. J. Doppelberger and other technically capable personnel, are available for consultation. A second line of products, including binders for high-solids, cementitious coating systems and soluble vinyls and polyvinyl butyrals, is also presented.

THE WARREN RUPP CO.
Mansfield, OH 44901

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

WEATHERING RESEARCH SERVICE CO.
Princeton, FL 33032

Outdoor exposure testing in sub-tropical south Florida, featuring a slide show of weathered samples, is highlighted. On display are actual paint, plastic, and fabric samples showing various degrees of weathering. Technical personnel are available.

WELLCO PRODUCTS DIV. AND ITASCO DIV.
Summit, IL 60501

Exhibited is the new D. O. T. approved bulk liquid, portable shipping tanks ranging in size from 325-525 gallon capacity. Also exhibited are new high impact tank cleaning, spray nozzles along with other information regarding tank washing systems.

WILDEN PUMP & ENGINEERING CO.
Grand Terrace, CA 92324

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

WITCO CHEMICAL CORP.
Organics Div.
New York, NY 10222

The exhibit features the Witcobond urethane aqueous dispersions series, both anionic and cationic types, developed for a wide range of coatings applications. They include self-crosslinking dispersions for many protective finishes.

CARL ZEISS CANADA LTD.
Don Mills, Ontario, Canada M3B 2S6

This is the Canadian debut of world-renowned, expandable, state-of-the-art Industrial Colorimetry and Computer Matching Systems featuring ELREPHOMAT/DFC 5, RFC 16, RFC 16-4000, including HP 85 and HP 1000 computers and surface inspection microscopes. You're invited to have your own paint panels measured.

Errata

Mobay Chemical Corp., a major supplier of inorganic pigments to the industry, was omitted from the Inorganic Pigments Section of the Exhibitor Product/Service Classification listing in the September issue of the JCT and the Paint Show Program Book.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

1984
49^{th} Annual
Paint Industries' Show

CONRAD HILTON HOTEL
CHICAGO, ILLINOIS
OCTOBER 24, 25, 26

Being held in conjunction with the 62nd Annual Meeting
of the Federation of Societies for Coatings Technology

An Educational Exhibit of Materials and Equipment Used In the Manufacture of Paints and Related Coatings

Shining Examples:

Reynolds Aluminum Pigments put more glow into your metallics.

If the new cars look especially rich in their finishes, with a higher gloss and a softer-glowing color, there's a good reason. So many of them are finished in metallics made with Reynolds Stain Resistant Aluminum Pigments.

Reynolds has extremely rigid controls on particle size and uniformity for its nonleafing pastes. And these controls give you lower seed levels, better reflectivity and brightness.

In effect, the Reynolds Pigments add depth and eye appeal by maintaining maximum gloss in both straight metallic and polychromatic coatings. They don't mask the colors; they enhance them. There's a big family of these Reynolds Stain Resistant Pigments, including coarse, fine and medium particle sizes. And any one of them might be the answer to your more perfect finish.

For details and technical data, write to Reynolds Metals Company, Post Office Box 35030-PD, Louisville, KY 40232.

REYNOLDS ALUMINUM PIGMENTS
For Quality Coatings

Federation to Sponsor Seminar on Paint Manufacturing Practices, May 15-16

A seminar on "Producing Paint Efficiently, Safely, and Economically," sponsored by the Federation of Societies for Coatings Technology, will be held May 15 and 16, at the Galt House, Louisville, KY.

The 1½ day event, the second national seminar under Federation sponsorship, is designed to upgrade the industry's manufacturing practices, and will feature speakers experienced and knowledgeable in their fields who will provide practical, down-to-earth information on all phases of the paint manufacturing process.

Presentations will range from production planning through the storage and handling of raw materials, to pigment dispersion, paint processing, color matching, filtration, filling, packaging and shipping, as well as waste management, health and safety, and employee motivation.

The programming is being developed by Royal A. Brown, FSCT Technical Advisor, in cooperation with the Federation staff, which will be responsible for all other arrangements.

The week of May 14, 1984 marks the initiation of "Federation Spring Week" in that meetings of Society Officers and the Federation Board of Directors will be held on May 17 and 18, respectively, also in the Galt House.

Complete details on the program and registration for the seminar will be available shortly. In the meantime, further information may be obtained by contacting T. A. Kocis, Director of Field Services, Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

Federation Announces Paint Testing Program

The Federation of Societies for Coatings Technology has announced a new program designed to improve the reliability of paint testing. The Federation has reached agreement with Collaborative Testing Services Inc. of McLean, VA, to operate the program.

CTS, which specializes in offering proficiency testing programs for a wide range of industries, will be the administrator for the program. The Federation will supply technical advice and will choose the test methods and coatings to be used.

The objective of the program will be to upgrade the test instruments, the test methods, and the testing proficiency of the paint and coatings industry.

The program is open to any company manufacturing paints or raw materials, commercial testing laboratories, and other organizations involved with paint and coatings.

The program will have a testing frequency of six times a year with two tests per sample being conducted or a total of 12 tests per year. The test methods will be essentially ASTM methods and will concentrate on tests of primary interest to the paint and coatings industry. Paint samples used will be representative of those produced by most coatings manufacturers.

CTS will send liquid paint samples to each participating company along with instructions and copies of test methods to be used. The company returns their test results to CTS who will then issue a summary report for each test method showing data from all participants. Confidentiality is maintained through assigning code numbers to each participant.

It is anticipated that the first set of samples will be ready for distribution around April 1, 1984. A tentative pricing schedule has been set for $40.00 a test or $360.00 for all twelve tests.

CTS and The Federation stress the many benefits a company will receive by being able to compare its testing proficiency with that of others in the paint industry.

Additional information will be published soon in two paint industry journals: *The American Paint & Coatings Journal* and the *Journal of Coatings Technology*. Brochures and enrollment forms can be obtained from Collaborative Testing Services Inc., 8343-A Greensboro Dr., McLean, VA 22102 or from The Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107.

New England Society's Boston Stone Project Receives Contributions from FSCT Societies

Earlier this year, the New England Society embarked on a program to preserve and protect the earliest known implement of the paint industry in America—and the basis for the Federation's logo. This is the nearly 300-year old Boston Stone, part of which still sits today at the base of a building in the City of Boston.

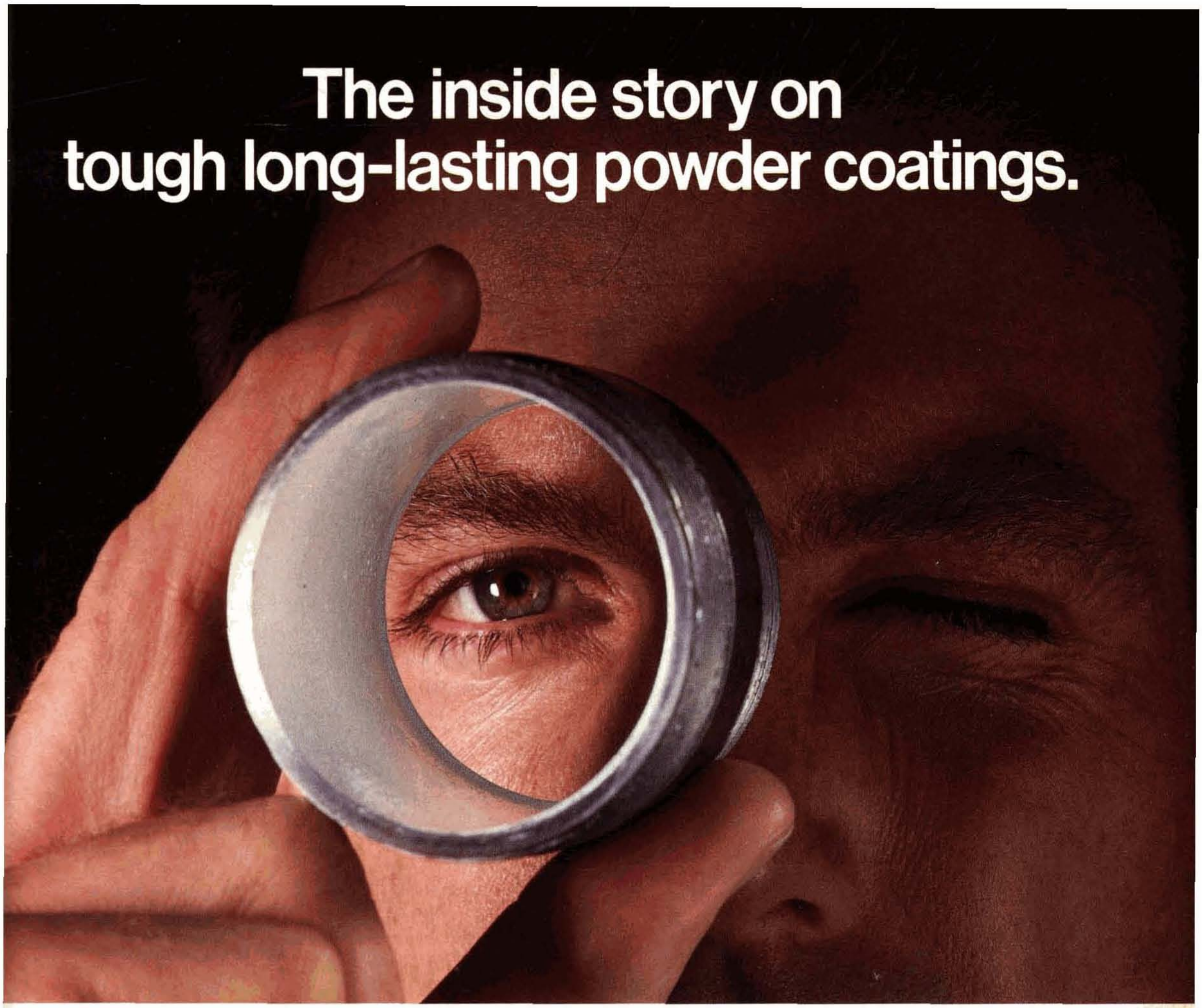
New England has sought contributions from the Federation's Societies to fund a two-phase program, the first of which will be to establish—through research conducted by the New England Society for the Preservation of Antiquities—the true background and historical significance of the Stone.

Robert G. Modrak, Chairman of the Project and a Society Past-President, reported that 13 Societies, one PCA, and the Federation have contributed over $4,000.

The contributors are: the Federation; the Baltimore, Chicago, Detroit, Golden Gate, Houston, Kansas City, New England, New York, Pacific Northwest, Piedmont, Southern, Toronto, and Western New York Societies; and the Kansas City Paint & Coatings Association.

Mr. Modrak indicated that he is now in a position to enter into discussions with the Preservation Society and the Boston Landmarks Commission.

The inside story on tough long-lasting powder coatings.



2″ pipe coated inside with powder coating containing Modaflow®

Modaflow® is a dependable way to help improve the durability of your coatings.

For over 25 years, Modaflow® resin modifier has been helping to protect the coatings industry against coverage problems. Whether they are formulating liquid or powder coatings, paint chemists know they can depend on liquid Modaflow and Modaflow Powder II to virtually eliminate imperfections and help assure durable, long-lasting coatings.

Developed by Monsanto, the pioneer in acrylic flow aid technology, liquid Modaflow and Modaflow Powder II help promote flow and total coverage. And with Modaflow, coatings adhere better. So you get the kind of coverage that helps inhibit rust and corrosion, even in salty, acidic, wet environments.

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Surface Characteristics That Control the Phosphatability Of Cold-Rolled Steel Sheet

Shigeyoshi Maeda
Nippon Steel Corporation*

The factors that control phosphatability were investigated using various cold-rolled steel sheets with different manufacturing conditions. The contributing factors to the phosphatability were studied by Auger electron spectroscopy and secondary ion mass spectrometry from the view point of adsorption of nucleating agents (Ti-colloid and Ni^{2+} ion, both generally used in a commercial phosphate treatment) because the adsorption of the nucleators substantially controls the grain size of the phosphate coatings. A high steel surface carbon level leads to a coarse grain size of the zinc phosphate coating, resulting in poor paint performance. This result is attributed to a reduction of titanium adsorption. On the other hand, the surface manganese improves the phosphatability because, unlike the carbon, it increases nickel adsorption by increasing the activity of ferric oxide films on steel sheets. The effects of manufacturing conditions such as annealing on surface compositions are also discussed.

INTRODUCTION

Cold-rolled steel sheet, which is now widely used for car bodies and appliances, has a bright finished surface with an appropriate surface roughness to hold a lubricant and to prevent galling† during stamping. Any rust or oxidation tint (temper color) must be avoided since these materials are directly subjected to surface treatment (degreasing, conversion coating, and painting) after being stamped.

The surface of cold-rolled steel sheets is usually covered with carbon, iron particles, and other adhering contaminants.[1-7] Recent techniques for surface analysis, such as secondary ion mass spectrometry (SIMS or IMA), Auger electron spectroscopy (AES), and X-ray photoelectron spectroscopy (ESCA or XPS), have revealed that various elements, such as manganese, silicon, aluminum, and chromium are enriched in the surface layer as an oxide.[8-11] Many researchers have already shown that carbonaceous contaminants on the surface deteriorate subsequent conversion coating (phosphate treatment), with resultant poor corrosion performance after painting.[1-7] However, the function of carbon on phosphate crystal formation has not always been clarified, although the mechanism based on electrochemical inactivity of the carbon film has been proposed by Iezzi and Leidheiser.[7] Furthermore, the effect of other enriched elements like manganese and silicon on phosphatability has not been investigated.

In phosphatizing, titanium colloid and nickel ion are generally used as a nucleating agent in order to provide nucleating sites on the surface for grain refining. Titanium colloid is used prior to phosphating (immediately after degreasing) and nickel ion is added in the phosphate solution itself. The effect of nucleators (both titanium and nickel) is of great consequence when it is considered that paint performance is primarily governed by the grain refining of the phosphate film, but no particular attention has been paid to the function of the above nucleators to date. One exception is the work done by Claus and Wenz[12] in which they tried to determine the titanium adsorption with respect to surface cleanliness of steel, but unfortunately and quite curiously, titanium could not be detected by either AES or SIMS.

The objective of the present paper is to clarify the effect of surface composition including carbon on paint performance and to provide further insight into the phosphatability by investigating the relationship between deposition of nucleators (titanium and nickel) and steel surface composition.

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†Galling is surface damage caused by local welding as a consequence of friction between moving metal parts.

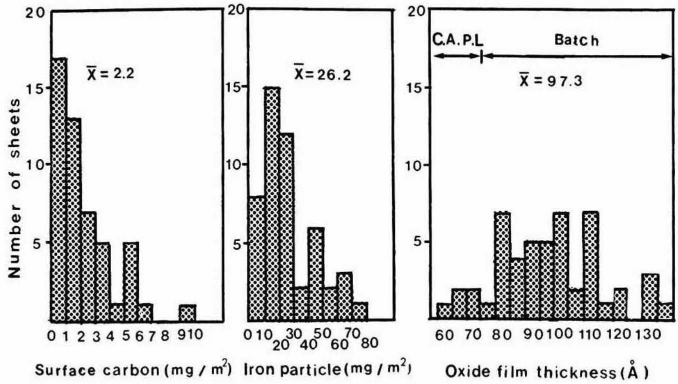

Figure 1—Surface cleanliness levels and oxide film thickness of cold-rolled steel sheets

EXPERIMENTAL

Materials

COMMERCIAL SHEETS: Fifty sheets of various compositions (Rimmed,** Al-killed,‡ and Si-killed steels) and different manufacturing conditions (with and without electro-degreasing, batch, and continuous annealing) were taken from various steel coils.

LABORATORY-ANNEALED SHEETS: Two typical types of sheets (Al-killed and Si-killed steels) were taken from coils prior to annealing in production line, and then subjected to laboratory annealing for 4 hr at 700°C in an atmosphere of N_2 containing 5% H_2 at different dew points (−40°C~ +20°C).

Measurement of Surface Contamination

Surface contaminants of the sheets include carbonaceous deposits and iron particles. A practical test to evaluate sheet cleanliness is the so-called tape test in which adhesive tape is applied to the steel surface and then peeled off. The degree of blacking of the tape is measured using a densitometer. The tape opacity was defined as 100% on transparent tape (obtained on white paper) and zero percent on black tape. To measure quantitatively the carbonaceous surface contaminant, the method proposed by Hospadaruk, et al.[2] was used in which the contaminant is removed by mopping with a glassfiber filter saturated with 50% HCl solution, and then, the total carbon content of the paper is measured in a combustion test.

**Rimmed steel is the steel in which the dissolved oxygen gas is removed from the liquid steel as CO_2 by a heat-convection-induced stirring (rimming action) during solidification.

‡ Killed steel is deoxidized by adding aluminum or silicon.

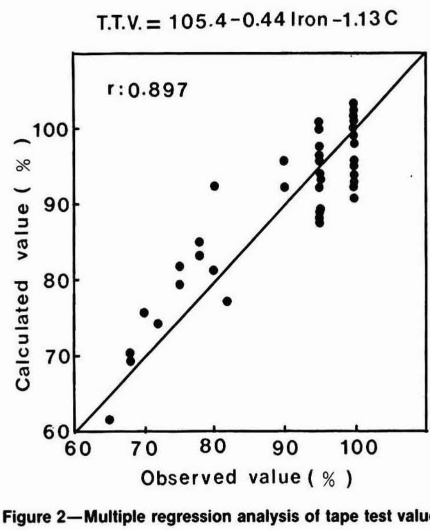

Figure 2—Multiple regression analysis of tape test values

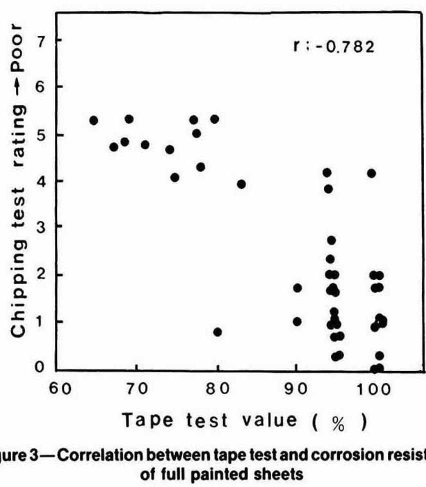

Figure 3—Correlation between tape test and corrosion resistance of full painted sheets

Analysis of Surface Layer

The oxide film thickness on the steel surface was measured by the ellipsometer and the surface composition was analyzed by AES and SIMS. Measuring conditions were as follows.

(1) *AES measurement*

Instrument:	SAM-590 (made by PHI)
Accelerating voltage of primary beam:	5 kV
Current of primary beam:	3.0×10^{-6} A
Modulating energy:	6 eV_{p-p}
Beam radius:	100 $\mu m\phi$
Vacuum:	6×10^{-10} torr

(2) *SIMS measurement*

Instrument:	IMA-Model II (made by HITACHI)
Accelerating voltage of primary beam:	12 kV
Current of primary beam:	2.2×10^{-7} A
Species of primary ion:	O_2^+
Diameter of primary ion beam:	1 $mm\phi$
Vacuum:	6×10^{-7} torr
Sputtering speed:	10Å/min (as Fe)

Phosphate Treatment and Coating

Both spray and immersion commercial zinc phosphate solutions were used to phosphate coat the various steel sheet panels. After being zinc-phosphated, the panels were electrocoated with an anodic primer by applying a constant voltage of 150 V, followed by baking for 20 min at 180° C, producing a dry film thickness of 20 μm. The primer coated sheets were scribed and subjected to a salt spray test (SST).

For cyclic corrosion test, full coated panels were used. After electrocoat, an alkyd resin surfacer was spray applied to a dry film thickness of 35 μm and baked for 30 minutes at 140° C, and then an alkyd resin topcoat was spray applied to 35 μm thickness and baked under the same conditions.

Table 1—Correlation Coefficients between Surface Enriched Elements and Paintability of Cold-rolled Steel Sheets (50 sheets)

Surface elements/ Performance	Phosphate crystal size	SST (480 hr) Creepback	SST (480 hr) Blistering
C (mg/m^2)	0.039	0.218	0.367[b]
C (AES)	0.055	0.178	0.304[b]
C^+ (SIMS)	0.135	0.251	0.385[b]
Si^+ (SIMS)	0.141	−0.065	−0.223
Mn^+ (SIMS)	0.363[b]	−0.329[a]	−0.347[b]
Al^+ (SIMS)	0.083	0.052	0.017
Cr^+ (SIMS)	0.141	−0.101	0.022
Ti^+ (SIMS)	0.158	−0.145	−0.225

(a) Significant at below the 0.05 probability unit
(b) Significant at below the 0.01 probability unit

Evaluation of Phosphatability And Paint Performance

To evaluate the porosity of phosphate film, two different methods were used: the ferroxyl test proposed by Cheever[13] and oxygen reduction method proposed by Zurilla and Hospadaruk.[14]

Paint performance was evaluated by salt spray test (SST) for primer-coated sheets and by cyclic corrosion

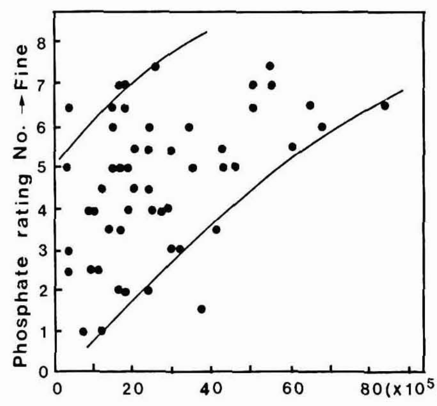

Figure 4—Effect of the surface enriched manganese on phosphate crystals formed on cold-rolled steel sheets

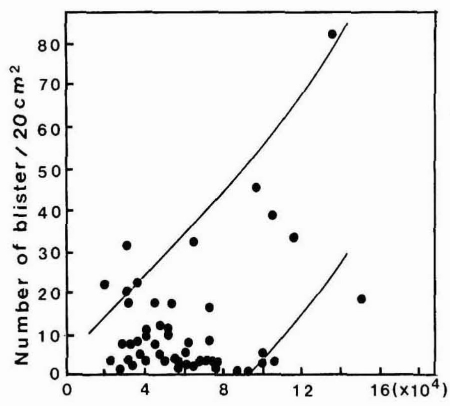

Figure 5—Effect of the surface carbon on blistering of the phosphated and painted sheets (SST, 480 hr)

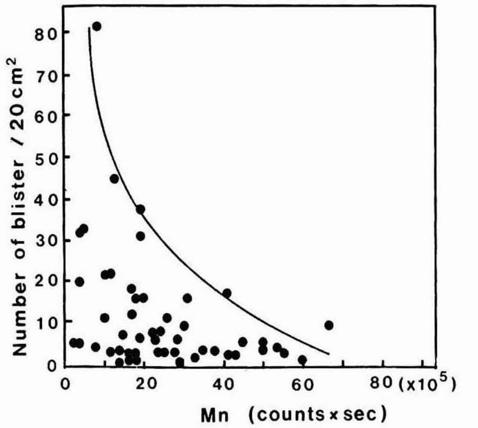

Figure 6—Effect of the surface manganese on blistering of the phosphated and painted sheets (SST, 480 hr)

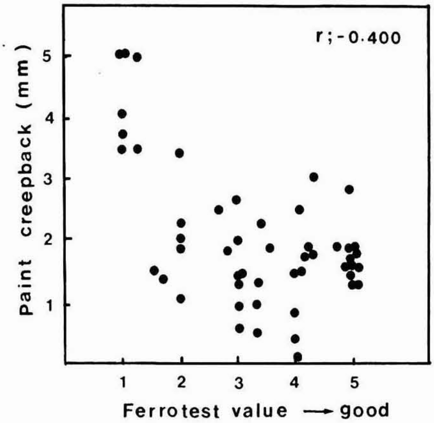

Figure 8—Relationship between ferroxyl test values for various phosphated sheets and salt spray creepback for the phosphated and painted sheets (SST, 480 hr)

test for full painted sheets. On salt spray test, paint creepback of the scribed marks and blistering besides the scribe (test area: $20cm^2$) were evaluated after 480 hr exposure. The cyclic corrosion test conditions were as follows.

(1) Immersed in warm water (38° C) for 5 days and air dried.

(2) Stone chipped by a drop method using steel nuts of ¼ in ϕ (panel angle: 45°, projection height: 4.5 m).

(3) Subjected to cyclic test (SST 3 days-outdoor exposure 4 days) for 4 cycles and SST 3 days.

(4) Air dried for 30 min and tape peel tested.

The corrosion performance was evaluated by chipping test rating (1–10 rating) after tape peel testing.

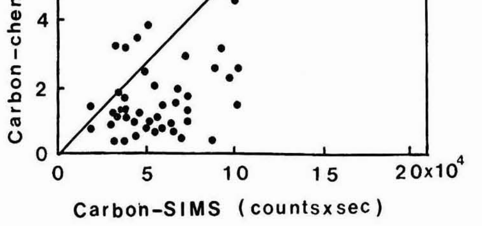

Figure 7—Correlation between chemically determined carbon and SIMS-carbon

Measurement of Nucleators Deposition

Deposition of the titanium on the steel surface was measured by AES and SIMS on the sample after pretreatment prior to zinc phosphating. The titanium pretreatment was carried out according to the standard procedure of phosphate treatment, in which the degreased panels were dipped in 0.1% solution of PN-Z (made by Nihon Parkerizing Co.) for 20 sec at room temperature, followed by warm water rinse (5 sec dipping).

In the case of nickel deposition, nickel chloride solution (0.6 g/L Ni^{2+}, pH 4.7) was used instead of the actual phosphating solution because the precipitated phosphate crystals inhibit the direct measurement of the deposited nickel. The deposited nickel was measured by AES on the sample after being dipped in $NiCl_2$ solution for 2 min at room temperature, followed by warm water rinse.

Measurement of Stability of Oxide Film On Steel Surface

It is known that the ferric oxide film (Fe_2O_3) on steel surface is removed by autoreduction phenomena when the steel sheet is immersed in a borate-HCl buffer solution.[15] The auto reduction reaction is described as follows.

Anodic reaction: $Fe = Fe^{2+} + 2e$

Cathodic reaction: $Fe_2O_3 + 3H_2O + 2e = 2Fe^{2+} + 6OH^-$

The autoreduction time is used for estimating the oxide film stability.[16] Since the ferric oxide films have more noble potential than iron, the autoreduction time can be determined by measuring the potential change which occurs when the oxide film dissolves into solution.

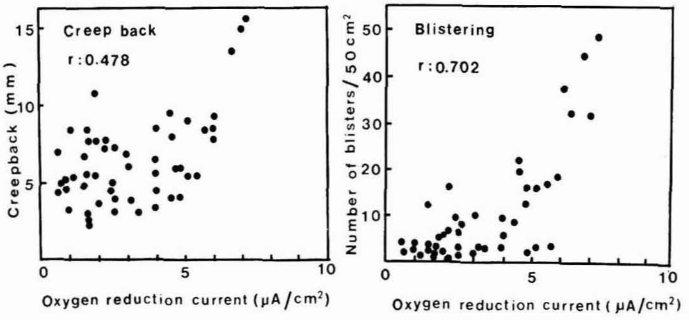

Figure 9—Relationship between oxygen reduction current measured for various phosphated sheets and salt spray performance for the phosphated and painted sheets (Left: *scribe creepback, right:* blisters besides scribe, SST, 480 hr)

RESULTS AND DISCUSSION

Surface Cleanliness and Paintability

Figure 1 summarizes surface carbon, iron particle level, and oxide film thickness of 50 sheets. The average carbon value was 2.2 mg/m^2 (0.20 mg/ft^2) and over 96% of the sheets passed the carbon limit indicated by Hospadaruk, et al.,[2] as a dividing point between clean and dirty steel (0.65 mg/ft^2). When comparing batch annealing (B.A.) with continuous annealing (Continuous Annealing and Processing Line, C.A.P.L.), the average values of carbon and iron particles were smaller in C.A.P.L. than in B.A. (2.4 mg/m^2 of carbon and 27.2 mg/m^2 of iron particles in B.A. but 1.0 mg/m^2 of carbon and 17.2 mg/m^2 of iron particles in C.A.P.L.). One of the reasons is that C.A.P.L. materials are electrodegreased before annealing but B.A. includes the materials with and without electrodegreasing. *Figure* 1 also shows that the average of the oxide film thickness is about 100Å and is thicker in batch annealing then in continuous annealing (C.A.P.L.).

Sheet cleanliness by tape test is said to be determined by carbonaceous contaminant and iron particles. This was proved by the multiple regression analysis for tape test values as shown in *Figure* 2. The multiple regression equation induced by the amounts of carbon and iron particles is expressed as follows:

$$\text{T.T.V. (Tape Test Value)} = 105.4 - 0.44\ \text{Iron}\ (mg/m^2) - 1.13C\ (mg/m^2) \quad (1)$$

In *Figure* 2, the ordinate indicates the calculated values from carbon and iron particles according to equation (1) and the abcissa is the actual tape test values. A high correlation coefficient (r:0.897) between calculated and observed values and an intercept constant (105.4) close to 100 (corresponds to clean surface) prove that the tape cleanliness is substantially determined by surface carbon and iron particles.

Figure 3 shows the correlation between tape test values and corrosion performance of the full painted sheets. The corrosion resistance of the full painted samples is clearly improved with increasing surface cleanliness of the sheets.

To clarify the influence of surface composition including carbon on paintability, the chemical composition determined by SIMS and AES were compared with salt spray performance of electrocoated sheets (primer alone) and phosphate crystal size. The statistical analysis results (correlation coefficient) are shown in *Table* 1. Here, the steel surface composition was analyzed for carbon, silicon, manganese, aluminum, chromium, and titanium. The concentration of these elements determined by SIMS was represented as integrated values (counts × sec) from top to 150Å in depth, but the carbon by AES is represented as atomic concentration. Although the correlation coefficients are not high, the surface carbon, regardless of the measuring method, has an adverse effect on salt spray performance, particularly on blistering. The statistical analysis also revealed that surface manganese improved the corrosion performance, which was supported by the fact that manganese makes the phosphate crystals finer and more dense, as shown in *Figure* 4. *Figures* 5 and 6, respectively, show the effect of the carbon and manganese on salt spray performance. A similar result for manganese salt spray test was also reported by Westberg and Barjessen,[17] but they state that, in an exposure test, the manganese does not always have a good effect on corrosion performance. The cause of this discrepancy has not yet been clarified. However, some car makers strongly demand a finely grained phosphate coating since they have abandoned chromate sealing (rinse) after phosphating on the grounds of health and pollution concerns. Therefore, as far as the phosphatability is concerned, surface manganese is considered to be a desirable element. The functions of surface carbon and manganese on phosphatability will be discussed later. *Figure* 7 shows the relationship between chemically determined carbon and SIMS carbon. A reasonably good correlation was obtained between these tests.

Evaluation Methods for Phosphate Coating

It is generally agreed that a "good" phosphate coating is not dependent on its quantity (coating weight) but on its quality which involves finely grained phosphate crystals (less porosity). The simplest and best known test for evalulating porosity is the ferroxyl test (Ferrotest) developed by Cheever.[13] *Figure* 8 shows the relation between ferroxyl values and salt spray creepback for

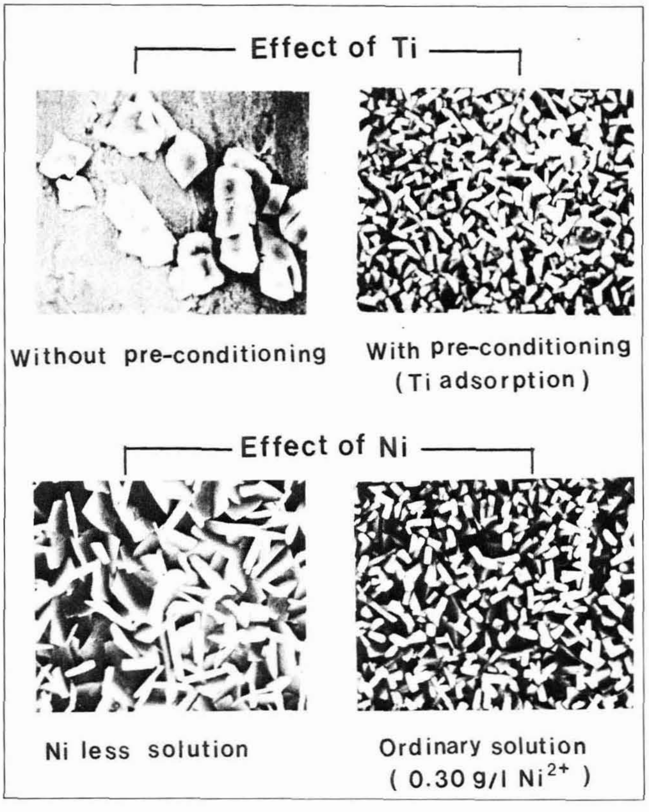

Figure 10—Effect of surface activator (Ti colloid) and nucleating agent (Ni ion) on phosphate crystal formation

primer coated sheets. There exists a fairly good correlation between them but the data are considerably scattered.

A method proposed in recent years is measurement of current density for oxygen cathodic reduction in an alkaline solution,[14] which is based on the assumption that oxygen can be cathodically reduced only on a bare steel area (pores in phosphate film). The results of the oxygen reduction current measurements are shown in *Figure* 9. In this case, salt spray performance was evaluated, respectively, by creepback from scribe marks and blistering besides the scribe marks. The oxygen reduction current appears to correspond better to blistering than to scribe creepback.

Factors Controlling Phosphatability

As is well known, the phosphate reaction is initiated by iron dissolution by phosphoric acid; as a result of hydrogen ion consumption, zinc phosphate crystals precipitate at the local cathodes on the iron surface. Therefore, the reaction is essentially electrochemical. However, it should be noted that nucleating agents such as titanium salts and nickel are generally used in commercial phosphatizing to provide finely grained phosphate film. *Figure* 10 shows the extent to which the titanium and nickel affect grain refining of the phosphate coating. It can be seen that the crystal grain becomes very coarse without chemical activation (titanium colloid treatment) and nickel ions in phosphate solution. This result shows that both titanium and nickel substantially control the grain size. Therefore, the main concern now is with investigating the role of the nucleating agent with respect to phosphatability. *Figure* 11 shows an AES spectrum of the sample after chemical activation (titanium treatment). *Figure* 12 shows the relation between surface carbon and adsorbed titanium determined by AES. For this measurement, samples with a wide range of surface cleanliness were selected. The result clearly shows that surface carbon inhibits the titanium adsorption and thereby deteriorates the phosphate coating. The reason that Claus, et al., could not detect the titanium may be due to a difference in the chemical activation agent used.

Unlike titanium adsorption, nickel deposition is closely related to stability of the ferric oxide film on steel sheet. *Figure* 13 shows the effect of autoreduction time of the oxide films on nickel deposition. The shorter the autoreduction time, the greater is the nickel deposition.

As shown in *Figure* 14, the autoreduction time is mainly dependent on manganese and decreases with

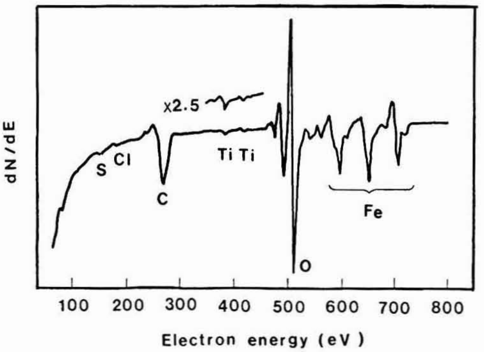

Figure 11—Auger spectrum of the sheet chemically activated by titanium salt solution

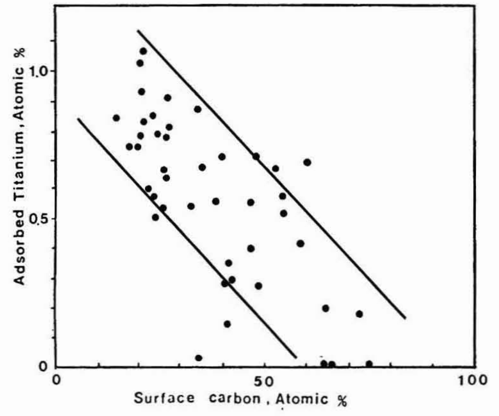

Figure 12—Relationship between titanium adsorption and surface carbon of various cold-rolled steel sheets (Al killed steel)

increasing surface manganese. It is well known that the autoreduction is essentially governed by the anodic defects present in the oxide film and not by the oxide film thickness.[16] Accordingly, the manganese contributes to form the anodic defect in the oxide film and makes the oxide film unstable. As is well known, nickel ions precipitate on steel surface by a substitution reaction ($Ni^{2+} + Fe = Ni + Fe^{2+}$) due to a potential difference between nickel (−0.23 V vs NHE at standard state) and iron (−0.44 V vs NHE). Ferric oxide film (Fe_2O_3) on steel surface, however, has extremely noble potential (for example; 0 ~ −0.1 V vs NHE) and therefore, the nickel can not precipitate not so far as the ferric oxide is removed. It is therefore quite reasonable that nickel deposition is increased with a decrease in autoreduction time (increase in anodic defects). However, the limitations of these considerations should be kept in mind because the nickel deposition experiment is simulated by nickel chloride solution.

An increase in manganese content in steel also causes an increase in manganese sulfide (MnS) as a result of the reaction of Mn + S = MnS in steel, where sulfur is entrapped in steel as impurity. It is well known that the manganese sulfide functions as an anodic depolarizer and thereby accelerates the dissolution reaction in acid media and results in good phosphatability.[17] As reported before,[19] the manganese increases surface manganese (MnO) and also inhibits the graphitization. Therefore, it can be concluded that the manganese in steel is a beneficial element for phosphatizing.

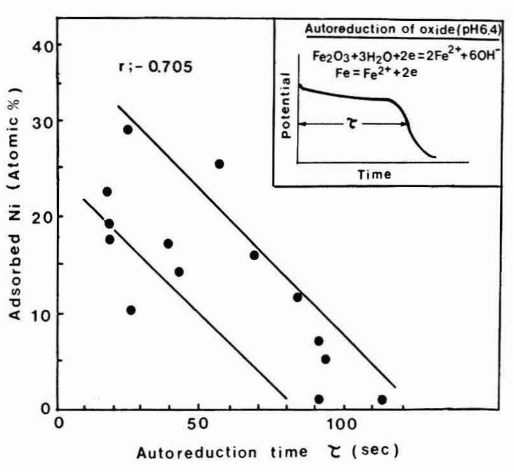

Figure 13—Relation between autoreduction time of the ferric oxide films (in pH 6.4 borate buffer solution) and Ni deposition from $NiCl_2$ solution

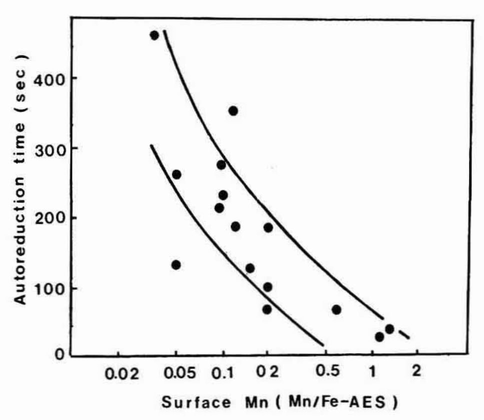

Figure 14—Effect of surface manganese on the autoreduction time of the ferric oxide films

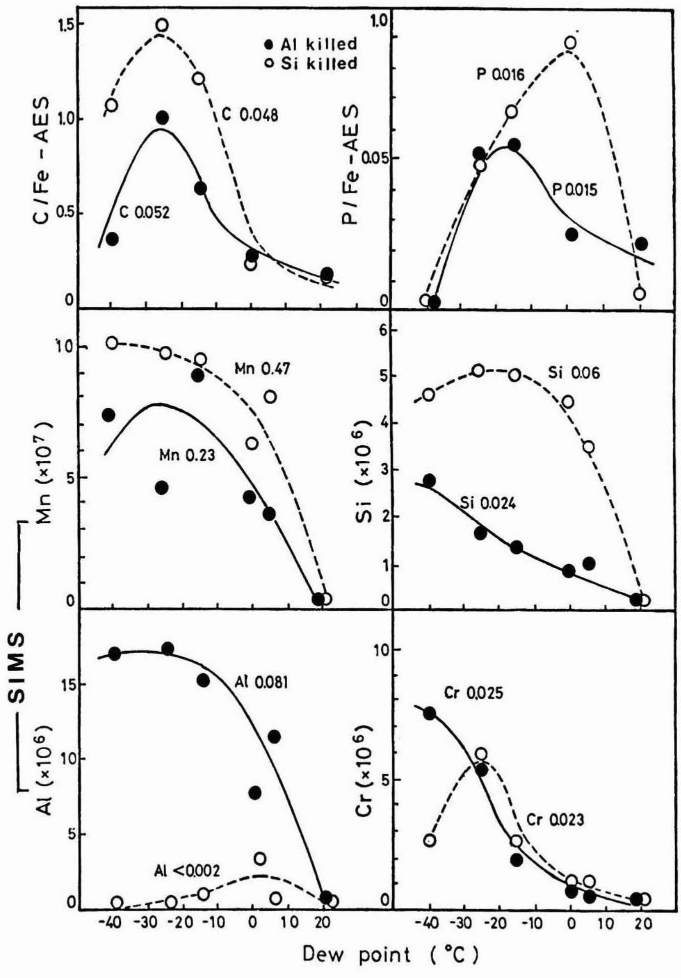

Figure 15—Effect of the dew point of 5% $H_2 - N_2$ gas on the surface enrichment of various elements (annealed at 700° C, 4 hr)

Surface Segregation and Its Control By Manufacturing Conditions

The surface carbon is believed to originate from residual rolling oil, deposition of gas component, and graphite formation. To minimize the surface carbon, electrodegreasing in alkaline (orthosilicate) solution prior to annealing and change to HNX gas ($H_2 - N_2$) from DX gas (CO, CO_2, H_2 and N_2) are widely adopted at production sites. However, the electrocleaned and HNX gas annealed coils are occasionally contaminated by graphite carbon which is attributed to the decomposition of carbide (cementite, Fe_3C) present in the vicinity of the steel surface.[19,20] The graphite formation can be inhibited by adding elements like manganese and chromium which stabilize cementite at high temperatures. An increase in sulfur content in steel or application of sulfate coating prior to annealing is another effective method to inhibit the graphitization. Recent work of the authors has revealed that silicon in steel remarkably facilitates the surface carbon segregation and thereby leads to poor phosphatability.[19]

Other surface enriched elements observed besides carbon are manganese, silicon, aluminum, chromium, phosphorus, etc. Enrichment of these elements is believed to be due to preferential oxidation by gas reaction in a protective atmosphere. Since the above elements have a higher affinity for oxygen than iron, they segreate to the surface where they are present as oxides. With regard to silicon, its origin is also from the orthosilicate bath. In HNX gas atmosphere, whether or not the oxidation occurs depends on the ratios of P_{H_2O} and P_{H_2} which correspond to the equilibrium $x M + yH_2O = M_xO_y + yH_2$ at the annealing temperature.[9] *Figure* 15 indicates the dependency of surface of enrichment on H_2O content (represented as dew point) in the atmosphere of 5% H_2 –

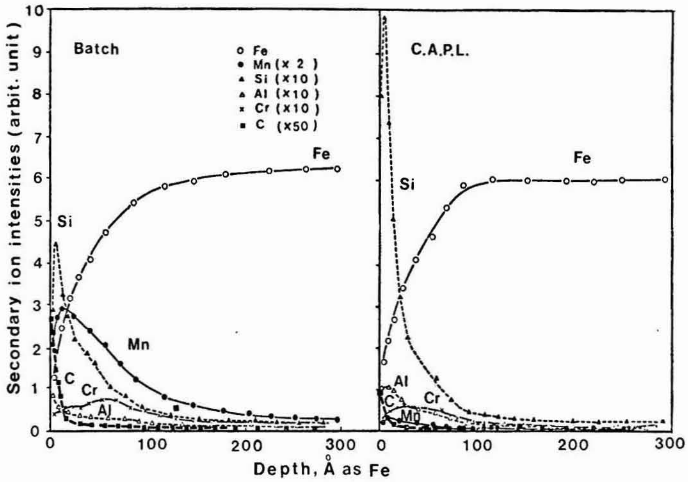

Figure 16—SIMS in-depth profiles of the surfaces on batch and continuously annealed materials. (Both sheets were electrodegreased prior to annealing)

N_2. It can be seen that a maximum enrichment exists at a specific dew point for all elements involved and that it is difficult to prevent such elements as manganese, silicon, and aluminum from oxidizing even though the dew point is below −40° C (except +20° C at which substrate iron is oxidized). In order to prevent the graphitization, it is useful to keep the dew point at about 0° C (20° C of dew point leads to the oxidation tint of the sheet). One possible procedure for reducing the enrichment is to use the time-saving C.A.P.L., which also has the advantage of reducing the surface carbon by gas cleaning action since the free surface of the steel strip can interact more freely with the protective gas in the continuous annealing than in the batch annealing. In addition, an electrodegreasing section is equipped at entry section of the C.A.P.L. *Figure* 16 compares the surface composition between batch and continuously annealed sheets. Surface segregation of the elements except silicon is greater in B.A. than in C.A.P.L. since annealing time of B.A. is longer than that of C.A.P.L. (soaking time; 6 hr in B.A. and 5 min in C.A.P.L.). The major part of the segregated silicon originates from the orthosilicate in the degreasing bath, and it appears as a back-diffusion of silicon into bulk on B.A. material.

CONCLUSION

There are several factors which influence paint performance of cold-rolled steel sheets. One major factor is the surface cleanliness which is affected by both carbonaceous contaminants and iron particles. The carbon, in particular, leads to an increase in porosity for zinc phosphate coatings, resulting in poor paint performance. The carbon originates from the breakdown of residual rolling oils left on the steel surface and from the decomposition of cementite in the vicinity of the surface layer during annealing. The carbonaceous residue can be minimized by using an electrodegreasing process prior to annealing. C.A.P.L. is more advantageous for surface cleanliness due to its gas cleaning action. Another factor contributing to phosphatability is surface manganese which is enriched in steel surface by preferential oxidation during annealing. The manganese makes phosphate coating denser, leading to improved paint performance.

Grain refining of the phosphate coatings is greatly dependent on adsorption of titanium and nickel used in the treatment as nucleating agents. Surface carbon inhibits the titanium adsorption, resulting in a coarse grained phosphate. Nickel deposition is mainly controlled by stability of ferric oxide films on steel surface. Surface manganese makes the oxide films unstable, with resultant higher nickel deposition, exhibiting good phosphatability.

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Particle Packing Analysis Of Coatings Above the Critical Pigment Volume Concentration

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Juan Caprari, and Monica Damia
CIDEPINT*

Dry film densities are determined by hydrostatic weighing; the method is rapid, precise, and can be applied on real films. The experimental data for films constituted by zinc, zinc oxide, or aluminum as pigment, and a mixture of chlorinated rubber plus chlorinated paraffin as binder are reported and interpreted by a packing model. This model predicts the existence of two characteristic points in the plots of film properties against PVC: the CPVC, defined in 1949 by Asbeck and Van Loo, and a point of maximum film porosity designated CPVC*. There is a nonlinear decrease in film density between the two points. A method for their location is proposed.

INTRODUCTION

Extensive experimental research performed during the last 30 years has led to the universal recognition of the importance of the volumetric relationship between pigment and binder in the determination of paint film properties. Consequently, the formulation in terms of weight relationship, usual at the early period of the paint industry, has been substituted for volume relationships. The most common of these is the pigment volume concentration, PVC, and is defined by

$$PVC = \frac{V_p}{V_p + V_b} \qquad (1)$$

where V_p is the pigment volume and V_b the volume of binder.

In 1949, Asbeck and Van Loo[1] demonstrated that there is a critical pigment volume concentration, the CPVC, above and below which many of the physical properties of paint films show dramatic changes. The CPVC corresponds to the pigment volume concentration at which the binder just fills the voids between the packed pigment particles. The method proposed by Asbeck and Van Loo for its determination depends on the measurement of the volume of a filter cake of pigment and binder containing a known pigment volume. However, the packing of pigment particles in liquid paints can be quite different from that in dry films, especially with non-spherical particles. The estimation of CPVC from oil absorption[2] is affected by the same limitation.

Changes in dry film properties can be used to determine its CPVC value.[3,4] Film density is the property most closely associated with CPVC, and the densities of dry films have been measured by means of two experimental procedures. The method proposed by Cole[5] consists of painting a piece of a tungsten rod (a metal denser than mercury) and weighing it successively in air and in mercury. Pierce and Holsworth[6] determined the volume of paint films stripped from Teflon-coated metal sheets by cutting 3×1 in. pieces using a microscope slide as a template and measuring their thickness using a micrometer reading to 10^{-4} in.

Film density determination by water immersion method are reported in this paper. The formulation can be studied on the support material for which it was projected, the conditions being closer to reality than in stripped film or on a tungsten surface; the only obvious limitation is imposed by the eventual hygroscopicity of the film.

Density data obtained for three different pigment-binder combinations on a broad range of PVC values are discussed in terms of a packing model that accounts for density changes from PVC = 0 to PVC = 1. Both the model and the experimental data point to a nonlinear density-PVC relationship above the CPVC, and to the existence of a new characteristic point.

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Nomenclature

V_p: pigment volume
V_b: binder volume
d: pigment particle diameter
a: adsorbed layer thickness
V_a: air volume
ϕ': film packing factor
ϕ: pure pigment packing factor
ρ_b: pure binder density
ρ_p: pure pigment true density
ρ: film density
W_p: pigment weight fraction
P: film porosity

MODEL DESCRIPTION

The first characteristic point on a plot of film properties against pigment concentration will be that corresponding to PVC = 0, that is a pure binder film (*Figure* 1 a). As pigment is introduced into the system, a given quantity of binder will be strongly adsorbed on the surface of the particles. Along this region (Region I), the system may be imagined as constituted by pigment particles covered by the adsorption layer, dispersed in a free binder medium (*Figure* 1 b). An additional assumption of this model is that the thickness of the adsorption layer is independent both of the particle size and of the

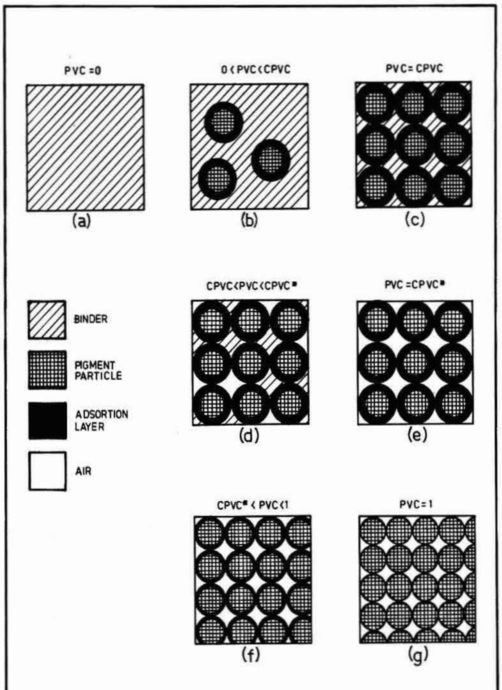

Figure 1—Schematic of the different stages in the packing of homogeneous, spherical particles

PVC, depending only on the chemical properties of the pigment surface and of the binder molecules.

With increasing pigment concentration, the mean distance between particles will decrease, until the point of maximum packing density is reached. This is the second characteristic point on the plot of film properties against PVC, and corresponds to the Critical Pigment Volume Concentration of Asbeck and Van Loo (*Figure* 1 c). At this point, the particles will be in contact through their adsorption layers, and the free binder just fills the voids between particles. The evidence of the existence of an adsorption layer is found in the comparison of experimental CPVC values with the packing factors of dry particles. A survey of the literature[7] indicates CPVC values between 0.35 and 0.75, while the minimum packing factor (corresponding to a randomly packed bed of spherical particles of uniform size) is 0.64. This value increases with particle size differences. The adsorbed layer prevents particle-to-particle contacts, and the packing factors attainable in paint films are smaller than those corresponding to dry pigment beds.

PVC increments above the CPVC cannot promote closer particle approach. The system does not contain binder enough as to fill the voids between particles, and this volume difference is occupied by air. The appearance of this new phase in the system characterizes its entrance into Region II (*Figure* 1 d). It is an assumption of this model to suppose that the adsorbed layer remains unaffected along this region, and that the rise in film porosity with increasing PVC is made exclusively at the expense of the free (interparticle) binder.

A point will be reached in which air fills all the voids between particles, and all of the binder in the system is allocated in the adsorption layer. This is the third characteristic point of the system, henceforth designated as CPVC* (*Figure* 1 c). According to the assumptions of this model, the adsorption layer in this point will be identical to that in the CPVC.

Further increments in the PVC are made at the expense of the adsorption layer, whose thickness will lessen with each pigment increment. The film has entered into Region III (*Figure* 1 f) where its porosity will not suffer large variations, as the point of larger porosity was reached at the CPVC*. This region has its theoretical end at PVC = 1, the fourth characteristic point of the system, where it will rarely exist as a film (*Figure* 1 g).

Latex coatings are not covered by this model. Latex vehicles are suspensions of discrete spheres whose particle size range may be close with that of the pigment. The vehicles of the paints studied in the present paper are solutions of binder in solvent. Patton[3] has discussed the differences between both packing mechanisms.

FILM DENSITY AS A FUNCTION OF PVC

At different points of this section, with the aim of a better visualization, reference will be made to an ideal system. Such a system is constituted by spherical particles of a uniform diameter, d, distributed uniformly throughout the film according to a cubical packing arrangement. The addition of binder does not modify the particles spatial distribution, but these will now be covered by an adsorbed layer of uniform thickness, a. Systems of practical interest can be quite distant from this ideal one; a double parenthesis in the number corresponding to an equation means that it is valid only for the ideal system.

The film packing factor will be symbolized in general as ϕ', and is defined by the equation

$$\phi' = \frac{V_p}{V_f} \tag{2}$$

V_f is the film total volume, equal to $V_p + V_b + V_a$, where V_a is the air volume in the film. The symbol ϕ will represent the pure pigment packing factor. The relationship between ϕ' and ϕ can be highlighted by means of the ideal system: a cubic bed with n spheres of uniform diameter, d, on each edge, distributed according to a cubical packing arrangement, will contain a total of n^3 spheres; the pigment volume will, therefore, be $n^3 (\pi d^3/6)$. When the bed is composed by pigment particles only, the length of the edge of the cube will be nd, and the packing factor ϕ can be written

$$\phi = \frac{n^3 (\pi d^3/6)}{(nd)^3} = \pi/6 \qquad ((3))^*$$

However, when each particle is covered by an adsorption layer of thickness a, the length of the cube edge will be n(d + 2 a) and the packing factor, ϕ', may be expressed

$$\phi' = \frac{n^3(\pi d^3/6)}{[n(d+2a)]^3} = \phi \left(\frac{d}{d + 2 a}\right)^3 \qquad ((4))$$

The mass (m) of the film can be expressed by

$$m = V_p \rho_p + V_b \rho_b = (V_p + V_b) [\rho_b + (\rho_p - \rho_b) PVC] \tag{5}$$

where ρ_b is the pure binder density and ρ_p the pure pigment (true) density. By combining equations (5) and (2), it is possible to obtain a general equation for the film density, ρ:

$$\rho = \frac{\phi'}{PVC}[\rho_b + (\rho_p - \rho_b) PVC] \tag{6}$$

Differences in the quotient ϕ'/PVC account for differences in the ρ-PVC relationship in the different system regions sketched in the former section.

PVC = 0—The result for a pure binder film is obvious: $\rho = \rho_b$.

REGION I: *0 < PVC < CPVC*—Along this region all of the film volume is occupied by the binder and by the pigment particles; thus, from equations (1) and (2),

$$\phi'_I = \frac{V_p}{V_p + V_b} = PVC \tag{7}$$

where the suffix I has been added to the packing factor symbol ϕ' to emphasize that equation (7) is valid only within Region I. The general film density equation (6) is reduced to

*Equations indicated in double parenthesis are valid only for the "ideal system": a bed of spherical particles of uniform diameter, spaced according to a cubical arrangement. The remaining equations are not limited to this system, but can be applied to the described model. This is obviously more general than the ideal system.

Table I—Variation in the Packing Fraction Of a Given Distribution of Spherical Particles Caused by a Constant Increment in the Particles Diameter (Arbitrary Units)

Original Distribution		Incremented Diameters	
Volume Fraction	Particle Diameter	Increment = 1	Increment = 2
0.05	1	2	3
0.10	2	3	4
0.20	3	4	5
0.30	4	5	6
0.20	5	6	7
0.10	6	7	8
0.05	7	8	9
Packing Fraction	0.663	0.652	0.649
Percent Variation	—	−1.6	−2.1

$$\rho_I = \rho_b + (\rho_p - \rho_b) PVC \tag{8}$$

indicating a linear relationship between ρ and PVC.

PVC = CPVC—The considerations leading to equation (7) are still valid at this transition point, and the system CPVC value is equal to the film packing factor ϕ' at this point. For an ideal system, from equation ((4)), it is possible to write

$$CPVC = \phi \left[\frac{d}{d + 2 a}\right]^3 \qquad ((9))$$

REGION II: *CPVC < PVC < CPVC**—Once the pigment particles have reached the arrangement of maximum approach allowed by their adsorption layers, further increments in pigment concentration provoke the displacement of binder by air. However, the thickness of the adsorption layer (and therefore the mean distance between particle centers) remains unaffected. Consequently, the packing fraction within this region, ϕ'_{II}, retains the value attained at the CPVC, i.e.

$$\phi'_{II} = CPVC \tag{10}$$

When this expression is introduced in equation (6), the relationship between film density and PVC along Region II is obtained:

$$\rho_{II} = (\rho_p - \rho_b)\ CPVC + \frac{\rho_b\,(CPVC)}{PVC} \tag{11}$$

This indicates a nonlinear fall in film density.

*PVC = CPVC**—When all of the interparticle binder has been substituted by air, the binder remaining in the system is forming the adsorption layer. Designating this binder volume at the CPVC* as V_c^*, it is possible to write:

$$CPVC^* = \frac{V_p}{V_p + V_c^*} = \frac{1}{1 + \frac{V_c^*}{V_p}} \tag{12}$$

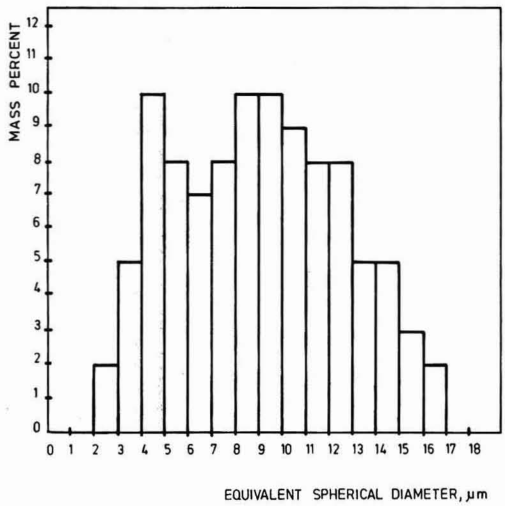

Figure 2—Particle size distribution of zinc

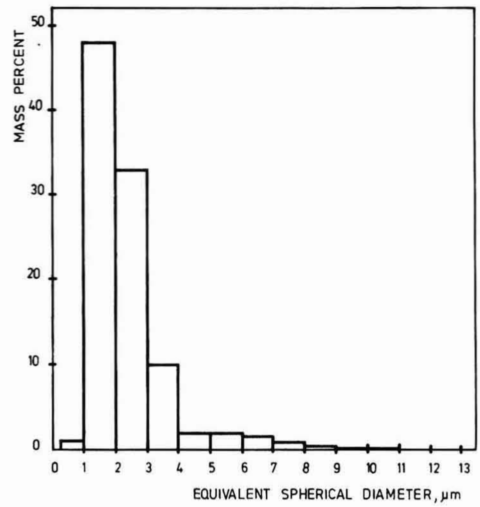

Figure 3—Particle size distribution of zinc oxide

For an ideal system,

$$\frac{V_c^*}{V_p} = \left[\frac{d + 2a}{d}\right]^3 - 1 \qquad ((13))$$

Combining equations (12), ((13)) and ((9)), it is possible to write:

$$CPVC^* = \frac{CPVC}{\phi} \qquad ((14))$$

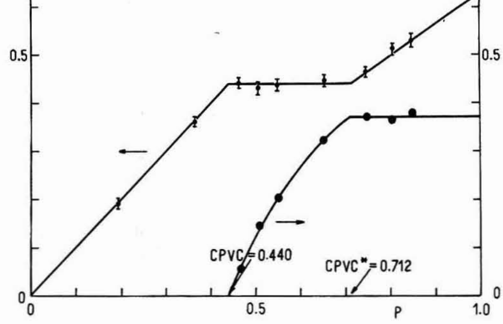

Figure 4—Linearized plots of film packing factor (ϕ') and porosity (P) against PVC, for zinc particles

REGION III: *CPVC* < PVC < 1*—Any increase of the pigment concentration above the CPVC* implies a decrease of V_c, the volume at the adsorbed layer, a parameter that was considered as a system constant up to this point. Within this region,

$$\frac{\phi'_{III}}{PVC} = \frac{V_p + V_c}{V} \qquad (15)$$

It is possible to gain an idea about the variation of this quotient along Region III by considering it as the packing factor of particles whose diameter is d + 2a. The results of such a calculation starting with a particle size distribution resembling that of our zinc oxide sample and incrementing the particle diameter in 1 and 2 units have been gathered in *Table* 1. The calculations were performed by means of a computer program that follows the original Lee[8] analytical method, and make evident that very large variations in the layer thicknesses provoke only minor changes in the packing factor of the spheres made up of pigment particles and their coatings. Consequently, the quotient in equation (15) is going to remain practically constant along Region III. This result together with the general equation (6), predict an almost linear increment in film density for this region.

For the ideal system, using equation ((4)) and ((13)),

$$PVC = \frac{1}{1 + \frac{V_c}{V_p}} = \left[\frac{d}{d + 2a}\right]^3 = \frac{\phi'_{III}}{\phi} \qquad ((16))$$

where a is now a decreasing thickness. Combining this result with equation (6),

$$\rho_{III} = \phi\,[\rho_b + (\rho_p - \rho_b)\,PVC] \qquad ((17))$$

PVC = 1—Finally, at the last characteristic point $\phi' = \phi$ and $\rho = \phi\,\rho_p$.

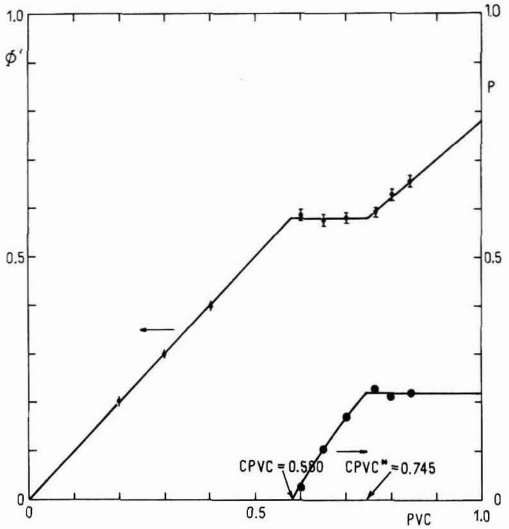

Figure 5—Linearized plots of film packing factor (ϕ') and porosity (P) against PVC, for zinc oxide particles

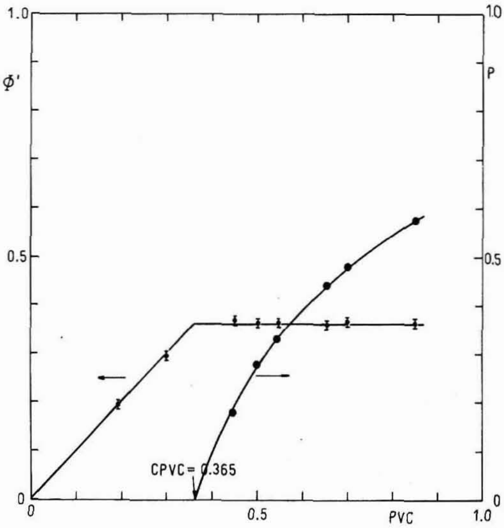

Figure 6—Linearized plots of film packing factor (ϕ') and porosity (P) against PVC, for aluminum particles

PLOTS LINEARIZATIONS AND FILM POROSITY

Plots of film density against PVC are nonlinear along Region II. Unless a large number of experimental data is available, the location of the characteristic points will be difficult. A method of linearization would be useful and is easily accomplished through the introduction of the pigment weight fraction, W_p:

$$W_p = \frac{\rho_p V_p}{m} = \frac{\rho_p V_p}{\rho V} = \phi' \frac{\rho_p}{\rho} \tag{18}$$

A plot of $\rho W_p / \rho_p = \phi'$ against PVC will display the following behavior:

(1) $0 < PVC < CPVC$: a straight line with unitary slope (equation (7)).

(2) $CPVC < PVC < CPVC^*$: a straight line, parallel to the abscissa axis, and intercepting the ordenate axis at $\phi' = CPVC$ (equation (10)).

(3) $CPVC^* < PVC < 1$: an almost straight line with a slope $(V_p + V_c)/V \simeq \phi$ (equations (15) and ((16)), respectively).

As the extreme values both of ϕ' and PVC are 0 and 1, this type of plot has the additional advantage of being normalized.

Film porosity, P, can be defined by,

$$P = \frac{V_a}{V} = \frac{V - (V_p + V_b)}{V} = 1 - \frac{\phi'}{PVC} \tag{19}$$

EXPERIMENTAL

The Films

Three different pigments were studied, chosen due to their importance in formulations with high solids concentrations. An analysis performed on zinc (nodular particles) with a Sedigraph *5000** revealed the equivalent spherical diameter distribution sketched in *Figure* 2. In

*Micromeritics Instrument Co., Norcross, GA.

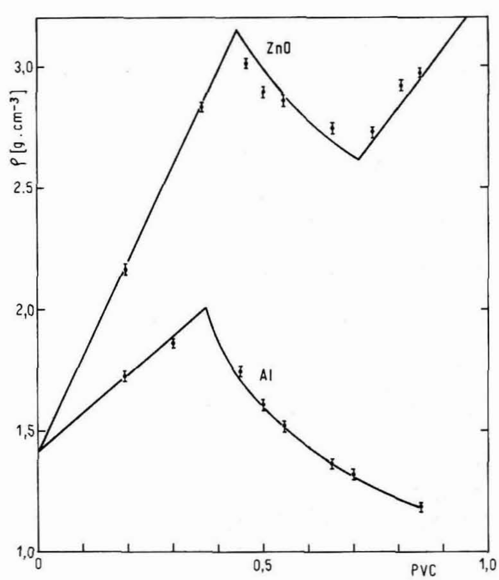

Figure 7—Film density against PVC for zinc oxide and aluminum films

Figure 3, the results of a similar analysis performed on the second pigment, zinc oxide, have been represented; zinc oxide particles were acicular. The particles of the third pigment, aluminum, were laminar; measurement by microscopy indicated that 90% of them were smaller than 21 μm, 6% ranged between 21 and 42 μm, and 4% had diameters between 42 and 54 μm.

A mixture ratio of 10:1, weight by weight, of chlorinated rubber (20 cp) and chlorinated paraffin (42% of chlorine) was used as the binder. The solvent mixture (composed by equal volumes of toluene and xylene) was chosen so as to obtain a dry-to-touch time longer than 15 minutes for 50 μm film thickness. The preparations were performed in a Cowles disperser, under the constant conditions of 20 minutes at 1250 rpm, at a temperature lower than 40°C. After an aging period of 48 hours, all the preparations were adjusted to the same viscosity by addition of the mentioned solvents mixture.

Prior to painting, each system was mechanically stirred at 200 rpm for 20 minutes. The application was performed by brushing on both faces at 60 mm × 30 mm × 1.5 mm stainless steel sand-blasted panels that were kept flat until dry. Each preparation was applied on 15 panels.

Density Measurements

Hydrostatic weighing constitutes a very rapid and efficient method to determine the density of solids. In the case of a film applied on the surface of a metallic panel, the film density can be calculated through the following equation:

$$\rho = \rho_w \frac{\Delta W_A}{\Delta W_A - \Delta W_w} \qquad (20)$$

where,

ΔW_A = difference between the weights of panel plus film and nonpainted panel in air.

ΔW_w = difference between the weights of panel plus film and nonpainted panel in water.

ρ_w = density of water.

The weighings were performed on a Mettler H 20 balance, reading to 0.01 mg. No trend to weight increase with time could be detected during the determinations in water for periods of up to one hour. This can be interpreted both as a nonpenetration of water in the film voids or as an instantaneous penetration, with only a remote possibility of the latter in face of the hydrophobic nature of the binder. The percent standard deviation of the results obtained for a given formulation was of 0.25% as a maximum.

Pigment densities were measured by ASTM Method D153, variant B, and the results (in g/cm^{-3}) were: 6.68 for Zn, 5.37 for ZnO, and 3.00 for Al.

RESULTS

Figures 4, 5, and 6 are linearized plots of our experimental results with zinc, zinc oxide, and aluminum, respectively. The straight lines for Regions I and II were drawn following the criteria mentioned in plots linearization; an ideal system was assumed for Region III. The vertical lines at each experimental point are an estimate of our experimental error. Porosities, calculated through equation (19), are plotted on the same figures.

Figure 7 is a direct representation of the experimental data for zinc oxide and aluminum. The lines were drawn using equation (8) for Region I and equation (11) for Region II; an ideal system was again assumed for Region III. The necessary values of PVC and CPVC* were taken from the linearized plots.

The behavior of the formulations containing zinc or zinc oxide as pigment follow the predictions of the packing model. The ideal system provides a good interpretation for the experimental results in Region III.

No CPVC* characteristic point was detected for paints containing aluminum. However, the plots of density against PVC are markedly nonlinear above the CPVC, and the experimental points fall on the plot drawn by means of equation (11) using the experimental values of ρ_p, ρ_b, and CPVC. In accordance with equation (12), when the volume of the adsorbed layer tends to zero the CPVC* approaches unity. The CPVC* probably exists in systems of this type but at a very high PVC value, which is experimentally unattainable. A given pigment + binder combination can give rise to a very thin adsorbed film as a consequence of very low affinity; the detection of the causes of such a low affinity constitutes a surface chemistry problem that exceeds the scope of this paper.

CONCLUSIONS

Film density determination by hydrostatic weighing constitutes a rapid and precise method to measure changes in film properties as a function of its composition. The elements required are available at any laboratory, and the measurements are performed on a real film, applied to the support surface for which the formulation has been projected.

The packing of the pigment particles can be described by a simple model that predicts the existence of a new characteristic point, designated CPVC*, different from the CPVC and at higher pigment concentrations. Experimental data for two of the studied systems corroborate the existence of the CPVC*, and reasons are advanced to justify its absence in the formulations containing aluminum. Both characteristic points can be located through density determinations; the linearized plots facilitate this task.

At the CPVC*, the film reaches its maximum porosity. Although it is difficult to foresee the exigences of the future technological development, its location will probably be more important in order to formulate farther from the CPVC* than now practiced. From any point of view, its introduction as a new concept in pigment packing is important.

ACKNOWLEDGMENTS

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PRI Paint Research Institute
of the Federation of Societies for Coatings Technology

PROCEEDINGS/NUMBER 153

The Accomplishments Of the Mildew Consortium

Consortium-Funded PRI Research Project On Mildew Defacement of Painted Surfaces

Charles C. Yeager
Program Manager*

The Paint Research Institute, the research arm of the Federation of Societies for Coatings Technology, is charged with organizing and supporting fundamental research on problems related to the coatings industry. Findings of the research are made available to the public, and no patents are issued. Individuals and companies may use the information to develop their own proprietary products.

This report summarizes a research program authorized by the Paint Research Institute and supported and directed by a consortium of organizations interested in the control of defacement of painted surfaces by mildew. The research was conducted mainly in university laboratories. The supporting organizations helped with advice and assistance in their laboratories.

The Trustees of PRI, believing that sufficient information and techniques are now available to make proprietary research attractive, has discontinued their association with the consortium. The published papers are given in the Bibliography.—*Dr. Seymore Hochberg, Executive Director, Paint Research Institute*

*Registration Consulting Associates, 1024 Crestview Dr., Millbrae, CA 94030.

INTRODUCTION

Defacement of paints and coatings may be caused by numerous agents. Among the most important are dirt, chemical stains, and mildew or fungi. Although many fungi can foul a painted surface, the organism found most often is *Aureobasidium pullulans*. Formerly identified as *Pullularia pullulans*, it was first reported by Goll and Coffey in 1948.[1] Later confirmed by Rothwell, *Cladosporium sp.* was found to predominate in certain geographical areas.[2] Both organisms were found to grow better on weathered rather than unweathered films.

On paint films, two forms of *A. pullulans* are found: i.e., clusters of spherical dark-colored spores or thread-like mycelial structures. The form is determined by the condition of the paint film and the particular environmental conditions at the time of observation. When weather conditions are proper for growth, the mycelial forms predominate. During dry weather, clusters of spores enable the organism to survive. Both forms disfigure the film to the point where repainting may be necessary. Many observers confuse fungi with dirt; but, whereas dirt can usually be removed, fungal growth is extremely tenacious. Repainting can temporarily solve the problem, but the organism often erupts through the new coating.[3] The black appearance of the mildew growth is due to melanin, a pigment synthesized by the microorganism.

Before 1940, little effort was made to preserve a paint system from fungal attack. Various pigments were used for this purpose; the most common of which was zinc oxide. However, this had side effects, such as accelerating blistering, causing embrittlement, and slowing down chalking in the vehicles then commonly used. Chalking has long been known as a defacement controlling characteristic of paint films. As the film chalks, the surface weathers away, and the dirt and mildew are removed with it. The faster the chalking process, the better the surface is cleared of mildew and dirt. Unfortunately, as the paint weathers away, its life is reduced. A proper balance is sought between chalking rate and mildew growth to achieve long life.

A paint system may, however, be protected against defacing microorganisms with little effect on erosion rate through chemical controls—the addition of a suitable fungistat. At this time, many chemical agents are available for preventing the growth of defacing organisms on paint.

The following list includes most of the commercially important fungistats used in the manufacture of both exterior and interior paints:

Inorganic Pigments:
(1) Zinc oxide
(2) Cuprous oxide
(3) Barium metaborate

Organics:
(1) Phenylmercuric acetate
(2) Phenylmercuric oleate
(3) Phenylmercuric succinate
(4) Bis(tributyltin)oxide
(5) 2,3,4,6-tetrachlorophenol
(6) Pentachlorophenol
(7) 2,3,5,6-tetrachloro-4-(methylsulfonyl)pyridine
(8) N-(trichloromethylthio)phthalimide
(9) N-(trichloromethylthio)4-cyclohexene-1,2-dicarboximide
(10) 2,4,6-dichloro-6(0-chloroaniline)-S-triazine
(11) 1,2-bis(N-propylsulfonyl)ethene
(12) 2-(4-thiazolyl)benzimidazole
(13) 3-iodo-2-propynyl butyl carbamate
(14) Copper 8-quinolinolate
(15) Various quarternary ammonium compounds

The extensive use of paint fungicides has encouraged the development of many laboratory tests. Ranging from testing the paint film on paper, string, metal, and wood substrates, to the essential field-exposure studies, all claim to be effective and reproducible in proving the effectiveness of a chemically protected system in the particular environment of the test. But, because of the peculiarities of the principal defacement organism, *A. pullulans,* and the weathering properties of the paint substrate, laboratory tests cannot be considered as good replacements for long-term exposure testing.

Most of the paint that is ultimately exposed to attack by mildew is applied from an aqueous latex system in which the polymer is dispersed as discreet particles. Such paints are usually more or less sensitive to various chemical, thermal, and mechanical disturbances, as a result of which the paints form into jellies which cannot be applied properly. The preparation of a satisfactory, new, latex-based composition is frequently a tedious process.

In 1978, a group of eight companies, representing the paint and chemical industries and the National Paint and Coatings Association, agreed to contribute $5,000 each annually to support and direct the necessary research efforts to develop new approaches to the problem of mildew defacement of paints and coatings.

RESEARCH OBJECTIVES AND RESULTS

Chemically-Bonded Fungicide

An objective was to chemically bond available fungicides to a polymer, suitable for paints, in such a way that the fungicide could be released at a controlled rate on exposure.

Dr. Charles U. Pittman, of the University of Alabama, had been interested in the idea that fungicides could be attached to acrylic and methacrylic monomer molecules, thus giving the polymers produced therefrom a potentially fungistatic quality, providing greater durability of the fungicide and detoxifying the chemical to humans at the same time. He called the polymers, "Resins that Fight Back." The fungistatic quality would be achieved, it was hoped, through release of the fungicide by hydrolysis, oxidation, or another type of reaction.

In 1980, Dr. Pittman had already accumulated several small samples of various monomers and polymers. He had synthesized resins containing pentachlorophenol, 8-hydroxyquinoline, orthobenzylparachlorophenol, and tribromosalicylanilide connected to a variety of acrylic systems. All of these were awaiting testing for compatibility with other paint additives and effectiveness. Dr. Pittman was asked to send his candidate monomer and polymer samples to Dr. Robert A. Zabel, a microbiologist at the State University of New York at Syracuse, for distribution to others, for the preparation of paint films and for tests to determine antifungal activity.

Several of the Pittman samples containing 40% pentachlorophenol were incorporated into paint formulae. Because of the physical nature of the polymers and the subsequent paint systems, the resultant coatings had several deficiencies such as poor adhesion, a tendency to gel, and poor paintability. Nevertheless, they were applied to wood panels and placed on exposure. After 15 months of exposure in Florida and Pittsburgh, it was found that, although there was some resistance at the start, the samples showed no significant improvement over the control panels.

Accelerated Lab Testing

A second objective was to develop a test procedure for paint films that would permit typical growth of *Aureobasidium pullulans* in two weeks in the laboratory. This had never been done before without first subjecting the paint film to extensive weathering. Dr. Zabel developed such a test and published the method.[4] For the first time, it was possible to test the resistance of coatings to mildew defacement in the laboratory using the organism that is most frequently found on exterior paint systems.

Field Tests

A third objective was to prepare and test quantities of selected polymer for utility in paints. Local Societies of the Federation of Societies for Coatings Technology volunteered to prepare and apply coatings on test panels and to evaluate their peformance.

A monomer, pentachlorophenylacrylate, had been prepared by an independent laboratory using a Pittman procedure. For the needs of the coatings industry, a copolymer was to be developed in latex form, which was stable chemically and mechanically to pigmentation processes and hopefuly to application by brush. The resultant films were expected to be strong enough mechanically to withstand exposure for two years or more.

Such a stable copolymer, with untested weathering capability, however, was eventually synthesized with pentachlorophenol as 20% of the total copolymer. Samples were distributed to eight of the local Societies.

During this time, the Department of Defense of Australia had been working with Dr. Pittman's ideas. From numerous Pittman publications and through several communications with him, they had used his procedures and prepared their own monomers and polymers of PCP-acrylate. Their exposure studies started out badly with no apparent fungicidal activity; but, at the end of 18 months, they found the panels to be equal to the best of their commercial fungicidal paint panels.[7]

At the same time, Union Carbide Corp. also became interested in Dr. Pittman's work. After conferences with him and individual work of their employees, they applied for a patent on September 30, 1980. It was issued on July 6, 1982, entitled "Pentachlorophenyl 3-(triethoxysilyl) Propyl Ether."[8] A second group of compounds involving certain mildewcidal carbamate and ester compounds for which a patent has been applied are in process under Application No. 192,604.

Melanin Study

The study of melanin in *A. pullulans* was assigned to Dr. Donald J. Siehr, of the University of Missouri at Rolla, in a low-budget study over a five-year period. In October 1981, his paper, "Melanin Biosynthesis in *Aureobasidium pullulans*," was published in JCT,[9] a valuable addition to our knowledge of the principal organism responsible for defacement.

Alternaria Study

In 1981, it was decided to conduct exploratory research to uncover new leads. Dr. John Jakubowski, of Merck, Inc., then a member of the consortium, had suggested that the fungal organism, *Alternaria*, was a major contributor to defacement of the new latex paints. Dr. Paul Klens, of Lock Haven State College, studied the incidence of *Alternaria* and other fungal organisms on exposed paint films and chips to be supplied by the committee and various Societies of the Federation. Dr. Warren Iverson, of the National Bureau of Standards, looked for actinomycetes, algae, and bacteria on similar and/or the same panels or chips. Dr. Klens found that those he did examine showed little evidence of *Alternaria* contamination and recommended that we go no further in the study of that area. His paper entitled, "Effects of *Alternaria* Species on Latex Paint Films," has been submitted to JCT for publication.[10] Dr. Iverson's interim report did little to establish bacteria and actinomycetes as serious defacement organisms. He found algae, as always, in high moisture and slow drying areas. He, too, is preparing a paper to be submitted soon to JCT.

Tortuosity Study

At the Massachusetts Institute of Technology, a group under the tutelage of Dr. Robert Langer had been engaged for several years in studying the control of release of molecules from polymers. In 1982, Dr. Langer undertook to develop a theoretical understanding of how tortuosity affects diffusion and how it may be controlled.

SEM Study

The final program is one started in 1981 and is now beginning to produce most exciting results. Dr. Richard E. Crang, of the University of Illinois, was asked to study the effects of sublethal doses of leading paint fungicides on *A. pullulans* through the use of the electron microscope. His first paper was presented at the 1982 Federation Annual Meeting in Washington and has been submitted to JCT for publication. It is entitled, "Mildewcide Testing and Ultrastructural Analyses with *Aureobasidium pullulans*."[11] The formation of melanin actually increases with sublethal doses of fungicide. The effects on the growth of the organism can be distinguished from the darkening caused by melanin production using electron-microscopy.

SUMMARY

The Mildew Consortium Steering Committee has been operating for five years. The Pittman program has accomplished some important objectives. It clearly shows that we must learn how to control release rate. A possibility that must be explored is that Dr. Pittman may have tied the active moiety, in this case, pentachlorophenol, too close to the backbone of the acrylic molecule. It might be moved further out by introducing various atoms between, as did Gagliardi, in 1963, when he used ethylene thiourea between the acrylic molecule and silver nitrate to produce an acrylic polymer with silver as a powerful biocide.[12] The type of "bridging" agent used will determine the degree of release and the type of control, whether by U-V, humidity, temperature, ozone, or other. Use of polymeric acid catalysts may also be effective. We expect to be receiving paint samples shortly from eight Societies that have received polymer to be tested at Memphis State University while the Societies are conducting outdoor exposures. Perhaps these will confirm the findings of the Australians, from whom we expect further reports.

Papers have been published on their findings by Dr. Zabel,[4] Dr. Pittman,[5,6] and Dr. Siehr.[9] Papers by both Dr. Klens[10] and Dr. Iverson on defacement organism populations are either ready for publication or are in preparation. Their work, though negative in some aspects, still gives us a clearer picture of the defacement problem as it relates to the organisms present.

Finally, Dr. Crang's work is revealing new and hitherto unknown aspects of the effect of fungicides on the defacement organism, *A. pullulans*.[11] We expect that the electron microscope may become an important tool in the resolution of the defacement program.

Mildew Consortium Steering Committee

The members of the Steering Committee are as follows:

Raymond J. Connor, National Paint and Coatings Association.

John DuPont, Rohm and Haas Co.

Amy Leathers, PPG Industries, Inc.

Dr. Robert Oppermann, Cosan Chemical Corp.

Dr. Richard T. Ross, Buckman Laboratories, Inc.

William Singer, Troy Chemical Corp.

Dr. E. Robert Werner, E.I. duPont de Nemours & Co., Inc.

Royal A. Brown, FSCT Technical Advisor.

Dr. Seymour Hochberg, PRI Executive Director.

Dr. Charles C. Yeager, Mildew Consortium Program Manager.

The research was assigned to and carried out at the following institutions:

University of Alabama
Bowling Green State University
Fairleigh Dickinson University
University of Illinois
Lehigh University
Lock Haven State College
Massachusetts Institute of Technology
Memphis State University
University of Missouri-Rolla
National Bureau of Standards
State University of New York at Syracuse
Ohio State University

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Much credit must be reserved for Dr. Stephen Bowell (deceased) of Glidden Coatings & Resins, whose counseling and sage advice had much to do with our progress. We also would like to give credit to Dr. Raymond R. Myers, retired Research Director of PRI, who initiated the consortium idea and helped guide it through its first four years, and to Colin Penny, of Hampton Paint Mfg. Co., Inc., who is helping to distribute the polymer kits to various Societies. He is a Trustee of PRI.

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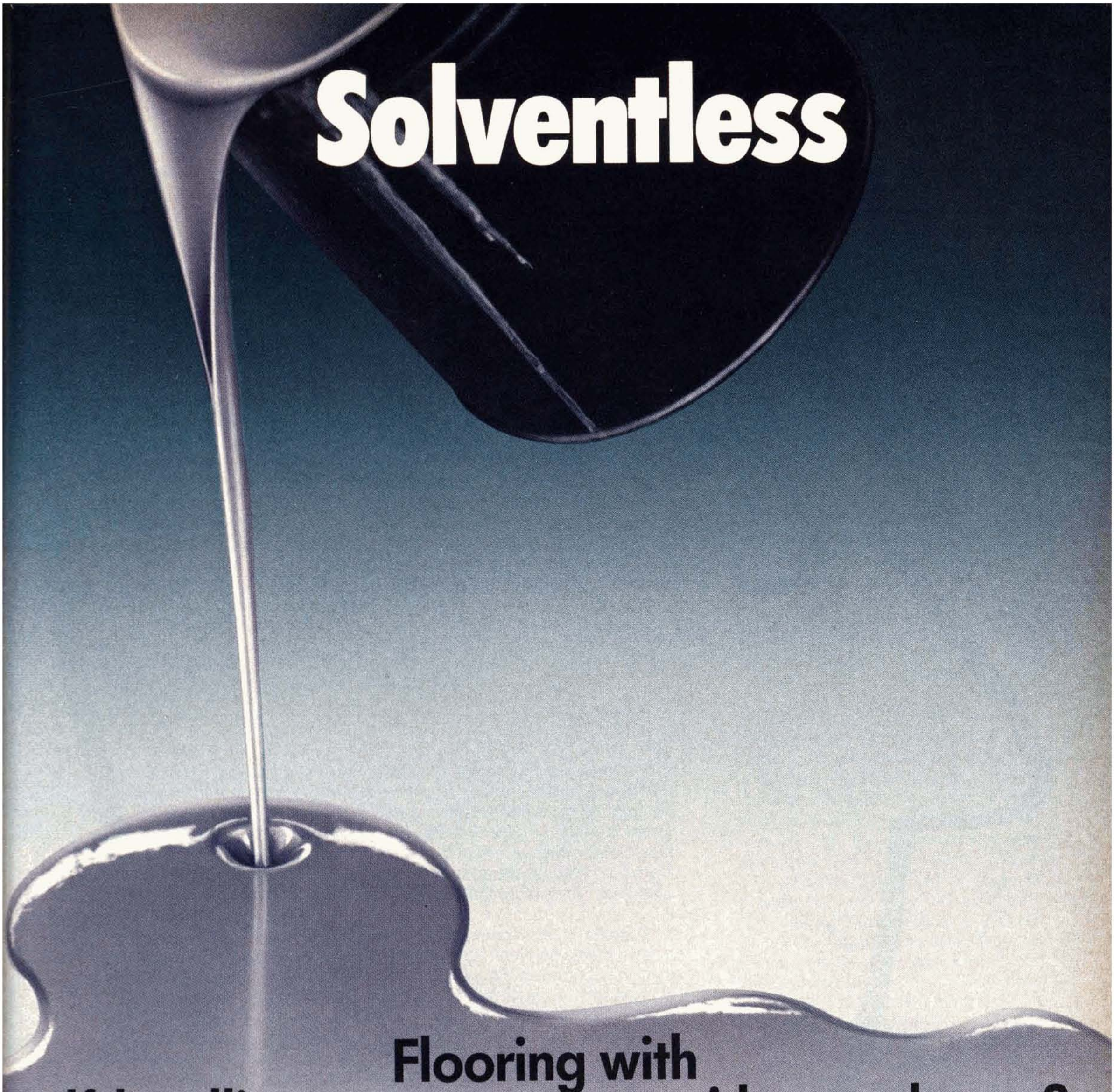

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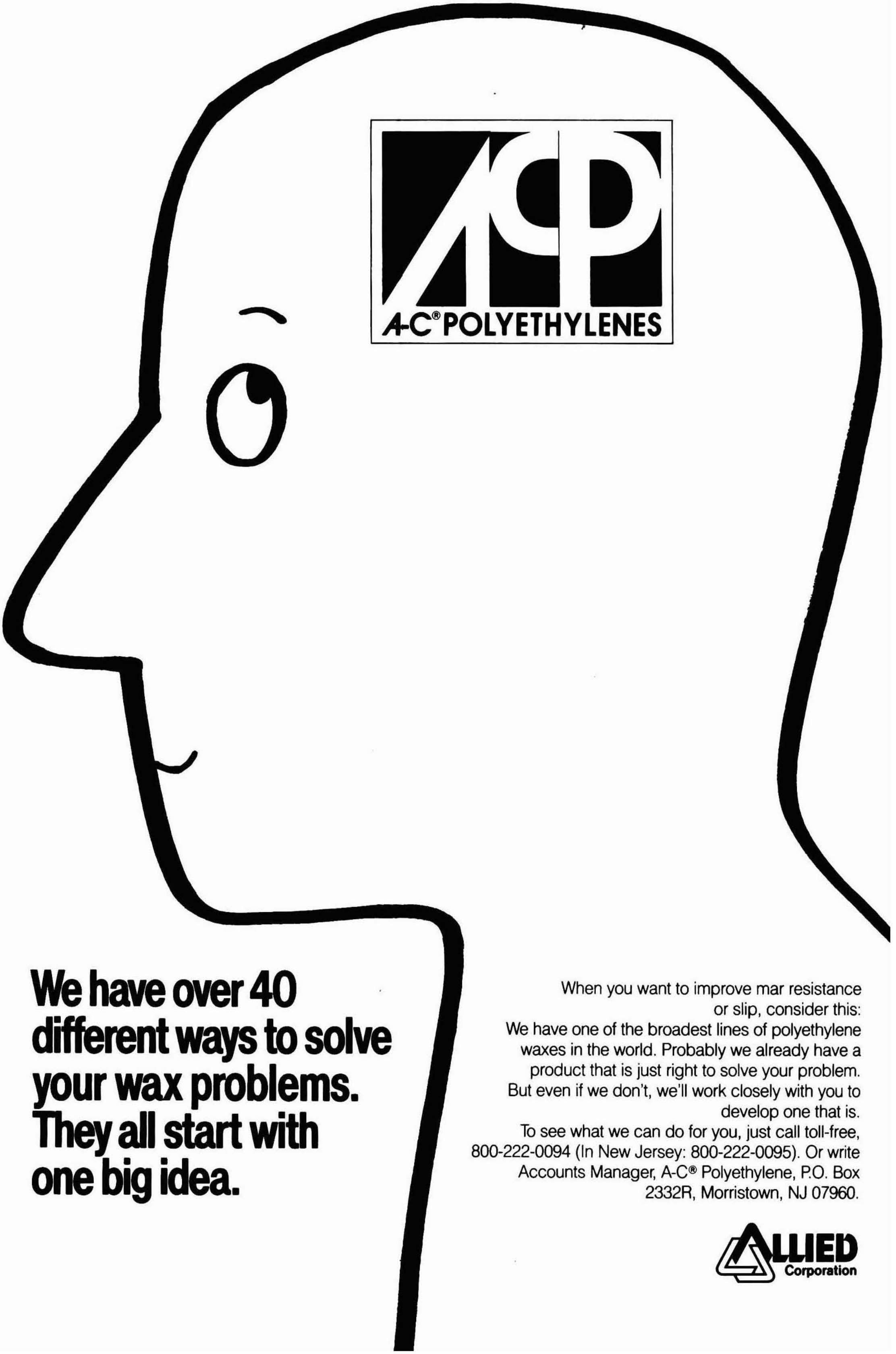

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Visual Color Technology Development In the Coatings Industry

James T. DeGroff
Applied Color Systems, Incorporated*

There has been a need for a visual method of generating a color without preparing a paint standard or finished product. In the majority of visual approaches, a color chip or other reference has been used as a guide, which must then be matched with coating materials on a manual basis. Even in the utilization of an automated color system, the visual appearance of many materials cannot be fully duplicated until the actual coating materials are available. A mechanical/electrical approach could supply many of the answers to solve this need.

A device, based on the basic Maxwell spinning disk concept, was developed. It is a solid-state, fully integrated system that creates visual color simulations that duplicate a wide range of typical coatings finishes. By adding visual modifications to the disks, the operator can create steps at various loadings of white or create a metallic "look" to simulate metal loadings of several of the metal sizes available. He can then take the data output results of this visual capability and convert them into paint formulas on a fully automated basis. This same data can be used to communicate colors from one location to another, making it possible to see those colors in the second location. The coatings industry may also be able to use such a device as a merchandising aid to help the customer to visualize the finished coating surface.

Introduction

When a specifier of products requires a paint manufacturer to produce paint giving a surface finish of exact color and appearance, the present sample method is to actually prepare a panel or drawdown of product to act as a guide to the paint manufacturer. This physical standard serves both the purchaser of paint materials and manufacturer of the coating product as the basis for manufacture, purchase, and specification. The coatings manufacturer may manually mix colors to match the color standard and prepare samples of the actual batch being produced to compare actual against standard. Visual comparisons and the experience of a colorist are often utilized to produce the coatings batch on a commercial basis.[1]

DEFINING THE CONCEPT: Since the coatings industry requires physical standards for sample submission to customers and production as well as for the styling requirements of finished product to visualize the effect of various coatings systems, the industry has developed several techniques for color specification. Typically, the paint manufacturer prepares drawdowns, paint chips, or panels with the actual coating materials on a substrate similar in nature to the final surface to be coated. Samples prepared in this manner are time consuming, costly, and often tend to deteriorate over time.

A second technique is to use a specification reference system, such as the Munsell color book, the Swedish "Natural Color" system, or the German DIN (Deutsche Industrie Norm) color system. These systematized, nicely defined color references can frequently be used as a first approach to a color specification. The weakness of all of these systems, however, is that even with several thousand colors the exact specification color and appearance cannot be finalized without the preparation of an actual coatings sample. Also, the commercially prepared samples in each of the color and appearance reference systems have a tendency to deteriorate over time and serve as questionable references unless updated and tied in with actual coatings samples.

Because the human observer differs in the ability to judge color,[2] and judgement may vary in the use of the proper materials to correct the batch,[3] instrumental devices have become standard tools for paint color control. Colori-

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*P.O. Box 5800, Princeton, NJ 08540.

meters are basic devices used to match batch against standard and assure a dependable evaluation of standard versus batch. Further development of color instrumentation made available spectrophotometers which can provide much more detailed colorimetric information. Tied to computers, the spectrophotometer allows the paint manufacturer to produce the lowest cost formulation and limit the choice of pigments in the correction of the final paint batch. Fast batch correction improves utilization of the paint manufacturing plant while assuring an acceptable product for the customer.

Spectrophotometers and colorimeters are used in the laboratory and manufacturing plant. But, there has been an additional need for a technique to specify color quickly, change specifications, and communicate color specifications. The system should automatically convert color to formulations for a variety of industrial coatings system application techniques and changing resin and solvent material requirements. Styling of color, the most subjective part of paint manufacturing, depends on human weaknesses and agreement between specifier and paint manufacturer. If a product could be produced that would allow a specifier to observe a wide number of colors and then, when the correct color and appearance has been chosen, to quickly and easily communicate that specification to the paint manufacturer and allow the paint manufacturer to use that specification as the basis for automated paint manufacture, the transaction between specifier and paint manufacturer could be simplified and speeded. In addition, a great deal of the risk of producing a batch of paint that is acceptable to the purchaser would be improved.

CONCEPT DEVELOPMENT: Applied Color Systems approached the color communications question beginning in 1975 with a technology review of color simulation techniques. In the review of the various state-of-the-art techniques available, systems were studied utilizing projection of image techniques, video displays, and the integration of color based on the Maxwell spinning disk.

In the technology review, devices had been produced for design applications which had styling possibilities, especially in the area of presentation and stylist interaction. These graphic systems and projection systems were interesting for the designer; however, they all had major flaws in color reproducibility and color gamut when compared to the needs of both trade sales and industrial color coating systems. Of all available technologies, it was our opinion that only the Maxwell spinning disk solved both the color and appearance problems and gave colorimetrically reproducible results that could generate predictable coatings simulations on a repeatable basis.[4,5] In 1978, the decision was made to move ahead in the development of a practical device based on the Maxwell spinning disk.

PRODUCT CONCEPT: In the period of the 1860's, J. Clark Maxwell, a former professor of experimental physics of Cambridge University, used rotating disks in studies of color.[6,7] He showed that by varying the relative size of the colored sectors, visual color simulation could be made when the disks were spun. The concept, although scientifically interesting, did not achieve commercial use and remained an academic teaching curiosity.

During the last 20 years, a number of simulation devices have been attempted using the spinning disk principle. In 1962, Color Corporation of America introduced a product which was driven by mechanical wires. It had minimum gamut and was based on nonrepeatable lighting sources. The output was mechanically read and the pastel gamut was narrower than the trade sales colors which it attempted to simulate. This product did not succeed commercially and no others have been seriously attempted since.

In order to develop a successful commercial product, it became clear that four elements of design would be required:

(1) The lighting source would be repeatable and highly predictable across the disks and would provide a narrow range of color temperature on a long term basis.

(2) The device would be fully automated with the operator in control of disk area as the device spun.

(3) The area of the disks would be read automatically and calculated by computer means.

(4) The output of the device would be highly repeatable from unit to unit and be

Table 2—Visual Color System Disk Set Color Calculations

(1) Compare Segments to Standard:

CIELab	ILL	X	Y	Z	L*	a*	b*	C*
GREEN Standard	I	17.33	33.85	11.20	64.84	−61.78	46.99	77.62
GREEN Disk-Centroid.....	I	16.49	32.56	10.70	63.81	−62.03	46.60	77.58
GREEN Disk-Lighter......	I	18.34	35.36	11.83	66.03	−61.41	47.34	77.54
GREEN Disk-Darker......	I	17.22	33.69	11.13	64.71	−61.78	46.96	77.67

CIELab	ILL	DL*	Da*	Db*	DE*	DC*	DH*
GREEN RO/16...........	I	−1.04	−0.25	−0.40	1.14	−0.04	0.47
GREEN RO/16...........	is	1.04 Darker than GREEN RO/10					
GREEN RO/16...........	is	0.04 Duller than GREEN RO/10					
GREEN R1/205...........	I	1.18	0.36	0.35	1.29	−0.07	−0.50
GREEN R1/205...........	is	1.18 Lighter than GREEN RO/10					
GREEN R1/205...........	is	0.07 Duller than GREEN RO/10					
GREEN R2/112...........	I	−0.13	−0.09	−0.03	0.16	0.05	0.08
GREEN R2/112...........	is	0.13 Darker than GREEN RO/10					
GREEN R2/112...........	is	0.05 Brighter than GREEN RO/10					

(2) Compare Average Readings of Segment Set to Standard:

CIELab	ILL	X	Y	Z	L*	a*	b*	C*
GREEN Standard	I	17.33	33.85	11.20	64.84	−61.78	46.99	77.62
GREEN/Average of all three disks............	I	17.35	33.87	11.22	64.86	−61.75	46.96	77.58

CIELab	ILL	DL*	Da*	Db*	DE*	DC*	DH*
GREEN/011..............	I	0.02	0.03	−0.03	0.04	−0.04	0.01
GREEN/011..............	is	0.02 Lighter than GREEN RO/10					
GREEN/011..............	is	0.04 Duller than GREEN RO/10					

Table 1—Long Term Lamp Test

Equipment

VCS-10 Simulator Apparatus
2 Lamps Illuminant I-14WT12 Daylight Simulation
EG&G Spectroradiometer Model 555-66

Procedure

Two lamps chosen at random from manufacturers batch. Lamps mounted in VCS-10 apparatus and turned on March 2, 1982. Lamps were left on continuously during test period through 1/12/83. An EG&G Spectroradiometer was aimed at the lamps and read at least every 2 months during the test period.

Results

Date	Continuous Hours On	Color Temperature (Degrees Kelvin)
3/4	45	6936.45
3/10	167	6916.78
3/17	357	7002.67
3/24	528	6939.70
4/27	1338	6950.07
5/17	1819	6874.63
7/7	3047	6766.57
7/27	3522	7018.37
8/17	4032	6919.00
8/31	4368	6844.83
10/4	5184	6925.77
11/9	6042	6804.08
12/2	6597	6733.84
1/12	7585	6780.15
	AVERAGE COLOR TEMPERATURE:	6886.64

Table 3—VCS Performance—Calculated vs. Measured

Equipment:

VCS-10 Simulator Apparatus
EG&G Spectroradiometer Model 555-66

Procedure

#1 Set Black Disk to 100%, read spectrophotometer set at 10 inches normal to disks.
#2 Set Red to full out (98%), 2% Black remains. Read Spectroradiometer set at 10 inches normal to disks.
#3 Calculate 100% Red from #2 data.
#4-12 Set disk area; calculate theoretical reading from #1 to #3 data; read spectroradiometer set at 10 inches normal to disks; calculate data differential calculated reading to actual reading.

Results:

#	Display Counts	Spectral Radiometer Reading Nanoampheres at 620 nm Calculated	Measured	Delta
1	200,0		0.159	
2	196,4		0.464	
3		0.470		
4	100,100	0.315	0.315	0.000
5	97,103	0.320	0.324	0.004
6	92,108	0.327	0.331	0.004
7	107,93	0.304	0.305	0.001
8	150,50	0.237	0.240	0.003
9	147,53	0.241	0.243	0.002
10	157,43	0.227	0.227	0.000
11	165,35	0.214	0.213	0.001
12	157,43	0.226	0.226	0.000

suitable as base data for computer calculated coatings formulation development.

An initial prototype was designed and numerous tests run to develop disk preparation techniques, controllable light sources, and techniques to capture device data. Several prototypes were built and by early 1980 a demonstratable unit gave results of sufficient quality to assure that a final design could be developed.[8]

A panel of industrial coatings and trade sales coatings manufacturers was asked to review the unit and to make comment. A wide variance of opinion was given. However, the general attitude was positive, indicating that if technical problems could be overcome the product would have practical application in the coatings manufacturing and coatings using industries. Therefore, the design was completed and a prototype was shown at the 1980 Federation Paint Show where the device was received with enthusiasm and general interest.

A decision was made to go to commercial design and bring the product to market. The task proved formidable since it required the development of six separate subsystems; these became the final product. Development projects in specialty lighting, high speed photo-optic bar code reading, power distribution and micro-motor drive, the development of a micro-readout and operator control system, the development of a pigmentation application system for wide color gamut and long term stability, and the development of a mechanical movement and control system to assure disk movement at high speed rotation were conducted. Each of these projects proved successful and the final product design was completed by the summer of 1982.

Two production prototype units were built based on this design, and reproducibility and repeatability studies were begun. The results of these studies proved that dependable, repeatable colors could be simulated. The areas representing these colors were captured with a light source that had excellent color distribution in the daylight simulation area and reproducibility from instrument to instrument. The final design prototype was shown at the 1982 Federation meeting, and units are in current field testing.

Software has been developed which converts the additive color output of the Visual Color System to colorimetric reflection data for coatings color formulation. Tests to-date indicate that the data output of the Visual Color System can be reliably converted to paint formulations and can be used in the production of practical paint formulas. In a similar way, it has been shown that a paint sample can be read by a computerized spectrophotometer, converted to area readings which can then be entered on the Visual Color System, and the color will represent the paint standard in a visually acceptable way.

VCS Design Elements

The detail of the VCS design can be broken down into three basic elements: the lighting system, the object, and the system operation and logic.

THE LIGHTING SYSTEM : The development of the lighting system required the production of an overhood and a light that would create a natural viewing environment with a well diffused daylight simulation lamp. Further, the lamp must fire in such a way that strobing was not caused on the spinning disks. It was also important that long term life give a predictable, even color temperature to provide an economically and technically dependable lighting source. Specifications were developed and submitted to key producers of light sources. Several

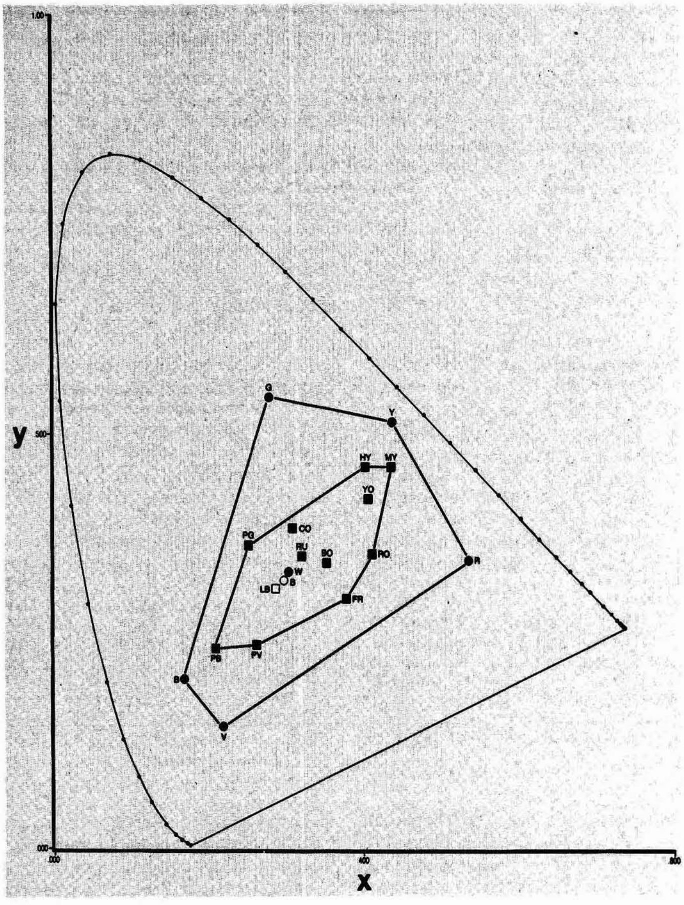

Figure 1—VCS (outer) and trade sales color pallet (inner)

prototype lamps were tested. The final vendor of the lighting source was Duro-Test, Inc., of North Bergen, NJ. Jointly, an acceptable lamp was developed and tested. A pair of lamps was mounted in an overhood which was coated in neutral gray to provide a nonconflicting viewing environment. Both short term and long term lighting tests indicate a significantly superior lighting system for viewing the spinning disks. Two lamps are mounted in opposing positions, providing even illumination across the spinning disks.

Long term lamp tests were run from March 1982 through January 1983 (*Table* 1). The results of these tests show long life and continuous color temperature. A short term lamp cycling test was run, turning on the lamps for 2½ minutes and turning off the lamps for 2½ minutes. This was repeated automatically for 7,440 cycles. At the end of the tests, the color temperature was measured and was found to be within 0.13°K of the average color temperature of the long term lamp test. The long term lamp test and lamp cycling test were run with different lamps from the same manufacturer's batch.

In addition to the daylight simulation, tungsten lamps have been added to the lighting system to give an indication of metamerism for visual consideration. However, it is normally suggested that specification data be read with the daylight simulation, since this data can be converted to other illumination predictions by color formulation software.

THE OBJECT: In the case of the Visual Color System device, the object is the disks themselves. It is important that a mechanically stable disk be constructed that could be automatically controlled while moving at integration speeds in excess of 1600 RPM. The mechanical construction of the disks was attempted with a variety of materials. The final choice was a lamination of a stainless steel backing with a polycarbonate base substrate. The disks are mounted mechanically around a hub in three segments of 120° each. The movement of the segments is done by a gearing system driven by a micro DC powered motor mounted on the turning shaft. Each of six moving disks has a dedicated motor which is powered through a commutator from the central power core. The control of the power distribution is done by microprocessor.

A variety of coloring techniques was attempted, including coating systems, printing systems, and the lamination of plastic film. We found that the most practical reproducible technique was a screen printing technique utilizing inks with pigments of stability to withstand more than 1000 hours QUV artificial weathering exposure. The following pigment types were chosen:

Yellow—Pigment Yellow 93
Green—Pigment Green 7
Violet—Violet 23
Blue—Pigment Blue 15

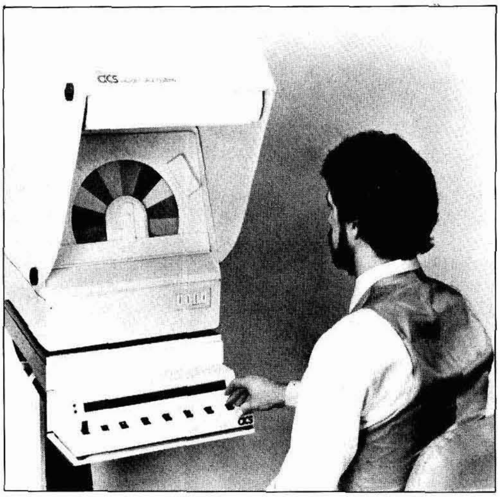

Figure 2—The Visual Color System

Red—Pigment Red 104 Blend with Pigment Red 149
Orange—Pigment Red 104

A quality control technique for the printed disks has been developed which provides excellent color reproducibility from set to set (*Table* 2). All disk quality control is accomplished with spectrophotometer assistance. For each set of three, a batch centroid is located and a chromatically balanced pair, based on lightness/darkness, is chosen. The set of three, when spun, create a repeatability as a set of less than one Δ E CIELab. This quality control technique, based on ACS colorimetric experience, indicated that each set of disks can be dependably supplied, providing reproducible results from instrument to instrument.

The pigments chosen and the additive effect of the disks have created a wide color gamut in simulated daylight. This gamut is represented in the CIE diagram which, although it only represents a slice through color space, is an indication of how broad the gamut is. As an initial review of the system, we reviewed typical trade sales color palettes and industrial coatings systems color palettes. Shown in *Figure* 1 is a typical machine colorant palette for trade sales applications superimposed within the gamut of the VCS disk gamut. The present disk sets will provide styling capability for most coatings systems. However, since all real colorants have limitations in visual appearance, there will be some applications where some colors cannot be simulated. In these cases, additional colors or modifications to the disks may be required.

We initiated studies using area modification and masking techniques to provide simulations to give the effect of metallic coatings systems, high/flat gloss, and other visual appearances. Continued development work is expected in these areas to provide the broadest gamut of color simulation capabilities. Software factors have also been developed so that one color simulation can be used to create coatings systems in various gloss applications. It was found that samples of several gloss levels must be simulated separately to give the proper visual representation. The computer calculation of the coatings formula, however, is achieved in the same manner for both high and flat gloss levels.

SYSTEM OPERATION AND LOGIC: When the system's power is turned on, the main drive motor spins the complete disk pack. As the motor comes to full speed, the light system is turned on automatically. Each set of segments has a distinctive white bar code located on the outer edge of the segments. These bar codes are arranged in such a manner that their location identifies their color. Three optical reading heads are mounted at 120° intervals around the circumference of the disk pack. As the pack spins, each of the optical sensors reads a section of the bar codes. A microprocessor samples the output of these devices and automatically identifies each of the segments exposed and calculates the exposed area. This data, revised every few seconds, is displayed at the operator's keyboard. Thus, as the disks are moved by the planetary gear motors and gear mechanism, the operator will see the response of the area data to his motion of the control switches. The significance of reading the actual area exposed compensates for malfunction in the movement of the displays; that is, the unit reads only the actual disk area being viewed by the operator. Complete operation, electronic distribution, and the display mechanism are fully automated. The miniaturization of the components and the consolidation of the micro controls allows the device to be offered in a practical size for most styling and laboratory locations.

The control board is engineered to allow the operator to change the area of each of the colors in the disk pack and is provided with a jog switch that allows minute step-by-step color changes to see exacting color modifications. The operator sees the actual color and is able to compare or contrast that color to swatches or other materials. The Visual Color System thus provides the real color to the observer and yet captures the output on a repeatable and reproducible basis. Software is available that will convert the data output of the Visual Color System and calculate reflectance curves which can be inputted to formulation systems, colorant search programs, or batch correction programs. The complete product package includes the Visual Color System and the color software for ACS Chroma-Pac licensees.

VCS Performance

The three major elements, that is, lighting, disk elements, and logic, when brought together, were tested in a number of ways. The actual versus calculated device output was measured by a spectroradiometer aimed at base disks and then by calculating the theoretical ratio between various settings of the disks. In this case, we found the correlation between calculated and measured to be very nearly 100% (*Table* 3). The reliability of the device to perform across the full area of the disk settings is highly predictable.

Further tests were run using sample panels, measuring them on a spectrophotometer, taking the calculated VCS settings directly from an ACS Color Control System, and setting them up on the Visual Color System. A panel of observers indicated that the first settings were within a visual match of the panels provided. Both trained and random observers tested a broad range of samples in this manner.

Similar tests have been accomplished by generating VCS data and calculating coatings formulations, preparing samples of the formulations, preparing a drawdown and comparing the drawdown to the VCS disk appearance at the calculated settings. Continued testing is in progress on a wide number of coatings formulations to assure further the correlation between the color appearance of the Visual Color System and actual coatings systems.

Practical Use of the System

It has been indicated that the Visual Color System can allow a paint colorist to generate millions of colors of great color gamut and to repeatedly see these colors on one device, or by giving the same data to another operator, see the same color on a second device. This capability can provide the basis for color communications in multi-plant operations, or it can be utilized to set color standards between manufacturer and purchaser/specifier. It is conceivable that such a device could be utilized to store color standards and serve as a replacement for literally thousands of freezer samples or wet samples. The device could also be useful in the development of new color systems for paint chip styling applications by paint merchandisers and color card manufacturers. The device may be useful in the development of new sales concepts for merchandising activities.

It is also conceivable that this device could be used in working with architectural and contract customers in choosing colors and formulating these colors for specific jobs. As a color development product, as a communication product, or as a merchandising product, the device seems to have significant practical potential in the coatings industry. We feel that this device offers the first opportunity for a paint colorist to create visually real colors under reproducibly automatic viewing conditions that can simulate actual coatings applications. The invention has been created; the usefulness needs to be further tested and proven.

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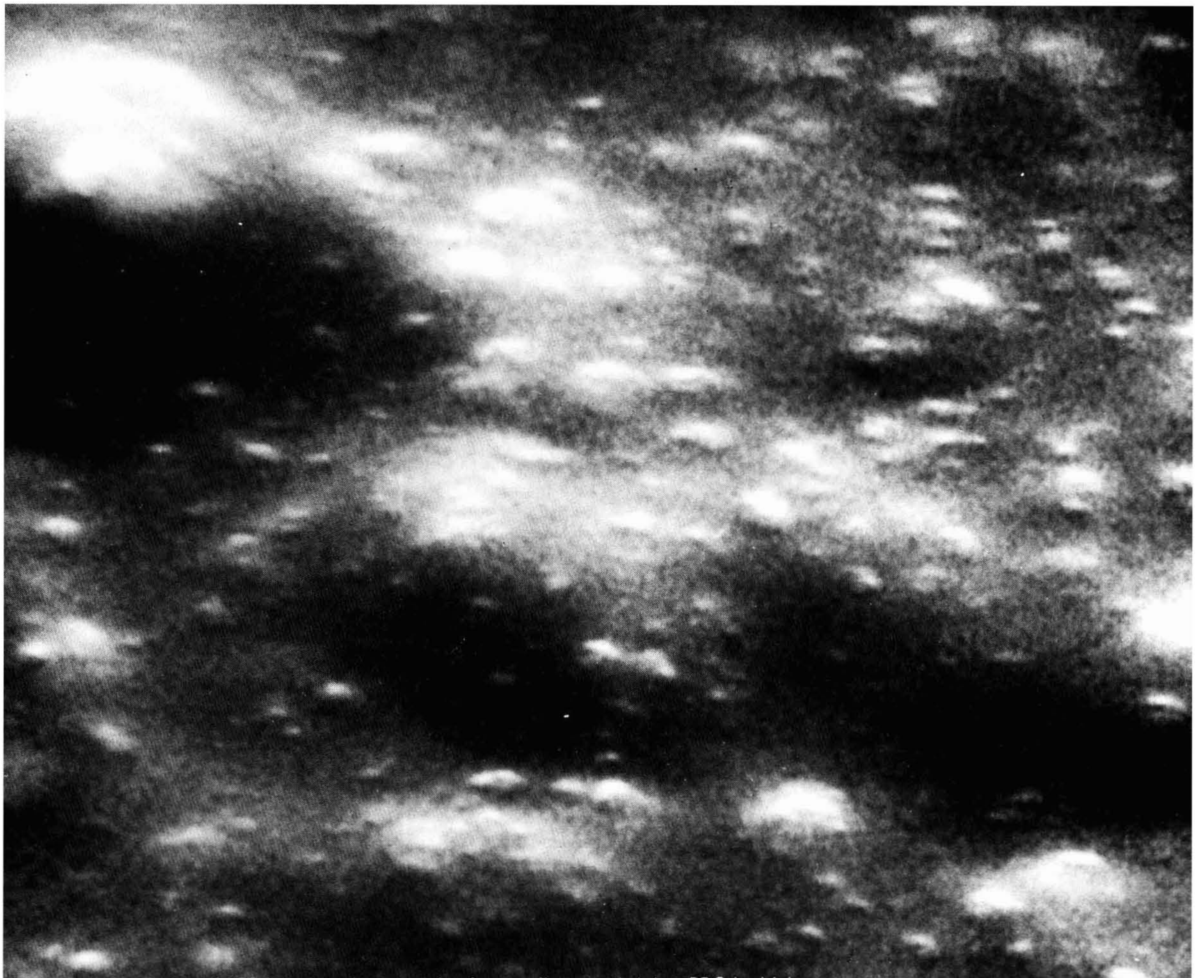

Actual 2000X photomicrograph of a coating containing PPG Lo-Vel

What Did the PRI Questionnaire Tell Us?

Royal A. Brown
FSCT Technical Advisor

Development of the Questionnaire

In 1982, the Trustees of the Paint Research Institute gave everyone in the paint industry an opportunity to express an opinion concerning the type of research in which PRI should be engaged. A one-page questionnaire was developed, (see *Figure* 1), and interested persons were encouraged to complete it and mail to Federation Headquarters. The questionnaire was intentionally brief and uncomplicated so that little time would be required to complete it.

The PRI questionnaire was published in the July and October 1982 issues of the *Journal of Coatings Technology*, and also in the July 12 issue of the *American Paint and Coatings Journal*. Two hundred seventy-six completed questionnaires were received.

Before describing the results, it should be pointed out that all questionnaires received were not totally completed. Some people chose to answer one part and to omit others. Some failed to identify their jobs as management, sales, technical, etc. Some did not indicate the relative size of their companies, or did not identify their business as paint manufacturer, raw material supplier, equipment manufacturer, or otherwise. This resulted in the difference in the total number of responses to questions as illustrated in the several charts included in this article.

In designing the questionnaire, we wanted to give people an opportunity to indicate which specific research projects they believe are most needed by the industry and to suggest activities other than research the PRI might undertake.

We requested first and second choices, and asked why the suggested project would help our industry. In response to Question No. 1 we received 445 suggestions for research projects. This amounts to an average of 1.6 suggestions per completed questionnaire. The 1.6 figure is explained by noting that many respondents suggested two projects while others made only one, and a few made none at all.

SURVEY QUESTIONNAIRE
ON PRI PROJECT SELECTION

(1) If you could choose a research project for PRI work, what would it be?
First Choice ______________________

Second Choice ______________________

(2) Explain why you believe this project(s) will help industry if the research is successful.

____

(3) Will you please rate the following areas of research as you view their importance to the paint and coatings industry.

	Very Important	Moderately Valuable	Of Little Value
(a) Elimination of mildew growth on paint films	☐	☐	☐
(b) Prevention of steel corrosion	☐	☐	☐
(c) Waste treatment, recycling, and disposal	☐	☐	☐
(d) Coatings transfer efficiency improvement	☐	☐	☐
(e) Promotion of coatings adhesion	☐	☐	☐
(f) Waterborne coatings technology	☐	☐	☐
(g) High solids coatings technology	☐	☐	☐
(h) Better accelerated weathering testing	☐	☐	☐
(i) Improved pigment dispersion techniques	☐	☐	☐
(j) Improved test methods for evaluating coatings performance	☐	☐	☐
(k) Investigation of renewable natural raw materials	☐	☐	☐

(4) Please list other areas of research which you believe could be valuable to the paint and coatings industry.

____

(5) Can you suggest areas other than research, in which PRI could be helpful?

____

(6) *Your job:* ☐ Technical; ☐ Manufacturing; ☐ Sales; ☐ Management.
Company size: ☐ Large (over $80 million); ☐ Medium ($10 to $80 million); ☐ Small (under $10 million)
Type business: ☐ Paint mfg.; ☐ Raw Mat'l. Supplier; ☐ Equipment mfg.; ☐ Other ______

Figure 1

Table 1—Who Answered the Questionnaire?

Type of Business	Type of Job: Technical	Manufacturing	Sales	Management	Total
Paint Manufacturer	126	4	5	32	167
Raw Material Supplier	32		14	9	55
Equipment Manufacturer	1	2			3
Other	41		2	8	51
Total	200	6	21	49	276

Who Answered the Questionnaire?

Table 1 shows a classification by job description of individuals who sent in completed questionnaires. As might be expected, greatest interest was shown by paint manufacturers. Slightly more than 60% of the responses came from paint manufacturing personnel. Also, as expected, most responses came from individuals in technical positions as opposed to management, sales, and manufacturing. Technical personnel accounted for 72% of the questionnaires.

Forty-two percent of the responses came from companies with more than $80 million annual sales; 28% from companies with $10 to $80 million; 30% from companies with less than $10 million.

Table 1 shows a sizeable group identified as "Other" under the *"Type of Business"* heading. This group includes consultants, paint retailers, coatings users, and employees of government and academia.

What Type of Research Is Most Important?

Studying the many suggestions for research projects offered by the respondents, we placed the majority of suggested research projects into several groups. Each group contains research suggestions in a specific area. Although suggestions might be directed to certain facets of the problem, they did fit neatly into the categories indicated in *Table* 2. This table shows a total of 373 suggestions divided into 19 separate categories. Of the total of 445 research suggestions, 84% fall into the 19 categories listed in *Table* 2. Moreover, if we consider only the first 12 categories of *Table* 2, we will have included about 80% of all suggestions.

There were many suggestions for research projects which did not fit any of the categories listed in *Table* 2. Many of these would make interesting research projects; however, because of their specific nature or because they required the development of a product, most do not fit the objectives or requirements for PRI research. Other suggestions involved the study of a specific type of raw material or a specific substrate. Others outlined research areas which were so broad in nature that the funds required would be far beyond the PRI budget. For the readers' information, a sampling of suggestions which fit the above descriptions are noted:

Developments

Better anti-fouling coatings
Universal colorant binders
Conductive polymers
Dry powder, water emulsifiable architectural paints
High heat-resistant coatings
New trade sales products to revitalize the market
Coatings for plastics
Abrasion-resistant coatings
Replacements for glycol ethers and esters

Studies of Specific Materials

Surfactants
Microvoids for opacity
Extender pigments
Silica compounds
Opacifying agents

Extensive Long Term Research Suggestions

Study mechanisms of paint failure
Study the function of extender pigments in paint
Study the function of prime pigments in paint
Study the pre-treatment of substrates
Study the emulsification of all types of resins
Study paint rheology
Study paint and coatings adhesion

General or Practical Type Work Suggestions

Formulate guidelines for paint appearance
Establish quality standards for consumer paints
Compare performance of high versus low quality paints
Educate public on how to purchase paint

Table 2—Suggestions for PRI Research (Based on Responses to Question 1)

Rank	Research Project Suggestions	Number of Times Mentioned
1	Waterborne Coatings Technology	56
2	High Solids Coatings Technology	50
3	Prevention of Steel (and other metals) Corrosion	41
4	Waste Treatment, Recycling and Disposal	40
5	Improved Test Methods for Evaluating Coatings Performance	31
6	Investigation of Renewable Natural Raw Materials	26
7	Prevention of Mildew and Bacterial Contamination	23
8	Improved Adhesion of Coatings	23
9	Emulsion Polymer and Latex Paint Improvements	16
10	Pigment Dispersion	15
11	Improved Durability of Exterior Paints	15
12	Improved Coatings Application and Curing Methods	14
13	Study Toxicity of Paint and Raw Materials	6
14	Use of Computers in R & D Work	4
15	Fire Retardant Paint Research	3
16	Inorganic Coatings Vehicle Research	3
17	Wax Bleed of Hardboard Siding into Exterior Paints	3
18	Powder Coatings Research	2
19	Aerosol Coatings Research	2

Table 3—Research Areas—Ratings of Importance

Areas of Research (Question 3)	Importance Rating	Opinion by Type of Job: Technical — Based on 200 Responses (Percent)	Management — Based on 47 Responses (Percent)	Sales — Based on 16 Responses (Percent)	All Jobs Combined — Based on 267 Responses (Percent)
(a) Elimination of Mildew Growth	Very	30	29	31	29
	Moderate	54	51	44	54
	Little Value	16	20	25	17
(b) Prevention of Steel Corrosion	Very	78	68	73	77
	Moderate	18	30	20	19
	Little Value	4	2	7	4
(c) Waste Treatment Recycling and Disposal	Very	50	54	50	51
	Moderate	35	35	37	35
	Little Value	15	11	13	14
(d) Improve Coatings Transfer Efficiency	Very	19	12	7	18
	Moderate	54	56	71	55
	Little Value	27	32	22	27
(e) Promotion of Coatings Adhesion	Very	54	48	40	53
	Moderate	40	36	53	40
	Little Value	6	16	7	7
(f) Waterborne Coatings Technology	Very	66	70	37	65
	Moderate	30	23	50	30
	Little Value	4	7	13	5
(g) High Solids Coatings Technology	Very	58	61	75	60
	Moderate	37	37	25	35
	Little Value	5	2	0	5
(h) Better Accelerated Weathering Tests	Very	27	28	14	27
	Moderate	52	46	57	51
	Little Value	21	26	29	22
(i) Improve Pigment Dispersion Techniques	Very	23	26	7	24
	Moderate	53	51	60	52
	Little Value	24	23	33	24
(j) Better Test Methods for Coatings Performance	Very	41	35	7	38
	Moderate	48	57	67	50
	Little Value	11	8	26	12
(k) Investigate Renewable Natural Raw Materials	Very	36	34	53	38
	Moderate	40	49	47	41
	Little Value	24	17	0	21

Rating the Importance Of Research Areas

From earlier informal surveys of smaller groups, conversations with many individuals, and many years experience in the industry, we believed that we had a pretty good idea of the types of research most needed by our industry. We listed 11 research areas in Question No. 3, and asked that respondents rate them for importance by checking one of three boxes: *Very important*, *Moderately important*, and *Of little value*.

Our belief that the 11 research areas listed in Question No. 3 were important ones was confirmed by the 445 research suggestions in answer to Question No. 1. All but one were included in the first 12 categories most often suggested (*Table* 2).

Tables 3, 4, and 5 display the ratings of importance given to the 11 research areas listed in Question No. 3. *Table* 3 shows opinions by type of job: technical management, and sales. *Table* 4 gives opinions of personnel in paint manufacturing companies only. It displays the opinions of technical vs management people. *Table* 5 gives ratings by individuals employed in different segments of our industry. These three charts permit the reader to draw his or her own conclusions concerning the types of research considered most important.

Can PRI Be Helpful In Areas Others than Research?

Question No. 5 asked, "Can you suggest areas other than research in which PRI could be helpful?." The majority of respondents did not answer this question. There were, however, a number of suggestions. Following is a list of the more interesting ones. The number of people who made the suggestion is shown in parentheses following the suggestion.

(1) Educate paint users and promote the importance of good quality products. This should include the development of performance standards for architectural paints with instructions to assist users to purchase paints. (22)

(2) Develop technical education programs to aid technical personnel employed in the paint industry. (13)

(3) Establish a Data Bank of information on raw materials. (8)

(4) Become an institute for solving

Table 4—Research Areas—Ratings of Importance

Areas of Research (Question 3)	Importance Rating	Opinion by Paint Manufacturers: Technical — Based on 126 Responses (Percent)	Management — Based on 32 Responses (Percent)
(a) Elimination of Mildew Growth	Very	31	37
	Moderate	53	46
	Little Value	16	17
(b) Prevention of Steel Corrosion	Very	78	66
	Moderate	18	31
	Little Value	4	3
(c) Waste Treatment Recycling and Disposal	Very	53	64
	Moderate	32	26
	Little Value	15	10
(d) Improve Coatings Transfer Efficiency	Very	17	18
	Moderate	53	50
	Little Value	30	32
(e) Promotion of Coatings Adhesion	Very	55	47
	Moderate	37	37
	Little Value	8	16
(f) Waterborne Coatings Technology	Very	64	76
	Moderate	30	21
	Little Value	6	3
(g) High Solids Coatings Technology	Very	58	59
	Moderate	35	38
	Little Value	7	3
(h) Better Accelerated Weathering Tests	Very	22	32
	Moderate	54	49
	Little Value	24	19
(i) Improve Pigment Dispersion Techniques	Very	20	25
	Moderate	57	50
	Little Value	23	25
(j) Better Test Methods for Coatings Performance	Very	38	42
	Moderate	48	52
	Little Value	14	6
(k) Investigate Renewable Natural Raw Materials	Very	37	25
	Moderate	37	53
	Little Value	26	22

Table 5—Research Areas—Ratings of Importance

Areas of Research (Question 3)	Importance Rating	Opinion by Type of Business: Paint Mfgr. — Based on 167 Responses (Percent)	Mat'l. Supplier — Based on 55 Responses (Percent)	Other Types — Based on 51 Responses (Percent)
(a) Elimination of Mildew Growth	Very	31	21	31
	Moderate	53	60	48
	Little Value	16	19	21
(b) Prevention of Steel Corrosion	Very	76	78	78
	Moderate	20	20	16
	Little Value	4	2	6
(c) Waste Treatment Recycling and Disposal	Very	55	48	36
	Moderate	31	44	42
	Little Value	14	8	22
(d) Improve Coatings Transfer Efficiency	Very	18	10	27
	Moderate	53	60	55
	Little Value	29	30	18
(e) Promotion of Coatings Adhesion	Very	54	43	62
	Moderate	37	51	34
	Little Value	9	6	4
(f) Waterborne Coatings Technology	Very	66	61	68
	Moderate	28	37	26
	Little Value	6	2	6
(g) High Solids Coatings Technology	Very	57	66	63
	Moderate	37	32	33
	Little Value	6	2	4
(h) Better Accelerated Weathering Tests	Very	24	27	35
	Moderate	53	52	45
	Little Value	23	21	20
(i) Improve Pigment Dispersion Techniques	Very	22	27	29
	Moderate	55	45	49
	Little Value	23	28	22
(j) Better Test Methods for Coatings Performance	Very	37	28	49
	Moderate	50	59	45
	Little Value	13	13	6
(k) Investigate Renewable Natural Raw Materials	Very	35	47	37
	Moderate	41	43	43
	Little Value	24	10	20

technical problems—do consulting work. (8)

(5) Form a committee to interpret PRI research results. (7)

(6) Educate our industry regarding the importance of product improvement. (5)

(7) Clarify EPA regulations relating to our industry. (4)

(8) Become involved in government and public relations. (4)

(9) Improve quality control testing procedures. (3)

(10) Help government agencies develop paint performance specifications. (3)

(11) Establish a PRI library. (1)

(12) Study materials competitive to paint. (1)

(13) Develop standard definitions for the various types of paint, specifying composition. (1)

The Value of the Questionnaire

We believe that the questionnaire project was a successful one and that it will be of considerable value to the PRI Trustees in planning future work. The fact that 276 individuals took the time and effort to give PRI and the Federation the benefit of their ideas and opinions is encouraging. It is obvious that many people in technical, sales, and management positions recognize industry problems and shortcomings, and are looking for help.

This again raises the subject of cooperative research in the Paint and Coatings Industry. Does the industry want and need cooperative research? Who is for it and who is against it? Can the industry afford the cost of cooperative research? If so, where will the money come from? We know that many American industries do a great deal more cooperative research than our industry.

We invite the reader to study the results of the PRI Questionnaire. Carefully examine the charts. We are sure that you will gain insight into such areas as the differences in the opinions of technical, management, and sales personnel. You may be able to determine whether there are differences in the types of research considered most valuable by paint manufacturers as opposed to raw material suppliers. Or you may discover that, in the paint industry, technical people differ from management people with respect to what they believe is important.

The readers are invited to study the data and draw their own conclusions.

OPEN FORUM

Elements of a Successful Research Project: The Development of an Opaque Polymer

Richard E. Harren
Rohm and Haas Company*

Papers in the JOURNAL OF COATINGS TECHNOLOGY are generally concerned with the scientific and technical aspects of principles, materials, and processes of coatings science and technology. Very rarely are any papers submittted that discuss the interface between research people and management/marketing groups. A conspicuous exception was the text of the 1974 Mattiello Lecture, "Innovation in Organic Coatings," by Milton A. Glaser (JOURNAL OF PAINT TECHNOLOGY, *46,* No. 599, 39 Dec., 1974). Readers affiliated with companies large and small could cite innumerable instances, from their own experience, of promising technical developments that died a-borning for lack of courageous, venturesome management commitment to "long shot," high-risk projects.

A recent paper, titled "The Development of Epichlorhydrin Elastomers," by E.J. Vandenberg (*CHEMTECH, 13,* 8, 474 Aug., 1983) in the series "The Innovators," gives a fascinating and inspiring account of innovations in polymer chemistry, achieved by the dogged persistence of a team of researchers who had the good fortune to be backed by managers who had confidence in them. We recommend that paper to our readers.

The paper that follows, from a member of the research organization of a large resin producer, similarly illustrates what can be accomplished by researchers who have the imagination to conceive the principles of a novel, industrially useful material; the persistence and courage to follow the trail through setbacks and disappointments; and, especially, the backing of managers who had confidence in them, and who were willing to put their money—more than three million dollars worth—where their confidence was.

This account, too, is an object lesson, illustrating the benefits that can result when steadfast management commitment is coupled to persevering technical skill.

The exploratory research leading to the development of an emulsion polymer with an encapsulated void began in 1974 and culminated in a successful new product in 1981. However, the genesis of the lead to this new product came in 1965 when an alert and persistent research chemist first noted the presence of water-filled voids in an experimental emulsion. The research process leading to the commercial development of an emulsion polymer with a fully encapsulated water-filled void is described.

Introduction

The elements of successful research projects leading to innovation and new products are identified by describing the development of a new product which is referred to as an opaque polymer. To set the stage, let us look at coatings resins research in a historical perspective at Rohm and Haas Co.

In 1954, the Rohm and Haas Company's coatings resin business was composed entirely of these product lines: thermoplastic acrylic resins, phenolic resins, rosin esters, urea and melamine formaldehyde resins, alkyd resins, and polyester resins. Total resin sales were approximately 30 million pounds. Today, only one of these six product lines is still sold, yet today, Rohm and Haas annual sales to the Coatings Industry are well in

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excess of a half billion pounds. These sales today are >98% due to new products, which did not exist in 1953.

An extensive line of acrylic emulsion polymers for trade sales and industrial coatings make up the bulk of these sales today. The first of this new line of products was introduced in 1953. It was the first acrylic polymer for house paints.

How Was It Conceived And Developed

Prior to 1953, Rohm and Haas had withdrawn a recently introduced new emulsified alkyd resin for water-based house paints because of stability and performance problems. At that time, Rohm and Haas was selling a line of acrylic emulsion binders for textile and leather coatings, and our Research Director, Dr. McBurney, commissioned a group of chemists to develop an acrylic emulsion binder for house paints. This work started in 1951 and by building on our textile and leather emulsion polymer background, it culminated in the development of an acrylic latex for house paints in 1953. Some top management people, who had been associated with the failure of the aqueous alkyd resin, were reluctant to consider another aqueous paint vehicle and opposed this product, allowing it to barely survive.

By today's standards, this latex is, indeed, a primitive paint binder, but it launched us on a development path which today has established Rohm and Haas as a major supplier of latex paint polymers to the coatings industry. Below are highlighted some of the major technical advances made from 1953, after a slow start, to date in the house paint polymer field.

Major Technologies

1953—Acrylic Latex Polymers for Paints
1963—Adhesion
1964—Flow, Build (Interior Flat Paints)
1967—Flow, Build (Exterior Flat Paints)
1968—Semigloss (Interior)
1969—Semigloss (Exterior)
1974—Chalk Adhesion
1981—Opaque Polymer (Ropaque OP-42)
1981—Rheology Modifiers
1982—Aqueous Gloss Enamel Vehicles
1982—Chalk Adhesion, Build

Our start was indeed slow. In retrospect, we spent too much time between 1953 and 1963 attempting to solve problems in rheology by minor product modification and by formulation. Fortunately, there was a fundamental research program underway at this time which was directed to improving adhesion of coatings.

By 1963, although we still had not solved the rheology problem, we learned how to substantially improve the adhesion of acrylic latex polymer to both wood and to oleoresinous substrates. This resulted in major, new successful product developments.

We learned from this experience the importance of maintaining a proper balance between short term product improvement research and longer range fundamental research. We also became committed to the policy of working in research to make each new product obsolete by developing improved analogs.

I will now describe the process by which longer range fundamental research resulted in a successful product, opaque polymer. First, however, I will briefly describe the main elements of this technology for those of you not familiar with it.

Ropaque® OP-42 is a latex polymer consisting of a hard, spherical, nonfilm forming shell which has an encapsulated, water-filled void. Upon drying in a paint film, the water diffuses out, leaving a fully encapsulated air void. The air void serves as a light scattering site because of the difference in refractive index between the polymer shell and the air. It, therefore, contributes to the opacity of the paint film and is, indeed, an organic pigment.

The Challenge

The coatings industry has recognized that air voids in a paint film will contribute to opacity. The challenge has been to generate the air voids without increasing the porosity of the film, i.e., to fully encapsulate the air void.

TiO_2 is the major white opacifying pigment used in a coating because of its refractive index compared to commonly used coatings binders. However, as the level of TiO_2 in a paint film increases, its light scattering efficiency decreases due to close packing or self crowding of the TiO_2 particles. Fine particle size inorganic and organic pigments are commonly used with TiO_2 to prevent or reduce the self crowding of the TiO_2 particles. However, they do not contribute to paint film opacity by themselves unless they are used at levels high enough to induce porosity (air voids) in the film.

In contrast, Ropaque OP-42 serves two functions: its particle size is remarkably uniform (around 0.5 micrometers) and it serves, therefore, to separate or space TiO_2 particles so as to prevent close packing or crowding, and since it has an encapsulated air void, it serves also to scatter light and to enhance paint film opacity.

The Innovation Process

The research leading to the development of Ropaque OP-42 began in 1974. We established an exploratory project to begin the search for leads to incorporating encapsulated air voids in a paint film.

Quote from Project Proposal—July 1974 "Our major key result . . . . assess feasibility of developing more economic routes to opacity in coatings than TiO_2 . . . propose acceptable program proposal within six months for continued research."

In 1975, the exploratory research project was extended. Quote from Project Proposal—October 1975 "Most of the work to date has involved established 'state of the art' which is extensive. We have also identified several leads."

A Technical Breakthrough

None of the identified leads survived. Two years later another lead was uncovered and the project extended again. Quote from Project Proposal—May 1977 "A technical breakthrough . . . based on hollow particle technology."

The genesis of the lead announced in the project extension came from an alert and persistent researcher who continued to wonder and worry about the presence of a few water-filled polymeric particles he had observed in experimental emulsions way back in 1965. Where did these peculiar particles come from? How were they formed? Could they be made in large numbers? Could they be controlled in size? The answers to these questions began to come into focus as he worked to find a lead to developing an encapsulated air void.

The mechanism by which these original water-filled particles formed was identified. However, this mechanism could not be extended to accomplish the objective, which was to develop a hard, nonfilm-forming shell around the water. Nevertheless, the knowledge that water-filled particles existed gave the researcher confidence to persist in his quest.

By June 1978, the technical route to a controlled polymerization of a water-filled, hard, nonfilm-forming polymer was defined. However, in a quote from the project proposal—June 1978 "An unexpected snag has developed."

The hollow beads were not strong enough to survive film formation pressures in paint under some conditions. It took another two years of research and two more project extensions to overcome these problems. Throughout this time, there were serious concerns and reservations expressed by many of the management team about the wisdom of funding what seemed to be a very speculative goal.

Economics

There were valid concerns by some about the economics. Can this additive really be cost-effective as a hiding aid in paints? Nevertheless, the exploratory project was approved for extension again in 1978. Finally, by December 1980, the research had progressed to the point where feasibility of the technology was assured and in December of 1980 a "Development" project was approved to develop a plant process and formulation protocol for E-1742 (the experimental designation of Ropaque OP-42).

To recap: an idea, which had its genesis in 1965, resulted in heavy research expenditures in excess of three million dollars from 1974 to 1980 before it was determined that the concept might be viable and a commercial product developed. The idea of economically polymerizing a latex polymer, of finely controlled particle size, with a very uniform void in the center of the particle, seemed so difficult and remote that the project could have been terminated at any time by management refusing to approve any one of the project extensions.

Ropaque OP-42 has now been commercially available since 1981, and annual sales are already in the millions of pounds.

Future Outlook

So far, Ropaque OP-42 has been developed and formulated for Trade Sales Coatings. However, we see potential outlets wherever high opacity is required; i.e., paper coatings, inks, and those industrial applications where low temperature cures are used. Ropaque OP-42 is a thermoplastic polymer so high baking temperatures must be avoided.

We have what we believe to be a strong patent application pending, and we are already working with high priority on the second generation improved analog.

Summary

The key elements of a successful research project, the development of an opaque polymer, have been discussed. Opaque Polymer, known commercially as Ropaque OP-42, is a latex polymer consisting of a hard, spherical, nonfilm forming shell which has a water-filled void. Upon drying, the water diffuses out leaving a fully encapsulated air void. The air void serves as a light scattering site which contributes to opacity when opaque polymer is used in latex paints.

Research began in 1974 with an exploratory research project to "assess the feasibility of developing more economic routes to opacity in coatings"—and it culminated in 1980 with the introduction of Ropaque OP-42.

Key elements contributing to the success in industrial research are:

(1) Corporate management support of high risk research.

(2) A research management policy of maintaining a balance between short term product improvement and longer range, higher risk research and of working to make new products obsolete by developing improved analogs.

(3) Innovative and creative chemists.

Acknowledgment

My thanks to the two innovative and creative Rohm and Haas Chemists, Alexander Kowalski and Martin Vogel, who invented Opaque Polymer.

Open Forum is an experiment in communications designed to give readers the opportunity to share creative concepts in all aspects of coatings. Suggested topics include color, formulation and manufacture, testing, and selection of raw materials. These "tricks of the trade" need not be prepared formally such as research papers, but should, however, be thorough in their preparation and presentation. Submissions should be sent to "Open Forum" Editor, Journal of Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107.

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Proceedings Of the Paint Research Institute

Constituent Society Papers

Society Meetings

BALTIMORE .... SEPT.

"Composite vs. Single Dispersants In Colorants and Coatings"

Tom Mitchell, of Nuodex, Inc., presented the Nuodex Gavel to Society President Joseph Giusto. Other 1983–84 officers are: President-Elect—Robert M. Hopkins; Secretary—Frank H. Gerhardt; Treasurer—Harry Poth; and Society Representative—James A. McCormick.

"COMPOSITE VS. SINGLE DISPERSANTS IN COLORANTS AND COATINGS" was presented by Michael C. Frantz, of Daniel Products Co.

Mr. Frantz discussed the benefits of using composite dispersants in the mill base. These benefits included: improved manufacturing process; improved product stability; and enhanced end use.

To demonstrate these benefits, a series of slides were shown which graphically depicted the benefits of one dispersant system over another.

Mr. Frantz concluded the presentation by stating that the choice of the correct dispersant will improve the manufacturing process, the stability of the product, its ease of use, and will same money at the same time.

Q. What steps do you take to achieve the ideal combination? What is the trial and error process?

A. You start with a combination that works, then you change one component at a time and recheck your results. It is long and laborious. There are no easy short cuts. It requires time and patience.

FRANK GERHARDT, *Secretary*

CLEVELAND .... SEPT.

"Advantages of the Late Addition of Water To Certain High-Solids Coatings"

Carl J. Knauss, Society Past-President, installed the new 1983–84 officers. They include: President—Harry Scott; President-Elect—Robert Thomas; Secretary—Scott Ricket; Treasurer—Madelyn Harding; and Society Representative—Fred Schwab.

Richard Johnson, of Cargill, Inc., spoke on "THE ADVANTAGES OF THE LATE ADDITION OF WATER TO CERTAIN HIGH-SOLIDS COATINGS."

Among the advantages discussed by Mr. Johnson were low V.O.C., low application viscosity, better atomization, and better adhesion as compared with conventional high solids coatings. In particular, said Mr. Johnson, the introduction of water into hydrophilic resins and solvents will allow the high solids formulation of colored coatings and metallic coatings as well.

SCOTT RICKERT, *Secretary*

DETROIT .... SEPT.

"Painting and Testing Of Multi-Metal Substrates"

The President's Gavel was presented to incoming President Charles Collinson. Other 1983–84 officers include: President-Elect—William Passeno; Secretary—Al Moy; Treasurer—Robert Feisel; and Society Representative—Harry B. Majcher.

"PAINTING AND TESTING OF MULTI-METAL SUBSTRATES" was given by Dr. Robert D. Wyvill, of Chemfil Corp.

Aided with the use of slides, Dr. Wyvil discussed the conventional applications of phosphate treatment on cold-rolled steel and galvanized steel. These applications included both the spray and immersion process.

Dr. Wyvill stated that phosphate treatments containing iron (phosphophyllite) give better corrosion resistance than phosphate treatment (hopeite) without iron. Conventional salt spray tests do not show the difference, but scab corrosion tests definitely show the improvement.

Different types of galvanized steel were discussed. Dr. Wyvill explained that electrogalvanized steel yields a uniformed crystalline structure and hot dipped galvanized steel has a crystalline structure which is not uniform.

Dr. Wyvill noted that most American industries use a chrome rinse on their phosphating process for better adhesion to coatings. The favored method of application is the spray process, said Dr. Wyvill.

Q. Would increased dwell time of the spray process improve the phosphate coating for adhesion, corrosion resistance, etc.?

A. Ninety percent of the phosphate coating is deposited in the first 10 seconds, therefore, the answer is no.

ALLAN Q. MOY, *Secretary*

1983-84 Officers of the Cleveland Society. (Front row, left to right): Secretary—Scott Rickert; President—Harry Scott; and President-Elect—Robert Thomas. (Back row): Assistant Treasurer—George Sajner; Society Representative—Fred Schwab; Past-President—Carl Knauss; and Treasurer—Madeline Harding

HOUSTON .... SEPT.

"Formulation of Architectural And Maintenance Coatings"

William K. McCormick, of Tenneco Chemicals, presented President Don Montgomery with the Nuodex Gavel. Other 1983-84 officers include: Vice-President—Richard D. Batchelor; Secretary—Arthur R. McDermott; Treasurer—Rudolf F. Buri; and Society Representative—Willy C. P. Busch.

Past-Presidents K.D. Jacobson was awarded a Past-President's Pin by President Montgomery.

John Ballard, of Kurfees Coatings, Inc., discussed "APPROACH TO FORMULATION OF ARCHITECTURAL AND MAINTENANCE COATINGS."

Mr. Ballard presented eight computer generated formulations that produce marketable coatings. He pointed out that it was the responsibility of the formulator to come up with a marketable coating, and stressed the need for the formulator to have sufficient interaction with the marketing and sales departments.

According to Mr. Ballard, excellent low-cost formulations can be made with careful raw material selection and that minimum raw material inventories can be maintained if care is taken in choosing those inventories.

ARTHUR R. MCDERMOTT, *Secretary*

LOS ANGELES .... SEPT.

"Vinylidene Chloride"

New officers for 1983-84 were installed. They include: President—L. Lloyd Haanstra; Vice-President—Earl B. Smith; Secretary—Henry J. Kirsch; Treasurer—Mike Gildon; and Society Representative—Duke Cromwell.

Hans Roest, of Tenneco Chemicals, Inc., presented the Nuodex Gavel to President Haanstra. Immediate Past-President Romer Johnson was awarded with a Past-President's pin.

A moment of silence was observed for William A. Gerhardt, Jr., former Sales Manager of Reichhold Chemicals and Past-President of the LASCT (1940-41), who died on September 10.

Educational Committee Chairman James Hall presented Certificates of Completion to students of the Paint Technology course.

Joe King, Chairman of the Environmental Committee, presented a brief update on various AQMD rulings. On Rule 1113, Mr. King explained that the Committee presented an excellent discussion to the SCAQMD board on August 5, 1983. However, Mr. King said, apathy ensued among the board members and little was accomplished. The general feeling of the Committee was that further political channels needed to be pursued to gain fuller attention. Mr. King announced a meeting date for a Public Hearing on Rule 1136. On Rule 1107, he explained that a workshop is being designed. Mr. King concluded his report with information on rules pertaining to containers.

Violette Stevens, of Dow Chemicals, USA, presented a talk featuring "VINYLIDENE CHLORIDE: A COMONOMER FOR SURFACE COATINGS RESINS."

Ms. Stevens explained that new resins are being developed in order to advance the new coatings technologies made popular in the '70's. Vinylidene chloride is a versatile monomer that can contribute to needed properties such as weatherability, chemical resistance, gloss, and flame retardance to coatings resins.

Q. Is VDC a corrosive monomer? What materials of construction are needed for handling VDC?

A. In its dry state VDC will not cause corrosion. The monomer itself is extremely stable, and has 200 ppm of MEHQ as the free radical inhibitor present; however, as any chlorinated product, it will become corrosive if water is present. Take normal precautionary measures in handling VDC if moisture is present.

Q. What type of reactor would you recommend for carrying out polymerization?

A. In traditional latices where the VDC level is 80-90%, you need a glass-lined reactor since the pH may drift as low as 1. When in a recipe containing 50-60% or less VDC, your pH drift is not much (people have used stainless steel kettles where the pH is greater than 3.5.) At pH's below 3.5, stress cracking of stainless steel may occur.

Q. What high gloss are you speaking of? Would a gloss of 90° and 60° be possible with certain copolymers?

A. The gloss we are referring to is relative gloss. In water-borne coatings, the solution types may have similar gloss to solvent-borne coatings. The water solution-type coatings are also glossier than the emulsion and latex types. Incorporation of vinylidene chloride into a latex seems to increase overall gloss. Scott Bader has developed and published information on latices that provide similar gloss as alkyd solution coatings.

Q. Some regulators are treating all halogenated materials as hazardous and are not to be allowed in landfills—your comments.

A. VDC is a low-boiling, reactive liquid monomer and as such should be considered as a hazardous waste and should be treated by incineration. This is also true for any acrylic or methacrylic monomers.

Q. Since opacity is a function of the difference in RI (refractive index) of pigment and vehicle, won't there be a hiding problem with VDC resins?

A. Opacity does depend on the type of pigments selected for their refractive index, you should avoid pigments of similar RI to VDC. Published reports indicate that you can improve your gloss without sacrificing hiding if you pay attention to your pigment selections and their RI values.

Q. What solvents are recommended in VDC acrylic copolymers where the solubility parameter is 10.1? Are we looking at ketones and/or glycol ethers? What suggested diluents?

A. In selecting solvents, you should consider the solvating power of solvent and air regulations. Methylene chloride and 1,1,1,-trichloroethane would be good solvents from the solubility standpoint and regulation standpoint. In general, H-bonded solvents, such as alcohols and glycol ethers, are not usually good solvents with VDC containing polymers, but may be used as diluents. Solvents with lower H-bonding, such as chlorinated solvents, hydrocarbon solvents, and ketones, should be better.

Q. What are the hardness properties of VDC copolymers, if you are looking for 4 H hardness?

A. The effect of VDC on hardness will depend on the type of copolymer and the level of VDC since it can either soften or harden the coatings.

Q. Are any VDC resins commercially available for coatings?

A. VDC copolymers are commercially available. The companies offering these products include Dow Chemical, Scott Bader, ICI, Union Oil, Morton, B.F. Goodrich, and W.R. Grace. However, not many final products are designed for paint binders. However, much research is being done and you should ask your potential supplier for availability.

Q. Are you able to explain from a thermodynamics or a kinetic molecular basis why VDC/MMA does not follow the Fox equation prediction?

A. MMA and VDC do follow conventional Tg composition theories such as the Fox equation. However, in most cases, the stiffness of a VDC unit next to a comonomer unit is not simply the average value as required to fit the conventional theory; you have to use a modified Fox equation containing cross terms to take this into account. For example, VDC is a soft monomer with vinyl chloride and MMA, but it is a hard monomer with the acrylate esters. With vinyl acetate, there is little change in Tg until levels over 60% VDC are incorporated, it then becomes a soft monomer.

Q. Architectural coatings depend on penetration and surface protection for durability. There must be an optimum relation. How does VDC relate in this area?

A. My knowledge of coatings is limited. However, I expect particle size and viscosity would need to be optimized for penetration. If you can also get a continuous film or complete film formation, VDC copolymer properties should ensure protection of surface.

Q. Have you done studies on what metals reduce the yellowing effect on VDC?

A. I am not aware of any metal that will reduce yellowing. Most of them will catalyze discoloration. Discoloration in this case is associated with dehyrohalogenation. The extent of color development will increase with high VDC levels and long VDC sequences in the polymer. To minimize color development, you'll need to keep VDC levels to less than 70% and the VDC sequence lengths of less than 4 or 5 units.

Q. What is the curing mechanism for VDC resins?

A. VDC copolymers are normally thermoplastic systems and depend on controlled Tg to control the coating's hardness. However, it is possible to make a thermosetting copolymer if you need to.

Q. Isn't the relatively low cost per pound offset by high density and relatively high cost per unit volume?

A. The density of VDC is higher and your cost may suffer on a volume basis, but the current cost per pound is low and the pricing offset must be considered as the levels of incorporation and the replacement copolymers are evaluated, ie, VDC is 32–34¢ per pound with a specific gravity of 0.93.

Q. What is the relationship of the production of VDC to the production of caustic soda/chlorine? Will cost, therefore, be in relationship to the supply of caustic soda/chlorine?

A. There is a strong relationship between the production of caustic and chlorine and therefore the products of caustic/chlorine will have a cost effect on VDC; however, it is not as great as would be expected because VDC production is not based on petroleum. VDC is a further integrated product than chlorine. Therefore, the price of VDC will be affected by chlorine/caustic supply. However, the problem is not as severe as the price sensitivity of other monomers to the price of petroleum.

Q. What percent of VDC can be blended with acrylic emulsion to improve salt spray without losing adhesion on cold rolled steel (air dry system)? Doesn't VDC exhibit poor adhesion to steel?

A. ICI has done some detailed work in metal application and formulation and may be able to offer the best response to this question. To the best of my knowledge, VDC copolymers do not exhibit poor adhesion. Often, chlorine-containing products promote adhesion.

Q. Can these polymers be made in vinyl acetate acrylic reactors?

A. Yes, it is possible providing the pH is compatible and remembering that depending on the choice of a comonomer you may need a comonomer feed system to control composition. Vinyl acetate reacts much slower than VDC. The reactivity ratios for VDC and VAC are $r_1 = 4.73$ and $r_2 = 0.031$. In a batch system VDC will react preferentially and this will lead to longer VDC sequences. One way to overcome this is to change your reactor with VAC and add VDC with controlled feed rate in order to optimize desirable VDC sequence lengths.

HENRY J. KIRSCH, *Secretary*

LOUISVILLE . . . . SEPT.

"An Easier Dispersing Rheological Additive"

President John Lanning, of Porter Paint Co., was presented with the Incoming President's Gavel by Jim Eagen, of The Argus Co., Inc. Other officers for 1983-84 are: President-Elect—Edward Thomasson; Secretary—Joyce Specht; Treasurer—Jerry Morris; and Society Representative—James Hoeck.

It was reported that the LSCT/LPCA Environmental Symposium will be held April 18 at the Marriott Inn, Clarksville, IN.

Don Aikman (right), of D.H. Litter Co., presents the traditional gavel to N. Bradford Brakke, President of the New England Society, 1983-84

"QUALITY AND CONSISTENCY FROM AN EASIER DISPERSING RHEOLOGICAL ADDITIVE" was discussed by Robert Van Dorn, of NL Chemicals/NL Industries, Inc.

Mr. Van Dorn stated that their established research goals in organoclays were three-fold: (1) simplier to use; (2) easy dispersion; and (3) maintainance of high paint quality.

A comparison of conventional organoclays and the new technology developed for organoclays was given by Mr. Van Dorn. He called special attention to the inherent problems of pigment dispersion.

Mr. Van Dorn explained how the new organoclays are quite applicable to use with aliphatic hydrocarbon solvent systems and in the manufacture of paints.

Q. Is there a cost advantage to adding an organoclay at the letdown stage as opposed to the grind?

A. There is indeed a cost advantage because of the improvement in throughput.

Q. What effect do organoclays have on color acceptance, i.e., tintability?

A. There was no effect whatsoever on the color acceptance.

Q. Do organoclays work well with high solids (greater than 70%) coatings or water-based products?

A. It varies due to the different polarity of systems.

M. JOYCE SPECHT, *Secretary*

NEW ENGLAND .... SEPT.

"Antimicrobials Used in Coatings And Plastics"

Donald Aikman, of D.H. Litter Co., Inc., presented the Nuodex Gavel to President N. Bradford Brakke. Other officers for 1983-84 are: Vice-President—Paul J. Mueller; Secretary—Maureen M. Lein; Treasurer—Charles J. Hoar; and Society Representative—Daniel L. Toombs.

David Whithington, Technical Committee Chairperson, announced the proposed projects of the Technical Committee. These included: work on the PRI mildewcide consortium cooperative project; the next phase of the "Design of an Aqueous Coating for the Corrosion Protection of Steel" project, which involves the study of extender pigments and optimization of PVC; and completion of the computer formulation project.

It was announced that the Society would establish a Long Range Planning Committee for the purpose of discussing any subject relative to prospective Society activities up to five years into the future.

"ANTIMICROBIALS USED IN COATINGS AND PLASTICS" was discussed by William Woods, of Nuodex, Inc.

Mr. Woods discussed and illustrated with the use of slides the types of antimicrobials, conditions suitable for microbial growth, sources of contamination, the effects of spoilage, and the ideal preservatives.

According to Mr. Woods, antimicrobials can be described as bactericides, which are preservatives, and fungicides or mildewcides. In a separate category are

New England Society Officers for 1983-84. (Front row, left to right): Society Representative—Daniel Toombs; and President—N. Bradford Brakke. (Back row): Vice-President—Paul J. Mueller; Secretary—Maureen Lein; and Treasurer—Charles J. Hoar

fungicides for controlling wood rot fungi. These are termed wood preservatives.

The conditions suitable for microbial growth were discussed. The raw materials used in latex paints, caulks, and adhesives are prime food sources for microbial growth, stated Mr. Woods. Suitable conditions for such growth include water, degradable organics (thickeners, surfactants, etc.), and a wide pH range. These conditions are all common in latex paints, stressed Mr. Woods.

Mr. Woods discussed the sources of contamination which include airborne dust, impure water, contaminated raw materials, and dirty equipment. It was stressed that bacterial cells multiply rapidly throughout the bulk of the liquid paint, not just at the surface.

The effects of spoilage were discussed. Mr. Woods explained that spoilage manifests itself as a loss in functionality, i.e., monetary loss, and occurs in package or in bulk storage. The effects of spoilage include gassing, viscosity loss, objectionable odor, pH drift, and loss of color acceptance. To prevent spoilage, Mr. Woods stated that it is imperative to limit contamination during manufacture, and to incorporate an antimicrobial additive to control those contaminants present.

Lastly, Mr. Woods discussed the ideal preservative. He explained that the ideal preservative should be compatible with many formulations; should be effective at low cost (3¢/gal); should have a low order of toxicity; should be stable during long term storage; and should be easily handled.

Mr. Woods outlined the types of preservatives. These included: mercurials and non-mercurials. He discussed their mechanism for protection, their use levels, and their relative advantages and disadvantages.

When evaluating which type of preservative best suits the end use, Mr. Woods suggested conducting bacterial insult tests using Petrie dishes containing agar medium. These test dishes would be preconditioned prior to innoculation and then would be monitored for organisms and physical properties, he said.

Q. Are water-reducible polyesters and alkyds as susceptible to microbial attack?

A. These are less of a problem because the additives are not as susceptible to degradation.

Q. Are mercurial and non-mercurial preservatives light stable?

A. Carbamates are photosensitive, so there is a loss of protection at the surface. But one can formulate around this by using UV stabilizers.

Q. You mentioned fungicides and mildewcides. What about enzymicides? How do you treat against enzyme attack?

A. When detected, use a mercurial compound which denatures enzymes and then rebuild viscosity with a different thickener. You can also pasteurize, but it's tricky.

MAUREEN M. LEIN, *Secretary*

NORTHWESTERN .... SEPT.

"Latex Water-Reducible Blend System"

The President's Gavel was presented to Robert Mady, President for 1983-84. Other officers include: Vice-President—Richard Johnson; Secretary—Alfred Yokubonis; Treasurer—Jim Lawlor; and Society Representative—Richard Fricker.

Theodore A. DelDonno, of Rohm and Haas Co., presented "LATEX WATER-REDUCIBLE BLEND SYSTEM." This presentation was originally given at the Water-Borne & Higher-Solids Coatings Symposium, February 7-9, 1983, New Orleans, LA, and is co-authored by Ronald D. Bakule, of Rohm and Haas.

"INVESTMENT OPPORTUNITIES" was given by Jim Vieburg, of Piper, Jaffray, and Hopwood, of Minneapolis, MN.

ALFRED YOKUBONIS, *Secretary*

PIEDMONT .... SEPT.

"An Easier Dispersing Rheology Additive"

1983–84 officers were installed. They include: President—Jim Husted; President-Elect—Phillip Wong; Secretary—Michael S. Davis; Treasurer—Steve Lasine; and Society Representative—Gary Marshall. Thomas W. Mitchell, of Tenneco Chemicals Co., presented President Husted with the Nuodex Gavel of Office.

President Husted stated that the Society is celebrating its 25th Anniversary this year and solicited ideas for its celebration.

Educational Committee Chairman, Robert Matejka, stated that he and Dr. Hurwitz are compiling a list of possible research areas to be submitted to the society. The Paint Research Institute will match funds up to $1,000 for paint research that would be of interest to the local society and would fit the local technology and use. Dr. Hurwitz stated that one area of possible research would be latex coatings applied at low temperatures. It was reported that the "Industrial Polymer Chemistry" course will be held at UNC-G in January. This course will complement last year's polymer chemistry course.

Robert H. Dey, of NL Chemicals/NL Industries, Inc., spoke on the "QUALITY AND CONSISTENCY FROM AN EASIER DISPERSING RHEOLOGY ADDITIVE."

The easier dispersing additive is a new type of organoclay that does not require the chemical activation nor the high shear necessary for the standard organoclays.

Mr. Dey stated that organoclays are the most common rheological additives used to impart viscosity, sag and pigment settling control, and application properties to solvent based paints. But to be effective in paint production, the standard organoclays have to be added to batches at a certain time under high shear and a polar activator added to completely disperse the clay platelets. Mr. Dey said that the required order of entry to achieve maximum dispersion is usually the solvent, the resin, organoclay, the polar activator, and then the pigment. This order reduces the tendency for an agglomeration of the organoclay, but it also reduces the pigment loading on some pieces of equipment. This reduces the potential for total paint production when manufacturers are seeking greater plant efficiency and lower manufacturing costs.

The introduction of equipment with higher output and lower shear rates required an organoclay that would be easier to use, activated by a low shear rate and still maintain a high paint quality. A super-dispersible organoclay was therefore produced, said Mr. Dey.

A new organoclay was developed and though the technology is only one year old, the results are good and research is progressing for an organoclay for strong solvent systems. The present, easy dispersing organoclay is for aliphatic solvent systems. Mr. Dey stated that by chemical reactions the distance between the clay platelets has been increased from the 26 angstroms in standard organoclays to 40 angstroms in the new organoclays. This increased distance between the platelets reduces Van Der Wals forces, thereby reducing the shear necessary to disperse the platelets. Besides low shear, the new clay can be added anywhere in the production process. Rheology development is consistent to that of the conventional organoclays.

MICHAEL S. DAVIS, *Secretary*

PITTSBURGH .... SEPT.

"Water-Extendible High Solids Enamels"

Rich Johnson, of Cargill Research Laboratories, spoke on "WATER-EXTENDIBLE HIGH SOLIDS ENAMELS."

Mr. Johnson reviewed the types of coatings which were being sold in the industrial coatings market in the early 1980's, when only 4% of the market was high solids. He noted that his firm has now projected that by 1985, 14% of the market will be high solids and, by 1990, that will increase to 20%. The basis for this optimistic forecast is ease of formulation, efficiency of application with existing equipment, economics, low V.O.C.'s and government regulations, and performance and versatility, stated Mr. Johnson. However, with all coatings systems, certain shortcomings must be faced, and high solids are no exception. Mr. Johnson said that problems occur when formulating in darker colors, semigloss and metallic coatings. Consequently, Cargill has developed a new technology called water-extendible high solids, said Mr. Johnson.

According to Mr. Johnson, polyester resins seem well suited to this water-extendible concept. This is true especially where certain coatings resins with high hydroxyl values, that normally would not be soluble, will imbide a limited amount of water to give transparent mixtures. By careful selection of formula ingredients, high solids can be formulated which can be thinned 20 to 54% with water, causing few undesirable side effects and improving certain film properties.

Mr. Johnson explained that with 24 to 50% of the organic solvent replaced with water, low V.O.C. requirements can be met, using specially designed polyester resins, whose viscosity will decrease as the water is added.

A series of representative paint formulas were presented. These demonstrated formulation and performance parameters in the cases when water additions were made where water-extendible polyester resins were used. Mr. Johnson stressed that these prototype enamel formulations were adequate starting points for formulating chemists.

Mr. Johnson presented some observations of formulations and properties.

(1) Water-diluent levels: Exact effects of each resin will have to be determined. But overall, the presence of water appears as likely to help the overall balance of properties as to hurt it. Gloss, hardness, and scribe blistering resistance improved, but impact resistance and humidity resistance showed inconsistent results.

(2) Amino resins level: Various ratios of resin to HMMM were evaluated with no significant performance changes noted. Water-extendibles did, however, consistently show better performance characteristics than water-reducible enamels and compared favorably with solvent reducible polyester enamels.

(3) Polymeric melamine/Formaldehyde crosslinkers: No adverse effects were noted with either and some improvement in humidity and salt spray resistance was noted.

(4) Additives: Non-water-reducible rheology control additives, such as cellulose acetate butyrate, can be added to improve sag resistance. Liquid epoxies can be used with water-extendible polyesters. Dimethyl etharol amine, in low levels, can help color acceptance and also prevent flash rusting. Metallics may also be formulated by adding the water portion to the formula at the time of application, so long as the aluminum pigment is dispersed in the base resin and treated with a hydrophobic silica.

(5) Stability: No problems have been noted with stability, but lined containers should be used if storage is to take place after water is added.

Q. In your test work, what was the ph of your water?

A. Approximately 5.5. We did evaluate tap water from various parts of the country, and encountered no difficulty with the different lots of water.

Q. When you increased the hydroxyl values of your resin, what effect did this have on corrosion resistance?

A. None that we were able to determine, but we did stay within certain predetermined limits.

Q. What is the approximate cost of these new resins?

A. Under $1.00 per pound, probably in the mid $.90/pound range.

Q. Do you have any knowledge of these resins being used in a dip system and do you feel they are practical for this type of application?

A. We have no knowledge of their use in this fashion, and question if high solids can be formulated to work in dip systems.

Q. Do you have any results of exterior durability tests with water-extendible polyesters?

A. Yes, we have 18 months of Florida exposure with a loss of only about 20 gloss units and we rate that as being very good.

Q. If these polyesters were to be baked, what sort of cycle do you recommend?

A. About 300-325°F for 10 minutes should be adequate.

Q. Your tests show a 30% melamine content as having poorer salt spray resistance than a 20% content. Did you do any studies comparing hydroxyl content versus melamine content?

A. No, but we know that you cannot allow any free melamine available. It all has to be tied up. In theory, they would like to see a 12% melamine content, but it does not work out at that level. Probably a 25% content is more realistic.

JOSEPH L. MASCIA, *Secretary*

ROCKY MOUNTAIN .....SEPT.

"Vinylidine Chloride"

President Donald Shillingburg introduced the officers for 1983-84 which include: Vice-President—Larry Lewandowski; Secretary—Carwin Beardall; Treasurer—Craig R. Hansen; and Society Representative—James E. Peterson.

A moment of silence was observed for Society Retired Member, George Hartter, who recently died.

Educational Committee Chairman, Steve Crouse, reported on a training program that the Committee is trying to establish.

Violet L. Stevens, of Dow Chemical Co., presented "VINYLIDINE CHLORIDE: A COMONOMER FOR SURFACE COATINGS RESINS."

CARWIN BEARDALL, *Secretary*

ST. LOUIS...............SEPT.

"Environmental Update"

Past-President Joseph J. Wrobel, Jr. installed Robert J. Giery as President. President Giery was presented the Nuodex Gavel by Fran Wagner, of Mozel Chemical Products. A Past-President's Pin was awarded to Mr. Wrobel. New officers for 1983-84 include: President-Elect—William Truszkowski; Secretary—Charles L. Grubbs; Treasurer—Merle D. Held; and Society Representative—Thomas Fitzgerald, Sr.

A moment of silence was observed in honor of the memory of Ralph Gatti, Society Past-President, who died during the summer.

Educational Committee Chairperson, Suzanne Bailey, discussed a request from the American Chemical Society for support of a high school function during its spring meeting in St. Louis. The consensus was that the society will support this effort.

President Giery presented the Technical Committee's report. He stated that the present project is almost complete and asked for suggestions for a new project. One of the suggestions was for an audio visual presentation which could become a permanent teaching and training tool.

Twenty-five Year Pins were presented to Dr. Herman Lansen, of Lanchem Corp., and Francis Schulte, of Schulte Paint Co. Fran Wagner, of Mozel Chemical Co., Elmer Meyer, and A.F. Gross, of Missouri Paint & Varnish Co., were also honored as 25-Year Members but were not present to receive their pins.

Howard Jerome, of Spatz Paint Industries, Inc., and Environmental Control Commitee Chairman, Richard Storm, of Sinnett Lacquer Manufacturing Co., presented an update on the Missouri Department of Natural Resources proposals for new laws to enhance the environmental quality in the St. Louis and Kansas City areas.

It was stressed that these laws in present form are not realistic. Mr. Jerome explained that Missouri wants to identify the products made, how many solvents are used, the amount of solvents, and the specific gravity. They are under pressure from the National Environmental Protection Agency to come up with a set of standards for St. Louis and Kansas City.

Mr. Storm discussed the surplus raw material forms program which was initiated last year. He said that there will be a $5.00 per page charge for this year's forms to be paid by the companies submitting the forms for inclusion with the monthly mail. Upon a request from the membership, it was decided by acclamation that surplus equipment could be included on the listing.

Dr. Hugh Smith, of Sun Chemical Corp., presented a talk entitled, "ENVIRONMENTAL UPDATE."

Dr. Smith discussed how the new government regulations will effect the coatings industry. He also spoke of the pitfalls in allowing scientific regulations to be prepared by non-scientists.

CHARLES GRUBBS, *Secretary*

WESTERN NEW YORK...SEPT.

"High Solids Coatings"

Robert N. Price, of Spencer-Kellogg, Div., Textron, Inc., presented "HIGH SOLIDS COATINGS ARE HERE!"

Mr. Price pointed out that as recently as six or seven years ago, high solids coatings were still largely a lab curiosity. Even three-four years ago, polyesters were the only high solids resins in the market place. Today, a broad variety of polymer types are available to the coatings formulator, including: polyesters, air-dry and bake alkyds, two-component urethanes, VT copolymers, polyester-epoxy, etc.

Based on strong interest shown by individual companies and supported by results of a broad market survey, it is clear that high solids coatings have arrived as one of the viable coatings systems of the future—and are here to stay. They will undoubtedly be the fastest growing segment of the industrial finishes market in the immediate future.

Reasons for high solids rapid acceptance as well as performance and formulating information on the various resin systems were discussed by Mr. Price.

CHARLES C. TABBI, *Secretary*

TO OUR READERS:

The JOURNAL OF COATINGS TECHNOLOGY welcomes any responsible views pertaining to the Coatings Industry, Federation activities, and the editorial content of the JCT. Letters should be brief and signed with the writer's address and company affiliation.

Correspondence should be addressed to: Letters to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

Future Society Meetings

Baltimore

(Jan. 19)—Speaker from Universal Color Systems.

(Feb. 16)—EDUCATIONAL COMMITTEE PRESENTATION.

(Mar. 15)—SOCIAL COMMITTEE NIGHT.

(Apr. 19)—TECHNICAL STEERING COMMITTEE PROGRAM.

(May 17)—ANNUAL BUSINESS MEETING AND ELECTION OF OFFICERS.

(June)—JOINT OUTING WITH BPCA.

Birmingham

(Jan. 12)—"THE TECHNICAL DEPARTMENT—A DRAIN ON RESOURCES OR AN AID TO PROFITABILITY"—Dr. P.P.W. Weiss, Croda Paints.

(Feb. 2)—"MONITORING LEAD IN PAINT PRODUCTION"—A.C.D. Cowley, Imperial Chemical Industries PLC.

(Mar. 1)—"POWDER COATINGS MANUFACTURING METHODS PRESENT AND FUTURE"—E.W. Byerley, Byerley Machinery Sales.

(Apr. 5)—"SATURATED POLYESTER DEVELOPMENTS FOR THE INDUSTRIAL PAINT INDUSTRY"—B. Langdon, Dynomit U.K. Ltd.

(May 3)—"Trends in Automotive Finishes"—R. Hurn, Ford Motor Co. Ltd.

Chicago

(Jan. 9)—"SOLVENT RECYCLING"—Richard Schlack, Hydrite Chemical. "DIATOMITE FOR THE COATINGS INDUSTRY"—Thomas E. Remmers, Manville Products Corp.

(Feb. 6)—"ORGANO CLAYS: A NEW LOOK AT A MATURE PRODUCT"—Thomas W. Powell, Jr., United Catalysts, Inc. "LIGHT SCATTERING EXTENDERS"—Craig J. Stoneback, Englehard Corp.

(Mar. 5)—"OVERVIEW AND CONCEPTUAL DESIGN OF A MODERN PAINT DEPARTMENT"—Thomas Daly, Ace Paint Div. "ILLINOIS ENVIRONMENTAL REGULATIONS AS THEY AFFECT COATINGS"—Karl Franson, Illinois E.P.A.

(Apr. 2)—"COLLOIDAL SILICA—A UNIQUE PIGMENT" R. Thornton, Nalco Chemical Co. "ROLE OF ADDITIVES IN THE '80'S"—E. Antonucci, Drew Chemical Co.

(Apr. 27)—AWARDS NIGHT.

Cleveland

(Jan. 17)—Topic to be announced—Irving Foote, SCM Corp.

(Jan. 18)—Joint Meeting with CPCA.

(Feb. 21)—"RHEOLOGY OF LATEX SYSTEMS"—Irving Krieger, Case Western Reserve University.

(Mar. 20)—Manufacturing Committee to sponsor Plant Tour.

(Apr. 16)—"WATER-BORNE MAINTENANCE COATINGS"—Speaker from Spencer-Kellogg Div., Textron, Inc.

(May 21)—Annual Meeting/Spouses' Night. "PAINT EXAMINATION TECHNIQUES UTILIZED IN THE FBI LABORATORY"—James E. Corby, Federal Bureau of Investigation.

Detroit

(May 15)—Joint Meeting with DPCA.

Golden Gate

(Jan. 17)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(Mar. 14)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 18)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 16)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

Houston

(Jan. 11)—"COMPOSITE VS. SINGLE DISPERSANTS IN COLORANTS AND COATINGS"—Elio Cohen, Daniel Products Co.

(Feb. 11)—Lady's Nite Out.

(Mar. 14)—"POWDER HANDLING WITH THE AIR PALLET SEMI-BULK CONTAINER SYSTEM"—Charles S. Alack, Semi-Bulk Systems, Inc.

(Apr. 12-14)—Southwestern Paint Convention.

(May 9)—"CONTROL FOR THE MODERN PAINT PLANT"—James T. DeGroff, Applied Color Systems, Inc.

Kansas City

(Jan. 12)—"APPROACH TO FORMULATION OF ARCHITECTURAL AND MAINTENANCE COATINGS"—John C. Ballard, Kurfees Coatings, Inc.

(Feb. 9)—"CURRENT USE AND TRENDS OF ACCELERATED WEATHERING TESTS IN THE U.S."—R. "Woody" Metzinger, Atlas Electronic Devices.

(Mar. 8)—Ladies' Night.

(Apr. 12)—"DISPOSAL OF HAZARDOUS COMBUSTIBLE WASTE"—Melvin C. Eifert and Joseph J. Durczynski, Systech Corp.

(June 8-9)—Joint Meeting of the Kansas City and St. Louis Societies.

Los Angeles

(Jan. 11)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(Feb. 8)—LADIES NIGHT.

(Mar. 14)—PAST PRESIDENTS' NIGHT. "INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 11)—MANUFACTURING SEMINAR/BOSSES' NIGHT. "DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 9)—AWARDS NIGHT. "THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

(June 13)—ANNUAL MEETING/ELECTION OF OFFICERS. TECHNICAL COMMITTEE PROGRAM.

Montreal

(Jan. 11)—"COATINGS AND THE DEPARTMENT OF NATIONAL DEFENSE"—A. Afzal, Department of National Defense.

(Feb. 8)—"INFLUENCE OF SURFACE PREPARATION UPON PERFORMANCE OF PROTECTIVE COATINGS IN ATMOSPHERIC ENVIRONMENTS"—John D. Trim, Corrosion Service Co., Ltd. Joint Meeting with N.A.C.E.

(Feb. 14)—SYMPOSIUM—"UPDATE ON TRANSPORTATION COATINGS."

(Mar. 7)—Technical Committee's Presentation, "COLOR ACCEPTANCE"—Steve Velente.

(Apr. 4)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(May 2)—MANUFACTURING COMMITTEE'S PRESENTATION.

New York

(Jan. 10)—"PROPELLOR AND TURBINE MIXERS"—Frank H. Tatreau, MixMor, Inc.

(Feb. 9)—LEGISLATIVE UPDATE AND JOINT MEETING WITH NYPCA.

(Mar. 13)—FEDERATION OFFICERS' VISIT.

(Apr. 10)—Subject to be announced.

(May 8)—PAVAC NIGHT.

Pacific Northwest

(Jan. 18)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(Mar. 15)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 19)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 17)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

Piedmont

(Jan. 18)—"LABORATORY CALCULATION TECHNIQUE AND THE PAINT CHEMIST"—James T. Degroff, Applied Color Systems, Inc.

(Mar. 21)—"PAINT EXAMINATION TECHNIQUES UTILIZED IN THE FBI LABORATORY"—James E. Corby, Federal Bureau of Investigation.

(Apr. 18)—"CURRENT USE AND TRENDS—ACCELERATED WEATHERING TESTS IN THE UNITED STATES"—R. Metsinger, Atlas Electric Devices Co.

(May 16)—"INERTING FOR SAFETY IN COATINGS PLANTS"—Kevin Donahue, Neutronics, Inc.

(June 20)—"COMPOSITE VS. SINGLE DISPERSANT IN COLORANTS AND COATINGS"—Elio Cohen, Daniel Products Co.

Pittsburgh

(Jan. 9)—PAST-PRESIDENTS' NIGHT AND 25-YEAR PINS. "MORE EFFICIENT INDUSTRIAL PAINTING"—Carl Izzo, Westinghouse Electric Corp.

(Feb. 6)—JOINT MEETING WITH THE PITTSBURGH CHAPTER OF THE NATIONAL ASSOCIATION OF CORROSION ENGINEERS.

(Mar. 5)—"TRENDS IN FUTURE COATINGS"—Dr. Marco Wismer, PPG Industries, Inc.

(Apr. 2)—"EFFECT OF SURFACE TENSION AND VISCOSITY ON SURFACE DEFECTS IN COATINGS"—Cliff Schoff, PPG Industries, Inc.

(May 7)—"INS AND OUTS OF TiO_2"—Richard Ensminger, NL Industries.

Rocky Mountain

(Jan. 10)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(Mar. 7)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 11)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 9)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

St. Louis

(Jan. 17)—"A LOOK AT THE COLORANT PILOT PLANT PRODUCTION AND THE MAKE-UP, USAGE, AND ADVANTAGES OF COLORANTS"—Dr. Marty Feldman, Nuodex Inc.

(Feb. 21)—LADIES' NIGHT.

(Mar. 20)—FEDERATION VISIT.

(Apr. 17)—TEACHERS' NIGHT.

(May 15)—MANUFACTURING NIGHT.

FSCT Membership Anniversaries

50-YEAR MEMBERS

Los Angeles

Carl C. Howson, Retired.

25-YEAR MEMBERS

Los Angeles

Gene E. Alley, E.T. Horn Co.
Wallace E. Brede, Spencer Kellogg Div., Textron, Inc.
Thomas Donohoe, TCR Industries, Inc.
Alfons J. Drzewinski, Decratrend Corp.
Vern Fifer, P.F.I. Inc.
Henry C. Jacoby, Specialty Coatings, Inc.
Kent Little, Retired.
Bert Osen, Behr Process Corp.
John G. Prinz, Sinclair Paint Co.
Maurice Gould Whittaker, Ram Chemicals.
Kevin A. Worrall, Textured Coatings of America, Inc.

Elections

BALTIMORE

Active

CZEBOTAR, MARTIN T.—Sherwin-Williams Co., Baltimore, MD.
DUCKETT, JR., ROBERT L.—Valspar Corp., Baltimore.
GROSS, JR., LAWRENCE J.—Bruning Paint Co., Baltimore.
KOERNER, JR., JOSEPH—Contact Paint & Chemical Co., Baltimore.
MILLER, ROBERT G.—Valspar Corp., Baltimore.
ROST, C. MCKINLEY—Valspar Corp., Baltimore.
SCHRUEFER, FRED—Contact Paint & Chemical Co., Baltimore.
SOMERVILLE, MARY—Bruning Paint Co., Baltimore.
WETZEL, MASON—Genstar Stone Products Co., Hunt Valley, MD.

Associate

ADAMS, STANLEY C.—Cello Corp., Havre De Grace, MD.
CARTY, KEN R.—Abell Lumber Corp., Lawrenceville, VA.
DIMARCANTONIA, RICH—Bruning Paint Co., Baltimore, MD.
HILLIARD, DONALD—Union Chemicals, Baltimore.
SHERMAN, DANA—Cummings Chem & Container, Elkridge, MD.
STENGER, JR., WILLIAM J.—E.I. Dupont de Nemours & Co., Inc., Wynnewood, PA.

BIRMINGHAM

Active

BENNETT, PAUL—Steetley Minerals, Etwall, Derbys, England.
CANTERFORD, BARRY A.—Valentine Varnish & Lacquer Co. Ltd., West Drayton, Middlesex, England.
DODD, WILLIAM—Sonneborn-Rieck, Westerndowns, Stafford.
PACE, G.—Trimite Ltd., Uxbridge, Middlesex.
RAJ, MULAKH—Astley Paints Ltd., N. Coventry, Warwickshire, England.
STRINGER, ROBERT—Charles Tennant Co. Ltd., Oadby Leicester, England.
VENUS, DEREK—Becker Paint Ltd., Cheslyn May, Walsall.

C-D-I-C

Active

FISHER, JR., C. EDWARD—Lilly Industrial Coatings, Indianapolis, IN.
NIEMEYER, ALFRED C.—Lilly Industrial Coatings, Indianapolis.

CHICAGO

Active

BURT, ARLENE R.—Sun Chemical Corp., Northlake, IL.
CAPLAN, BETH A.—The Enterprise Companies, Wheeling, IL.
COTTON, II, SAMUEL F.—The Enterprise Companies, Wheeling.
CZICZO, RAYMOND J.—Reliance Universal, Inc., Zion, IL.
DOLAN, STEPHEN J.—V.J. Dolan & Co., Inc., Chicago, IL.
DREW, HELEN—DeSoto, Inc., Des Plaines, IL.
GREENWALD, JOHN R.—Arco Metals Co., Arlington Heights, IL.
JARRAD, MIKE—Rust-Oleum Corp., Evanston, IL.
MCINERNEY, JAMES R.—O'Brien Corp., South Bend, IN.
MOY, WYNN—Sherwin-Williams Co., Chicago.
ROCH, ANTONELLA—The Enterprise Companies, Wheeling.
ROSATI, JOSEPH A.—Sherwin-Williams Co., Chicago.
SCIENSKI, JOSEPH R.—O'Brien Corp., South Bend.
SMITH, JOANN—DeSoto, Inc., Des Plaines.

Associate

BENING, P. SCOTT—Mobay Chemical Corp., Rosemont, IL.
CAMPBELL, C.K.—Alcan Ingot & Powder, Chicago, IL.
CIEZ, MARGO—Rohm and Haas Co., Niles, IL.
COMERFORD, GENE—Atlas Electric Dev., Chicago.
DEVOTO, JOSEPH—Hilton-Davis Chemicals, Schaumburg, IL.
FERRARI, NANCY J.—Buckman Industries, Oak Park, IL.
GUSTITUS, WILLIAM L.—Mobay Chemical Corp., Rosemont.
HODGE, THOMAS C.—Dow Chemical USA, Rolling Meadows, IL.
MATERA, MICHAEL V.—Kay-Fries, Inc., Schaumburg.
MCCORMICK, ROBERT—Eiger Machinery Inc., Bensenville, IL.
METZINGER, RAY—Atlas Electric Devices, Co., Chicago.
MILLER DENNIS G.—Cabot Corp., Tuscola, IL.
O'CALLAGHAN, GARY—Hilton-Davis Chemical, Lombard, IL.
O'FARRELL, THOMAS F.—U.S.Movidyn, Chicago.
PETERSON, DAVE L.—Eiger Machinery, Inc., Bensenville.
PRODROMO, STEVEN E.—Hilton-Davis Chemical, Des Plaines.
RICE, KENNETH M.—Kenneth M. Rice Co., Bensenville.
WHITEMORE, JAY B.—Ropak Central, Inc., Elk Grove Village, IL.

HOUSTON

Active

SIPTAK, DWAINE—E.C.C. America Inc., Gonzales, TX.
STEWART, RICHARD W.—Esgard, Inc., Scott, LA.

Associate

BATT, JIM—Union Carbide Corp., Houston, TX.
GROSS, JR., JOSEPH A.—J.A. Gross Co., Inc., Houston.
ORR, SUSAN E.—Union Carbide Corp., Houston.

NEW ENGLAND

Active

DALZELL, HALDEAN—Skinner & Sherman Labs, Waltham, MA.
DEMETRIOU, JANICE R.—Virjune Manufacturing Inc., Waterbury, CT.
KATSEFF, DAVID A.—Syenergy Methods Inc., Cranston, RI.
PATTEK, PAUL J.—Syenergy Methods Inc., Cranston.

Associate

COTTON, ROY—Washburn-Linder & Co., Inc., Framingham, MA.
FITZPATRICK, GAIL M.—Harshaw Chemical Co., Jamestown, RI.
GELLER, DAVID B.—Pacific Scientific, Danville, NH.
MARTIN, GARY A.—Washburn-Linder & Co., Inc., Framingham.
MURRAY, RICHARD E.—Arco Chemical Co., Ware, MA.

NEW YORK

Active

BERNDLMAIER, RUDY—R.T. Vanderbilt Co., Norwalk, CT.
YOSHIHARA, ICHIRO—Kansai Paint Co., Ltd., New York, NY.

Associate

CASSHIE, TONY—McCloskey Varnish Co., Long Branch, NJ.
MACKENZIE, DAVID A.—Henley & Co., Inc., New York, NY.
MASSEY, EUGENE S.—Hercules Inc., Wilmington, DE.
SITVER, LEONARD—Dexter Chemical Corp., New York.
WYLLIE, KENNETH F.—Sherwin-Williams Co., Cincinnati, OH.

PHILADELPHIA

Active

BARTUSIAK, JOHN F.—Fielco Chemical Corp., Huntington Valley, PA.

Associate

CLARK, GARY W.—Nalco Chemical Co., Cherry Hill, NJ.
GIORDANO, JOSEPH J.—Products Research & Chemical Corp., Gloucester City, NJ.
ROTAR, FREDERICK D.—Netzsch Inc., Exton, PA.

SOUTHERN

Active

BEAN, CLINTON WAYNE—The Gilman Paint & Varnish Co., Chattanooga, TN.
EUDY, KAREN D.—Union Carbide Corp., Tucker, GA.
FRANCIS, ENRIQUE—Glidden Coatings, Atlanta, GA.
MANN, MARK A.—Mobile Paint Mfg. Co., Theodore, AL.
MCCLAIN, J.E.—Glidden Coatings, Atlanta.
RUSSELL, JAMES A.—PPG Industries, Inc., East Point, GA.
SMART, DALE—Burris Chemical Inc., East Point.
WALDO, ROSALYN M.—Glidden Coatings, Atlanta.
WRIGHT, PAUL—Burk-Hall Co., Memphis, TN.

Associate

BITTMANN, FREDERICK R.—Tampa Printing Co., Tampa, FL.
JANSEN, THEODOR—Mobay Chemical Corp., Atlanta, GA.
MCCALL, NORMAN—Chemarco Inc., Stone Mountain, GA.
MOSS, NORMAN W.—General Steel Drum Co., Stone Mountain.
POPE, PAUL—AZS Chemical Co., Atlanta.
VANOSSE, OLIVER—Martin Trading Corp., Ft. Lauderdale, FL.
WHITAKER, BART—Whitaker Oil Co., Atlanta.

Educator/Student

HOYLE, CHARLES E.—University of Southern Mississippi, Hattiesburg, MS.
HUTCHENS, DALE E.—Hattiesburg.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD; FRANK GERHARDT, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA).

BIRMINGHAM (First Thursday—Westbourne Suite, Botanical Gardens, Birmingham). D. H. CLEMENT, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ. England.

CHICAGO (First Monday—meeting sites in various suburban locations). MARTIN F. BALOW, United Coatings, Inc., 3050 N. Rockwell Ave., Chicago, IL 60618.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). BILL M. HOLLIFIELD, Perry & Derrick Co., Inc., P.O. Box 12049, Cincinnati, OH 45212.

CLEVELAND (Third Tuesday—meeting sites vary). SCOTT E. RICKERT, Case Western Reserve University, Cleveland, OH 44106.

DALLAS (Thursday following second Wednesday—Steak & Ale Restaurant). VAN G. FALCONE, Koppers Co., 801 E. Lee St., Irving, TX 75060.

DETROIT (Fourth Tuesday—meeting sites vary). AL MOY, Glasurit America, Inc., P.O. Box 38009—Fenkell Station, Detroit, MI 48238.

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabella's Restaurant on Fisherman's Wharf and Francesco's, Oakland, CA). SANDRA LUND, The O'Brien Corp., 450 E. Grand Ave., S. San Francisco, CA 94080.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX) ARTHUR MCDERMOTT, Nalco Chemical Co. P.O. Box 87, Sugarland, TX 77478.

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

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). HENRY J. KIRSCH, Trans Western Chemicals, 7240 Crider Ave., Pico Rivera, CA 90660.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). JOYCE SPECHT, Porter Paint Co., 400 S. 13th St., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary). GEORGE CARRINGTON, Nuodex Mexicana, Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). JEAN BRUNET, Van Waters & Rogers Ltd., 2700 Jean Baptist Deschamps, Lachine, Que., Can., H8T 1E1.

NEW ENGLAND (Third Thursday—Hillcrest Function Facilities, Waltham). MAUREEN M. LEIN, Raffi & Swanson, Inc., 100 Eames St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). RAYMOND P. GANGI, Woolsey Marine, 183 Lorraine St., Brooklyn, NY 11231.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). ALFRED F. YOKUBONIS, Celanese Specialty Resins, 5008 W. 99th St., Bloomington, MN 55437.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). GERALD MCKNIGHT, Lilly Industrial Coatings, 619 S.W. Wood St., Hillsboro, OR 97123.

PHILADELPHIA (Second Thursday—Dugan's Restaurant). ROBERT L. TOZER, Delkote, Div. of Lilly Ind. Coatings, Inc., 76 S. Virginia Ave., Penns Grove, NJ 08069.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood exit of I-85, High Point, NC.) MICHAEL DAVIS, Paint Products Co., Inc., P.O. Box 648, Walkertown, NC 27051.

PITTSBURGH (First Monday—Skibo Hall, Carnegie Mellon Univ.). JOSEPH MASCIA, Campbell Chemical Co., P.O. Box 11182, Pittsburgh, PA 15237.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). CARWIN BEARDALL, Howells, Inc., 4285 S. State St., Salt Lake City, UT 84107.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). CHARLES L. GRUBBS, Rockford Coatings Corp., 1825 Ave. H, St. Louis, MO 63125.

SOUTHERN (Gulf Coast Section—Various Dates; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). S.G. SANFILIPPO, Reichhold Chemicals, Inc., Technical Services Lab., P.O. Box 1610, Tuscaloosa, LA 35401.

TORONTO (Second Monday—Cambridge Motor Hotel). GORDON MAJOR, Mactac Canada Ltd., 100 Kennedy Rd., S., Brampton, Ont., Can., L6W 3E8.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). CHARLES C. TABBI, Spencer-Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 13319.

Kent State University Offers Short Courses

Kent State University, Kent, OH, will present three short courses designed for polymer and coatings specialists in the spring of 1984. The courses will cover the subjects of dispersion, adhesion, and thermal and rheological characterization of coatings and polymers.

Sponsored by the Rheology and Coatings Division of the Chemistry Department, the short courses are:

"Dispersion of Pigments and Resins in Fluid Media"—May 7-11.

Featuring industry and university experts knowledgeable on the subject of dispersion, the course will concentrate on the fundamentals of surface chemistry and physics related to dispersion of pigments and resins in water and classic systems. The session will also focus on lectures pertaining to the mechanics of dispersion and the selection of the dispersion equipment for specific needs.

"Adhesion Principles and Practice for Coatings and Polymer Scientists"—May 21-25.

Designed to review adhesion principles, the course also discusses adhesion promoters, surface analysis and preparation, the rheology of application and fracture of joints, adhesion measurements, environmental effects on adhesive joints, and the science of structural, composite, plastic, and elastomer adhesives.

"Thermal and Rheological Characterization of Coatings and Polymers"—June 4-8.

Additional information may be obtained by contacting Dr. Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242; or by calling (216) 672-2327.

ACS Issues Call for Papers For Pacific Chemical Congress

The American Chemical Society has issued a Call for Papers for the 1984 International Chemical Congress of Pacific Basin Societies. Co-sponsored by the ACS, The Chemical Institute of Canada, and the Chemical Society of Japan, the Congress will be held December 16-21, 1984, in Honolulu, Hawaii.

The program will feature 60 symposia and a large number of general papers covering the topics: Agrochemistry, Analytical/Clinical/Environmental/Health Chemistry, Applied Chemistry, Biological/Pharmaceutical Chemistry, Catalysis/Colloidal/Physical/Surface Chemistry, Economics/Management, Geo/Inorganic Nuclear Chemistry, Information Transfer/Computation, Macromolecular Chemistry, and Organic Chemistry.

Authors wishing to submit abstracts for consideration should contact the ACS for information at: PAC CHEM '84, Meetings and Divisional Activities Dept., American Chemical Society, 1155 Sixteenth St., N.W., Washington, D.C. 20036.

Graduates in Polymers and Coatings from EMU

In the Spring of 1984, Eastern Michigan University will graduate its first class of majors in Polymers and Coatings.

Program requirements for graduation in the 124 credit hour program, include the following:

—9 credit hours in the formulation and evaluation of coatings

—10 credit hours in polymer synthesis and characterization

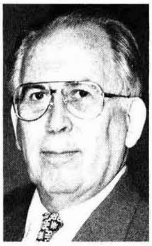
—a four-month cooperative education experience in industry

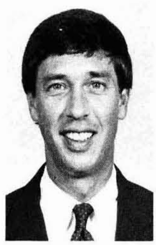
—37 credit hours in chemistry

Employers interested in interviewing these candidates on campus or obtaining more information regarding the program are urged to contact the program coordinator. Inquiries may be addressed to:

Dr. John C. Graham
EMU
130 Sill Hall
Ypsilanti, MI 48197
(313) 487-1161

People


R.L. Feller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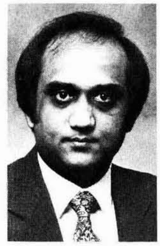
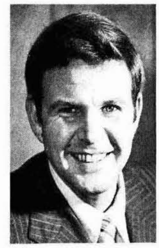

S. Patel


J. Molski

Dr. Robert L. Feller, Director of the Research Center on the Materials of the Artist and Conservator at Mellon Institute, is the recipient of the 1983 Pittsburgh Award presented by the Pittsburgh Section of the American Chemical Society. The Award is presented "as a tribute to his international recognition as an expert in placing the conservation of art works on a scientific basis and for using the international language of chemistry to show the important relationship between the physical sciences and art." Dr. Feller is a member of the Pittsburgh Society.

The appointment of **Stephen B. Lasine** as Sales Representative was announced by McCullough & Benton, Inc., Atlanta, GA. Mr. Lasine is responsible for the areas of North and South Carolina. Prior to his appointment, Mr. Lasine served as Regional Sales Manager for Southchem, Inc., Durham, NC. He is a member of the Piedmont Society and is currently serving as the Society's Treasurer.

O'Brien Corp., South San Francisco, CA, has announced the following appointments.

James Ross has been named Vice-President of the Product Finishes Group, Chemical Coatings Division.

Louis Vincent has rejoined the firm as Vice-President of Napko Protective Coatings. Most recently Vice-President and General Manager of an offshore maintenance contractor in Louisiana, Mr. Vincent has previous experience as Vice-President of Napko Industrial/Marine.

Promoted to Corporate Quality Assurance Director is **Karl L. Erickson.** Previously, Mr. Erickson served as Manufacturing Manager of the company's Southwestern facility in Houston, TX. He is a member of the Houston Society.

John Macrae has joined the firm as Technical Manager for the Napko Protective Coatings Group headquartered in Houston. He most recently served as Technical Director of International Paint, New Orleans, LA. Mr. Macrae is a Southern Society member.

John J. Espelage has been elected President of Ameritone Paint Corp., a subsidiary of Grow Corp., Long Beach, CA.

Muralo Co., Bayonne, NJ, has appointed **Shashi Patel** to the position of Vice-President for Technology. Prior to his promotion, Mr. Patel served as Technical Director. He is a New York Society member.

Joseph A. Budash has been named Vice-President for Research and Development of the Scott Paint Corp., Sarasota, FL. In this capacity, Mr. Budash continues in the development of new coatings and assumes the responsibility for the market development of those products. Mr. Budash is a member of the Southern Society and is the immediate Past-Chairman of its Central Florida Section. He also served as the Society's Chairman of the Technical Committee which prepared the consumer guide, "Know Paint Quality Before You Buy."

Dr. George E. Pekarek has been appointed Associate Director of Trade Maintenance Coatings, Research and Development for Glidden Coatings and Resins, Div. of SCM Corp., Strongsville, OH. Prior to his appointment, Dr. Pekarek served as Technical Manager of Trade Maintenance Coatings. He is a member of the Cleveland Society.

Also announced by Glidden is the appointment of **James E. Depew** as Director of Purchasing.

Dr. Gary W. Simmons, Professor of Chemistry at Lehigh University, Bethlehem, PA, has been appointed Director of the University's Center for Surface and Coatings Research. He succeeds **Dr. Henry Leidheiser, Jr.,** who retired from the position to return to full-time teaching and research activities.

Dr. Simmons, a member of the Lehigh faculty since 1970, is a specialist in the fields of surface chemistry and electron spectroscopies used in surface analysis.

John Molski has been named Technical Director of United Gilsonite Laboratories, Scranton, PA. Prior to his promotion, Mr. Molski was Assistant Technical Director. He is a member of the Philadelphia Society.

The firm has also promoted **Frank Balish** to Vice-President, Manufacturing. Prior to his appointment, Mr. Balish was Purchasing Agent, Materials Manager, and General Manager.

Alex Siegel, Director of Technical Service and Product Application for Silberline Manufacturing Co., Lansford, PA, has announced his retirement effective August 31.

Prior to his employment with Silberline, Mr. Siegel had been employed as Plant Manager and Technical Director of Everseal Manufacturing Co., Ridgefield, NJ.

Mr. Siegel was a member of the New York Society and the NYPCA. He served as president of the NYPCA's Young Executive Group. Mr. Siegel was also chairman of the Technical and Standards Committee of the Aluminum Association.

Mr. Siegel will remain active in the coatings field by serving as a private consultant from his current residence at 221 Wilson Dr., Hazelton, PA 18201.

Several appointments have been announced by Kenrich Petrochemicals, Inc., Bayonne, N.J.: **O.B. Samler** to Vice-President-Sales; **Charles A. Lucania** to Vice-President-Operations; **Raja M. Dakwala** to Plant Manager; **Jeffrey J. Buda** to Eastern District Sales Manager; **Thomas J. Schirripa** to Southern District Technical Sales; **James M. Harris** to Buyer; **Steven W. Amato** to Assistant Lab Manager; and **James C. Evans** to Laboratory Technician.

S.C. Johnson and Son, Ltd. has appointed **John F. Ambury** Product Specialist for its Canadian Specialty Chemicals Group. He is responsible for marketing and technical sales support for Johnson Wax polymer products used by the ink and coatings industries. Mr. Ambury is a member of the Toronto Society.

Geoffrey Broadhurst and **Loren R. Munson** have exchanged positions in the Plastics and Additives Division of Ciba-Geigy Corp., Hawthorne, NY, in cooperation with the division's Management Development Program.

Mr. Broadhurst was named Director of Marketing and Sales for the Resins Department, and Mr. Munson was appointed Director of the Coatings, Radiation Curing, and Photography Business Center in the Additives Department. Both have experience in the sales and marketing of plastics and coatings.

Mr. Broadhurst joined the Additives Department in 1963 and served in several sales and marketing positions. He directed the Coatings, Radiation Curing, and Photography Business Center since 1978.

Starting as Manager of New Product Development with the Resins Department in 1974, Mr. Munson subsequently was appointed Sales Manager. He was named Director of Marketing in 1980 and Director of Marketing and Sales two years later. Mr. Munson is a member of the New York Society.

Tioxide of American, Inc., has appointed **Tony E. Sacco** Pigments and Solvents, Inc., as a distributor of Tioxide titanium pigments and titanates. Mr. Sacco had been a Vice-President of Sales at Fisher-Calo Chemicals & Solvents Corp. for the past 23 years. He is a member of the Chicago Society.

H.R. Garner has been appointed General Manager, Surface Technology Department for Harshaw Chemical Co., Cleveland, OH. Prior to his appointment, Mr. Garner was Business Manager for the department's Industrial Finishing Group.

Martin E. Havlin has been named Automotive Technical Director of Wyandotte Paint Products Co., Troy, MI. Prior to his appointment, Mr. Havlin had been associated with Celanese Corp.

Allan Bullman has joined the technical staff of Superior Sealants, Atlanta, GA. He was formerly associated with Union Carbide Corp.

Tony Casshie has been named Sales Representative in the Industrial Division of McCloskey Varnish Co., Philadelphia, PA. Mr. Casshie will represent the firm in Eastern Pennsylvania, New Jersey, and New York. Prior to his appointment, Mr. Casshie was associated with Harshaw Chemical Co.

Russ Lyons has been promoted to Manager of Manufacturing for Chemical Coatings Division of the Sherwin-Williams Co., Chicago, IL. Previously, Mr. Lyons served the division as Plant Manager of the Chicago paint plant.

Raymond E. Martin has been promoted to District Sales Manager for Manville Filtration and Minerals. Based in Atlanta, GA, Mr. Martin is responsible for sales of all filtration and mineral products in a 12-state area in Southeastern United States. Prior to his promotion, Mr. Martin served as Senior Sales Representative in the New York metropolitan region.

Mautz Paint Co., Madison, WI, has announced the appointment of **Dan Drury** to Vice-President of Operations.

Fred Marschall has been promoted to Vice-President, Manufacturing and Research, of D.P.I. Quality Paints, Inc., Clearwater, FL. Mr. Marschall, a member of the Southern Society, has 25 years experience in the paint and coatings industry, and most recently served as the company's Plant Manager and Technical Director.

Theo Borsboom has been appointed Executive Vice-President and General Manager of Hempel's Marine Paints, Inc., Wallington, NJ.

PPG Industries' Coatings and Resins Division has announced the appointment of **Jack D. Linn** to the position of Assistant to the Vice-President of Automotive and Industrial Products. Prior to his appointment, Mr. Linn had served as Manager of Coil, Container, and Appliance Products for the Div.

Henkel Corp., Minneapolis, MN, has announced two promotions in its Technology Group. **Thomas N. Juday** has been named Vice-President, Director of Engineering. Promoted to Vice-President, Director of Research, is **Kenneth D. MacKay.**

Clifford G. Ruderer has been named Marketing Manager for the Coatings Division of Ferro Corp., Cleveland, OH.

The appointment of **Laurence A. Backus** as Systems Sales Manager for the Color Communications Group has been announced by Macbeth, a division of Kollmorgen Corp. Mr. Backus is based in Belmont, MA.

The Golden Gate Society presented $1,000 scholarships to two children of Society members: (1) Dean Powell, of the University of California at Berkeley and (2) Scott Waldron, of California Polytechnic Institute. Their dads are associated with the Sherwin-Williams and duPont Cos., respectively.

Obituary

William B. Manuel, 69, died September 29. He served as Western Regional Vice-President of the National Paint and Coatings Association in 1979–80 and was President of the Golden Gate Paint and Coatings Association in 1975.

Mr. Manuel was Sales Administrator for Pacific Coast Chemicals since 1978. Previously, he had been associated with Tenneco Chemicals, Inc. and California Ink.

Richard J. Stark, 66, President of Empire State Varnish Co., Inc., Brooklyn, NY, died September 24.

Mr. Stark began his carrer at Stark in 1935 and became President of the firm in 1972. He attended Pratt Institute, Brooklyn, majoring in Chemistry.

Mr. Stark was associated with the New York Society for Coatings Technology and was a 40-Year Club member of the NYPCA.

William A. Harshaw, President of Harshaw Chemical Co. from 1967 to 1983, died on September 20 in Moreland Hills, OH. He was 63. He was the grandson and namesake of the founder of Cleveland Commercial Co., which later became Harshaw.

Nathan W. (Bud) Putnam, formerly with Imperial Color and Chemical Co., died on August 21, in Glens Falls, NY. He was 84. He was associated with Imperial for 37 years until his retirement in 1965. He served in various sales capacities and rose to Director of Sales and Assistant General Manager of Operations. He was Secretary of the Cleveland Paint and Coatings Association for 13 years and served as its President in 1941.

Literature

Tanks

Information is available on liquid storage tanks which are flat bottom tanks constructed of heavy steel with welded seams to withstand maximum loads and prevent ruptures. Standards and capacities of the tanks are listed. For literature, contact Certified Equipment & Manufacturing Co., P.O. Box 298, Springfield, IL 62705.

Elastomeric Coating

A new elastomeric coating developed for application on flexible substrates and cures at a lower temperature than currently available elastomeric coatings is featured in recent literature. Application uses, performance characteristics, and advantages of Polane® Elastomeric are highlighted. For additional information, write Sherwin-Williams Co., Chemical Coatings Div., 11541 S. Champlain Ave., Chicago, IL 60628.

Additive

Literature featuring a new, super dispersible organclay rheological additive is now available. Bentone SD-2 is described and its use with coatings based on medium to high polarity solvents is explained. Its application advantages are highlighted which include its use to simplify paint making and provide greater formulating and production flexibility. For additional information, contact NL Chemicals/NL Industries, Inc., P.O. Box 700, Hightstown, NJ 08520.

Plasticizer

An eight-page booklet on FLEXOL Plasticizer 4G0, a hexoate ester of tetraethylene glycol, is available. The products' usefullness as a primary plasticizer in rubber compounds and nitrocellulose lacquers, and as a secondary plasticizer in PVC compounds is discussed. Its outstanding characteristics, performance data, and compatibility with various other resins are included. Tables list physical properties, specifications, and shipping data for the plasticizer. Additional information is given on health effects and handling. Copies of "FLEXOL Plasticizer 4G0," designated F-40257D, are available from Union Carbide Corp., Specialty Chemicals Div., Dept. K3446, Danbury, CT 06817.

Corrosion Inhibitors

A new brochure is available which introduces a new generation of phosphate-based corrosion inhibitors for open recirculating cooling water systems. How CONDUCTOR™ cooling water products control corrosion in single and mixed metal systems is explained, as are the products' capabilities and proven advantages. For a copy of the literature, contact Hercules Incorporated, Hercules Plaza, Wilmington, DE 19894.

Organic Preservative

Literature is available featuring a new liquid organic preservative designed specifically for water-based systems. Highlighted is the preservative's ability to impart excellent anti-microbial protection which arise from bacterial contamination such as viscosity loss, gassing, and off-odors. Discussed is how the preservative does not discolor, or affect the physical properties of the composition. Also, its capability of being heat stable is explained as is its ability to be added during any point of manufacturing. For additional information, contact Cosan Chemical Corp., 400 Fourteenth St., Carlstadt, NJ 10172.

Color Recognition System

A small, low-cost color recognition system capable of sorting products by color or detecting out-of-tolerance shades of a specific color quickly and easily is featured in recent literature. Features, modes of operation, and advantages of the Color Discriminator™ system are described. Further information may be obtained from Macbeth, division of Kollmorgen Corp., Dept. CD, P.O. Box 950, Newburgh, NY 12550.

Phenolic Resin

A new phenolic resin developed primarily for high-solids coatings has been introduced in recent literature. CK-2500 is described as a non-heat reactive, 100% phenolic, oil-soluble resin. Its solubility and low viscosity, which facilitate the formulation of high-solids coatings complying with the most stringent air pollution regulations, are discussed. Also featured are its major application uses and advantages. Further information can be obtained from Union Carbide Corp., Specialty Chemicals Div., Dept. K3442, Danbury, CT 06817.

Emulsions

Literature is available introducing a new generation of super vinyl acrylic copolymer emulsions with superior wet adhesion. Design of the emulsion is described as are its useful advantages. For further information, contact Thibaut & Walker Co., 49 Rutherford St., Newark, NJ 07105.

Hardener

Information is available on a new, unique, medium viscosity amine based hardener which yields superior chemical, solvent and inorganic acid resistant coatings when formulated with either standard or multifunctional epoxy resins. Recommended uses, suggested formulations, and test results of the hardener are detailed. For additional information, contact Ciba-Geigy Corp., Resins Dept., Three Skyline Dr., Hawthorne, NY 10532.

Products and Services Directory

A complete directory of special purpose chemical and petroleum products has been recently published. Designed as a convenient reference, the directory lists hundreds of product categories and, within them, specific products in alphabetical order. They range from absorbers (dust) to zinc stearate and apply to a host of industries. The directory also presents a brief profile with sales office and plant addresses for each of 18 domestic and three other North American operations. Major businesses include metal finishing chemicals, plastics additivies, industrial coated fabrics, automotive and industrial lubricants, organic chemicals, filter aids, asphalt specialties, battery parts, graphic arts materials, and special purpose petroleum products. Copies of the directory may be obtained from the Marketing Communications Dept., Witco Chemical Corp., 520 Madison Ave., New York, NY 10022.

Clays

Literature is available featuring two new grades of acid-washed clays for the paint and adhesives industries. Features of the clays are highlighted and their design for fast dispersion in non-aqueous systems is discussed. Additional information is available from J.M. Huber Corp., Clay Div., Rt. 4 Huber, Macon, GA 31298.

Silicas

Literature is available introducing two new silica products. Performance and property data of Silene 732D and Hi-Sil 532-EP silica are featured. For additional information, write PPG Industries, Inc., One PPG Place, Pittsburgh, PA 15272.

UV Stabilizer

Information is available on a new heat stabilizer for PVC siding. Characteristics, applications, and advantages of Stanclere® T-233P, a liquid Estertin stabilizer, are highlighted. Literature is available from Interstab Chemicals, Inc., P.O. Box 638, New Brunswick, NJ.

Titanates

A patent survey covering the application of titanate coupling agents in various polymer composites is available. Copies are available from Kenrich Petrochemicals, Inc., P.O. Box 32, Bayonee, NJ 07002.

Storage Tanks

Cone bottom, Type 304 stainless steel ribbed tanks, which have 14 gauge shells and cone tops and 12 gauge cone bottoms, are featured in new literature. For information, write Certified Equipment & Manufacturing Co., P.O. Box 298, Springfield, IL 62705.

Polyolefin

A highly chlorinated, low-molecular weight resin dissolved in xylene is the subject of new literature. Featured is chlorinated polyolefin CP-343-3 (25%) and its uses as an adhesion promoting additive for primers, inks, and coatings, that are applied to polyolefin films or molded parts. For information, write Eastman Chemical Products, Inc., Chemicals, Div., Building 280, Kingsport, TN 37662.

Polymer

Field failures of coated exterior hardboard siding can be prevented in many cases when the primer is formulated from NeoCryl® A-622, a water-borne acrylic polymer which is featured in recent literature. Test data and formulations are discussed. For additional information, contact Polyvinyl Chemical Industries, 730 Main St., Wilmington, MA 01887.

Spectrocolorimeter

Literature is available which introduces a new color and appearance measurement instrument. The LabScan II™ Spectrocolorimeter is fully described as are its recommended uses and features. For additional information, contact HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090.

Industry Standards Directory

An *Index and Directory of U.S. Industry Standards* has been published and is now available. The two volume, 1,700 page set contains four sections. The first section is a subject index which contains over 4,000 subject headings covering over 20,000 standards representing over 35 standardizing bodies in the United States. Section 2 is a concordance of pre-1978 ANSI designations to current designations. Provided in Section 3 is a complete address and telephone number file for over 400 standardizing bodies. Section 4 contains the designation, date of issue, title, and added information for over 20,000 U.S. Industry Standards. The Index will be updated and expanded annually. The current edition is available for $425 (in the U.S.) from Information Handling Services, Inc., 15 Inverness Way East, Englewood, CO 80150.

Inorganic Chemicals

A complete line of inorganic chemicals for industry which include a broad range of industrial inorganics, acids, and salts, is described in a recently published bulletin. To obtain Bulletin 1556, write Ashland Chemical Co., Dept. IC, P.O. Box 2219, Columbus, OH 43216.

Formulating Guide

A guide to formulating air dry waterborne acrylic coatings for business machines is now available. The nine-page brochure offers formulation suggestions and performance data for coatings based on NeoCryl® A-645 and A-655, which are water-borne acrylic polymers that provide the basis for textured coatings on plastics and metals. Formulating Guide FG-1 is available from Polyvinyl Chemical Industries, 730 Main St., Wilmington, MA 01887.

Product Catalog

A new comprehensive catalog of chemicals and chemical products is now available. The catalog includes a listing of aliphatic and aromatic solvents, ethers, oxides, chlorinated solvents, alcohols, esters, ketones, amines, and glycols. Also included are glycol ethers, poly glycols, plasticizers, silicone products, fatty chemicals, specialty quats, fabric softening quats, antioxidants, acids, and inorganic chemicals. In addition, the brochure describes a line of metal finishing, textile, gas conditioning, and foundry products. Other products included are maleic anhydride, methanol, sodium sulfate, sulfur, high purity chemicals, HPLC solvents and reagents, carbon black, pressure sensitive adhesive resins, paper resins, crosslinking aqueous adhesive systems, and a broad range of general purpose and halogenated polyester, vinyl ester and bisphenol-A resins. The literature also describes gas curing coatings which cure in seconds without heat and a unique nationwide chemical waste collection service. For a copy of the catalog, request Bulletin 1558 from Ashland Chemical Co., Dept. TW, P.O. Box 2219, Columbus, OH 43216.

Color Control Systems

Literature is available introducing a new series of economical computer color control systems, which include the IBM personal computer, feature color graphics display, and utilize COLOR-CALC software, a program package recently developed. For more information, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08540.

Additive

The second member of the BENTONE family of super dispersable organoclay rheological additives, BENTONE SD-2 additive, is introduced in new literature. Uses of the additive are discussed which include its use in ketones, esters, glycol ethers and esters, and alcohols. For information, contact NL Chemicals, P.O. Box 700, Hightstown, NJ 08520.

Coming Events

FEDERATION MEETINGS

(May 15–18)—Federation "Spring Week." Manufacturing Seminar on 15th and 16th; Society Officers on 17th; and Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

(Oct. 24–26)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1985

(May 14–17)—Federation "Spring Week." Seminar on 14th and 15th; Society Officers on 16th; and Board of Directors on 17th. Hilton Hotel, Baltimore, MD. (FSCT, 1315 Walnut St., Philadelphia, PA. 19107).

(Oct. 7–9)—63rd Annual Meeting and 50th Paint Industries' Show. Convention Center, St. Louis, MO. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

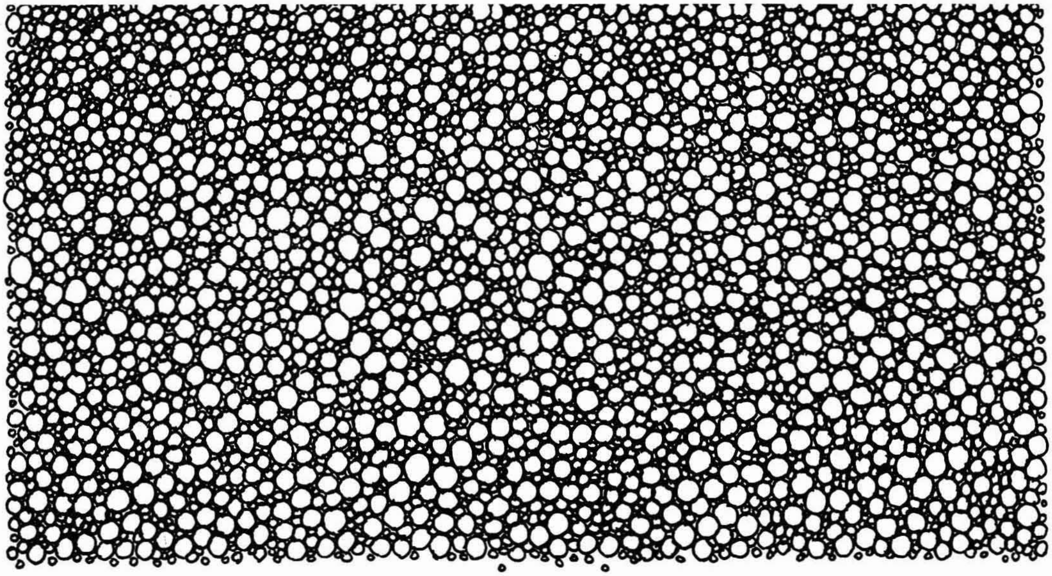
SPECIAL SOCIETY MEETINGS

(Jan. 17–18)—Cleveland Society for Coatings Technology. Joint Manufacturing Committee Symposium with the Cleveland PCA. "Tools for Tomorrow: Increased Profitability Thru Innovative Manufacturing Concepts." Cleveland Engineering Center. (Frank Passen, McNally-Weber Co., P.O. Box 18152, Cleveland, OH 44118).

(Feb. 7–9)—"Water-Borne and Higher-Solids Coatings" Symposium sponsored by the Southern Society for Coatings Technology and the University of Southern Mississippi. New Orleans, LA. (Dr. Gordon L. Nelson, Chairman, Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS 39406).

(Mar. 7–9)—Southern Society for Coatings Technology. Fiftieth Anniversary Meeting. Surfside Hotel, Clearwater, FL. (James E. Geiger, Sun Coatings, Inc., 12295 75th St., N., Largo, FL 33543).

(Apr. 12–14)—Southwestern Paint Convention of Dallas and Houston Societies. Shamrock Hilton Hotel, Houston, TX. (John Pennington, Cron Chemical Corp., P.O. Box 14042, Houston, TX 77021).



(Apr. 18)—Environmental Symposium sponsored by the Louisville Society for Coatings Technology and the LPCA. Marriott Inn, Clarksville, IN. (Joyce Specht, Porter Paint Co., Coatings Div., 400 S. 13th St., Louisville, KY 40203).

(May 3–5)—Pacific Northwest Society for Coatings Technology Symposium. Park Hilton Hotel, Seattle, WA. (Robert Hogg, Preservative Paint Co., 5410 Airport Way S., Seattle, WA 98108).

(May 15–16)—Cleveland Society for Coatings Technology 27th Annual Technical Conference, "Advances in Coatings Technology." (Richard Eley, Glidden Coatings & Resins Div. SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(May 16–17)-"Coatings Tech Expo '84." 3rd Biennial Convention & Exposition sponsored by New England Society for Coatings Technology. Sheraton Inn & Conference Center, Boxborough, MA. (Chairman Paul J. Mueller, D.H. Litter Co., Inc., P.O. Box 247, Ballardvale, MA 01810).

(June 8–9)—Joint Meeting of St. Louis and Kansas City Societies for Coatings Technology. Kansas City, MO.

(June 18)—Golden Gate Society for Coatings Technology's Manufacturing Committee Symposium on "Safety and Robotics." Sabella's, San Francisco, CA. (Louie Sanguinetti, Jasco Chemical Co., P.O. Drawer J. Mountain View, CA 94042).

1985

(Feb. 26–Mar. 1)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA.

(Apr. 25–27)—Pacific Northwest Society for Coatings Technology Symposium. Empress Hotel, Victoria, B.C. (Ottwin Schmidt, Shanahan's Ltd., 8400 124th St., Surrey, B.C., Canada V3W 6K1).

OTHER ORGANIZATIONS

(Feb. 8–10)—"Appearance Science Workshop." HunterLab, Reston, VA. (Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090).

(Feb. 12–15)—Inter-Society Color Council Conference. Colonial Williamsburg Lodge. Williamsburg, VA. (Fred W. Billmeyer, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Feb. 12–16)—14th Australian Polymer Symposium sponsored by the Polymer Div. of the Royal Australian Chemical Institute. Old Ballarat Motor Inn, Ballarat, Australia. (Dr. G.B. Guise, RACI Polymer Div., P.O. Box 224, Belmont, Vic., 3216, Australia).

(Feb. 16–17)—"Frontiers in Color Science" Symposium. Rochester Institute of Technology, Rochester, NY. (Dr. Franc Grum, School of Photographic Arts and Sciences, RIT, P.O. Box 9887, Rochester, NY 14623).

(Mar. 25)—Painting and Decorating Contractors of America Convention and Show. New York Hilton, New York, NY. (Mr. E. Glen Craven, PDCA, 7223 Lee Hwy., Falls Church, VA 22046).

(Apr. 4–11)—"Surface Treatment Exhibition" at the 1984 Hannover Fair, Hannover, West Germany. (Hannover Fairs Information Center, P.O. Box 338, Rt. 22 E., Whitehouse, NJ 08888).

(Apr. 8–10)—Inter-Society Color Council Annual Meeting. Michigan Inn, Southfield, MI. (Fred W. Billmeyer, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Apr. 12–13)—"Electrochemical Test Methods of the Protecting Properties of Metals Coatings" Meeting. Genoa University, Genoa, Italy, (Prof. P.L. Bonora, Istituto di Chemica, Fac. Ingegneria—Fiera del Mare Pad. DI 16129 Genoa, Italy).

(Apr. 12–15)—"FARBE 84". Munich Trade Fair Centre, Munich, West Germany. (Kallman Associates, Five Maple Court, Ridgewood, NJ 07450).

(Apr. 24–25)—Electrocoat/84 Conference, sponsored by *Products Finishing* Magazine. Drawbridge Inn, Cincinnati, OH. (Anne Porter, Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(May 1–4)—Painting and Decorating Contractors of America. 100th Anniversary Meeting. New York, NY.

(May 1–3)—Oil & Colour Chemists' Association's 35th Annual Exhibition. London, England. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(May 16–18)—"Appearance Science Workshop." HunterLab, Reston, VA. (Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090).

(June 10–13)—"58th Colloid and Surface Science Symposium." Carnegie-Mellon University, Pittsburgh, PA. (G.D. Parfitt, Chemical Engineering Dept., Carnegie-Mellon University, Pittsburgh, PA 15213).

(June 17–20)—Dry Color Manufacturers' Association's Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (P.J. Lehr, DCMA, Suite 202, 206 N. Washington St., Alexandria, VA 22314).

(July 9–13)—10th International Conference on "Organic Coatings Science & Technology." Athens, Greece. (Prof. Angelos V. Patsis, Director, Materials Research Lab., CSB 209, State University of New York, New Paltz, NY 12561).

(Sept.)—"Maintenance Painting of Industrial Plants" Symposium sponsored by the Steel Structures Painting Council. Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Sept. 22–25)—Canadian Paint and Coatings Association. Annual Convention. Westin Hotel, Winnipeg, Man., Canada. (CPCA, 515 St. Catherine St. W., Montreal, Que. H3B 1B4, Canada).

Advertisers Index

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'Humbug' from Hillman

This month's "Humbug" features a delightful potpourri from new and old friends from far flung spots on the globe. Incidentally, "potpourri" literally means "rotten pot", but I prefer for this column to adopt the dictionary meanings, viz.: 1. "a jar of flower petals and spices used for scent" and 2. "a miscellaneous collection."

We include contributions from Alec Foster in Bermuda; Joe Boatwright, the Chicago historian and itinerant consultant; H. Earl Hill, one of our most dedicated contributors; Dan Toombs; and Gene Wayenberg. All will have to pardon the helter skelter arrangement without specific credits due to my efficient filing system which went to hell when the drawer fell on the floor. If I missed *you*, it's because *your* note is stuck someplace under my desk.

Here's a classified ad from the *Bermuda Royal Gazette:*

"Shendon Bowling Club—Locker Holders are reminded that 1983 dues are now payable. Balls will be removed if not paid."

That's only fair!

Rules of Life

- If the store's out of it, you'll have a coupon for it—and vice versa.
- Put it in the computer—at least you'll know where it is, even though you can't find it again.
- Just about the time you get it all together, you'll find someone else made off with the box you put it in.

• • •

The following contract is made publik for all our people by the Cane Patch School Board of Elders. If any citizen learns about any violation of this contract by any teacher, they should report same to the Board of Elders promptly and be under oath.

Teacher Contract

1. Not to get married.
2. Not to keep company with men.
3. Be home between the hours of 8 p.m. and 6 a.m. unless in attendance at a school function.
4. Not to loiter downtown in ice cream stores.
5. Not to leave town at any time without permission of the chairman of the board.
6. Not to smoke cigarettes.
7. Not to drink beer, wine or whisky.
8. Not to get in a carriage or automobile with any man, except her brother or her father.
9. Not to dress in bright colors.
10. Not to dye her hair.
11. Wear at least two petticoats.
12. Not to wear dresses more than two inches above the ankles.
13. Keep the school room neat and clean; (a) sweep the floor at least once daily; (b) scrub the floor at least once weekly with hot water and soap; (c) clean the blackboards at least once daily; and (d) start the fire at 7 a.m. so the room will be warm by 8 a.m.

—From Aunt Maude's Restaurant's Cane Patch Dispatch, Myrtle Beach, SC

• • •

On the Lighter Side

- On the neck of a giraffe, a flea begins to believe in immortality.
- A home-accident survey showed that 90% of accidents on staircases involved either the top or bottom stairs. When this information was fed into a computer, its solution was simple: "Remove the top and bottom stairs."
- Two of the most frustrating things that a weekend athlete has to face: playing baseball, he can't hit a curve; playing golf, he can and often does!

—The Chemist

Remember Dan Toombs and his *Boston Business Journal* business definitions? Here are a few more—

Conscientious (Scared)
Has leadership qualities (Is tall or has a loud voice)
Slightly below average (Stupid)

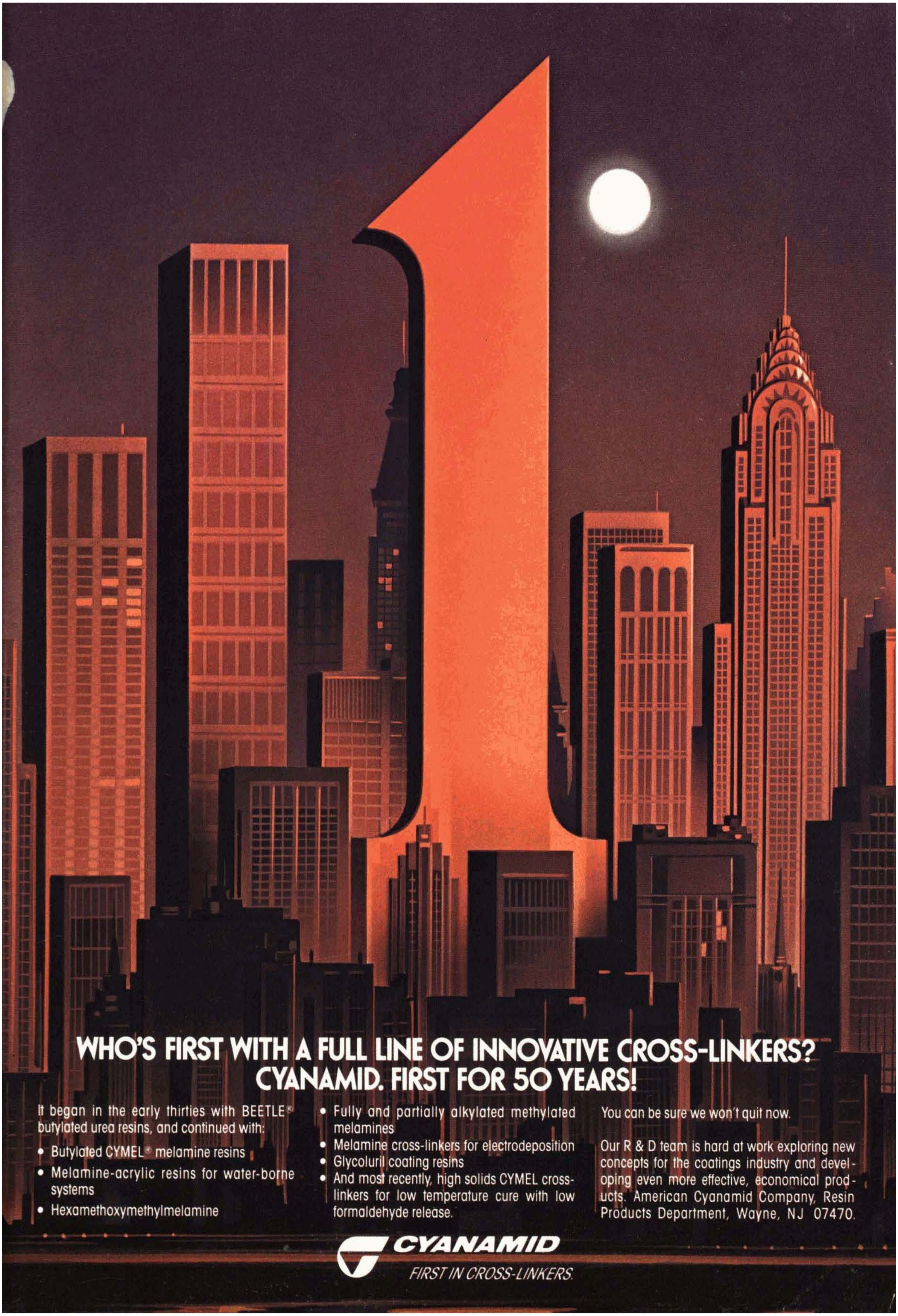
And from Gene Wayenberg—

Two Can Play the Game

A farmer shopped around for a new pickup truck and became thoroughly disenchanted with the pricing system, what with all the talk about optional equipment and "extras." But he settled on his purchase. A few days later the dealer who had sold him his new pickup arrived at the farm to buy a cow for his small acreage. The farmer quickly sized up the situation and wrote this itemized bill:

Basic cow	$2,000.00
Two-toned exterior	45.00
Extra stomach	75.00
Product storage compartment	60.00
Dispensing device (4 spigots at $10 each)	40.00
Genuine cowhide upholstery	125.00
Automatic fly swatter	35.00
Dual horns	15.00
TOTAL (exclusive of tax and delivery)	$2,395.00

—Herb Hillman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• Melamine cross-linkers for electrodeposition
• Glycoluril coating resins
• And most recently, high solids CYMEL cross-linkers for low temperature cure with low formaldehyde release.
You can be sure we won't quit now.
Our R & D team is hard at work exploring new concepts for the coatings industry and developing even more effective, economical products. American Cyanamid Company, Resin Products Department, Wayne, NJ 07470.
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