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JOURNAL OF COATINGS TECHNOLOGY

SEPTEMBER 1983

CONVENTION ISSUE

FSCT

61st Annual Meeting
48th
Paint Industries' Show

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October 12-14, 1983
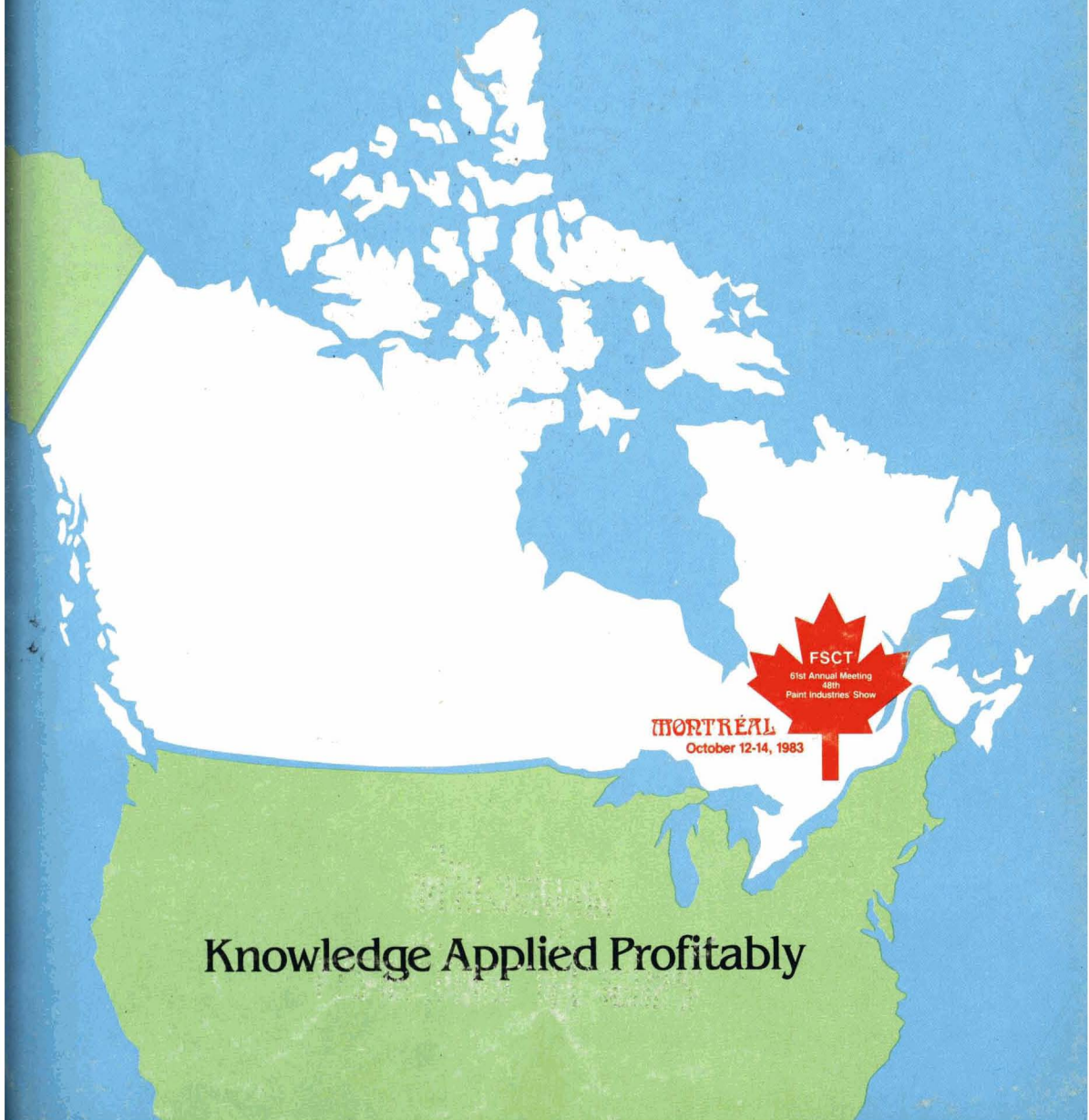
Knowledge Applied Profitably

A WHOLE NEW INDUSTRY WAS CONCEIVED HERE.

Over seven decades ago, an experimental coating made from phenolic resins was put on a brass bed to protect it from tarnish and corrosion, as well as to maintain the original lustre of the brass.

Needless to say, the experiment was a success. So much so that it started a whole new concept in high-performance coatings.

Today, our UCAR Phenolic Resins are used on everything from airplanes to zippers.

That's because they not only offer exceptional protection against corrosion, they also provide excellent abrasion resistance, outstanding chemical resistance, and good adhesive and electrical insulation properties. Plus, they're adaptable to a wide range of coatings technologies, such as high solids, powder, and waterborne. And, with most substrates, little or no surface preparation is required.

UCAR Phenolic Resins can also be used to upgrade the performance properties of alkyds, epoxies, and many other coatings resins.

To find out what UCAR Phenolic Resins can do for you, contact your local Union Carbide Sales Representative. Or write to Dept. K3442, Danbury, CT 06817.

Rest assured you'll like what we have to say.
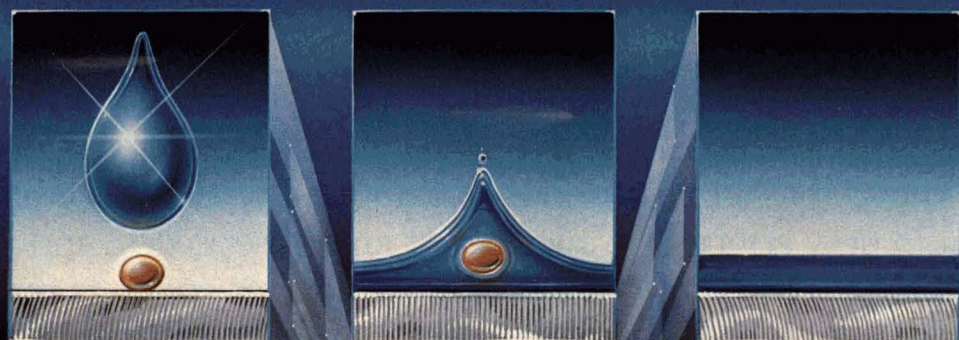
UNION CARBIDE

Coatings Materials

Now there's a water-borne polymer that goes beyond mere adhesion–to real bonding–on oily metals.

NeoCryl® A-655-based coatings surround, lift off and actually absorb residual oils to bond directly to the metal surface. This fast air dry, water-borne acrylic is easy to formulate and provides superior durability and salt spray resistance.

Starting formulations for A-655 are available from our computer. We've set up this on-line data base to give you immediate service, so call (800) 225-0947 (in MA (617) 658-6600). Or write Dept. WC2, 730 Main Street, Wilmington, MA 01887.

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RHOPLEX® AC-829.
NOW EVERY OTHER ANCIENT HISTORY.
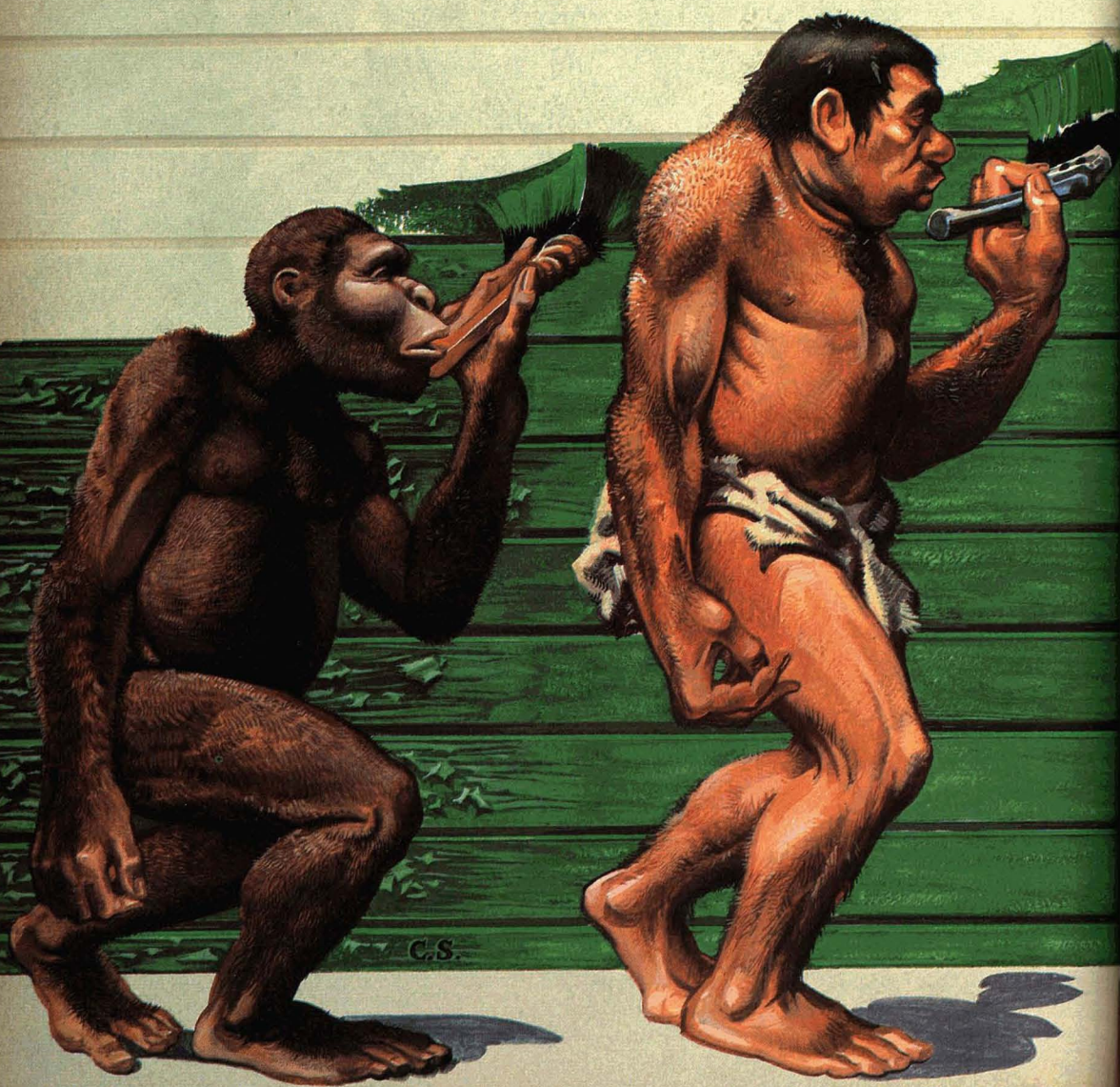
EMULSION IS

A breakthrough technology that combines superior film build and chalk adhesion in one emulsion.

Announcing a giant step forward in paint evolution. Rhoplex AC-829 acrylic emulsion.

Until now, you had to make a choice: an acrylic emulsion that offered excellent film build — or one that provided outstanding chalk adhesion. Technologically, it just wasn't possible to produce one that delivered both.

Rhoplex AC-829 has changed all that. This new acrylic emulsion provides both exceptional adhesion to chalky surfaces and superb flow, leveling and film build. Now you'll be able to formulate the highest quality exterior house paints possible — with fewer tinting problems, better weatherability and maximum hiding. All without a drop of alkyd modification.

For more information and literature, contact your local Rohm and Haas Company technical representative or write to Rohm and Haas Company, Independence Mall West, Philadelphia, PA 19105, Attention: Marketing Services Department.

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PHILADELPHIA, PA. 19105

Our chemistry begins with you.

Comment

Bienvenue à Montréal

For the first time ever, the Annual Meeting and Paint Industries' Show of the Federation is moving outside the continental limits of the United States. This year the FSCT is heading North of the Border to Montreal, Quebec, Canada, the city on the St. Lawrence.

The theme of this year's Annual Meeting program is "Knowledge Applied Profitably," which accurately reflects the excellent schedule of presentations developed by the Program Committee under the direction of Chairman Peter Hiscocks, of CIL Paints Inc., Toronto. From the opening session on Wednesday with the Keynote Address by Jean-Marc Chaput, noted Canadian motivational speaker, through Friday's Mattiello Lecture by well-known coatings specialist Fred Daniel, the program promises to deliver a plethora of information to help attendees increase performance, production, and profitability.

The Paint Show, again a record-breaker, will feature the products and services of 170 supplier companies, many of which are exhibiting for the first time (17 are from Canada). This offering of technology should be a priority on everyone's agenda.

If you haven't already done so, make your plans now to be in Montreal October 12–14 and be part of a truly international event.

Robert F. Ziegler,
Editor

THEY WOULDN'T BE SO DYNAMIC IF THEY WEREN'T A DUO.

Together, WHAM! CRASH! KA-POW! they're Bat Heroes. Caped Crusaders. The Dynamic Duo.

But apart? Somehow, "The Dynamic Uno" just doesn't have the same impact.

Our point is simple. Teamwork. You can't say enough for it. Or at least we at Union Carbide can't.

So, if you come to us for oxygenated solvents, don't be surprised to see our Sales and Technical Service representatives rush to your aid with a wide range of technical assistance.

As for our Research and Development people, they've been working closely with solvents and solvent users for over 50 years. Which is why we can be called upon to help you meet upcoming volume requirements and clear environmental hurdles through the '80s. We'll show you a surprisingly wide range of oxygenated solvents used in the formulation of higher solids coatings.

To learn more, reach for the Batphone or any other phone and call your Union Carbide Sales Representative. Or write to us for a free copy of Oxygenated Solvents for Higher Solids Coatings, at Dept. K4436, Danbury, CT 06817.

You'll find that Batman and Robin aren't the only ones who can form a dynamic duo.

And you won't have to work in a cape and tights, either.

UNION CARBIDE

Solvents & Coatings Materials

Abstracts of Papers in This Issue

ESTIMATION OF SOLUBILITY PARAMETERS FROM SOLUTION PROPERTIES OF POLYMERS—C.M. Kok and A. Rudin

Journal of Coatings Technology, 55, No. 704, 57 (Sept. 1983)

Solubility parameters are widely used in designing coatings formulations. Various experimental methods for determining solubility parameters are tedious and do not always give the same results for the same material. Group contribution calculations provide convenient estimates of solubility parameters but are not applicable in a straightforward manner to complicated polymers like alkyds or multicomponent vinyl copolymers.

This article describes a new method for measuring solubility parameters of polymers. Experimentally, two samples with different average molecular weights and the same composition are required. Intrinsic viscosities and gel permeation chromatograms of the two polymer samples provide the data needed for these calculations. The procedure also provides estimates of the molecular weight distributions of the samples, if these are of interest. If the Mark-Houwink constants of the polymer of interest are known in several solvents, its solubility parameter can be calculated without recourse to experiment. The method is illustrated for a variety of homopolymers and an alkyd.

FACTORS GOVERNING TINTER PERFORMANCE—E. Cohen and R. Pineiro

Journal of Coatings Technology, 55, No. 704, 69 (Sept. 1983)

The paint formulator is confronted with the task of shading an evergrowing number of tint bases with the least number of tinting colors. Therefore, an understanding of the factors that govern tinter performance has become important. The controlling factors will be discussed, in turn, and data will be presented which will show that tinter performance depends on an interplay of all components present in the tinted system, as well as on the intensity of grinding and of admixing base and tinter.

DISPERSIBILITY OF PIGMENTS AS A CRITERION FOR DETERMINING OPTIMUM MILL BASE FORMULATIONS—J. Oyarzún

Journal of Coatings Technology, 55, No. 704, 77 (Sept. 1983)

The possibility of optimizing mill base formulations taking as a criterion the dispersibility of the pigments is discussed. The fineness of grind, the tinting strength, and the lightness flop are used as criteria for the degree of dispersion. Mill base formulation is considered optimum

(Continued)

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December 1983 JCT Post Convention Issue

Post Convention Coverage of the Annual Meeting and Paint Industries' Show of the Federation of Societies for Coatings Technology will be published in the December 1983 issue of the *Journal of Coatings Technology*. This event will be held October 12–14 in Place Bonaventure, Montreal, Quebec, Canada. An event not to be missed. This issue will feature the follow up:

- Awards
- Photographs
- Technical Proceedings
- Exhibitor Booth Descriptions
- Convention and Annual Meeting News

Abstracts of Papers in This Issue

when showing the best dispersibility (degree of effectiveness). By varying the concentration of resin and pigment and by determining the corresponding dispersibility, optimum mill base formulations can be obtained.

LATENT ACID CATALYST FOR WATER-BORNE COATINGS—D.J. Hart

Ethyl N, N-dimethylsulfamate (EDMS) has been shown to be an effective latent acid catalyst for water-borne coatings. At ambient temperatures, EDMS is inactive as a catalyst and thus provides excellent storage stability to water-borne coatings even at high concentrations. EDMS rearranges at elevated temperatures and becomes fully activated as an acid catalyst at 121° C (250° F). Reformulation of the commercial coatings will be necessary, however, in order to successfully reduce the bake temperature to 121° C regardless of the type or concentration of acid catalyst used.

REVIEW OF DIELECTRIC AND DYNAMIC MECHANICAL RELAXATION TECHNIQUES FOR THE CHARACTERIZATION OF ORGANIC COATINGS—K. Varadarajan

The complimentary techniques of dielectric relaxation and dynamic mechanical relaxation experiments provide valuable information on the performance of coatings. In a dielectric relaxation experiment, a periodic electrical potential is applied to the sample between two electrodes and the dielectric constant, ε', and the dissipation factor, tan $\delta = \varepsilon''/\varepsilon'$, are measured as a function of frequency and temperature. The minimum film forming temperature (MFT), adhesion, corrosion resistance, aging, end use, water sorption, film defects, and curing of organic coatings have been characterized by dielectric relaxation measurements. In a dynamic mechanical experiment, the viscoelastic properties of coatings are characterized by the application of a cyclic stress and by measuring their strain response. A review of the successful application of the dynamic mechanical methods in characterizing the glass transition temperature, adhesion, aging, water uptake, kinetics of curing, and crack resistance of coatings is also presented.

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Papers to Be Featured in the October Issue

Compositional Heterogeneity in Low Molecular Weight Copolymers as Revealed by Monte Carlo Simulations—K.F. O'Driscoll, University of Waterloo

Microbiology of Modern Coatings Systems—J.A. Jakubowski, J. Gyuris, and S.L. Simpson, Merck & Co., Inc.

Pigment/Resin Interactions in Thixatropic Alkyd Media—J.E. Hall, Tioxide UK Ltd.

Towards Environmentally Acceptable Corrosion Protection Through Organic Coatings—Problems and Realization—Dr. Werner Funke, University of Stuttgart

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

PROGRAM

1983 ANNUAL MEETING and PAINT INDUSTRIES' SHOW

Place Bonaventure

Montreal, Que., Canada

October 12-14

Program

WEDNESDAY, OCTOBER 12

OPENING SESSION
(10:00–10:30)

Sixty-First Annual Meeting of the Federation of Societies for Coatings Technology opened by President A. Clarke Boyce

Invocation and In Memoriam

Welcome: Bert Papenburg, President of Montreal Society for Coatings Technology

Horace Philipp, Chairman of the Host Committee

Peter A. Hiscocks, Chairman of the Program Committee

Deryk R. Pawsey, Chairman of the Paint Industries' Show Committee

Introduction of Distinguished Guests

Report of President Boyce

E. W. FASIG KEYNOTE ADDRESS
(10:30–11:15)

Keynote Address by Jean-Marc Chaput, motivational speaker and author of the book, "Living is Selling."

INNOVATIONS IN COATINGS
(2:00–5:00)

USE OF EDP-SYSTEMS IN A PAINT MANUFACTURING COMPANY—POSSIBILITIES, PROBLEMS, AND GAINS—Robert Adahl, Teknos-Maalit OY, Helsinki, Finland (Presented on behalf of SLF: Federation of Scandinavian Paint and Varnish Technologists).

THE PHENOMENOLOGICAL APPROACH TO ADHESION—Ivar P. Thomassen, The O'Brien Corp., South Bend, IN.

ONE COAT EMULSION PAINT—Leslie A. Simpson, Tioxide UK Limited, Cleveland, England (Presented on behalf of OCCA: Oil and Colour Chemists' Association).

NEW FLUOROPOLYMER COATINGS ON FRP—Hiromichi Higaki, Asahi Glass Co., Ltd., Yokohama, Japan.

NOVEL, WATER-BORNE COATINGS DERIVED FROM EPOXY RESINS—Donald E. Brody, Skeist Laboratories, Inc., Livingston, NJ.

POLYMER KETTLE AUTOMATION—YORK PAINTS—M.A. Lortie, C-I-L Paints, Inc., Toronto, Canada.

SYMPOSIUM ON TESTING AND PERFORMANCE
(2:00–4:30)

PERFORMANCE COMPARISON OF EXTERIOR FLAT FINISHES ON HARDBOARD SIDING—Kansas City Society for Coatings Technology. Presented by Roger Haines, Farmland Industries, Inc., North Kansas City, MO.

CHROMATOGRAPHIC CHARACTERIZATION OF EPOXY RESINS, D.R. Scheuing, Midland Div., The Dexter Corp., Waukegan, IL.

TRANSFORMATION OF LIQUID TO AMORPHOUS SOLID: EFFECT OF REACTION MECHANISM ON THE TIME TO VITRIFY FOR LINEAR AND NETWORK POLYMERIZATION—Marc T. Aronhime and J.K. Gillham, Dept. of Chem. Eng., Princeton University, Princeton, NJ.

PROTECTION OF MILDEWCIDES AND FUNGICIDES FROM ULTRAVIOLET LIGHT INDUCED PHOTO-OXIDATION—Peter D. Gabriele and Robert M. Iannucci, Additives Dept., CIBA-GEIGY Corp., Ardsley, NY.

SEDIMENTATION OF SUSPENSIONS—Montreal Society for Coatings Technology. Presented by Luigi Cutrone, Tioxide Canada Inc., Sorel, Quebec, Canada.

COMPUTER BASICS
FOR THE COATINGS INDUSTRY-I
(9:00–11:30)

This two-part seminar will introduce attendees to the ABC's of computers and software, answer basic computer-related questions, and present affordable computer solutions to typical coatings problems. Computer equipment will be on display for demonstrations and "hands-on" learning experience.

Moderator—Alan Brandau, DeSoto, Inc., Des Plaines, IL.

IBM SOFTWARE FOR GENERATING COMPUTERIZED FORMULATIONS AND BATCH TICKET PREPARATION—Donald Erwin, Erwin, Schafer & Associates, Louisville, KY.

TURNKEY COMPUTER SYSTEMS FOR SMALL AND LARGE PAINT COMPANIES—James DeGroff, Applied Color Systems, Inc., Princeton, NJ.

PERSONAL COMPUTERS FOR INVENTORY SYSTEMS—John Wallerius, IBM Personal Computer Systems, Rolling Meadows, IL.

COLOR CONTROL WITH THE SMALL COMPUTER—Hugh R. Davidson, Davidson Colleagues, Tatamy, PA.

SOFTWARE AVAILABLE FOR MICROCOMPUTERS—Richard Parizeault, Radio Shack Div. of Tandy Corp., Montreal, Canada.

MANUFACTURING COMMITTEE SEMINAR
ON IMPROVED PROFITABILITY THROUGH
EFFICIENT CLEANING, RECYCLING,
AND RECLAMATION TECHNIQUES
(9:00–12:00)

Discussions will focus on profitable resource reclamation techniques in key areas of coatings manufacture. Open-forum period for audience participation will follow speaker presentations.

TANK CLEANING—(Moderator) Richard E. Max, Synkote Paint Co., Elmwood Park, NJ.

A Tank Cleaning Plant for the Small Paint Plant—Alun G. Morris, L. V. Lomas Chemical Co., Mississauga, Ontario, Canada.

WASTE DISPOSAL—(Moderator) Larry Kytasaari, Tnemec, Inc., North Kansas City, MO.

Waste Solvents as Fuel for Cement Kiln Operation (Incineration)—Melvin C. Eifert, Systech Corp., Xenia, OH.

Redistillation and Recovery of Waste Solvents—Ken O'Morrow, Oil and Solvent Process Co., Azusa, CA.

SOLVENT RECOVERY AND RECLAMATION (IN-HOUSE)—(Moderator) Joseph P. Walton, Jamestown Paint & Varnish Co., Jamestown, PA.

Distillation Technologies—Past, Present, and Future—Earl Pifer, Finish Engineering Co., Erie, PA.

Economics of Small Scale In-House Solvent Distillation—Michael J. Schmutzer, Disti, Inc., New York, NY.

Wiped Film Evaporators—Anthony Bellavia, The Pfaudler Co., Rochester, NY.

A Novel Fluid Bed Adsorption Process for Vent Gas Cleaning and Solvent Recovery—Kent A. Dickinson, Union Carbide Corp., Tonawanda, NY.

A CRITIQUE AND HISTORICAL OVERVIEW OF THE PAINT MANUFACTURER RECYCLING WASTES—Gabriel Malkin, P.E., Consulting Engineer, Westfield, NJ (former Chief Engineer, Benjamin Moore & Co.).

ENVIRONMENTAL COMPLIANCE
(10:00–11:30)

TOXICOLOGY, THE LAW, AND THE COATINGS CHEMIST—H. Everett Myer, Plastics and Coatings Div., Mobay Chemical Corp., Pittsburgh, PA.

WATER-BASED AEROSOLS—Los Angeles Society for Coatings Technology. Presented by Dodwell DeSilva, Lawson Chemical Prod. Co., Torrance, CA.

REPLACEMENT OF LEAD AND CHROMATE PIGMENT IN NAVY CORROSION INHIBITING PRIMERS—Alexander A. Chasan, and Thomas A. Gracik, U.S. Navy, David Taylor Naval Ship R&D Center, Annapolis, MD.
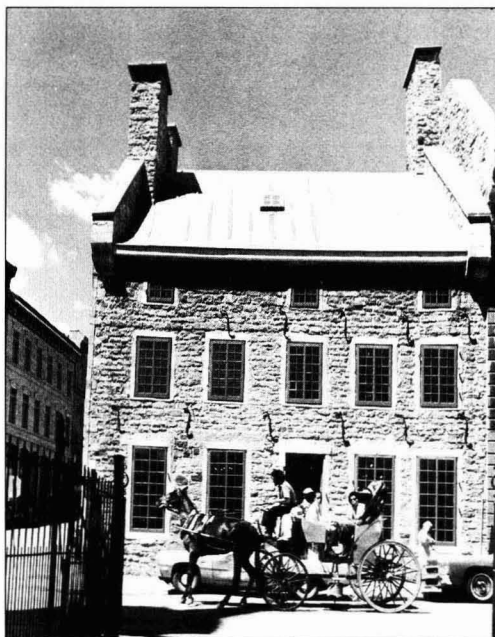
THURSDAY, OCTOBER 13

(Continued)

COMPUTER BASICS
FOR THE COATINGS INDUSTRY-II
(2:00–3:30)

Moderator—Alan Brandau, DeSoto, Inc., Des Plaines, IL.

ELECTRONIC SPREADSHEETS VS. FINANCIAL MODELING SOFTWARE—Steve Weinburg, Digital Equipment Corp., Rolling Meadows, IL.

LABORATORY MANAGEMENT SOFTWARE—Lloyd Kusack, Hewlett Packard, Rolling Meadows, IL.

UTILIZATION OF COMPUTERS IN THE COATINGS INDUSTRY—New York Society for Coatings Technology. Presented by Saul Spindel, D/L Laboratories, New York, NY.

Following the formal presentations, speakers will demonstrate computer hardware, and attendees will be given opportunity for "hands-on" learning experience and problem solving. This portion of the seminar will be open-ended, continuing through the afternoon and into the evening (as required) to accommodate everyone wishing to take part.

CORROSION COMMITTEE PANEL DISCUSSION
ON AIR-DRY AQUEOUS BINDERS
FOR ANTI-CORROSIVE COATINGS
(2:00–5:00)

Representatives from various resin manufacturers will present brief discussions of current technology to help fulfill market needs through a comparison of air-dry aqueous binders.

Moderator—Richard E. Max, Synkote Paint Co., Elmwood Park, NJ.

Al Heitkamp, Cargill, Inc., Minneapolis, MN.

Thomas M. Powanda, Celanese Chemical Co., Inc., Summit, NJ.

Richard Albers, Deft, Inc., Irvine, CA.

Marvin L. Caine, ICI Americas Inc., Wilmington, DE.

R. N. Washburne, Rohm and Haas Co., Philadelphia, PA.

Carol J. Williams, Spencer Kellogg Div., of Textron, Inc., Buffalo, NY.

Moderator and speakers will assemble as a panel for an open-discussion period following presentations.

SEMINAR ON FORMULATION
(2:00–4:30)

PRACTICAL RHEOLOGICAL STUDY OF LATEX GLOSS ENAMELS—Los Angeles Society for Coatings Technology. Presented by Carl Thompson, Durochrome Products, Inc., Anaheim, CA.

HIGH SOLIDS MILL BASE DESIGN FOR HIGH SPEED DISPERSION—Luigi Cutrone, Tioxide Canada, Inc., Sorel, Quebec, Canada.

PIGMENT VOLUME CONCENTRATIONS AND AN INTERPRETATION OF THE OIL ABSORPTION OF PIGMENTS—H. F. Huisman, PD Magnetics B.V., Oosterhout, The Netherlands.

OXIDATIVE DRY RETENTION OF WATER-SOLUBLE ALKYDS IN THE PRESENCE OF GLYCOL ETHERS—Toronto Society for Coatings Technology. Presented by Andy Jones, Degussa Canada Ltd., Burlington, Canada.

FILM FORMATION AND RHEOLOGY OF POWDER COATINGS—P. G. de Lange, Teteringen, The Netherlands (Presented on behalf of NVVT, the Dutch Section of FATIPEC: Federation of Associations of Technicians in the Paint, Varnish, Lacquer, and Printing Ink Industries of Continental Europe).

PRODUCTION MANAGEMENT
(4:30–5:00)

HOW PRODUCTIVE IS YOUR PAINT PLANT?—Roy Kennedy, Inmont Canada Ltd., Brantford, Ontario, Canada.

The Old City of Montreal will be the focus of the Spouses' Tour on Thursday. Also included is Olympic Park, Mount Royal, and lunch.

FRIDAY, OCTOBER 14

SYMPOSIUM ON TESTING AND PERFORMANCE
(9:30–10:30)

NONDESTRUCTIVE DATING OF PAINTINGS WITH ENERGY DISPERSIVE X-RAY EMISSION SCANNING ELECTRON MICROSCOPY—Stephen J. Callan and James D. Stoffer, Chemistry Dept., University of Missouri-Rolla, Rolla, MO.

HEAT STABILITY VS. AMBIENT AGING—A CORRELATION—Los Angeles Society for Coatings Technology. Presented by V. C. Jenkins, Ellis Paint Co., Los Angeles, CA.

COLOR AND APPEARANCE
(9:00–10:30)

CHEMISTRY OF THE AZO PIGMENT DYES—James Grey, C.A., Venezolano de Pigmentos, Valencia, Venezuela.

NUMERICAL COLOR CONTROL FOR EXTERIOR AUTOMOTIVE COATINGS—Susan A. Schultz, Marcus Chao, and Brian Hake, Fisher Body Div., General Motors Corp., Warren, MI.

IDENTIFICATION OF PIGMENTS IN PAINTS—Romesh Kumar, Industrial Chemical Div., American Hoechst Corp., Coventry, RI, Fred W. Billmeyer, Jr., Chemistry Dept., Rensselaer Polytechnic Institute, Troy, NY, and Max Saltzman, Consultant, Los Angeles.

MATTIELLO LECTURE
(10:30–11:30)

THE OBSTACLE COURSE FROM MILL BASE TO FINISHED COATING—Frederick K. Daniel, Coatings Consultant, Princeton, NJ.

FEDERATION LUNCHEON
(11:45)

Grand Salon, Queen Elizabeth Hotel

Presentation of the George Baugh Heckel and Paint Show Awards

Winners of other Federation awards to be announced

Featured Speaker: David Broadfoot, Canadian humorist

ENVIRONMENTAL CONTROL COMMITTEE PRESENTATION ON HOW GOVERNMENT REGULATIONS AFFECT THE COATINGS INDUSTRY
(2:00–4:00)

Speakers will present an overview of environmental regulations in Canada, Europe, and the United States and their impact on the coatings industry. Open-forum period for audience participation will follow.

Al Marchetti, Canadian Paint and Coatings Association, Montreal, Quebec, Canada.

Ken Zacharias, National Paint and Coatings Association, Washington, DC.

V. C. Jenkins, Ellis Paint Co., Los Angeles, CA.

Lawrence N. Streff, PPG Industries, Inc., Allison Park, PA.

ANNUAL BUSINESS MEETING
(4:00–5:00)

Annual Business Meeting of the Federation

Presentation of these awards: Roon Foundation . . . American Paint & Coatings Journal/ A.F. Voss . . . Materials Marketing Associates . . . Program Committee . . . Ernest T. Trigg

Installation of Officers, 1983–84

REGISTRATION HOURS

Tuesday, October 11 . . . . 8:00 a.m. to 5:00 p.m.
Wednesday, October 12. . . . . 8:00 a.m. to 5:30 p.m.
Thursday, October 13. . . . . 8:00 a.m. to 5:30 p.m.
Friday, October 14. . . . . 8:00 a.m. to 3:00 p.m.

Now, one high-performance pigment for rust-inhibiting systems.
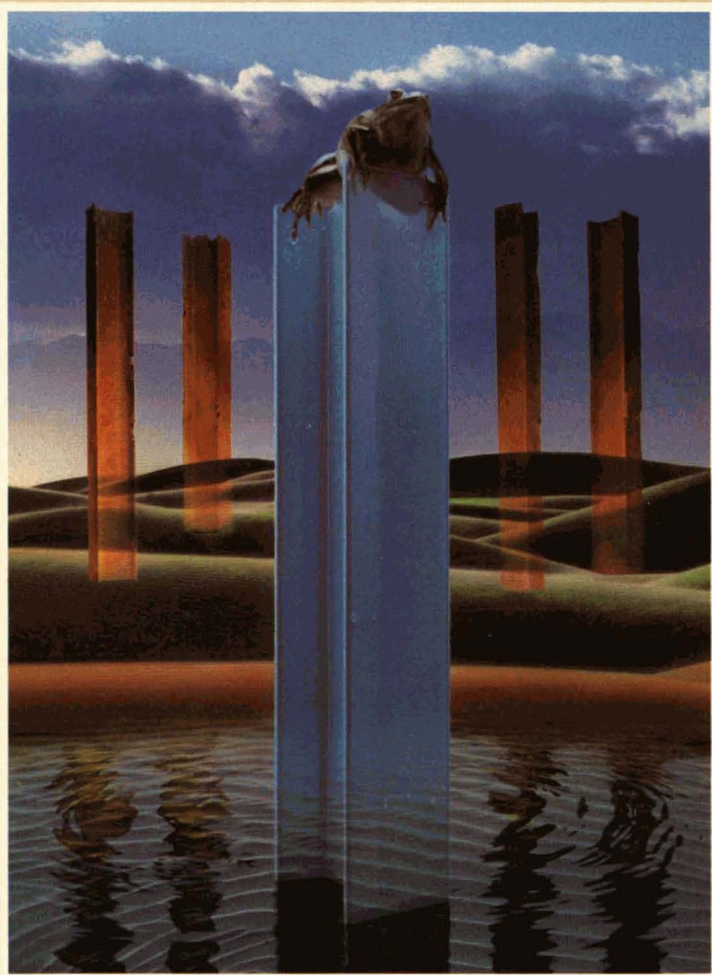
Introducing non-toxic NALZIN* 2 anticorrosive pigment.

It's an environmentally safe replacement for strontium, lead and chrome-containing pigments. Great versatility, too. **NALZIN 2** is an excellent anticorrosive pigment that works equally well in aqueous and solvent-based coatings alike.

Oil-absorption level is low, particle size is small. So you can increase the amount of anticorrosive pigment in your formulation. Which results in better stability, a higher performance product.

Dispersion is easy. And the ability to generate high gloss, in the broadest range of colors, is inherent. Our proof is in the sample. Mail the coupon, write or call.

NL Chemicals

OTHER CONVENTION INFORMATION

PAINT INDUSTRIES' SHOW

In its initial appearance in Canada, the 48th Annual Paint Industries' Show will feature the exhibits of over 170 supplier companies who have purchased all available booth space making the 1983 Paint Show the largest in Federation history.

The Show will be held in conjunction with the 61st Annual Meeting of the Federation at the Place Bonaventure in Montreal, Quebec.

Exhibit hours will be 11:30 am to 5:30 pm on Wednesday, October 12; 9:30 am to 5:30 pm on Thursday, October 13; and 9:30 am to 3:00 pm on Friday, October 14.

The Paint Show is the only national exhibit of raw materials, and equipment used in the manufacture of paints and related coatings, and participating firms will have their top technical personnel on hand to discuss the latest developments in coatings manufacturing technology.

REGISTRATION

Advance registration is available at $50 for members and $65 for nonmembers. Fee for spouses activities is $35 in advance.

Once again there will be a special advance only registration fee of $25 each for retired members and their spouses.

On-site registration fees will be $60 full time and $40 one day for members. Nonmember fees will be $75 full time and $50 one day. Spouses registration will be $45 on-site.

Cash payment of on-site registration fees will be accepted in Canadian currency only at the then current rate of exchange. A currency exchange booth will be available in the registration area. Checks in both U.S. and Canadian funds will be accepted.

Registration forms were mailed to all members in April.

FEDERATION LUNCHEON

The Annual Federation Luncheon will be held on Friday at the Queen Elizabeth Hotel.

Presentations will be made to the recipients of the George Baugh Heckel Award (outstanding individual who has contributed to the advancement of the Federation) and the Flynn Awards (firms judged to have the best exhibit booths in the 1983 Paint Industries' Show). Announced will be the winners of the Annual Meeting awards, including the winning entries in the Roon Awards Competition.

Featured entertainment will be Dave Broadfoot, Canada's premier comedian and satirist. Winner of the many media awards for his performances, *Variety* calls him "Canada's Bob Hope." Appearing before 120 conventions a year, Mr. Broadfoot has given command performances before President Reagan and Her Majesty Queen Elizabeth.

Tickets at $20 each are available both in advance and on site in the registration area.

SPOUSES' PROGRAM

A schedule of activities has been planned for each day for spouses attending the Annual Meeting, and a Hospitality Suite will be maintained at the Queen Elizabeth Hotel.

A get acquainted Wine and Cheese Social is scheduled for Wednesday afternoon.

On Thursday, a continental breakfast will precede a fascinating tour of Montreal, which will include historical sites, Olympic Park, and lunch and shopping in beautiful Old Montreal.

Continental breakfast will again be available on Friday morning.

HEADQUARTERS HOTEL

The Queen Elizabeth will serve as headquarters hotel. Other hotels with blocks of rooms set aside for the Annual Meeting are the Hotel Bonaventure, L'Centre Sheraton, Regence Hyatt Montreal, Chateau Champlain, Hotel Meridien Montreal, Ramada Inn, Holiday Inn Downtown, and the Mt. Royal.

WALKING TO PLACE BONAVENTURE

The best way to walk to Place Bonventure from any hotel is on the street level. You can also walk to PB via Montreal underground, but the route is circuitous. All program sessions will be held in the Bonaventure Hotel which is situated on the top two floors of PB. Elevator service to the hotel is available at all entrances to PB and also inside the exhibition hall.

ROOM RESERVATIONS

All requests for rooms and suites must be sent to the Federation office on the official housing form which has been mailed to all members. Additional housing forms are available from the Federation headquarters office.

BOARD MEETING

The Fall Board of Directors Meeting of the Federation will be held at the Queen Elizabeth Hotel on Tuesday, October 11.

SPEAKERS' BREAKFAST

A breakfast and briefing for each day's program participants will be held at the Bonaventure Hotel on Wednesday, Thursday, and Friday.

PUBLICATION OF PAPERS

No *Proceedings* is offered of papers presented at the Annual Meeting, nor are reprints of presentations available. The JOURNAL OF COATINGS TECHNOLOGY has prior rights to the publication of all papers presented at the Annual Meeting.

PROGRAM STEERING COMMITTEE

Chairman Peter Hiscocks, of C-I-L Paints, Inc., Toronto; Darlene Brezinski (Vice-Chairman), of DeSoto, Inc., Des Plaines, IL; N. Bradford Brakke, Lilly Industrial Coatings, Inc., Templeton, MA; Glenn Cunningham, PPG Industries, Inc., Allison Park, PA; John Flack, International Paints Ltd., Outremont, Quebec, Canada; and F. Louis Floyd, Glidden Coatings & Resins Div. of SCM Corp., Strongsville, OH.

HOST COMMITTEE

Members of the Montreal and Toronto Societies are serving on the Host Committee under the General Chairmanship of Horace S. Phillip, Sherwin-Williams Co. of Canada, Montreal. Assisting him are: *(Program Operations)* Arthur Hagopian, CIL Paints, Inc.; *(Information Services)* Dennis H. Yokota, Consultant; *(FSCT Booth)* Andrew J. Jones, Degussa Canada Ltd.; *(Registration)* Jean Brunet, Van Waters & Rogers Ltd.; *(Language)* Andre Lamarre, Hercules Canada Ltd.; and *(Publicity and Spouses' Program)* Robert O. Payette, L.V. Lomas Chemical Co. and Ruth Malone.

ABSTRACTS OF PAPERS

USE OF EDP-SYSTEMS IN A PAINT MANUFACTURING COMPANY— POSSIBILITIES, PROBLEMS AND GAINS

Robert Adahl, Teknos-Maalit OY

Described are three application areas where EDP-systems are used: totally integrated production and marketing system; color matching; and information service.

The production and marketing system includes purchasing routines, production planning and production control, stock control, selling and marketing routines, and technical calculation routines. The color matching system is partly integrated to the production system; main features are color matching and hiding power of the paint. The information system is not integrated with other two systems, its main feature is the potential for using the Lockheed Dialogue System through a direct line.

Main features are discussed, as well as demands on the hardware and personnel. The gains of systems are reported, based on their use during one year.

PHENOMENOLOGICAL APPROACH TO ADHESION

Ivar P. Thomassen, The O'Brien Corp.

Quantum and thermodynamic methods have contributed generously towards a general understanding of adhesive phenomena, but have failed to provide certain numerical values needed for extensive utilization.

In restricting the theory to specific magnitudes disclosed by observation on the macroscopic level, the phenomenological approach suggests a method by which the phenomena can be transcribed into a mathematical form yielding the desired numerical values.

ONE COAT EMULSION PAINT

Leslie A. Simpson, Tioxide UK Ltd.

The concept of producing a one coat white emulsion paint which is easily applied by brush/roller over most surfaces and produces adequate opacity, has satisfactory film integrity and exhibits negligible staining, is an interesting prospect.

Inevitably, formulation variables, such as type of titanium dioxide pigment, binder, extender, thickener, and pigment volume concentration, will all play a part in affecting opacity development, film build/flow, and ease of application. These aspects of formulation are discussed in some detail, and the merits and potential pitfalls in marketing such a product are outlined.

NEW FLUOROPOLYMER COATINGS ON FRP

H. Higaki, Asahi Glass Co.

Discussed is a polymer designed to be soluble in most kinds of solvents and to be reactive with isocyanate and melamine compounds at the wide range of temperature from ambient to over 300°C.

This product can be easily applied on FRP sheet with high transparency and good adhesion.

This coated FRP sheet shows the following advantages: (1) Outstanding weatherability—little damage has been observed on its surface even after over 5,000 hours of irradiation by sunshine Weather-O-Meter; (2) Excellent solvent resistance.

This fluoropolymer is also useful as protective coatings for other plastics.

NOVEL, WATER-BORNE COATINGS DERIVED FROM EPOXY RESINS

Donald E. Brody, Skeist Laboratories, Inc.

Durable, solvent-resistant coatings for metal were obtained by baking aqueous solutions of the reaction products of poly-functional epoxides with secondary and primary alkanolamines. Although the polymers contained substantially no residual epoxide groups, the coatings nevertheless cured on baking, in the absence of any auxiliary crosslinking agents, to highly solvent resistant and corrosion resistant films.

These aqueous coatings, which are covered by U.S. Patent 3,962,499, are considered suitable for use as can, pail, and drum linings.

POLYMER KETTLE AUTOMATION— YORK PAINTS

M.A. Lortie, C-I-L Paints Inc.

The design and implementation of the automation of a batch copolymer reactor is reviewed, with emphasis on the mathematical basis for the control package, as well as the reaction of operations personnel to the new technology.

The scope of the control system involvement is bounded by the selection of raw materials in bulk storage and the evacuation of the reactor to the filtering station.

Within these limits, a computer is totally involved in all facets of the production. The broad control areas involved include target weighing and target metering of all liquid components, recipe-based blending cycles, surfactant and monomer transfers to the reactor, reaction seeding and exotherm control where adaptive loop tuning is used to map the process dynamics, final product cooling and transfer to the filtering station.

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PERFORMANCE COMPARISON OF EXTERIOR FLAT FINISHES ON HARDBOARD SIDING

Kansas City Society for Coatings Technology

Exposure studies, on the comparative performance of several flat exterior finishes on a variety of hardboard siding substrates, have demonstrated a significant improvement in both substrate protection and coating performance with two coat systems versus a single topcoat application. Ten different hardboard siding products were included as substrates for this evaluation. These boards were shown to have a wide range of densities, impact resistance, and moisture content. Substrate tests were also run to identify the edge swell and moisture absorption tendency of each board.

Best overall performance was achieved with a latex emulsion topcoat over either an alkyd/oil undercoat or acrylic latex primer. A single coat of oil/alkyd house paint was given the worst overall rating. Coating performance was generally better on smooth hardboard than on the textured products.

R. Adahl   I.P. Thomassen   L.A. Simpson
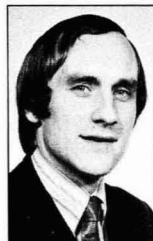
R.E. Haines   D.R. Scheuing   D. Erwin

CHROMATOGRAPHIC CHARACTERIZATION OF EPOXY RESINS

D.R. Scheuing, Midland Div., Dexter Corp.

High performance size exclusion and reverse phase liquid chromatography can be applied to the characterization of epoxy resins of a wide molecular weight range. Oligomer separations can be achieved which not only differentiate advancement epoxy resins from "taffy" types, but also reveal the composition of modified resins. The reactions of various molecular weight oligomers can be monitored with reverse phase LC.

Several types of reverse phase packings are compared in terms of analysis time and selectivity.

J. DeGroff   E. Pifer   H.E. Myer

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

A model is presented for the calculation of the time to vitrify of low molecular weight liquid on isothermal chemical reaction for linear and network forming polymerizations. Step growth and chain reaction mechanisms are investigated. In all cases the vitrification curve is S-shaped; the time passes through a maximum just above the glass transition temperature of the unreacted monomer(s) and passes through a minimum just below the glass transition temperature of the fully reacted material, which is in agreement with the limited available experimental data. The extent of reaction at vitrification is also predicted.

For the case of linear free radical polymerization, existing free volume theory was used to predict the extent of conversion at vitrification, which was found to fit the present model well.
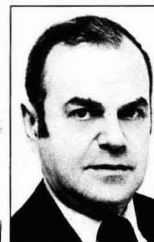
A. Chasan   S. Spindel   A. Heitkamp

M.L. Caine   C.J. Williams   L. Cutrone
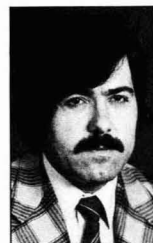
New ideas for industrial baking finishes.
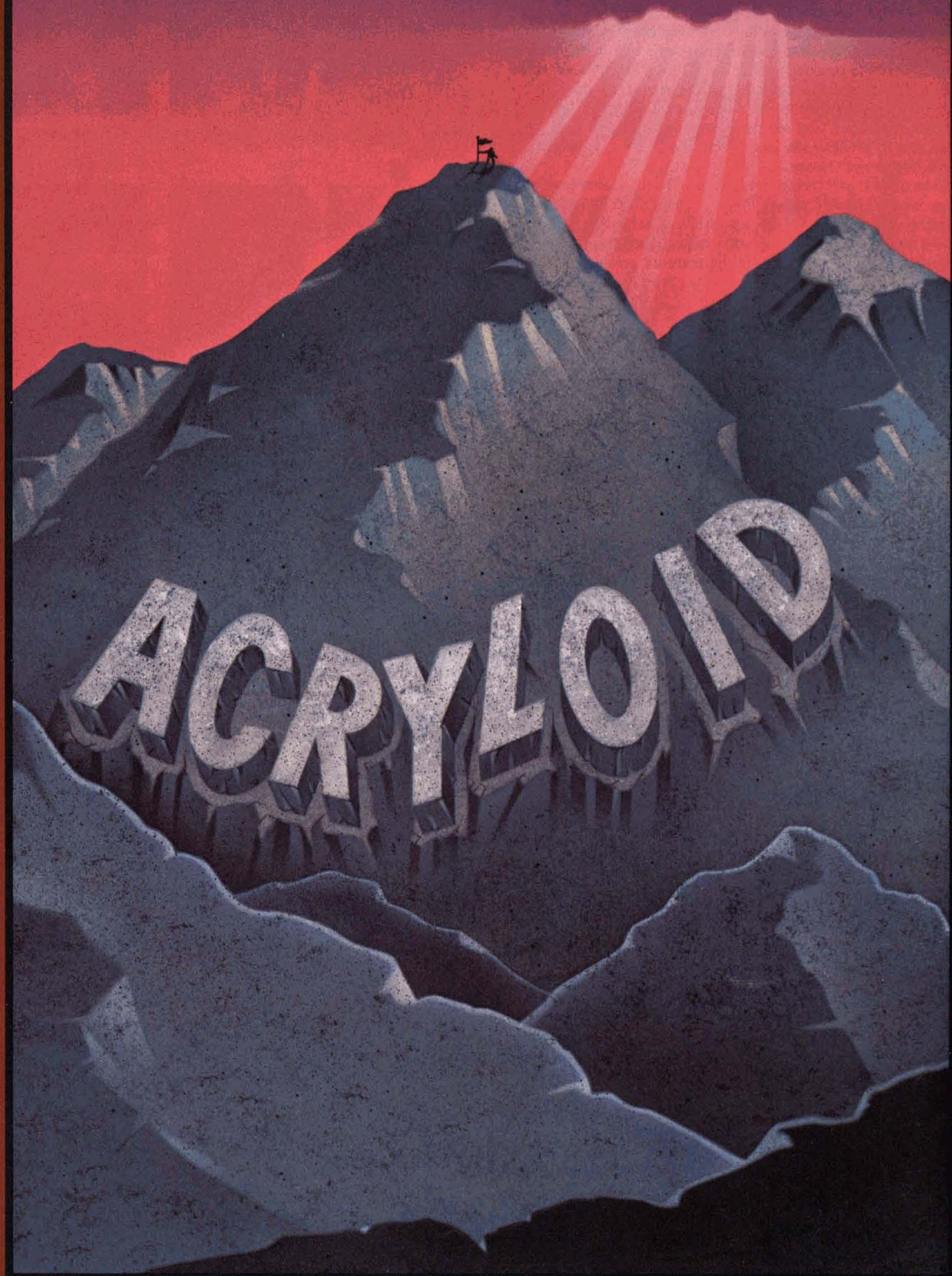
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PROTECTION OF MILDEWCIDES AND FUNGICIDES FROM ULTRAVIOLET LIGHT INDUCED PHOTO-OXIDATION

Peter D. Gabriele and Robert M. Iannucci, CIBA-GEIGY Corp.

The biological activity of most organic and organometallic biocides (fungicides, mildewcides, antifoulants, pesticides, etc.) are significantly diminished by photo-oxidation from terrestrial solar radiation. Photo-oxidation reduces biocide efficacy to an extent that a coating service life is lost as a result of biological surface defacement.

The purpose of this study was to determine whether organic and organometallic mildewcides and fungicides can be protected from the effects of ultraviolet photo-oxidation. The methodology demonstrates the protection of mildewcides through the use of hydroxyphenyl benzotriazole ultraviolet light absorbers and/or hindered tetraalkyl piperdinol compounds. The evidence developed demonstrates a practical application of a theoretical analysis of mildewcide photo-oxidation. Laboratory analysis and determination of the effectiveness of mildewcide stabilization was accomplished by thin layer chromatography (TLC) and electron capture gas chromatography (ECGC). A simple accelerated laboratory procedure is described for testing and analysis of biocide breakdown and stabilization.

SEDIMENTATION OF SUSPENSIONS

Montreal Society for Coatings Technology

The settling phenomenon often found in surface coatings is an area which is not fully understood, hence, very hard to predict. Simple models are well known, but when the same theory is applied to actual paints, it fails and the chemist must resort to lengthy methods to assess settling.

In order to gain a better insight of pigment settling, a method described by P. E. Pierce to obtain the yield value was studied. The method uses a Brookfield viscometer, a special measuring technique, computer processing of the data, and fitting the data into the Casson Equation.

IBM SOFTWARE FOR GENERATING COMPUTERIZED FORMULATIONS AND BATCH TICKET PREPARATION

Donald C. Erwin, Erwin, Schafer, & Associates

The software presented has been designed for the IBM Systems 34 and 36 computers. These computers are considered "mini" in size as contrasted to the smaller "micro processor" computers. Certain definitions and characteristic differences are discussed.

While the software developed consists of 12 modules, the emphasis is on Formula Management, Raw Material Management, Production Management, Material Requirements Planning, and Purchase Order Management. The review consists of reporting highlights and benefits derived from these applications.

Also included is a review of hardware and software costs, and expected benefits when implementing the software, along with a brief discussion of top management's role and responsibility in computer implementation and certain impacts on the company's organization.

TURNKEY COMPUTER SYSTEMS FOR SMALL AND LARGE PAINT COMPANIES

James T. DeGroff, Applied Color Systems, Inc.

In recent years, computer systems have been developed to aid the paint chemist in creating paint formulas and the scheduling and warehousing department in running production and inventory control. In most cases, each area had its own computer—for financial use, cost evaluation, full production control, and the laboratory. Each was an independent computer which was expensive and lacked capability to develop a unified set of information that could be communicated.

Devices are now becoming available which will be capable of efficiently formulating a paint system, generating formulas which can be used in the operation of the plant, keeping track of raw materials and inventories, writing batch tickets and costing new products from a cost planning standpoint. These new devices will be lower in cost and able to perform many of the functions of the older, more expensive systems.

The current offerings are discussed from a full system standpoint available to the small paint producer to give the most efficient business and production laboratory operating systems. A discussion of where new products are now and where they are going concludes with suggestions for products that can be purchased today which will grow into an ability to control the complete paint business of a small to medium paint company. These systems are also described as capable of supporting individual plant sites of larger paint companies.

WASTE SOLVENTS AS FUEL FOR CEMENT KILN OPERATION (INCINERATION)

Melvin C. Eifert, Systech Corp.

Discussed is the firm's four years of experience in the use of organic hazardous waste as a fuel for use in a cement kiln, as well as its qualification and analysis procedures used for handling these wastes in an environmentally sound manner.

Special emphasis is placed on the extensive analysis performed on each truckload of material received.

DISTILLATION TECHNOLOGIES PAST, PRESENT, AND FUTURE

Earl E. Pifer, Finish Engineering Co., Inc.

Equipment for distillation of solvents has been available for many years. Various technologies—pot stills, batch and continuous differential heat, azeotropic and thin film evaporators—have been used profitably by paint manufacturers.

Discussed are the pros and cons of each, with suggestions on how to select equipment for now and the future.

A NOVEL FLUID BED ADSORPTION PROCESS FOR VENT GAS CLEANING AND SOLVENT RECOVERY

Kent A. Dickinson, Union Carbide Corp.

The PURASIV HR system represents a commercially proven advanced technology for the removal and recovery of hydrocarbon vapors from gases by activated carbon adsorption. It is a continuous fluidized bed system with separate sections for the adsorption and desorption steps.

The key to the system is a spherical, beaded, activated carbon that possesses the physical characteristics essential for fluidized bed operation.

TOXICOLOGY, THE LAW, AND THE COATINGS CHEMIST

H. Everett Myer, Mobay Chemical Corp.

Toxicology, the science concerned with the setting of no effect levels, is basic to the scientific effort known as risk assessment. The judgment of risk goes one step further, in that it involves value judgments as to what society considers an acceptable level of risk. Such judgments are reflected in the passage of health and safety regulations as well as in the decisions handed down in product liability cases. The coatings chemist must consider these concerns in the planning of his or her work. Only in this way can the chemist best serve society and also hope to avoid delays and hassles as the work progresses.

H.F. Huisman A. Jones P.G. de Lange

REPLACEMENT OF LEAD AND CHROMATE PIGMENT IN NAVY CORROSION INHIBITING PRIMERS

Alexander A. Chasan and Thomas A. Gracik, U.S. Navy, David Taylor Naval Ship R&D Center

Materials in many standard Navy paints commercially listed in Naval Ship's Technical Manual Chapter 631 (Surface Preparation and Painting) have become or soon will become limited in use because of their toxicity. For this reason, Navy corrosion-inhibiting primers containing lead or chromate pigmentations are being replaced with non-toxic alternate materials. In replacing lead and chromate pigments, alternate materials are being introduced which are (1) compliant to Rule 66/442 solvent restrictions; (2) free of lead driers; and (3) alternatives to MIL-P-24441 type epoxy primers systems.

Navy coatings being reformulated and candidate alternative corrosion inhibiting pigmentation are identified. Results of alternative coatings are also reported. Preliminary results indicate several promising alkyd and vinyl formulations that appear to provide equivalent or superior corrosion protection to standard Navy primer systems (based upon long-term laboratory tests).

S.A. Schultz M. Chao B. Hake

F.K. Daniel K. Zacharias V.C. Jenkins
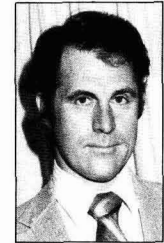
UTILIZATION OF COMPUTERS IN THE COATINGS INDUSTRY

New York Society for Coatings Technology

Over 800 manufacturers of coatings were surveyed to determine their use of computers. Information was developed regarding the type of equipment in use, the length of time of usage, and whether it was leased or purchased. Additionally, data was developed on the specific types of procedures employed in manufacturing, laboratory, process control, and office uses.

The data has been analyzed to include both industrial and trade sales companies and, in addition, has been further analyzed by dollar volume of each of the reporting organizations.

H.R. Davidson G. Malkin D.E. Brody

AIR-DRY AQUEOUS BINDERS FOR ANTI-CORROSIVE COATINGS— THE ALKYDS

Al Heitkamp, Cargill, Inc.

Today's water-reducible alkyds are actually superior to conventional solvent resins in formulations without typical anti-corrosive pigments present.

R. Kennedy P.D. Gabriele R.M. Iannucci

The use of zinc phosphate and other pigments overcomes the generally limited use of anti-corrosive pigments in aqueous systems.

Recent efforts to make primer systems less vulnerable to lifting when topcoats are applied are compared with conventional solvent alkyd-based primers.

TRIMETHYLOLPROPANE AND PENTAERYTHRITOL IN WATER–SOLUBLE, AIR-DRY ALKYD RESINS

Thomas M. Powanda, Celanese Chemical Co., Inc.

Air-dry industrial water-soluble maintenance coatings have been investigated and significant improvement has been demonstrated. Increased water dilutability of the resins and improved early water resistance of the coatings have been accomplished.

The experimental alkyd resins can be prepared using either trimethylolpropane, a trifunctional polyol, or pentaerythritol, a tetrafunctional polyol. These air-dry systems are low viscosity vehicles at 75% solids when diluted with organic coupling solvent. Further reduction in solids content to 50% is effected with water, resulting in systems that conform to current pollution legislation.

A UNIQUE VOC COMPLIANT PRIMER SYSTEM FOR STEEL

R.A. Albers, Deft Inc.

A new catalyzed epoxy coating system has been developed from which VOC compliant primers for the protection of steel have been formulated. This unique coating system is reducible with water for application, and produces ambient temperature cured primers which are equivalent to many traditional solvent-borne epoxy-polyamide primers. The corrosion resistance of both chromate and non-chromate primers are discussed, as well as a brief overview of the paint and film properties.

PERFORMANCE OF HALOFLEX® 202 PRIMERS ON STEEL

Marvin L. Caine, ICI Americas Inc.

Primers made with a copolymer of vinyl chloride, vinylidene chloride and acrylates, have been found to give excellent protection to steel in corrosive environments. The films have very low water vapor and oxygen permeability, and are tough, flexible, and nonflammable. The primers have good adhesion to steel substrates, including galvanized steel and old paint, are relatively fast drying, and if properly formulated will not cause flash rusting.

These primers have filled a gap in water-borne technology to give performance equivalent to many solvent-borne coatings.

A NEW DIMENSION IN WATER-BORNE ACRYLIC MAINTENANCE FINISHES

R.N. Washburne, Rohm and Haas Co.

A new type of water–borne acrylic maintenance paint vehicle has been developed. This material gives the paint manufacturer the ability to produce maintenance paints with excellent flow, gloss, and hardness. In addition to good exterior durability, these paints exhibit a certain degree of chemical resistance.

WATER-BASED COATINGS THAT PREVENT RUST

Carol J. Williams, Spencer Kellogg Div., Textron, Inc.

Industries are turning to water-dispersible alkyds for compliance coatings that do not sacrifice corrosion resistance or other performance properties while application characteristics remain similar to the solvent-borne standards. Industrial maintenance is also emerging as a growth field for acrylic emulsions as well as the water-dispersible alkyds. Chromate and nonchromate formulations are discussed for both areas.

HIGH SOLIDS MILL BASE DESIGN FOR HIGH SPEED DISPERSION

Luigi Cutrone, Tioxide Canada Inc.

Because of low solvent content, high solids mill base formulations must be very carefully designed if they are to have acceptable dispersion and viscosity characteristics. The approach used in conventional systems, Daniel's flow point and the Guggenheim method, cannot be used because of the low resin solids required.

A new approach to formulate high solids mill base was investigated. The method utilizes the incorporation time, which is a measure of the wetting rate of the pigment, and is defined as the time required for a given amount of pigment to be wetted by the medium. The Haake Rotovisco is used to describe the rheological behavior of the mill bases. A method is proposed for the design of high resin solids mill bases for use on high speed dispersers.

PIGMENT VOLUME CONCENTRATIONS AND AN INTERPRETATION OF THE OIL ABSORPTION OF PIGMENTS

H.F. Huisman, PD Magnetics B.V.

A new description for the pigment volume concentration, PVC, is given, based on the average effective density of the aggregated particles as these particles are present, e.g., in dispersions, in coating layers, and in oil absorption pastes.

The average effective particle density can be measured by mercury porosimetry.

The model is applied to pigment powder packings, and to oil absorption pastes. For powder packings good agreement is obtained with model calculations. For oil absorptions the mathematical description of the OA paste contains three contributions: (1) Average effective particle density; (2) Packing of the particles; (3) Wettability of the particles by the oil. The contribution of the adsorbed oil layer is of minor

importance. It is shown that the generally accepted description for the oil absorption, e.g., as formulated by Stieg, is an extreme case of the model given in this paper. This model clarifies why it was not previously possible to solve the problem of how to exactly adjust the OA-measurements or the powder compaction to give pigments packings that correlate with CPVC's derived from actual paint results.

OXIDATIVE DRY RETENTION OF WATER-SOLUBLE ALKYDS IN THE PRESENCE OF GLYCOL ETHERS

Toronto Society for Coatings Technology

Seven samples of ethylene glycol monobutyl ether were obtained from seven sources in the Province of Ontario, and were subsequently prepared as 20% solutions in water. The pH of these solutions was monitored for a period of one year, during which they became increasingly more acidic. Oxidizing agents presumed to be peroxide were identified in the aged samples and quantitative determinations of peroxide indicated a relationship between loss of pH and peroxide concentration. Clear varnishes were prepared using aged E.G.M.B.E. containing such peroxide materials and fresh E.G.M.B.E. containing only slight peroxide materials. Dry tests conducted with these varnishes did not indicate dry loss in the presence of the acidic and peroxide components resulting from the degradation of E.G.M.B.E.

FILM FORMATION AND RHEOLOGY OF POWDER COATINGS

Peter G. de Lange, Consultant

Film formation and flow of thermosetting powder coatings are reviewed as functions of the two main parameters, namely, surface tension and melt viscosity.

The influence of flow additives, stoving temperature, stoving time, heating rate, particle size, and pigment concentration on these two parameters are discussed. It is indicated that in order to obtain maximum flow, a powder coating should have minimum melt viscosity, lowest reactivity, and maximum surface tension, and the highest practicable heating rate should be used. Furthermore, particle size should be small and pigment volume concentration should be below 20%. It is shown that good flow can only be obtained when the yield value of the molten coating powder is low.

HOW PRODUCTIVE IS YOUR PAINT PLANT?

R. Kennedy, Inmont Canada Ltd.

Productivity improvements come only as a direct result of managerial actions. In fact, improving productivity is the specific job of management.

It is imperative, therefore, that every manager refocus attention on the primary role as the "raiser" of productivity. In recognition of this, there is an urgent need in the paint industry to establish a common method for measuring productivity.

The primary resource of the paint industry is raw materials, which in Canada account for approximately 55% of the sales dollar. Accordingly, it is most important to continually focus on methods to decrease material cost, as this has the highest single impact on overall productivity improvements.

The "measure" of productivity discussed deals specifically with the output of personnel employed in the production process. It enables a production comparison to be made between one paint manufacturing facility and another, irrespective of the country of location.

NONDESTRUCTIVE DATING OF PAINTINGS WITH ENERGY DISPERSIVE X-RAY EMISSION SCANNING ELECTRON MICROSCOPY

Stephen J. Callan and James O. Stoffer, University of Missouri-Rolla

X-ray Emission Scanning Electron Microscopy was employed to characterize pigments used to paint a Madonna believed to be painted by a student of Leonardo da Vinci in the 15th century. Six pigment samples were removed from the painting. The entire chemical analysis was run on single grains of pigment classifying the analysis procedure as a nondestructive, and essentially a noninterfering dating technique useful for confirming the validity of even potentially priceless paintings. The pigments sampled were identified as synthetic red madder, maya blue, an opaque white mixture of lead oxide/zinc oxide, and a transparent white-aluminum hydroxide.

The presence of the opaque mixture dated the Madonna as being painted no earlier than 1830, and the presence of synthetic red madder dated the painting as being painted no earlier than 1870. The painting's first appearance was in the year 1940, thus dating the work between the years 1870 and 1940.

HEAT STABILITY VS. AMBIENT AGING— A CORRELATION

Los Angeles Society for Coatings Technology

Six different formulations were tested for viscosity change at one, three, six, and 10 weeks in the 120° F oven and each month for six months at room temperature. Eight to 12 batches of each formula were made without adjusting to a certain viscosity and their viscosity changes against time were plotted on graph paper. The constant range in viscosities and similar shapes of the curves suggest that the 120° oven is a reliable testing tool in determining stability. However, to correlate exactly the number of weeks at 120° F that will equal the number of months at ambient temperature, the basic system has to be evaluated as we have done.

CHEMISTRY OF AZO PIGMENT DYES

James Grey, Venezolano de Pigmentos

A long-term study of the manufacture of para nitroaniline red has been used as a model for the development of effective and successful techniques for pigment process development. These lead to the manufacture of high-quality pigments of improved color, strength, and chemical purity, and permitted the design of processes to use energy efficiently, with very low outputs of toxic waste.

Para nitroaniline red was chosen because of its simple structure; being no longer of commercial importance it is possible to discuss the manufacture in more detail than is normally possible. The study covers a wide range of precipitation conditions, including those at much higher concentrations than normally employed in classical kinetic studies.

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NUMERICAL COLOR CONTROL FOR EXTERIOR AUTOMOTIVE COATINGS

Susan Schultz, Marcus Chao, and Brian Hake, General Motors Corp.

A numerical color control program has been established using the latest colorimetry equipment. Part of this program includes color tolerances which have been designed based on visual judgments and instrumental measurements. These tolerances can be used to minimize the subjectivity from the color matching process and provide a tool to improve the quality of automotive coatings.

Studies that have been conducted indicate that the color tolerances developed in the Laboratory are also feasible in production facilities as an ongoing quality control technique.

IDENTIFICATION OF PIGMENTS IN PAINTS

Romesh Kumar, American Hoechst Corp., Fred W. Billmeyer, Jr., Rensselaer Polytechnic Institute, and Max Saltzman, Consultant

Organic pigments present in paints can be easily analyzed by solution spectrophotometry. The pigment is extracted from dry or liquid paint in selected solvents and the solution thus obtained is measured on a visible range spectrophotometer in the form of log absorbance versus wavelength spectrum. This spectrum is then compared with a set of reference spectra of organic pigments to establish the identity of the unknown pigment.

Mixtures of pigments present in a given paint can also be analyzed by solution spectrophotometry. Inorganic pigments, relatively few in number, can be analyzed by well established analytical methods such as atomic absorption spectroscopy.

THE OBSTACLE COURSE FROM MILL BASE TO FINISHED COATING

Frederick K. Daniel, Coatings Consultant

The quality of a coating depends not only on the physical and chemical properties of its components, but also on the way they are combined and how they interact with each other. Many rheological and colloidal problems are encountered during all phases of manufacture, storage, and coating application.

The role and control of osmosis, diffusion, surface tension, pigment/vehicle incompatibility, syneresis, convection, deflocculation, weak and strong flocculation, and co-flocculation are discussed.

HOW GOVERNMENT ENVIRONMENTAL REGULATIONS AFFECT THE COATINGS INDUSTRY IN EUROPE

Kenneth Zacharias, National Paint and Coatings Association

International commerce has been complicated by the adoption of diverse rules for regulation of chemicals for the coatings industry. All 10 member states of the European Economic Community (EEC), as well as Canada, Japan, the Scandinavian Countries, Australia, and New Zealand, now have toxic substances control legislation on the books. Most of these countries require industry to notify the government when it produces or markets new chemical substances.

This discussion compares and contrasts the EEC's Sixth Amendment on Labeling of Hazardous Materials with the PMN requirements of the Toxic Substances Control Act, and describes the impact on the coatings industry, both domestically and abroad.

HOW GOVERNMENT ENVIRONMENTAL REGULATIONS AFFECT THE COATINGS INDUSTRY IN CALIFORNIA

V.C. Jenkins, Ellis Paint Co.

California has made it a practice of taking the EPA standards and making them stricter. The many air pollution control districts in the state likewise choose to make CARB regulations stricter in different ways. This results in marketing problems for California paint manufacturers, since a formula that satisfies Los Angeles' air quality regulations may not work in San Diego or San Francisco.

Site of the 1983 Annual Meeting, Montreal is an exciting blend of Old World and modern metropolis. The St. Lawrence River is in the background.

1983 PAINT INDUSTRIES' SHOW

EXHIBITORS

Place Bonaventure
Montreal, Quebec, Canada
October 12, 13, 14

PAINT SHOW HOURS

Wednesday, October 12	11:30 am to 5:30 pm
Thursday, October 13	9:30 am to 5:30 pm
Friday, October 14	9:30 am to 3:00 pm

Exhibitors	Booth(s)
Aceto Chemical Co., Inc.	401
Air Products & Chemicals, Inc.	429-431
Alcan Ingot and Powders	1124-1125
Aluminum Co. of America	811-813-910-912
C. M. Ambrose Co.	823-825
Angus Co.	810-812-814
Applied Color Systems, Inc.	144
ARCO Chemical Co.	1118-1119
Ashland Chemical Co./Ashland Chem. Canada	511-513 515-517-519-610-612-614-616-618
Atlas Electric Devices Co.	529-531
B.A.G. Corp.	746
BASF Wyandotte Corp.	603-605-607
Bausch and Lomb, Inc.	1111-1112
Berol Chemicals, Inc.	945-947
Blackmer Pump Div., Dover Corp.	101
Bowers Process Equipment, Inc.	1216-1217
Brookfield Engineering Labs., Inc.	1100-1101
Buckman Laboratories, Inc.	105-107
Burgess Pigment Co.	633
Byk-Mallinckrodt USA, Inc.	843-845-847-942-944-946
Cabot Corp.	516-518
Canada Colors & Chemicals Ltd.	1004-1006
Canada Talc Industries Ltd.	601
Canadian Paint & Ctgs. Association	1122
Cargill, Inc.	329-331-333-428-430-432
CDI Dispersions	133
Celanese Chemical Co., Inc.	1027-1029
Celanese Specialty Resins	523-525-622-624
CEM Corp.	411
Certified Equipment Mfg. Co.	1102
Chemical & Engineering News (ACS)	901
Chemische Werke Huels AG	1108-1109
Chicago Boiler Co.	925-1022-1024

Exhibitors	Booth(s)
Chromalloy, Ind. Minerals Div.	1120
Clawson Tank Co.	1205-1206
Clough, Inc.	1123
Color Corp. of America	723-725
Columbian Chemicals Co.	123-125
Continental Fibre Drum Co.	214-216-218
Cordova Chemical Co. of Michigan	1219
Cosan Chemical Corp.	711-713
Daniel Products Co.	629-631
Degussa Corp.	804-806
Frank E. Dempsey & Sons Ltd.	744
Diamond Shamrock Corp., Process Chem. Div.	405-407
Disti, Inc.	1121
D/L Laboratories	224
Dominion Colour Co. Ltd.	343-345
Dow Chemical USA	301-303-305-307
Dow Corning Corp.	1116
Draiswerke, Inc.	442-444
Drew Chemical Corp.	829-831
DSET Laboratories, Inc.	937
DuPont Canada Ltd.	1042-1044
Eastman Chemical Products, Inc.	229-231-233-328 330-332
Ebonex Corp.	715
Eiger Machinery, Inc.	1036-1038
Elektro-Physik, Inc.	147
EM Chemicals	924
Engelhard Corp., Minerals & Chem. Div.	404-406
Epworth Manufacturing Co., Inc.	801-803
Erwin, Schafer & Associates, Inc.	1032
Fawcett Co., Inc.	807
Fed. of Socs. for Coatings Technology	124

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TONE™ Polymeric Intermediates is the new name of our broad range of caprolactone-based products especially designed for today's high performance coatings. Among them, you'll find: □ a completely new <u>hydroxy functional acrylate monomer</u> for improving the flexibility, impact resistance and durability of higher solids acrylic or vinyl copolymer coatings □ a broad spectrum of <u>multifunctional polyols</u> for producing high-quality polyurethanes, or for flexibilizing and upgrading the properties of thermoset coatings □ low viscosity <u>reactive diluents</u> for high solids thermoset coatings that achieve an overall balance of properties as required for automotive and other metal finishes.

TONE Polymeric Intermediates help you keep pace with the ever-changing demands of industrial coatings. In addition to our current collection of TONE products, we have more on the drawing board. And our technical staff is ready to provide assistance to help you meet your needs.

For complete information, just write Union Carbide, Department M1553, Danbury, CT 06817. We'll show you how great it can be living in the TONE Age.

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1983 PAINT INDUSTRIES' SHOW

Escalator To Restaurant

EXIT EMERGENCY ONLY

North Mezzanine

RESTAURANT

Stairway To Restaurant

Elev. To/From Program Sessions IN Bonav. Hotel

1223 | 1222 | 1221 | 1220 | 1219 | 1218 | 1217 | 1216 | 1215 | 1214 | 1213 | 1212 | 1210

1042 1044 1046 | 945 947 | 942 944 946 | 843 845 847 | 842 844 846 | 743 745 747 | 744 746 | 643 645 647 | 646 644 642 640 638 636

1036 1038 | 937 939 | 936 938 | 837 839 | 836 838 | 737 739 | 736 738 | 637 639

1028 1030 1032 | 929 931 | 928 930 932 | 829 831 833 | 828 830 832 | 729 731 733 | 728 730 | 629 631 633 | 628 630 632

1022 1024 | 925 | 922 924 | 823 825 | 822 824 | 723 725 | 724 | 623 625 | 622 624

1015 1017 1019 1021 1023 1025 1027 1029 1031 1033 1035

1016 1018 | 917 919 | 916 918 | 817 819 | 814 816 818 | 717 719 | 714 716 718 | 615 617 619 | 614 616 618

1010 1012 | 911 | 910 912 | 811 813 | 810 812 | 711 713 | 710 | 611 613 | 610 612

1000 1002 1004 1006 | 901 | 905 907 | 900 902 904 906 | 801 803 805 807 | 800 802 804 806 | 701 703 705 707 | 700 704 706 | 601 603 605 607

1125 1124 1123 1122 1121 1120 1119 1118 1117 1116 1115 1114 1113 1112

PLACE BONAVENTURE
WEST EXHIBIT HALL
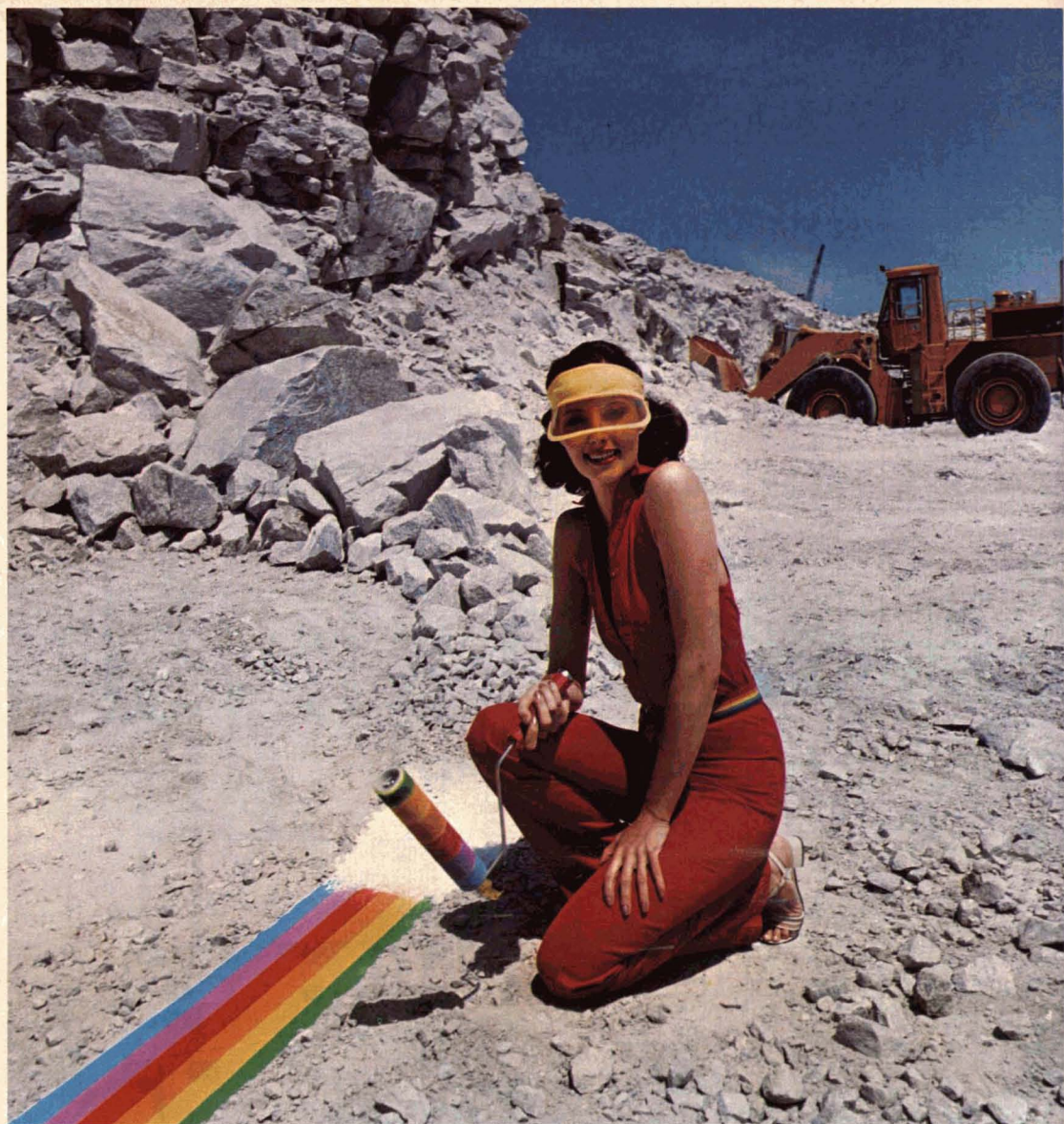
SHOW ENTRANCE

REGISTRATION AREA

UP TO SHOW ENTRANCE

MESSAGE CENTER

Escalator To/From South Mezzanine Meeting Rooms

Stairway To South Mezzanine Meeting Rooms

Elev. To/From Program Sessions in Bonav. Hotel

Federation of Societies for Coatings Technology

NAEM — NATIONAL ASSOCIATION OF EXPOSITION MANAGERS

CHEAPER
&BETTER
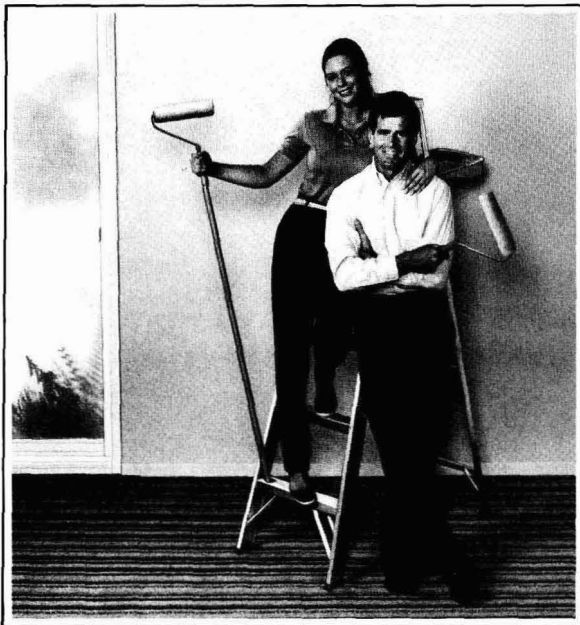
Your customers will be happy to find that you've improved the spatter resistance in your interior flat paints.

You will be happy to find that you've reduced RMC while improving paint application properties.

How is this possible?

A new low cost thickener, Acrysol® TT-935, an easily incorporated emulsion, is now available that can provide the following benefits to manufacturers of interior flat paints.

- **reduce raw material and handling costs**
- **excellent spatter resistance**
- **superior film build**

- **outstanding viscosity profile vs. that attained with competitive thickeners**

Furthermore, Acrysol TT-935 resists loss of paint viscosity because of microbial growth during long term storage on the shelf.

Low cost, excellent performance and handling properties, all found in one thickener — Acrysol TT-935. See for yourself if Acrysol TT-935 will outperform the current thickeners in your interior flat formulations. Contact your local Rohm and Haas Technical Representative for a sample or additional technical information or write to Marketing Services, Rohm and Haas Company, Independence Mall West, Philadelphia, PA 19105.

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PHILADELPHIA, PA. 19105

ANNOUNCING A NEW LOW COST THICKENER FOR INTERIOR FLAT PAINTS THAT ARE EASIER TO APPLY.

Exhibitors Listed By Product/Services Classification

Raw Materials

ADDITIVES

Aceto Chemical Co., Inc.
Air Products & Chemicals, Inc.
Angus Chemical Co.
Berol Chemicals, Inc.
Buckman Laboratories, Inc.
Byk-Mallinckrodt USA, Inc.
Cabot Corp.
Canada Colors & Chemicals Ltd.
Chemische Werke Huels AG
Chromalloy Industrial Minerals
Cordova Chemical Co. of Michigan
Cosan Chemical Corp.
Daniel Products Co.
Degussa Corp.
Frank E. Dempsey & Sons Ltd.
Diamond Shamrock Corp.
Dow Corning Corp.
Drew Chemical Corp.
GAF Corp.
W.R. Grace & Co.
Henkel Corp.
J.M. Huber Corp.
ICI Americas, Inc.
Interstab Chemicals, Inc.
Johnson Wax
Kay-Fries, Inc.
Kenrich Petrochemicals, Inc.
3M Co.
Merck & Co., Inc.
Nalco Chemical Co.
NL Chemicals/NL Industries, Inc.
Nuodex, Inc.
NYCO
Penn Color, Inc.
PPG Industries, Inc.
Rohm and Haas Co.
Sandoz Colors & Chemicals
Shamrock Chemicals Corp.
Southern Clay Products, Inc.
Triangle Imex Ltd.
Troy Chemical Corp.
Union Carbide Corp.
United Catalysts, Inc.
Universal Color Dispersions
R.T. Vanderbilt Co., Inc.
Wacker Chemical Co.

CHEMICAL INTERMEDIATES

Buckman Laboratories, Inc.
Canada Colors & Chemicals Ltd.
Celanese Chemical Co., Inc.
Chemische Werke Huels AG
Cordova Chemical Co. of Michigan
Dow Corning Corp.
GAF Corp.
Laporte (United States) Inc.
Rohm and Haas Co.
Triangle Imex Ltd.
Union Carbide Corp.

COLORANTS

BASF Wyandotte Corp.
CDI Dispersions
Color Corp. of America
Daniel Products Co.
Ebonex Corp.
EM Chemicals
Hilton-Davis Chemical Group
ICI Americas, Inc.
Mearl Corp.
Nuodex, Inc.
Penn Color, Inc.
Sandoz Colors & Chemicals
Sun Chemical Corp.
Universal Color Dispersions

EXTENDERS

Burgess Pigment Co.
Canada Colors & Chemicals Ltd.
Canada Talc Industries Ltd.
Chemische Werke Huels AG
Engelhard Corp.
GAF Corp.
Georgia Kaolin Co., Inc.
J.M. Huber Corp.
Indusmin Ltd.
International Minerals & Chemicals Corp.
Laporte (United States) Inc.
Manville Products Corp.
MiniFIBERS, Inc.
NYCO
Ore & Chemical Co.
Ottawa Silica Co.
Pennsylvania Glass Sand Corp.
PPG Industries, Inc.
Southern Clay Products, Inc.
Triangle Imex Ltd.
R.T. Vanderbilt Co., Inc.

LATICES AND EMULSIONS

Chemische Werke Huels AG
Johnson Wax
McCloskey Varnish Co.
Mobay Chemical Co.
Polyvinyl Chemical Industries, Inc.
Reichhold Canada Ltd.
Rohm and Haas Co.
Thibaut & Walker Co., Inc.
Union Carbide Corp.
Union Chemicals
Wacker Chemical Co.
Witco Chemical Corp.

OILS (DRYING / NON-DRYING)

Chemische Werke Huels AG

PIGMENTS, INORGANIC

Aceto Chemical Co., Inc.
BASF Wyandotte Corp.
Buckman Laboratories, Inc.
Columbian Chemicals Co.
Degussa Corp.
Dominion Colour Co. Ltd.
DuPont Canada Ltd.
EM Chemicals
Halox Pigments
Harshaw Chemical Co.
Dr. Hans Heubach GmbH & Co. KG
Hooker Industrial & Specialty Chemicals
J.M. Huber Corp.
ISC Alloys Ltd.
Laporte (United States) Inc.
Meadowbrook Corp.
Mearl Corp.
Mineral Pigments Corp.
NL Chemicals/NL Industries, Inc.
Northern Pigment
Ore & Chemical Co.
Pfizer, Inc.
PPG Industries, Inc.
Reichard-Coulston, Inc.
Tioxide Canada, Inc.
R.T. Vanderbilt Co., Inc.

PIGMENTS, ORGANIC

BASF Wyandotte Corp.
Canada Colors & Chemicals Ltd.
Columbian Chemicals Co.
Dominion Colour Co. Ltd.
DuPont Canada Ltd.
Ebonex Corp.
Harshaw Chemical Co.
Hilton-Davis Chemical Group
Laporte (United States) Inc.
Mobay Chemical Co.
Sandoz Colors & Chemicals
Sun Chemical Corp.

PIGMENTS, METALLIC

Alcan Ingot & Powders
Aluminum Co. of America
Canada Colors & Chemicals Ltd.
Meadowbrook Corp.
Purity Zinc Metals Co. Ltd.
Silberline Mfg. Co., Inc.

RESINS

ARCO Chemical Co.
Ashland Chemical Co.
Ashland Chemicals Canada
Cargill, Inc.
Celanese Specialty Resins
Chemische Werke Huels AG
Dow Chemical U.S.A.
Dow Corning Corp.

Eastman Chemical Products
Henkel Corp.
Hercules Incorporated
ICI Americas, Inc.
Johnson Wax
Kay-Fries, Inc.
Lorama Chemicals, Inc.
3M Co.
McCloskey Varnish Co.
Mobay Chemical Co.
Neville Chemical Co.
Polyvinyl Chemical Industries, Inc.
Reichhold Chemicals, Inc.
Reichhold Canada Ltd.
Rohm and Haas Co.
Spencer Kellogg
Synray Corp.
Thibaut & Walker Co., Inc.
Triangle Imex Ltd.
Union Camp Corp.
Union Carbide Corp.

SOLVENTS

Aceto Chemical Co., Inc.
Angus Chemical Co.
ARCO Chemical Co.
Canada Colors & Chemicals Ltd.
Celanese Chemical Co., Inc.
Chemische Werke Huels AG
Dow Chemical USA
DuPont Canada Ltd.
Eastman Chemical Products
GAF Corp.
Polyvinyl Chemical Industries, Inc.
Triangle Imex Ltd.
Union Carbide Corp.
Union Chemicals

Production Equipment

CLEANING

Wellco Products

FILLING / PACKAGING / LABELLING

C.M. Ambrose Co.
Bowers Process Equipment, Inc.
Fricke Enterprises
Ideal Mfg. & Sales Corp.
Semi-Bulk Systems, Inc.
Thiele Engineering Co.

FILTERING / STRAINING

Bowers Process Equipment, Inc.
Felco Industries Ltd.
Filter Specialists, Inc.
Russell Finex, Inc.
Vorti-Siv Div., M&M Machine

TINT BASE TINTING

Miller Paint Equipment, Inc.

GRINDING / MILLING

Bowers Process Equipment, Inc.
Chicago Boiler Co.
Draiswerke, Inc.
Eiger Machinery, Inc.
Netzsch Incorporated
Premier Mill Corp.
Union Process, Inc.

INSTRUMENTATION & CONTROL

Applied Color Systems, Inc.
Bausch & Lomb, Inc.
Brookfield Engineering Labs., Inc.
CEM Corp.
Elektro-Physik, Inc.
Macbeth
Minolta Corp.

MATERIALS HANDLING

B.A.G. Corp.
Certified Equipment Mfg. Co.
Clawson Tank Co.
Draiswerke, Inc.
Gregory Industrial Trucks
Semi-Bulk Systems, Inc.
Wellco Products

MIXING / DISPERSING

Applied Color Systems, Inc.
Bowers Process Equipment, Inc.
Draiswerke, Inc.
Eiger Machinery, Inc.
Epworth Mfg. Co., Inc.
Fawcett Co., Inc.
Graco, Inc.
Hockmeyer Equipment Corp.
Morehouse Industries, Inc.
Myers Engineering
Netzsch Incorporated
Premier Mill Corp.
Union Process, Inc.

PUMPING / METERING

Applied Color Systems, Inc.
Blackmer Pump
Granco Pump
Liquid Controls Corp.
Netzsch Incorporated
Warren Rupp Co.
Wilden Pump & Engineering Co.

Services

CONSULTING / TESTING

D/L Laboratories
Elektro-Physik, Inc.
Weathering Research Service Co.

EDUCATIONAL

Canadian Paint & Coatings Assoc.
Chemical & Engineering News
Federation of Societies for Coatings Technology
National Assoc. of Corrosion Engineers
Paint Research Institute
University of Detroit
University of Missouri-Rolla

EXPOSURE TESTING

Atlas Electric Devices Co.
D/L Laboratories
DSET Laboratories, Inc.
South Florida Test Service, Inc.
Weathering Research Service Co.

PUBLISHING

Canadian Paint & Coatings Assoc.
Chemical & Engineering News
Federation of Societies for Coatings Technology
Kay Publishing
Modern Paint & Coatings
Paint Research Institute
Technology Marketing Corp.

SOLVENT RECLAMATION

Disti, Inc.
Union Carbide Corp.

WASTE DISPOSAL

Ashland Chemical Co.
Ashland Chemicals Canada

CONTAINERS

B.A.G. Corp.
Certified Equipment Mfg. Co.
Continental Fibre Drum Co.
Hoover Universal, Inc.
Plastican, Inc.
Reliance Products Ltd.
Semi-Bulk Systems, Inc.
Sherwin-Williams Co.
Standard Container Co.

Laboratory Apparatus & Testing Equipment

ACCELERATED WEATHERING

Atlas Electric Devices Co.
Byk-Mallinckrodt USA, Inc.
D/L Laboratories
DSET Laboratories, Inc.
Q-Panel Co.
South Florida Test Service, Inc.
Weathering Research Service Co.

COATINGS APPLICATION

Byk-Mallinckrodt USA, Inc.
D/L Laboratories
Leneta Co.
Polyvinyl Chemical Industries, Inc.
Union Carbide Corp.
Carl Zeiss Canada Ltd.

COLOR / OPTICAL / APPEARANCE MEASUREMENTS

Applied Color Systems, Inc.
Bausch & Lomb, Inc.
Byk-Mallinckrodt USA, Inc.
D/L Laboratories
DSET Laboratories, Inc.
Hunter Associates Lab., Inc.
Macbeth
Minolta Corp.
Pacific Scientific Co.
Weathering Research Service Co.
Carl Zeiss Canada Ltd.

COMPUTERS / MICROPROCESSORS / SOFTWARE

Applied Color Systems, Inc.
CEM Corp.
Clough, Inc.
Erwin, Schafer & Associates, Inc.
University of Missouri-Rolla
Carl Zeiss Canada Ltd.

LAB MILLS

Eiger Machinery, Inc.
Netzsch Incorporated

PHYSICAL / MECHANICAL

Byk-Mallinckrodt USA, Inc.
D/L Laboratories
Elektro-Physik, Inc.
Hockmeyer Equipment Corp.
Pacific Scientific Co.
Polyvinyl Chemical Industries, Inc.

RHEOLOGICAL
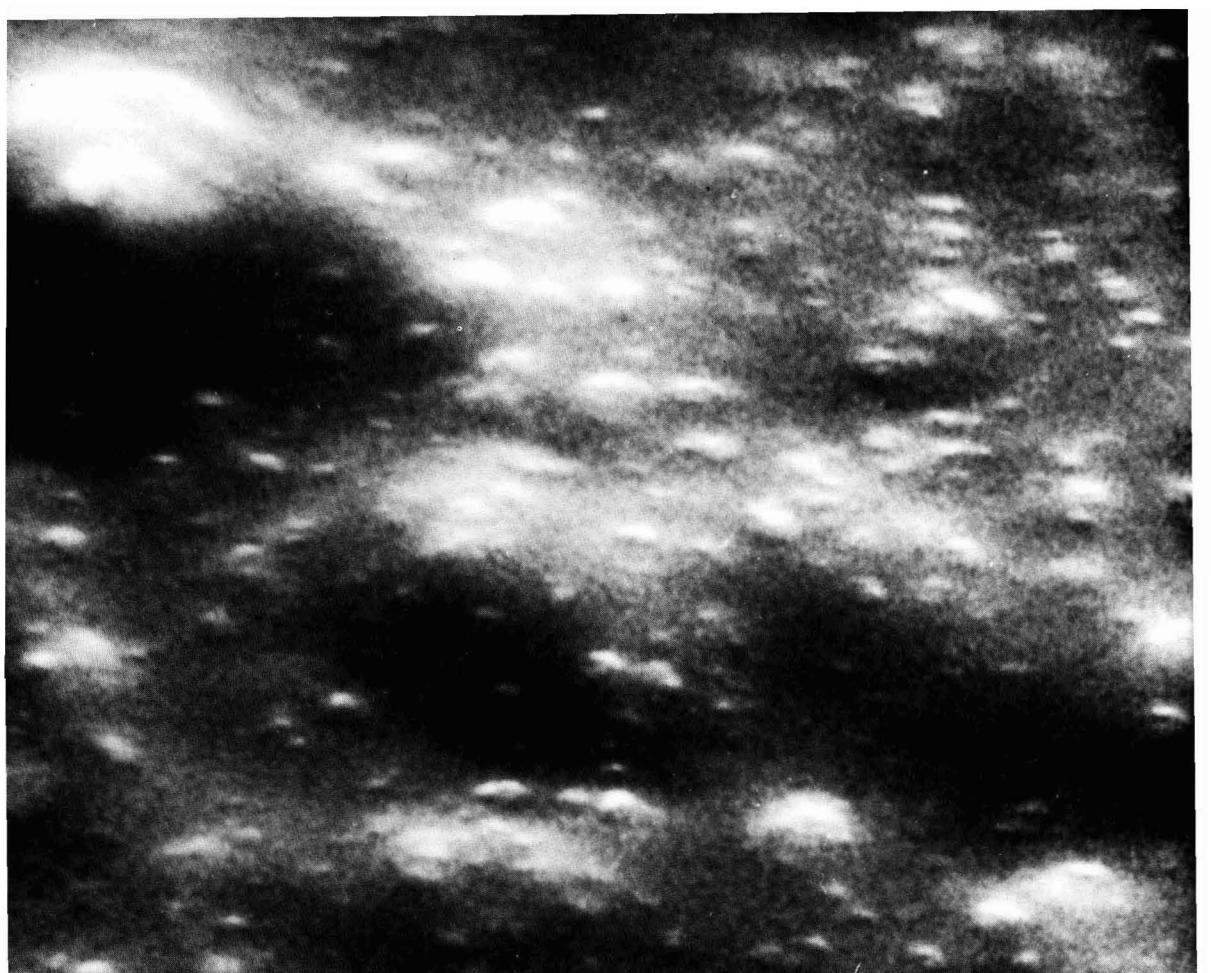
Brookfield Engineering Lab., Inc.
Byk-Mallinckrodt USA, Inc.
Leneta Co.
Union Carbide Corp.

TEST CHARTS

Leneta

Message Center

Freeport Kaolin Co.

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

Look closely and you'll see why LO-VEL® always leaves you flat.
SILICA

At 2000 magnifications, you can certainly see why PPG Lo-Vel® silica flatting agents reduce gloss in coatings so effectively. The microscopic irregularities Lo-Vel creates on the surface of a film break up light reflection and reduce gloss. To the naked eye, this makes the finish appear smooth and flat. But if you take an even closer look, you'll see there are even more good reasons to use Lo-Vel.

PPG makes a variety of Lo-Vel silica flatting agents which can be used to reduce the gloss of coil coatings, vinyl fabric top-coat lacquers and nitrocellulose lacquers, varnishes, extrusion coatings, high solid coatings, and even microtexture finishes. Lo-Vel flatting agents are easy to wet and disperse, so they can be used with a wide range of mixing techniques. They provide excellent suspension in pigment-ed finishes and many clears. And in problem finishes, adding small amounts of strong, hydrogen-bonding solvents will also provide excellent suspension of Lo-Vel.

Best of all, Lo-Vel flatting agents can be very cost effec-tive. In fact, even on a pound-for-pound basis, you'll be impressed with the cost advan-tages of Lo-Vel. In applications such as coil coatings, they typi-cally require less loading than competitive flatting agents to produce comparable finishes. That, of course, can mean sub-stantial raw material cost sav-ings. And Lo-Vel flatting agents will not abrade spray guns or equipment.

A close look will convince you. PPG Lo-Vel flatting agents will always leave you flat. But they'll never let you down. For more information, contact PPG Industries, Inc., One PPG Place, Pittsburgh, PA 15272.

PPG

Government and Industry

Corrosion Research Ongoing at Lehigh University

A multi-faceted corrosion research program at Lehigh University, Bethlehem, PA, currently funded by more than $1 million in annual research grants from government and industry, has resulted in a number of major discoveries representing new and potentially more effective means of inhibiting rust and corrosion.

Employing sophisticated research techniques, described as "unique and classic applications" by the National Association of Corrosion Engineers, the program is being conducted under the general leadership of Dr. Henry Leidheiser, Jr., Director of Lehigh's Center for Surface and Coatings Research.

The Lehigh corrosion research activity has several major thrusts, including an on-going study of the atomic properties of surfaces as they relate to the development of new methods of bonding an inorganic compound, such as a paint or lacquer, to a metal surface.

"Basically," Dr. Leidheiser said, "the rusting process is electrochemical, meaning that both electrical and chemical reactions occur."

He cited the chemical nature of the interface region joining coating to metal as representing "the major gap in the understanding of organic protective coatings." It is a gap that has been progressively narrowed through research conducted at Lehigh.

"Given an understanding of the physical, chemical, and electrical behavior of the surface," Dr. Leidheiser noted, "it can be pre-treated electrochemically, creating a condition with qualities that are more compatible with the qualities of a coating.

He explained that the chemical and physical pre-treatment alters the molecular surface of the metal to a thickness measured at from 20 to 30 angstroms, or one 1-millionth of an inch.

"The process," he said, "involving an inorganic compound, β-hydroxyquinoline, creates a surface that offers a poorer base for chemical reactions that lead to the deterioration of metal.

A supplemental electrochemical treatment, developed at Lehigh creates a tighter bond between coating and metal.

Dr. Leidheiser said that the process, for which a patent has been applied for, represents a potentially better means of preventing corrosion.

The project is one of a variety of Lehigh investigations involving coating and surface analysis as it relates to the sources, occurrence, and prevention of rust and corrosion.

Among other major projects is an effort to eliminate the effects of cathode delamination, or the peeling of paint adjacent to small holes or chips resulting from minor damage to the surfaces of ships, bridges, and other metal structures.

According to Dr. Leidheiser, research undertaken at Lehigh has led to an explanation of the cathode delamination process which could lead to the development of a surface treatment that would prevent the spread of corrosion from defects in coatings.

The Lehigh corrosion research program has been characterized by a number of pioneering efforts, particularly in the application of Mossbauer spectroscopy to the study of surfaces, rather than the conventional application to solids. Other research techniques that have been used in new and innovative ways at Lehigh include the application of impedence methods to predict the performance of painted metals, Auger spectroscopy, and electron X-ray photoelectron spectroscopy.

Sponsors of the Lehigh corrosion research program, as related to organic coatings, include the Office of Naval Research, the Electric Power Research Institute, IBM, Bethlehem Steel, Mobil, and the Kendall Co.

CMA Contracts for Study on Hazardous Waste

The Chemical Manufacturers Association announced it will contract for an independent $1 million study to provide the scientific foundation needed to help the government develop sound public policy on health and hazardous waste.

William G. Simeral, an Executive Vice-President of the DuPont Co. and the immediate past board chairman of CMA said: "The study will clearly identify what is and what isn't known about the effects of exposure to hazardous waste." This analysis, he said, "can form the basis of interim public policy. We can learn, then legislate, if necessary, all in a reasonable time frame."

The study, to begin in September, will take eight to 10 months to complete. It will be conducted by Universities Associated for Research and Education in Pathology (UAREP), an independent consortium of 15 major universities, established in 1964 to conduct public health research.

The study will review the vast amount of existing data to assess the potential health hazards of waste sites.

The objectives of the study will be:
• To identify chemicals associated with waste sites which could prove hazardous to humans as a result of excessive exposure.
• To identify, if possible, the levels of human exposure likely to occur in association with waste sites.
• To define and classify the probable health effects, if any, likely to occur in association with waste sites.
• To identify the clinical and laboratory end results that would be useful in investigating problem sites.
• To identify the epidemiological criteria necessary to establish causal relationships.

If the study's findings indicate that people are being affected, Simeral said, "then we can determine with greater assurance what needs to be done, where, and how quickly. If, on the other hand, the findings indicate little or no risk of exposure and harm being done, we will have an enlightened basis for directing future public policy decisions."

And the chemical industry, he said, "will support the outcome in either case." The CMA believes this work deserves the broadest possible sponsorship and financial support, Simeral said.

A coalition of government, academic, business, and environmental groups will be gathered to join in the effort. Copies of the UAREP proposal already have been distributed to many organizations.

It was emphasized that the study in no way undermines (the chemical industry's) resolve to clean up waste sites as soon as possible.

Chemical Industry Most Energy Efficient, Reports CMA

During 1982, chemical industry energy efficiency improved by 24.2% compared with 1972. This is a significant achievement since operating rates dropped to 69%, the lowest in a decade. During the same period production volume of chemicals grew by about 37%.

For the 12-month period ending December 1982, 101 companies reported conservation figures to the Chemical Manufacturers Association, which in turn compiles an industry-wide report for the Department of Energy.

The 24.2% reduction is the same as that reported last year. The base year used to compare figures is 1972.

CMA President Robert A. Roland said that if general economic conditions continue to improve, the industry should achieve its own voluntary conservation goal of 30% by 1985. "The chemical industry continues to view conservation as a high national goal," he said. "As the nation's largest industrial energy consumer, we have a responsibility to our customers and the American people to

manufacture products at maximum efficiency to help reduce our dependency on foreign energy sources."

The aggregate energy savings in 1982 for the reporting companies is about 850 trillion Btu. That is equivalent to nearly 146 million barrels of crude oil or about 10% of U.S. imports in 1982.

The 850 trillion Btu savings is the largest for any industrial sector, according to DOE, which has identified the

chemical industry as the largest industrial energy consumer.

The companies reporting conservation progress sited a number of methods used to obtain results including more efficient technology in plants and equipment, process improvements, operational changes, and greater waste heat recovery. Other significant measures taken by the companies included improvements in power and steam operations, improved insulation, and maintenance and shutdown of older, less-efficient units.

Battelle Evaluates Antifouling Coatings

Coatings designed to prevent sea mussels and other organisms from obstructing selected operations at coastal power plants are being evaluated by researchers at Battelle's New England Marine Research Laboratory in Duxbury, MA.

Battelle scientists are working under contract with the Stone & Webster Engineering Corp., which is being funded more than $750,000 by the Electric

Power Research Institute (EPRI). Twenty electric utilities also are cooperating in the project.

Battelle's role is to determine whether one or several organotin coatings are effective in inhibiting macroinvertebrates from settling and growing in or on intake systems at coastal power plants. Such a coating would prevent costly outages due to restricted cooling water flow when ¾-inch tube in the condenser becomes clogged with marine growth.

According to Dr. Robert E. Hillman, who heads Battelle's research team, Battelle's marine scientists are installing a series of steel and concrete exposure panels coated with potential antifouling compounds in or near the intake structures of 20 coastal power plants from California to the Gulf of Mexico, around Florida, and up the East Coast to Maine.

Eight racks, each containing either eight steel or eight concrete panels, are being submerged at each of the 20 generating stations. Each rack holds seven coated panels and one uncoated panel as a control, for a total of 64 panels at each site.

Researchers will inspect the 12- by 6-inch panels after 12, 24, 30, and 36 months to gather data on the amount of macroinvertebrate settling and growth that has occurred. A history data sheet will be maintained for each panel, and color photographs recording the condition of each panel at inspection will be taken.

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Estimation of Solubility Parameters From Solution Properties of Polymers

C.M. Kok[†] and Alfred Rudin
University of Waterloo*

Solubility parameters are widely used in design-ing coatings formulations. Various experimental methods for determining solubility parameters are tedious and do not always give the same results for the same material. Group contribution calculations provide convenient estimates of solubility param-eters but are not applicable in a straightforward manner to complicated polymers like alkyds or multicomponent vinyl copolymers.

This article describes a new method for measur-ing solubility parameters of polymers. Experimen-tally, two samples with different average molecular weights and the same composition are required. Intrinsic viscosities and gel permeation chromato-grams of the two polymer samples provide the data needed for these calculations. The procedure also provides estimates of the molecular weight distribu-tions of the samples, if these are of interest. If the Mark-Houwink constants of the polymer of interest are known in several solvents, its solubility param-eter can be calculated without recourse to experi-ment. The method is illustrated for a variety of homopolymers and an alkyd.

INTRODUCTION

Solubility parameters are widely used in formulating coatings.[1] Experimentally, the solubility parameter of a polymer is usually taken as equal to that of a solvent that will produce the greatest swelling of a lightly cross-linked polymer or the highest intrinsic viscosity of a soluble sample of the polymer. These methods may give somewhat different results for the same material, depend-ing on the polarity and hydrogen-bonding properties of the solvents used.

Solubility parameters can also be calculated from group contribution tabulations[2-4] if the structure of the polymer is clearly known. Such techniques are not applicable in a straightforward manner to complicated polymers such as alkyds or multicomponent vinyl poly-mers. This article describes a new method for measuring solubility parameters of film forming and other poly-mers. It requires two samples of the material with different average molecular weights. Intrinsic viscosities and gel permeation chromatograms of the two polymer samples are measured to provide the data needed for these calculations. In effect, this method enables one to proceed from a measurement of the Mark-Houwink constants of the polymer to its solubility parameter. Two polymer samples with different (unknown) average molecular weights are needed to estimate the Mark-Houwink constants of polymers with complicated or uncertain compositions.

A previous article from this laboratory has demon-strated a method for predicting Flory-Huggins inter-action parameters using intrinsic viscosities as input parameters.[5] This technique is further extended to calcu-lation of solubility parameters in this report.

THEORY

The present method is based on a model which has been used to predict osmotic pressures,[6] second virial coefficients of polymer solutions,[7] sedimentation coeffi-cients,[8] and Flory-Huggins interaction coefficients.[5] It has also been used to account for concentration effects in size exclusion chromatographic analyses of poly-mers.[9-11] A brief outline of the model is given below. The procedures appear to be complicated in the bare-bones

summary given here, but they are not so in practice. Solubility parameters are readily estimated from easily accessible input data even when the polymer structure is complex or uncertain.

The theoretical calculations stem from an estimate of the hydrodynamic volume, v_ϵ, of a solvated polymer molecule with molecular weight, M. This volume is given by:[9,10]

$$v_\epsilon = \frac{4\pi[\eta]M}{(9.3)10^{24} + 4\pi N_o c([\eta] - [\eta]_\theta)} \qquad (1)$$

where N_o is Avogadro's constant (6.0235×10^{23}), c is the polymer concentration $(g.cm^{-3})$ and the intrinsic viscosity, $[\eta]$, and the theta solution intrinsic viscosity, $[\eta]_\theta$, are both expressed in $cm^3 g^{-1}$ units. The input parameters here are c, M, $[\eta]$ and $[\eta]_\theta$. We show below how the last three can be obtained, if necessary, from size exclusion chromatographic (SEC) analyses.

Once the hydrodynamic volume of the dissolved polymer can be calculated at any concentration, c, it is possible to insert this value into simple statistical-mechanical hard-sphere models to obtain accurate predictions of some thermodynamic[5-7] and transport[8-11] properties of the polymer solution. Some of these properties are used in the calculation of solubility parameters and the relations needed follow.

According to this model, the osmotic pressure of polymer solution of concentration c is obtained from the equation

$$\frac{\pi}{c} = \frac{RT}{\overline{M}_n} \left[1 + A_2^* \frac{\overline{M}_n c}{2} \right]^2 \qquad (2)$$

in which π is the osmotic pressure of a solution of polymer with number average weight $\overline{M}_n$, R and T have their usual meanings, and A_2^* is defined in equation (4). The corresponding form for simulation of light scattering results is

$$\frac{Hc}{\tau} = \frac{1}{\overline{M}_w} (1 + A_2^* \overline{M}_w c)^2 \qquad (3)$$

where H is an optical constant for the particular solvent and apparatus and τ is the turbidity of the solution.

In equations (2) and (3) the parameter A_2^* is given by

$$A_2^* = \frac{16\pi N_o[\eta]}{M((9.3)10^{24} + 4\pi N_o c([\eta] - [\eta]_\theta))} \left(1 - \frac{[\eta]_\theta}{[\eta]} \right) \qquad (4)$$

where all the symbols have been defined earlier. M in this case stands for an appropriate average molecular weight of the polymer solute.

Equation (2) or (3) can be used to predict reduced osmotic pressure (π/c) or turbidity (Hc/τ) data as a function of c. These results are calculated up to a concentration = 0.5 c_x, where

$$c_x = \frac{9.3 \times 10^{24}}{4\eta N_o[\eta]_\theta} \qquad (5)$$

The second virial coefficient A_2 is then obtained by least squares fitting to the plots of $(\pi/c)^{1/2}$ [equation (2)] or $(Hc/\tau)^{1/2}$ [equation (3)] against c for $0 \leqslant c \leqslant 0.5 c_x$. This procedure differs from other methods for estimating second virial coefficients, in that the model summarized

here first simulates the raw experimental data. It then obtains A_2 by the same data-fitting technique as would be applied to laboratory results. The agreement with experimental values of A_2 is good.[6]

Once the second virial coefficient has been obtained for a given polymer-solvent system one can calculate the corresponding Flory-Huggins interaction parameter, χ, from the equation:

$$A_2 = \frac{\left(\frac{1}{2} - \chi\right)}{\rho_2^2 V_1} \qquad (6)$$

where ρ_2 is the density of the polymer $(g\,cm^{-3})$ and V_1 is molar volume of the solvent $(cm^3 mol^{-1})$.

We now have summarized a method for calculating the Flory-Huggins interaction parameter, χ, for a given polymer and solvent. The solubility parameter of the polymer is obtained by repeating this procedure for the given polymer in a few solvents with known solubility parameters. The method is as follows:

The solubility parameter of the polymer, δ_2, can be related to χ by:[12,13]

$$\chi = \frac{V_1}{RT} (\delta_1 - \delta_2)^2 \qquad (7)$$

where δ_1 is the solubility parameter of the solvent. (Units of solubility parameter are $(energy/volume)^{1/2}$, generally $cal^{1/2} cm^{-3/2}$.) Equation (7) can be rewritten as

$$\frac{\delta_1^2}{RT} - \frac{\chi}{V_1} = \left[\frac{2\delta_2}{RT}\right]\delta_1 = \frac{\delta_2^2}{RT} \qquad (8)$$

This is the equation of a straight line. Hence, when the left-hand side is plotted as a function of δ_1 one can estimate δ_2. The polymer solubility parameter is preferably[12,13] calculated from the slope of this plot, rather than the intercept or the last term of equation (8).

As mentioned, application of the model requires knowledge of the intrinsic viscosities $[\eta]$ and $[\eta]_\theta$. When these are known the polymer molecular weight, M, is available from the Mark-Houwink equations:

$$[\eta] = KM^a \qquad (9)$$

and

$$[\eta]_\theta = K_\theta M^{0.5} \qquad (10)$$

The Mark-Houwink constants (K, K_θ, and a) are tabulated for common solvents and many polymers that have relatively simple structures. When the Mark-Houwink constants are not available they can be measured readily by the method described by Dobbin, Tchir, and Rudin.[14,15] Two samples are required, with the same composition and different (unknown) molecular weights. The intrinsic viscosities of the two polymers are measured, along with their gel permeation chromatograms. Intrinsic viscosities can be measured in a number of solvents but at least one of the solvents must be the same as that used in the size exclusion chromatographic analyses. In this method, a simple computer search produces Mark-Houwink constants by comparing the ratio of measured intrinsic viscosities with ratios of parameters derived from SEC elution volumes.

Table 1—Input Parameters for Calculations[4,21]

Polymer	Solvent	K_θ cm³/g	K cm³/g	a	Solvent Molar Volume cm³/mol	Solubility Parameter of Solvent
1. Poly(vinyl acetate)	Acetone	82.0	15.8	0.69	73.4	9.7
	Acetonitrile		16.2	0.71	52.3	11.9
	Benzene		56.3	0.62	89.0	9.22
	Methyl ethyl ketone		42.0	0.62	89.5	9.6
	Chlorobenzene		20.3	0.72	80.2	9.3
	Chloroform					
2. Poly(methyl methacrylate)	Acetone	48.0	7.5	0.70	73.4	9.7
	Benzene		7.24	0.76	89.0	9.2
	Methyl ethyl ketone		6.8	0.72	89.5	9.6
	Chloroform		9.6	0.78	80.2	9.3
	1,2-Dichloroethane		17.0	0.68	86.8	10.0
	Toluene		7.1	0.73	106.2	9.0
3. Poly(vinyl chloride)	Chlorobenzene	100	71.2	0.59	102.1	9.5
	Cyclohexanone		174.0	0.55	104.2	9.3
	Tetrahydrofuran		15.0	0.77	81.1	9.1
4. Nylon 66....................	o-Chlorophenol	227	168	0.62	101.8	9.79
	m-Cresol		240	0.61	95.8	10.2
	Aqueous formic acid (90%)		35.3	0.79	37.3	14.3
5. Polystyrene.................	Chlorobenzene	84.5	7.4	0.749	102.1	9.5
	Methyl ethyl ketone		39	0.58	89.5	9.56
	Benzene		9.18	0.743	89.0	9.2
	Ethyl benzene		17.6	0.68	122.7	8.9
	Toluene		17.0	0.69	106.2	9.0
	Dichloroethane		21.0	0.66	86.8	10.0
6. Poly(acrylonitrile)............	α-Butyrolactone	210.0	57.2	0.67	76.3	12.6
	Dimethyl formamide		39.2	0.75	77.0	12.1
	Dimethylacetamide		30.7	0.76	93.0	10.8
	Dimethyl sulfoxide		32.1	0.75	70.9	12.0
7. Poly(chloroprene)...........	Benzene	107	15.5	0.71	89	9.2
	Butylacetate		37.8	0.62	131.6	8.5
	Carbon tetrachloride		22.1	0.69	96.5	8.6
8. Poly(isobutene)	Carbon tetrachloride	182	29.0	0.68	96.5	8.6
	Cyclohexane		27.6	0.69	108.2	8.2
	Decalin		22.0	0.70	154.2	8.8
	Diisobutylene		36.0	0.64	157.0	7.7
	Toluene		20.0	0.67	106.2	8.9
9. Polypropylene	Benzene	119	27.0	0.71	89.0	9.2
	Cyclohexane		16.0	0.80	108.2	8.2
	Decalin		15.8	0.77	154.2	8.8
	Toluene		21.8	0.73	106.2	9.0
10. Natural rubber..............	Benzene		18.5	0.74	89.0	9.2
	Cyclohexane		30.0	0.70	108.2	8.2
	Toluene		50.2	0.667	106.2	8.9

It should be noted, also, that the labor involved in intrinsic viscosity measurements can be reduced considerably by use of one of a number of generally effective single point methods.[16-18] (It may be advisable, however, to check the accuracy of the particular single point method chosen with some conventional multi-concentration intrinsic viscosity measurements.)

Once K and a are known, K_θ can be estimated from the empirical relationship:[4]

$$-\log\left(\frac{K}{K_\theta}\right) = 3.7(a - 1/2) \qquad (11)$$

The procedure outlined requires the use of a microcomputer. The input data are readily obtained from SEC and intrinsic viscosity measurements, as described. Solubility parameters of some polymers can be calculated by using tabulated Mark-Houwink constants. The materials for which this information is available are, however, not very widely used in coating formulations.

Table 2—Solubility Parameters of Polymers

Polymer	Solvent used in Calculation	χ	δ_2 $(cal cm^{-3})^{1/2}$ Quoted for MW = 500,000	Literature Values of δ_2[21]
1. Poly(vinyl acetate)	Acetone	0.465	10.2	9.35 to 11.05
	Acetonitrile	0.467		
	Benzene	0.441		
	MEK	0.454		
	Chlorobenzene	0.447		
	Chloroform	0.435		
2. Poly(methyl methacrylate)	Acetone	0.482	9.1	9.0 to 12.84
	Benzene	0.458		
	MEK	0.473		
	Chloroform	0.454		
	1,2-Dichloroethane	0.464		
	Toluene	0.462		
3. Poly(vinyl chloride)	Chlorobenzene	0.413	9.7	9.4 to 10.8
	Cyclohexanone	0.372		
	THF	0.369		
4. Nylon 66	o-Chlorophenol	0.327	11.6	13.6
	m-Cresol	0.315		
	Aqueous formic acid (90% vol.)	0.416		
5. Polystyrene	Chlorobenzene	0.461	9.0	8.5 to 10.3
	MEK	0.486		
	Benzene	0.461		
	Ethyl benzene	0.455		
	Toluene	0.457		
	Dichloroethane	0.472		
6. Poly(acrylonitrile)	α-Butyrolactone	0.418	11.4	12.4 to 15.4
	DMF	0.375		
	Dimethylacetamide	0.355		
	DMS	0.394		
7. Poly(chloroprene)	Benzene	0.432	8.4	8.11 to 9.38
	Butylacetate	0.438		
	Carbon tetrachloride	0.417		
8. Poly(isobutene)	Carbon tetrachloride	0.450	8.1	7.1 to 8.3
	Cyclohexane	0.440		
	Decalin	0.421		
	Diisobutylene	0.442		
	Toluene	0.471		
9. Polypropylene	Benzene	0.447	8.3	9.2 to 9.4
	Cyclohexane	0.394		
	Decalin	0.383		
	Toluene	0.438		
10. Natural rubber	Benzene	0.439	8.4	7.9 to 8.4
	Cyclohexane	0.428		
	Toluene	0.425		

EXPERIMENTAL

Solutions of two commercial 50% oil length alkyd resins were made in tetrahydrofuran, chloroform, carbon tetrachloride, and methyl ethyl ketone.

Size exclusion chromatography was carried out using tetrahydrofuran as the solvent. Injected concentrations were about 2 mg/mL. The flow rate was 2.5 mL/min through a set of four polystyrene gel columns. Nominal exclusion sizes (in Å) of these packings were 10^3, 10^4, 10^5, and 10^6.

A universal calibration curve based on elution volumes of anionic polystyrene standards was constructed in terms of hydrodynamic volumes.[9,10] The Mark-Houwink constants for the alkyd resin in tetrahydrofuran and the other solvents were obtained from the SEC chromatograms and the corresponding intrinsic viscosities, using the procedure mentioned above.[14,15]

Intrinsic viscosities were measured with Ubbelohde suspended level glass viscometers and $[\eta]$ values were obtained in this case with the usual Huggins[19] and Kraemer[20] plots.

RESULTS

Solubility parameters for 10 common polymers were calculated from equation (8), as described. The χ values needed for each polymer-solvent combination were estimated as outlined.[5] The input parameters for these calculations are listed in *Table* 1. *Table* 2 shows the χ and solubility parameters obtained for these polymers. The Flory-Huggins interaction parameters[5] and the second virial coefficients[7] to which they are related are dependent to some extent on the molecular weight of the polymer solute. For calculation of solubility parameters, we have here assumed a molecular weight of 500,000. The values calculated and listed in *Table* 2 are in good agreement with literature values obtained by a variety of other methods.

Figure 1 is an example of a plot obtained from equation (8). The values of R and T used were 1.99 cal/mol K and 298 K, respectively. Linear regression gives a correlation coefficient of 0.9996. The δ_2 value estimated is 10.2 $cal^{1/2} cm^{-3/2}$.

As illustrated above, the solubility parameter of a polymer can be calculated from tabulated values of its Mark-Houwink constants in several solvents. When these constants are not available they can be estimated as outlined above and illustrated here for the case of an alkyd resin.

Table 3 lists the Mark-Houwink constants of the two alkyd samples as estimated by the Dobbin-Tchir-Rudin SEC method.[14,15] K_θ for each pair of K and a values was calculated according to equation (11). Flory-Huggins *interaction parameters were also calculated*[5] *and are* listed in this table. The χ values are all equal and high, indicating that all the solvents used are marginal for this alkyd type.

The SEC method also provides a measurement of the parameters of the molecular weight distribution of the polymer samples involved in the experiment. These values are enumerated in *Table* 4. In this case, both alkyds had number average molecular weights of 28,000 but higher averages differed significantly. The molecular weight distributions are extremely broad in both cases.
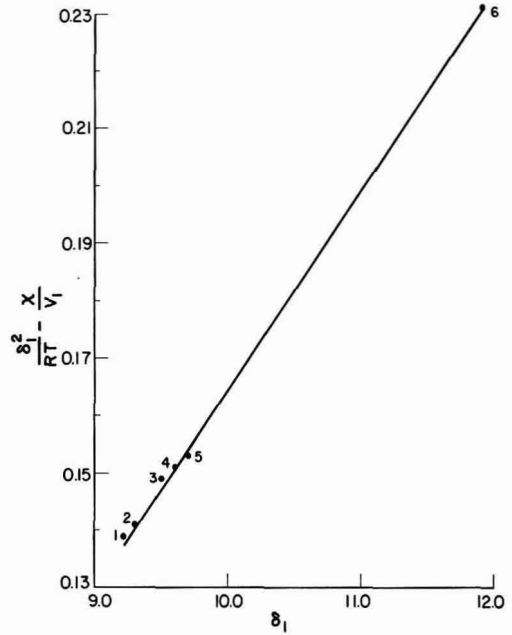
Figure 1—Plot of equation (8) for poly(vinyl acetate) in benzene (1), chloroform (2), chlorobenzene (3), methyl ethyl ketone (4), acetone (5), and acetonitrile (6)

The Mark-Houwink coefficients of *Table* 3 were used as input parameters to calculate simulated light scattering second virial coefficients[7] and hence, χ values.[5] The χ parameters were found not to change significantly with alkyd molecular weight in the range 20,000 to 1,300,000. This is because the second virial coefficients which were calculated were all low (of the order of $10^{-5} cm^3 mol\ g^{-2}$). As mentioned, the χ values calculated for 500,000 molecular weight are also recorded in *Table* 3. Insertion of these figures in equation (8) gives a δ_2 value for a 50% oil length alkyd of 8.63 $(cal\ cm^{-3})^{1/2}$. For alkyd resins in general, solubility parameters of 7.0 to 14.7 $(cal\ cm^{-3})^{1/2}$ have been quoted from various measurements[21] and the agreement here is evidently quite good.

Table 3—Mark-Houwink Constants Of 50% Oil Length Alkyd Resin

Solvent	$K \times 10^3$ cm^3/g	a	χ	$K_\theta \times 10^3$ cm^3/g (eq. (11))
Tetrahydrofuran	0.510	0.673	0.499	2.208
Chloroform	0.305	0.614	0.499	0.806
Carbon tetrachloride	1.278	0.587	0.499	2.682
Methyl ethyl ketone	4.298	0.634	0.499	13.46

Table 4—Molecular Weight Parameters of Alkyd Resins[a]

Sample	A	B
$\overline{M}_n$	28,000	28,000
$\overline{M}$,[b]	3.6×10^5	1.3×10^6
$\overline{M}_w$	1×10^6	4.5×10^6

(a) From SEC using K and a derived for THF solutions.
(b) From $[\eta]$ in THF.

DISCUSSION

The procedure outlined used the empirical relation of equation (11) to estimate K_θ. Four different values of K_θ were obtained from K and a values for four different solvents (*Table* 3), whereas only one K_θ exists theoretically. The χ value for each polymer/solvent pair was calculated using the respective K_θ value. It is, of course, possible and more rigorous to resort to theoretical methods for calculating K_θ.[22] This approach will, however, greatly complicate the simple mathematics involved in the method described here. Since the applications of solubility parameter values do not require great precision, we believe the method used will be generally adequate.

CONCLUSIONS

It should be noted that the aim of this article is to demonstrate the application of our model in calculating polymer solubility parameters. This model has already been shown to be capable of estimating second virial coefficients[7] and Flory-Huggins interaction parameters[5] for a variety of polymer/solvent systems. Hence, the present approach rests solely on the use of equation (8) in calculating δ_2. Although this equation is often used to calculate solubility parameters, it is important to realize its limitations. As pointed out previously by Mangaraj,[23] the use of this relation is not entirely satisfactory. χ/V_1 is very small as compared to δ_1^2/RT [typically 1:30] and hence, the δ_2 values calculated are not very sensitive to χ. In other words, solubility parameters estimated for polymers will depend significantly on the choice of solvents selected for the particular polymers. This is probably not a severe limitation, however, since all solvents for a given polymer may be expected to have similar δ_1 values if they do not differ greatly in hydrogen bonding or polarity characteristics.

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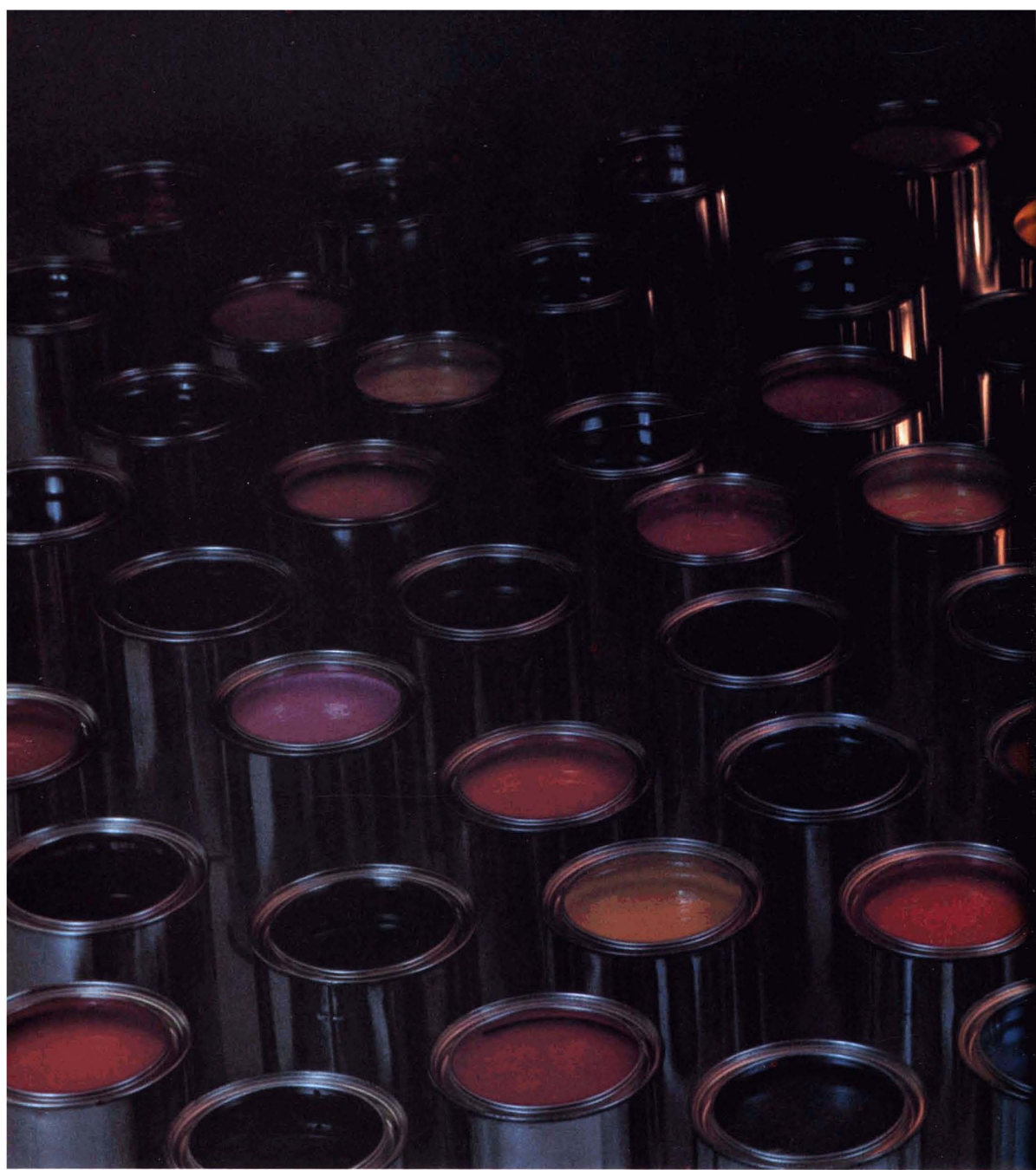
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Daniel Products Company*

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INTRODUCTION

The factors that govern tinter performance are: (1) dispersing medium (vehicles and additives); (2) pigments; (3) solvents; (4) dispersing equipment; and (5) tinter interactions.

EFFECT OF DISPERSING MEDIUM ON TINTER PERFORMANCE

Ever since the paint industry abandoned co-grinding white and colored pigments in favor of tinting white bases with concentrated tinting colors, it has been taken for granted that the best way to assure good tinter performance is to grind the colored pigment in the same vehicle as the white base. This assumption is partly correct and partly fallacious. It is true that the film properties cannot be adversely affected if tinter and white base contain the same vehicle, but it is not true that such a tinter will

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necessarily produce good color uniformity, maximum tint strength, good stability, or good rheological properties. Furthermore, in a diversified paint company, this approach leads to a wholly unmanageable and uneconomical proliferation of tinter lines.

Figure 1 shows what may, and often does, happen when a tinter is added to a white containing the self-same vehicle system, in this case, an acrylic resin. Strong rub-up occurs due to incomplete incorporation or flocculation of the tinter pigment. High-energy mixing would diminish the rub-up but would not eliminate it altogether.

In other vehicle systems, this effect may not be observed initially as, for instance, when tinter and white contain identical medium- or long-oil alkyds, but on aging the tinters for two weeks before incorporation into the base, considerable loss of dispersability occurs (see *Table* 1). The aged acrylic and medium-oil alkyd systems lose 20 to 25% apparent tint strength. In the long-oil alkyd system the loss of tint strength on aging is only 10%. One could conclude from this that long-oil alkyds are fairly suitable tinter vehicles.

However, as *Table* 2 shows, the trouble-free performance of such long-oil alkyd tinters in a variety of different tint bases is more limited than one would expect from known compatibility data of the vehicles themselves. Specially selected combinations of some broadly compatible vehicles with certain additives do much better. *Figure* 2 shows that a phthalo blue dispersed in such a special binder/additive vehicle produces no measurable rub-up in a variety of tint bases, even after the tinter has aged.

CONCLUSION: The dispersing medium affects the range of tinter usefulness, sometimes in unexpected ways. A properly selected dispersing vehicle can be beneficial for color acceptance, compatibility, and stability of the tinter.

*400 Claremont Ave., Jersey City, NJ 07304.
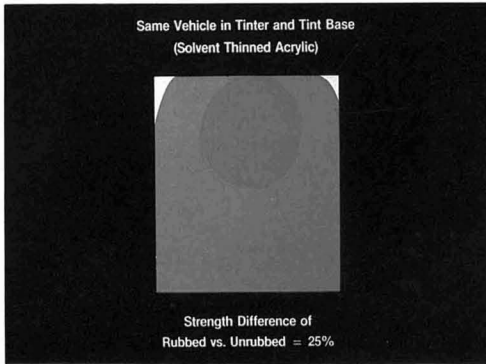
Figure 1—Effects of dispersing medium
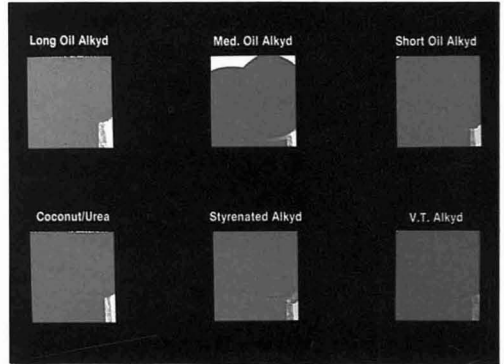
Figure 2—Performance of tinter based on a special dispersing vehicle "SDV" in various tint bases

Many vehicles chosen for their good exterior durability and chemical resistance properties lack pigment dispersing qualities. It is important to develop tinters which used at normal tint levels (maximum 10% addition) perform well in high performance coatings without sacrificing exterior durability and chemical resistance. Special binder/additive combinations often do just that.

However, caution is indicated when high levels of such tinters are added to a coating which just barely meets specifications. The tinter may reduce exterior durability, adhesion, chemical or other film properties of the coating to a degree that cannot be tolerated. Such marginal systems must be tested carefully before approving the use of tinters containing extraneous vehicles.

EFFECTS OF PIGMENT ON TINTER PERFORMANCE

Unfortunately, a good dispersing vehicle choice alone does not always guarantee good tint performance. *Figure* 3 shows what happens when the above-mentioned special dispersing vehicle (SDV) is used to disperse two different NFNC phthalo blue pigments. The tinter made with pigment "A" does not show rub-up when added to a white semi-gloss medium-oil alkyd tint base while the tinter containing pigment "B" rubs up in the same base. One may conclude from this that pigment "B" is less flocculation-resistant than "A". However, pigments

"A" and "B" dispersed in a universal vehicle consisting of a surfactant/water/glycol mixture, perform identically in a white acrylic emulsion coating. Neither tinter shows any rub-up. Yet, when these same "universal" tinters are added to a white alkyd semi-gloss, the pigment "A" tinter rubs up badly (see *Figure 4*).

Figure 5 is a composite of *Figures* 3 and 4. When viewing the effects in total, one can see that pigment "B" has more versatility than pigment "A". This proves that combinations of pigment and dispersing vehicle should be evaluated in a variety of tint bases before deciding which makes the more broadly useful tinter.

To further demonstrate the influence of pigments on tinter performance, two other phthalo blues, "X" and "Y", were dispersed in a surfactant/water/glycol system suitable only for tinting water-thinnable paints. *Figure* 6 shows that when these tinters are added to a water-reducible acrylic lacquer tint base, the tinter containing "X" flocculates badly, while the tinter containing "Y" does not. On the other hand, in an acrylic emulsion tint base, both tinters appear to be interchangeable.

Pigments can also have great influence on tinter rheology which, in turn, will greatly influence tint performance. To demonstrate this, three yellow oxides, "A", "B", and "C", from three different manufacturers were dispersed in several dispersing media. The manufacturers claim the pigments to be interchangeable for shade and tintorial strength. They provide the following specifications:

Table 1—Effects of Dispersing Medium

Same Vehicle in Tinter & Tint Base

Vehicle (Tinter & Tint Base)	Loss of Color in Unrubbed Area	
	Fresh	Aged
Long-oil alkyd	1%	10%
Medium-oil alkyd	3%	22%
Solution acrylic	10%	25%

Table 2—Performance of Long-oil Alkyd Tinter in Various Tint Bases

Tint Base Vehicle	Loss of Color in Unrubbed Area	
	Fresh	Aged
Long-oil alkyd	1%	10%
Medium-oil alkyd	1%	10%
Short-oil alkyd (baking)	5%	15%
Coconut/urea (baking)	5%	15%
Styrenated alkyd	60%	Incompatible
V. T. alkyd	100%	Incompatible
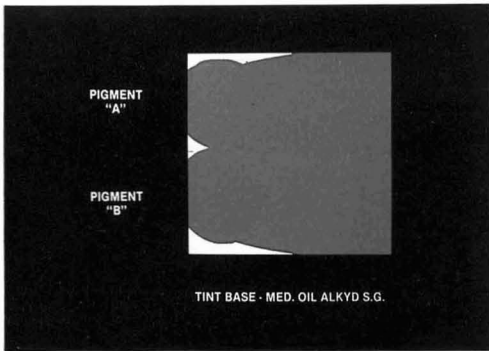
Figure 3—Effect of pigment on tinter performance. Phthalo blue "A" vs "B" dispersed in vehicle "SDV"
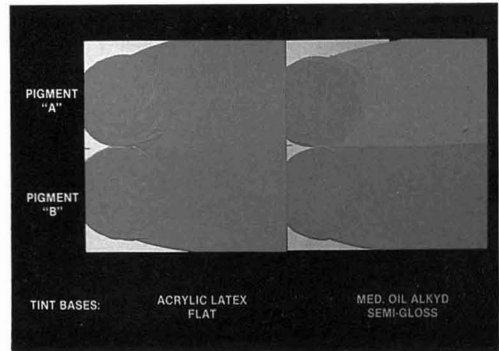
Figure 4—Effect of pigment on tinter performance. Phthalo blue "A" vs "B" dispersed in a "universal" vehicle

YELLOW OXIDE	SP. GR.	OIL ABS.	PH
A	4.03	36	6.8
B	4.06	38	6.5
C	4.08	24	3.2

Note that pigment "C" has considerably lower oil absorption and pH than pigment "A" and "B".

Each of the oxides were dispersed in (1) special dispersing vehicle "SDV", (2) a glycol-free universal vehicle, and (3) a surfactant/water/glycol medium. Dispersions were prepared at 25%, 35%, 45%, 50%, 55%, 60%, 65%, and 70% pigment loading in each vehicle. The viscosity, in centipoises, of all the dispersions, was measured on the Brookfield Viscometer Model No. LVG, with spindle No. 4, at 30 RPM. The data are plotted in Graphs 1, 2, and 3 as per cent pigment concentration versus viscosity (in centipoises).

Graph 1 shows the results obtained when the three pigments are dispersed in vehicle SDV. Pigment "C" behaves as one would expect from the oil absorption figures, i.e., it produces the lowest viscosity at the highest pigment concentration of the three pigments tested. Pigments "A" and "B" have similar oil absorption and pH, yet pigment "B" displays dilatancy at a 55% or higher pigment loading. This is indicated by the sudden jump in apparent viscosity, depicted on the graph by the broken line. By contrast, the viscosities of dispersions

based on pigments "A" and "C" continue to rise gradually with increased pigment loading.

Graph 2 shows the results obtained when pigments "A", "B", and "C" are dispersed in a surfactant/water/glycol mixture. In this case, pigments "A" and "B" *both* display dilatancy in the dispersion when a 55% pigment loading is reached.

Graph 3 shows the results obtained when pigments "A", "B", and "C" were dispersed in a "universal" vehicle. In this case, pigment "A" produces the lowest viscosity tinter at the highest pigment loading. This differs from Graph 1 where "C" with the lowest oil absorption produces the lowest viscosity tinter at highest pigment concentration. Note that the big differences in rheology in all three pigments begin to show up only above 45% pigment loading. In a finished coating, the pigment loading rarely exceeds 20 to 25%; therefore, it may appear as if all three pigments are interchangeable when they are really not. The dilatancy at high pigment loading in dispersions based on Pigments "A" and "B" indicates a tendency to hard sedimentation on aging in the finished paint.

CONCLUSION: When formulating tinters, one should be aware of the specific interplay of pigment, vehicle, and tint base. It is necessary to evaluate the same type of pigment from several suppliers and check carefully how they behave in a variety of film formers and dispersing

Figure 5—Effect of pigment on tinter performance. Phthalo blue "A" vs "B" dispersed in two different vehicle systems
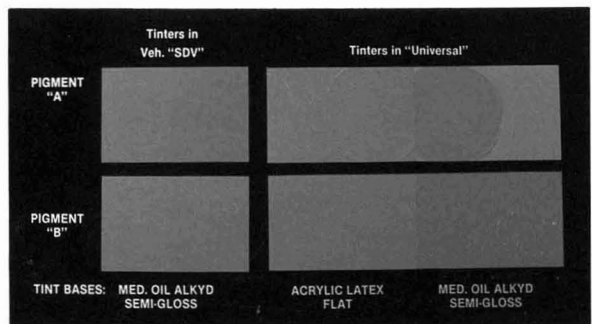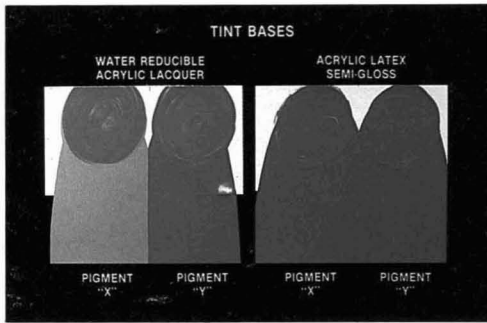
Figure 6—Effect of pigment on tinter performance. Phthalo blue "X" vs "Y" dispersed in a surfactants/water/glycol system
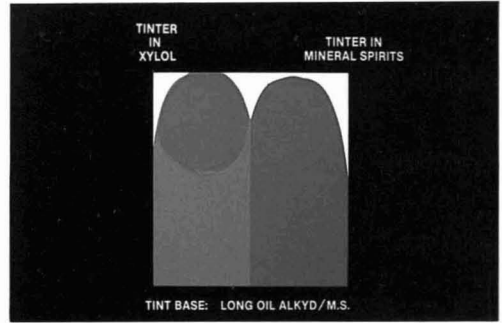
Figure 7—Effect of solvents on tinter performance. Phthalo blue dispersed in vehicle "SDV", varying solvent only

vehicles. The preferred pigment is the one which gives uniform tinter performance in the greatest number of important tint bases. Never assume that pigments of the same hue from different suppliers are fully interchangeable.

EFFECT OF SOLVENTS ON TINTER PERFORMANCE

The influence of solvents on tinter performance was demonstrated by preparing two dispersions of a phthalo blue, at 20% pigment concentration, dispersed in vehicle "SDV". In one dispersion, the solvent used was mineral spirits, and in the other, xylol. The dynamic viscosities of the two dispersions were equal, but the one containing xylol showed more thixotropy. The two tinters were added, using normal mixing energy, at the 3% level to a long-oil alkyd white tint base that contained mineral spirits. The resulting paints were drawn down and rubbed up.

Figure 7 shows that the paint with the tinter containing xylol rubs up badly. High-shear mixing energy will correct the rub-up problem. This indicates that the solvent influences the diffusion or spreading characteristics of a tinter into a tint base.

CONCLUSION: Solvents influence the rheology of tinters which, in turn, determines the ease of incorporation. To insure ease of tinter diffusion into a tint base, the thixotropy factor should be low but not to the point that pigment settling will occur. Thixotropy can be controlled by manipulating the solvent and vehicle content in a tinter.

EFFECT OF DISPERSING EQUIPMENT ON TINTER PERFORMANCE

The fourth important factor in tinter performance is the dispersion process itself. Color development varies greatly with the pigment type, the milling process, and the milling time. For some pigments, the high speed disperser is good enough to achieve the required fineness of grind and full tintorial strength, while others require high milling energy. It is good economics to go for full tintorial strength with high-priced pigments. An additional benefit, not recognized by all coating chemists, is that hard-to-grind organic pigments tend to flocculate less and show higher saturation if ground to sub-micron size.

The comparative tint strength development of sand mill, pebble mill, and attritor are shown in *Figure* 8.
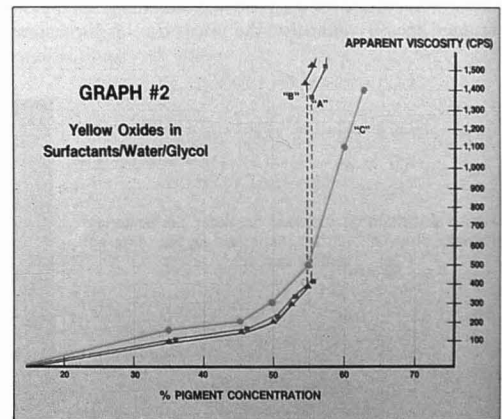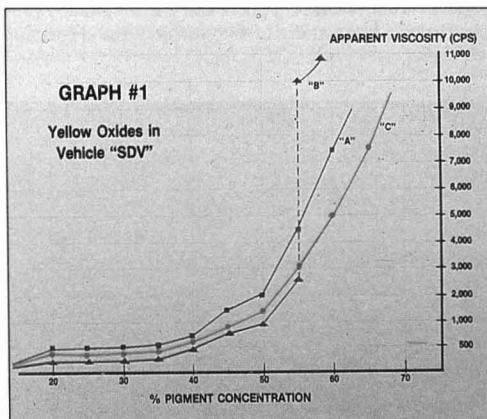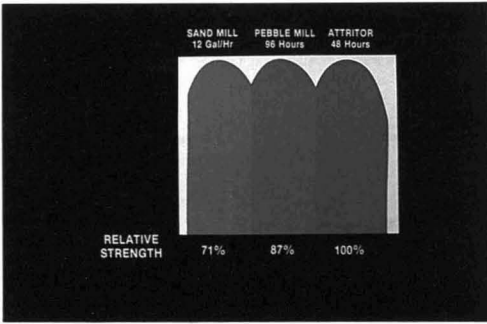
Figure 8—Effect of equipment on tint strength of hard-to-grind pigment. Phthalo blue dispersed in vehicle "SDV"
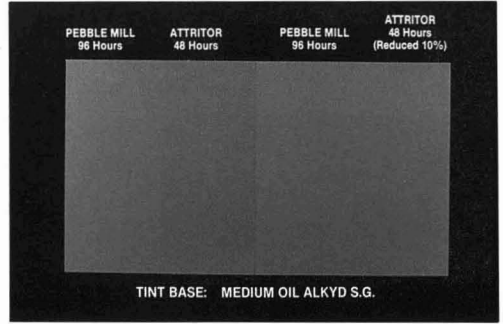
Figure 9—Effect of grinding on strength and hue. Carbazole violet in vehicle "SDV"

Here, the same hard-to-grind phthalo blue was ground in vehicle "SDV" under different conditions. The mill base composition was adjusted to 25% pigment. The tinters were added to a white alkyd paint at the level of 3%. Drawdowns were made of the mix, and percentage of tint-strength differences were determined. The tinter produced by milling 48 hours in an attritor had the highest tintorial strength. The tinter produced in the pebble mill shows 13% less tint strength after 96 hours than the 48-hour attritor grind. The tinter produced in the 8-gallon sand mill at the rate of 12 gallons/hour showed 29% less strength than the 48-hour attritor grind.

The fineness of grind on all three dispersions was 7½ NS on the Hegeman gauge. The viscosity of the attritor dispersion was 550 cps with some thixotropy, while that of the pebble mill was 350 cps, and the sand mill dispersion only 150 cps. The latter showed pigment settling on aging. The tint made with the 48-hour attritor grind produced the cleanest shade of blue.

An even more striking example of the relation between grind intensity, color development, and hue is shown in *Figure* 9. Carbazole Violet was milled in vehicle SDV, using a pebble mill and an attritor. Ninety-six hours in the pebble mill yields only 90% of the tint strength achieved by a 48-hour attritor grind.

More important than the 10% loss in tint strength is the unexpected difference in behavior of the two dispersions upon incorporation into a white tint base. The attritor dispersion yields 100% tint strength, regardless of whether it is merely shaken into the base for two minutes on the Red Devil® shaker, or is mixed under the powerful Osterizer® which approximates the shear rate of high-speed dispersers or paint brush action. By con-

Red Devil is a registered trademark of Red Devil, Inc., Union, NJ.
Osterizer is a registered trademark of Sunbeam Corp., Milwaukee, WI.
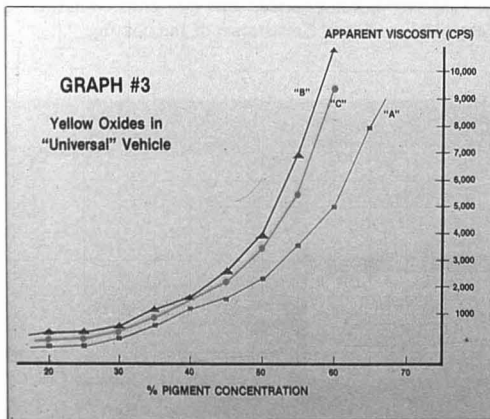
ELIO COHEN, Vice President/Marketing, started his professional career at Cook & Dunn Paint Co., Newark, NJ, as a vehicle chemist and, four years later, became Technical Director of the Paint Laboratory. He has been with Daniel Products Co. for 24 years, holding positions of Technical Director and, for the last 10 years, Vice President/Marketing. Over the years he has developed expertise in pigment dispersion and additive technology. He received his B.S. degree from City University of New York.

RAMON PINEIRO, Vice President/ R&D, joined Daniel Products Co. in 1962. He had been previously employed at Magruder Color Co. He has 23 years' experience in dealing with color and coatings problems in the paint, ink, and related industries. Prior to being named Vice President/ R&D in 1979, he advanced through various technical positions where he became involved with the development of tinting color systems and specialty additives. He received a B.S. degree in Chemistry from Wagner College.
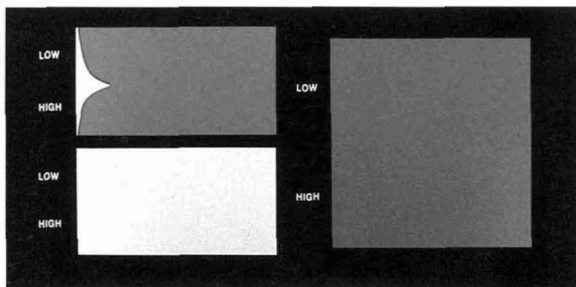
Figure 10—Effects of tinter interactions. "Universal" phthalo blue and ferrite yellow incorporated into latex semi-gloss white at low vs high energy

trast, the 96-hour pebble mill dispersion produces only 78% relative tint strength on the Red Devil shaker, as compared to 90% on the Osterizer. The additional 12% loss in tint strength is accompanied by a hue shift from a cleaner, redder violet to a grayer, bluer violet.

CONCLUSION: Better milling often produces tinters with greater tint strength, cleaner hues, and trouble-free incorporation into a base by low mixing energy.

EFFECT OF TINTER INTERACTION

Most colored coatings require more than one tinter. Normally, combinations of tinters work trouble-free, if each single colorant performs well. However, this is not always the case. Interference between tinters becomes a prime consideration in "universal" tinting systems used in trade sales paints at the dealer level. Usually, the formula calls for two or more tinters to be added into the tint base before proceeding with the mechanical incorporation on a paint shaker.

Figure 10 shows an example of tinters interfering with each other to produce an unexpected hue. Tinters of phthalo blue and yellow oxide, dispersed in the same universal vehicle, were added to a latex semi-gloss paint. In order to determine complete diffusion of the tinter with no flocculation, they were first mixed in with low-energy mixing, such as a paint shaker, and then remixed with high energy, as would be accomplished with a high shear disperser. The chips on the left show that when the tinters are added individually they perform well with no change in hue or saturation, regardless of mixing proce-

dure. The chips on the right show that when the tinters are added together, high energy mixing develops the yellow component to a much greater extent. This indicates that the hue shift is the result of interference between the tinters, instead of incompatibility of either tinter.

Figure 11 shows similar tinter interference with other types of pigments. In this case, hansa yellow and quinacridone red in the same "universal" vehicle show poor color development when added together to an exterior acrylic latex paint. Again, note that each tinter, when added singly to the same white paint, disperses fully on the paint shaker.

These tinter interference problems occur not only in the paint store but also in the plant using slow agitators for shading instead of higher energy devices.

CONCLUSION: The performance of a tinter should never be judged without also evaluating combinations with other tinters in a variety of tint bases. The order of addition and mixing energy will have a great influence on color development when multiple tinters are used.

SUMMARY

For ideal performance, tinters should have the following properties:

(1) Wide range of compatibility with trouble-free color acceptance.

(2) No adverse effect on the drying time of the coating.

(3) No adverse effect on the gloss, weathering, chemical- and water-resistance of the coating.
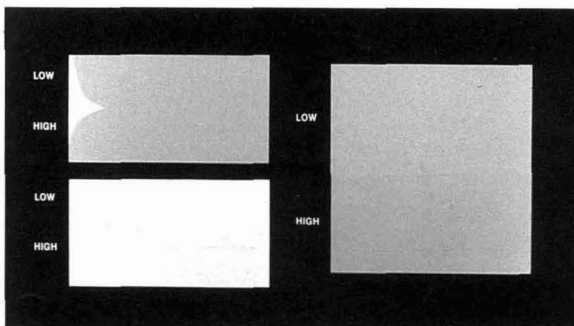
Figure 11—Effect of tinter interactions. "Universal" quinacridone red and hansa yellow incorporated into an acrylic latex white paint at low vs high energy

(4) Fine grind.

(5) Maximum tintorial strength development.

(6) Low, stable viscosity at high pigment loading.

(7) No hard settling or separation.

(8) No skinning or drying out in part-full containers.

(9) Freeze/thaw stability and no putrefaction for water-thinnable tinters.

(10) Meet environmental restrictions.

As shown, all of these properties are not only dependent upon the performance characteristics of the single components, but also on their interactions and on the milling equipment used.

There is no sure way of predicting the behavior of any tinter in all coatings systems. Therefore, testing remains necessary. However, the problems can be minimized by careful attention to the above discussed factors which govern tinter performance.

ACKNOWLEDGMENT

Dispersibility of Pigments As a Criterion for Determining Optimum Mill Base Formulations

Juan Oyarzún
Deutsche Akzo Coatings GmbH.*

The possibility of optimizing mill base formulations taking as a criterion the dispersibility of the pigments is discussed. The fineness of grind, the tinting strength, and the lightness flop are used as criteria for the degree of dispersion. Mill base formulation is considered optimum when showing the best dispersibility (degree of effectiveness). By varying the concentration of resin and pigment and by determining the corresponding dispersibility, optimum mill base formulations can be obtained.

INTRODUCTION

Several methods for determining the dispersibility of pigments have been devised. However, critical circles find them in some way or other unsatisfactory. Such methods assess the dispersibility by considering the energy expenditure required to attain a given quality level, but do not take into account the amount of pigment dispersed. Eckhoff[1] has suggested a definition of dispersibility as the energy expenditure necessary to grind a fixed amount of pigment to a predetermined quality level. Consequently, the dispersibility has the dimensions of mass-per-unit-energy and represents a measure of the quantity of pigment which can be dispersed in a resin solution under given conditions.

Since the dispersibility is not only dependent upon the nature of the pigment, but also upon the ratio of solvent to resin, the pigment concentration, the temperature, the interaction between the individual components of the system and on the mill itself, we should not regard the dispersibility as being pigment-dependent only, but rather as a property of the whole system including the mill. Hence, the ratio between the mass of pigment ground to a particular quality level and the required relevant energy expenditure is actually a measure for the effectiveness of the whole dispersion process.

In previous papers,[2,3] the concept of "degree of effectiveness" in connection with a dispersion process was discussed. Therein, the "degree of effectiveness" has been defined as the ratio of the pigment concentration in the mill base to the required energy expenditure, expressed indirectly as milling time, in order to attain a predetermined quality level. Therefore, this "degree of effectiveness" is nothing more than the dispersibility of a pigment related to the time unit and a consequence of the united action of all given dispersing conditions. Consequently, it ought to be possible to optimize mill base formulations using the dispersibility as criterion.

The development of properties which depend on the degree of dispersion, such as fineness of grind, tinting strength, gloss or hiding power, do not take parallel courses. Therefore, it is possible to obtain different results with one and the same system depending upon the criterion chosen. For this reason it is important to choose a criterion for assessing the dispersibility in accordance with relevant future requirements. In the present work, the criteria used for assessing dispersibility were the tinting strength in the case of perylene red, the fineness of grind in the case of chrome titanium yellow, and the lightness flop for the transparent iron oxide yellow.
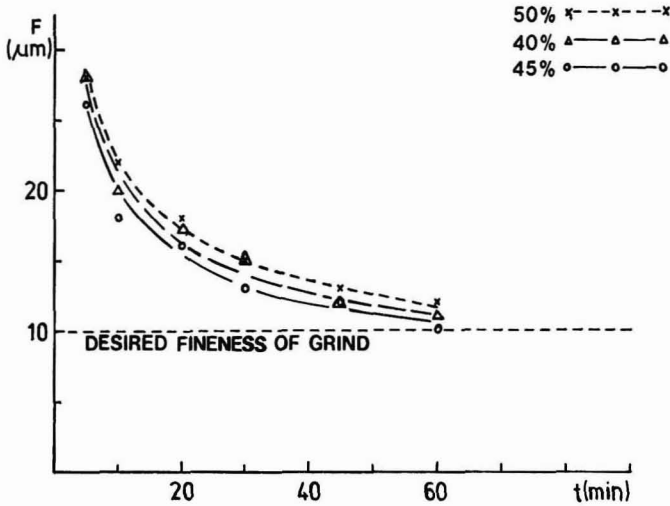
Figure 1—Fineness of grind vs grinding time for Pigment Yellow 118 at constant PVC (15.5%) and different resin concentrations. Linear division of the axes

EXPERIMENTAL

The following pigments were used in the experiments:

(1) C. I. Pigment Yellow 118, No. 77894: A chrome titanium yellow.

Average particle size:	0.19 μm
Specific surface:	7 m^2/g
Dispersibility:	medium

(2) C. I. Pigment Red 179, No. 71130: A perylene red.

Average particle size:	0.25 μm
Specific surface:	34 m^2/g
Dispersibility:	medium

(3) C. I. Pigment Yellow 42, No. 77492: An iron oxide yellow.

Average particle size:	0.02 μm
Specific surface:	90 m^2/g
Dispersibility:	difficult to disperse

Denominations of these pigments are according to Colour Index, 3rd Edition, 1971. Data are from technical information of the producers. The average particle size and the dispersibility values depend not only on the pigment tested, but also on the method of evaluation.

The binder solution consisted of a short-oil alkyd resin in xylene. For some experiments the xylene was partly
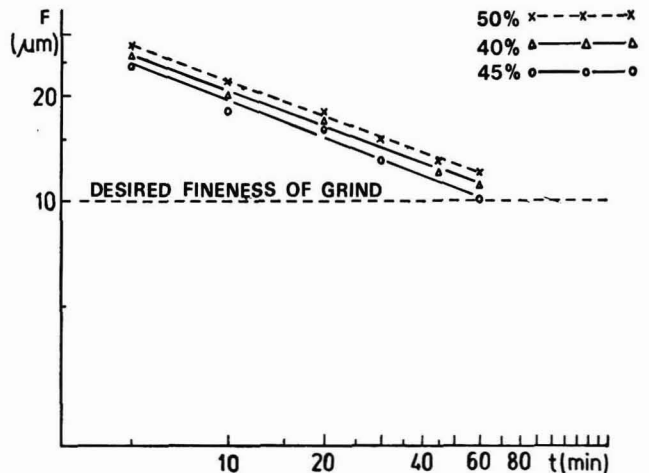
Figure 2—Fineness of grind vs grinding time for Pigment Yellow 118 at constant PVC (15.5%) and different resin concentrations. Logarithmic division of the axes
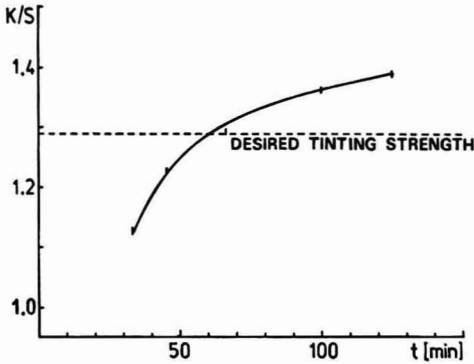
Figure 3—Model curve illustrating the relationship between the milling time t and the tinting strength K/S
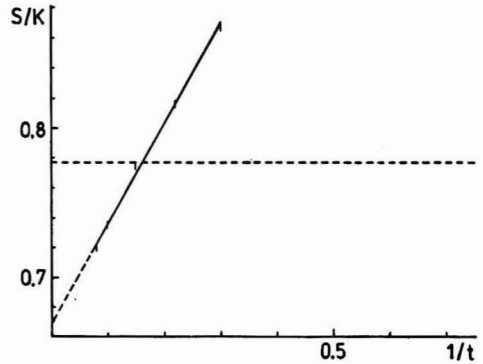
Figure 4—Linearization of curve in *Figure* 3

replaced by isobutanol. The dispersion process took place under the following conditions:

Milling apparatus: Süβmeyer laboratory bead-mill.

Grinding media: glass beads 3 mm diameter for Pigment Yellow 118 and Pigment Red 179; steel balls 3 mm diameter for Pigment Yellow 42.

Maximum milling time: 60 min for Pigment Yellow 118; 125 min for Pigment Red 179 and Pigment Yellow 42.

At measured intervals during the milling process, samples of the mill base were taken.

Criterion "Fineness-of-Grind"

The samples containing Pigment Yellow 118 were diluted with resin solution (60% solid content) to a pigment concentration of 20% by weight. The fineness of grind was measured on a grindometer having a scale of 0–50 μm.[4]

Criterion "Tinting Strength"

The samples containing Pigment Red 179 were let down with a white paste to a reduction ratio of 1:30. Two test cards were made from each reduction and their reflectance was measured by means of a Zeiss RFC 3 spectrophotometer. The corresponding K/S-values were calculated according to the Kubelka-Munk equation. The averages from six measurements were used for this calculation.

Criterion "Lightness Flop"

In the case of Pigment Yellow 42, the samples were diluted with the resin solution to a pigment content of 2.5% by weight and were then applied with a bar coater onto aluminum foil at a wet film thickness of 40 μm. The dry films were measured with a Zeiss RFC 3 spectrophotometer. The measurements were carried out first

with diffuse light (SGI, d/8°) and then without the central part of the radiation gloss trap, (SGE, d/8°). In this manner, the flatly incident radiation is taken more strongly into account. We used the averages from four measurements.

EVALUATION

Pigment Yellow 118

Figure 1 illustrates the dependence of the fineness of grind (F) on the milling time (t). By plotting log F against log t, a straight line is obtained (*Figure* 2). If a particular fineness of grind is required, e.g. 10 μm, the logarithm of the milling time necessary is at that point where the ordinate corresponding to log 10 is crossed by the straight line. The dispersibility of the system can be calculated from the ratio of pigment concentration to milling time.
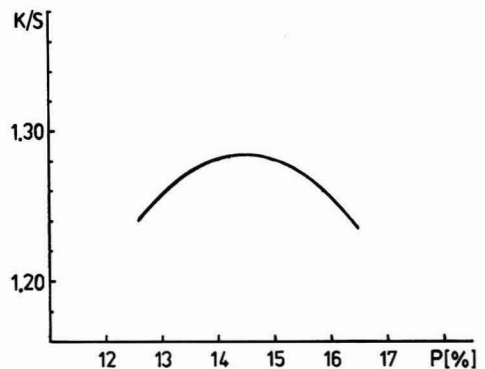
Figure 5—Model curve showing the dependence of K/S on the pigment concentration
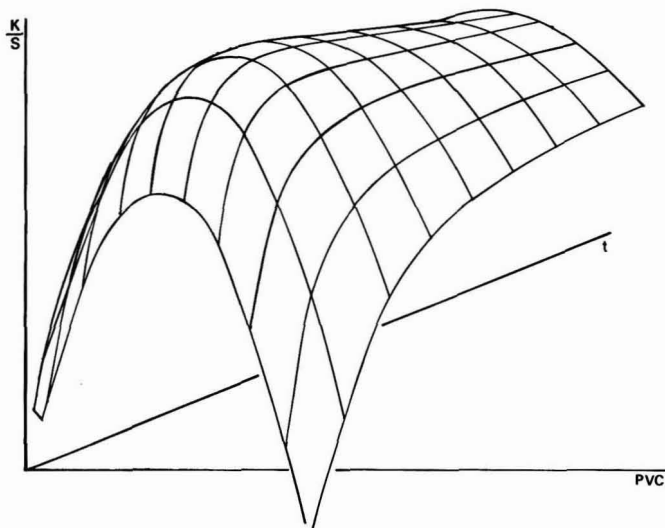
Figure 6—Tinting strength K/S vs milling time and pigment concentration for Perylene Red (C. I. Pigment Red 179)

$$D = \frac{P}{t} \qquad (1)$$

where:

D = dispersibility

P = pigment concentration in the mill base

t = time in minutes necessary to attain the required fineness of grind

Pigment Red 179

Dietwulf von Pigenot has shown that the curve representing the development of tinting strength as a function of milling time (*Figure* 3) can be considered to be a hyperbola.[5]

By transforming the coordinates, i.e., by plotting S/K against l/t instead of K/S against t, the tinting-strength development curve can be converted to a straight line (*Figure* 4).

At the intersection point of this straight line with the ordinate corresponding to a predetermined tinting strength, the reciprocal value of the time required to attain this tinting strength under the given experimental conditions can be read off. Multiplication of this value by the pigment concentration gives the corresponding dispersibility.
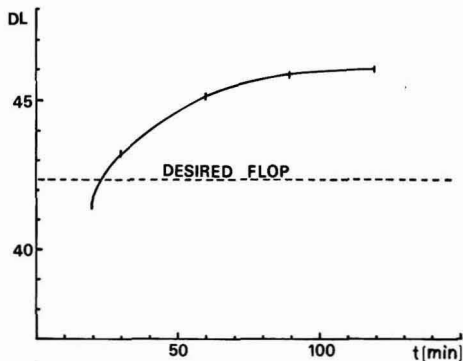
Figure 7—Lightness flop DL vs milling time for Iron Oxide Yellow (C. I. Pigment Yellow 42)
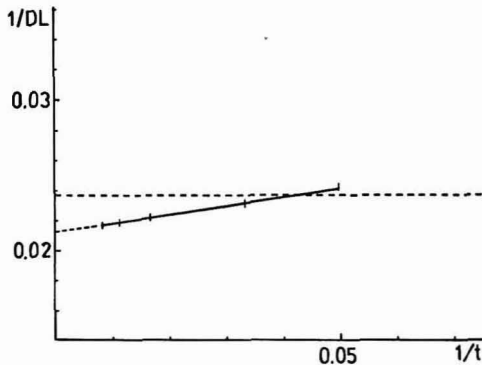
Figure 8—Linearization of curve in *Figure* 7

Figure 9—Fineness of grind vs milling time for Pigment Yellow 118 at constant resin concentration (45%) and different pigment volume concentrations. Logarithmic division of the axes
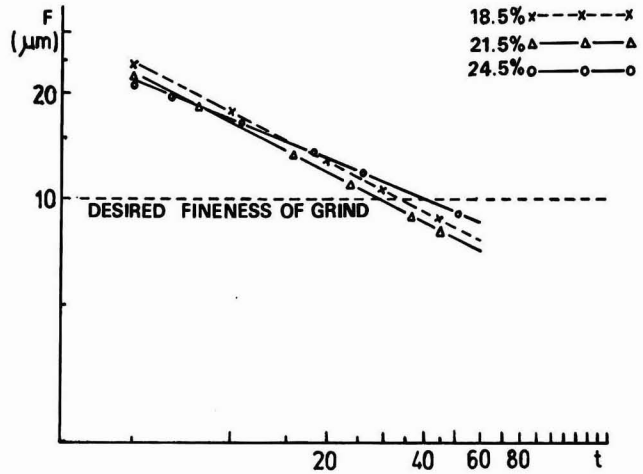
$$D = P \times \frac{1}{t} \qquad (2)$$

where:

D = dispersibility
P = pigment concentration in the mill base
t = time in minutes necessary to attain the required tinting strength

If a series of experiments is carried out with increasing pigment concentration but all other milling conditions unchanged, it will be found that the tinting strength of a given amount of pigment first increases with increasing pigment concentration, attains a maximum, and then drops (*Figure 5*). From this it follows that the tinting strength yielded by a fixed quantity of pigment is a function of milling time and the concentration of pigment in the mill base when all other dispersion conditions remain constant. *Figure 6* shows this dependence for C.I. Pigment Red 179 in a three-dimensional system of coordinates. W. Carr and A. Kelly carried out a thorough research work on the optimization of factors which affect the efficiency of pigment dispersion; its results confirming our conclusions.[6,7]

The explanation of such behavior is evident. At low pigment concentrations the beads can move fast and
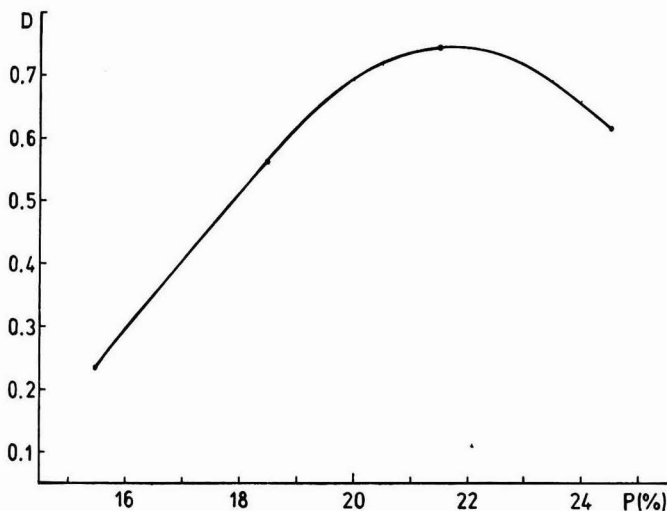
Figure 10—Dispersibility D vs pigment concentration for Pigment Yellow 118
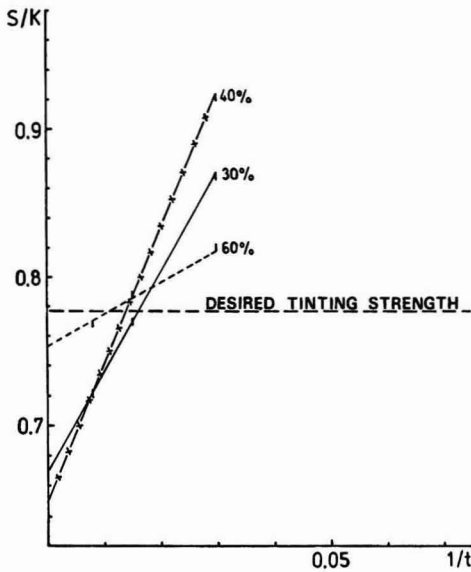
Figure 11—Reciprocal tinting strength vs reciprocal milling time for Pigment Red 179 at constant PVC (14.7%) and three different resin concentrations
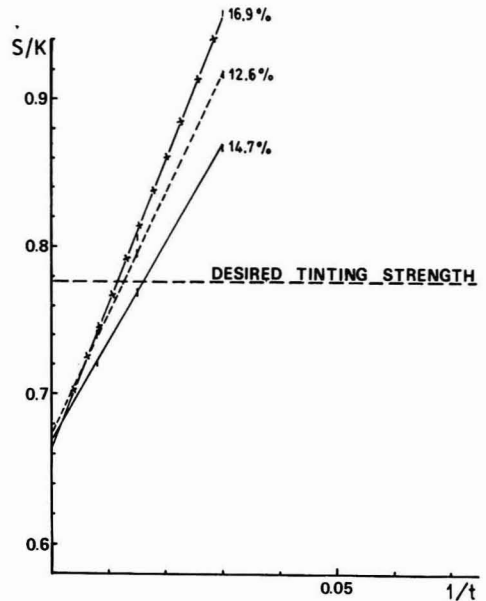
Figure 12—Reciprocal tinting strength vs reciprocal milling time for Pigment Red 179 at constant resin concentration (30%) and different pigment concentrations

without hindrance. However, due to the small quantity of agglomerates present, numerous collisions take place without effect, i.e., without agglomerates being broken down. It is quite obvious that under these conditions a considerable part of the energy expenditure has no milling effect at all, and is wasted.

The maximum on the curve represents the optimum pigment concentration. Because of the high number of pigment particles in the mill base, the majority of the impacts between beads result in crushed agglomerates. On the other hand, the agglomerates themselves act as grinding media when colliding against each other. In this case, the best effect from the expended energy can be obtained and the efficiency of the system is consequently very high.

At extremely high pigment concentrations, the viscosity of the system is also high and the mobility of the grinding media is very limited. In addition, anomalous flow properties such as the yield value, pseudoplastic or dilatant flow may also impair the speed of the beads. Therefore, the number of collisions decreases and the efficiency is lower.

Summarizing, it can be stated that mill bases containing too low as well as those containing too high a pigment concentration are unfavorable for the milling process. Somewhere between both extremes there is a determinable pigment concentration which is an optimum with regard to the efficiency of the system. This optimum pigment concentration in the mill base can be determined

either by the dispersibility (D_{max}) or by assessing the tinting strength after a given milling time. Both criteria lead to the same result.

On the basis of practical experiments it will be shown that these considerations also apply to fineness of grind and transparency. Generally speaking, they are valid for all those properties of the paint which depend on the degree of dispersion.

Pigment Yellow 42

For this pigment, a transparent iron oxide yellow, the lightness flop was used as a criterion for the dispersibility. The lightness flop is the change of the lightness of a coating when regarded under different angles. This change occurs mainly in the case of transparent layers applied on an underground with strong reflectance. With transparent pigments a higher degree of dispersion causes a higher transparency and thus, a higher lightness flop.

Finus devised a method for determining the lightness flop based on two measurements of a film on aluminum foil using a goniophotometer.[8] The values that we obtained according to this method possessed large amounts of scatter in the data and thus, we developed a different method using diffuse instead of nearly parallel light. This was found to deliver results having good reproducibility.

The lightness difference in CIE-LAB units between a measurement with almost ideal diffuse light (without
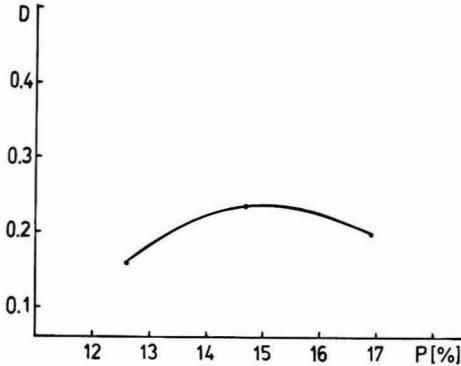
Figure 13—Dispersibility D vs pigment concentration for Pigment Red 179

Figure 14—Reciprocal tinting strength vs reciprocal milling time for Pigment Red 179 with different solvent mixtures. Resin concentration = 30%, PVC = 15.1%; $D_1 = 0.235$; $D_2 = 0.397$

gloss trap) and a measurement with ring-shaped diffuse light (with gloss trap) corresponds to the typical decrease in lightness of objects exhibiting a lightness flop when the angle of the light source is increased from normal (90° from substrate). It still comprises the surface gloss, and for this reason, only objects with equal (if possible high gloss) surfaces can be compared. Our measurements gave gloss values within a range of about 4% reflectance as it was the result of measuring a high gloss glass panel. Since the width of the specular envelope caused by the uneven aluminium foil is increased by the scattering coefficient, the measured flop rises with improving transparency of the pigment - a phenomenon also known with metallic coatings. The evaluation of the results showed that with this method, using the Zeiss RFC 3, even small differences in transparency which are hardly noticeable on contrast cards could be well defined. Moreover, it is also possible to measure shade flops - an impossibility with the goniophotometer.

The values obtained from the first three experiments were computer analyzed. The intention was to find a type of curve describing the dependence of the lightness flop to the milling time as accurately as possible. From 13 equations that could be transformed to a straight line, the best fit was

$$y = \frac{x}{a + bx} \qquad (3)$$

which yielded the correlation coefficient 1. Accordingly, in our case the equation is:

$$DL = \frac{t}{a + bt} \qquad (4)$$

where:

DL = lightness flop
t = milling time
a, b = constants

Equation (4) may also be written as:

$$\frac{1}{DL} = a\frac{1}{t} + b \qquad (5)$$

and thus, we obtain the equation of a straight line, i.e., the lightness-flop development curve can be transformed into a straight line by plotting $1/DL$ against $1/t$ instead of DL against t, as is the case with the tinting strength development. At the intersection point of the straight line with the ordinate corresponding to the desired lightness
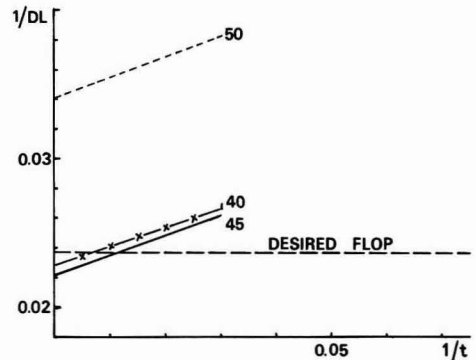
Figure 15—Reciprocal lightness flop vs reciprocal milling time for Pigment Yellow 42 at constant PVC (11.5%) and different resin concentrations
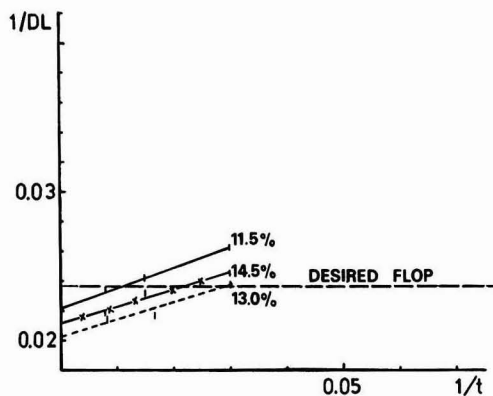
Figure 16—Reciprocal lightness flop vs reciprocal milling time for Pigment Yellow 42 at constant resin concentration (45%) and different pigment concentrations
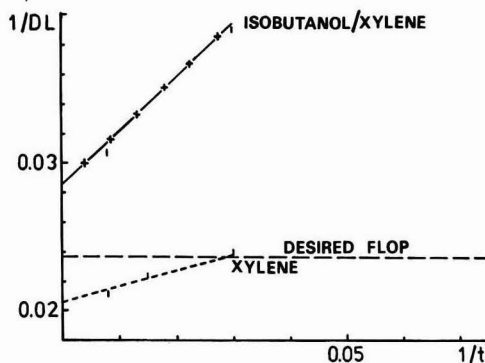
Figure 18—Reciprocal lightness flop vs reciprocal milling time for Pigment Yellow 42 with different solvent mixtures. Resin concentration = 45%, PVC = 13.5%

flop, the reciprocal value of the required milling time can be read off (*Figures* 7 and 8).

The dispersibility of the system can again be calculated from:

$$D = P \times \frac{1}{t}$$

where:

D = dispersibility
P = pigment concentration in the mill base
t = milling time required for the desired lightness flop

In a former paper it had been pointed out that pigment concentration can be expressed in terms of either mass or volume. Since it is the volume ratios that play the decisive role in the processes taking place during dispersion, we
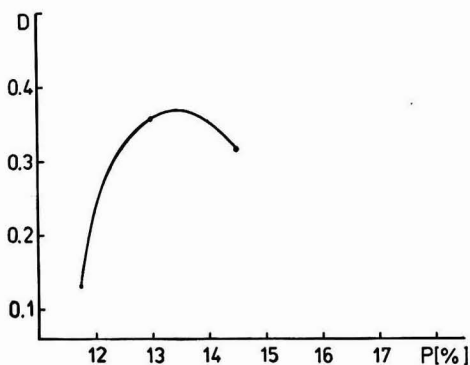
Figure 17—Dispersibility D vs pigment concentration for Pigment Yellow 42

preferred to work out our conclusions on the basis of the pigment volume concentration.

Independently of the changes brought into the mill base, i.e., variations in either the pigment concentration or the resin concentration or the solvent mixture, the resulting dispersibility will always indicate whether the introduced variation has a positive or a negative effect.

RESULTS

Pigment Yellow 118

Figure 2 shows the result of the experiments to determine a favorable resin concentration. Data concerning resin concentrations refer to the resin solution, whereas data concerning pigment concentrations refer to the concentration in the mill base. The fineness of grind required was fixed at 10 μm.

None of the three experiments yielded the required fineness of grind within the scheduled milling time (60 min) and, thus, the relevant t-values were obtained by extrapolation. With these t-values and the pigment concentration, which was constant for all three experiments (15.5%), the corresponding dispersibility values were calculated. The highest value was obtained with the resin solution containing 45% solids. This solution was therefore chosen for further experiments.

Figure 9 shows the results yielded by experiments with varying pigment concentration. By plotting the dispersibility values, D, against the pigment concentration, we obtain the curve shown in *Figure* 10, the course of which corresponds approximately to a Gaussian distribution curve. The upper part can be regarded as a parabola.

The vertex of this parabola is found at the coordinates:

$$D_{max} = 0.742$$
$$P_{opt} = 21.8\%$$

A more accurate interpolation procedure is explained in a previous paper.[3]

Pigment Red 179

The first three experiments with this pigment were also carried out in order to determine a convenient concentration of the resin solution. The pattern of concentration data used for Pigment Yellow 42 was also applied here. The required tinting strength was arbitrarily chosen to be 85% of the average final tinting strength (i.e., the tinting strength after an infinitely long milling time, thus $1/t = 0$).

The straight lines illustrating the development of tinting strength are shown in *Figure* 11. It can clearly be seen that the dispersion in the resin solution with the lowest concentration (30%) yields the best result. Further experiments were therefore carried out with this resin solution.

The aim of the second series of experiments was the determination of the optimum pigment concentration. In *Figure* 12 the reciprocal values of the tinting strength vs the reciprocal values of the milling time have been plotted. The calculated dispersibility values plotted against the pigment concentration are shown in *Figure* 13. The vertex of the parabola has the coordinates

$$D_{max} = 0.235$$
$$P_{opt} = 15.1\%$$

A further experiment was carried out with this optimum PVC, yielding a dispersibility of 0.232. The slight difference lies within the range of experimental error.

In order to determine a more favorable solvent mixture, 40% by weight of the xylene in the optimized formulation was replaced by isobutanol. All other parameters remained unchanged. *Figure* 14 shows a comparison between the results obtained with both formulations. The considerable improvement in the dispersibility of the isobutanol/xylene system can be attributed to the increased interaction between the polar resin solution and the polar Pigment Red 179, thus confirming the statements of Gall and Kaluza.[9]

Pigment Yellow 42

Concerning the concentration data, the scheme used for Pigment Yellow 118 and Pigment Red 179 was also applied in this case. The required lightness flop was arbitrarily fixed at 95% of the average final lightness flop yielded by the first two experiments (with 40% and 45% resin solutions). The results are illustrated in *Figure* 15.

It was not possible to determine the milling time needed to attain the required lightness flop in the case of the third experiment (with 50% solids resin solution), because this degree of lightness flop could not be attained, no matter how long the milling time. However, the experiment yields a positive result in so far as it shows that a resin concentration of 50% is unfavorable for the milling process. According to the results obtained, the solution with the lowest resin concentration is obviously not the best one—a statement already made by Kaluza.[10] For this reason the resin solution with 45% solids content was chosen for the second series of experiments, the results of which are shown in *Figure* 16. The parabola illustrating the change in dispersibility with respect to the pigment concentration can be seen in *Figure* 17.

Its vertex has the coordinates

$$D_{max} = 0.387$$
$$P_{opt} = 13.5\%$$

An experiment with the optimized formulation yielded a dispersibility value of 0.382.

After having optimized the resin and pigment concentrations in the mill base, the influence of higher polarity of the system on the dispersion process was investigated. For this purpose, 20% by weight of the xylene in the resin solution was replaced by isobutanol.

Pigment Yellow 42 has a polar character and an increase in the polarity of the mill base would be expected to bring an improvement in the dispersibility. From *Figure* 18 it can be seen that the system with higher polarity impairs the dispersion effect to such an extent that the required quality level cannot be reached. This behavior can be explained by the affinity between the solvent and pigment being stronger than between resin molecules and pigment. Thus, more solvent than resin is absorbed onto the pigment surface. The system exhibits poor stability and has a high tendency to reagglomeration. Another reason lies in the considerable increase in anomalous flow properties caused by the interaction pigment/resin in the isobutanol/xylene system, despite the fact that the viscosity itself was lower. This was noticeable during the milling process as well as from the flow of the mill base in the outlet channel.

SUMMARY

It is possible to optimize mill base formulations by determining the dispersibility (degree of effectiveness) of the system.

Either tinting strength or lightness flop or fineness of grind can be used as a criterion for the dispersibility. Which criterion is to be taken into consideration depends on the pigment and the particular properties of the paint to be produced.

It should be possible to use other criteria, such as gloss or hiding power, for the dispersibility. Independent of the criterion considered, the dispersibility curve, $D = f(P)$, always shows a determinable maximum.

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Latent Acid Catalyst
For Water-Borne Coatings

Donald J. Hart

General Motors Research Laboratories*

Ethyl N,N-dimethylsulfamate (EDMS) has been shown to be an effective latent acid catalyst for water-borne coatings. At ambient temperatures, EDMS is inactive as a catalyst and thus provides excellent storage stability to water-borne coatings even at high concentrations. EDMS rearranges at elevated temperatures and becomes fully activated as an acid catalyst at 121°C (250°F). Reformulation of the commercial coatings will be necessary, however, in order to successfully reduce the bake temperature to 121°C regardless of the type or concentration of acid catalyst used.

INTRODUCTION

In response to the Los Angeles County Air Pollution Control District's Amended Rule 66 which limited the amount of solvent emissions from stationary sites, the automotive industry introduced water-borne enamel topcoats into some of their assembly plants in 1974. Other assembly plants have since adopted water-borne enamel topcoats because of considerations of solvent emissions.

As presently formulated, water-borne coatings are baked at 163°C (325°F) in order to obtain a proper cure of the acrylic/melamine resin. In order to achieve this temperature, natural gas or electrical heaters are used in the bake ovens. Because of the rising costs of these energy sources, it would be desirable to cure the water-borne coatings at temperatures of 121°C (250°F) or less. Temperatures of 121°C can be achieved using low pressure steam which in turn can be generated by a number of alternate energy sources.

The water-borne paints cure by the acid catalyzed crosslinking reaction of methylol or alkoxy groups on a melamine-formaldehyde resin with hydroxyl groups on an acrylic resin. A simplified reaction scheme is depicted in *Figure* 1. In addition to these crosslinking reactions, self-condensation of the melamine-formaldehyde resin can occur as shown in *Figure* 2. Other self-condensation reactions are discussed in more detail by Blank.[1] As mentioned previously, water-borne paints require a bake temperature of 163°C in order for these crosslinking reactions to occur. However, the cure temperature might be lowered by either increasing the acid catalyst concentration or changing to a more reactive melamine-formaldehyde resin. Both of these changes would reduce the storage stability of the paint.

In order to avoid the storage stability problem at high acid catalyst concentrations, a latent catalyst could be employed. To qualify as a latent catalyst for water-borne coatings, a material must be unreactive at ambient temperatures (thereby giving good storage stability), but when heated to 100-120°C, it must generate an acid *in situ* at high enough concentrations to allow for proper cure of the water-borne coatings.
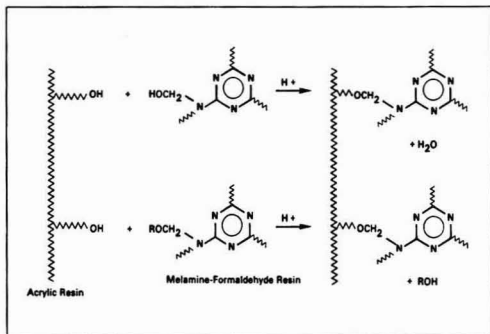
Figure 1—Typical crosslinking reactions of water-borne paints
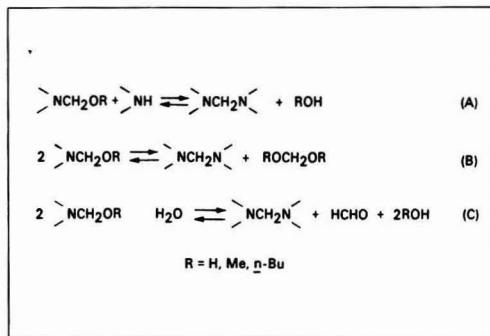
Figure 2—Typical reactions that lead to self-condensation of melamine-formaldehyde resins

Sulfamate esters have potential as latent catalysts for water-borne coatings since they can rearrange ($\longrightarrow$) to their betaine form[2] which in turn, in the presence of water, can hydrolyze to an acid as depicted in reaction sequences (1)–(3).

$$R' \atop R \!\!\searrow\!\! N-SO_2\,OR'' \xrightarrow{\;\;\;\;} R'' \atop R \!\!\searrow\!\! N^{\oplus}\!-SO_3^{\ominus} \qquad (1)$$

$$R'' \atop R \!\!\searrow\!\! N^{\oplus}\!-SO_3^{\ominus} \xrightarrow{H_2O} R'' \atop R \!\!\searrow\!\! N^{\oplus}\!-H + HSO_4^{\ominus} \qquad (2)$$

$$R'' \atop R \!\!\searrow\!\! N^{\oplus}\!-H + HSO_4^{\ominus} \xrightarrow{\Delta} R'' \atop R \!\!\searrow\!\! N \uparrow + H_2SO_4 \qquad (3)$$
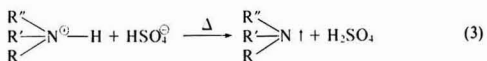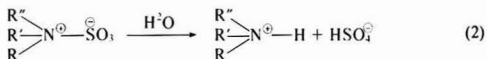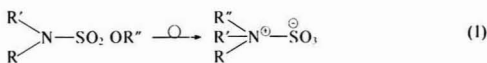
Consequently, a study was initiated in which the use of ethyl N,N-dimethylsulfamate as a latent catalyst was investigated. This paper describes the investigation.

EXPERIMENTAL

General

Melting points above 25°C were measured using a Thomas melting point apparatus and are uncorrected. Melting points below 25°C were obtained from differential scanning calorimetry (DSC) spectra using a DuPont Model 990 Thermal Analyzer. Proton NMR and IR spectra were obtained using Varian HA-100 and Perkin-Elmer 621 instruments, respectively.

Materials

The two acrylic/melamine water-borne resins used in the investigation contained no pigment and were obtained commercially. Resin A was identical to a commercial water-borne resin. Resin B was identical to Resin A except that no strong acid was incorporated into the backbone of the resin. In addition, two commercial white pigmented coatings were used to determine the effective-

ness of ethyl N,N-dimethylsulfamate as a catalyst in water-borne coating systems. Resins C and D were identical to Resins A and B, respectively, except for the pigment. All catalyst concentrations discussed are by weight percent unless otherwise noted.

1,2-Dimethoxyethane was stored over Linde 3A molecular sieves before use. p-Toluenesulfonic acid (PTSA) was supplied as a 40% solution in isopropanol (Cycat® 4040). All other reagents were obtained commercially and used without further purification.

Synthesis of Ethyl N,N-Dimethylsulfamate (EDMS)

Sodium hydride (50% dispersion in oil, 2.69 mole) was placed in a 5000 mL three-necked flask equipped with magnetic stirrer, thermometer, addition funnel, and nitrogen inlet. 1,2-Dimethoxyethane (2000 mL) was added to the flask and the flask was placed in an ice bath. Ethanol (150 mL, 2.57 mole) was added dropwise over one hour. The mixture was stirred for 1.5 hours at which time hydrogen evolution had ceased. N,N-Dimethyl-sulfamoyl chloride (276 mL, 2.57 mole) was added dropwise over one hour, the mixture was stirred an additional 1.5 hours, and then the mixture was filtered to remove the resulting NaCl and excess NaH. The solvent was removed under vacuum and the resulting sulfamate was washed with water and diethyl ether. The sulfamate was distilled under vacuum giving a colorless liquid; boiling point 50°C/0.70 Torr (lit.[3] bp 70–71°C/1.5 Torr); melting point −22°C; refractive index (26°C) 1.4184 (lit.[3] refractive index (27°) 1.4185); NMR (CDCl₃) δ 1.38 (t, J=7.2 Hz, 3H), 2.88 (s, 6H), 4.24 (q, J=7.2 Hz, 2H); IR matched the literature spectrum.[3] *Anal.* Calcd. for $C_4H_{11}NO_3S$: C, 31.36; H, 7.24; N, 9.14. Found: C, 31.50; H, 7.28; N, 8.95.

Preparation of Ethyl N,N-Dimethylsulfamate, Betaine Form

METHOD A: Ethyl N,N-dimethylsulfamate was heated at 120°C for two hours and then cooled gradually to

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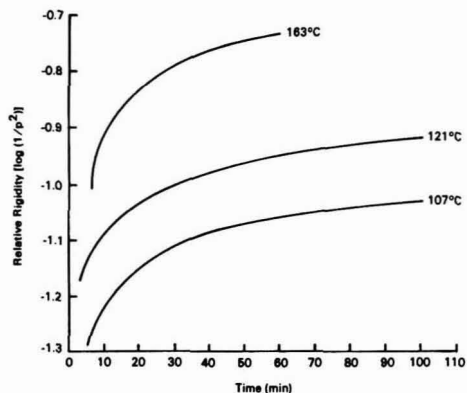
Figure 3—Curing profile of Resin A at various temperatures
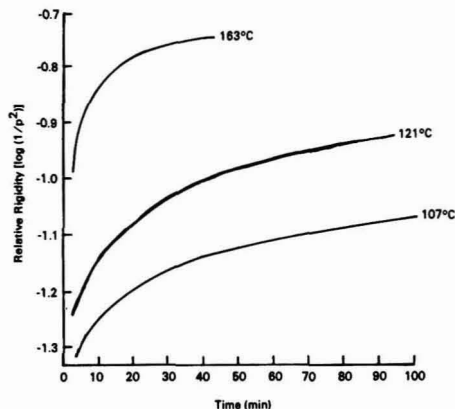
Figure 4—Curing profile at various temperatures of Resin B containing 1% PTSA

−78°C to crystallize the resulting betaine. The mixture was then allowed to warm gradually to 25°C. The crystals were filtered, washed with ice-cold water and then ether, recrystallized from water, and then dried overnight at 1.0 Torr giving white crystals; melting point 134.0–134.4°C (lit.[3] mp 135°); NMR (acetone-d_6) δ 1.20 (t, J=7.4 Hz, 3H), 2.76 (s, 6H), 3.11 (q, J=7.4 Hz, 2H); IR matched the literature spectrum.[3] *Anal.* Calcd. for $C_4H_{11}NO_3S$: C, 31.36; H, 7.24; N, 9.14. Found: C, 31.28; H, 7.30; N, 8.95.

METHOD B: Ethyldimethylamine (3.0 mL, 0.028 mole) was dissolved in water (18.0 g, 1.00 mole) giving a 10% solution. Pyridine-sulfur trioxide complex (4.37 g, 0.0275 mole) was added slowly with stirring to the amine solution. *Caution: Amine concentrations of 50% or more cause a vigorous exothermic reaction with the pyridine-SO_3 complex.* After stirring an additional 15 minutes, the resulting white crystals were filtered, washed with ice-cold water, and then recrystallized from water; melting point 134.5–135.5°C.

Torsional Braid Analyses

The cure of the water-borne resins was followed by the use of a Chemical Instruments Corp. torsional braid analyzer (TBA). The test specimens were prepared by soaking a fiberglass braid in the appropriate water-borne resin for a minimum of three hours and then hanging the braid vertically under some light tension for 30 minutes to allow the resin to "flash." The TBA itself was allowed to stabilize at the appropriate cure temperature for 30 minutes before any testing was conducted. The impregnated braid was then lowered into the TBA and the torsional pendulum in the TBA was intermittently set into oscillation to generate a series of freely damped waves. The period (p) of the resulting waves is related to the relative rigidity ($\log 1/p^2$) of the resin which, in turn,

is directly proportional to the in-phase or elastic portion of the shear modulus.[4] As the resin cures, the resin's modulus changes. Since the period of the waves changes as the modulus changes, the TBA provides a convenient method of following the cure. Each cure condition was run in duplicate or triplicate.

RESULTS AND DISCUSSION

Torsional Braid Analysis of Water-borne Resins

Two unpigmented acrylic/melamine water-borne resins were used in these studies. Resin A is identical to a commercial water-borne resin and incorporates into the backbone of the acrylic resin a derivative of the strong acid *p*-toluenesulfonic acid (PTSA), 1:

$$H_3C-\!\!\!\bigcirc\!\!\!-\overset{\displaystyle O}{\underset{\displaystyle O}{\overset{\|}{\underset{\|}{S}}}}-OH$$

1
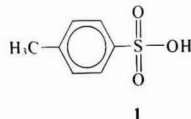
DR. DONALD J. HART is a Senior Research Scientist at General Motors Research Laboratories, where he has been investigating fundamentals of surface coatings. His recent efforts have been directed towards the research and development of high solids and elastomeric topcoats. Dr. Hart received the B.A. Degree in Chemistry from Oakland University and the Ph.D. Degree in Organic Chemistry from the University of Illinois.
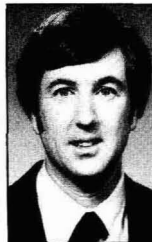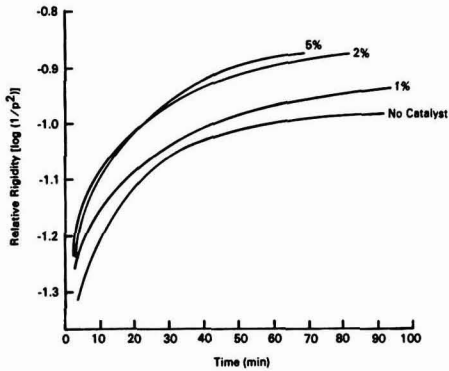
Figure 5—Curing profile at 121°C of Resin B with various levels of PTSA
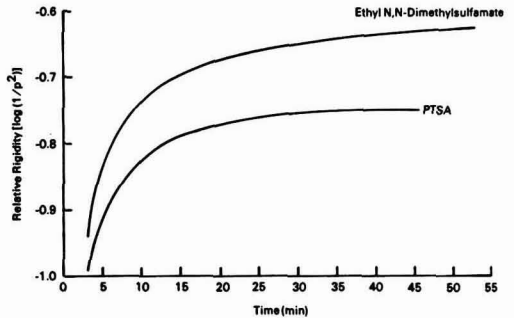
Figure 6—Curing profile at 163°C of Resin B with various catalysts at 1.0% level

Resin B is identical to Resin A except that no strong acid is incorporated into the backbone of the resin.

Figure 3 shows the curing profiles of Resin A at various temperatures. Both the curing rates and the final relative rigidities are much lower at 121°C (250°F) and 107°C (225°F) than at the standard cure temperature of 163°C (325°F). In this case, the cure of the water-borne coatings is probably inadequate at the lower temperatures. To insure a proper level of cure, a catalyst should give the coating a cure response similar to that obtained at 163°C.

The curing profiles at various temperatures of Resin B which had no incorporation of a strong acid catalyst into the resin backbone, but did contain 1.0% free PTSA, are shown in *Figure* 4. As before, the cure rates and final relative rigidities are significantly lower for the lower cure temperatures than for the standard cure temperature of 163°C. The rates of cure and the final relative rigidities for this coating (Resin B) are slightly higher than for the coating incorporating strong acid catalyst (Resin A). Thus, the effective strong acid concentration of the latter coating is less than one percent. The effect of concentration of strong acid catalyst on the curing profile at 121°C of Resin B is demonstrated in *Figure* 5. Both the rate of cure and final relative rigidity increase with increasing PTSA catalyst level up to 2.0%. The cure profiles at the 2.0% and the 5.0% levels are nearly identical. Even at the higher catalyst levels, however, both the cure rate and the final relative rigidity at 121°C are lower than they are at 163°C with 1.0% PTSA.

The effectiveness at the 1.0% level of ethyl N,N-dimethylsulfamate as a catalyst at 163°C is compared to that of PTSA in *Figure* 6. EDMS gives a higher relative rigidity than does PTSA. This result is somewhat misleading, however, because the effective acid concentration of EDMS is considerably higher than that of PTSA due to differences in catalyst molecular weight and the fact that EDMS has two acid protons per molecule and PTSA has only one. *Figure* 7 compares the effectiveness at 163°C of the two catalysts at equal molar concentrations and equal equivalent concentrations. At

these concentrations EDMS and PTSA have the same effectiveness as catalysts for the water-borne resin.

The effect of concentration of EDMS on the curing profile of Resin B at 121°C is shown in *Figure* 8. A level of 2% EDMS gives a slightly higher relative rigidity than does a level of 1%. Surprisingly, the 5% level gives the lowest rigidity of the three concentrations studied. None of the levels of EDMS gives a cure rate or final relative rigidity at 121°C that matches the current water-borne system cured at 163°C.

Ethyl N,N-dimethylsulfamate is fully active as an acid catalyst at 121°C as revealed in *Figure* 9. The hydrolyzed form (sulfuric acid) (6) gives a rate of cure and relative rigidity that is nearly the same as EDMS itself. EDMS must therefore be already rearranged and hydrolyzed during the initial stages of cure. Consequently, at 121°C the rate determining step in the curing of water-borne resins using EDMS as a catalyst is not the generation of acid from the sulfamate, but rather the curing reaction itself between the acrylic resin and the melamine.

$$\underset{Me}{\overset{Me}{>}}N-SO_2-OEt \xrightarrow{\Delta} \underset{Et}{\overset{Me}{>}}N^+-SO_3^- \quad (4)$$

$$\underset{Et}{\overset{Me}{>}}N^+-SO_3^- \xrightarrow{H_2O} \underset{Et}{\overset{Me}{>}}N^+-H + HSO_4^- \quad (5)$$

$$\underset{Et}{\overset{Me}{>}}N^+-H + HSO_4^- \xrightarrow{\Delta} \underset{Et}{\overset{Me}{>}}N \uparrow + H_2SO_4 \quad (6)$$
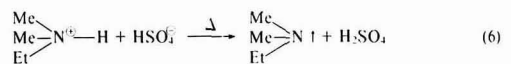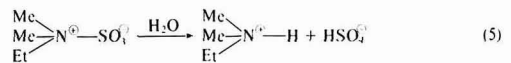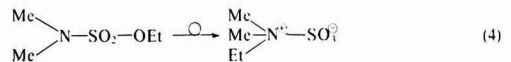
As mentioned previously, a 5% level of EDMS gave a lower relative rigidity at 121°C for the water-borne paint than did a 2% level (*Figure* 8). This result is surprising but real. An identical curing profile resulted when the experiment was repeated one month later with a freshly prepared paint. A possible explanation for this result stems from the two competing reactions occurring during cure: namely, the crosslinking reactions between mela-
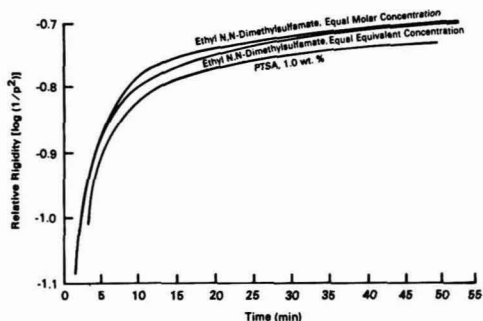
Figure 7—Curing profile at 163°C of Resin B. Comparison of catalyst effectiveness of ethyl N,N-dimethylsulfamate and PTSA at equal molar concentrations and equal equivalent concentrations

Figure 8—Curing profile at 121°C of Resin B with various levels of ethyl N,N-dimethylsulfamate

mine and acrylic resin (*Figure* 1) and the self-condensation reactions of the melamine ·(*Figure* 2). At this relatively low bake temperature (121°C), increasing the catalyst level increases the rate of the cross-linking reactions and can actually *decrease* the amount of self-condensation taking place.[1] Therefore, at the higher catalyst level, the ratio of crosslinking reaction to self-condensation reaction increases. Since the self-condensation reaction leads to more rigid segments than does the crosslinking reaction, one would expect the modulus, and, consequently, the relative rigidity, of the resulting paint film to decrease at higher catalyst levels at 121°C.

At higher bake temperatures, the effect of catalyst concentration on the crosslinking/self-condensation ratio becomes less significant.[1] *Figure* 7 confirms this observation since at 163°C the cure rates and final relative rigidities of the paints containing different concentrations of EDMS are identical within experimental error.

Curing of Pigmented Water-borne Coatings

The effectivenss of ethyl N,N-dimethylsulfamate as a catalyst in an actual pigmented water-borne coating system was also investigated. Two pigmented topcoats were used in this investigation: a standard production white water-borne enamel topcoat containing incorporated strong acid catalyst (Resin C); and a white water-borne enamel topcoat identical to Resin C except that it did not contain any incorporated strong acid catalyst (Resin D). EDMS and PTSA were added to Resin D at 1.0 weight percent levels while a third paint from Resin D was prepared which contained no added acid catalyst. The four white topcoats (Resin C and the three paints prepared from Resin D) were applied to steel substrates using conventional spray techniques and then cured. Two different bake schedules were used for the cure reaction: 163°C for 30 minutes and 121°C for 45 minutes. *Table* 1 shows that all paints were cured at 163°C. At the 121°C cure temperature, the two coatings containing strong acid catalyst and the coating containing EDMS all had Knoop hardness values of at least 13 and all passed
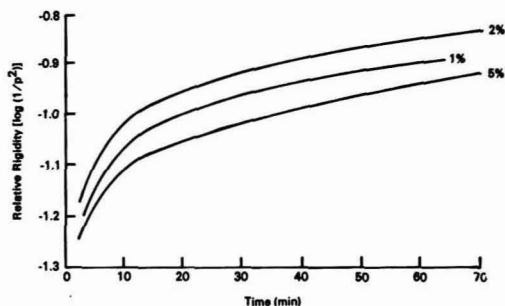
condensing humidity. The coating containing no acid catalyst was not properly cured as it had only a marginally acceptable Knoop hardness of 10 and developed blisters during condensing humidity.

These results demonstrate that EDMS does rearrange to generate a strong acid catalyst for water-borne coatings at 121°C.

Ethyl N,N-Dimethylsulfamate— Suitability as Latent Catalyst

In order to qualify as a latent acid catalyst for water-borne coatings, a material must be unreactive at ambient temperatures and thereby give good storage stability. The suitability of ethyl N,N-dimethyl sulfamate as a latent acid catalyst was determined by monitoring the viscosity of water-borne resin solutions containing varying levels of the sulfamate. Solutions containing up to 2.0 weight percent EDMS (equivalent to 4.5 weight percent PTSA on an equal acid equivalent basis) had no increase in viscosity after two years storage at ambient temperature. In contrast, solutions containing the betaine form of this sulfamate (which has no latent acid qualities) or PTSA at the same catalyst level gelled within four days. Relative stabilities of resin solutions at moderate temperatures
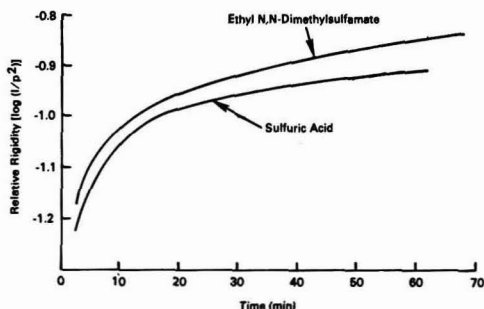
Figure 9—Curing profile at 121°C of Resin B with various catalysts at 2.0% level

(50–70°C) and stability of formulations to circulation were not determined.

SUMMARY AND CONCLUSIONS

In an attempt to lower the cure temperature of water-borne enamel topcoats, increases in the amount of acid catalyst used were studied. Since this leads to a decrease in the storage stability of these coatings, the suitability of ethyl N,N-dimethylsulfamate as a latent catalyst was investigated. This material was found to be as effective as the standard acid catalysts such as p-toluenesulfonic acid (PTSA) in commercial water-borne coatings. Even at high concentrations, this material has no adverse effects on storage stability and becomes fully activated as an acid catalyst at a bake temperature of 121°C. However, reformulation of the commercial coatings will be necessary in order to successfully reduce the bake temperature to 121°C regardless of the type or concentration of acid catalyst used.

Ethyl N,N-dimethylsulfamate is as effective an acid catalyst as PTSA or any other strong acid. It can be valuable whenever high concentrations of acid or long water-borne coating storage stabilities are required.

ACKNOWLEDGMENTS

Table 1—Knoop Hardness and Condensing Humidity Results For White Water-borne Enamel Topcoats Containing Various Catalysts

Resin Used	Catalyst	Bake Temp., °C	Bake Time, min	Knoop Hardness	Condensing Humidity[a]
C	Incorporated	163	30	17	Pass
D	EDMS	163	30	15	Pass
D	PTSA	163	30	17	Pass
D	None	163	30	16	Pass
C	Incorporated	121	45	16	Pass
D	EDMS	121	45	13	Pass
D	PTSA	121	45	16	Pass
D	None	121	45	10	Fail

(a) *Pass*—No change in paint appearance after 24 hours of condensing humidity at 60°C. *Fail*—Developed blisters in paint film after 24 hours of condensing humidity at 60°C.

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Color-matching Aptitude Test

Color-matching Aptitude Test Set was created by the Inter-Society Color Council and sponsored by the Federation. It is in world-wide use as a means for estimating color-matching skill. The 1978 edition contains minor refinements over the previous editions (1944, 1953, 1964), and these bring it closer to the original ISCC plan, making it a still more successful tool for evaluating color-matching skill.

The basic aim of the Test is to provide an objective measure that will aid in determining an individual's ability for performing color-matching tasks accurately. Changes in a person's color-matching skill may occur over a period of time, improving due to training, experience, and motivation, or lessening when removed from practice, or as a result of health disorders. Retesting at regular intervals will provide an indication of any such changes in an individual's ability.

The Test is not designed to indicate or measure "color-blindness" (anomalous color vision). Special tests designed for this purpose should be used.

The Color-matching Aptitude Test Set consists of a carrying case, an easel on which are mounted 48 color chips, a dispenser which holds 48 matching chips, score sheets, and a scoring key.

Brochure available upon request. Price: $400.

Orders must be prepaid. U.S. and Canada—Add $10.00 shipping. All others—Add $50.00 shipping.
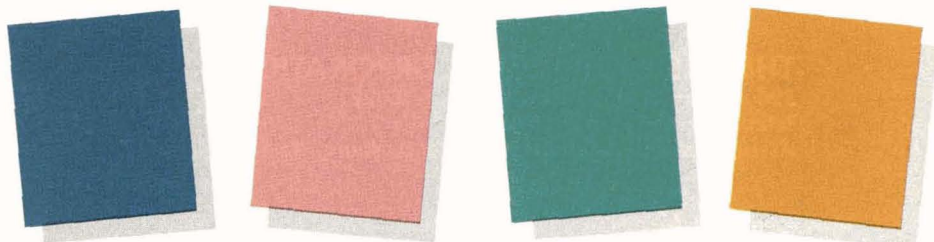
Federation of Societies for Coatings Technology
1315 Walnut Street, Suite 830, Philadelphia, Pa. 19107 (215) 545-1506

Review of Dielectric and Dynamic Mechanical Relaxation Techniques For the Characterization of Organic Coatings

K. Varadarajan
American Can Company*

The complimentary techniques of dielectric relaxation and dynamic mechanical relaxation experiments provide valuable information on the performance of coatings. In a dielectric relaxation experiment, a periodic electrical potential is applied to the sample between two electrodes and the dielectric constant, ε', and the dissipation factor, tan $\delta = \varepsilon''/\varepsilon'$, are measured as a function of frequency and temperature. The minimum film forming temperature (MFT), adhesion, corrosion resistance, aging, end use, water sorption, film defects, and curing of organic coatings have been characterized by dielectric relaxation measurements. In a dynamic mechanical experiment, the viscoelastic properties of coatings are characterized by the application of a cyclic stress and by measuring their strain response. A review of the successful application of the dynamic mechanical methods in characterizing the glass transition temperature, adhesion, aging, water uptake, kinetics of curing, and crack resistance of coatings is also presented.

INTRODUCTION

The applications of dynamic mechanical and dynamic dielectric relaxation techniques in characterizing bulk polymers and polymer solutions are well known. Numerous publications, review articles, and text books have appeared and continue to appear in the literature on dielectric and dynamic mechanical testing of polymers. References 1–13 are representative of the vast literature available on dynamic mechanical and dielectric testing of polymers. This article briefly reviews the principles of the dynamic mechanical and dynamic dielectric analyses, the experimental techniques and the applications of these two similar and complimentary methods in characterizing organic coatings.

PRINCIPLES

In a dynamic mechanical experiment a periodic stress or strain is applied to the sample and its periodic response is monitored. If the stress is sinusoidal, the strain response is sinusoidal as well. For a perfectly elastic solid, stress and strain are in phase, and all of the energy used in producing the deformation is recoverable. For a purely viscous liquid, stress and strain are 90° out of phase and all the energy is dissipated as heat. Polymers and hence, organic coatings are neither perfectly elastic nor purely viscous, i.e., they are viscoelastic. There is a phase lag between 0–90° between stress and strain, the magnitude of the phase angle being a measure of the ratio of the viscous to the elastic behavior of the sample. For viscoelastic materials, part of the energy used in producing the deformation is recoverable and the rest is dissipated as heat during viscous flow. The ratio of the stress to strain, the modulus, is a complex quantity, $E^*=E'+iE''$ in a tensile experiment, and the ratio between the imaginary and real parts of the modulus, E''/E', is equal to tangent δ, where δ is the phase angle (tan $\delta = E''/E'$).

Table 1—Comparison of the Glass Transition Region Descriptive Parameters for Epon 828, Tertiary Amine Catalyzed as a Function of Cure History[25]

Cure	T_g °C	T_s °C	T_l °C	$T_l - T_s$ °C	$E_{RT} \times 10^{-10}$ dynes/cm²
15 min/204°C (400°F)	73.5	57	91	34	1.29
15 min/204°C + 4.5 hr 200°C ...	127	110	139	29	1.13
0.1°C/min 50°C .. 200°C 180°C	163	132	182	50	1.13

In a dynamic dielectric experiment, a periodic potential is applied to the sample and the capacitive and conductive responses of the sample are monitored. The dielectric constant is a complex quantity ($\epsilon^* = \epsilon' - i\epsilon''$) and the ratio ϵ''/ϵ' (= tan δ) is a measure of the conductive to the capacitive properties of the material.

The viscoelastic and the dynamic dielectric properties of organic coatings are time, and hence, frequency and temperature dependent. Long time properties at low temperatures are equivalent to the short time properties at high temperature. This is known as the time-temperature equivalence principle[14,15] and is a powerful tool, especially in dynamic mechanical experiments, for expanding the usefulness of dynamic mechanical data over a wide frequency scale at a reference temperature.

Detailed discussions of the principles of dynamic mechanical measurements are given in References 7–9. The principles of dynamic dielectric testing are discussed in References 9–11.

EXPERIMENTAL TECHNIQUES

Boyer[16] has recently reviewed the various commercially available dynamic mechanical instruments and has discussed the choice of an instrument with respect to the types of specimens, temperature ranges, constant or variable frequency, frequency of measurement, and resolving power. The developments in dynamic mechanical testing of organic coatings from its origin to 1977 have been tabulated by Roller and Gillham.[17] The most common methods of dynamic mechanical testing are in tension, resulting in information of complex Young's or tensile modulus, and in shear, leading to complex shear moduli data. The dynamic mechanical experiment can be a resonant frequency experiment or a forced oscillation method. In a resonance method, the sample is allowed to oscillate at a resonant frequency, determined by the sample dimensions, the instrument constants, and the modulus of the sample. The Dynamic Mechanical Analyzer[18] is one such example operating in one dimension. The Torsion Pendulum[19,20] and the Torsional Braid Analyzer[21] are resonance instruments where a shear deformation is imposed on the specimen. In a forced oscillation or fixed frequency method, the specimen is subjected to a fixed frequency of oscillation and its response is monitored. The Rheovibron[22] is an example of a fixed frequency instrument operating in tension. It is capable of measuring dynamic mechanical tensile modulus at 3.5, 11, 35, and 110 Hz. The Rheometrics Mechanical Spectrometer[23] is a fixed frequency instrument which can be used either in tension or in shear. No attempt is made in this article to list all of the various dynamic mechanical instruments available in the market or their methods of operation and the treatment of experimental data. The reader is referred to
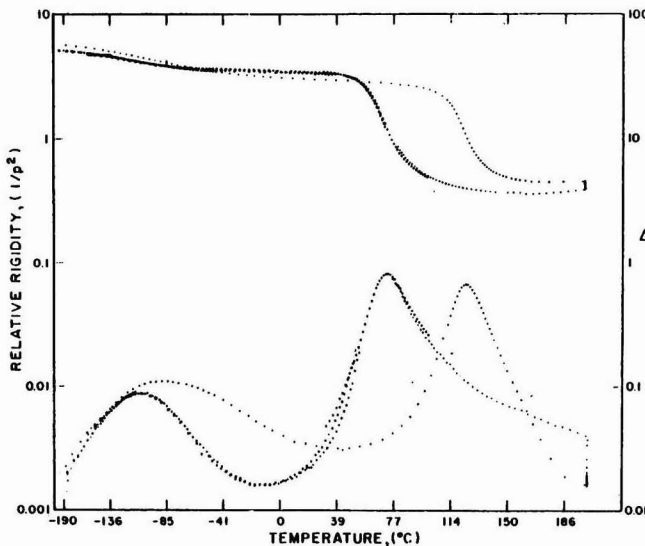
Figure 1—Dynamic Mechanical Spectra of Epon 828, tertiary amine catalyzed and cured 15 min. at 400°F. Data obtained −180 −200°C; hold 4.5 hr. → 180°C at 2°C/min. (Ref. 25) *Reprinted by permission of the publisher, The Electrochemical Society, Inc.*
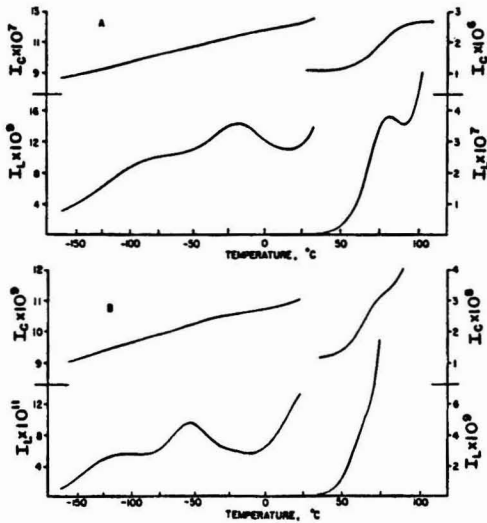
Figure 2—Dielectric loss current, I_L and charging current I_C for a film of Epon 1002/Versamid 100 at (A) 1000 Hz and (B) 10 Hz. At 10 Hz the ionic conductivity masks the T_g maximum in I_L which could be seen at 75°C for 1000 Hz measurement. (Ref. 26) *Reprinted by permission of the publisher, The Electrochemical Society, Inc.*

Figure 3—Variation of viscoelastic properties during baking for a water based polyester formulation, obtained by Dynamic Spring Analysis. The early increase in tan δ signifies an increase in viscosity due to skin formation resulting in film popping. (Ref. 53) *Reprinted by permission of the publisher, The Electrochemical Society, Inc.*

References 7–9 and 16, and references therein for detailed information on each of these instruments.

Negami[11] and Hedvig[12] have described the dielectric measuring techniques currently in use at different experimental frequencies. The most commonly used frequency range of measurements in the dielectric characterization of organic coatings is $10- 10^6$ Hz, where various bridge circuits are employed for the determination of the capacitance and conductance of the specimens. Table 1–1 of Reference 11 lists the different suppliers of dielectric measuring apparatus.

APPLICATIONS

The Glass Transition Temperature

Determination of the dynamic mechanical shear modulus $G^*=G'+iG''$, or the dynamic dielectric constants, $\epsilon^*=\epsilon'-i\epsilon''$ over a series of temperatures at a fixed frequency or at various frequencies at the same temperature, provides valuable information on the transitions and relaxations in polymers and in coatings. As the organic coating under goes a transition or relaxation, the dynamic mechanical and dielectric properties change to different extents, depending upon the strength of the transition.

The most prominent changes in physical properties occur at the glass transition temperature, T_g. In the glass transition region, the real part of the modulus, the

storage modulus, decreases two to three decades in magnitude, the dielectric constant increases significantly and the imaginary parts of the modulus and the dielectric constant, loss modulus and dielectric loss, respectively, and tan δ (G''/G' or ϵ''/ϵ') go through maxima. These changes are frequency dependent in isothermal experiments and temperature dependent in isochronal (constant frequency) experiments. Thus, dynamic testing is a very sensitive method of determining the glass transition temperature of an organic coating.

The glass transition temperature is determined by the chemical constitution, tacticity, molecular weight, morphology of the binder, the amount and nature of pigments and the presence or absence of plasticizers and the degree of crosslinking. The glass transition temperature in turn determines the type and nature of coating produced by a particular paint formulation.[24] Hence, a knowledge of the glass transition temperature of a dried film is vital in formulating a paint for coatings with the desired properties.

Roller has discussed the importance of the glass transition temperature in organic coatings.[25] Six crosslinked films of various compositions were prepared by impregnating glass braids with monomers and crosslinking resins of six different compositions, and by radiation curing. The log decrement ($\Delta\approx\P$ tan δ) and the relative rigidity were recorded as a function of temperature for these six composites by torsional braid analysis. The glass transition temperature, the damping maximum, and
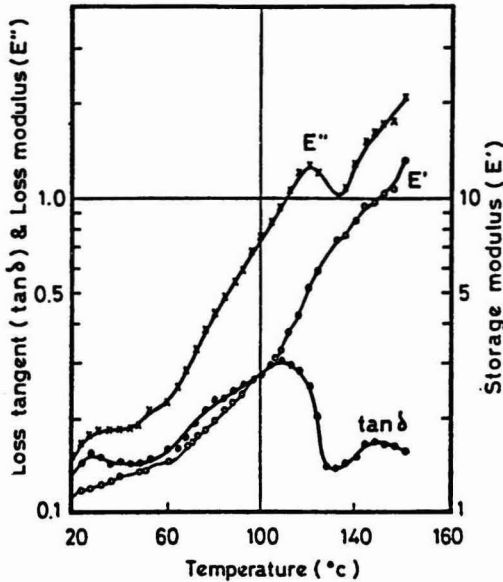
Figure 4—Dynamic Spring Analysis data for a solvent-based polyester formulation. Tan δ remains low for a longer period of time after baking has been started. (Ref. 53) *Reprinted by permission of the publisher, The Electrochemical Society, Inc.*

THERMOSETS : PHASES

Figure 5—Time-Temperature-Transformation Diagram for an epoxy thermoset system. T_{gg} is the cure temperature below with vitrification occurs without gelation. At and above $T_{g\infty}$ vitrification does not occur. The thermoset gels and transforms into a rubbery state directly. (Ref. 17) *Reprinted by permission of the publisher, The Electrochemical Society, Inc.*

the width of the transition have been observed to indicate local distribution of the compositional parts of the film. Roller has also found that different cure histories for tertiary amine cured Epon® 828, although results in different glass transition characteristics result in similar levels of reactions and effective crosslink density as indicated by a similar glassy state and rubbery moduli. The dynamic mechanical spectra of Epon 828, tertiary amine catalyzed and cured for 15 minutes at 400°F is given in *Figure* 1. The effect of cure history on the glass transition temperature, T_g, the onset of the glass transition region, T_s, the end of the glass transition region, T_l, the breadth of the glass transition region, $T_l - T_s$, and the room temperature moduli for Epon 828 are given in *Table* 1. *Table* 1 shows that the glass transition temperature of the slow cured system is much higher compared to the high temperature gelled sample which was subjected to a post-cure. However, the similar rubbery moduli data in *Table* 1 indicate that the different cure histories resulted in similar levels of reactions and degrees of crosslinking. Standish and Leidheiser[26] illustrate the determination of the glass transition temperature for films of poly (vinyl acetate) and Epon 1002/Versamid® 100 by the dielectric relaxation technique. For the Epon 1002/Versamid 100 film the glass transition temperature peak at 10 Hz is masked by ionic conductivity in contrast to the 1000 Hz measurement as shown in *Figure* 2. At low

Epon is a registered tradename of Shell Chemical Co.
Versamid is a registered tradename of General Mills, Inc., Chemical Div.

frequencies, dc conductivity dominates in contributing to the dielectric loss[27] and the dc conductivity effect can be reduced by analyzing the derivative of ϵ' with respect to either temperature or frequency.[28-30]

Plasticizers and Water

In order to formulate a coating with desired final property, plasticizers may be added to the paint to lower the glass transition temperature to predetermined levels. A fundamental understanding of the action of plasticizers in reducing the glass transition temperature helps in selecting a plasticizer and its concentration. The effect of plasticizers on the glass transition and physical properties of films of copolymers of polyethyl methacrylate has been reported by Chae.[31] The glass transition of a polymer can be decreased by the copolymerization of its monomer with the monomer of a low T_g polymer. The glass transition of the copolymer normally follows the Gordon-Taylor equation.[32] The polymerization of the low T_g monomer into the high T_g polymer internally plasticizes the high T_g polymer and lowers the glass transition temperature. Certain low molecular weight compounds which lower the glass transition tempera-

tures are known to cause antiplasticization in polymers. For example, addition of arochlor, a polychlorinated biphenyl, to poly(bisphenol-A carbonate) reduces the free volume of polycarbonate in the glassy state, increases its modulus, lowers its impact strength, and changes the mode of fracture of polycarbonate from ductile to brittle fracture at room temperature,[33,34] in spite of lowering the glass transition temperature of polycarbonate. The presence of residual solvents in organic coatings can act as plasticizers and reduce the glass transition temperature as well. Unreacted monomers in radiation cured coatings and telechelic polymer coatings can also act as plasticizers. Interaction of plasticizers can also lead to additional dynamic mechanical and dielectric loss peaks. For instance, Pochan and coworkers showed that the presence of n-butyl-4,5,7-trinitrofluorenone-2-carboxylate in poly(bisphenol-A carbonate) gives rise to a dielectric loss peak due to the polymer-plasticizer interaction.[35]

Polar polymers such as nylon are known to absorb moisture, and water has a plasticizing effect on the glass transition of polyamides as revealed by dynamic mechanical studies of Nylon 612 by Illers[36] and dielectric studies of Nylon 66 by Boyd.[37] Absorption of moisture can also result in additional relaxation peaks below T_g in polymers, as had been illustrated by dielectric results for Nylon 66 by Curtis[38] and dynamic mechanical studies[36] of Nylon 612. Similar results of plasticization of the glass transition and appearance of relaxation peaks due to absorbed moisture have been reported for epoxy thermosets by Gillham and McPherson[39] from their experiments in which epoxy thermoset coatings were exposed to controlled levels of water vapor in the atmosphere by varying the relative humidities. For pigmented and unpigmented alkyd and epoxy films, the capacitance values at a given frequency have been used to monitor the water uptake of these films when immersed in aqueous electrolytes.[40] Y. Oyabu, et al., from their measurements of tan δ at 1 KHz for melamin-alkyd paint films, deduced that the principal mechanisms of water penetration into these coatings is by osmosis and that the coatings exhibit selective permeability to cations.[41]

Crosslinking

With increasing degrees of crosslinking, the damping peaks due to T_g in dynamic mechanical and dynamic dielectric tests occur at higher temperatures; their intensities are lower and; the peaks are broader. The rubbery modulus above T_g is higher at higher degrees of crosslinking.[42] Roller and Gillham have shown that the nature of the crosslinker can drastically affect the properties of a cured thermoset coating based on acid functional acrylic acid prepolymer.[43] Sokolava, et al., have reviewed the dynamic mechanical properties of three-dimensional network structures of epoxy resins.[44]

Kinetics of Drying and Cure

The kinetics of drying of organic coatings can be followed by dynamic mechanical and dielectric methods. Myers and coworkers have described a method of moni-
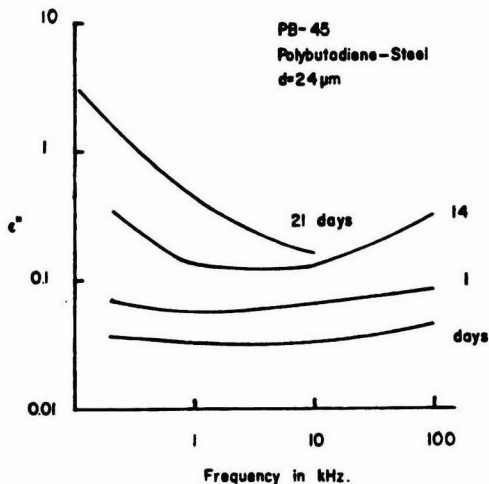
Figure 6—A plot of log permittivity loss vs. log frequency for a polybutadiene-coated steel that was intentionally pricked with a needle and was then exposed to 0.52M NaCl at room temperature. In the damaged sample the slope is −1 indicating ionic conduction. (Reprinted with permission from Ref. 59)

toring the drying of an organic coating in the ultrasonic frequency region, known as ultrasonic impedometry.[45-47] The organic coating is applied on a quartz bar and subjected to ultrasonic shear waves. As the coating dries and acquires rigidity, it absorbs more of the shear waves. By monitoring the attenuation of the shear waves by the coating, the drying of the organic coating can be followed. Recently, Myers and coworkers, from their studies of alkali and amine neutralized poly (acrylic acid)[48] and acrylic acid-butyl methacrylate and ethylene-maleic anhydride copolymers[49] by impedometry, concluded that water clusters around carboxylate groups in close proximity, thus providing a mechanism for retention of water in films of water-borne coatings.

The drying of an unsaturated polyester resin has been investigated as a function of frequency of oscillation, temperature, and time by Imai.[50] The dynamic shear storage and loss moduli data at different temperatures show that with increasing temperature the induction time for drying is shortened and gelation occurs faster. The real part of the modulus at the completion of drying is independent of the temperature of drying and the time to reach the asymptotic modulus is independent of temperature. Imai and Tsubouchi, using dynamic spring analysis,[51,52] a recently developed dynamic mechanical technique for the dynamic mechanical study of low modulus materials, investigated the evaporation of solvents from bake-type water-borne acrylic and polyester coatings.[53] *Figures 3 and 4* show the variation of the viscoelastic properties of a water-based and a solvent-based polyester coating as a function of temperature during baking. The dynamic viscoelastic properties of the water-based system, as

Figure 7—Activation Energy, E_A vs. Time of Storage for polyurethane cured with aliphatic isocyanate. Rutile pigmented coating does not undergo structural change with time compared to the anatase pigmented and unpigmented coatings as shown by changes in E_A. *(Reprinted with permission from Ref. 69)*

the reaction mechanism of the curing process was elucidated by Ushiama.

The mechanism of film formation of alkyl silicate zinc-rich coatings was evaluated by Ginsberg by observing the drying behavior of these coatings by a combination of techniques, including dynamic mechanical analysis.[55] The coatings were supported on cellulose strips and their dynamic mechanical relative storage, shear and tensile, moduli were monitored as a function of dry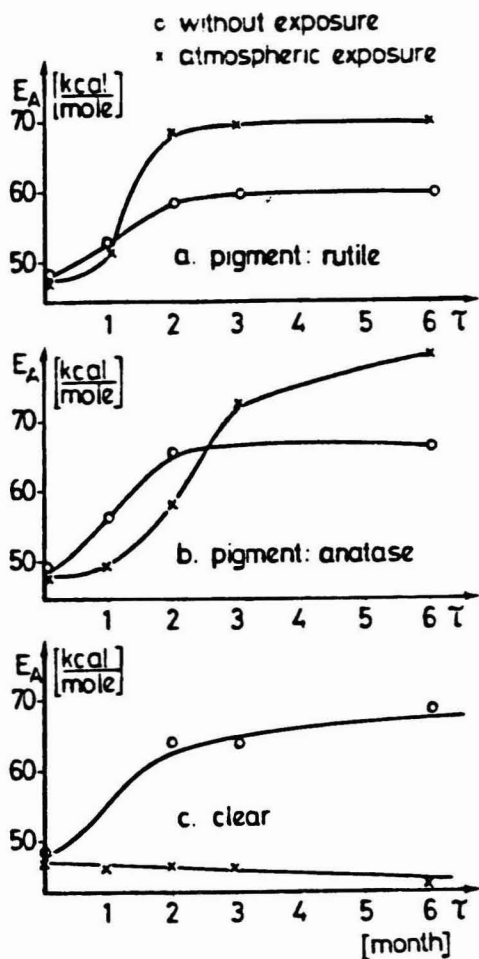ing time by Torsion Pendulum and Rheovibron, respectively.[55] The alkyl silicate zinc-rich coatings undergo most of their changes through solvent evaporation leading to a critical packing of zinc particles and a consequent increase in modulus in the first few hours of drying.

Gillham and coworkers, from their Torsional Braid Analysis studies of curing of epoxy system at a series of constant temperatures,[56,21] constructed a generalized time-temperature transformation diagram, given in *Figure 5*, for the isothermal curing of epoxy resins.[17] They identified three types of curing behaviors: (1) gelation without vitrification at high temperatures; (2) vitrification without gelation at low temperatures; and, (3) gelation and then vitrification at intermediate temperatures. If the curing temperature is below T_{gg}, the temperature for gelation, vitrification occurs without gelation. In between T_{gg} and $T_{g\infty}$, gelation occurs first followed by vitrification, and the curing temperature will be the glass transition temperature of the epoxy system. Above $T_{g\infty}$, there is only gelation and no vitrification and the T_g of the epoxy thermoset will be $T_{g\infty}$. Any thermoset system which was cured below $T_{g\infty}$ can be post-cured by heating it to above $T_{g\infty}$. The importance of the time-temperature transformation diagram from the practical view point of shelf-life and post-cure of epoxy thermosets is discussed in detail in Reference 43.

Similar to the dynamic mechanical study of the kinetics of drying and curing of coatings, dynamic dielectric method also can be applied to monitor changes in coatings during drying by conducting isothermal experiments and measuring dielectric parameters as a function of time at constant frequency. The dielectric dissipation factor, tan δ, was measured as a function of temperature at constant frequency for polyester amide-imide wire enamel applied on a wire at various tower speeds by Sanjana.[57] He observed that the tan δ maximum occurred at higher temperatures as the tower speed decreased from 40 to 20 ft/min indicating that with decreasing tower speed the cure of the wire enamel coating is enhanced.

Corrosion and Defects

The application of dynamic dielectric method in detecting film defects and corrosion of substrates with organic coatings has been reviewed by Leidheiser and coworkers.[58,59] Standish and Leidheiser describe an ac method for the determination of defects and corrosion in coatings on substrates.[60] An ac signal is applied on the underside of the metal substrate and a probe is passed over the surface of the coating and the electrical properties of the coatings, impedance and the phase angle, are monitored. From the measurement of the electrical prop-

revealed by the magnitudes of E″ and tan δ, increase at shorter times, indicating skin formation during the early stages of baking, in contrast to the solvent-based coating for which the tan δ value remains at a lower level for a considerable time after baking has been started. The surface skin formed in these water-borne coatings impedes the diffusion of solvent from the bulk to the surface resulting in film popping. Ushiama studied the curing of seven different compositions of acrylic acid-butyl acrylate-2-hydroxyethyl acrylate with melamine-formaldehyde resins by dynamic mechanical analysis.[54] He observed that the change in viscoelastic properties correlated with the chemical reactions occurring during curing. From the measurement of viscoelastic properties,

erties, defects in coatings, corrosion beneath the coatings, and the rate of corrosion were followed for an epoxy-polyamide coating. The ac method of dielectric measurement for organic coatings on a metal substrate has the advantage of eliminating the resistance due to the dc polarization at the interface, and provides information useful in understanding the mechanism of corrosion. The dielectric loss, ϵ'', is nearly constant as a function of frequency for a defect free coating on a substrate, whereas it decreases linearly with increase in frequency with a slope of -1 for a coating with a direct pathway for conduction of ions through the coating. This has been predicted and shown by Kendig and Leidheiser[61] for poly (butadiene) coated on steel (*Figure* 6) and by Bellobono and co-workers for acrylated polyurethane and acrylated acrylic coatings on steel substrates.[62] The slope of -1 results from the inverse proportionality between the dielectric loss due to dc conductivity and frequency.[27] Reinhard and Hahn have observed that the capacitance and tan δ of defective films on metal substrates depend on the type of coating and are independent of the substrate and the electrolyte to which the films have been exposed.[40] Sekine investigated tan δ and resistance as a function of frequency and time of exposure to sodium chloride by dielectric measurements on 11 different test coatings on steel, and found that the films with the best corrosion protective properties had lower tan δ and higher resistivity values.[63]

Adhesion

Tsubota and coworkers studied the effects of surface treated pigments on the adhesive strength of enamels at various pigment volume concentration by dynamic viscoelastic methods and adhesive strength tests.[64] They observed that the increase in pigment-vehicle interaction, as revealed by increase in the glass transition temperature in dynamic mechanical tests, correlated with the adhesive strength of the alkyd paint films. Julien and coworkers in their studies of dielectric properties of polyurethane, epoxy, and alkyd films found that:

(1) With increasing specific impedance the adhesive strength decreased slightly for polyurethanes;

(2) The impedance and adhesion of epoxy films were independent of the chemical nature of the epoxy; and

(3) The impedances of an alkyd resin, a 2-vinyl phoric primer and a silicone resin correlated with their adhesive strengths.[65]

Immersion of these films in salt solution resulted in loss of adhesion, the extent of which depended on the electrical properties of the coatings. The higher the electrical properties and adhesion, the higher was the salt spray resistance in salt spray tests, further confirming the correlations among adhesion, electrical properties, and corrosion protective properties of films.

Impact Resistance

The correlation of impact properties with the dynamic mechanical properties is well known in polymers.[1,66,67] A knowledge of the variation of tan δ as a function of temperature of an organic coating will be useful in
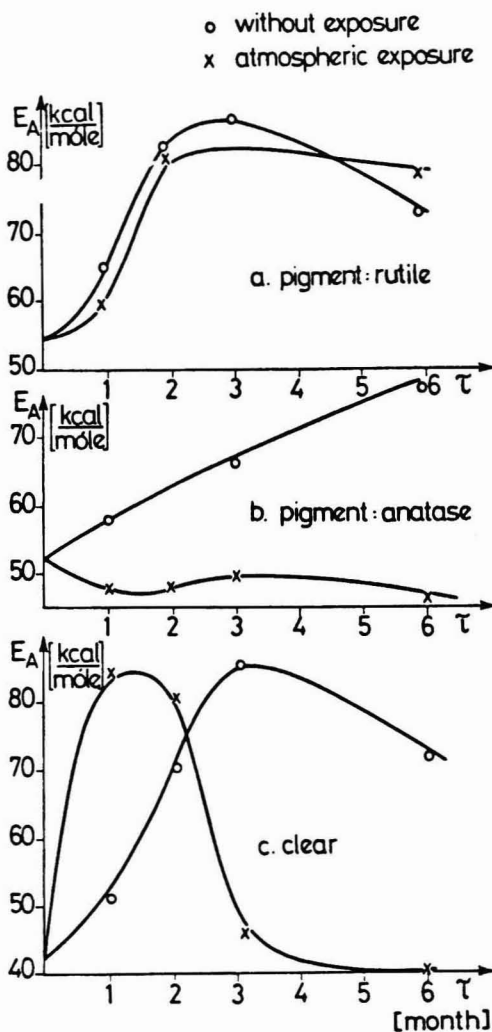
Figure 8—E_A vs. Time of Storage for polyurethane cured with aromatic isocyanate. Rutile and anatase pigmented and unpigmented coatings undergo significant structural changes as the activation energy changes considerably with time for all the three cases. *(Reprinted with permission from Ref. 69)*

designing a coating with desirable impact resistance, since the tan δ loss peaks represent different mechanisms of dissipation of energy as heat by the coating. In order to get a tough coating, the energy of impact should be dissipated by mechanisms other than the cracking of paint films. This could be accomplished by (1) dissipation of energy through main chain molecular motions in the binder, (2) loss of adhesion between the binder and the pigment, and (3) loss of adhesion between the coating and substrate if the fracture of the substrate is of major concern.
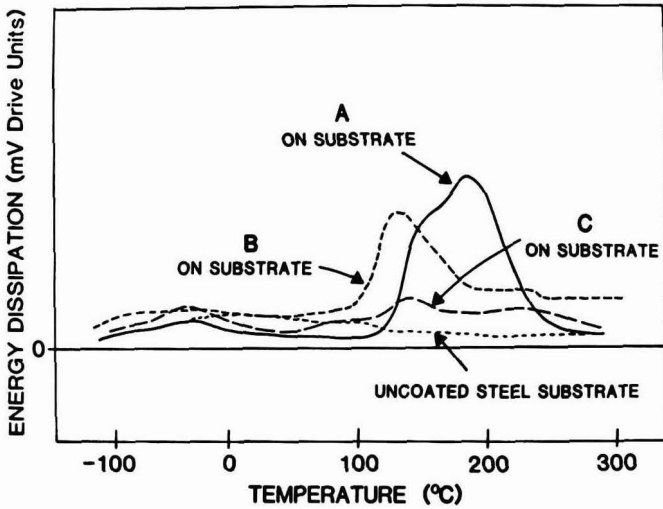
Figure 9—Dynamic mechanical loss vs. temperature for three different can coatings. Coating A has the best performance due to microphase separation as indicated by two overlapping T_g peaks. (Reprinted with permission from Ref. 70)

Aging

Devay investigated the effect of aging of pigmented coatings on the dielectric relaxation temperatures and activation energies of these relaxation processes.[68,69] Heat treatment of clear EPAMIN coatings for various times shifted the relaxation spectrum and the relaxation temperature to higher values with increasing time of heat treatment. Polyurethane lacquers cured by aliphatic and aromatic isocyanates and pigmented by rutile or anatase showed that exposure to the atmosphere for six months resulted in an increase in the relaxation temperature as well. The variation of activation energies with time of exposure to the atmosphere and storage without exposure for these coatings, Figures 7 and 8, indicates that the coatings pigmented with rutile did not undergo structural changes. Whereas, the coating containing anatase undergoes significant structural changes with time of exposure, when cured with aliphatic isocyanate, while rutile and anatase pigmented and unpigmented coatings undergo significant structural changes when cured with aromatic isocyanate. Analyses of the activation energy

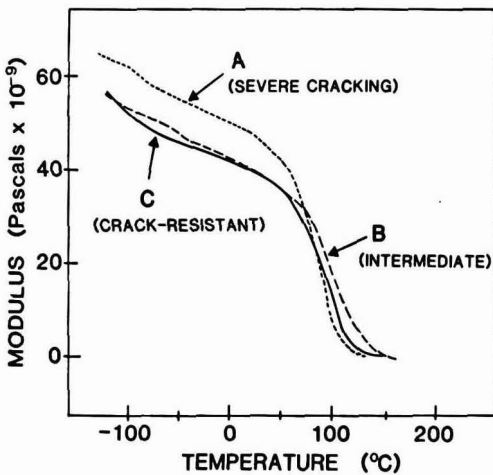Figure 10—Dynamic mechanical modulus for three different polyester gel coats. (Reprinted with permission from Ref. 70)

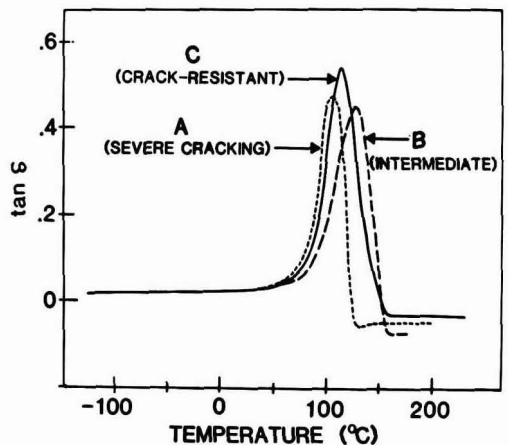

Figure 11—Dynamic mechanical tan δ vs. temperature for the three gel coats. Sample C has the best stress crack resistance after one year since it has the most intense loss peak resulting in better energy dissipation mechanisms other than by stress cracking. (Reprinted with permission from Ref. 70)

data also showed that rutile pigmented aliphatic iso-cyanate cured polyurethane coating has superior weather resistance, whereas, pigmentation with rutile did not improve the weather resistance characteristics of aromatic isocyanate cured polyurethane films.

Performance

Grentzer, et al., evaluated can coatings and gel coats by analyzing their dynamic mechanical properties.[70] Three water-borne epoxy acrylic graft copolymer can coatings were applied to a steel substrate and the temperature variations of tan δ for these coatings were studied. Analysis of the tan δ curves for the three coatings, *Figure 9*, reveals that one of the coatings has a microscopic aggregation due to the difference in solubility parameters between the grafts and the polymer backbone, as seen from the two overlapping peaks in tan δ. This coating showed the overall best performance in the end use application with high impact strength as a result of phase aggregation. *Figure 9* also shows that overbaking of a can coating results in reduced damping peak. The overbaked coating failed by loss of adhesion.

Tan δ and modulus values of three gel coat formations were studied by Grentzer and coworkers.[70] Sample A was an isophthalic/orthophthalic acid based resin, Sample B was a neopentyl glycol modified resin, whereas, Sample C was an isophthalic acid based system with more unsaturation than Samples A and B. Modulus and tan δ data for Samples A, B, and C are given in *Figures* 10 and 11. Sample C, which has a broad and intense damping peak, had the best environmental stress crack resistance after one year. This would be anticipated due to its greater potential for dissipating the energy of crack initiation and propagation.

Glass showed that the flow and leveling characteristics of coatings are related to the dynamic mechanical shear modulus G*. He elucidated the role of water-soluble polymers, used as paint thickeners, in coatings performance by observing the intermediate G* value of the coatings, which is related to the contribution of the water soluble thickeners to flow and leveling.[71,72]

Badran and coworkers formulated organic coatings based on maleinized castor oil.[73] They calculated the activation enthalpy and entropy changes of the dielectric relaxation from their dynamic dielectric studies. They deduced that the low power factor and the low activation energy of these coatings make these coatings ideal candidates for insulating surface coatings.

SUMMARY

The dynamic mechanical and dynamic dielectric methods are powerful and valuable tools in characterizing organic coatings. Dynamic mechanical and dynamic dielectric studies can be used in studying the effects of chemical constitution, tacticity, morphology, pigments, plasticizers, water, and crosslinking on the glass transition temperature of coatings. The kinetics of drying of coatings can be monitored by these complimentary methods. The end use performance, impact resistance, aging, adhesion, and corrosion protective properties of coatings correlate well with their dynamic mechanical and dynamic dielectric properties.

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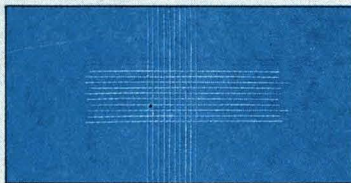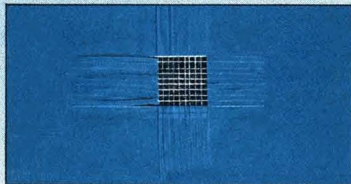
OPEN FORUM

Gadgets and Gimmicks . . .

*Presented at the Southern Society Annual Meeting**

PRIZE-WINNING ENTRY

Nigrosine
As a Porosity Indicator

DAN ADRIEN

Burgess Pigment Co.
P.O. Box 349
Sandersville, GA 31082

Nigrosine is a black water-soluble dye available from most scientific houses.

A 3% solution is prepared with tap water. The 3% solution is either flooded across the panel by making a puddle, then tipping the panel or applied uniformly across the panel with a cotton swab.

Once a uniform coverage is obtained, the panel is immediately washed off under a running faucet and patted dry with tissue.

The greater the retention of nigrosine, the greater the porosity and the darker the color. This test should always be conducted vs a control, as the depth of color will vary with length of time the nigrosine solution is in contact with the film.

The advantage of nigrosine is the ability to differentiate very small differences in porosity as illustrated by the latex ladder. Each 10 lb reduction in latex from 280 lb/100 gal down to 180 lb/100 gal is clearly shown in terms of increased porosity.

There are many applications of this useful test from the lab through to the

---

marketing of paint. In the lab, nigrosine enables the chemist, in conjunction with other tests, to educate himself as to the true hiding contribution of a pigment system vs dry hiding. It enables the chemist to realize why, for instance, tint strength varies when hiding power in "whites" is thought to be equal. It enables explanation of what is actually happening in a paint film when enamel holdout contradicts scrub resistance. Porosity differences in low PVC paints can be demonstrated.

As a quality control test, nigrosine readily demonstrates the differences in latex binding power, dispersion differences, and difference in hiding due to differences in oil absorption of key pigments.

In the marketing of paint, nigrosine enables quick dramatic visual demonstration of good quality vs poor quality.

Nigrosine, as a porosity indicator, cannot be a stain resistance indicator, as many other factors become involved beyond porosity alone.

No other test is known to be such a definite, reliable, and quick indicator of porosity. As always, there are some exceptions and some situations that will contradict porosity as indicated by nigrosine, but these can usually be explained.

Once nigrosine is adopted, we doubt if it will ever be dropped as it is so useful and so fast. Demonstrations include the following:

    (1) Latex Ladders
    (2) 40% PVC Comparison
    (3) Dispersant Study
    (4) Enamel Holdout/Scrub Resistance
    (5) TiO$_2$ Comparison
    (6) Technical Service Applications.

Rapid Method
Of Cooling Paint Samples
For Evaluation by Quality Control

HARVEY LEIBOWITZ

Associated Paint & Plastic, Inc.
7575 N.W. 74th Ave.
Medley, FL 33166

A simple, yet effective, shortcut in the laboratory that saves time in checking batches is the method by which samples are cooled to room temperature. Many paint labs have a bucket of cold water which they keep in the refrigerator to cool samples. They very often will add ice to the water to speed the cooling of the samples. I have found that it generally takes 10 to 15 minutes to cool a sample depending on how much heat is developed in manufacturing. Since water can only be cooled to 32°F before it freezes, every effort is made to keep the water temperature close to 32°F to speed checking.

I have found that since most companies carry ethylene glycol as a raw material, all one has to do is use a 50–50 mixture of ethylene glycol and water in their water bucket. This mixture can be kept in the freezer section of the refrigerator where its temperature can go far below 32°F (as low as −10°F depending on the freezer) and still remain a liquid. This mixture will cool the sample in about half the time as conventional plain cold water.

We like to keep two buckets in the freezer, that way one is always at minimum temperature. Obviously over the course of a year with thousands of samples, the time savings can be enormous.
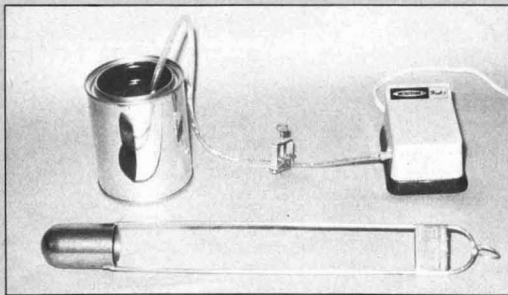
Figure 1

Figure 2

I am sure many companies use this system, but I am personally aware that many have never even thought about it. Anything the lab can do to speed production is always greatly appreciated by those in production, which leads to better cooperation between production and quality control.

Dip Tank Stability Checker

STANLEY HARSHFIELD

United Paint Co.
P.O. Box 9037
Memphis, TN 38109

An important property of a dip tank coating is its stability during use. Open dip tanks are subject to constant agitation and aeration, caused by parts being immersed and withdrawn. The paint can increase in viscosity or develop a foam, resulting in thick films and/or surface irregularities.

To compare the suitability of a freshly charged dip tank with one that has been in service for an extended length of time, it is necessary to simulate the effects of solvent evaporation polymerization, and air entrapment. This can be done by the use of an inexpensive electric fish tank aerator (*Figure* 1), available in pet shops. The plastic tube supplied may be immersed directly into the paint, or if desired, a glass tip may be inserted into the end of the tube for paints containing strong solvents. The air flow may be regulated with a simple adjustable hose clamp. Viscosity obtained before and after a 24-hour exposure will frequently indicate which of two formulations is more stable. It is not advisable to attempt to use a single pump to simultaneously compare two formulations through a "T" fitting, because a viscosity increase in one paint will result in a disproportionate amount of air to be bubbled through the other paint. It is better to run separate tests on successive days, or to use two pumps if two formulations are to be compared.
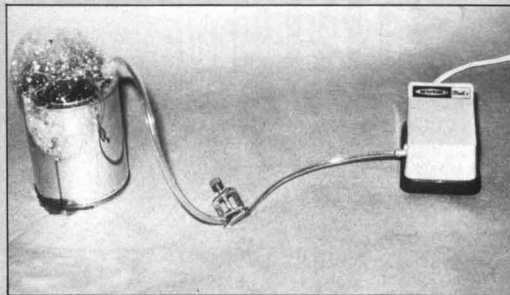
This method will also pinpoint a formula that is likely to foam (*Figure* 2) or entrap air during the dipping process. In this way, a formula may be tested in simulated service conditions, and will eliminate the need for corrective additives to be on hand during a customer trial.

Variable Film Thickness Bird Film Applicator

HAROLD H. GOSLEN

Gilman Paint & Varnish Co.
P.O. Box 1257
Chattanooga, TN 37402

For many years, people in the paint industry have used drawdown bars (Bird Film Applicators) of various spacings to apply paint on black and white hiding power charts. Then, a visual check would be done to see if the paint hid at three mils wet, four mils wet, etc.

We have been able to save a lot of time

Figure 3

and hiding charts by using a Multirange Drawdown Bar six inches long, ranging from zero to six mils. (The actual measurement at the .006 end is .012 inches clearance.)

We make one pulldown, judge visually where it hides and measure the distance in inches. This is equivalent to the mils at which the paint hides (*Figure* 3).

They no longer make drawdown bars like this. However, you can buy a .006 to .006 drawdown bar and have a local machine shop machine one end to a zero clearance.

For critical comparison testing, a side by side drawdown with a uniform clearance bar is the most critical.

Thermometer Holder

JOHN C. BALLARD

Kurfees Paint Co.
201 E. Market St.
Louisville, KY 40502

In the various areas of our plant and in our laboratory, we use several types of thermometers to measure premix, mill pastes, thindown slurries, and finished paint samples. Metal, dial thermometers are used mostly in our plant. These are very easily knocked over or they roll onto the floor. In the plant we also use a magnet thermometer with a wire coil. In the laboratory we use a glass thermometer.

We have found that by placing the thermometers in a gallon or a quart can of spherical particle size sand, they can be held upright at a standard temperature, reducing breakage and keeping the temperature of the thermometer constant. The stationary position of the thermometer makes for easy access and the can of sand is quite stable. Also, it is not necessary to wipe off the thermometers. A quart can can easily store four to six thermometers.

Breakage was reduced by approximately 75%.

Basic Lead Silicochromate
Is Still a Staple of Anticorrosion Formulations

Douglas N. Nash
NL Industries, Incorporated*

Introduction

From the adverse publicity over lead in paints during the past two decades, one might suppose that lead-based anticorrosion coatings would be as extinct as the dinosaurs. Yet, the fact is that coatings containing lead continue to be favorites of state DOT's for the protection of bridges, viaducts, and other public structures. Lead-based anticorrosion formulations are more than holding their own for coating jobs such as on water tanks, fuel storage tanks, buildings, harborside structures, ships, barges, and automobiles.

While the earliest lead coatings for protecting steel against corrosion contained the still widely used red lead, more and more manufacturers are offering alternatives containing a pigment with substantially improved performance and cost characteristics—basic lead silicochromate.

Basic lead silicochromate is no newcomer to the anticorrosion scene. The pigment was first developed in the late 1940's and was first marketed in the early 1950's. Its continued popularity compared to red lead is due in large measure to the benefits it provides:

- Better corrosion resistance in paints and coatings.
- Substantially lower density, cutting down the weight of the formulation.

- Compatibility with a wider range of vehicles.
- Lower tint strength, making its color easy to mask with a wider variety of coloring pigments.
- Less extensive surface preparation needed than with paints containing other pigments.
- Versatility enough for use in primers and top coats, often allowing elimination of one extra paint coat. This saves money for users.
- Less toxicity than red lead.

Fusion Feature

The unique feature of basic lead silicochromate compared to red lead is the fusion of the active material—lead chromate and lead silicate—onto a lightweight and inert silica core. This results in a pigment of lower density than red lead, but with undiminished anticorrosion properties. Therefore, a lower amount of basic lead silicochromate can be used in the end product to achieve the same PVC as red lead coatings.

Basic lead silicochromate has a well established track record. There are, in fact, literally thousands of grade separations on rural stretches of interstate highways on which basic lead silicochromate/alkyd coatings continue to protect metal structures satisfactorily after 15 or 20 years.

Primers containing basic lead silicochromate have been specified by the U.S. government since the early 1960's. (The federal spec. designation is TT-P-615.) In

addition, the highway departments of more than 30 states, several Canadian provinces, as well as numerous toll and authority organizations, cities, and counties specify basic lead silicochromate as primers, under coats and finishes. Besides specification paints, basic lead silicochromate has found its way into formulations used in such environments as general chemical and industrial, salt- and freshwater immersion, shop and maintenance, and marine atmospheres. They are also used in electro-deposited coatings.

Pigment Compatibility

One reason for the extensive list of end users of basic lead silicochromate is the pigment's compatibility with an unusually broad array of binders. These include linseed oil, fish oil, alkyd, phenolic urethane, vinyl and epoxy resins, as well as chlorinated rubber, water–soluble resins, and petroleum resins. This versatility gives basic lead silicochromate a major advantage over red lead, which is compatible with a far smaller range of vehicles.

Another plus for basic lead silicochromate—its low tint strength—permits its natural orange color to be easily masked by mixing it with titanium dioxide or with any light fast colored pigments to produce a variety of colors. Therefore, basic lead silicochromate coatings now come in such hues as green, blue, yellow, gray, brown, and beige. Aside from providing attractive finishes,
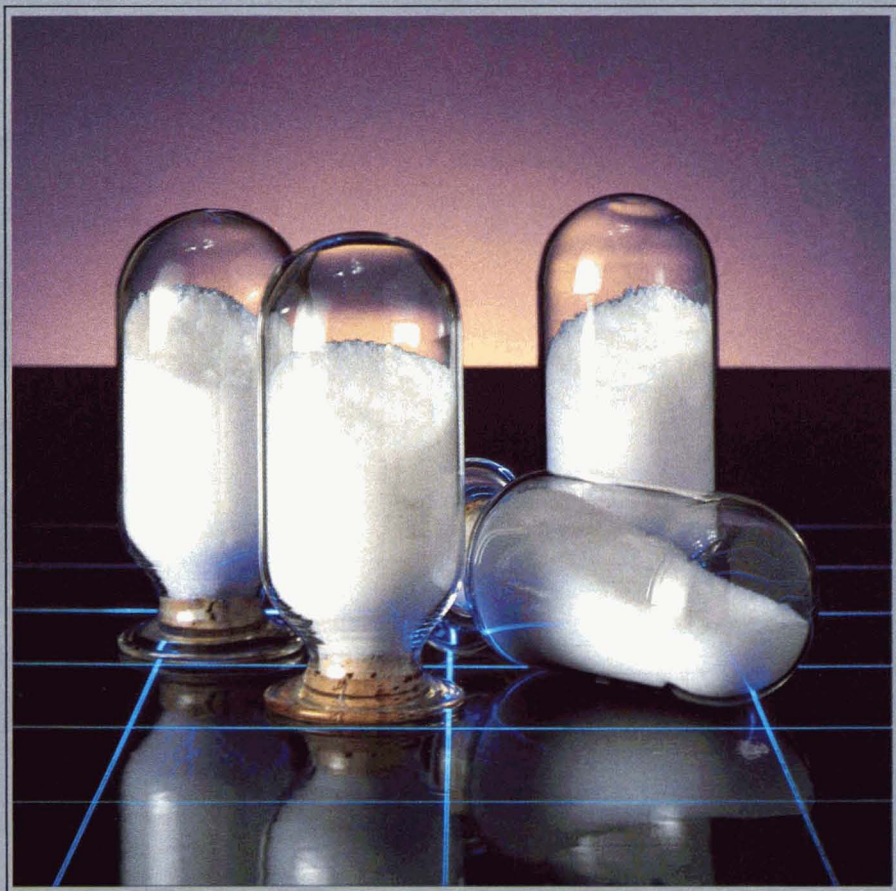
these colored coatings also protect against corrosion. By contrast, the orange-brown color of red lead is extremely difficult to mask in a formulation; and any colored finishes painted over a red lead primer generally do not protect against corrosion as well.

Auxiliary Pigments

A great many auxiliary pigments have been used with basic lead silicochromate over the years. The most common ones are siliceous red iron oxide, pure (98%) iron oxide, titanium dioxide, graphite, barium sulfate, magnesium silicate, mica and aluminum flake. In Europe, barium sulfate has been a particularly useful additive because it augments the useful PVC protective range of basic lead silicochromate coatings. In one test of alkyd primers for structural steel containing a constant amount of basic lead silicochromate, addition of barium sulfate increased the PVC from 45% to 55% without reducing corrosion protection.

Aluminum pigment is another handy additive to basic lead silicochromate formulations, particularly in marine primers, because the two pigments mutually reinforce each other's anticorrosive properties. In general, however, addition of other anticorrosive pigments—zinc chromate, for example—does not markedly improve the overall corrosion resistance of basic lead silicochromate.

Formulation

The formulation of basic lead silicochromate paints and coatings is, of course, largely an empirical process. But certain basic guidelines are apparent. To obtain the best performance over the wide range of surface conditions on which basic lead silicochromate coatings are to be applied, it is useful to blend oils and resins rather than use a single vehicle.

The particular mix of vehicle ingredients and pigments in a formulation is critical to the performance of the product. For example, alkyd resin can be added to an acrylic latex to aid surface wetting characteristics and make the paint less permeable. And alkyd or epoxy esters can be added to a formulation to reduce permeability without changing the wettability.

Regardless of specific recipes used by formulators, basic lead silicochromate coatings provide a long list of benefits to the end user. Superior corrosion protection relative to red lead coatings is one example. A 1971 study[1] measured the corrosion resistance of slightly rusted mill scale carrying specimens after they were coated with single pigment shop primers of standard grade basic lead silicochromate, and with primers of red lead.

The panels were exposed in a rural environment at an angle of 45°, facing south. After 69 months, the red lead panels retained only one-tenth the corrosion resistance of their counterparts coated with basic lead silicochromate. Part of the failure of red lead was attributed by carbonation (chalking) and eventual erosion of the coating. By contrast basic lead silicochromate showed high resistance of chalking.[1]

Another important benefit is the more "forgiving" nature of basic lead silicochromate coatings relative to competitors such as zinc rich or vinyl systems. Basic lead silicochromate coatings may be applied to steel surfaces that still retain a bit of rust or dirt, whereas zinc rich and vinyl coatings require surfaces that are scrupulously clean. In the latter case, the cleaning often required is a white metal blast, a process that is not only costly, but is frequently impossible on intricate bridge structures. Cleaning of the metal surface is still recommended with basic lead silicochromate paints. It is usually possible to get away with a lower cost process such as hand cleaning with a wire brush, or a commercial metal blast, which may still leave some residue on the metal.

Another benefit of basic lead silicochromate coatings is their adaptability to top coats. The outer coats, aside from providing coloring and weathering stability, can also offer corrosion protection over weak spots in the underlying primer. Red lead, on the other hand, is generally used only in the primer. The subsequent coats, typically based on aluminum, do not assure corrosion protection over weak spots in the primer. To compensate for this, extra top coats have to be added. By contrast, use of basic lead silicochromate saves money by allowing the use of fewer coats of paint.

Toxicity

Another point worth noting is the lower level of toxicity of basic lead silicochromate. All lead compounds can be toxic. But only about one quarter of the weight of basic lead silicochromate can be considered potentially dangerous; whereas all the weight of red lead is a toxic agent.

Despite a movement in OSHA to restrict the use of lead-based coatings in the workplace, the agency has tacitly agreed with the National Paints and Coatings Association's contention that,

for some purposes, there really is no substitute for lead. For example, in response to a NPCA request, OSHA recently cancelled plans to require the use of elaborate engineering controls over application of lead-based paints in shipyards, on bridges, and in auto body shops. NPCA has argued that such controls are expensive and impractical.

For the immediate future, at least, OSHA intends to enforce the old requirement that workers applying lead-based paints in these environments wear respirators. (Engineering controls will still be required, however, for the use of lead-based paints in other industrial environments, but OSHA last January granted employers a 2-1/2 year extension of the deadline for compliance.)

Search for Substitutes

The fact that there really are no adequate substitutes for lead in some applications has been borne out in several studies. For example, a project initiated about five years ago by the Steel Structural Painting Council, Pittsburgh, PA, looked for non-lead, non-chromate, and water-borne paints and coatings that would presumably be safer than lead in the environment. Phase I of the study, known as PACE (Performance of Alternative Coatings in the Environment), has been completed. With the exception of zinc rich coating systems and those with vinyl resins, none of the coatings examined in Phase I approached the performance and longevity of the two coatings that were used as standards: TT-P-615 (basic lead silicochromate) and TT-P-86 (red lead).

Phase II of the PACE project, now under way, will evaluate the most promising coatings studied in Phase I. It will also take a closer look at the water-borne systems.

Although the PACE study has so far failed to come up with a safe and effective replacement for lead-based coatings in their current applications, efforts along these lines are continuing. Meanwhile, lead-based systems are still very much around. And, in the case of basic lead silicochromate, the reason for this persistence is clear: there is no getting away from the pigment's superior cost and performance record established over the past three decades.

References

(1) Bates, R.P., *J. Oil Colour Chemists' Assoc.*, 54, No. 10, 952.

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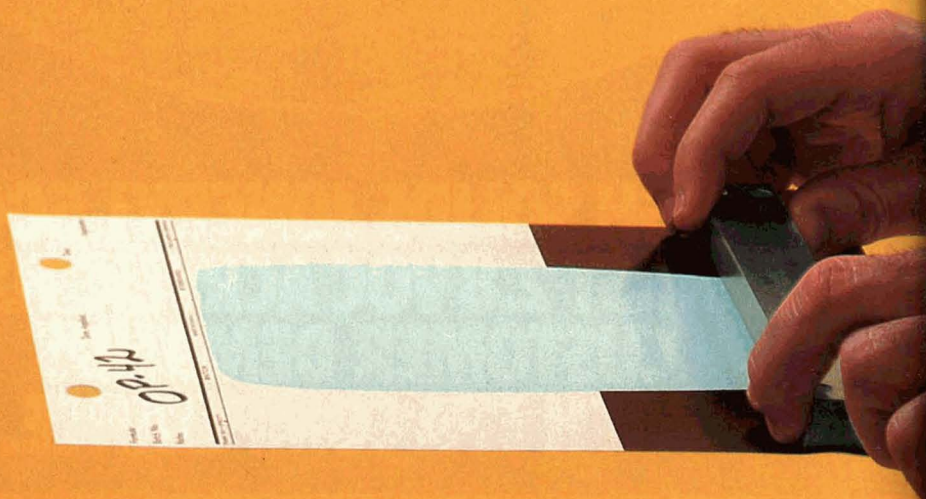
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OP-42

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Committee Activities

Sponsorship of Coatings Courses Highlights Society Educational Committees Reports

This annual update reflects the continuing effort of Constituent Societies of the Federation to provide meaningful educational programs, and is published to keep members informed of such activities, both underway and planned, and to stimulate interest in formulating new programs both locally and nationally.

Baltimore

Continuing coatings course at Essex Community College . . . Hosted seminar in February on productivity and communications . . . Considering sponsorship of course on paint additives for coming year.

Chicago

Jointly sponsored, with local PCA, a February management seminar on "Managing People in the Eighties". . . Annual two-day SYMCO seminar was held April 19–20; theme this year was "Emerging Technology, A Close Encounter". . . Developing coatings course for Fall of '83 . . . Sent representative to Career Day, sponsored by Chicago Association of Technological Societies, at which high school guidance counsellors have opportunity to hear of various career opportunities. . . Increasing scholarship contributions to North Dakota State University, University of Missouri—Rolla, and Eastern Michigan University. . . Again made an award (check and plaque) to student with winning exhibit at Science Fair, presented at Annual Awards Night Banquet.

C-D-I-C

Continuing sponsorship of educational presentations as part of meeting programming. Current year included presentations on estate planning and tax advice, safety programs, personal home computers, and nuclear power. . . Planning to invite local high school science teachers and selected students to attend monthly meetings.

Cleveland

Annual Technical Conference, was held April 26–28, at NASA's Lewis Research Center; 16 speakers addressed various aspects of coatings technology. . . Considering programs to promote awareness of industry among students, i.e., establishing student chapters at local universities, inviting students to attend

monthly Society meetings, offering reduced student registration fees for annual technical conference.

Detroit

Continuing sponsorship of coatings courses on polymer chemistry, surface coatings technology, principles of color matching, fundamentals of automotive paint systems, and a coatings lab course . . . Success of recent one-day Industrial Paint program has prompted plans to offer follow-up presentation on Paint Defects. . . Working with Eastern Michigan University on research project . . . Will again hold Education Night, to which local high school science teachers are invited. . . Annual FOCUS symposium was held May 4; this year's event was titled, "Rust Never Sleeps,". . . Plan to continue two-hour adult education lectures on automotive refinishing basics, as well as to compile automotive terms for next edition of *Paint/Coatings Dictionary.*

Kansas City

Main activity is cooperating in local Science Fair; committee works with elementary and high school teachers and students in selecting suitable projects, attending the Fair, and judging entries in the coatings competition. Three winning students are awarded savings bonds, and their school science departments receive a check in matching amount; these are presented at Society monthly meeting, at which winning exhibits are displayed . . . Continuing appropriation to scholarship fund at University of Missouri—Rolla.

Los Angeles

Paint technology course at Cal State University—Los Angeles had 19 students enrolled; formal set of notes being developed for student use, to supplement lectures . . . Committee has been formed to compile a text for use in teaching introductory paint technology course . . . Continuing scholarship program for stu-

dents planning to major in coatings technology . . . Sponsoring summer employment program for qualified science or engineering undergraduates . . . Continuing to assist in maintenance of coatings section at City of Commerce Library.

Louisville

Planning Fall course on "Use of Small Computer in the Laboratory," in conjunction with University of Louisville. In future semesters, courses are planned on: Resins; Formulations; Quality Control; Water-Borne Coatings; and Instrumental Analysis . . . Sponsored one-day symposium in March on Coatings Plant Safety; topics featured were employee safety programs, fire safety, handling solvents, medical programs, and OSHA compliance, capped by a tour of local duPont plant . . . Continuing cooperative project work with University of Louisville on treating of coatings wastes.

Montreal

Sponsoring bilingual course on coatings technology, for individuals entering the industry . . . Planning color course for presentation next year . . . Conducting survey of membership to determine needs and interests for educational courses.

New England

Support and publicize coatings science and technology courses at University of Lowell; these can be taken at undergraduate or graduate level . . . Joint effort with Technical Committee being considered for development of video tape instructional program for lab technicians . . . Planning scholarship program for "best paper" contest; winners would present papers at Society meeting.

New York

Two courses being sponsored jointly with local PCA: Understanding Basics of Coatings, and Lab Course for Paint Technicians. First is 30-week, two-semester course at New York City Technical College, designed for persons who have no previous courses in chemistry as well as those technologists with some prior training—course qualifies for two continuing education units; second is 12-week course, designed for new techni-

cians in the industry and given at the laboratory of the lecturer's employer . . . Continuing efforts to establish training program for local high school science teachers, to instruct vocational/technical school students in coatings technology . . . Simplified Organic Chemistry for Coatings Technologists, given every other year, will be merged into Understanding Basics of Coatings, which will be expanded into a two-year, four-semester curriculum.

Philadelphia

Sponsored ACS Short Course in Organic Coatings, under direction of Dr. Seymore Hochberg; 12 participants from member companies enrolled in the 16-hour comprehensive course . . . Assisting in efforts to develop project work on High Solids Solvent Diffusion, in conjunction with Philadelphia College of Science & Textiles . . . Membership survey, currently underway, will help provide input as to future educational activities.

Piedmont

Polymer course successfully established at University of North Carolina at Greensboro. Total of 30 students were enrolled for initial term. The 15-week course is subsidized by Society . . . Promoting local industry support for summer co-op program for coatings students.

Pittsburgh

Continuing participation in Regional School Science and Engineering Fair; provide cash awards for winning projects on coatings development, manufacture, or use . . . Among future programs being considered are: mini-course (four to six weeks) on coatings technology; sponsor industry speakers for local student groups; develop, and provide, participants for booth at local home show to promote paint quality.

Rocky Mountain

Planning establishment of training course to improve knowledge at customer/salesperson interface, thereby enhancing industry image; course would be open to anyone interested in coatings, with initial emphasis on those who are first line of information for the customer. Curriculum would be open-ended, to be expanded as students become more sophisticated. As program develops, it might be made available to broader local segment, as community service . . . Considering compilation of scholarships available to students interested in coatings as a career; when sufficient information is gathered,

Society will take part in job/career fairs, using data to help promote coatings careers.

Southern

Continuing support of scholarship program at University of Southern Mississippi, as well as co-sponsoring annual Water-Borne and Higher Solids Symposium there . . . USM students invited to take part in programming for Society Annual Meeting.

St. Louis

Two main areas of focus are sponsoring Education Night and participating in

Science Fair. Industry and academic speakers take part in the Education Night program to which local high school science teachers are invited, to acquaint them with coatings career opportunities . . . Four cash prizes awarded to elementary and secondary school students (two winners in each category) in this year's Science Fair, for best exhibits dealing with paints or polymers.

Toronto

Both basic and advanced coatings technology courses are sponsored in conjunction with George Brown College, available on either evenings or Saturdays. Certificates are presented to those completing the courses.

Scholarships and Career Promotion Among Topics Discussed at Education Committee Meeting

Sixteen Society Educational Committee representatives met recently in Detroit with members of the Federation Educational Steering Committee to discuss current programs and future activities at both the local and national level. (For summary of reports on Society educational activities, see pages 116–117.)

Major items of discussion focused on scholarships, promoting career opportunities, and developing cooperative research programs with local colleges.

An increasing number of Societies have implemented scholarship programs, providing substantial funding in support of schools with coatings technology curricula, and these were discussed at length.

The group also reviewed the current Federation scholarship program and endorsed the procedures for administering the program, as well as the schools supported and the level of funding awarded for the 1983–84 academic year: University of Southern Mississippi—$6,000; North Dakota State University—$6,000; University of Detroit—$2,000; Kent State University—$2,000; University of Missouri (Rolla)—$1,000; and Eastern Michigan University—$1,000.

Representatives of two of the schools receiving scholarship funding attended the meeting—Dr. Adolph Damusas, University of Detroit, and Dr. John Graham, Eastern Michigan University. They expressed their appreciation for the scholarship support and briefly discussed the polymers and coatings curriculum at their respective institutions.

Meanwhile, the continuing shortage of graduates entering the industry indicates the need to pursue ways and means to promote and publicize career opportunities in coatings. A Federation Ad Hoc Committee, appointed to study the matter, reported its findings at last Fall's Board meeting and confirmed that the industry suffers from an "image" problem; it recommended a number of promotional efforts to help foster a greater awareness of, and interest in, the industry by high school students, their guidance counsellors and science teachers. As a follow-up, the Educational Committee was requested to provide supplementary input on how best to communicate the coatings industry story.

Initial discussions dealt with determining the approximate number of new people required each year to meet industry needs, and it was agreed that this could be accommodated by conducting a survey of each Constituent Society as to job opportunities for chemists and technicians. Development of a career promotion slide/tape presentation, sup-

port literature, and appropriate publicity were among the suggested subsequent efforts to follow the survey determination.

The group agreed the industry has an interesting story to tell, that emphasis should be on communicating that story to students at an early stage in their career planning, and that developing contact with teachers and guidance counsellors is an important part of this effort.

And promotion of career opportunities at the college level should not be overlooked. Such efforts could be aided by a program proposed by the Paint Research Institute Trustees to encourage Society cooperative research programs with schools in their area. The Trustees recently approved a matching funds program to assist in subsidizing costs involved in such efforts.

The cooperative programs could offer a number of benefits. Society members would profit from awareness of neighboring academic sources; the industry would benefit from an increased interest by educators and students in its activities; colleges participating would receive funding, practical objectives for research, and, potentially, expanded job opportunities for their graduates; and PRI would enjoy broadened and improved relationships with those participating in the program.

To date, three Societies have expressed interest and are readying specific proposals for presentation to PRI.

Presiding at the meeting was Steering Committee Chairman Jim Hoeck, Reliance Universal, Inc. (Louisville). Members of the Steering Committee attending were: Don Brody, Skeist Laboratories, Inc. (New York); John Gordon, University of Missouri—Rolla (St. Louis); and Carl Knauss, Kent State University (Cleveland).

Society Educational Committee representatives attending were: Lee Kamasinski, Lenmar, Inc. (Baltimore); Ray Cziczo, Glidden Coatings & Resins Div., SCM Corp. (Chicago); Lloyd Reindl, Inland Div., General Motors Corp. (C-D-I-C); Richard Eley, Glidden Coatings & Resins Div., SCM Corp. (Cleveland); Daniel Melnyk, Chrysler Corp. (Detroit); Charles Hann, Douglas Paint Co. (Kansas City); James Hall, Sinclair Paint Co. (Los Angeles); Walter Kolanitch, Sherwin-Williams Canada, Inc. (Montreal); Kevin Mulkern, Samuel Cabot, Inc. (New England); Jeff Kaye, Maas & Waldstein Co. (New York); William Fabiny, Sermetel, Inc. (Philadelphia); Pat Dawson, Drakenfeld Colors (Pittsburgh); Steve Crouse, Kwal Paints,

Inc. (Rocky Mountain); Susan Bailey, Marsh Stencil & Machine Co. (St. Louis); Ken Haagenson, Buckman Laboratories, Inc. (Southern); and Kurt Weitz, Indusmin Ltd. (Toronto).

Also attending were: Steve Vargo, Argo Paint & Chemical Co., President of Detroit Society; Roy Brown, FSCT Technical Advisor; and Tom Kocis, FSCT Director of Field Services.

Publications Group to Revise JCT Guide for Authors

The Guide for Authors which is published in every January issue of the JCT will be improved by the Publications Committee of the Federation. This was decided at the recent annual meeting of the committee with the JCT Editorial Review Board.

In attendance at the meeting were: *Chairman* Dr. Thomas J. Miranda, Whirlpool Corp.; *Vice-Chairman* Paul R. Guevin, Jr., AMF Corp.; Dr. Gordon P. Bierwagen, Sherwin-Williams Co.; Dr. Darlene Brezinski, DeSoto, Inc.; Dr. Ray A. Dickie, Ford Motor Co.; Dr. Ross Dowbenko, PPG Industries, Inc.; Dr. F. Louis Floyd, Glidden Coatings & Resins Div. of SCM Corp.; H. Earl Hill, Lord Corp.; Dr. Loren W. Hill, Monsanto Co.; Dr. Joseph V. Koleske, Union Carbide Corp.; Sidney Lauren, Coatings Research Group, Inc.; Hugh Lowrey, Perry & Derrick Co., Inc.; Dr. Maurice J. McDowell, duPont Co.; Dr. Percy E. Pierce, PPG Industries, Inc.; Helen Skowronska, Consultant; Dr. Peter R. Sperry, Rohm and Haas Co.; and Dr. Joseph A. Vasta, duPont Co.

Also attending were JCT staff members Lorraine Ledford, Jane Paluda, and Robert Ziegler.

The revision of the guide will be undertaken by a committee headed by Mr. Guevin.

In other actions, the committee decided to:

(1) Contact Society Technical Committees and encourage them to submit progress reports of their activities/projects to the JCT for publication.

(2) Commend Richard D. Gross, JCT Art Director for the quality and effectiveness of the JCT front covers which he designs.

(3) Commend Herbert E. Hillman for continuing to write the "Humbug From Hillman" column which he initiated in September 1980.

Society Educational Committee Representatives Meet with FSCT Educational Steering Committee

Diversity of Project Work Undertaken By Society Technical Committees

These reports are published as part of the Federation's efforts to inform members of technical activities, both underway and planned, to stimulate interest in formulating new programs at the local level.

Birmingham

Two subcommittees currently active; one is compiling historical data on the history of the paint industry in the industrial midlands of England, the other is attempting a correlation of the Color-Matching Aptitude Test Set . . . Developing series of special lectures and programs on such topics as powder coatings, labeling, and operation of a coatings lab . . . Continuing marketing efforts on behalf of Federation publications and training aids in the UK and Europe . . . Developing "publicity board" to publicize Club's achievements to management; this would be displayed on premises of companies who provide membership support.

Chicago

Actively pursuing four projects. Renewable Resources—Current emphasis is on commercially available materials based on renewable resources in U.S. (e.g., starch, seed, fish and by-product oils, meat by-products, and wood products). Hope to present paper at 1983 Annual Meeting . . . Oven Stability of Latex Paints—Literature search has resulted in formulation of a screening experiment to actually test the correlation of the results from oven stability tests with storage tests. The experimental design will be a round-robin type, involving 10 different formulated test paints and 10 different testers, each testing three different paints . . . Cooperating in formulating and testing program with Mildew Consortium . . . Natural Biocides—Two naturally occurring biocidal compounds which are being considered for use in exterior exposure studies are thujaplacin and pisantin. Literature study indicates that both compounds possess anti-fungal and anti-bacterial activity.

C-D-I-C

Conducting round-robin test of sample paints, evaluating ASTM D-2369 for determining VOC. Plan to report findings in paper being prepared for 1983 Annual Meeting . . . Study underway to investigate can corrosion and method to predict it. Considering project to study use of liquid wedge to test for adhesion of polymers.

Cleveland

Subcommittee working on causes of blistering, to determine what film properties influence this and how composition changes affect film properties. System being studied is a thermoplastic industrial emulsion . . . Cooperating in formulating and testing program with Mildew Consortium.

Dallas

Nearing completion on study of important factors for industrial finishers considering sprayable water-borne coatings. Paints have been prepared and tests are being conducted. Points considered in handling or changing from a solvent-thinned enamel to water-thinnable one include: coating application problems; substrate problem areas; curing problems; vehicle storage, handling, and equipment problems; and current and future market projections for low-solvent and water-thinned baking product finishes. Hope to present paper at 1983 Annual Meeting.

Golden Gate

Project work continuing on comparing preparative drying conditions and the salt spray performance for a water-borne alkyd primer, alkyd modified latex primer, and a solvent-based alkyd primer; these then may be related to existing exterior exposure. Hope to have results in time for 1983 Annual Meeting . . . Preparing paper for submission to JCT on earlier project on study of exterior exposure of a water-borne primer and surface prep vs. two solvent-borne systems . . . Cooperating in formulating and testing program with Mildew Consortium . . . Considering project on water mark and tannin staining with water-borne coatings.
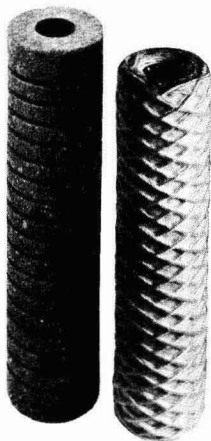
Houston

Project work being revived, utilizing talents of some of Society's "senior citizens." Current work is on photo-recording and interpretation of paint particles in flight during spray. Planning paper for presentation at 1983 Annual Meeting.

Kansas City

Continuing study to obtain comparative data on weathering performance of a representative sampling of exterior flat finishing systems on a selection of currently available hardboard siding materials. Exposure data and hardboard information compiled in 2½-year study being organized for presentation at 1983 Annual Meeting . . . Cooperating in Mildew Consortium formulating/testing program.

Los Angeles

Reports on three projects being readied for presentation at 1983 Annual Meeting. Heat Stability vs. Ambient Aging—A number of paint systems, mostly water-based, have been put through battery of tests to determine

stability. Questionnaire will be developed to survey predictive skills of Society members as to what correlative factor might be from a particular system, then compared with actual result for each system tested . . . Practical Rheology Study of Latex Gloss Enamel—designed to find latex formula giving properties most similar to a conventional alkyd gloss enamels . . . Water-Based Aerosols—Study of new propellants, atomization problems, paint stability, pattern defects, and new aerosol can design . . . Project also underway on Color Changes with Change of Viewing Angle; this is a follow-up to earlier work, to determine certain color abnormalities in coatings . . . Cooperating in formulating and testing program with Mildew Consortium.

Louisville

Have completed literature survey on corrosion-inhibitive pigments and analyzing data to determine type of study to pursue . . . Continuing work on waste disposal through pyrolysis, reported on at 1981 and 1982 Annual Meetings; next step, hopefully, is to scale up to pilot

plant evaluation . . . Cosponsored with Educational Committee a symposium on Safety in the Laboratory, and plan similar joint sponsorship of course on computers at University of Louisville . . . Collected and shipped paint chips supporting mildew growth for evaluation by Mildew Consortium, and cooperating with the Consortium in formulating and testing program.

Montreal

Three projects currently underway. Sedimentation of Suspensions—Study of causes of settling, methods of controlling it and available instrumentation to assess settling, as well as introducing a method of predicting settling using Brookfield Viscometer and a programmable calculator; results will be described in paper to be presented at 1983 Annual Meeting . . . Identification and Effect of Color Acceptance Problem in High-Gloss Alkyds—Measure of the degree of the problem will be investigated via colorimetric standards, established by optimizing dispersion of colorants in tints; variables to be studied are effects of wetting agents (in grind), rheological additives, and post additives. The high-

gloss alkyd system was chosen because of its simplicity as related to controlling variables . . . Adhesion of Semi Gloss Latex Paint to Alkyd Substrates—Test method has been studied with various substrates, testing times and different labs, used as variables, and a designed experiment undertaken to evaluate formulation variables; the most significant variables will be identified and additional work carried out.

New England

Continuing study on Design of Aqueous Coatings for Corrosion Protection of Steel. Part IV includes optimization of PVC, effect of extender pigments on corrosion, and addition of non-lead, non-chrome anti-corrosive pigments . . . Report of Part III, Effect of Surfactants, presented at 1982 Annual Meeting, appeared in August 1983 JCT . . . Developing cooperative research program with University of Lowell; will submit proposal to PRI for matching funds support . . . Considering joint effort with Education Committee to produce Basic Lab Technician Course for video taping . . . Looking into feasibility of marketing coatings formulation program developed for use with a personal computer . . . Cooperating in formulating and testing program with Mildew Consortium.

New York

Survey on utilization of computers in the coatings industry has been completed and report will be presented at 1983 Annual Meeting; includes information, hardware, software (manufacturing, laboratory, specialized process, and office procedures) . . . Cooperating in formulating and testing program with Mildew Consortium.

Northwestern

Two projects currently being pursued: Slightly Soluble Anti-Corrosive Pigments (lead and zinc chromate free), and Additives to Help Prevent Flooding and Floating in Phthalo Blue and Titanium Dioxide Pigmented Systems.

Philadelphia

Sponsored May seminar on Substrate Technology . . . Arrhenius Plot Study, initiated some time ago and then tabled, has been renewed; extensive literature search has been initiated and mathe-

matical models studied with help of computer; objective is to determine plot techniques as applicable to time/temperature variables from lab studies vs. control tests . . . High Solids Solvent Diffusion—proposed study, to be carried out in conjunction with Philadelphia College of Textile and Science, aimed at determining the solvent ratio as it leaves the film, and how solvents affect the flash point; proposal being prepared for submission to PRI for matching funds support . . . HLB System for Water-Dispersible Resins—Objective is to classify water-dispersible resins according to HLB classification system. Standard surfactant solutions have been prepared . . . A/V program planned on microbiological audit for a paint plant, as well as one on color . . . Pictorial Standards subcommittee has prepared a new standard on Impact Resistance for Federation's Pictorial Standards of Coatings Defects manual . . . Jointly sponsored with Education Committee an ACS course on Advanced Coatings Technology, under direction of Dr. Seymore Hochberg.

Piedmont

Committee being formed to develop furniture refinishing terms for inclusion in next edition of *Paint/Coatings Dictionary.*

Rocky Mountain

Project underway on Contribution of Find Particle Size Extenders to Opacity: The Titanium Extender or Spacer Concept, Myth or Fact? Goal is to study number of fine particle size extenders in latex flats, well below and above the CPVC, using electron microscope; also can study particle morphology, contribution of pigment shapes to light scattering, as well as determine possibilities of deagglomerated titanium in suitable dispersed systems.

Southern

Work preceeding on second brochure on Know Paint Quality Before You Buy, this one on Latex Exterior Flat Paints. It is designed to educate the consumer on quality criteria and an awareness of the limitations of lower-priced products . . . Cooperating in formulating and testing program with Mildew Consortium.

Toronto

Two projects currently being pursued. The Effect of Glycol Ethers on the Dry Retention of Water-Reducible Alkyds is an investigation of the degradation of glycol ethers and its effect on dry retention; report is planned for 1983 Annual Meeting.

Elections

C-D-I-C

Active

CHOUNG, HUN R.—DAP Inc., Dayton, OH.
GRAHAM, DAVID W.—Lilly Industrial Coatings, Indianapolis, IN.
HOLTZAPFEL, P. J.—Ashland Oil Co., Ashland, KY.
LOHFF, RUEDIGER R.—Fischer Ind. Coatings, Cincinnati, OH.
MCKAY, GRETCHEN L.—Texo Corp., Cincinnati.
POWERS, JOHN W.—Ball Corp., Muncie, IN.

Associate

BAKER, JOHN C.—DuPont Co., Milford, OH.
HARRISON, E. BARRY—Eastman Chemical Products, Loveland, OH.

CLEVELAND

Associate

ROWDER, ALAN G.—Sun Chemical Corp., Medina, OH.

GOLDEN GATE

Active

BORGFELDT, MERTON J.—Eureka Chemical Co., South San Francisco, CA.
BROWN, BARRY DAVID—Datak West, Sparks, NV.
DEPETRIS, STEPHEN S.—Flecto Co., Inc., Oakland, CA.
FILSON, DAVID—The Clorox Co., Pleasanton, CA.
GILBERT, DAN—V I P Enterprises, Inc., Hayward, CA.
RICE, KENNETH K.—Rice Consulting, Walnut Creek, CA.
SHAW, PATRICIA—Davlin Paint Co., Berkeley, CA.

Associate

BACKLIN, ROBERT—Nuodex Inc., Buena Park, CA.

HOUSTON

Active

SCHOPPE, I. RICHARD—Dow Chemical U.S.A., Freeport, TX.
SIMMONS, NORMAN K.—Devoe & Raynolds Co., Inc., Houston, TX.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD; Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA). Section Secretary—FRANK GERHARDT, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224.

BIRMINGHAM (First Thursday—Westbourne Site, Edgbaston). D. H. CLEMENT, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ. England.

CHICAGO (First Monday—meeting sites in various suburban locations). FRED FOOTE, U.S. Gypsum Co., 700 N. Rte. 45, Libertyville, IL 60048.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). BILL M. HOLLIFIELD, Perry & Derrick Co., Inc., P.O. Box 12049, Cincinnati, OH 45212.

CLEVELAND (Third Thursday—meeting sites vary). ROBERT THOMAS, PPG Industries, Inc., Chemical Div., P.O. Box 31, Barberton, OH 44203.

DALLAS (Thursday following second Wednesday—Steak & Ale Restaurant). T. LEON EVERETT, Dan-Tex Paint & Ctg. Mfg., Inc., P.O. Box 18045, Dallas, TX 75218.

DETROIT (Fourth Tuesday—meeting sites vary). 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 the Sea Wolf at Jack London Square, San Francisco). KENDALL E. TRAUTWEIN, Sherwin-Williams Co., P.O. Box 23505, 1450 Sherwin Ave., Oakland, CA 94623.

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—Howard Johnson's, Louisville, KY). W. JERRY MORRIS, Celanese Plastics & Specialties Co., P.O. Box 99038, Jeffersontown, KY 40299.

MEXICO (Fourth Thursday—meeting sites vary). 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—Fantasia Restaurant, Cambridge). 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—Boulevard Cafe, Golden Valley, 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—Valle's Steak House). 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—Gusthaus Ridgeview, Lakewood, 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). R.H. STEVENSON, Tenneco Chems., Canada Ltd., 235 Orenda Rd., Bramalea, Ont., Can., L6T 1E6.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). DONALD M. KRESSIN, Spencer Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 14225.

Associate

KING, CHAM J.—Southern Clay Products, Spring, TX.

NEW ENGLAND

Associate

GELLER, DAVID B.—Pacific Scientific, Danville, NJ.

NEW YORK

Active

BAIRD, EDWARD—United States Testing Co., Hoboken, NJ.
BERNDLMAIER, RUDY—R.T. Vanderbilt Co., Norwalk, CT.

Associate

MASSEY, EUGENE S.—Hercules Inc., Wilmington, DE.
WILLIS, STAN—Jansan Chemical Co., Port Murray, NJ.
WYLLIE, KENNETH F.—Sherwin-Williams, Co., Cincinnati, OH.

NORTHWESTERN

Active

LOES, TIMOTHY G.—Coatings Research Inc., St. Paul, MN.
SULLIVAN, ROGER—Loes Enterprises Inc., St. Paul.

SOUTHERN

Active

COCHRAN, WILLIAM TOM—Bruning Paint Co., Pompano, FL.
GREENE, M.A.—Union Carbide Corp., Tucker, GA.
HARRELL, HENRY E.—AZS Corp., Lakeland, FL.
SCHARFETTER, GREGORY—W.M. Barr, Memphis, TN.
THOMPSON, BETTIE—Devoe & Raynolds Co., Tampa, FL.
WHEAT, THOMAS J.—AVX Ceramics, Myrtle Beach, SC.

Associate

BILLINGSLEY, MARK C.—Pentagon Plastics, Inc., West Palm Beach, FL.
COX, WILSON—Chem Central, Orlando, FL.
DURAN, GABRIEL—Mat Chemicals, Inc., Hialeah, FL.
HENSCHEN, ROZ—Burks, Inc., Atlanta, GA.
KRAMER, KIMBERLY M.—Mat Chemicals, Inc., Hialeah.
RENWICK, JOEL—Mat Chemicals, Inc., Hialeah.

Meetings/Education

Macbeth Color Course Schedule Set for 1983–84 Session

Macbeth, A Division of Kollmorgen Corp., Newburgh, NY, has announced the 1983–1984 schedule for its color science seminar, "The Fundamentals of Color." Fourteen presentations have been scheduled this year.

The seminar presents a solid foundation in basic color science, providing attendees with a clear understanding of the problems and solutions associated with the measurement, specification, and control of color.

The first day of the seminar is devoted to lectures and practical demonstrations in the use of visual standards, controlled lighting and viewing conditions, and color measurement instrumentation. The second day gives attendees the oppor-

tunity to apply color science theory in a "real world" hands-on session using lighting control and instrumentation.

The fee for the first day is $125 (U.S.) per person and includes reference material, workbook, and lunch; there is no charge for the second day.

As in the past, attendees are urged to bring color samples of any materials with which they are having problems, for discussion with the technical experts who will be on hand to provide solutions.

The locations and dates for the new schedule are as follows: (1983) Toronto, Ont., Canada, September 13–14; Minneapolis, MN, September 15–16; Cleveland, OH, October 25–26; Cherry Hill, NJ, October 27–28; Grand Rapids, MI,

November 17–18; Boston, MA, December 8–9; (1984) Dallas, TX, January 10–11; Charlotte, NC, January 12–13; Atlanta, GA, February 14–15; Los Angeles, CA, February 16–17; Seattle, WA, April 5–6; Cherry Hill, NJ, May 8–9; Chicago, IL, May 10–11; and San Francisco, CA, June 7–8.

In addition to the foregoing schedule, arrangements can be made for an in-house presentation of "The Fundamentals of Color."

Additional information and application forms can be obtained from Jeanne M. Dolan, Macbeth, Little Britain Rd., P.O. Box 950, Newburgh, NY 12550.

HunterLab Announces Appearance Science Workshops

HunterLab, Reston, VA, is sponsoring a 2½ day "Appearance Science Workshop" on October 26–28, February 8–10, and May 16–18 in Reston.

Designed to provide appearance technologists and other interested individuals with a comprehensive understanding of color and appearance science, the workshops will cover both theory and practical application in the description, specification, and measurement of appearance.

The sessions are comprised of lectures, discussions, practical demonstrations, and a hands-on instrument application session. Color theory, colorimetry, specimen handling, and spectrophotometry are explained. Lectures also include the effects of geometric attributes, including gloss and haze. During *the instrument application session*, participants will be able to work with trained instructors and will have the opportunity to measure samples on any of the HunterLab instruments. Participants are encouraged to bring their own samples.

The course fee of $350 includes all course material.

For additional information, contact Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA. 22090.

Color Science Seminars Sponsored by HunterLab

HunterLab is presenting its series of two-day seminars on color from October through June 1984 in various cities throughout the United States. These seminars are introductory courses which provide appearance technologists with a basic knowledge of color science. They feature both theory and practice in the description, specification, and measurement of color, and are of interest to personnel in the paint, textile, paper, plastics, food, pharmaceutical, metal, and cosmetic industries.

The opening day of the program is devoted to lectures, discussions, and practical demonstrations. Featured in the second day are a brief summary, specific application studies, and an instrument laboratory session where staff members will be on hand to discuss particular product requirements.

The seminar schedule is as follows:

Oct. 18–19	Newark, NJ
Nov. 2–3	Detroit, MI
Nov. .16–17	Dallas, TX
Jan. 18–19	Seattle, WA
Jan. 25–26	Atlanta, GA
Mar. 21–22	San Francisco, CA
Apr. 4–5	Kansas City, MO
Apr. 18–19	Chicago, IL
May 9–10	Charlotte, NC
May 23–24	Cincinnati, OH
June 6–7	Boston, MA

The seminar fee of $145 includes lunches, reference material, and a copy of R.S. Hunter's "The Measurement of Appearance."

Additional information and application forms can be obtained from Ms. H. Moore, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090.

'Electrocoat/84' Scheduled for April 24–25, Cincinnati, OH

"Electrocoat/84", a comprehensive technical conference on the electrodeposition of paint which is sponsored by *Products Finishing* Magazine, will be held April 24–25 at the Drawbridge Inn, Greater Cincinnati Airport Area, OH.

The conference will present the latest information of interest to current and prospective users of electrocoating. More than 20 papers are planned.

Highlighting the program will be presentations by Dr. Thomas J. Miranda, of Whirlpool Corp., "Is Electrocoating for You?;" Howard Ellerhorst, of Chemical Marketing Services, "Electrocoating Now and in the Future;" Ron Brownlee, of Borg-Warner Central Environmental Systems, "Maintenance and Operation of an Electrocoating Line;" Jack Winters, of Jackson Manufacturing, "The Electrocoat Operator: Finding, Training, and Keeping;" William Springer, of Ford Motor Co., "Closing the Loop with Reverse Osmosis;" and Dr. George Brewer, a leading authority on the electrodeposition of paint, "Bulk Electrocoating."

There will also be presentations on design parameters, operating parameters, high-film build electrocoats, one-coat electrocoats, clear electrocoats, and more.

For additional information and complete program when available, contact Electrocoat/84, *Products Finishing* Magazine, 6600 Clough Pike, Cincinnati, OH 45244.

Chicago Coatings Course Starts October 5 in Evanston

The Joint Education Committee of the Chicago Society for Coatings Technology and Chicago Paint & Coatings Association will sponsor a course in coatings technology at Kendall College, Evanston, IL, beginning October 5 and each Wednesday evening through March 21. Classes will run from 6:00 to 9:00 pm.

The course is designed for the chemical, technical, and sales personnel of the coatings industry, and will focus on such subjects as raw materials, formulation, quality control, application methods, problem solving, and environmental considerations.

Instructors will be personnel drawn from industry who are experts in the various subjects.

Class size will be limited to 50 students. Fee for the course is $325.

For more information, or to register, please contact Ron Kleinlein, Sherwin-Williams Co., 10909 S. Cottage Grove Ave., Chicago, IL.

People

Milton A. Glaser, industry consultant from Glencoe, IL, will present a paper on behalf of the Federation at the XVII Congress of FATIPEC in Lugano, Switzerland, during the week of September 23, 1984. Mr. Glaser, a Past-President of the Federation, will speak on "Barriers to Innovation: the R&D/Production Interface."

Progress Paint Manufacturing Co., Louisville, KY, has announced the promotion of Nick Lanning to Vice-President of Research and Development. He will direct new product development and laboratory research for both the Industrial Coatings Div. and Progress' Trade Sales, which include Gray-Seal Paint products. An eight-year employee of the firm, Mr. Lanning previously served as Technical Director. Mr. Lanning is a Past-President of the Louisville Society and is a member of the LPCA.

Howard B. Burchett has become a partner in Abner Hood, Inc., a warehousing distributor for industrial chemical manufacturers. He will assume the duties of Vice-President and Secretary. Mr. Burchett was previously associated with Thompson Hayward Chemical Co. as Kansas City Regional Sales Manager for its Industrial Chemicals Div. He is a past-president of the Kansas City Paint and Coatings Association and is a member of the Kansas City Society.

Pratt & Lambert, Inc. has announced a management realignment at its Southern Coatings & Chemicals Co., Sumter, SC. Austin E. Floyd has been named President and Chief Operating Officer. He succeeds Ross S. McKenzie who was appointed Vice-Chairman. R.D. Stevens, Jr. will continue as Chairman. Also, elected to the position of Vice-President were James T. Robertson, James C. Stevens, and R. Scott McKenzie, Jr. Messrs. Floyd, Robertson, Stevens, and McKenzie, Jr. are members of the Southern Society.

Elected 1983–84 President of the Buffalo Paint & Coatings Association was Dennis P. Jordan, of L.V. Loomis Chemical Co., Ltd., Buffalo, NY. Mr. Jordan is a Western New York Society member.
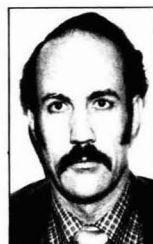

M.A. Glaser   N. Lanning   R. Ferguson, Jr.   B.C. Henshaw

The appointment of Russell Ferguson, Jr. to the newly created position of Technical Director has been announced by Silberline Manufacturing Co., Inc., Lansford, PA. Prior to his appointment, Mr. Ferguson served as Assistant Director, Technical Service and Product Application. Mr. Ferguson is a Philadelphia Society member.

Carl C. Howson was presented the 50-year membership pin at the Los Angeles Society meeting of June 8. Clarence Meyers, Good Fellowship Chairman for many years, was elected to Honorary Membership. Outstanding service awards were presented to: Past-President Fred Croad, of Tnemec Co.; George Kashmer, of Dunn-Edwards Corp.; Past-President Robert Koperek, of Mobile Chemical Co.; John Plant, of John K. Bice & Co.; Tony Rumfola, of TCR Industries; Past-President Al Seneker, of Ameron, Inc.; Dick Sutherland, of E.T. Horn Co.; Geneva Wells, of H.M. Royal, Inc.; and Past-President Gerald H. West, of Devoe Marine Coatings.

Franklin M. de Beers, Jr. has announced the formation of De Beers Enterprises, Glenview, IL, an export sales agency representing selected American manufacturers of high performance industrial coatings, selling primarily in the Far East. Mr. de Beers retired recently from Midland Div., The Dexter Corp., Waukegan, IL. He is a Chicago Society member.

Albert Kloos has been appointed Vice-President—Technical and Manufacturing for Devoe Marine Coatings Co., a division of Grow Group, Inc. Mr. Kloos is based at the firm's Louisville, KY headquarters. He is a member of the Louisville Society.

Bruce C. Henshaw has been named Corporate Director of Research and Development at McCloskey Varnish Co. He will oversee development of new water-based products and will supervise technical affairs, maintain product quality, and generate improvements. Mr. Henshaw is a member of the Pacific Northwest Society.

Lewis P. Larson, well-known instructor of the Paint Short Courses at the University of Missouri-Rolla and former Manager of the Pigment Sales Service Laboratories of American Zinc Sales Co., is retiring from the paint industry after a career of 53 years.

Mr. Larson began his career with American Zinc following graduation from the North Dakota State University at Fargo with a B.S. Degree from the, then, Paint Chemistry Dept.

He is a Past-President of the C-D-I-C Society where he has been a member since 1952. He is a former member of the Federation Board of Directors, and was a member of the Federation's Liaison, APJ Awards, and Public Relations Committees.

Mr. Larson is a long time lecturer and author on the uses of zinc oxide in paints and has been an instructor for the Paint Short Courses at Rolla for over seven years. Mr. Larson will reside in Columbus, OH.

Richard G. Fuchs has been promoted to the newly created position of Executive Vice-President for The Enterprise Companies, Wheeling, IL. Prior to his appointment, Mr. Fuchs served as Senior Vice-President of Sales and Marketing. He will broaden his responsibilities in addition to retaining his administration of sales and marketing.

Harold Weinberg, Vice-President of Administration for KOMAC Paint, Inc., Denver, Co., has announced his retirement. Mr. Weinberg, active in the paint and decorating business for over 50 years, began his career in 1930 with Economy Wallpaper Co., Boston, MA. He later served as Director of Wallcovering Sales for Morris Paint, St. Louis, MO, and then joined Frontier Paint, Denver. In 1951, Mr. Weinberg was associated with KWAL Paint, Denver, as a Salesman and over the next 30 years served in many positions, including President and Chairman of the Board.

Mr. Weinberg is a past-president of the Rocky Mountain Paint and Coatings Association and has served as vice-president of the Southwest Region of the National Paint and Coatings Association, and as a board member of the NPCA.

Lord Aberconway has announced his retirement as Chairman of English China Clays P.L.C. effective February 1984. Alan Dalton, currently Deputy Chairman of ECC and Managing Director of the Clay Div., will become Chairman. Dr. Stanley Dennison will succeed Mr. Dalton as Managing Director of the Clay Div.

C.R.A. Senior, Vice-President and General Manager of Baker Perkins' Plastics Equipment Div., has retired after a 21-year career with the company. Replacing Mr. Senior is Daniel K. Pearce who previously served as Manager of Engineering for the division.

Mark A. McCusker has been promoted to Technical Sales Representative for the Coatings, Radiation Curing and Photography Group in the Additives Department of CIBA-GEIGY Corp., Ardsley, NY.

Ronald L. Jones has been promoted to Regional Sales Manager of the Midwest Region for the Solvents and Coatings Materials Div. of Union Carbide Corp. Mr. Jones will also serve as Field Sales Manager and is based in Chicago, IL.

Color Communications Group of Macbeth, Div. of Kollmorgen Corp., has appointed John W. Peterson Applications Specialist. Mr. Peterson will be based in Newburgh, NY.

Michael S. Tsangeos has joined Donald McKay Smith Inc., Lakewood, OH, as a Salesman. Prior to joining the firm, Mr. Tsangeos had been associated with The Sherwin-Williams Co., Cleveland, OH, as a Formulator/Chemist.

Gary S. Greenwood has been named a Sales Representative for the Southwest region of the Georgia-Pacific Corp. Commodity Chemicals Div.

The O'Brien Corp., South San Francisco, CA, has promoted John Beater to the position of Director of Corporate Purchasing.

George Christman has been appointed Vice-President of Sales and Marketing for Custom Tapes, Inc., Harwood Heights, IL.

Ronald Van Mynen has been named Corporate Director of Environmental Affairs for Union Carbide Corp., Danbury, CT. He replaces Fred M. Charles, who has retired after 33 years of service with the firm.

PPG Industries, Inc., Pittsburgh, PA, has announced several new appointments in its corporate and chemical environmental affairs departments. Dr. Zeb G. Bell, Jr. has been named Director of Health Administration and Toxicology in the corporate environmental affairs department. J.C. Delgado has been promoted to Manager of Industrial Health and Hygiene for chemicals, and Dr. A. Philip Leber has been appointed Manager of Industrial Toxicology—chemicals.

Ippolito A. (Tony) Magnelli has been named the Northeast District Sales Manager for the Coatings Div. of Ferro Corp., Cleveland, OH.

Mark E. Fischer has joined the Pigments Department of the Hilton-Davis Chemical Group as a Sales Representative in the Midwest Region.

Jon D. Owen has been named Director of International Marketing for The O'Brien Corp., S. San Francisco, CA. Prior to his appointment, Mr. Owen served as Western Region Sales Manager for the firm's Napko Industrial/Marine Div.

Joining O'Brien as Trade Sales Laboratory Group Leader is **Joseph R. Scienski.** Based at the company's Midwestern Region headquarters in South Bend, IN, Mr. Scienski will be responsible for providing information and technical support.

Paul B. Raeder, an executive of Benjamin Moore & Co., Newark, NJ, has been elected President of the New York Paint & Coatings Association.

Wayne B. LeGrande has been appointed Vice-President, General Manager, and Technical Director of Seaguard Corp., Portsmouth, VA. Prior to joining Seaguard, Mr. LeGrande was a Supervisory Chemist for the Corrosion Control Branch at the Norfolk Naval Shipyard. He is a Baltimore Society member.

Bruce F. Dies has been named Vice-President of Marketing for Seymour of Sycamore, Inc., Sycamore, IL. Previously, Mr. Dies served as Vice-President of the firm's automotive division.

Frank A. Flynn has been named Market Area Manager for the Northwest Region by Sartomer, Co., an operating unit of the ARCO Chemical Division of Atlantic Richfield Co. Headquartered in West Chester, PA, Mr. Flynn will service chemical and end-use industry customers throughout New England and New York.

Dr. John C. Cehen, Professor of Chemical Engineering at Lehigh University, Bethlehem, PA, has been named Chairman of the Department of Chemical Engineering at the University.

He succeeds **Dr. Leonard A. Wenzel,** who will return to full-time teaching and research activities, following 21 years as Department Chairman. Dr. Wenzel will be on academic leave during 1983–84 academic year with the Aeromatics Technology Division of the Exxon Chemical Co., Baytown, TX.

Neville Chemical Co., Pittsburgh, PA, has announced the retirement of **Donald L. Marsh** and **William T. Cloake,** District Sales Managers in the Eastern and Western regions, respectively. Mr. Marsh, a 47-year Neville employee, began his career with the firm in its Production Department. Later he served as Laboratory Technician, Technical Sales Representative, and in 1967 acheived his most recent position. Mr. Cloake began his career with the firm in 1951 as a Chemist in its Quality Control Laboratory. Later, Mr. Cloake served in the Technical Service Department, in the position of Technical Sales Representative, and in the Southwestern Sales District. In 1964, he was promoted to his present position. Messrs. Marsh and Cloake are members of the New York and Los Angeles Societies, respectively.

Succeeding Mr. Cloake in the position of Western District Sales Manager is **Gail D. Crew.** Prior to his promotion, Mr. Crew served as Technical Sales Representative in the Western Division. Replacing Mr. Crew as Technical Sales Representative is **John H. Rogeri, Jr.** Previously, Mr. Rogeri was Technical Sales Representative in the firm's Solvents and Chemicals Div. Messrs. Crew and Rogeri are members of the Los Angeles and Pittsburgh Societies, respectively.

Raymond G. Downey has been appointed Director of International Sales, Pigments and Extenders Group for the Minerals and Chemicals Div., Engelhard Corp., Menlo Park, NJ.

Paint America Manufacturing Co., a division of Paint America Co., Dayton, OH, has announced the promotion of **Norman J. Huber, Jr.** to the position of Plant Manager. Prior to his appointment, Mr. Huber served as Director of Operations of the Manufacturing Division.

Eastman Chemical Products, New York, NY, has announced the promotion of **R. Barnes Parsons** to Assistant Director of its Chemicals Field Marketing Div. Prior to his appointment, Mr. Parsons had served as Regional Sales Manager, Health Services Markets Div.

Ron Farrell of SCM-Glidden was re-elected President of The Powder Coatings Institute for 1983–84 at the Institute's second annual meeting. Other officers elected were: Vice-President/Secretary—**Robert Korecki,** of the Polymer Corp., and Treasurer—**Charles Johnson,** of Ferro Corp.

As part of a general realignment of its Coatings Technical Marketing Department of the Plastics and Coatings Div., Mobay Chemical Corp. has announced the following new appointments. **John L. Williams** has been named Market Manager of the Industrial Coatings Group, responsible for products and technologies that serve factory finishing applications. Prior to his appointment, Dr. Williams served as Manager, Coatings—Application Development. He is a member of the Pittsburgh Society.

Also appointed to the position of Market Manager were **Jack J. Bracco** and **Terry A. Bell.** Mr. Bracco will serve in the Maintenance and Construction Group and Mr. Bell will be responsible for the Transportation Coatings Group.

Brian Olson has been appointed Midwest Region Sales Manager for NYCO, Willsboro, NY. Prior to his appointment, Mr. Olson was associated with the Valspar Corp. as a Technical Sales Representative.

Rust-Oleum Corp., Vernon Hills, IL, has named **Rene L. Durr** as International Petroleum Industry Manager. Prior to joining the firm, Mr. Durr was associated with Napko/O'Brien Corp.

The Polymer Science Department of the University of Southern Mississippi has announced the appointment of **Dr. Charles E. Hoyle** to its faculty. Prior to his appointment, Dr. Hoyle was employed with Armstrong World Industries.

Whittaker Corp. has announced the promotion of **Edward A. Adkins** to Vice-President and General Manager of its Decatur Coatings Div., Decatur, AL. Prior to his promotion, Mr. Adkins had been General Manager of the division.

Gholi Darehshori has been named an Assistant Vice-President of Cargill's Chemical Division. Mr. Darehshori will continue general supervision of resin products production, marketing, and sales.

Obituary

Frank Hallett, 67, who had been associated with the Pigments Department of Ciba-Geigy Corp. until his retirement last year, died in June. At his retirement, Mr. Hallett concluded a pigment sales career that spanned more than 33 years. He had first been associated with the Imperial Color & Chemical Corp. when he began his career in 1949.

Mr. Hallett held memberships in the Baltimore, New England, Philadelphia, and Piedmont coatings organizations.

Bazel H. Secord, former Technical Director of Superior Sealants, Inc., Atlanta, GA, died June 13. Mr. Secord, 83, retired from Superior in 1973 after 52 years of service to the paint industry.

In 1921, Mr. Secord began his career as a paint chemist with Forman Ford & Co. He joined Minnesota Paints in 1943 as a paint chemist and served as chief chemist in several of their plants.

Mr. Secord was an Honorary Member of the Southern Society, and was a past member of the Chicago and Northwestern Societies. In 1971, the National Paint & Coatings Association presented Mr. Secord with its Gold Membership Certificate, making him a member of the Fifty Year Club. Mr. Secord was also a member of ASTM.

Robert Toothill, Technical Director of United Gilsonite Laboratories, Scranton, PA, died July 3. Mr. Toothill had been employed by UGL for more than 20 years and had been involved in the coatings industry for 46 years.

Mr. Toothill was a member of the Philadelphia Society and served as its President in 1959. He received the George B. Heckel Award from the Federation at its 1961 Annual Meeting for the Society's presentation, "A Five Year Exposure Study of Emulsion Paints." In 1964, Mr. Toothill was presented with the Philadelphia Society's Liberty Bell Award and in 1980 with its Technical Award.

Mr. Toothill was a member of the Gallows Birds. He also developed a federal specification for ready-mixed waterproofing masonry paint.

A native of Philadelphia, Mr. Toothill graduated from Drexel Institute of Technology in chemical engineering.

Calvin H. Marcus, Sr., 82, President and Chairman of the Board of Edward H. Marcus Paint Co., Louisville, KY, died July 6. Mr. Marcus was the third generation of the family to head the 130-year-old company. He was a past-president of the Louisville Paint and Coatings Association (1941–42) and was a member of the 50-Year Club of NPCA.

Literature

Magnesium Compounds

A new 12-page brochure explains the wide variety of performance characteristics and applications of specialty magnesium products. Compounds of magnesium oxide, magnesium hydroxide, and magnesium carbonate are described and their applications in the paint industry are detailed. Brochure No. 30-11 is available from Merck/Calgon Corp., 11 Central Ave., Teterboro, NJ 07608.

Diols

Two new and unique lines of diols that give improved performance when substituted for polyester and polyether glycols in polyurethane systems are introduced in recent literature. For additional information, contact PPG Industries, Inc., 10 North, One Gateway Center, Pittsburgh, PA 15272.

Spray Nozzles

A new design of airless spray nozzles developed to improve the atomization and film build control of many types of coatings, including high solids and waterbornes, is discussed in recent literature. Contact Nordson Corp., 555 Jackson St., P.O. Box 151, Amherst, OH 44001 for information.

Filter Plates

New filter plates, which offer a new concept in filter press plate design which reduces operating and maintenance costs while increasing production capacities, are featured in literature. Application uses, which include the paint and coatings industry and the printing and ink industries are detailed. For information, Restel-Goodman-America, Inc., 75 Spruce St., Paterson, NJ 07509.

Pigments

Two new quinacridone red pigments which can provide higher gloss and better surface aesthetics in red finishes are detailed in recently published literature. "Monastral" magenta, a yellow shade, and "Monastral" red, an intense red quinacridone pigment, are discussed as are their application uses and benefits. Write Du Pont Co., Wilmington, DE 19898 for additional information.

Tensile Tester

Information is available on a horizontal tensile tester with digital display of force and crosshead movements, which is designed to test all low- or medium-extension materials. For literature, write Monsanto Polymer Products Co., 800 N. Lindbergh Blvd., St. Louis, MO 63167.

'World Surface Coating Abstracts'

Pergamon Press has announced the availability of the Paint Research Association's database entitled, "World Surface Coating Abstracts." Pergamon is offering the database on-line through its subsidiary, Pergamon-InfoLine in London. The printed version of the database, together with two related publications, "Hazards, Pollution and Legislation" and "Paint Titles," are also distributed and marketed by Pergamon Press. For additional information, contact Pergamon Press, Maxwell House, Fairview Park, Elmsford, NY 10523, or Headington Hill Hall, Oxford OX3 0BW, England.

Dispensing System

A new computer-controlled low volume dispensing system, designed for laboratory sample preparation and low-volume production applications, is featured in literature. For information, write Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08540.

Spectrophotometer

Literature is available featuring a highly sensitive, microprocessor-driven UV spectrophotometer with digital electronic design for high performance liquid chromatography. Write Du Pont Co., Wilmington, DE 19898 for additional information.

Color System

Information is available on an entry level computerized color measurement and control system that simplifies initial formulation and batch correction tasks and dramatically reduces the installation investment. For literature, contact Macbeth Color Communications, Div. of Kollmorgen Corp., P.O. Box 950, Newburgh, NY 12550.

Decorating Colors

A booklet has been published illustrating 35 new decorating colors for porcelain, earthenware, and bone china. Various application techniques are described. For additional information, contact Degussa AG, Postfach 11 05 33, D-6000 Frankfurt 11, Germany.

Photoiniator

Literature is available announcing a new edition to a photoiniator line. Darocur® 1664, which is particularly suited for applications involving titanium dioxide pigmented systems, is featured. A data sheet and additional information is available from EM Chemicals, Plastics and Coatings Group, 5 Skyline Dr., Hawthorne, NY 10532.

Filter

A new cylindrical polymer filter for thermoplastic processors that can be quickly changed with only a brief line shutdown is being introduced in recent literature. For more information, contact Beringer Co., Inc., P.O. Box 485, Marblehead, MA 01945.

Coatings System

A bulletin describing a new VPC™ high performance polyurethane coatings system is available. Application uses and benefits of the coatings system are listed. For bulletin 1544, write Ashland Chemical Co., Dept. ELB, P.O. Box 2219, Columbus, OH 43216.

Pigment

The physical properties and applications of Meteor® colors, which are high temperature inorganic oxide pigments, are detailed in a new bulletin. Information is provided on the technical coverage of 15 different pigments including their application uses and advantages. Copies of the "Meteor Colors" Chromatechs bulletin are available by contacting, Harshaw Chemical Co., 1945 E. 97th St., Cleveland, OH 44106.

Optical Sensor

Literature announcing the introduction of a reduced area illumination option for a tristimulus colorimeter sensor is now available. Design features of the optical sensor with its integrating sphere and reduced area illumination option are included, as are its capabilities to measure smaller sized samples. For additional information, contact Hunter-Lab, 11495 Sunset Hills Rd., Reston, VA 22090.

Powder Coatings

A new brochure describes the technology and application of powder coating, the new finishing process that is making a major impact in the finishing industry. "Powder Coatings" describes how the technology works, step-by-step coating process, and several application techniques, including automatic systems and robotics. Also noted are product advantages such as superior finish, a full range of colors and textures, exceptional toughness and durability, and resistance to corrosion. The brochure is available from The Powder Coating Institute, 44 Husted Lane, Greenwich, CT 06830.

Bridge Painting

A four-page brochure is available which compares the costs involved in painting bridges. Evaluated are total costs—preparation, paint, and application costs for both poor-wetting inorganic and oil/alkyd coating systems. A key feature of the literature is a graph that provides typical cost per square foot for five specific painting systems. For a copy of the brochure, contact NL Chemicals/NL Industries, Inc., P.O. Box 700, Hightstown, NJ 08520.

Coating System

A new architectural coating system which provides a textured surface on properly pretreated aluminum panels and extrusions is the subject of recently published literature. Features and recommended uses of the coating system, which is based on a fluropolymer resin, are detailed. For information, contact PPG Industries, One PPG Place, Pittsburgh, PA 15272.
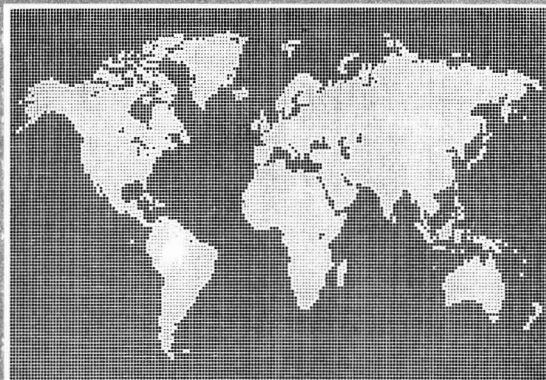
Dispersion

A new aqueous urethane dispersion that can impart high gloss and exceptional resistance to both impact and waterspotting is detailed in recently published literature. Formulations, applications, and properties of the dispersion are noted. Further information can be obtained from Witco Chemical Corp., Organics Div., 1000 Convery Blvd., Perth Amboy, NJ 08861.

Column

Information is available featuring a rapid analysis, small particle (3 micron) column for high performance liquid chromatography. For further information, contact DuPont Co., Liquid Chromatography, Concord Plaza, Quillen Bldg., Wilmington, DE 19898.

Fine Particle Clay

A new high brightness, excellent whiteness, fine particle size hydrous clay for use in both solvent or water systems is featured in recently issued literature. Recommended uses are listed which include its application for improving hiding and gloss in paints. Information is available from Burgess Pigment Co., P.O. Box 4146, Macon, GA 31208.

Foreign Technology Newsletter

A new weekly abstract newsletter is available from the National Technical Information Service (NTIS). The *Foreign Technology Abstract Newsletter* summarizes and classifies worldwide technical information into 10 subject areas. Compiling technical information from more than 50 countries, the Newsletter covers subjects such as: biomedical technology, engineering, materials sciences, applied physical sciences, and electro and optical technology. For additional information, contact U.S. Dept. of Commerce, NTIS, 5285 Port Royal Rd., Springfield, VA 22161.

Filter Cartridges

A revised six-page brochure on the full line of high-performance fiber glass filter cartridges, including a new high micron product, is available. In addition to describing cartridge construction, the literature points out that the fiber glass filter cartridges are available in comparable micron ratings from ½ to 125. It demonstrates via specific application data how cartridges improve filtration rate, throughput and clarity in water, paint, resins, and chemical applications. Color charts compare throughput, average efficiency, and dirt holding capacities of the resin-bonded fiber glass cartridges with other common cartridges. For a copy of "Manville High Performance Fiber Glass Filter Cartridges" write, Manville Service Center, 1601 23rd St., Denver, CO 80216.

Pump

Literature is available featuring a new pump series for handling abrasive liquids. Standard features and application uses of the pumps are listed. For information, contact Viking Pump Div., Houdaille Industries, Inc., Cedar Falls, IA 50613.

Surfactant

An organic phosphate ester surfactant that exhibits high surface-activity under either acid or alkaline conditions is the subject of new literature. The surfactant's characteristics and application uses are described. For information, contact Witco Chemical Corp., Organics Div., Dept. 1-6, 520 Madison Ave., New York, NY 10022.

Cleaning Oven

Information is available on a new form of heat cleaning oven designed to heat clean parts effectively and economically. Engineering data and literature is available from Armature Coil Equipment, Inc., 4725 Manufacturing Rd., Cleveland, OH 44135.

Balances

Electronic precision balances, which offer ease of operation, are featured in new literature. Features and applications uses of the balances are discussed. For information, contact Mettler Instrument Corp., Box 71, Hightstown, NJ 08520.

Book Review

SOLUTION BEHAVIOR OF SURFACTANTS
Volumes 1 and 2

Published by
American Chemical Society
K. Mittal and E.J. Fendler, Eds.
Washington, DC

Reviewed by
G.P. Bierwagen
The Sherwin Williams Co.
Chicago, IL

These two volumes are the reviewed and edited proceedings of the symposium of the same name held at the 11th Northeast Regional Meeting of the American Chemical Society in Potsdam, NY on June 30–July 3, 1980. The 85 papers in the 1544 pages of these volumes constitute a large compilation of recent studies on surfactants in solution.

The major topic of these two volumes is one which should be of interest to most coating scientists. The behavior of surfactants in solutions is important in many ways in coatings, e.g., in many aspects of pigment dispersion, latex coating storage stability, solubilization of silicone defoamers in water dilutable coatings.

As will all such symposium proceedings, the quality and value of the papers vary greatly, as does the subject matter. A random reading shows some problems [e.g., three misspelled words on one page (p. 226)], some very interesting articles (e.g., the article on the use of surfactant selective electrodes on p. 665), and some articles which seem to offer little to the two volumes (e.g., the articles beginning on pp. 933 and 215).

Since the valuable works of Shinoda (ed.) [*Colloidal Surfactants* (1963)] and Tanford [*The Hydrophobic Effect* (1973)], this area of study has cried for a definitive text to put the many experimental studies and proposed theories in perspective. These two volumes do not satisfy that need. What they offer is a somewhat organized compilation of papers of some of the workers in the area. Very little of the volumes applies directly to coatings science, but some of the studies can be extended with care to coating use (e.g., the articles on pp. 1319, 1333).

At $150 per set, readers might be better served by searching in relevant technical journals for articles on this area of science.

COLOR IN BUSINESS, SCIENCE, AND INDUSTRY

Published by
John Wiley and Sons
D. B. Judd and G. Wyszecki, Eds.
New York, NY

Reviewed by
Patricia Verlodt
Color Communications, Inc.
Chicago, IL

For those involved in everyday contact with color in one form or another will find this book an excellent reference source. For the novice or perhaps the individual that has worked with color successfully but may not understand the mechanics of color, it would prove to be a valuable tool of the trade.

This book contains all the definitions and "catch words" used in the color industry today. It also extensively describes the physical and psychological aspects of color. For those that require more in-depth information as it relates to color science and theory, this volume provides superior insight into that area as well.

I would consider this book a requisite for anyone involved with color from the designer to the manufacturer.

STEEL STRUCTURES PAINTING MANUAL

Published by
Steel Structures Painting Council
Pittsburgh, PA
$98.00

Reviewed by
W. G. Boberski
PPG Industries, Inc.
Springdale, PA

This two volume set is an encyclopedia of methods and materials involved in the painting of steel structures. It provides detailed information on coatings used on structures such as tanks, bridges, pipelines, and ships, and the safe and proper application and end use of these paints.

Volume 1, *Good Painting Practice,* contains chapters describing corrosion theory, surface preparation, pretreatment of steel, primers, paint application, safety, and inspection. It also covers painting practices for use on several types of specific structures and for various types of industrial plants. The information in this volume provides a description of the techniques involved in steel structures painting and compliments the specifications given in Volume 2.

Volume 2, *Systems and Specifications,* compiles the Steel Structures Painting Council surface preparation, painting system, paint and paint application specifications. The specifications in this volume describe many available coatings from both performance and composition viewpoints and provide a good basis for selection of coatings systems.

Although this is an excellent treatise, relatively little information is given regarding repainting over existing coatings. Considering that this is a commonly encountered situation, this would be an area worth expanding in future editions of the manual.

The foreword states that this manual is designed primarily for the paint user. However, the information it contains is of considerable value to all involved in painting: specifiers, contractors, paint manufacturers. It is a reference that should be frequently used by those concerned with the various aspects of painting steel structures.

**COLOR SCIENCE:
CONCEPTS AND METHODS,
QUANTITATIVE DATA
AND FORMULAE
2nd Edition**

Published by
John Wiley and Sons, Inc.
New York, NY

Reviewed by
Ralph Stanziola
Applied Color Systems, Inc.
Princeton, NJ

This book should be readily available to every serious worker in the field of color science. It is an extremely comprehensive source of information including much of the physics, psychophysics, and physiology concerning color. Anyone interested in becoming more familiar with the field will find the extensive references to be invaluable.

The book is slightly more than 50%

larger than the first edition published in 1967. The chapter on colorimetry is a very detailed discussion of basic colorimetric concepts, as well as the CIE Colorimetric System. This chapter contains 37 pages of discussion on the industrially important subject of metamerism. Unfortunately, there is only approximately one page of discussion on the subject of colorant formulation. This edition also contains a chapter on theories and models of color vision which was not covered in the first edition.

SOLIDS AND LIQUIDS CONVEYING SYSTEMS

Published by
Technomic Publishing Co.
Mahesh V. Bhation, Ed.
Westport, CT

Reviewed by
W.B. Callahan
E.I. du Pont de Nemours & Co.,
Philadelphia, PA

If a coatings technologist also wants to be a knowledgeable colorimetrist, then this book should be part of his library. On the other hand, if the coatings technologist is only interested in spectro-photometry and colorimetry as tools to help in the manufacturing of his products, this definitely is not the first book he should read on the subject. While this book discusses the basic tools needed for industrial applications of color science, it does not tell the reader how to use these tools.

This volume provides a working understanding of standard powder conveying and liquid pumping systems. It will be helpful to anyone detailing such designs or dealing with vendors on specific system arrangements. The technical details covered are clearly presented. Although the authors only attempt to cover essential aspects of the subjects, their coverage is broad enough to assist the reader in correcting existing designs or for making design decisions on new systems. It is a useful book for the "hands on" person involved in processing operations.

Coming Events

FEDERATION MEETINGS

(Oct. 12–14)—61st Annual Meeting and 48th Paint Industries' Show. Place Bonaventure, Montreal, Quebec, Canada. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1984

(May 17–18)—Spring Meetings. Society Officers on 17th; Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Oct. 24–26)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

1984

(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."

(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.

(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).

(June 8–9)—Joint Meeting of St. Louis and Kansas City Societies for Coatings Technology. Kansas City, MO.

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

(Sept. 13–16)—"Marine Painting and Surface Preparation" Short Course. Norfolk, VA. (Institute of Applied Technology, P.O. Box 32331, Washington, DC 20007).

(Sept. 15)—"Color Matching Seminar". St. Louis Airport Hilton Inn, St. Louis, MO. (Janis Van Dyke Pacific Scientific, Gardner/Neotec Instrument Div., 2431 Linden Lane, Silver Spring, MD 20910).

(Sept. 17–19)—"Color Control Technology" Seminar sponsored by Applied Color Systems, Inc. Atlantic City, NJ. (ACS, Inc., P.O. Box 5800, Princeton, NJ 08540).

(Sept. 18–20)—Canadian Paint and Coatings Association's 71st Annual Convention. Hyatt Regency Hotel, Montreal, Quebec, Canada. (CPCA, 515 St. Catherine St. W., Suite 825, Montreal, Quebec H3B 1B4, Canada).

(Sept. 27–28)—Pulp Chemicals Association's 10th International Naval Stores Conference and Technical Symposium. Westin Peachtree Plaza Hotel, Atlanta, GA. (Pulp Chemicals Association, 60 E. 42nd St., New York, NY 10165).

(Sept. 27–29)—"Radiation Curing in the Printing and Converting Industry" Workshop sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers (AFP/SME). Hershey Hotel, Philadelphia, PA. (Donna Theisen, Administrator, Technical Activities Dept., SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121).

(Sept. 27–30)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency O'Hare, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Sept. 28–Oct. 1)—Oil & Colour Chemists' Association's Silver Jubilee Convention and Exhibition. Southern Cross Hotel, Melbourne, Australia. (O.C.C.A.A., 1983 Pacific Coatings Convention, C/- Tioxide Australis Pty. Ltd., Private Bag 13, Ascot Vale, Victoria, 3032, Australia).

(Oct. 5–6)—"Finishing of Plastics for Functional and Decorative Purposes" Technical Conference. Decorating Division of the Society of Plastics Engineers. Hyatt Regency, Cherry Hill, NJ. (Ed Stumpek, General Electric, One Plastics Ave., Pittsfield, MA 01201).

(Oct. 6–9)—Ninth Convention of Mexican Paint and Ink Industries. Riviera del Sol Hotel, Ixtapa, Gro., Mexico.

(Oct. 11–13)—"Finishing '83" sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Cincinnati Convention Center, Cincinnati, OH. (Susan Buhr, AFP/SME Administrator, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Oct. 26–28)—"Appearance Science Workshop." Hunter-Lab, Reston, VA. (Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090).

(Oct. 30–Nov. 2)—National Paint & Coatings Association 96th Annual Meeting. Bonaventure Hotel, Los Angeles, CA. (Karen Bradley, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Nov. 2–3)—3rd World Congress on Coatings Systems for Bridges and Steel Structures. Breckenridge Concourse Hotel, St. Louis, MO. (John A. Gordon, Jr., Conference Director, Arts & Sciences, Continuing Education, University of Missouri-Rolla, Rolla, MO. 65401).

(Nov. 2–4)—"Fundamentals of Adhesion: Theory, Practice, and Applications" Short Course. State University of New York, New Paltz, NY. (Dr. Angelos V. Patsis, Chemistry Dept., SUNY, New Paltz, NY 12561).

(Nov. 8–9)—Resins and Pigments Exhibition. Europa Hotel, London, England. (Polymers, Paints & Colour Journal, Queensway House, Redhill, Surrey, RH1 1QS, England).

(Nov. 11–13)—36th National Decorating Products Show. McCormick Place, Chicago, IL. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Dec. 7–8)—"Painting Public Structures: Practices and Economics" Symposium sponsored by the Steel Structures Painting Council. Cocoa Beach, FL. (Dr. Harold Hower, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Dec. 12–14)—"Color Control Technology" Seminar sponsored by Applied Color Systems, Inc. Disneyworld/Epcot Center, FL. (ACS, Inc., P.O. Box 5800, Princeton, NJ 08540).

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(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 Chemicstry, 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).

(Apr.)—"Electrochemical Test Methods of the Protecting Properties of Metals Coatings" Meeting. Genoa, Italy, (Prof. P.L. Bonora, Istituto di Chemica, Fac. Ingegneria—Fiera del Mare Pad. D. 16129 Genova, Italy).

(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. 12–15)—"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).

(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. 23–28)—XVIIth Congress of FATIPEC (Federation of Associations of Technicians in the Paint, Varnish, Lacquer and Printing Ink Industries of Continental Europe). Lugano, Switzerland. (C. Bourgery, Secretary General, FATIPEC, Maison de la Chimie, 28 Rue St.-Dominque, 75 Paris (7), France).

(Oct. 22–24)—National Paint & Coatings Association 97th Annual Meeting. Palmer House, Chicago, IL. (Karen Bradley, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

1985

(June 26–29)—Oil & Colour Chemists' Association's Biennial Conference. Edinburgh, Scotland. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(Sept. 2–4)—Federation of Scandinavian Paint and Varnish Technologists. 11th Congress. SAS Hotel Scandinavia, Oslo, Norway. (Paal Ivan, Nodest Industries A/S, Boks 500, N-3001 Drammen, Norway).

Advertisers Index

'Humbug' from Hillman

Seeing a lone jogger sweating and panting his way along a Vermont road lately, brought memories of some of the sights I have left behind in the big city. Watching joggers is one of them. Up here folks don't spend much time in such aimless pursuits. Mostly, we run to get someplace, like to the dinner table or the outhouse. Once in a while, though, some visitor to our area finds it impossible to slow down and feels the need to be chased by the barking dogs. If the visitor stays more than a week or two, he or she starts finding excuses for relaxing and having a good time.

As I sit on our mountain top and gaze contentedly on the bucolic scene below, I occasionally let my mind slip back to the mornings in New York when I walked along 6th Avenue (New Yorkers don't think of it as the Avenue of Americas). Joggers, runners, and trotters abound, threading their way through the crowds in their scanty attire—the men often bare chested and the women in the briefest of costumes.

As they pass before my memory's eye, I find myself putting these dedicated souls in various categories—viz:

The Waddlers—These are the broad in the beam enthusiasts who create much interest from passersby—from the rear. They sway along, shoulders thrusting one way and buttocks the other, at speeds that vary from a slow walk to that of a window shopper siddling along the avenue. They always seem to be on the verge of exhaustion, yet they always seem a happy and self-satisfied group.

The Liberated—I can vividly see these well endowed females who bounce along in enthusiastic celebration of their liberation from the confinement of the brassiere. Half the fun is watching the pop-eyed pedestrians as their heads swivel to watch the passing athletes. The other half of the fun is watching, pop-eyed, as the joggers approach. This group may be barred from the busy city streets as taxi drivers see the need to hang out their windows to shout encouragement—and other things.

The Dedicated and Determined—These are the men and women who keep their legs going in spite of any obstacles. One memory that flashes back is that of a jogger stopped by an inconsiderate traffic light, running in place looking not unlike a little boy waiting in agony in front of a locked men's room.

The Older Athlete—I must look at this category with something more than casual sympathy. These folks in their senior years of life, seem desperate to catch up with an elusive youth—or rather—an elusive middle age. Apparently, they feel that if they keep moving fast enough, Father Time won't catch up. I must confess to being an occasional participant for a hundred yards or so—feet barely lifted off the floor as I slog along imagining myself leading a marathon of much younger runners. Pretty soon I am caught up by—reality.

Happily, I can usually count on Howard Jerome as one of our most reliable correspondents. He gives us a few more serious thoughts to mull over rather than waste time by thinking of something constructive.

* If it jams—force it. If it breaks it probably needed replacing anyway.
* Leftover nuts never match leftover bolts.
* Them that has—gets.
* Live by the golden rule. Those that have the gold make the rules.
* The longer you stand in line, the greater the likelihood you are standing in the wrong line.
* A penny saved is still a penny.

The mention of a penny reminds me—
Remember when?
You could get a stamp for a penny?
You could bend to pick up a penny?
You could buy penny candy or a cigarette for a penny?
A candy slot machine would take a penny for chocolate that tasted like ex-lax.
If you can remember all the above—apply for Social Security. Your entitled!

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Barbara Lauren has sent these bits from her treasure trove of goodies.

Memo circulated at Virginia Commonwealth University:
"A 'spot-check' of randomly selected VCU directories indicated that a number of the directories contained several blank pages. In view of the foregoing it is suggested that each user review the issued directory and ascertain whether or not the directory is complete. In event the directory is incomplete, user should return the directory to issue source for disposition."
A university staff member supplied this translation: "If your directory has blank pages, send it back."

Headline in a flier from Contact Literacy Center, Lincoln, Nebraska:
LITERACY IS OUR ENEMY . . . TOGETHER WE CAN WIPE IT OUT!

Things are tough all over, as evident in an article in Carleton College's *Career Center Newsletter:*
"Even demand for bachelor engineers will be down," it says.

A memo entitled "Guidelines for Washington and Lee University Payroll Plan" contains the following:
III. WHAT YOU HAVE TO DO TO GET PAID
   A. Faculty (WL)—Do Nothing.

—Herb Hillman

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