

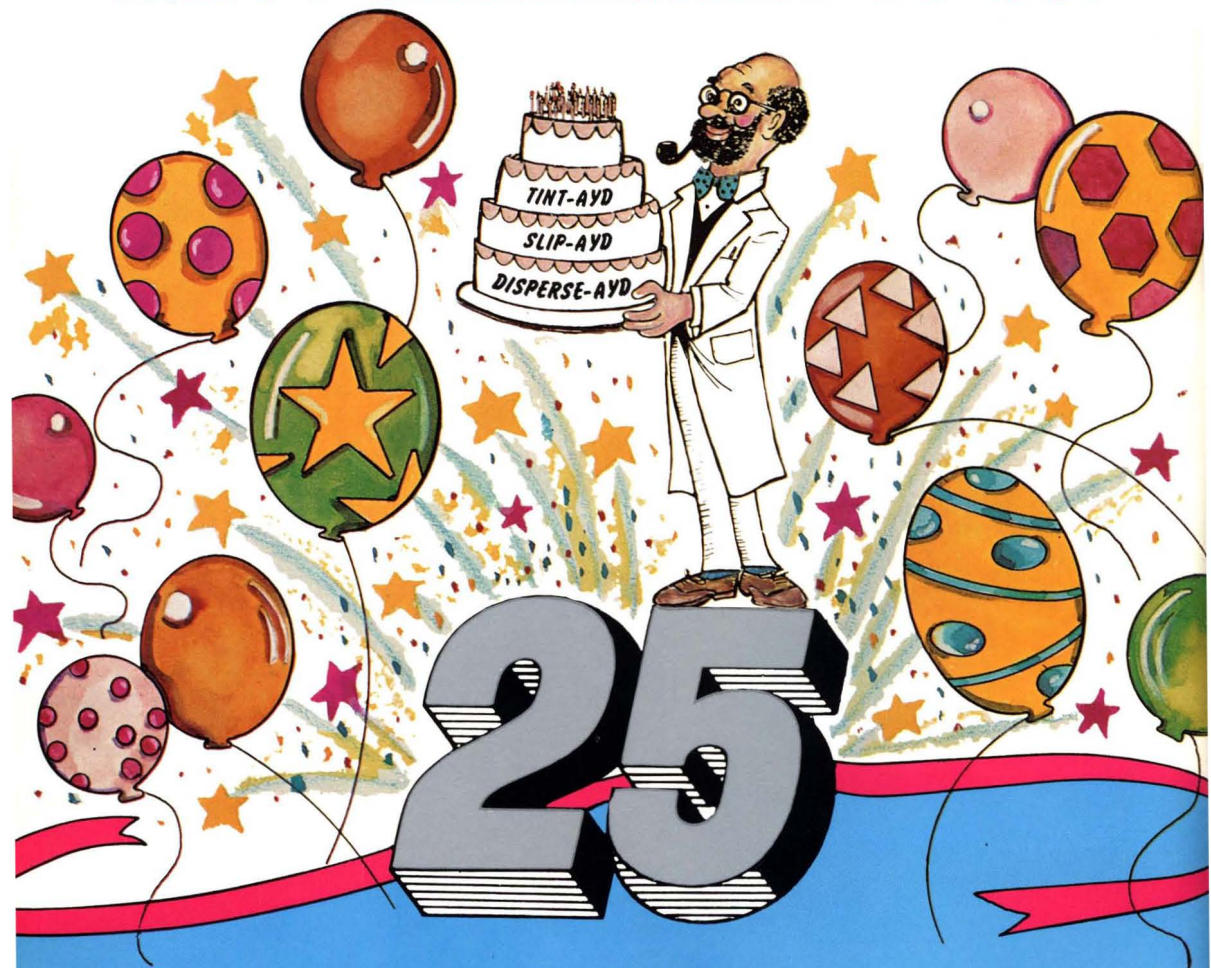
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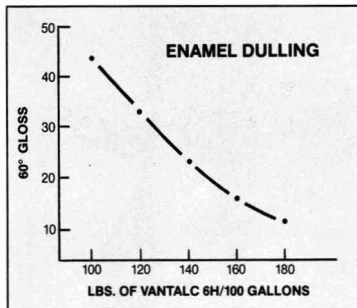
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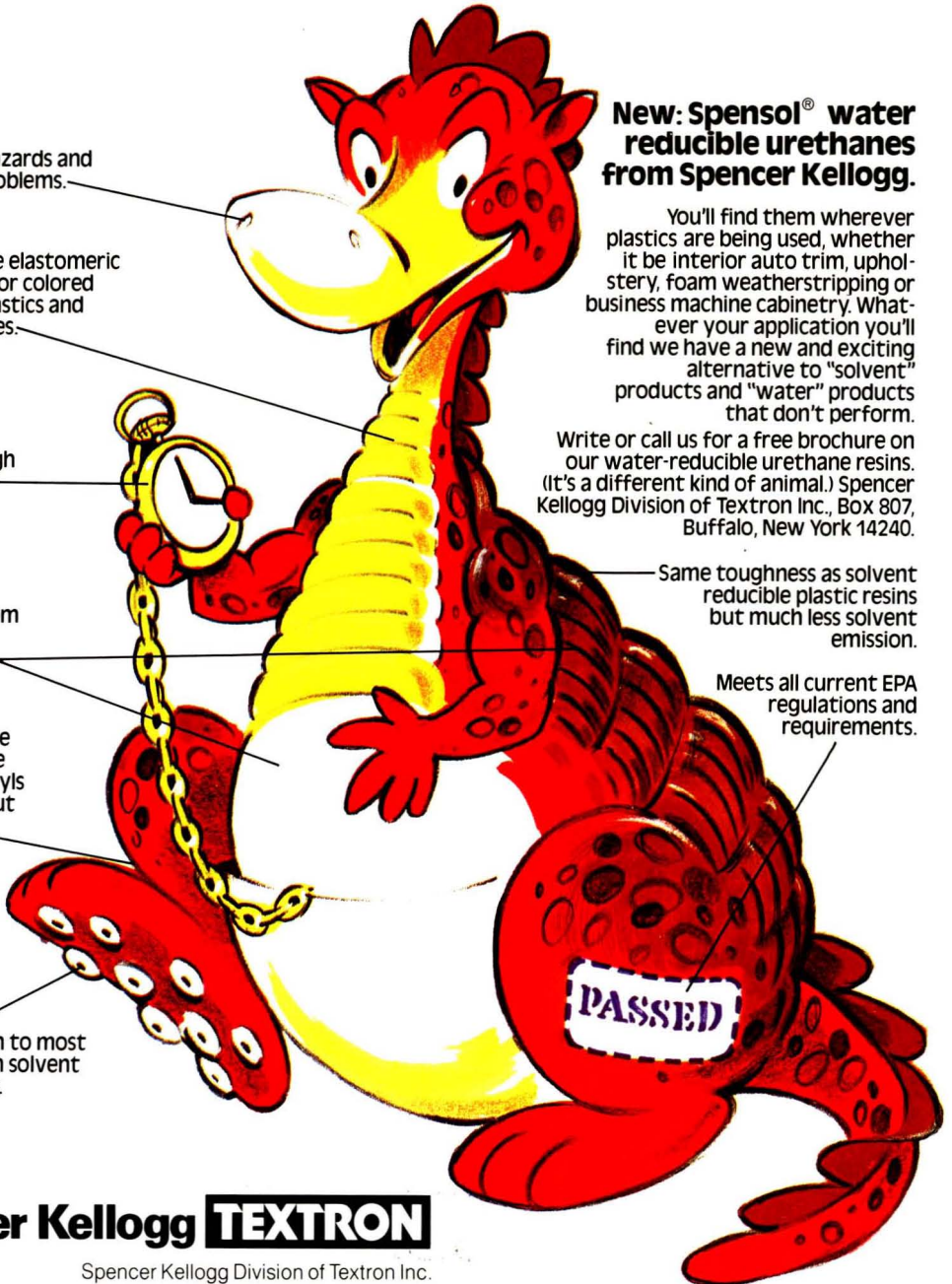
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JOURNAL OF
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Volume 53 Number 680

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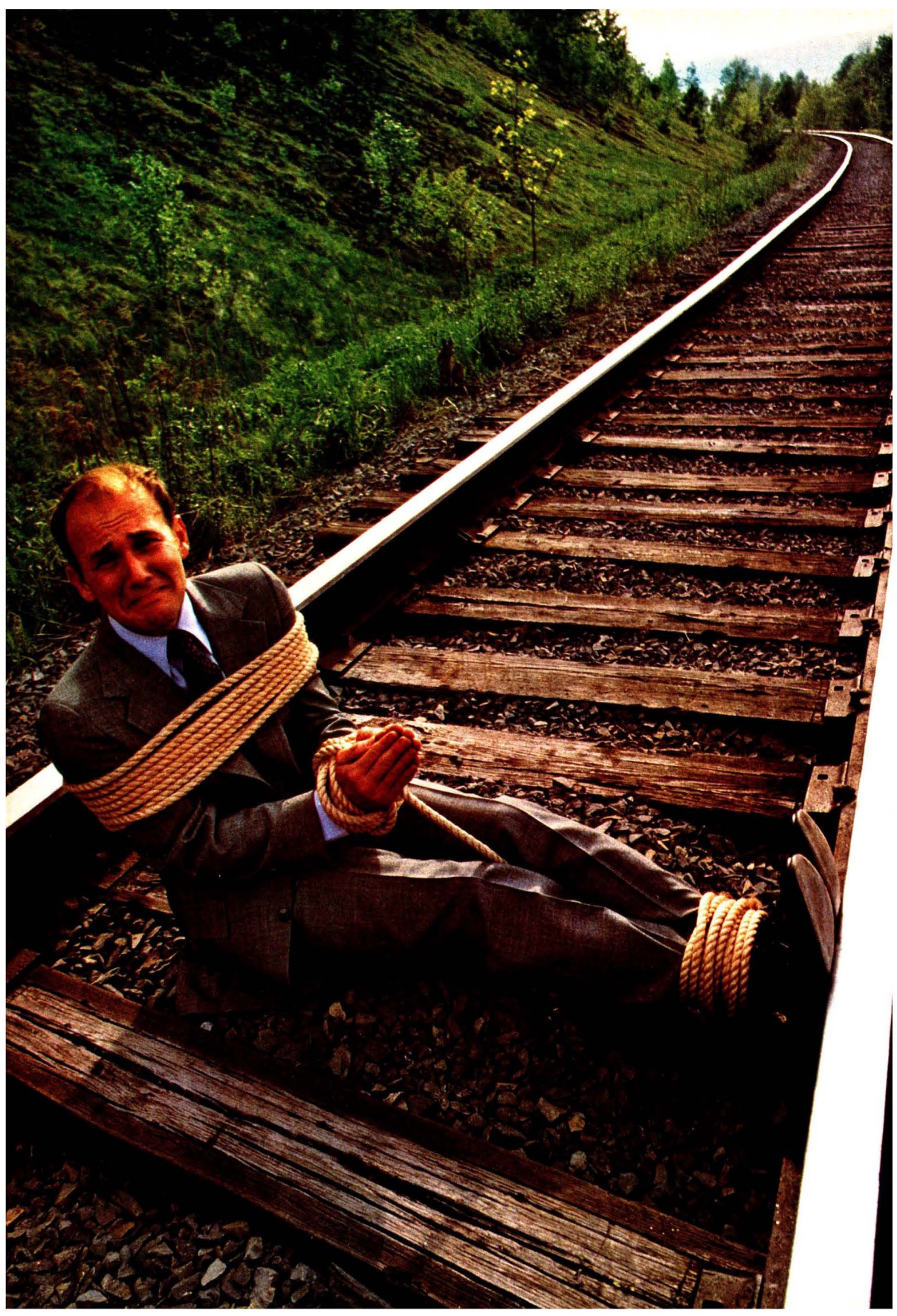
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Cobo Revisited: Another Winning Coatings Event

The Federation Annual Meeting and Paint Industries' Show returns to Detroit next month, and all indications point to a repeat of the very successful event held in the Motor City 10 years ago.

Hotel rooms are at a premium, advance registrations point to a turnout of some 5,000 attendees, and exhibitors have reserved booth space in record numbers to make this the biggest Paint Show ever.

Meanwhile, Program Chairman Tom Miranda and his committee members have lined up a collection of papers covering a wide range of topics, both theoretical and practical, built around the theme of "Challenge, Change, and Opportunity." Both lab and production personnel should find much of interest in the three days of programming devoted to a variety of coatings aspects. Complete details on all the activities are included in the program section of this issue, beginning on page 23.

In addition to the double-barreled helping of technology updating available from the exhibits and papers, there's the opportunity to talk shop with one's peers, to discuss mutual problems and exchange ideas on how to cope with and solve them.

All of which adds up to a "don't miss" event for coatings personnel who want to stay abreast of technical developments in the industry.

Hope you've made your plans to be in Motown on October 28-30!—TAK.,



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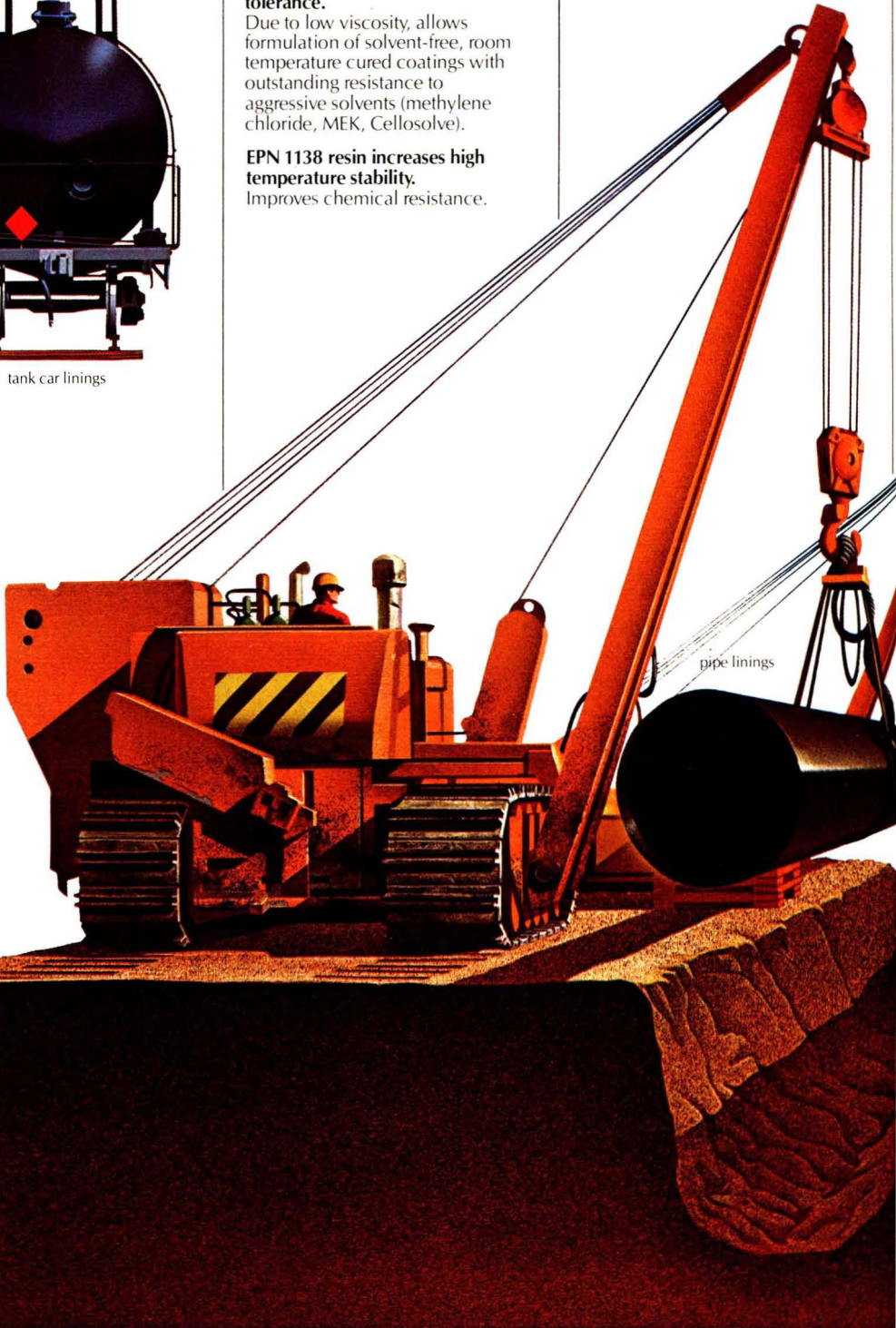
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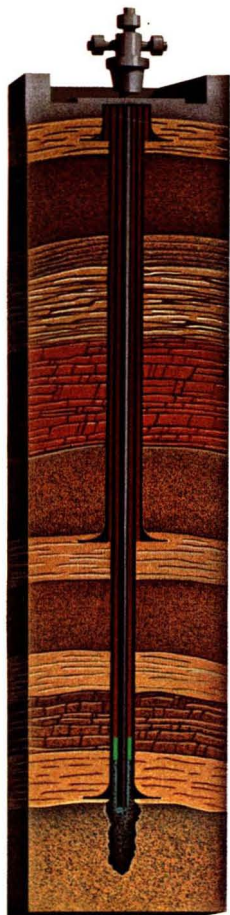
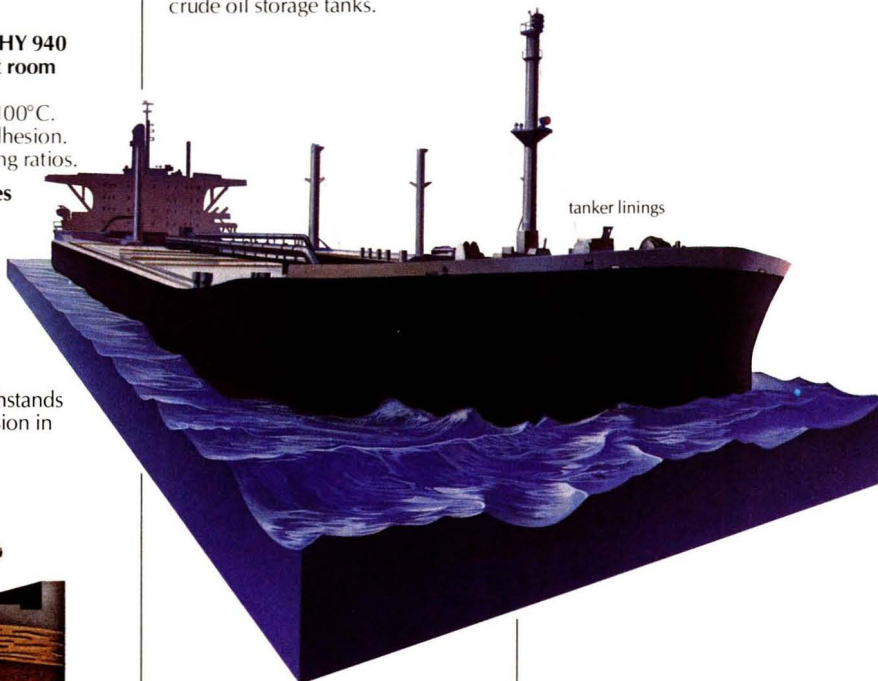
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MILDEW RESEARCH BY CONSORTIUM—C.C. Yeager

Journal of Coatings Technology, 53, No. 680, 47 (Sept. 1981)

Mildew problems have plagued the Paint Industry throughout history. The resolution of these problems has long been an individual matter. New attempts have been made to resolve these problems by consortium—the gathering together of the country's most knowledgeable microbiologists and paint chemists into a single committee. Its purpose is to direct the exploration of the entire problem and find the best and most economical ways to produce mildew resistant and/or funginert paint systems. The background, present status, initial results, and possible future programs are discussed.

ALUMINUM ORGANIC COMPOUNDS IN HIGH SOLIDS ALKYD COATINGS—D.J. Love

Journal of Coatings Technology, 53, No. 680, 55 (Sept. 1981)

Rule 1113 of the California Air Resources Board (CARB) regulations dictates that the volatile organic matter in architectural coatings shall not exceed 250 grams per litre. High solids coatings which conform to this rule and which are based on traditionally formulated alkyds, will suffer from slow drying and poor through-dry. In this paper it is shown that this poor drying, even in thick films, is improved greatly by the addition of certain aluminum organic compounds which give rise to crosslinking, in addition to the autooxidative crosslinking of the alkyds.

Additional benefits, including superior gloss retention, delayed chalking, and resistance to yellowing in the dark, are also conferred by using such aluminum compounds.

EVAPORATION AND VAPOR DIFFUSION RESISTANCE IN PERMEATION MEASUREMENTS BY THE CUP METHOD—E. Nilsson and C.M. Hansen

Journal of Coatings Technology, 53, No. 680, 61 (Sept. 1981)

The permeation of water through coatings and other materials is an important factor in their performance. The cup method, frequently used to determine permeability coefficients, inherently involves certain experimental effects which generally have not been recognized, and which are not mentioned in international standards, etc.

A simple method to account for inherent cup effects in permeation experiments is described. This method is necessary to properly interpret data for acrylic stains, wood, paper, and other relatively permeable materials.

Surface resistances to permeation can not be determined without considering these effects.

An improved simple method to determine vapor phase (water/air) permeation or diffusion coefficients is suggested and demonstrated with examples.

SELECTION OF SOLVENTS FOR HIGH SOLIDS COATINGS SYSTEMS—G. Sprinkle

Journal of Coatings Technology, 53, No. 680, 67 (Sept. 1981)

Two high solids coatings parameters, viscosity and surface tension, and the effect of solvent selection on those parameters are discussed. Various solvents were evaluated with high solids resins and complete high solids coating formulations to determine their effect on the viscosity and surface tension of the coating solutions. The results indicate that the viscosity vs. VOC content of a high solids coating can be optimized by the use of low density, high activity solvents such as ketones. Also, a direct relationship was found between the surface tension of the solvents used in a coating and the resulting surface tension of the coating. Therefore, the increase in surface tension of a high solids coating due to the increase in solids can be minimized through the use of low surface tension solvents.

DILUTION EFFICIENCY OF EXTENDERS—F.B. Stieg

Journal of Coatings Technology, 53, No. 680, 75 (Sept. 1981)

One of the more important functions to be served by an extender pigment is that of a diluent or "spacer" to improve the optical efficiency of expensive titanium dioxide. In the absence of any method for quantifying this spacing capability, however, the high dry-hiding produced in highly pigmented products such as flat latex paints by fine-particle-size, high-oil-absorption extenders has been erroneously attributed to spacing. By combining two previously published and proven concepts, altering one of them by the introduction of a new term indicative of spacing capability (the dilution efficiency, E_d), and by using a low-PVC test formulation to preclude any high dry-hiding effects, a simple test procedure is developed to measure this important characteristic. A tabulation of E_d values for some common extender types has been developed, and the predicted hiding power increase to be obtained by the partial replacement of one extender with a more efficient type, using these determined values, is confirmed experimentally in a practical flat latex paint system.



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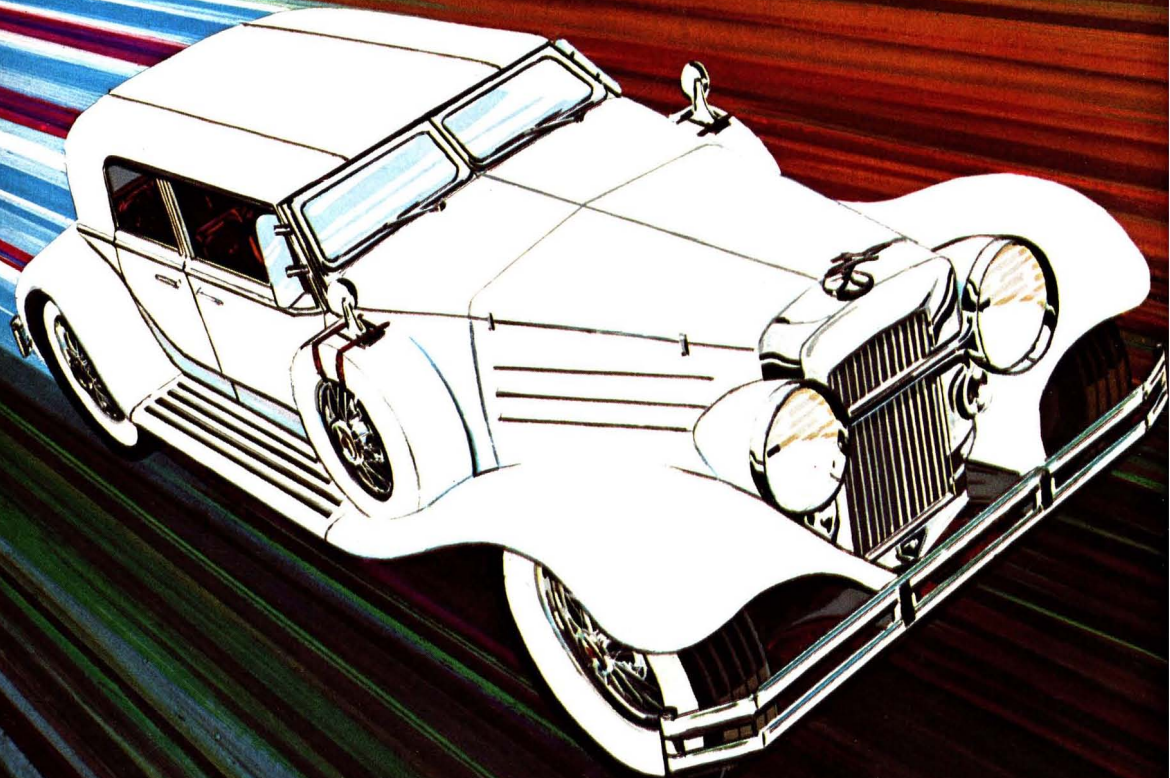
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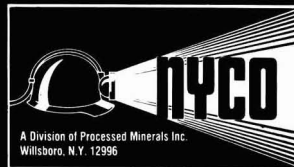


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Broad orientation

Formula is to be held simultaneously with Eurofinish/VOM and Euromaintenance. This will give the visitor to Formula the

chance to acquaint himself with all that is new in the way of finishing products, maintenance materials and techniques.

Congress

During Formula, a three-day international congress is to be organized. Its theme is: developments and research in the paint and printing-ink industries. The speakers at the congress will focus on practical issues. They will discuss such subjects as the applications of surface treatment techniques in the building trade, the chemical industry and the car industry. Paint research institutes from the Federal Republic of Germany, Belgium, Great Britain and The Netherlands will also cooperate in the congress.



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NOTICE

Freeport will have a Message Center located at the entrance to the Paint Show in Hall C, Cobo Hall, Detroit, MI, October 28-30, 1981.

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PROGRAM

**1981 ANNUAL MEETING and
PAINT INDUSTRIES' SHOW**

DETROIT

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CHANGE
OPPORTUNITY**

'81

**Cobo Hall
October 28, 29, 30**

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

Program

WEDNESDAY, OCTOBER 28

OPENING SESSION (10:00-10:30)

Fifty-ninth Annual Meeting of the Federation of Societies for Coatings Technology opened by President William H. Ellis.

Invocation and In Memoriam

Welcome: Gary Van de Streek, President of Detroit Society for Coatings Technology

Thomas J. Miranda, Chairman of the Program Committee

Jose Benavides, Chairman of the Host Committee

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

Introduction of Federation Officers

Introduction of Distinguished Guests

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

ENERGY RESOURCES FOR THE NEXT DECADE—John R. Thomas, President, Chevron Research Co., Richmond, CA.

INNOVATIONS IN COATINGS—I (2:00-4:30)

DYNAMIC SURFACE EFFECTS IN COATING PROCESSES—Ronald E. Smith, PPG Industries, Inc., Allison Park, PA.

EVALUATION OF LININGS FOR SO₂ SCRUBBER SERVICE—Dean M. Berger, Robert J. Trewella, and Carl J. Wunner, Gilbert Associates, Reading, PA. (A Roon Awards competition paper).

RECOVERY OF GLYCOL ETHER SOLVENTS FROM ULTRAFILTER PERMEATE IN CATHODIC ELECTROCOAT OPERATIONS USING REVERSE OSMOSIS—

W. S. Springer, G. G. Strosberg, and J. E. Anderson, Manufacturing Processes Laboratory, Ford Motor Co., Detroit, MI.

SHORT-TERM TESTING OF COATINGS: NEW DIRECTIONS—Raymond Tooke, Micro-Metrics Co., Atlanta, GA. (A Roon Awards competition paper).

COATINGS PERFORMANCE ON LOW ALLOY WEATHERING STEEL—A 20-YEAR STUDY—Arnold J. Eickhoff, Coatings Consultant, Ramsey, NJ, and Douglas N. Nash and Nunzio Pisani, N L Chemicals, N L Industries, Inc., Hightstown, N. J.

INNOVATIONS IN COATINGS—II (2:00-4:30)

FACTORS AFFECTING METAL MARKING—Leslie Simpson, BTP Tioxide Limited, Cleveland, England. (Presented on behalf of OCCA: Oil and Colour Chemists' Association). (A Roon Awards competition paper).

APPLICATION OF HPGPC AND HPLC TO CHARACTERIZE OLIGOMERS AND SMALL MOLECULES USED IN ENVIRONMENTALLY ACCEPTABLE COATINGS SYSTEMS—Cheng-Yih Kuo, Theodore Provder, Richard M. Holsworth, and Ann Kah, Glidden Coatings & Resins Div., SCM Corp., Strongsville, OH.

PHYSICO-CHEMICAL INTERPRETATION OF PAINT FILM ADHESION AND TECHNIQUES USED FOR ITS MEASUREMENT—Swaraj Paul, Soab AB, Molndal, Sweden. (Presented on behalf of SLF: Federation of Scandinavian Paint and Varnish Technologists).

A NEW DIMENSION IN CORROSION PROTECTION—Walter Sniff, CRS Company, Inc., Orville, OH.

COMPARATIVE CURE KINETICS AND THERMAL-MECHANICAL PROPERTY CHARACTERIZATION OF ORGANIC COATINGS BY DYNAMIC MECHANICAL ANALYSIS (DMA) AND DIFFERENTIAL SCANNING CALORIMETRY (DSC)—Theodore Provder, Richard M. Holsworth, and Thomas H. Grentzer, Glidden Coatings & Resins Div., SCM Corp., Strongsville, OH.

Dr. John Thomas, President of Chevron, to Present Keynote Address in Detroit

"Energy Resources for the Next Decade" will be the subject of the Keynote Address by Dr. John R. Thomas, President of Chevron Research Company, at the 59th Annual Meeting of the Federation on October 28 at Cobo Hall in Detroit.

Previously Assistant Secretary of the parent corporation, Standard Oil Company of California, Dr. Thomas first became associated with its research organization in 1948. Following a period of service with the U.S. Atomic Energy Commission, he returned to Standard in 1951, serving subsequently in a succession of increasingly important scientific research assignments with Chevron Research and as Manager of Research and Development for the Ortho Division of Chevron Chemical Company,



J. R. Thomas

another Standard subsidiary. He was appointed as Assistant Secretary of the Corporation in 1968.

Dr. Thomas holds a bachelor of science degree from the University of California and earned his doctorate in physical chemistry there in 1947. Research activities have been in a number of fields including combustion, oxidation, and free radical chemistry.

He is a member of the American Chemical Society, the American Association for the Advancement of Science, and the Industrial Research Institute. He serves on the Board of Directors of Cetus Corporation and the Coordinating Research Council. He is a member of the California Institute of Technology Energy Advisory Board, the Industrial Advisory Committee to the Department of Chemistry, University of California—San Diego, and the Industrial Advisory Panel for the Institute of Hydrocarbon Chemistry at the University of Southern California.

THURSDAY, OCTOBER 29

RAW MATERIALS TO FINISHED PRODUCT—I (9:00-11:30)

KINETICS OF THERMAL DISSOCIATION OF BLOCKED ISOCYANATE CROSSLINKERS—Detroit Society for Coatings Technology. Presented by Andrew Dervan, Paint Plant, Ford Motor Co., Mt. Clemens, MI.

WATER-BORNE INTUMESCENT COATINGS—G. O. Fanger, Great Lakes Chemical Corp., West Lafayette, IN.

EFFECT OF THE PIGMENT-VEHICLE INTERACTION ON MAGNETIC COATING FILM—Yukihiro Isobe, Kiyotaka Okuyama, Akihiko Hosaka, and Yuichi Kubota, Magnetic Recording Products, TDK Electronics Co., Ltd., Nagano, Japan.

THE EFFECT OF LATEX FUNCTIONALITY ON THE RATE OF AUTODEPOSITION—Cleveland Society for Coatings Technology. Presented by Michael McElroy, Glidden Coatings and Resins Div., SCM Corp., Strongsville, OH.

COATING INDUSTRY AND WASTE SOLVENT DISTILLATION—H. David Bowes, Finish Engineering Co., Inc., Erie, PA.

MANUFACTURING COMMITTEE SEMINAR ON DISPERSION TECHNOLOGY EQUIPMENT CAPABILITIES AND LIMITATIONS (9:00-12:00)

A critical review of the tools available to the paint manufacturer, this session will discuss in detail the optimum utilization of existing dispersion equipment, including a review of the role of formulation.

Moderator—Fred K. Daniel, Daniel Products Co., Jersey City, NJ.

HIGH SPEED DISPERSION—Speaker to be announced.

SMALL MEDIA MILLING—Leo Dombrowski, Chicago Boiler Co., Chicago, IL.

S-W MILL—Mike Fujimoto, The Sherwin-Williams Co., Chicago, IL.

BALL MILLS AND ATTRITORS—Elio Cohen and Ray Pineiro, Daniel Products Co., Jersey City, NJ.

Moderator and speakers will assemble as a panel for a 45-minute open-discussion period to conclude seminar.

Presentation of the Morehouse Industries Golden Impeller Award will be made at this session.

PRI SEMINAR ON CONTRIBUTIONS OF PRI FELLOWS TO THE COATINGS INDUSTRY (9:00-12:00)

Moderator—Raymond R. Myers, PRI Research Director and University Professor, Kent State University, Kent, OH.

MOLECULAR ORIENTATION IN SOLVENT-CAST POLYMERIC FILMS—William M. Prest, Xerox Corp., Webster, NY.

RHEOLOGICAL STUDIES AT GLIDDEN—Richard R. Eley, Glidden Coatings and Resins Div., SCM Corp., Strongsville, OH.

RESEARCH IN THE GRAPHIC ARTS—William D. Schaeffer, Graphic Arts Technical Foundation, Pittsburgh, PA.

RECENT DEVELOPMENTS IN COLOR MEASUREMENT—James G. Davidson, Macbeth Div. of Kollmorgen Corp., Newburgh, NY.

OSCILLATORY SHEARING AS A TECHNIQUE FOR EVALUATING LEVELING—James S. Dodge, B.F. Goodrich Co., Avon Lake, OH.

RAW MATERIALS TO FINISHED PRODUCT—II (2:00-4:00)

PRACTICAL APPLICATION OF KUBELKA-MUNK THEORY FOR THE NEAR INFRARED REGION—Dennis Osmer and Joseph Kettanecker, CIBA-GEIGY Corp., Ardsley, NY.

RECLAIMING THE ENERGY VALUE OF COATINGS WASTES THROUGH PYROLYSIS—Louisville Society for Coatings Technology. Presented by Dean Owen Harper, Dept. of Chemical and Environmental Engineering, University of Louisville, Louisville, KY.

STABILIZING THE VISCOSITY AND THIXOTROPIC INDEX OF HARDENER FREE EPOXY RESIN SYSTEMS WITH FUMED SILICA—Harold D. Stanley, Degussa Corp., Teterboro, NJ.

HIGH SOLIDS AND WATERBORNE SILICONE RESINS FOR HIGH TEMPERATURE DURABLE PROTECTIVE COATINGS—William T. Saad, Silicone Products Div., General Electric Co., Waterford, NY.

RAW MATERIALS TO FINISHED PRODUCT—III (2:00-4:00)

REACTIVE SILANE MODIFIED PIGMENTS—Los Angeles Society for Coatings Technology. Presented by R. D. Athey, Jr., Swedlow, Inc., Garden Grove, CA.

PIGMENT DISPERSIONS, ECOLOGY AND ECONOMICS—Russell R. Koch, Universal Color Dispersions, Lansing, IL.

THE EFFECTS OF FREEZE—THAW CYCLES OF SOME COMMERCIALY AVAILABLE LATEX AND EMULSION PAINTS ON MOLECULAR WEIGHT AND MOLECULAR WEIGHT DISTRIBUTION BY GEL PERMEATION CHROMATOGRAPHY—James A. Vance, Vance Laboratories, Inc., Indianapolis, IN. (A Roon Awards competition paper).

CORROSION AND A COMPLYING SYSTEM—Golden Gate Society for Coatings Technology. Presented by Tim Specht, The Sherwin-Williams Co., Oakland, CA.

FRIDAY, OCTOBER 30

IMPACT OF CORROSION—I (9:00-10:30)

CORROSION: A COATINGS MANUFACTURER'S DILEMMA—Dean M. Berger, Gilbert/Commonwealth, Reading, PA.

SULFONATE AND PHOSPHATE CHEMISTRY TO IMPROVE CORROSION INHIBITION AND ADHESION—W. A. Higgins, Lubrizol Corp., Wickliffe, OH.

APPLICATION OF PHOTOGONIOMETRY FOR THE CHARACTERIZATION OF THE REFLECTANCE PROPERTIES AND MORPHOLOGY OF COATINGS SYSTEMS—Thomas H. Grentzer, Theodore Provder, Richard M. Holsworth, Glidden Coatings & Resins Div., SCM Corp., Strongsville, OH.

COLOR AND APPEARANCE (9:00-10:30)

WHAT IS SCAI?—Dennis Osmer, CIBA-GEIGY Corp., Ardsley, NY.

USE AND MISUSE OF COMPUTERS IN COLOR CONTROL—Hugh R. Davidson, Davidson Colleagues, Tatamy, PA.

INSTRUMENTAL COLOR CONTROL—WHAT'S DOWN THE ROAD (*Bruning Award Lecture*)—Ralph Stanziola, Applied Color Systems, Inc., Princeton, NJ.

MATTIELLO LECTURE (10:30-11:45)

AMINO RESINS FOR HIGH SOLIDS COATINGS—Werner J. Blank, Manager of Resin Products at the Stamford Research Center of American Cyanamid Co., Stamford, CT.

FEDERATION LUNCHEON (11:45)

Ballroom A, Room 2001, Cobo Hall.

Presentation of the George Baugh Heckel and Paint Show Awards.

Winners of other Federation awards to be announced.

IMPACT OF CORROSION—II (2:00-4:00)

EFFECT OF ANTI-CORROSIVE PIGMENTATION ON THE PERFORMANCE OF VINYL SYSTEMS—Thomas Ginsberg, Union Carbide Corp., Bound Brook, NJ, and John D. Keane and Joseph A. Bruno, Steel Structures Painting Council, Pittsburgh, PA.

ORGANIC COATINGS FAILURE ANALYSIS—Richard M. Holsworth, Glidden Coatings & Resins Div., SCM Corp., Strongsville, OH.

EXAMINATION OF WEATHERED COATINGS BY PHOTOELECTRON SPECTROSCOPY AND FOURIER TRANSFORM INFRARED SPECTROSCOPY—Glenn Cunningham, PPG Industries, Allison Park, PA, and Charles M. Hansen, Scandinavian Paint and Printing Ink Research Institute, Horsholm, Denmark.

FACTORS AFFECTING THE DISTINCTION OF IMAGE (DOI) OF PAINTED FIBERGLASS REINFORCED REACTION INJECTED MOLDED (RRIM) URETHANE—Donald J. Hart, Polymers Dept., General Motors Research Laboratories, Warren, MI.

ANNUAL BUSINESS MEETING (4:00-5:00)

Annual Business Meeting of the Federation.

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

Installation of Officers, 1981-82.

Paint Show Hours

Wednesday, Oct. 28
12:00 p.m. to 5:30 p.m.

Thursday, Oct. 29
9:30 a.m. to 5:00 p.m.

Friday, Oct. 30
9:30 a.m. to 4:00 p.m.



Cobo Hall (left foreground), site of the 1981 Paint Show

OTHER CONVENTION INFORMATION

PAINT INDUSTRIES' SHOW

The 46th Annual Paint Industries' Show will run concurrently with the Annual Meeting in Cobo Hall, Detroit. The only national exposition of materials and equipment used in the formulation, testing, and manufacture of coatings, the Show will be open from 12:00 pm to 5:30 pm on Wednesday, October 28; 9:30 am to 5:00 pm on Thursday, October 29; and 9:30 am to 4:00 pm on Friday, October 30.

Participating supplier companies will have their top technical representatives on hand to discuss the latest developments with registrants at this year's event, the largest in Paint Show history.

REGISTRATION

Registration fees for the Annual Meeting and Paint Show are on a Federation member and nonmember basis:

	Member	Nonmember	Spouses
Advance*	\$40	\$55	\$25
In Detroit	\$45	\$60	\$30
One-Day	\$25	\$35	-

*Special registration for retired members and their spouses only: Advance registration will be \$20 each.

Registration form is included in this issue and has also been mailed to all members.

Note: Purchase of luncheon tickets is optional for both advance and on-site registration.

LUNCHEON

The Federation Luncheon will be held on Friday, October 30, at Cobo Hall.

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 1981 Paint Industries' Show).

A celebrity guest speaker will be featured.

SPOUSES' PROGRAM

A schedule of activities has been planned each day for spouses attending the Annual Meeting, and a Hospitality Room will be maintained at both the Detroit Plaza and Book Cadillac hotels.

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

On Thursday, a continental breakfast will precede an all-day tour of Detroit.

Continental breakfast will be available again on Friday morning.

Registration fees for the Spouses' Activities are \$25 in advance and \$30 on-site.

HEADQUARTERS HOTEL

The Detroit Plaza will be headquarters hotel, and the Book Cadillac will be co-headquarters. Other hotels with blocks of rooms set aside for the Annual Meeting are the Downtown Travelodge, Howard Johnson's, Leland House, Pontchartrain, and Shorecrest in Detroit, and the Holiday Inn, National Traveller, Richelieu, and Viscount in Windsor, Ontario.

Shuttle bus service will be provided between participating hotels and Cobo Hall.

ROOM RESERVATIONS

All requests for rooms and suites must be sent to the Federation Housing Bureau on the official form provided by the Federation. These have been mailed to all members. Additional forms are available from Federation Headquarters.

BOARD MEETING

The Fall Board Meeting of the Federation will be held on Tuesday, October 27, at Cobo Hall.

SPEAKERS' BREAKFAST

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

PUBLICATION OF PAPERS

The JOURNAL OF COATINGS TECHNOLOGY has prior rights to the publication of all papers presented at the Annual Meeting.

NPCA MEETS SAME WEEK

The National Paint and Coatings Association will hold its annual meeting from October 26-28 at the Detroit Plaza Hotel.

NPCA badges will be honored for admission to the Federation Annual Meeting and Paint Show on Wednesday, October 28.

PROGRAM STEERING COMMITTEE

Chairman—Dr. Thomas J. Miranda, of Whirlpool Corp., Benton Harbor, MI; *Vice-Chairman*—John C. Ballard, of Kurpees Coatings, Inc., Louisville, KY; Darlene Brezinski, of DeSoto, Inc., Des Plaines, IL; Percy E. Pierce, of PPG Industries, Inc., Allison Park, PA; Peter Hiscocks, of Canadian Industries, Ltd., Toronto, Canada; Theodore Provder, of Glidden Coatings & Resins Div., SCM Corp., Strongsville, OH; and Walter Stuecken, of Grow Group, Inc., Troy, MI.

MEETINGS COMMITTEE

Members of the Detroit Society are serving on the Meetings Committee under General Chairman Jose G. Benavides, of Ford Motor Co. Chairing the various subcommittees are: Information Services—Bohdan (Dan) Melnyk, of Chrysler Corp.; Program Operations—Taki Anagnostou, of Wyandotte Paint Products, Inc.; Publicity—Jack Dentler, of Pfizer, Inc., MPM Div.; Luncheon—Fred F. Boehle, of Boehle Chemicals, Inc.; Society President—Walter Stuecken, of Grow Group, Inc.

Co-chairing the Spouses' Activities Committee are Mrs. Fred (Rosemary) Boehle, Mrs. Walter (Lorraine) Stuecken, and Mrs. Jose (Lorraine) Benavides.

ABSTRACTS OF PAPERS

DYNAMIC SURFACE EFFECTS IN COATING PROCESSES

Ronald E. Smith, PPG Industries, Inc.

Dynamic surface tension is the time-dependent effect of surface area on surface tension. This property is characterized by the surface dilational modulus, and generally is the most important rheological property of a surface. It is especially important in processes such as spray application of coatings where the surface area (of the liquid-air interface) changes rapidly.

The surface dilational modulus can be determined using an instrument that is commercially available, with slight modifications. This technique is described, and illustrated by tests showing the effect of additives on the dynamic surface properties of a watersolubilized resin.

EVALUATIONS OF LININGS FOR SO₂ SCRUBBER SERVICE

Dean M. Berger, Robert J. Trewella, Carl J. Wummer, Gilbert/Commonwealth

Lining materials to protect steel surfaces from corrosion were evaluated utilizing the Atlas Test Cell. Collected gas condensate from within an operating flue following a SO₂ Scrubber Unit was analyzed and used as the media within the cell.

This synergistic test correlated closely with field experience and appears to be a very effective method to evaluate coating materials. Microscopic observations of both coating and steel were made after completion of the test.

RECOVERY OF GLYCOL ETHER SOLVENTS FROM ULTRAFILTER PERMEATE IN CATHODIC ELECTROCOAT OPERATIONS USING REVERSE OSMOSIS

**W. S. Springer, G. G. Strosberg, and J. E. Anderson,
Ford Motor Co.**

Cathodic electrocoat systems in automotive paint operations are controlled by regular purging of ultrafilter (uf) permeate extracted from the electrocoat bath. The uf permeate contains not only the undesirable ionic species but also essential glycol ether solvents used as basic materials for polymerization and flow-out of the electrocoat paint film.

A reverse osmosis (RO) machine equipped with cellulose acetate membranes, operating at about 3300 kPa (480 psi) and at a temperature of 24–28°C, was used to process the uf permeate and separate it into: (1) an RO concentrate stream containing the ionic contaminants, solvent, and water; and (2) an RO permeate stream of solvent and water. The RO concentrate stream was discarded, the RO permeate stream was returned to the bath.

SHORT-TERM TESTING OF COATINGS: NEW DIRECTIONS

Raymond Tooke, Jr. Micro-Metrics Co.

This paper addresses the prediction of protective painting performance on steel, more particularly, on structural steel in moderate to severely aggressive environments. The potential efficacy of selected short-term tests is affirmed, but effective utilization of such tests awaits mobilization of technical efforts of increased sophistication. Some of the "new directions" are

content and molecular weight distribution (MWD) of the binders are critical to the coatings formulation.

Described are the qualitative and quantitative methodologies we have developed for the analysis of oligomers and small molecules used in the above-mentioned environmentally acceptable coatings systems. Specifically, the analysis of surfactants (both nonionic and ionic), monomers, initiators, catalysts, reactive additives, epoxies, etc., by high performance liquid chromatography (HPLC) are described. Also, the use of high performance gel permeation chromatography (HPGPC) for (a) monitoring the quality of incoming materials, (b) guiding resin synthesis and processing (c) modifying resin synthesis to improve end-use properties, and (d) correlating oligomer and polymer MWD with end-use properties are discussed.

PHYSICO-CHEMICAL INTERPRETATION OF PAINT FILM ADHESION AND TECHNIQUES USED FOR ITS MEASUREMENT

Swaraj Paul, Soab AB

Paints are applied to different substrates mainly for protective and decorative reasons. Apart from other film properties, the performance of paint films depends very much on the adhesion properties. This subject has lately been investigated extensively and a large amount of research work has been carried out to understand the physico-chemical aspects of adhesion.

The earlier theories, namely, the electrical theory, the adsorption theory, the diffusion theory, the mechanical theory and, finally, the weakboundary layer (WBL) theory proposed to explain adhesion are reviewed, followed by an interpretation of the adhesion phenomenon based on the surface energetics of the adherend-adherent system and the energy dissipation in the adherend during peeling.

A NEW DIMENSION IN CORROSION PROTECTION

Walter G. Sniff, CRS Co., Inc.

A new dimension in corrosion protection has been under testing since 1975 with results which have proved far superior to pre-coated steel.

A unique metallo organic phosphate resin has been developed which is designed not to destroy itself when subjected to extreme heat during a welding operation.

COMPARATIVE CURE KINETICS AND THERMAL-MECHANICAL PROPERTY CHARACTERIZATION OF ORGANIC COATINGS BY DYNAMIC MECHANICAL ANALYSIS (DMA) AND DIFFERENTIAL SCANNING CALORIMETRY (DSC)

Thomas H. Grentzer, Richard M. Holsworth, and Theodore Provder, Glidden Coatings and Resins Div. of SCM Corp.

The ultimate performance properties of coatings based on the new technologies (high solids, powder, water-borne; radiation cure) depend upon the composition of the coating; cure chemistry and physics; and the resultant mechanical properties of the converted coating. Therefore, a basic understanding of the kinetics of polymerization and cure, and methods for relating end-use performance properties to fundamental dynamic mechanical properties are essential for developing useful environmentally acceptable coatings.

This paper will demonstrate that differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA) are complementary techniques for obtaining reaction kinetics and estimating degree of cure. It also will be shown that DMA is useful for solving production problems and identifying structure-property relationships. The application of the DSC and DMA techniques will be illustrated for a variety of coatings systems which include can coatings, gel coat resins, high solids coatings, and powder coatings.

MOLECULAR ORIENTATION IN SOLVENT-CAST POLYMERIC FILMS

William M. Prest, Jr., Xerox Corp.

The stresses that develop during the solvent coating and drying processes preferentially orient the polymeric backbone segments in the plane of the film. The degree of this alignment is controlled by the processing conditions and the molecular constituents of the coating resin. This paper describes how the resultant anisotropy can be measured using a single prism film coupler and integrated optics techniques.

The application of this technique to the evaluation of the effects of the molecular parameters and processing conditions on the structure of the film and the characterization of the orientations of the molecular constituents in polymer blends are discussed.

RHEOLOGICAL STUDIES AT GLIDDEN

Richard R. Eley, Glidden Coatings and Resins Div. of SCM Corp.

It was through Dr. Raymond R. Myers that I became interested in the rheology of film formation, and received a PRI Fellowship. Dr. Myers is also known as an inorganic chemist, and under him and Dr. Norman V. Duffy, I studied the chemistry of a class of iron coordination compounds with organic ligands (the diorganodithiocarbamates) that displayed highly unusual electronic energy states and were interesting from a potential catalytic standpoint, besides having been used as fungicides, free-radical accelerators, stabilizers, and adhesion promoters.

My work at Glidden has emphasized the chemorheology of thermosetting systems, and the rheology of coatings application. Some of the results of our thermoset studies (using an automated Ferranti-Shirley viscometer) are discussed, as well as some work on the atomization of water-based spray-applied coatings. Also covered are studies relating viscoelastic properties of some roll-applied water-based pigmented chemical coatings to their leveling behavior. Finally, the use of a high pressure capillary fluids rheometer for very high shear rate of sprayed coatings is described.

OSCILLATORY SHEARING AS A TECHNIQUE FOR EVALUATING LEVELING

James S. Dodge, BF Goodrich Co.

Techniques to investigate rapid time dependence of thixotropic and viscoelastic liquids were developed at Case Western Re-

serve University, partly with PRI support, using oscillatory shearing with a concentric cylinder viscometer. Computer modeling of steady state viscosity vs shear rate relations was carried out. Finite difference techniques were used to predict the behavior of liquids under oscillatory and superposed steady and oscillatory shearing. The observed and predicted results were compared.

In work performed at The Sherwin-Williams Co., a modification of this technique was used to measure the time-dependence of the complex viscosity of coatings, following a high shear rate corresponding to application, under conditions approximating leveling. By combination with a technique for surface profile measurement, insight was obtained into the rate at which leveling occurs.



H.D. Bowes



D. Osmer



H.D. Stanley

SEMINAR ON DISPERSION TECHNOLOGY/ EQUIPMENT CAPABILITIES AND LIMITATIONS

No single piece of equipment exists that meets all the varied pigment dispersing needs of the coatings industry satisfactorily. Each type of mixer or mill has advantages and shortcomings which must be balanced against each other: quantity vs quality; investment vs operating costs; versatility vs production rate, etc. Depending upon his markets and product mix, the coatings manufacturer must decide which types of equipment are most suitable for him. Then the chemist must formulate the mill bases to optimize the capabilities and minimize the limitations of each machine.

This seminar aims to present a balanced assessment of the pros and cons of the most important types of dispersing tools available to the paint manufacturer, and to discuss good formulating approaches that will make the best use of whatever machinery is available or should be acquired.



W.T. Saad



R.R. Koch



W.A. Higgins

WATER-BORNE INTUMESCENT COATINGS

G.O. Fanger, Great Lakes Chemical Corp.

The field of water-borne flame retardant coatings is briefly reviewed. The effectiveness of intumescent coatings and current technology are discussed.

A water-borne two-component intumescent coating is described which cures to a hard, durable finish on a variety of substrates. Solution rheology and the time-temperature relationship on curing rates and pot life are presented. Data on film properties are discussed.

Methods of testing for flame retardance are discussed. Flame spread ratings, as measured by the two-foot tunnel test, and intumescent activity of coatings are related to coating thickness. Current and potential applications for water-borne intumescent coatings are discussed.



H.R. Davidson



W.J. Blank



T. Ginsberg

EFFECT OF THE PIGMENT-VEHICLE INTERACTION ON THE MAGNETIC COATING FILM

Yukihiro Isobe, Kiyotaka Okuyama,
Akihiko Hosaka, and Yuichi Kubota,
TDK Electronic Co., Ltd.

Mechanical properties of the coating films containing acicular Co(Cobalt)-adsorbed γ -Fe₂O₃ were studied in comparison with the case of acicular γ -Fe₂O₃ and TiO₂.

Dynamic viscoelasticity, stress-strain properties and water absorption of the coating films were measured. The adsorption of the vehicle on the pigment was also investigated using gel



J.D. Keane



J.A. Bruno



C.M. Hansen

permeation chromatography. The thickness of the pigment-vehicle interfacial layer was estimated using the method proposed by K. D. Ziegel.

It was concluded that the interaction between co-adsorbed γ - Fe_2O_3 and the vehicle was stronger than that between γ - Fe_2O_3 and the vehicle.

COATING INDUSTRY AND WASTE SOLVENT DISTILLATION

H. David Bowes, Finish Engineering Co.

Coatings and solvents are predominantly combined for end use. But, in some cases, the combined is desired to be separated for primary re-use. Unable to be re-used, the contaminated paint and solvents are expensive and hazardous to discard.

There is contemporary technology utilizing batch or continuous distillation to virtually assure good separation and eliminate contaminated hazardous waste solvents.

This is accomplished by first distilling 80-90% of the contaminated solvent into clear, clean re-usable product.

A past problem here was other methods of distillation had no way of showing an operator what was happening to the contamination or residue (i.e. epoxys, resins, paints, etc.) that was being left while distillation was taking place. Such technology has an internal scraping device that cleans the distillation tank walls. In conjunction with this device, there are methods of measuring the thickness (viscosity) of the residue.

The remaining 10-20% (or the residue) is further distilled into clean solvent and disposable nonvolatile "rock-like" materials.

In addition to elimination of hazardous wastes, equipment in actual installations is reported to experience paybacks in as short as three months and save substantial cost savings annually.

PRACTICAL APPLICATION OF KUBELKA-MUNK THEORY FOR THE NEAR INFRARED REGION

Dennis Osmer and Joseph Kettenacker, CIBA-GEIGY Corp.

The Kubelka-Munk model is well established and widely used as a basis for computer color matching; however, the theory is not limited to the visible region. Practical necessity has compelled evaluation of its applicability to the near infrared region.

The camouflage and exterior rigid vinyl markets are rapidly growing areas where the near infrared reflectance plays an important role in formula acceptance. It is a tremendous advantage in these competitive markets to be able to predict the reflectance of various formulations in the near infrared as well as the visible regions. In this presentation, the theoretical application of the Kubelka-Munk model in the near infrared region and practical experimental results are reviewed.

RECLAIMING THE ENERGY VALUE OF COATINGS WASTES THROUGH PYROLYSIS

Dean Owen Harper, University of Louisville

The advantages of pyrolysis (thermal decomposition in the absence of oxygen) over incineration (thermal decomposition in the presence of oxygen) is that it produces a liquid fuel resource that is capable of being shipped, stored, and consumed as the need arises.

The overall process sets (1) material recovery as the highest priority, (2) energy recovery as the second priority, and (3) inert waste production as the third priority.

Given a waste product from the manufacture of a coatings system, in the form of wash wastes or off-specification material, distillation recovers the solvent for reuse as a material resource,

the resulting resin (solution) is pyrolyzed to a liquid fuel for use as an energy resource, and the pigment, char, and other non-pyrolyzable components are removed as a leach-stable solid waste for appropriate disposal.

A waste product from a commercial manufacturer of industrial coatings was studied. Following solvent recovery, pyrolysis conditions were varied. Two pressures, three temperatures, and three times were the independent variables in a factorial experimental design. The mass and volume fractions of solvent, pyrolysis product "fuel," and solids were measured as the dependent variables. The fraction of off-gases was determined by difference. Conclusions are drawn to determine the changes in operating conditions necessary to produce the most economically valuable split, within the constraints of the given waste and process.

STABILIZING THE VISCOSITY AND THIXOTROPIC INDEX OF HARDENER FREE EPOXY RESIN SYSTEMS WITH FUMED SILICA

Harold D. Stanley, Degussa Corp.

Epoxy resin systems are very polar and, as such, tend to induce viscosity and thixotropic index problems when fumed silicas are used as the thixotropic agents (T.I.). Typical of the problems observed are a rapid loss of viscosity and T.I. during storage and/or transportation, a drop in the thixotropic index of the system to the level of an inert filler, and limited shelf life because of these two factors. These problems often result because of competition between the silanol groups on the surface of the fumed silica particles and OH, NH groups and polar groups on the other ingredients of the system, chief of which is the epoxy resin molecule itself.

Traditional approaches to this problem have been to increase the total amount of fumed silica used, use a fumed silica with a higher BET surface area, and use bridging agents such as water, glycerin, ethylene glycol and the like. These methods have not proved successful in the majority of cases.

In the ideal case, the system should first be stabilized against excessive viscosity drift and loss of thixotropic index and, then, the viscosity can be boosted to the desired levels with additives. This can be accomplished by using mixtures of fumed silica and Aluminum Oxide C, a fumed aluminum oxide. The fumed aluminum oxide, which has a positive surface charge, exerts a charge screening effect on the polar epoxy system which allows the fumed silica to behave as though it were in a non-polar system, promoting stabilized viscosity and thixotropic index levels. Ratios of fumed silica to fumed aluminum oxide of 70 parts to 30 parts have been found useful. Additives such as bridging agents may be used to boost the viscosity of the now stabilized system. Tests showed systems stabilized in this way produced stable viscosities and thixotropic indexes for over 90 days.

HIGH SOLIDS AND WATERBORNE SILICONE RESINS FOR HIGH TEMPERATURE DURABLE PROTECTIVE COATINGS

William T. Saad, General Electric Co.

Government regulations on solvent emissions and the ever increasing cost of solvents dependent on (or derived from) crude oil have challenged researchers to look for alternate systems for protective coatings.

High solids and water-borne silicone resins are possibilities for meeting this challenge. Discussed are molecular weight considerations as related to application vs performance properties, wt % of silicone solids, and the corresponding viscosities in the range of 300/1000 cps. Suggested high solids, silicone

based starting point formulations of up to 85% total weight solids are included for protection in the range of 800° to 1200° F.

These coatings are of sprayable consistencies which use standard low solids spray equipment.

Also discussed are the emulsions made from these high solids silicone resins, and the suggested ingredients needed to make silicone-based water-borne coatings.

PIGMENT DISPERSIONS, ECOLOGY, AND ECONOMICS

Russell R. Koch, Universal Color Dispersions

Pigment dispersions are an integral part of the paint and coatings industry. A paint manufacturer uses dispersions to shade paints made by composite grinding of more than one type of pigment to match a given color standard.

Today, pigment dispersions, particularly those containing universally compatible vehicles, can play an important role with respect to OSHA and EPA regulations, production costs and productivity. Using dispersions as the sole source of color eliminates dusting, and along with it the need for protective equipment such as masks and air exhausts. Besides, universal dispersions can reduce dispersion inventories and costs by as much as 80%.

Universal dispersions can be used as the single source of color for deep tone colors by blending with clears, or they can work as a tint with a white base. The pre-mix tank, mill, and thin-down tank need be cleaned only periodically (since only a white base is required with this approach), rather than after every batch as required with composite grinding. Blending tanks still would have to be cleaned on a regular basis.

Disposal of hazardous material can cost \$25 to \$125 per drum, depending upon local restrictions. The use of universal dispersions can reduce these costs by 50% or more.

The use of universal dispersions also can reduce new product development time, particularly as it relates to samples. Translating formulas from the laboratory to the factory has always been troublesome. Universal dispersions can improve this situation since shear and horsepower differences are minimized.

THE EFFECTS OF FREEZE-THAW CYCLES OF SOME COMMERCIALY AVAILABLE LATEX AND EMULSION PAINTS ON MOLECULAR WEIGHT AND MOLECULAR WEIGHT DISTRIBUTION BY GEL PERMEATION CHROMATOGRAPHY

James A. Vance, Vance Laboratories, Inc.

Ten commercially available water-borne coatings were characterized for the number average molecular weight, weight average molecular weight, and polydispersity of their binders. These parameters were evaluated after each of three freeze-thaw cycles.

A decrease in number average molecular weight and weight average molecular weight was determined, as well as an increase in polydispersity.

CORROSION—A COATING MANUFACTURER'S DILEMMA

Dean M. Berger, Gilbert/Commonwealth

Coating manufacturers have always been called upon to help solve corrosion problems. Environmentalists and government

regulations have caused dramatic changes in the fight against corrosion. Coating formulations are restricted on the use of certain solvents. Some pigments have been restricted, blast cleaning operations have been curtailed, and exotic methods of surface preparation are being explored.

Lining materials and protective coatings for SO₂ scrubber systems within power plants have virtually been noneffective. Research and development efforts need to emphasize coating systems designed to prevent corrosion.

SULFONATE AND PHOSPHATE CHEMISTRY TO IMPROVE CORROSION INHIBITION AND ADHESION

W.A. Higgins, Lubrizol Corp.

The search for improved corrosion inhibitors for use in protective coatings is a continuing effort. Discussed is what is believed to be a new method of formulating coatings to provide improved protection for corrosion prone metal surfaces. The various properties, both chemical and physical, of the basic alkaline earth sulfonates and polymeric organic phosphates that are responsible for this improved performance are discussed.

Data are presented illustrating the corrosion inhibiting effects of these materials in both water-based latex coatings and hydrocarbon soluble urethane type coatings.

APPLICATION OF PHOTOGONIOMETRY FOR THE CHARACTERIZATION OF THE REFLECTANCE PROPERTIES AND MORPHOLOGY COATINGS SYSTEMS

Thomas H. Grentzer, Richard M. Holsworth, and Theodore Provder, Glidden Coatings and Resins Div. of SCM Corp.

A photogoniometer allows the measurement of the reflectance properties of materials at various incident angles and as a function of observation angle whereas a gloss meter produces single point measurement at a fixed angle of incidence and observation. Our photogoniometer was constructed by modifying an early model Brice Phoenix Light Scattering Photometer. A scanning motor assembly was interfaced to the photometer to allow the photodetector to scan at a fixed rate over a wide range of observation angle. The sample mounting platform was modified via a locking mechanism that allows setting a fixed angle of incidence over the same range as that for the angle of observation. Electrical modifications were made in order to increase the signal-to-noise ratio and stability of the output. The output from the photogoniometer was interfaced to a mini-computer via a microprocessor, in order to speed up the data analysis procedure.

Some of the coatings systems analyzed with the photogoniometer include powder coatings, coil coatings, weathered exterior paints and interior semi-gloss systems. A computer program was written to deconvolute the diffuse and specular portions of the photogoniometer reflectance curves and statistically analyze the deconvoluted curves. These results are correlated to morphological characteristics of a sample (as determined by scanning electron microscopy), gloss characteristics, and paint formula composition.

USE AND MISUSE OF COMPUTERS IN COLOR CONTROL

Hugh R. Davidson, Davidson Colleagues

The use of computers for color formulation and control is most successful when good formulation, production methods, and sample preparation principles are followed. Troubles will arise in trying to control a color made with three yellows and white for example, regardless of what instruments, including the eye, are used. If the texture on a deep blue varies as another example, no instrumentation can control the color satisfactorily. Computations, however, can be very useful in identifying the problems and in testing possible solutions.

Good pigment calibrations are essential for good first formulations, but of equal importance is the operator's understanding of what constitutes good formulation with a particular application. In any case it is unlikely, regardless of how well the pigments are calibrated, that an initial formulation of a high quality coating will be sufficiently close to the standard. A batch correction will have to be made and it is here that most of the problems of computer color control arise. Production methods, sample preparation, sample measurement, and computer programs become critical. It is here that a "correct" batch add in a "reasonable" batch add may not be the same and that errors of texture may be mistaken for errors in pigmentation. Examples of these and other computer control problems are presented.

AMINO RESINS FOR HIGH SOLIDS COATINGS

Werner J. Blank, American Cyanamid Co.

High solids coatings are one of the more promising approaches to reduce solvent emission during application of industrial coatings. The low molecular weight oligomers used in these coatings require larger levels of cross-linking agents to achieve acceptable cross-linking density and film properties. Commercially used amino resins dependent on their structure cure either by a specific acid or general acid catalyzed mechanism. The nature of the catalyst used has a strong influence on the amount of functional groups available on an amino resin and the kind of cross-linked network which is formed during cure.

Computer simulation have shown a limited ability of general acid catalyzed amino resins to react with functional groups on the polymer backbone. The resulting network is one of predominate self condensation of the amino resin and limited coreaction with the polymer. Specific acid catalyzed amino resin on the other hand are more effective cross-linking agents and are able to react with most functional sites on the polymer. The film properties vary considerably with either type of cross-linking agents. There is also evidence that the network formed with weak acids catalyzed amino resins is of heterogeneous nature.

EFFECT OF ANTI-CORROSIVE PIGMENTATION ON THE PERFORMANCE OF VINYL SYSTEMS

**Thomas Ginsberg, Union Carbide Corp.,
John D. Keane and Joseph A. Bruno,
Steel Structures Painting Council**

High-performance vinyl systems for the protection of steel have often included anti-corrosive pigments containing lead and chromium. The anticipated trend toward formulating without those heavy metals prompted the Steel Structures Painting Council to investigate a number of potential replacement

pigments. These were incorporated, at constant PVC, in a well-known vinyl anticorrosive primer. Complete systems were then exposed to a variety of natural and accelerated environmental tests.

Results demonstrate that traditional anti-corrosive pigmentation can be substituted without detriment to the performance of the system.

ORGANIC COATINGS FAILURE ANALYSIS

Richard M. Holsworth, Glidden Coatings and Resins Div. of SCM Corp.

Optical microscopy and scanning electron microscopy (SEM) have become almost routine methods for coatings failure analysis. The use of energy dispersive x-ray analysis (EDXRA) with the SEM has made this combination invaluable for coatings failure analysis and coatings/substrate defects analysis.

Different metal substrates and metal surface pretreatments used in electrocoat and coil coating applications will be examined in light of possible coatings failure. The physical mechanism of can corrosion in lined beverage cans will be examined with possible reasons and sites for corrosion being discussed. Surface defacing conditions such as mildew in trade sales coatings as well as a specific "seeding" problem encountered in lab scale-up of a coating will also be discussed.

EXAMINATION OF WEATHERED COATINGS BY PHOTOELECTRON SPECTROSCOPY AND FOURIER TRANSFORM INFRARED SPECTROSCOPY

**Glenn P. Cunningham, PPG Industries, Inc., and
Charles M. Hansen, Scandinavian Paint and
Printing Ink Research Institute**

This paper reports the results of a preliminary study of exposed panels by Electron Spectroscopy for Chemical Analysis (ESCA) and Fourier Transform Infrared Spectroscopy (FT-IR). It shows that these techniques provide valuable information and insight into the earliest manifestations of weathering. This evidence is particularly significant since conventional dispersive infrared spectroscopy, scanning electron microscopy, and profilometry were unable to provide any indication of early signs of weathering. This detection is only possible because of the enhanced sensitivity of ESCA and FT-IR over conventional methods and techniques.

FACTORS AFFECTING THE DISTINCTION OF IMAGE (DOI) OF PAINTED FIBERGLASS REINFORCED REACTION INJECTED MOLDED (RRIM) URETHANE

Donald J. Hart, General Motors Research Laboratories

Differences in DOI of painted RRIM parts containing various glass reinforcement levels are due to attack of the RRIM by the primer solvent causing increased macro surface roughening of the substrate. This roughness, on the order of 50-200 μ , is telegraphed to both the primed surface and the topcoated surface. The solvent attack is due to the solubility characteristics of the RRIM and is accelerated by the glass reinforcement in the RRIM. Removal of N-methyl-2-pyrrolidone from the solvent formulation of the primer eliminates the solvent attack resulting in improved DOI for painted RRIM parts.

1981 PAINT INDUSTRIES' SHOW

EXHIBITORS

Cobo Hall
Detroit, Michigan
October 28, 29, 30

PAINT SHOW HOURS

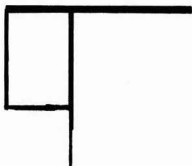
Wednesday, October 28
Thursday, October 29
Friday, October 30

12:30 to 5:30 pm
9:30 am to 5:00 pm
9:30 am to 4:00 pm

Exhibitors	Booth(s)	Exhibitors	Booth(s)
Aceto Chemical Co., Inc.	329	Diamond Shamrock Corp., Process Chems.	517-519
Air Products & Chemicals, Inc.	418-420	Diano Corp.	361-363
Aluminum Co. of America	642-644-741-743	D/L Laboratories	520
C.M. Ambrose Co.	262-264	Dominion Colour Co., Ltd.	851
American Hoechst Corp.	542-544-641-643	Dow Chemical USA	347-349-351
Applied Color Systems, Inc.	433-435-437	Dow Corning Corp.	563
Armstrong Containers, Inc.	561	Draiswerke, Inc.	241-243
Ashland Chemical Co.	524-526-528-530	Drew Chemical Corp., Spec. Chems.	846
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Beltron Corp.	129-131	Eiger Machinery, Inc.	655-657
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Brinkmann Instruments, Inc.	832	Elektro-Physik, Inc.	557
Brookfield Engineering Labs., Inc.	617	Encapsulair, Inc.	462
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Byk-Mallinckrodt Chem Prod GmbH	506-508-605-607	Epworth Mfg. Co., Inc.	618-620
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	823-825-827-829	Filter Specialists, Inc.	717-719
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		Henkel Corp.	148-150
Daniel Products Co.	334-336		
Degussa Corp.	341-343		

2048

Program Sessions
and Meeting Rooms



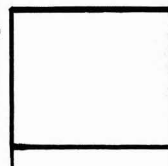
2043

Program Sessions
and Meeting Rooms



2040

Program Sessions
and Meeting Rooms



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350	449
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550	649
548	647

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752	851
750	849
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544	643
542	641

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642	741

744	843
742	841

SIDE ENTRANCE

138	237
136	235
134	233

238	337
236	335
234	333

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336	435
334	433

438	537
436	535
434	533

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536	635
534	633

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636	735
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Exhibitors	Booth(s)	Exhibitors	Booth(s)
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National Association Corrosion Engineers	828-830	University of Detroit	842-844
National Paint & Coatings Assn.	650	University of Missouri-Rolla	834
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Potters Industries	855		
PPG Industries, Inc.	356-358		
Premier Mill Corp.	223-225		

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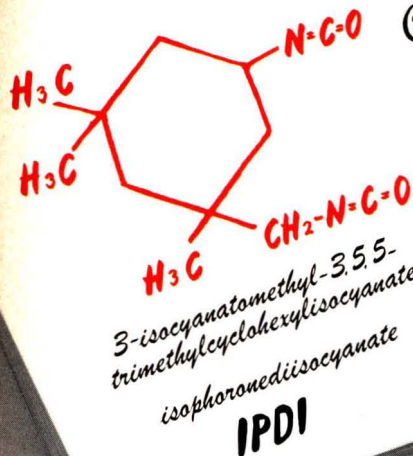
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② IPDI-H 3150 IPDI-H 2921	Oxyester T 1136 Oxyester V 2922 Polycaprolactones	Solvent-free coatings, PU compounds for technical articles	Soft and flexible to extremely hard compounds with good crack propagation resistance, permanent flexibility and yellowing resistance
③ IPDI-B 1065 IPDI-B 989 IPDI-B 1530 IPDI-BF 1540	Hydroxylated polyester Polyester 3353 Polyester 3356	Powder coatings Powder coatings Blocking-agent- free powder coatings	Coatings with good weather resistance, good flow and high gloss
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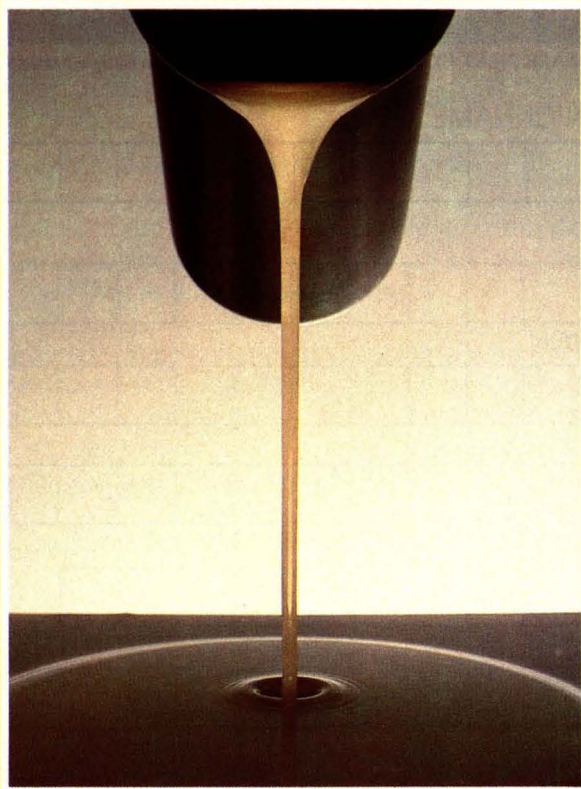
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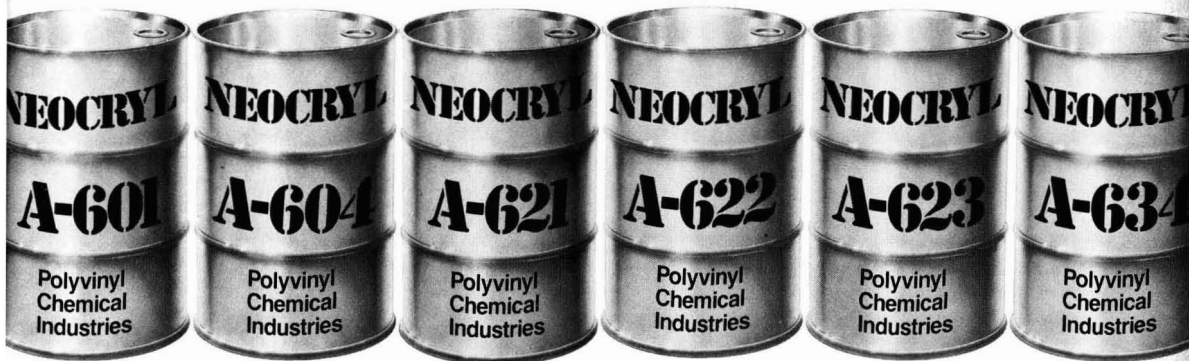
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Mildew Research By Consortium

Charles C. Yeager
Program Manager

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

Mildew problems have plagued the Paint Industry throughout history. The resolution of these problems has long been an individual matter. New attempts have been made to resolve these problems by consortium—the gathering together of the country's most knowledgeable microbiologists and paint chemists into a single committee. Its purpose is to direct the exploration of the entire problem and find the best and most economical ways to produce mildew resistant and/or funginert paint systems. The background, present status, initial results, and possible future programs are discussed.

INTRODUCTION

Although the use of preservatives was known as far back as the times of the Egyptians and Moses, it wasn't until 1940 that much attention was given to their use in paints. For that matter, very little was known of the effects of fungi on paint systems. The most commonly accepted procedure involved the use of certain pigments

to provide a small degree of protection. Zinc oxide and, in some instances, Paris Green were used to impart mildew resistance—too much and blistering occurred—too little and protection from mildew attack suffered.¹

In 1948, Goll and Coffey² reported the widespread growth of *Pullularia pullulans* (now *Aureobasidium pullulans*) as the principal organism affecting exterior paint films. This was confirmed in 1958 by Rothwell,³ who added *Cladosporium sp.* as predominating in certain areas. It was later found that these two organisms grew much better on weathered rather than unweathered films.

The *A. pullulans* appears on paint films in two forms, i.e., clusters of spherical dark colored spores or thread-like, filamentous structures. The form of growth is dependent upon the condition of the film and particular environmental conditions at time of observation. When weather conditions are proper for growth, the mycelial forms predominate. During dry weather, clusters of spores enable the organism to survive. Both forms may greatly disfigure the film to the point where repainting is necessary. Many untrained observers confuse the mildew growth with a dirty surface. Dirt can easily be removed, whereas mildew growth is much more difficult to remove. Such growth, if painted over, can erupt through the new coating.

For many years, paint manufacturers have added fungicides to their coating systems. This has most often been an individual thing. As a result, more chemical

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Presented at the 58th Annual Meeting of the Federation of Societies for Coatings Technology in Atlanta, GA., October 30, 1980.

agents have been recommended for the protection of exterior paint systems than for any other substrate. Some of the most important are as follows: Zinc oxide; Cuprous oxide; Barium metaborate; Phenylmercuric oleate; Di(phenylmercury)dodecylsuccinate; Phenylmercuric acetate; Bistributyltin oxide; 2,3,4,6-Tetrachlorophenol; 2,3,5,6-Tetrachloro-4-(methylsulfonyl)pyridine; N-(trichloromethylthio)phthalimide; N-(trichloromethylthio)4-cyclohexene-1,2-dicarboximid; 2,4,6-Dichloro-6(O-chloroaniline)-S-triazine; 1,2-Bis(N-propylsulfonyl)ethene; and 2-(4-Thiazolyl)benzimidazole. Others used in interior paints include chlorinated phenolics, Copper 8-quinolinolate, and quaternary ammonium compounds.

All mercurial compounds can be used in paint formulations in very small amounts for limiting bacterial growth in the paint can. Chlorinated phenolics are currently under study by the Environmental Protection Agency (EPA) and it is expected that their use in any package goods will be severely restricted. Although the list of fungicides is large, only a few are used in substantial quantities and even these are less than efficient. Weathering and lack of stability soon take their toll, further reducing the ability of the coating to withstand the onslaught of fungal organisms.

The search for new, biologically active compounds has been the subject of various cooperative studies.⁴ The result of this work reveals that the cost/performance effectiveness of the mercurials has not been matched by the proposed substitutes.⁵

In 1971, Pauli⁶ described as a "remote effect" the action required of a good paint fungicide. This is the ability of a fungicide to preserve surface properties even though the substrate is not directly affected. In 1974, Myers⁷ reported an evolutionary cycle of microorganism growth on an organic coating. The surface of the coating is defaced by surface growers before more severe attack occurred with the development of *A. pullulans*.

In this important area of mildew control, the entire paint industry has suffered severe setbacks. The EPA has banned the use of mercurials for most purposes and is purported to be planning to ban chlorophenolics. Canada has already severely restricted the use of this family of compounds. Bis(tributyltin)oxide has proven in many cases to be unstable in service; and most of the other available products are either much too expensive or affect important paint properties.

THE CONSORTIUM APPROACH

The Paint Research Institute has long recognized the need for an entirely new approach to the solution of mildew defacement. In 1978, it undertook the coordination of a consortium approach to the resolution of this important program. The word *consortium* means a coalition of organizations for a venture requiring the use of vast resources. Although in this instance the resources are somewhat less than vast, the word does serve to describe this PRI undertaking.

A committee was formed to sponsor and steer the new lines of research which were evolving. World authorities

on the microbiology and chemistry of paint, in cooperation with the National Paint and Coatings Association, agreed to provide the funds and advice necessary to launch these new programs. Several leading members of the paint industry, faced with severe government restrictions on their only effective anti-mildew compounds and few new additives to look forward to, are supporting new and ingenious research programs. These programs are expected to provide new funginert resin systems, quicker and more positive laboratory testing procedures, and a better understanding of the factors that make for more resistant coatings.

MILDEW RESISTANT RESIN SYSTEMS

In 1963, Gagliardi⁸ developed new resin systems that were purported to be funginert in some cases and fungicidal in others. His process utilized the functionality of resins such as methylolmelamine, urea formaldehyde, and acrylates. It utilized highly reactive compounds such as ethylene thiourea to which metals were attached. Several of these products are still used by the textile industry for such highly specialized products as shoe innersoles. Claims are made for the control of odor-causing microorganisms. It must be remembered that Gagliardi was interested in finishes that would react with cellulose, although his active acrylates are the only survivors today.

This idea of the development of resin systems that "fight back"—that are funginert enough so as to protect a paint film—has been carried further by Pittman.⁹ It is this work in which the consortium is interested. Pittman's ability to produce small but substantial amounts of fungistatic or fungicidal polymers has been the heart of this effort. He begins with the conversion of selected biocides, those containing a reactive group, into corresponding acrylates, 2-oxyethyl acrylates, and vinyl ether derivatives. The resultant monomers are then converted into targeted homopolymers, copolymers, and latices. Although he has prepared a variety of monomers, polymers, and latices of pentachlorophenyl acrylate, he has found it much more difficult to prepare the latices of other fungicidal monomers. Homopolymer emulsions and vinyl ether derivatives will apparently require considerable effort before satisfactory latex systems can be developed.

From the start, the aim of Pittman and his coworkers has been to chemically bind the fungicide into the polymer where it cannot vaporize, leach, or migrate from the paint. He has found that in some systems pentachlorophenol, though highly fungicidal itself, is so tightly bound by the resin system so as to produce no "zone of inhibition" or clear area around the film when tested in a Petri dish on a nutrient medium. This may or may not be a desirable characteristic. Although the paint film prepared from such a resin system may be inherently protected by the modified resin system so as to support no growth itself, it may have no protective effect to prevent mildew growth on the wood surface. Perhaps a slight amount of hydrolysis is desirable—a controlled release system.

In the Gagliardi work, the objective was to incorporate active metals into the resin molecule which then acted as a binder to hold the metal to a substrate. This is precisely Pittman's objective, but with organic moieties instead of metals. In the case of metallic fungicides, the metal is the active portion of the molecule. Few metals are biologically active enough to permit their use. The most active, Mercury, has been banned for most uses by the EPA, perhaps illogically, but nevertheless banned. Several metals impart such strong tinctorial effects that they are useless for white compounds. Zinc is a weak fungicide at best and must be used in extremely high quantities.

Silver is an extremely active, interesting metal that was considered at one time but is thought to be too expensive to use today. Silver may be more active than mercury and perhaps should be studied once again. If a pure silver coin were to be placed on a nutrient medium and inoculated with a spore culture of fungal organisms, a clear zone of inhibition would be easily seen around the coin. If analysis were made of the medium from this clear area, it would be almost impossible to find the silver ions. In other words, unbelievably few silver ions are producing this protective effect. Silver, which quickly blackens when sulfide ions in the air react readily with the silver ions, can be stabilized if incorporated into an acrylic polymer or copolymer.⁸

This interesting silver phenomenon is used to illustrate that perhaps we need this controlled release of antimicrobial substances to protect not only the paint film but the wood substrate as well. The current work at Alabama is directed toward a variety of such phenomena. It is now probable that Pittman's activities will disclose whether it is advisable to have (1) a system that does not hydrolyze (or release biocide) at all, (2) a system that hydrolyzes or releases biocide slowly, or (3) a system that readily hydrolyzes or releases its fungicide.

A TESTING INNOVATION

As with any physical or chemical process or property, it is essential that an effective testing program be available to prove, without question, the soundness of the principle involved. For that reason, the consortium has undertaken support of a testing program at State University of New York that will permit accelerated testing of paint films to closely approximate what happens on test fences in outdoor exposure. Zabel et al.^{10,11} have already been able to obtain growth of *Aureobasidium pullulans* in the laboratory that approximates what usually takes place outside only after months of exposure. We have previously stated that *Pullularia pullulans* (*A. pullulans*) and *Cladosporium sp.* grow much better on weathered rather than on unweathered films. Zabel is now able to produce this highly characteristic growth on wood chips in the laboratory in laboratory equipment in short periods of time. Since *A. pullulans* is the principal culprit in the defacement of paint films under exposure, this presents a real breakthrough for the industry.

Zabel's work, which perhaps would never have been undertaken by even a highly motivated industrial pro-

ducer, has revealed some interesting aspects to the mildew defacement problem. He found that sapwood extracts, pollen extracts, and paint extracts support substantial *A. pullulans* growth when they are the sole carbon sources. Moderate *A. pullulans* growth develops on the unleached paint films, but not on the leached films. This indicates that the paint leachate is the carbon source for growth.

The test consists of sterilized pine and hardwood veneers painted with one thick coat of latex paint. The painted strips are sterilized by steaming at 100°C, and then inserted vertically into French square bottles containing vermiculite moistened with 100 ml of a nutrient solution. The bottom of the painted area is ¼ in. above the vermiculite, and the spore suspension is introduced down the exposed surface.

This is a brief and incomplete description of the present procedure, but it serves to illustrate the simplicity and uniqueness of the procedure. Growth is first visible in two weeks and intensifies until about two months. Ratings can be assigned either visually or with the use of a reflectometer.

DR. CHARLES C. YEAGER has been active in the preservation field since 1945. An Edward Austin Fellow at Harvard University, he has served as a Plant Pathologist with the USDA and Chief of the Fungal Control Unit with the US Air Force. For 29 years, he was Technical Director, Technical Vice-President and Registration Manager with Scientific Chemicals (later Ventron Corp.). In 1974, he formed his own business as a Registration Consultant, assisting pesticide manufacturers with their registrations with EPA, Canada, and the various states.



CONTROL OF CELL WALL BIOSYNTHESIS

The third and most controversial program is one that few individual companies, if any, would support on their own. Entitled "Control of Cell Wall Biosynthesis in *Aureobasidium pullulans*," it was undertaken by Siehr et al. at University of Missouri-Rolla. This work embraces the study of the composition of the cell wall of the organism and its biosynthesis. Its end result, presumably, is the basis of an assay procedure for screening of fungicides interfering with cell wall biosynthesis.

Because of the pure scientific aspects of this program, only a consortium approach would make any real sense. The mechanism of action of many fungicides has been studied by various academic and governmental laboratories for at least 30 years. Few theories agree and fewer still go beyond the most rudimentary phases. Horsfall's "shaped-charge" theory is probably the most widely accepted. The shape and nature of the fungicide enable it to pass through the cell wall and interfere with the chemical processes which continually are going on in the cell. Others put the emphasis on the nature of the cell wall; still others, on the nature of the cell membrane.

It's an interesting research project and will require considerably more financial support than even the largest industrial grant is willing to spend. Perhaps if an industry-wide consortium were to decide that they wanted to resolve this age-old problem, we would be able to learn the chemical secrets of the fungal cell once and for all. The financial burden would be a great one.

CONCLUSIONS

The cost of research is rapidly becoming prohibitive for even the largest companies. No one can fully justify the support of basic problems still unsolved. Therefore, it behooves each of us to join in a combined effort to resolve these problems. All of us can greatly benefit by pooling our efforts. If suppliers and producers would join in a united effort, their overtaxed research staff could spend their time most profitably in formulation and improvement of their product line.

The Mildew Consortium is a small, highly motivated group that has already demonstrated its ability to support and direct several programs of a basic nature. It is quite possible that from this work will come new fungicidal resin systems ideally suited for paint formulation. Already it is apparent that we have a new testing tool that will soon be available to the industry. This should encourage all of us to seriously consider the consortium approach.

SUMMARY

For years, paint manufacturers and suppliers to that industry have conducted their own research and jealously guarded the results thereof. Many fungicidal compounds have been used to prevent defacement of the paint film. Since the formation of the EPA in 1968, this list of potential preservatives has been slowly whittled down to the point where we have few choices today.

Research is becoming a prohibitive expense. It therefore behooves us to consider pooling our resources. The

Mildew Consortium Steering Committee of the PRI is just such an attempt. Three programs are currently in progress: (1) the synthesis of new fungicidal or fungicidal acrylic resins; (2) the development of a new accelerated testing method that more closely approximates outdoor exposure; and (3) the mechanism of action of fungicides in interfering with cell wall development. This is a small effort backed by limited funds; but because of a dynamic and highly knowledgeable committee, it is working. It might easily serve as a model for future joint efforts by the paint industry.

ACKNOWLEDGMENTS

The author wishes to thank Thiokol Corp./Ventron Div. for its help in providing background data on the Gagliardi research. He is also grateful for the opportunity to be associated in this consortium effort with some of the most knowledgeable and energetic scientists with whom it has been his privilege to work.

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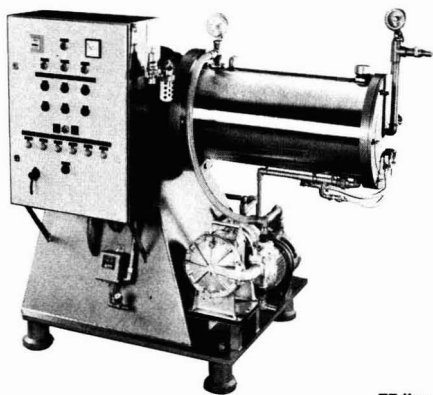
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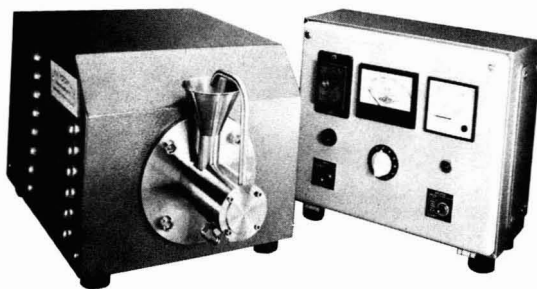
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Aluminum Organic Compounds In High Solids Alkyd Coatings

D.J. Love
Manchem Limited*

Rule 1113 of the California Air Resources Board (CARB) regulations dictates that the volatile organic matter in architectural coatings shall not exceed 250 grams per litre. High solids coatings which conform to this rule and which are based on traditionally formulated alkyds, will suffer from slow drying and poor through-dry. In this paper it is shown that this poor drying, even in thick films, is improved greatly by the addition of certain aluminum organic compounds which give rise to crosslinking, in addition to the autooxidative crosslinking of the alkyds.

Additional benefits, including superior gloss retention, delayed chalking, and resistance to yellowing in the dark, are also conferred by using such aluminum compounds.

INTRODUCTION

Presently in Europe and the USA, the paint industry is being pressured to produce products with much lower solvent content than before. This is partly due to the ever increasing cost of raw materials but mainly due to

legislation which has been enacted to improve health and the environment. For example, the California Air Resources Board (CARB) is about to enforce a regulation (Rule 1113) which will limit volatile organic content or VOC to less than 250g/litre for architectural coatings. Alkyd based paints today contain anything from 350–500g/litre, and will, therefore, have to undergo dramatic reformulation if they are to conform to such regulations.

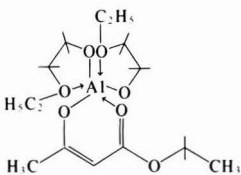
It may seem a relatively simple matter to produce high solids alkyd paints—just reduce the intrinsic viscosity, i.e., reduce the molecular weight, and leave out solvent. However, low viscosity versions of currently available alkyds when used with conventional drier systems will give much slower drying rates, very poor through-dry, and very soft films. Consequently, the resin and paint technologist will have to resort to various modifications to obtain the desired properties. Such modifications could be the use of certain aluminum complexes which have been shown^{1,2} to give greatly improved through-dry and hardness, but can also improve durability and resistance to in-dark yellowing.² Results are given here of experiments to upgrade the drying performance of high solids alkyd paints using a proprietary aluminum complex alkyd modifier. Four commercial alkyds were tested, one with linseed oil as a co-binder.

This aluminum compound is a solution of aluminum ethyl acetoacetato di-2 ethoxyethoxide (AEDE) in 2-ethoxy ethanol.

*Ashton New Road, Manchester M11 4AT, England.
Presented at the 1981 Western Coatings Societies Symposium, March 5, 1981, in Anaheim, CA.

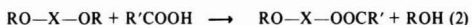
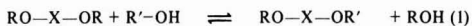
Table 1—Descriptions of Commercial Alkyls and Linseed Oil Used

A1	.....77% soya/o-phthalic alkyl. Acid value 6–10 mg KOH/g. Nonvolatile content of 2 poise solution (in mineral spirit at 25°C) : 79%
A2	.....72.5% linseed/o-phthalic alkyl. Acid value 10 mg KOH/g maximum. Nonvolatile content of 2 poise solution (in mineral spirit at 25°C) : 75%
A3	.....75% linoleic rich/o-phthalic/pentaerythritol alkyl. Acid value 10–15 mg KOH/g. Nonvolatile content of 2 poise solution (in mineral spirit at 25°C) : 80%
A4	.....65% linoleic rich/o-phthalic/pentaerythritol alkyl. Acid value 10 mg KOH/g maximum. Nonvolatile content of 2 poise solution (in mineral spirit at 25°C) : 62%
Linseed Oil	.....Alkali refined to BS242 1969. Acid value 4 mg KOH/g maximum



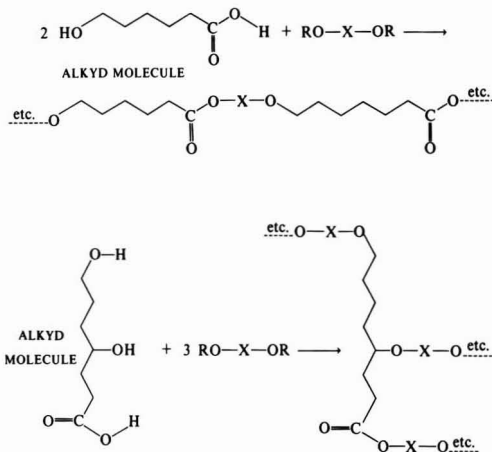
In considering reactions of AEDE with alkyls it is convenient to depict it simply as the dialkoxide RO—X—OR.

When AEDE is added to an alkyl solution the alkoxide groupings undergo displacement through reaction with hydroxyl and carboxyl groups. The chelating group (ethyl acetacetate) is believed not to be displaced under ambient conditions.



Since many of the alkyl molecules will be polyfunctional (difunctional, trifunctional, etc.) such reactions

lead to increases in viscosity, and gelation is observed in most alkyls. Examples of such reactions are shown below:



However, some commercially available alkyls have sufficiently low average molecular weights so that stable compositions with good viscosity characteristics can be produced. A rough but very useful rule is that: medium to long oil alkyls, which have solids of greater than 60%, when thinned to 2 poise in mineral spirits, will most probably give stable compositions with AEDE. Whereas if the solids content is less than 60% at 2 poise: compositions will probably be unstable, i.e., they will gel or give unacceptable viscosity increases on storage.

It is generally found that optimum performance is achieved when using AEDE at levels equivalent to about 2% aluminum metal on solid alkyl. Converting this concentration into alkoxide function and expressing as mg KOH/g we obtain:

Table 2—Paint Formulations

Paint code	1a	1b	2a	2b	3a	3b	4a	4b
Alkyd A1	50.40	44.90	—	—	—	—	—	—
Alkyd A2	—	—	48.94	45.23	—	—	—	—
Alkyd A3	—	—	—	—	47.70	42.60	—	—
Alkyd A4	—	—	—	—	—	—	39.03	34.39
Linseed oil	—	—	—	—	—	—	16.81	14.81
Rutile titanium dioxide	39.48	35.17	37.83	34.96	38.13	34.08	38.43	33.86
Mineral spirit	8.39	5.50	11.54	5.46	12.50	9.35	4.05	3.02
Methyl ethyl ketoxime	0.19	0.17	0.19	0.18	0.18	0.16	0.19	0.16
Cobalt 10% synthetic drier	0.30	0.26	0.29	0.26	0.29	0.26	0.29	0.26
Zirconium 18% synthetic drier	0.25	—	0.26	—	0.24	—	0.24	—
Calcium 10% synthetic drier	0.99	—	0.95	—	0.96	—	0.96	—
Alusec 510	—	14.00	—	13.91	—	13.55	—	13.50
	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>
SG @ 25°C	1.39	1.36	1.35	1.36	1.34	1.32	1.35	1.31
VOC (g/litre)	136	207	182	211	179	241	172	246
Viscosity poise @ 25°C	5.4	5.2	4.0	5.0	4.9	4.7	5.0	4.9
% Aluminum metal on binder	NIL	2	NIL	2	NIL	2	NIL	2
% Cobalt metal on binder	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
% Calcium metal on binder	0.2	NIL	0.2	NIL	0.2	NIL	0.2	NIL
% Zirconium metal on binder	0.09	NIL	0.09	NIL	0.09	NIL	0.09	NIL

$$\frac{2}{27} \cdot 2 \cdot \frac{56100}{100} = 83.1 \text{ mg KOH/g}$$

In most medium to long oil alkyds this concentration of alkoxide will be equal to or slightly greater than the level of total reactive groupings, i.e., carboxyl and hydroxyl. For example, in an alkyd with an acid value of 10 mg KOH/g and an hydroxyl value of 60 mg KOH/g, 2% aluminum will represent approximately 20% excess of alkoxide over reactive groups, as shown below:

$$\frac{\text{alkoxide}}{\text{carboxyl} + \text{hydroxyl}} \cdot 100 = \frac{83}{70} \cdot 100 = 119\%$$

It is expected that in practice most of the carboxyl groups will react but, because the hydroxyl/aluminum alkoxide reaction is a reversible one, only some of the hydroxyl groups will displace 2-ethoxy ethanol in the can. In the drying paint film, 2-ethoxy ethanol is lost by evaporation, and the reaction of alkyd hydroxyls with AEDE proceeds to completion. This is believed to be the mechanism responsible for the good through-drying of AEDE modified paints.

EXPERIMENTAL

Selection of Resins

Three commercial alkyds were selected, on the basis that (1) they gave stable compositions with AEDE and (2) their viscosity was low enough to make it probable that the resultant paints with AEDE would have VOC's less than 250g/litre. Table 1 gives the manufacturer's description of each resin.

A fourth resin was also chosen which gave stable compositions with AEDE but was too viscous to give the low VOC's which were required. It was, therefore, used in conjunction with alkali refined linseed oil at a level which gave the desired high solids (35% linseed oil on total binder).

Paint Preparation

Four white base paints were made by ball mill, from a chloride process exterior grade titanium dioxide, and the

Table 3—Nonvolatile Contents of Paint Ingredients

A1	99%
A2	100%
A3	100%
A4	80%
Alusec 510®	36.6% ^a
Cobalt 10% synthetic drier	48%
Zirconium 18% synthetic drier	55%
Calcium 10% synthetic drier	50%

(a) Theoretical contribution to solids of dry film, i.e., Al(EAA)(OR)₂ → Al(EAA) —

above mentioned low viscosity alkyds, at a pigment binder ratio of 0.8:1. The minimum amount of mineral spirits was used consistent with good milling.

Each base paint was divided into two portions. To one were added cobalt, zirconium, and calcium driers and to the other cobalt drier and AEDE at the 2% aluminum on binder level. The paints were then diluted to a brushing viscosity by addition of mineral spirit. The final paint formulations and the paint characteristics are given in Table 2.

VOC Calculations

The volatile content (w/w) of each paint was calculated from the formulation and the nonvolatile contents of the components (see Table 3). Finally, from the volatile content and the paint specific gravity the VOC for each paint was calculated.

Drying Rate Determination

After a maturation time of about two weeks, the drying rate of each paint was assessed with a Beck Koller drying recorder using thin (38 micron) and thick (76 micron) wet films under ambient and adverse drying conditions. The ambient conditions were those of a UK laboratory and the adverse conditions were obtained in a climate controlled cabinet set of 5°C and 80% relative humidity. The drying tests were carried out in triplicate and the mean values reported.

Table 4—Beck Koller Recorder Results

Paint	Ambient ^a								5°C/80% R.H.							
	38μ				76μ				38μ				76μ			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1a	4.1	4.1	8.4	>22	4.6	4.6	>22	—	24.7	26.3	28.8	32.7	27.3	27.3	>44	—
1b	3.9	4.6	5.9	8.6	4.7	5.0	8.0	18.1	19.1	22.0	25.0	35.1	22.3	23.8	34.8	>44
2a	2.8	2.8	>22	—	1.5	2.9	>22	—	9.7	10.9	>44	—	12.4	12.4	>44	—
2b	2.2	2.4	8.8	15.7	3.1	3.1	>22	—	7.7	9.9	19.5	28.2	11.4	11.4	>44	—
3a	4.0	4.2	8.2	12.2	5.9	5.9	>22	—	33.6	36.3	38.9	>44	38.9	38.9	>45	—
3b	2.9	4.3	5.8	9.4	4.3	6.7	10.3	17.6	2.2	18.3	22.3	31.6	4.9	25.4	>45	—
4a	2.8	2.8	8.1	8.1	3.6	3.6	>22	—	10.8	12.3	14.9	22.7	12.7	12.7	20.1	>43.1
4b	1.7	2.2	3.1	6.5	2.3	2.6	7.5	>22	4.7	7.4	8.8	10.3	5.8	7.9	16.6	>43.3

The times to end of drying stages 1, 2, 3, and 4 are given in hours and tenths of hours.

(a) 20–25°C/45–60% Relative humidity.

Table 5—König Hardness

Paint	(21–24° C/45–60% Relative Humidity)			
	1 day	7 days	14 days	21 days
1a	6.6	6.0	—	5.8
1b	13.4	13.3	—	14.5
2a	4.2	7.4	—	6.4
2b	5.8	10.2	—	10.5
3a	6.8	16.3	—	11.6
3b	12.8	28.7	—	27.9
4a	7.0	6.9	7.0	—
4b	11.1	12.3	13.6	—

Glass = 100

Hardening Rate

The rate at which the films continued to harden after the initial drying times, and the final hardness under ambient conditions, were studied using the König hardness pendulum.

RESULTS AND DISCUSSION

Volatile Organic Content

All the paints prepared had VOC's below the CARB maximum of 250g/litre at brushing viscosities.

Drying Speed

In the Beck Koller recorder, 6 styli are pulled at a steady rate through freshly cast paint films at a given wet film thickness (38 micron or 76 micron) on 12" × 1" glass slides. The time taken to travel the full length of the slides can be varied. We used 24 hour and 48 hour settings in our work; the longer time was necessary to accommodate the very long drying times obtained under adverse conditions.

The drying stages identified by the recorder are:

STAGE 1: The paint is still liquid and will flow back into the track made by the moving stylus. The end of this stage corresponds approximately to the wet edge time.

STAGE 2: The paint has gelled but has little strength and is tacky. The stylus leaves a definite groove down to the substrate.

STAGE 3: The paint was dried on the surface to give a skin but is still soft and tacky below. The stylus tears the skin. Dust-free and tack-free conditions are usually reached during this stage.

STAGE 4: The surface is sufficiently dry to resist tearing but is scratched slightly by the stylus.

STAGE 5: The film is sufficiently hard to be unmarked by the stylus and can be considered as being hard dry.

Most paints based on medium to long oil alkyds will exhibit the above stages but, in a few paints, one or more stages may be missing. It is usual to record the times taken for the paint to reach the ends of stages 1, 2, 3, and 4, but examination of the track left by the stylus can also give useful qualitative information. For example, the through-dry character of a paint may be assessed by studying the extent of tearing and wrinkling caused by the stylus while the paint is in the Stage 3 condition of dry, and also by examination of the underlying wet paint.

The Beck Koller drying results are given in Table 4. From the results it can be seen that, in general, significant reductions in drying times have been achieved by the use of AEDE with cobalt drier in place of the conventional cobalt/zirconium/calcium drier system. This improvement is seen under adverse drying conditions and in thick films, with the exception of paint 2b (linseed alkyd) which only showed improvements in the thin film. The ability of these paints to give quite satisfactory drying in thick film is evidence of the marked contribution to through-drying to be found when using AEDE.

In most cases the drying tracks showed much reduced tearing and wrinkling in Stage 3, when AEDE was present—which was further evidence for improved through-dry.

The drying speeds obtained for paint 4b were very good despite the very high level of linseed oil. The addition of drying oils could, therefore, be a very useful way of increasing non-volatile content without unduly affecting drying performance if AEDE is used.

Hardness

The König hardness results obtained for 50 micron wet films after one, seven and 21 days drying are shown in Table 5. It is quite clear that the addition of AEDE has greatly increased the hardness of these otherwise very soft paint films. Maximum hardness was achieved after about seven days.

CONCLUSIONS

It can be concluded from these results that aluminum ethyl acetoacetato di-2-ethoxy ethoxide modified alkyds (with or without linseed oil) can be used to make paints with much lower VOC's than hitherto encountered while having much better drying properties than would be obtained from the currently available low viscosity alkyds alone.

References

- (1) Turner, J. H. W., Paper given at 11th FATIPEC Congress. 1971.
- (2) Love, D. J., *J. Oil. Colour Chem. Assoc.*, 60, 214–221 (1977).

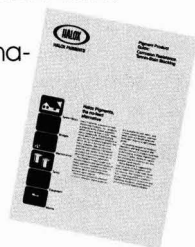
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Evaporation and Vapor Diffusion Resistance In Permeation Measurements by the Cup Method

Erik Nilsson and Charles M. Hansen
Scandinavian Paint and Printing Ink Research Institute*

The permeation of water through coatings and other materials is an important factor in their performance. The cup method, frequently used to determine permeability coefficients, inherently involves certain experimental effects which generally have not been recognized, and which are not mentioned in international standards, etc.

A simple method to account for inherent cup effects in permeation experiments is described. This method is necessary to properly interpret data for acrylic stains, wood, paper, and other relatively permeable materials. Surface resistances to permeation can not be determined without considering these effects.

An improved simple method to determine vapor phase (water/air) permeation or diffusion coefficients is suggested and demonstrated with examples.

INTRODUCTION

Permeation cup experiments are often used to evaluate the water vapor transmission properties of coatings and films.¹ The method is simple, rapid, and studies can be done with a relatively large number of samples at the same time. Assuming the films are sealed properly in the cups, all that remains is to follow weight loss with time as water escapes through the film of known thickness (and sufficient dimensional stability).

If it is assumed that the equilibrium water vapor transport rate is inversely proportional to film thickness

and that the concentrations in the film surfaces are proportional to vapor pressure, the following equation for the permeability coefficient, P , for a given temperature can be written as:

$$P = \frac{G \cdot d}{A \cdot t \cdot \Delta p} \quad (1)$$

P = Permeability coefficient ($\text{g} \cdot \text{cm}/(\text{cm}^2 \cdot \text{Pa} \cdot \text{s})$)

G = (equilibrium) water transport (g)

d = film thickness (cm)

Δp = ($p_1 - p_2$) where p_1 and p_2 are the partial pressures of the water vapor on opposite sides of the film (Pa)

A = surface area of sample (cm^2)

t = time of the experiment (s)

Unfortunately, it has been found that permeability constants obtained in this manner often vary with film thickness. This implies that there are other significant resistances in the system other than the resistance of the film. A special method has been developed to account for this effect.²⁻⁴ This method is demonstrated in detail below. Paper "films" have been used in this demonstration to determine several of the parameters with greater accuracy.

DISCUSSION

Method for Determining "True" Permeation Coefficients

The cup experiment, as schematically shown in Figure 1, consists of a number of resistances in series. The flux of water, F , can then be written as

$$F = \frac{\Delta p}{\frac{L}{P} + R_1 + R_2 + R_3} = \frac{\text{driving force}}{\text{sum of resistance}} \quad (2)$$

thus the resistances can be expressed by

* Agern Alle 3, DK 2970 Horsholm, Denmark.
Presented by Dr. Hansen at the 58th Annual Meeting of the Federation of Societies for Coatings Technology in Atlanta, GA, October 30, 1980.

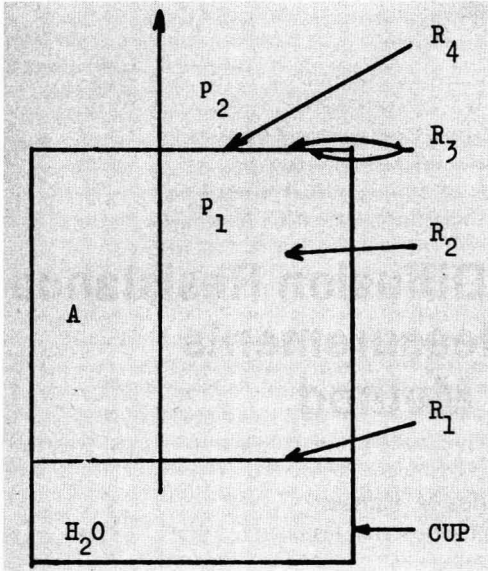


Figure 1—Resistances to water vapor flow in permeation cup experiments. R_1 - water evaporation, R_2 - air gap diffusion, R_3 - film surface resistances, R_4 - film resistance

Table 1—Examples of “True” Permeability Coefficients (P_∞) and Resistance ($R_1 + R_2 + R_3$)

Coating	P_∞	$R_1 + R_2 + R_3$	L_e (Microns)
Alkyd	$10(10)^{-14}$	0^b	—
Alkyd	$14(10)^{-14}$	0^b	—
Alkyd	$10(10)^{-14}$	0^b	—
Alkyd ^d	$6.9(10)^{-14}$	$1.8(10)^{10}$	12
Acrylic ^c , pigmented, white (NIF) 406	$100(10)^{-14}$	$0.18(10)^{10}$	18
Acrylic ^c , clear	$24(10)^{-14}$	$0.33(10)^{10}$	8
Acrylic ^c , pigmented, dark green	$53(10)^{-14}$	$0.35(10)^{10}$	19
Chlorinated rubber ^a	$6.67(10)^{-14}$	$7.8(10)^{10}$	52
Epoxy ^a	$7.4(10)^{-14}$	$7.8(10)^{10}$	58
Urethane ^a	$18.2(10)^{-14}$	$7.8(10)^{10}$	142
Wood (Pine), fiber direction	$118(10)^{-11}$	$0.12(10)^{10}$	14160
Wood (Pine), radial direction	$14(10)^{-11}$	0^b	—
Paper	$2.5(10)^{-11}$	$0.12(10)^{10}$	300

(a) Values found from data of Funke.⁵ Solvent retention may be the cause of a pseudo-surface effect here with thicker films retaining more solvent, which in turn plasticizes them more than the thinner films.
 (b) Can not be found with those film thicknesses commonly used in coatings.
 (c) The acrylic coatings are latex based.

$$\frac{L}{\bar{P}} = \frac{L}{P_\infty} + R_1 + R_2 + R_3 \quad (3)$$

and

$$\frac{1}{\bar{P}} = \frac{1}{P_\infty} + \frac{1}{L} (R_1 + R_2 + R_3) = \frac{1}{P_\infty} + \frac{1}{L} (\Sigma R_i) \quad (4)$$

here

- F = Flux ($g/s \cdot cm^2$)
- L = film thickness (cm)
- \bar{P} = apparent permeation coefficient found from equation (1) ($g \cdot cm$)/($cm^2 \cdot s \cdot Pa$)
- P_∞ = “True” permeation coefficient ($g \cdot cm$)/($cm^2 \cdot s \cdot Pa$)
- R_1 - R_4 = Various resistances as defined in Figure 1. ($cm^2 \cdot s \cdot Pa/g$)

According to equation (4), a plot of $(\bar{P})^{-1}$ vs $(L)^{-1}$ should give a straight line with an intercept of $(P_\infty)^{-1}$ and a slope equal to the sum of the other resistances in the system. Figure 2, which shows data for paper, and Table 1, confirm that many such permeation evaluations yield a combination of resistance in the film itself and other resistances in the cup or at the film surface. How to evaluate these resistances individually is demonstrated below. The relative importance of the cup and surface resistances can be seen in the third column in Table 1. This column gives the equivalent film thickness L_e at which $(R_1 + R_2 + R_3)$ is equal to the diffusional resistance within the film. This is readily found from

$$\frac{L_e}{P_\infty} = R_1 + R_2 + R_3$$

Diffusion coefficients, D , for water in these films have not been determined. This could have been done by independently measuring the water solubilities, S , and using the equation

$$D = \frac{P_\infty}{S}$$

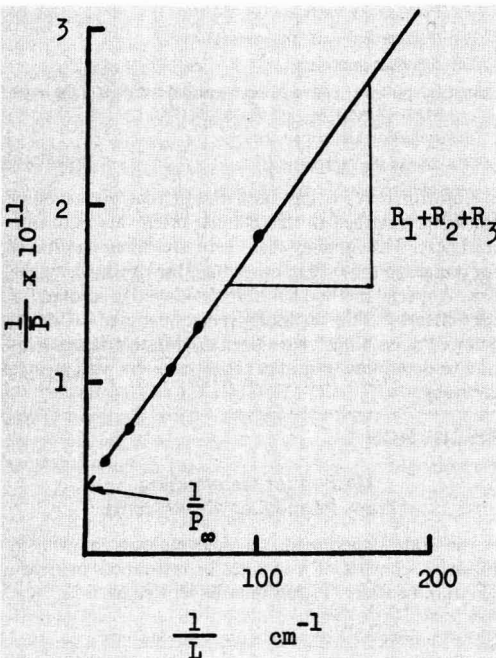


Figure 2—Water vapor permeability of paper at $23 \pm 2^\circ C$, $50 \pm 4\% RH$. L is paper thickness. $P_\infty = 2.5 (10)^{-11}$, $(R_1 + R_2 + R_3) = 1.2 (10)^9$, cups were metal

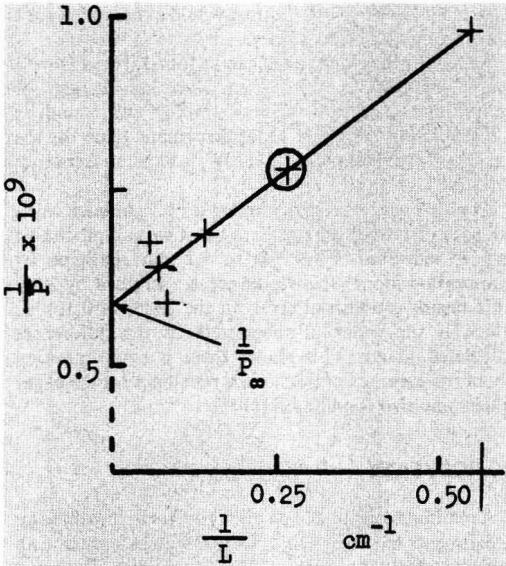


Figure 3—Determination of water vapor permeability in air at $23 \pm 2^\circ\text{C}$, $50 \pm 4\%$ RH. L = air gap thickness. $P_\infty = 1.69 (10)^{-9}$. Cups were glass. A single paper film was placed over the cup

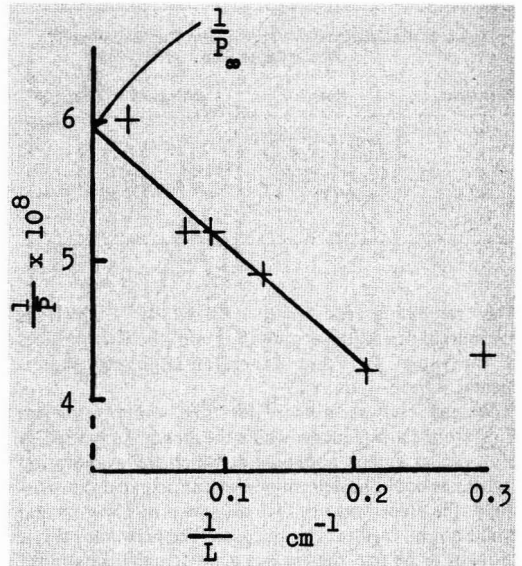


Figure 4—Determination of water vapor permeability in air at $23 \pm 2^\circ\text{C}$, $50 \pm 4\%$ RH by "free" evaporation. $P_\infty = 1.67 (10)^{-9}$. Cups were glass with no paper film. L = air gap length

Determination of P_∞ and the Diffusion Coefficient for Water Vapor in Still Air

A modification of the procedure described above allows for an evaluation of the permeation coefficient for water vapor in air. If one varies the length of the air gap in the "cup" while maintaining a constant "film" thickness, the same procedure can be used to extrapolate to $(P_\infty)^{-1}$ for water vapor in air. The "film" chosen was paper and its resistance remains a constant in each experiment. The data presented in Figure 3 demonstrate this procedure is valid yielding a P_∞ for water vapor in air of $1.69 (10)^{-9}$ ($\text{g} \cdot \text{cm}) / (\text{cm}^2 \cdot \text{s} \cdot \text{Pa})$. Note that the "cups" were made from glass. The diffusion coefficient for water in still air can be calculated from this permeation coefficient using the above equation. The solubility coefficient found from literature data at 23°C for saturated air

$$S = \frac{\text{Saturated water concentration}}{\text{Vapor Pressure at saturation}} = \frac{C_{\text{sat}}}{P_{\text{sat}}}$$

$$= \frac{20.5(10)^{-6}}{2809} = 7.3(10)^{-9} \frac{\text{g}}{\text{cm}^3 \text{ Pa}}$$

$$D = \frac{P_\infty}{S} = \frac{1.69(10)^{-9}}{7.3 (10)^{-9}} = .23 \frac{\text{cm}^2}{\text{sec}}$$

This value is in good agreement with literature data.

Determination of Surface Evaporation Resistance and Film Surface Resistances

At this time one experimental point in Figure 3 is considered in detail. That point has been circled in the figure. The data for this point are:

$$\bar{P} = 1.28(10)^{-9}$$

$$L = 3.66 \text{ cm}$$

$$\Sigma R_{\text{tot}} = \frac{L}{\bar{P}} = \frac{3.66}{1.28(10)^{-9}} = 2.86 \times 10^9$$

The resistance in the air gap is:

$$R_2 = \frac{L}{P_\infty} = \frac{3.66}{1.69(10)^{-9}} = 2.17(10)^9$$

The resistance in the 50 micron thick paper film is (P_∞ from Figure 1):

$$R_4 = \frac{L}{P_\infty} = \frac{5 \times 10^{-3}}{2.5(10)^{-11}} = 0.2(10)^9$$

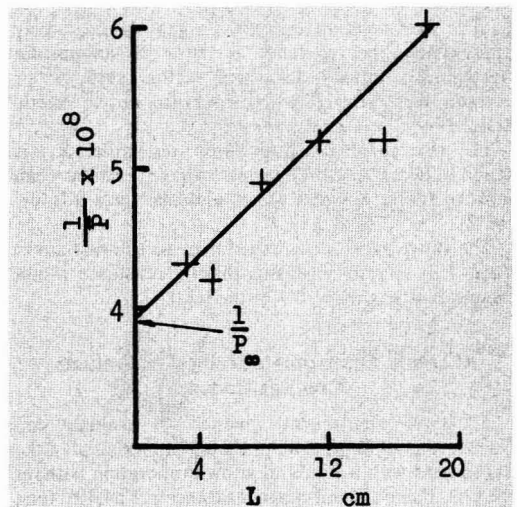


Figure 5—Determination of resistance to water evaporation for "free" evaporation at $23 \pm 2^\circ\text{C}$, $50 \pm 4\%$ RH. $(\bar{P})^{-1} = 0.39 (10)^9$ at $L = 0$ where L is air gap length

Table 2—Resistances in a Permeation Cup Experiment With a Paper Film

Resistance	Nature	value (cm ² · s · Pa/g) · 10 ⁻⁹
R ₁	Water evaporation	0.39
R ₂	Air gap (3.66 cm)	2.17
R ₃	Paper surfaces	0.10
R ₄	Paper (50 μ)	0.20
ΣR		2.86

The remaining resistance is $0.49(10)^9$, which is attributable to water evaporation and the two surfaces of the paper. To separate these an additional experimental series is required.

Weight loss was followed for "free" evaporation (no film) from glass cylinders where the air gap was varied. A plot similar to the above from which the evaporation resistance could be determined was anticipated. Surprisingly, the slope was negative as shown in *Figure 4* and could not be used for this purpose. The reason for this is thought to be that the various glass cylinders contained differing amounts of water to adjust the air gap length. The heat required for the evaporation could not be supplied uniformly enough through the glass. This was not observed in the previous experiments, presumably because the evaporation rates were slower since there was a layer of paper present. At any rate, this problem does not occur with our metal cups, which should be sufficient warning for the need to thoroughly study a given permeation cup being used for a given purpose. One can criticize the free evaporation experiment from several points of view⁶ but the extrapolated value (in *Figure 4*) of $(P_{\infty})^{-1}$ gives P_{∞} for water vapor in air of $1.67(10)^{-9}$ which agrees well with the data using a paper film found in *Figure 3*. These data are also in agreement with literature values.⁷⁻⁹

The data in *Figure 4* are replotted in *Figure 5* as $(\bar{P})^{-1}$ vs L . The extrapolation to zero air gap should closely approximate the resistance at the water/air surface (recognizing various disturbing factors such as air currents, etc. in the climatized room can not be exactly defined).

The (extrapolated) evaporation resistance, R_1 , is found to be $0.39(10)^9$. The paper surface resistances can now be found by subtraction, and one finds $0.1(10)^9$ for R_3 .

The above data for this experiment are summarized in *Table 2*. It appears surprising that the resistance within the paper is less than 10% of the total.

Alternate Approximate Method to Evaluate Cup Resistance

A simple approximate method to evaluate cup resistance is to fill the cup to the water level used in the experiment with a film and allow evaporation without the film. Using a metal cup, a resistance of $1.04(10)^9$ for a 1 cm air gap was found. If one calculates the expected resistance from P_{∞} for water vapor in air as determined above, a value of $0.59(10)^9$ is found as R_2 . For

$R_1 = 0.39(10)^9$ (in *Table 2*), one would expect $0.98(10)^9$. The agreement is satisfactory.

An additional comparison can be found from *Figure 2* where metal cups were used with an air gap of approximately 1 cm. ($R_1 + R_2 + R_3$) was found as $1.2(10)^9$. Subtraction of an approximate value for the paper surface resistance of $0.1(10)^9$ yields a cup resistance of $1.1(10)^9$.

At this point one can wonder how significant variations in the air gap length can be. If we assume the air gap is increased from 1.0 to 1.2 cm (perhaps by evaporation alone) this resistance is increased by 20%. This means a potential error on the order of $0.1(10)^9$, which is the order of magnitude of the differences calculated above. This shows there is some question about the accuracy of the surface resistance for the paper which was also found as $0.1(10)^9$.

CONCLUSION

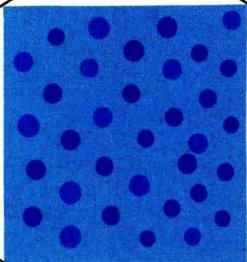
A method to evaluate cup resistance in permeation cup experiments has been demonstrated with examples. Cup resistance can vary from cup to cup and can be separated into an air gap resistance and a water evaporation resistance. This cup resistance has been found important in determining the permeation coefficients of stains, paper, and wood. In other cases it has not been significant.

An improved experimental method to measure vapor in air permeation (or diffusion) coefficients is also reported. Using mathematical relations which account for bulk flow,⁶ an experimental value can be extrapolated as shown above using a plot of (diffusion coefficient)⁻¹ vs $(L)^{-1}$. The diffusion coefficient (equal to 0.23 cm^2 for water vapor in air) agrees quite well with literature values^{8,9} and with $P_{\infty}(1.68(10)^{-9})$ calculated as a diffusion coefficient. The improved method involves both the extrapolation and use of a paper (or other) film to better control the experiment.

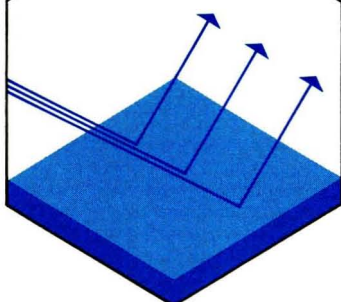
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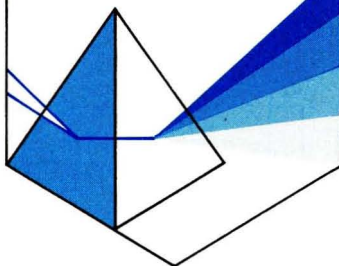
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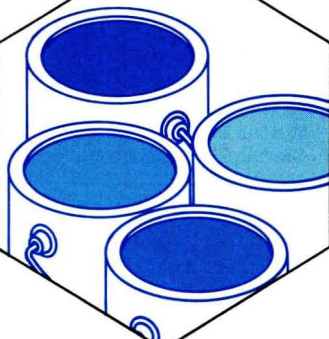


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South Coast District Adopts Workable Emission Level

Following a public hearing, California's South Coast Air Quality Management District's Board of Directors reconsidered its proposed amendment to

Rule 1113—Architectural Coatings and set emission levels at 250 grams per liter of coatings as applied excluding water for flat coatings and 450 grams per liter

of coatings as applied excluding water for non-flat coatings.

Any colorant added to tint bases has also been exempted from the determination of VOC content. The Small Business exemption provision of Rule 1113 has been rescinded since it is now considered to be unnecessary because of changes made in the new emission levels established for flat and non-flat coatings. Finally, the expiration date for the 16 exempt categories of coatings has been extended by one year to September 2, 1983.

The resolution adopted by the Board in making these changes to Rule 1113 also calls for a staff review and consideration of the state of technology in two years to determine if the newly adopted emission limits are still valid.

APCA Issues Position Statement on Clean Air Act

The Board of Directors of the Air Pollution Control Association (APCA) has issued a position statement on amendments to the Clean Air Act, specifically regarding those portions of the Act which address Prevention of Significant Deterioration (PSD), Long Range Transport (of air pollutants), National Ambient Air Quality Standards (NAAQS), Hazardous Air Pollutants, and State Implementation Plans (SIPs).

The statement of the Pittsburgh-based

technical society consists of brief statements of problems, discussions, and recommendations on each of the five subjects. In a summary, it states that APCA "is convinced that the basic Clean Air Act is sound and we support its principles. We are not in favor of a massive overhaul. However, implementation of some of its parts results in unnecessarily complex, time consuming, and costly procedures which tend to subvert the intent of the Act."

Army Seeks New Primers

The U.S. Army Mobility Equipment Research & Development Command is responsible for the development of paints and coatings for all Army equipment. At present, conventional coatings are in use but the Command is under pressure to meet current and anticipated restrictions on the content of volatile organic materials, as well as toxic inhibiting pigments, in these primers. Therefore, a contract has been awarded to the D/L Laboratories to investigate, formulate and evaluate water borne metal primers which contain no lead or Chromium VI.

The following parameters have been specified:

- (1) Contain no lead or Chromium VI.
- (2) Contain a maximum of 3.5 lbs/gal of volatile organic compounds (VOC) *when applied*.
- (3) Solvents present shall meet Rule 66 or Rule 102 of SCAPCD.
- (4) Shall be capable of conventional application.
- (5) Shall be air drying.

The polymers used in these primers may be either water emulsifiable or water soluble provided that they meet these requirements.

The cooperation of our industry is solicited. Representatives of companies wishing to have their anti-corrosive pigment(s) or water borne polymer(s) included in this program, should call or write—

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D/L Laboratories
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Selection of Solvents For High Solids Coatings Systems

Garland Sprinkle
Eastman Chemical Products, Inc.*

Two high solids coatings parameters, viscosity and surface tension, and the effect of solvent selection on those parameters are discussed. Various solvents were evaluated with high solids resins and complete high solids coating formulations to determine their effect on the viscosity and surface tension of the coating solutions. The results indicate that the viscosity vs. VOC content of a high solids coating can be optimized by the use of low density, high activity solvents such as ketones. Also, a direct relationship was found between the surface tension of the solvents used in a coating and the resulting surface tension of the coating. Therefore, the increase in surface tension of a high solids coating due to the increase in solids can be minimized through the use of low surface tension solvents.

INTRODUCTION

Because of the concern about air pollution and the effort being made to reduce solvent emission into the atmosphere, the coatings industry is going through a period of revolutionary change. Much of this change is directed

towards reducing the amount of solvents in coatings systems. Conventional coatings contained a high level of solvents which allowed the formulator wide latitude in selecting the solvent system. As a result, solvent selection was not considered very critical in these systems, and a number of solvents could be used interchangeably depending on cost. The important role that solvent plays in coatings was often overlooked. The new air pollution regulations will drastically limit the amount of solvent used in a coating system. For instance, while the old solution lacquer automobile topcoat contained approximately seven pounds of solvent for each pound of solids, the goal for high solids automobile enamels is in the range of 0.5 pounds of solvent for each pound of solids.

In these new high solids coatings, the solvent will still have to perform the same function that it did in conventional coatings. However, the amount of solvent allowed by the regulation is so limited that the coatings formulator must "engineer" the solvent system for high solids coatings in order to obtain maximum utility from the limited amount of solvent.

Many of the parameters of high solids coatings are largely determined by the solvent used in the system. As in all coatings, the final selection of the coating components will be a compromise based on a number of different performance parameters. Two coating parameters that are affected by solvents will be discussed here—viscosity and surface tension. This discussion will include the properties of solvents which affect those parameters and how viscosity and surface tension can be controlled with solvents.

*Technical Service and Development Division, P.O. Box 431, Kingsport, TN 37662.
Presented at the 1981 Western Coatings Societies Symposium, March 4-6, in Anaheim, CA.

Table 1—Solution Viscosity (cP) Medium Evaporating Solvent (At 3.3 Lbs. Solvent/Gallon Coating)

Solvent	Evaporation Rate	Viscosity Acrylic Resin ^a	Viscosity Polyester Resin ^a
MIBK	1.6	110	35
n-Butyl Acetate	1.0	202	58
Toluene	1.9	290	52

(a) Resins designed for high solids coatings.

Table 2—Solution Viscosity (cP) Slow Evaporating Solvent (At 3.3 Lbs. Solvent/Gallon Coating)

Solvent	Evaporation Rate	Viscosity Acrylic Resin ^a	Viscosity Polyester Resin ^a
MAK	0.4	147	50
IBIB	0.4	387	101
Xylene	0.6	387	69

(a) Resins designed for high solids coatings.

DISCUSSION

Viscosity of High Solids Coatings vs Solvent Selection

One of the primary considerations when selecting solvents for high-solids coatings is choosing a solvent system which will provide the proper viscosity. Certain classes of solvents are more active than others in reducing the viscosity of high solids coating systems. Studies comparing solvent activities in high-solids coatings have shown that ketone solvents are the most active just as they are for many other coating systems. For example, if ketones are compared with esters and aromatic hydrocarbons at equal evaporation rates (in this case, methyl isobutyl ketone [MIBK] is compared with toluene and n-butyl acetate), the ketone gives a much lower viscosity (Table 1). If the same classes of solvents are compared at a slower evaporation rate (e.g., methyl n-amyl ketone [MAK] when compared with isobutyl isobutyrate [IBIB] and xylene), again the ketone solvent gives a much lower viscosity (Table 2).

In addition to having the advantage of greater solvent activity for high-solids resins, the ketone solvents have a second advantage in that they are lower in density than either ester or aromatic hydrocarbon solvents. As a result of the way solvents are limited in the new air pollution regulation (i.e., on the basis of pounds of solvent per gallon of coating), the density of the solvent becomes

a determining factor in the volume percent solids necessary to meet a given limitation. The effect of the solvent weight per gallon on volume percent solids necessary to comply with a given limit is shown in Figure 1.

Figure 1 shows that as the solvents become more dense or higher in weight per gallon the volume percent solids necessary to comply with a given limitation increases accordingly. Note that the ketones, alcohols, and the aliphatic hydrocarbons are on the low density end of the scale while the esters and aromatic hydrocarbons are in the area of solvents with medium density.

The degree to which this difference in density affects viscosity variations between classes of solvents can be seen in Figures 2 and 3. Figure 2 is a comparison of MAK, IBIB, and xylene when used as the solvents for an acrylic/melamine high-solids coating on the basis of weight percent. When compared on this basis, only the activity of the solvents is being compared. You can see that MAK provides the lowest viscosity while xylene and IBIB have very similar viscosities. The same data are compared in Figure 3 on the basis of viscosity vs pounds of solvent per gallon of coating. The lower density of the MAK in combination with its greater solvent activity gives it a wider differential in viscosity when compared with the ester and aromatic hydrocarbon solvent. In addition, the difference in density of IBIB and xylene results in some diverging of their viscosity curves.

To the formulator, this means that at a given viscosity

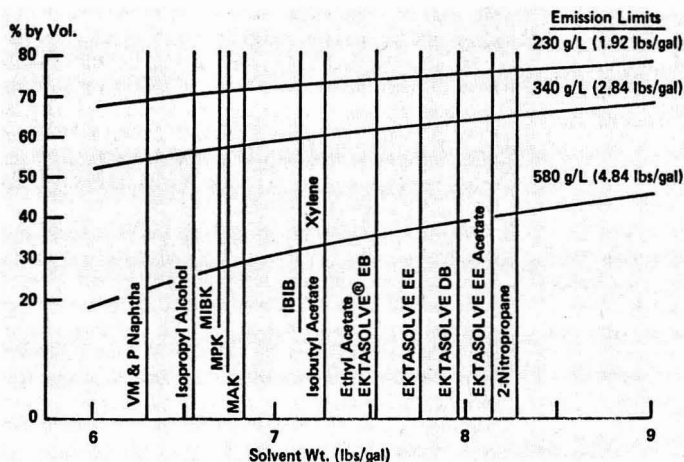


Figure 1—Effect of solvent weight on paint solids, percent by volume complying with EPA recommendations

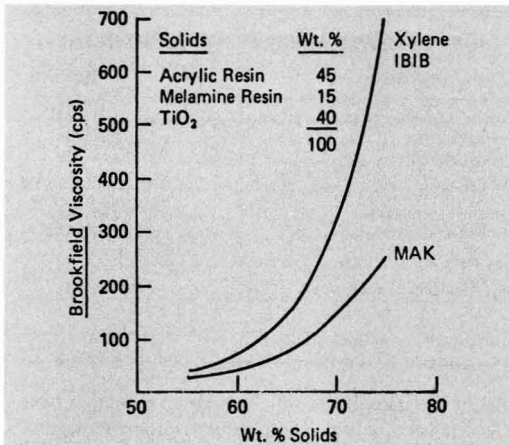


Figure 2—Viscosity of pigmented acrylic/melamine coating (wt. % solids)

(e.g., 100 centipoise) fewer pounds of solvent per gallon of coating can be used with ketone solvents than with higher density and lower activity solvents, such as xylene or IBIB. Notice that in this example only 3.3 lb of MAK is required to achieve 100 centipoise viscosity while 3.8 lb of either xylene or IBIB is required to achieve the same viscosity level (Table 3). As a result of this advantage which ketones have, ketone solvents will play a major role in achieving low viscosity high-solids coatings.

Surface Tension

Before the effect of solvents on the surface tension of coatings is discussed, it would be beneficial to define surface tension and examine its role in coatings. When the term "surface tension" is applied to liquids, it refers to the work required to form a unit area of surface between a liquid and vapor phase.¹ Surface tension is expressed in ergs/cm² or dynes/cm. There are several methods for measuring the surface tension of liquid. For this work, the duNuoy method was used. This method determines the surface tension of a liquid by measuring the force required to pull a platinum ring free from the surface of a liquid.

The surface tension of a solid is referred to as critical surface tension for spreading which is defined as the wettability of a solid surface by noting the lowest surface tension a liquid can have and still exhibit a contact angle greater than 0° on that solid.² Critical surface tension is also expressed in ergs/cm² or dynes/cm. An approximate value for critical surface tension of a solid can be determined simply by placing a measured amount of liquids with known surface tension values on the clean surface of a solid and observing which liquids spread and which do not. A more precise determination can be made by measuring the contact angle of the drop of liquid on the surface of the substrate with a contact angle goniometer. The critical surface tension of the solid can then be calculated based on the contact angle and the surface tension of the liquid.

ROLE OF SURFACE TENSION IN COATINGS: Examples of

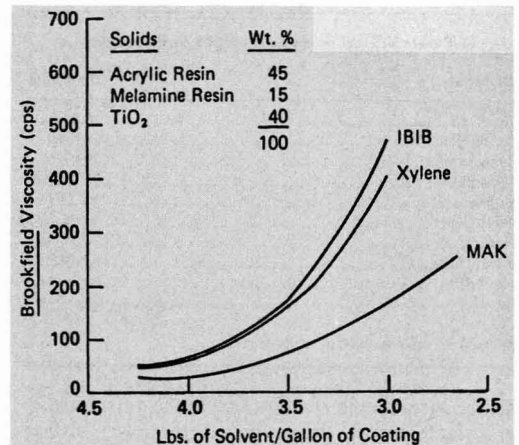


Figure 3—Viscosity of pigmented acrylic/melamine coating (lbs of solvent/gal)

the effects of surface tension can be seen every day. One example with which all of us are familiar is the beading of water on a freshly waxed car. In this case, the surface tension of the water is greater than the critical surface tension of the waxed surface of the car, and the water beads up rather than spreading out. It is this phenomenon that makes surface tension an important factor in coatings. In order for a coating to spread and "wet out" on a substrate, the surface tension of the liquid coating must be lower than the critical surface tension of the substrate.

In addition, surface tension manifests itself in other ways in coatings. According to Heitkamp, Larson, and Jones,³ the sprayability of a high-solids coating and a water-borne coating was more closely related to the surface tension of the coatings than to viscosity. The lower the surface tension of the coating, the better the sprayability of the coating. This is due to the fact that a liquid is easier to break up and to atomize when the surface tension is low.

Some coatings defects are also surface tension related, for example, cratering and "picture framing." Cratering occurs when a coating is applied to a substrate which has a contaminated surface. These contaminants such as dust and oil usually have a lower surface tension than the surrounding surface. When the coating is applied over the surface, the contaminants dissolve in the coating and create an area with lower surface tension

Table 3—Pounds Solvent/Gallon of Coating to Achieve 100 cP Viscosity

Solvent	Lbs. Solvent/ Gal. Coating
MAK	3.3
Xylene	3.8
IBIB	3.8
Ektasolve® EE acetate	4.1

Ektasolve is a registered trademark of Eastman Kodak Co.

Table 4—Critical Surface Tensions of Substrates

Substrate	Dynes/cm
Teflon® coating	18.5 ⁶
Polyurethane	29.0 ⁵
Polypropylene	29.0 ⁶
EPDM rubber	29.2–30.6 ⁵
Stainless steel	30 ⁴
Polyethylene	31.0 ⁶
Chrome	34 ⁴
Natural rubber	36–39 ⁴
Mylar® film	48 ¹
Mild steel	55 ⁴

(Superscripts refer to Bibliography.)

than the surrounding coating. Due to the differential in the surface tension, the coating in the lower surface tension area is drawn towards the surrounding coating with high surface tension creating a crater. "Picture framing" is the result of a similar process. It occurs because the solvent evaporates faster from the coating around the edges or a curved surface of a substrate than on the flat portion of the substrate. Since the solids in this area increase at a faster rate than the solids of a coating in the flat area, a surface tension differential is created in the coating. This differential in surface tension results in movement of the coating towards the edge of the panel which creates a heavy buildup of coating at the edge of the panel. In both examples, this phenomenon is known as the Marangoni effect.

Now that surface tension and its relation to coatings have been defined, let us look at the surface tension values encountered when coating typical substrates. Shown in *Table 4* are some values for the critical surface tension of various types of substrates. Note that the substrates having low surface tension values are the ones which present the greatest difficulty in coating. For example, polyethylene, polypropylene, and EPDM represent substrates on which it is very difficult to achieve good wetting and good adhesion with a coating. On the other hand, mild steel or similar substrates represent a surface which is relatively easy to coat because of its high surface tension value. However, these values represent the critical surface tension for clean, uncontaminated surfaces. The presence of oil, for example, which has a surface tension of 28.9 dynes/cm, can cause a wetting problem. Also, many have experienced the frustration of trying to coat a surface contaminated with silicone fluid which has a surface tension of 20.6 dynes/cm.

Table 5—Surface Tensions of Solvents

Type Solvent	Surface Tension Dynes/cm, 20° C
Alcohols	21.4–35.1
Esters	21.2–28.5
Ketones	22.5–26.6
Glycol ethers	26.6–34.8
Glycol ether esters	28.2–31.7
Aliphatic hydrocarbons	18–28
Aromatic hydrocarbons	28–30
Water	72.7

Table 6—Critical Surface Tensions of Polymers

Polymer	Dynes/cm
Poly n-butyl methacrylate	32 ⁶
Polyvinyl acetate	36 ⁶
Polyvinyl chloride	39 ⁶
Melamine resin	39
Polymethyl methacrylate	41 ⁶
Polyethylene terephthalate	43 ⁶
Epoxy resin	47 ²
Urea-formaldehyde resin	61 ⁶

(Superscripts refer to Bibliography.)

All of the ingredients which make up a coating have surface tension values. The resultant surface tension of the coating, therefore, represents the influence of all of its ingredients except those which are dispersed. Shown in *Table 5* are typical surface tension values for various types of solvents. Note that the values range from 18 dynes/cm to 35 dynes/cm. Very low values can be obtained with alcohols, esters, ketones, and aliphatic hydrocarbons. Polymers generally tend to have higher surface tension values than solvents; and in these examples, the surface tension values range from 32 dynes/cm to 61 dynes/cm (*Table 6*).

Conventional coatings which contain a high level of solvents have low surface tension values since the solvent is a major portion of the coating. For example, a typical automotive solution lacquer has a surface tension of approximately 26 dynes/cm. A conventional polyester enamel has a surface tension of 31.5 dynes/cm. As a result, the problems related to surface tension such as the wetting of the substrate are only rarely encountered with conventional coatings. For example, only substrates with an exceptionally low surface tension such as polyethylene or polypropylene create wetting problems with the use of conventional coatings. However, as illustrated in *Figure 4*, the surface tension of solutions of Acryloid® AT-400 resin, Cymel® 303 resin, and a blend

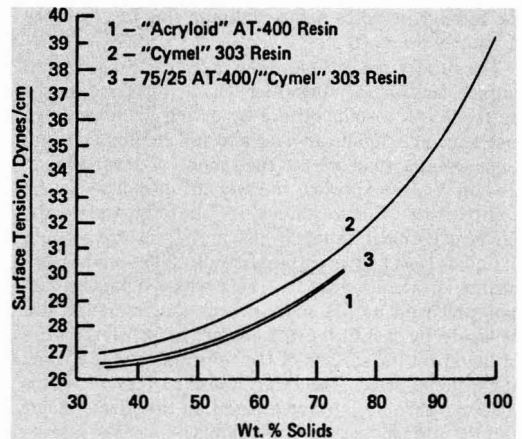
**Figure 4—Surface tension vs weight percent solids of Acryloid AT-400 resin and Cymel 303 resin in MAK**

Table 7—Surface Tension (Fast Evaporating Solvents)

Solvent	Surface Tension Dynes/cm, 20° C
Isopropyl acetate	21.2
Isopropyl alcohol	21.4
Ethyl acetate	23.7
MEK	24.6

of the two resins in MAK increases as coating solids increase.

As the resin becomes a major component of the coating, the influence of its higher surface tension value becomes apparent as the surface tension of the coating increases with the solids. The statement is often made by individuals who have had experience with high-solids coatings to the effect that all the problems encountered with conventional coatings become magnified with high-solids coatings. Many of these problems are surface tension related such as poor wetting, cratering, and "picture framing" and do, in fact, intensify with increasing solids. In addition, high-solids coatings are much more sensitive to dirt and to contaminated or oily surfaces than conventional solids coatings. It is possible, however, to minimize the increase in surface tension encountered with higher solids through the proper selection of solvents. In order to have a better understanding of the influence of solvents on the surface tension of coatings, the surface tension values of individual solvents should be examined.

Shown in *Table 7* are surface tension values for fast evaporating solvents. It can be seen that they have, for the most part, low surface tension. The isopropyl alcohol and isopropyl acetate have very low surface tension. The medium evaporating solvents are slightly higher in surface tension (*Table 8*). It is interesting that the branched chain solvents have lower surface tension values than their straight chain counterparts. For example, isobutyl alcohol has a surface tension of 22.8 dynes per cm, while n-butyl alcohol has a surface tension of 24.6 dynes per

Table 9—Surface Tension (Slow Evaporating Solvents)

Solvent	Surface Tension Dynes/cm, 20° C
DIBK	22.5
IBIB	23.2
MIAK	25.8
MAK	26.1
Ektasolve EB	26.6
Ektasolve EE acetate	28.2
Ektasolve EE	29.3
Xylene	30.0

cm. Isobutyl acetate has a surface tension of 23.6 dynes per cm, while n-butyl acetate has a surface tension of 27.6 dynes per cm. In most cases, as the solvents become slower evaporating, the surface tension values tend to increase. An exception to this is the glycol ethers where the surface tension values decrease as the evaporation rates of the solvents decrease. For instance, Ektasolve EE solvent has a higher surface tension value than Ektasolve EB. Again, the branched chain solvents have lower surface tension values than their straight chain counterparts. IBIB and DIBK are particularly notable in this group since their surface tension values are in the low 20s, while the average for this group is in the high 20s (*Table 9*). The surface tension values of the very slow evaporating solvents are in the 30 dynes per cm range. As before, the branched chain solvents such as DIAK, 2-ethylhexyl acetate, and Texanol™ solvent have relatively low surface tension values (*Table 10*).

The surface tension of coatings formulated with solvents with different surface tensions will correlate closely with the surface tension of the solvent. In a pigmented acrylic/melamine coating prepared using solvents with different surface tensions, the surface tension of the solvents in each case obviously influences the surface tension of the coatings. As seen in *Table 11*, the solvent with the lowest surface tension value, IBIB, results in a coating with the lowest surface tension. MAK gave the next lowest surface tension value.

Through proper selection of solvents, the surface tension of a coating can be controlled, thereby minimizing the problems associated with high surface tension.

Acryloid is a registered trademark of Rohm and Haas Co. Cymel is a registered trademark of American Cyanamid Co.

Texanol is a trademark of Eastman Chemical Products, Inc.

Table 8—Surface Tension (Medium Evaporating Solvents)

Solvent	Surface Tension Dynes/cm, 20° C
Isobutyl alcohol	22.8
Isobutyl acetate	23.6
n-Propyl alcohol	23.8
MIBK	23.9
MPK	24.1
n-Propyl acetate	24.2
n-Butyl alcohol	24.6
n-Butyl acetate	27.6

Table 10—Surface Tension (Very Slow Evaporating Solvents)

Solvent	Surface Tension Dynes/cm, 20° C
DIAK	24.9
2-Ethylhexyl acetate	25.8
Texanol	28.9
Ektasolve DB	30.0
Ektasolve DB acetate	30.0
Ektasolve DE	32.2
Ethylene glycol diacetate	33.7

Table 11—Surface Tension of Pigmented Acrylic/Melamine Coating Solution at 2.8 Lbs. Solvent/Gal. Coating

Solvent	Surface Tension of Coating Dynes/cm	Surface Tension of Solvent Dynes/cm
IBIB	26.5	23.2
MAK	29.5	26.1
Xylene	31.5	28.0
Ektasolve EE acetate	32.0	28.2

CONCLUSION

The viscosities of high-solids coatings formulated to meet the new air pollution regulations will be determined to a large extent by the activity and density of the solvents. Ketone solvents have the advantage in this respect due to their high activity and low density. Other types of solvents will be required in high solids for specific reasons but ketone solvents will form the backbone of a high-solids solvent blend.

Surface tension is a major factor which determines the sprayability and the wettability of a coating. Also paint defects such as cratering and "picture framing" are surface tension related. As coatings increase in solids, the surface tension of the coatings increases accordingly. This results in coatings with which greater difficulty is

encountered in achieving good sprayability and wettability. In addition, the paint defects which are surface tension related may increase in frequency. The increase in surface tension of the higher solids coatings can be minimized through the proper selection of solvents.

As coatings become higher in solids and the amount of solvent is reduced, the proper selection of solvents becomes more critical than ever.

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TECHNOLOGY REVIEW

Dilution Efficiency of Extenders

Fred B. Stieg
Pigmentech Consulting*

One of the more important functions to be served by an extender pigment is that of a diluent or "spacer" to improve the optical efficiency of expensive titanium dioxide. In the absence of any method for quantifying this spacing capability, however, the high dry-hiding produced in highly pigmented products such as flat latex paints by fine-particle-size, high-oil-absorption extenders has been erroneously attributed to spacing. By combining two previously published and proven concepts, altering one of them by the introduction of a new term indicative of spacing capability (the dilution efficiency, E_d), and by using a low-PVC test formulation to preclude any high dry-hiding effects, a simple test procedure is developed to measure this important characteristic. A tabulation of E_d values for some common extender types has been developed, and the predicted hiding power increases to be obtained by the partial replacement of one extender with a more efficient type, using these determined values, is confirmed experimentally in a practical flat latex paint system.

Introduction

One of the more important technical considerations in the trade sales coatings industry today is the efficient use of titanium dioxide. Rising raw material costs and strong competition from materials competitive with organic coatings have made it necessary to restrict its use to a minimum, but the consumer's identification of hiding power as a primary yardstick of paint quality—and the evidence of consumer dissatisfaction with current hiding power levels—indicates that that minimum can be acceptable only if its productivity, in terms of

hiding-power development, can be increased.

The optical efficiency of a given titanium pigment in any particular paint formulation, assuming that abnormal conditions such as severe flocculation are not present, is determined by the mutual separation of its particles in the dry paint film, and this, in turn, is determined by the pigment volume concentration (PVC) and the pigment/extender packing relationship. Since the choice of PVC is essentially dictated by the type of coating to be produced, this leaves proper extender selection as the only variable that may be manipulated by the paint formulator to keep that efficiency at a maximum. Unfortunately, the formulator has had few criteria other than the unsupported claims of extender pro-

ducers to assist him in making such a selection.

It is our purpose here to describe a novel technique for the experimental evaluation of extenders in terms of the characteristic most important to their ability to increase the optical efficiency of titanium dioxide.

Theory

It has been known for quite some time that the mutual separation of titanium dioxide particles in a dry paint film is greatly affected by the relative particle size of any extenders that may also be present.¹ Most common paint extenders are produced in a particle size that is so much larger than that of titanium dioxide that any intermixture of the two automatically results in a packing of the finer titanium dioxide particles into the voids existing between the coarser extender particles. When, however, an extender is of the same particle size as titanium dioxide, no such packing occurs when the two are intermixed, and the mutual separation of titanium dioxide particles is increased by its presence.

In a paint film containing no extender, the mutual separation of titanium dioxide particles is directly related to the formula PVC—the higher the pigment volume concentration, the smaller the spacing between individual pigment particles. Furthermore, it has been known for over 40 years that the higher the formula PVC of such a paint film, the lower the amount of white hiding power produced *per pound of titanium dioxide*—or, in other words, the lower its optical efficiency.

*903 Beachview Dr., Jekyll Island, GA 31520.
Presented by Mr. Stieg at the 1981 Western Coatings Societies Symposium, March 4-6, 1981, Anaheim, CA.

The relationship between the square feet of "absolute hiding power" (0.98 contrast ratio) produced by a pound of rutile titanium dioxide, and the formula PVC at which it is employed, may be accurately expressed by the following equation:

$$HP = 370 - 409 \text{ PVC}^{1/3} \quad (1)$$

The same equation may be employed in the presence of extender if the PVC term employed represents the effective concentration of titanium dioxide in the dry paint film, rather than the formula PVC. The difference between the so-called "effective PVC," and the formula PVC, results from the fact that only the mutual separation of the titanium dioxide particles is of importance in determining optical efficiency, and the extender volume is omitted from the numerator when calculating pigment volume concentration. Extender is included in the denominator, however, if it is sufficiently small in particle size to increase the mutual separation of titanium dioxide:

$$\text{Effective PVC} = \frac{\text{vol TiO}_2}{\text{vol (TiO}_2 + \text{fine extender} + \text{binder})} \quad (2)$$

The "fine extender" of this equation was originally defined as any extender possessing an average particle size at least as fine as that of titanium dioxide, and its effect upon the distribution of titanium dioxide in the dry paint film as "spacing." Consequently, extenders that claimed to fulfill this requirement have come to be commonly known as "spacing extenders."

Initial Application Of Spacing Extenders

Although the spacing effect of a fine extender on the hiding power of titanium dioxide may be demonstrated in an enamel or semi-gloss formulation, the very fact that the bulk of all extender is utilized in high-PVC finishes has resulted in the application of most spacing extenders to the formulation of flat wall paints, the greater portion of which have been flat latex paints.

Due to the typically low solids of flat latex paints, the production of adequate hiding power is virtually impossible without the development of the high dry-hiding to be obtained by formulating above the CPVC. Consequently, most of the claims that have been made for the spacing effect of various extender products have been based upon systems in which their total effect upon dry hiding power had resulted as much from increased film porosity due to their typically high oil-absorption as from any increase in optical efficiency.

Titanium pigments themselves were produced in so-called "latex-" or "high-

hiding" grades in which voluminous surface treatments of precipitated alumina and silica hydrates were employed to develop similar increases in film porosity and high dry-hiding. In this instance, however, the precipitated treatments were known to be fully effective spacers for the titanium dioxide—something that could only be presumed by the manufacturers of spacing extenders.

Since the replacement of these low-titanium-dioxide-containing pigments with blends of enamel-grade (higher TiO₂ content) pigments with a spacing extender offered obvious opportunities for reducing pigmentation costs,² many attempts were made utilizing calcined clays. The work was conducted in such a way that the production of matching dry hiding power would ensure equivalent film porosity if the extender were fully effective as a spacer.

It was found, however, that this was seldom true, and, furthermore, that substantial variations existed between different calcined clays. This indicated, of course, that the spacing capability was not a "go-or-no-go" effect that could be attributed to some specific particle size, but a characteristic that could be possessed to varying degrees by different extenders. Not only were some of the so-called spacing extenders less than fully effective, some extenders previously eliminated from this category were found to possess a spacing capability that, while lower than most of the finer extenders, was still definitely significant in affecting hiding power.

A major problem in assigning a relative spacing capability to any particular extender lay, however, in the coexistence of high dry-hiding due to the characteristic film porosity of the type of paint system being evaluated.

Dilution Efficiency Concept

Since film porosity, and, therefore, high dry-hiding, can be eliminated by formulating well below the CPVC, it was felt that it might be possible to obtain some indication of the relative spacing capability of different extenders. A direct comparison could be made of the hiding power levels produced by a fixed combination of titanium dioxide and extender in a relatively low-PVC formulation, with one extender being substituted for another on a volume basis. The only factor then affecting the mutual separation of titanium dioxide particles would necessarily be related to the type of extender present.

The effective PVC being the variable actually affected by the extender, as previously represented by the term "fine extender" in equation (2), it was decided to apply the term "dilution efficiency"

(E_d) to the ratio of that portion of the extender apparently effective as a diluent, or spacer, to the total volume of extender actually present. The effective PVC is then represented by:

$$\text{Effective PVC} = \frac{\text{vol TiO}_2}{\text{vol (TiO}_2 + \text{extender} \times E_d + \text{binder})} \quad (3)$$

Since the hiding power produced by the fixed amount of titanium dioxide could be accurately predicted, given the value for its effective PVC, using the hiding power equation (1), it was felt that the process might be reversed—using determined values for the relative hiding power produced by different extenders to calculate back to the relative E_d values required to account for the observed variation. It was felt preferable to employ relative hiding power rather than absolute hiding power values for this purpose because they might be determined quite easily from reflectance measurements, using the Kubelka-Munk relationship, as contrasted to the time-consuming and less-accurate determination of white hiding power by the ASTM standard method.

If the same amount of a dispersed absorbing colorant, such as lampblack, is added to equal volumes of two white paints in a quantity sufficient to lower the green reflectance level to 40–45%, the amount of absorption provided by the colorant so overwhelms the small differences in absorption that may exist between the two white paints, that the Kubelka-Munk absorption coefficient, K, may be assumed constant for the two tinted paints.³ Under these conditions, the relative white hiding power (at equal brightness) of paint #1 as compared to paint #2 may be expressed by:

$$HP_R = \frac{HP_1}{HP_2} = \frac{(1 - R_2)^2 \cdot R_1}{(1 - R_1)^2 \cdot R_2} \quad (4)$$

where R₁ = green reflectance of paint #1

R₂ = green reflectance of paint #2

HP_R = relative white hiding power

The ratio HP₁/HP₂ is, of course, equal to the ratio of the Kubelka-Munk scattering coefficients (S₁/S₂) for the two white paints.

Since the titanium dioxide content would be constant for any selected test formulation, relative hiding power might also be expressed by the following ratio derived from equation (1):

$$HP_R = \frac{370 - 409 (\text{PVC}_1)^{1/3}}{370 - 409 (\text{PVC}_2)^{1/3}} \quad (5)$$

The PVC₁ and PVC₂ terms in equation (5) are effective PVC's, as redefined by equation (3), permitting a relationship to be established between the determined

Table 1—Experimental Results

Extender	Reflectance	Relative Hiding	Dilution Efficiency
Duramite®	0.4290	1.0000	0
Atomite®	0.4385	1.0570	30
Omyacarb® F	0.4387	1.0583	31
Glomax® LL	0.4500	1.1306	74
Al-Sil-Ate O®	0.4523	1.1459	85
M-60®	0.4535	1.1540	90
Optiwhite®	0.4537	1.1554	91
Omyacarb® UF	0.4553	1.1663	99

Dilution efficiency is expressed as 100 E_d in the above table and carried out only to the nearest whole number.

dry-film reflectance and E_d . Investigation showed, however, that meaningful values of E_d could be calculated from this relationship only by the use of a control possessing one of the following three characteristics: (a) known absolute hiding power; (b) known effective PVC; and (c) known E_d for extender content.

Consideration was initially given to the use of a control in which an equal volume of vehicle solids replaced the volume occupied by extender in the test formulations. The resulting PVC difference was felt to introduce too many unknown variables, however, particularly in the latex paints that were of primary interest to this investigation.

Since it was still hoped to avoid the necessity for any absolute hiding power determinations, the only remaining option was to employ some extender as a control for which a reasonably accurate value of E_d might be assigned. It was therefore arbitrarily decided to assign the value of $E_d = 0$ to Duramite®, a classified, large-particle-size calcium carbonate. Past experience with the development of CPVC curves using this extender³ has provided evidence of a high degree of pigment packing for combinations with titanium dioxide.

Test Formulation

The selected test formulation for the determination of dilution efficiency was pigmented at 40 PVC with 2.22 lb/gal of an enamel grade titanium dioxide, which at 40% total solids by volume produced a combination of 6.50 gal of titanium dioxide to 9.50 gal of extender in a 100-gal batch.

TEST FORMULATION

TiO ₂	.....220.0 lb	6.50 gal
Extender	.....	9.50 gal
Latex solids	.....	24.00 gal
Water + additives	.....	60.00 gal
		100.00 gal

For this formulation, the equation for calculating the effective PVC will have the following form:

$$\text{Effective PVC} = \frac{6.50}{6.50 + 9.50 E_d + 24.00} \quad (3.1)$$

This can be rearranged to read:

$$E_d = \frac{0.6842}{\text{PVC}_{\text{eff}}} - 3.2105 \quad (3.2)$$

For $E_d = 0$, as arbitrarily established for the Duramite control, the effective PVC (PVC_{eff}) calculates to 0.2131; substituting this value for PVC_2 , and the effective PVC of equation (3.1) for PVC_1 , in equation (5), yields the following relationship for the test formulations:

$$E_d = \frac{23.605}{(2.9445 - \text{HP}_R)^3} - 3.2105 \quad (3.3)$$

Since HP_R may be calculated from measurements of dry-film reflectance for the control and a tested extender, using equation (4), the dilution efficiency of the latter may be calculated using the above equation (3.3).

Development of the Test Procedure

For a presumably perfect spacing extender, $E_d = 1.00$. If this value is entered into equation (3.1) it is found that the minimum effective PVC for the test formulation will be 0.1625, as compared to the previously calculated maximum of 0.2131 for the nonspacing control.

Using these two values for the effective PVC in equation (5), it will be seen that the maximum attainable value for HP_R will be 1.1680, which if entered into equation (4) with an assumed reflectance value of 0.4000 for the control, indicates a maximum reflectance value of only 0.4266 for a perfect spacing extender. A total reflectance difference of less than three percent for the range of $E_d = 0$ to $E_d = 1.00$ for the test system means that extreme care must be taken to make all colorant additions and reflectance measurements as accurate as possible. An analytical balance should be employed for the weighing of the colorant addition, and the reflectance measurement used should be the average of single reflectance readings taken on each of three replicate drawdowns for each test.

Experimental

A group of calcined clay and calcium carbonate (both natural and precipitated) extenders were incorporated in the test formulation. After determining the amount of lampblack required to reduce the dry reflectance of the Duramite control to the desired 40–45% range, exactly the same weight of colorant was added to an equal volume of each test batch.

Three drawdowns were made of each

tinted paint, and green reflectance was measured after drying at room temperature overnight. The three readings for each test were then averaged, and E_d calculated using equation (3.3). The results are shown in Table 1.

As expected, dilution efficiency increased in order of decreasing particle size, with the exception of Optiwhite, which contains considerably more particles in excess of 1.0 micron than does Glomax LL.

Discussion

The apparently anomalous relationship between the particle size of Optiwhite calcined clay and its indicated dilution efficiency is explained by the inability of the test method to distinguish between increases in optical efficiency produced by dilution, and those produced by the presence of air in the medium surrounding the titanium dioxide particles. According to its producer, a patented manufacturing process produces air occlusions in the extender particles, and these have a small "high dry-hiding" effect that is independent of film porosity.

The calculated value of E_d for Optiwhite is, therefore, largely the result of equation (3.3) having interpreted this "high dry-hiding" as a spacing effect.

Another possible source of anomalous results was felt to lie in any wide variation in extender dry brightness. Equation (4), derived from the Kubelka-Munk relationship, provides a value of relative white hiding power at equal film brightness, but equation (5) was empirically derived from experimental data at 0.98 contrast ratio, without adjustment for brightness differences. Since it must be assumed in the derivation of equation (3.3) for E_d that these two values of HP_R are identical, this means that a low-brightness, coarse extender might be assigned an E_d value of less than zero (negative), while an exceptionally bright, fine extender might appear to be more than 100% effective as a diluent.

Table 2—Dilution Efficiency Table

ΔR	% E_d	ΔR	% E_d	ΔR	E_d
0.0005	1.46	0.0095	29.97	0.0185	63.84
0.0010	2.92	0.0100	31.70	0.0190	65.91
0.0015	4.40	0.0105	33.45	0.0195	68.00
0.0020	5.89	0.0110	35.21	0.0200	70.10
0.0025	7.39	0.0115	36.99	0.0205	72.23
0.0030	8.91	0.0120	38.79	0.0210	74.39
0.0035	10.44	0.0125	40.61	0.0215	76.56
0.0040	11.99	0.0130	42.44	0.0220	78.76
0.0045	13.55	0.0135	44.29	0.0225	80.98
0.0050	15.12	0.0140	46.16	0.0230	83.22
0.0055	16.71	0.0145	48.05	0.0235	85.49
0.0060	18.31	0.0150	49.95	0.0240	87.78
0.0065	19.93	0.0155	51.88	0.0245	90.10
0.0070	21.57	0.0160	53.82	0.0250	92.44
0.0075	23.22	0.0165	55.79	0.0255	94.80
0.0080	24.88	0.0170	57.77	0.0260	97.19
0.0085	26.56	0.0175	59.77	0.0265	99.61
0.0090	28.26	0.0180	61.80		

Initially, it was felt that the lower brightness of the calcined clays, as compared to the calcium carbonates, might have resulted in disproportionately low E_d values for these extenders in the test series. Comparison of the data with particle-size distribution curves, however, suggested that the effect of dry brightness was not too significant. The difference in E_d between Al-Sil-Ate-“O” and the high-brightness precipitated M-60, for example, is considerably less than the difference in E_d between Glomax LL and Al-Sil-Ate “O”—two calcined clays of similar dry brightness—yet the difference in particle size is also greater between Al-Sil-Ate “O” and M-60 than between Glomax LL and Al-Sil-Ate “O”.

This comparison would also suggest that the entire particle-size distribution, rather than the percentage of particles in the titanium dioxide range, may be involved in determining dilution efficiency. Atomite and Glomax LL have essentially the same percentage of particles below 0.5 microns, but the Atomite has a much higher percentage in the 1-10 micron range. However, comparisons between clays and calcium carbonates based upon equivalent spherical diameters may be somewhat specious due to the distinctly nonspherical shape of the average clay particle.

The relative flatness of the Kubelka-Munk relationship over the 40-45% reflectance range makes it possible to replace the calculations previously described with a table from which values for E_d may be obtained from the reflectance difference (ΔR) between the Duramite control and the tested extender. An example is given as Table 2.

The values in Table 2 were calculated for a control reflectance of 42.50%, but may be applied with reasonable accuracy for any control reflectance in the 40-45%

range. The maximum deviation occurs for the maximum values of E_d , but amounts to less than 1.0%.

Verification

The importance of extender dilution efficiency is illustrated by the second column of Table 1. The replacement of a nonspacing extender such as Duramite with a highly efficient diluent such as Omyacarb UF, in the test formulation, has created an increase of almost 17% in white hiding power. The effect becomes even more impressive if one calculates the amount of additional titanium dioxide that would be required to provide a similar increase. Due to the fact that titanium dioxide becomes progressively less efficient as its concentration is increased, it would be necessary to add 43% more titanium dioxide to produce a 17% increase in white hiding power without the aid of a spacing extender!

The validity of the determined E_d values could be established, however, only by their successful use in predicting hiding power effects in a more practical latex paint system than the test formulation—which involved the use of only a single extender, and pigmentation well below the CPVC to eliminate high dry-hiding effects.

The flat latex paint formulation selected for this study had evolved as the result of the replacement of a latex-grade titanium pigment with a blend of an enamel-grade pigment with the highly efficient Omyacarb UF. In addition to the Omyacarb UF, it also contained a sizeable quantity of relatively coarse calcium carbonate and 35 lb of Celite #281 (see Table 3) at 62.5 PVC, and developed considerable high dry-hiding. It was arbitrarily decided to replace one-half of the coarse carbonate with Omyacarb UF, calculate the hiding power change to be expected from the predicted change in dilution efficiency, and then determine the actual change experimentally.

Although the oil absorption of Omyacarb UF (26.0) is very much lower than that of the other spacing extenders evaluated, it was still somewhat higher than that of the coarse calcium carbonate to be replaced, meaning that film porosity and high dry-hiding would be increased, unless compensated for by a PVC adjustment. Obviously the intended hiding power comparison would be meaningless if the film porosity was permitted to vary, although this factor has been conveniently ignored by the producers of many of the high oil-absorption “spacing extenders.”

The necessary PVC adjustment was determined using the following form of an equation for “latex porosity” from previously published work:⁵

$$\frac{1 - LP}{x} = \frac{CPVC(1-CPVC)}{PVC(1-CPVC)} \quad (6)$$

where CPVC = pigmentation CPVC from oil absorption

PVC = formulation PVC

LP = latex porosity

x = binding power index

So long as the left-hand side of equation (6) is constant, film porosity will remain constant. “x” is, of course, held constant if the same latex vehicle is employed.

The CPVC of the original pigmentation (see Table 3) was first calculated from the determined oil absorption for a dry blend of its components.⁶ At the endpoint of the spatula rub-out oil

Table 3—Formulas for Hiding Power Comparison

Titanium dioxide	153 lb	4.48 gal	153 lb	4.48 gal
Omyacarb® UF	91 "	4.03 "	186 "	8.24 "
Snowflake®	240 "	10.63 "	120 "	5.32 "
Celite® #281	35 "	1.82 "	35 "	1.82 "
Latex solids		12.57 "		13.67 "
Water + additives		66.57 "		66.47 "
		100.00 gal		100.00 gal
		PVC - 62.5		PVC - 59.0

absorption test, the paste contained 65.9% total pigment by volume—the pigmentation CPVC. Inserting this value in equation (6):

$$\frac{1 - LP}{x} = \frac{0.659(1 - 0.625)}{0.625(1 - 0.659)} \quad (6.1)$$

$$= 1.1595$$

A second series of oil-absorption determinations were then made on dry pigment blends in which one-half of the coarse calcium carbonate volume was replaced—first by an equal volume of Omycarb UF, and then by progressively smaller volumes, holding the volumes of titanium dioxide and Celite constant. Since the total solids by volume for the compared paints would also have to be held constant for a valid comparison, it was decided that this would be accomplished by replacing the reduction in pigment volume by an equivalent volume of latex solids. The effect on formula PVC could thus be calculated for each step-wise reduction in Omycarb UF content.

Values for the term $(1-LP)/x$ from equation (6) were obtained using the determined CPVC values and the calculated PVC values for each pigment composition. The pigmentation of the "experimental" formula in Table 3 has a CPVC calculated from oil absorption of 62.5%, while the formula PVC is 59.0%. This combination provides what should be an adequately close match for the porosity of the "original" formula.

$$\frac{1 - LP}{x} = \frac{0.625(1 - 0.590)}{0.590(1 - 0.625)} \quad (6.2)$$

$$= 1.1582$$

If the porosities of the two formulas to be compared are equivalent, any percentage change in white hiding power may be attributed entirely to a change in the dilution factor.⁷

Since the extenders of Table I had not included Snowflake calcium carbonate, two grinds were made of the test formula—one pigmented with the Duramite control, and the other with Snowflake. When tinted with equal amounts of dispersed colorant and allowed to dry over night, the dry-film reflectances were 0.3948 and 0.3998, respectively. From Table 2, this increase

of 0.0050 from the reflectance of the control indicates that Snowflake has a dilution efficiency of 15%.

For the "original" formula, the effective PVC and basic hiding power were then calculated as follows, using equations (3) and (1), in that order:

$$PVC_{eff} = \frac{4.48}{4.48 + (4.03 \times 0.99) + (10.63 \times 0.15) + 12.57}$$

$$= 0.198$$

$$HP = 1.53(370 - 409 \times 0.198^{1/3}) = 201 \text{ ft}^2/\text{gal}$$

Performing the same calculation for the "experimental" formula:

$$PVC_{eff} = \frac{4.48}{4.48 + (8.24 \times 0.99) + (5.32 \times 0.15) + 13.67}$$

$$= 0.165$$

$$HP = 1.53(370 - 409 \times 0.165^{1/3}) = 223 \text{ ft}^2/\text{gal}$$

Based upon this application of the determined E_d values, the replacement of one-half of the coarse calcium carbonate with a highly efficient spacing extender should produce a hiding power increase of about 10.6%.

To check this prediction, test grinds were made of the two formulas of Table 3. Both were tinted with the same amount of dispersed lamblack, and their relative white hiding powers calculated from their respective dry-film reflectances of 0.478 and 0.492 using equation (4):

$$HP_R = \frac{(1 - 0.478)^2 \times 0.492}{(1 - 0.492)^2 \times 0.478} = 1.087$$

This means that the actual hiding power increase was only 8.7% as compared to the predicted increase of 10.6%. While this difference is small enough to be well within the limits of experimental error in the determination of white hiding power, the comparison of film characteristics given in Table 4 indicates that its probable cause lies in a failure to quite duplicate the film porosity of the "original" formulation. This is evident from the lower ASTM Porosity⁸ value obtained for the "experimental" formulation, and would of course account for a slightly lower high dry-hiding effect.

Table 4—Film Characteristics

	Original	Experimental
Brightness	90.9	91.0
Contrast ratio	95.3	96.3
Angular sheen	1	1
ASTM Porosity	7.5	6.2
ASTM Scrub ⁹	102	112
Tint reflectance	47.8	49.2

Some small experimental error was apparently involved in the determination of the pigmentation CPVC's from which the PVC required for a porosity match was calculated. Under the circumstances, the correlation between predicted and determined hiding powers is considered more than adequate.

Summary

It has been demonstrated that the optical efficiency of titanium dioxide is significantly affected by the nature of the extender making up the balance of the pigmentation of flat latex paints.

Contrary to earlier opinion, the so-called "spacing effect" is not limited to high-oil-absorption extenders manufactured in the same particle-size range as titanium dioxide, but is possessed in varying degree by many common extenders.

The concept of a dilution efficiency, E_d , is a useful tool for the evaluation of the spacing capability of any given extender pigment, and may also be employed in the formulation of practical paint systems for the prediction of hiding Power effects.

Acknowledgment

Laboratory data reported in this research paper was developed by the staff of and in the laboratories of Omya, Inc., Proctor, Vermont, with close consultation with the author.

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Atomite®	Thompson-Weinman & Co., Inc.
Celite®	Johns-Manville Sales Corp.
Duramite®	Thompson-Weinman & Co., Inc.
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Constituent Societies Report on Technical Programs

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

Baltimore

Three subcommittee projects currently active:

(1) *Near Infrared Reflectance of Paint Pigments*—Study is focused on coatings with solar selective properties; major effort has been on development of coatings for solar energy systems for heating purposes. It has been demonstrated that dark-colored coatings reflect solar energy, and that selection of pigments with high reflectance in the spectral region between 0.6–2.5 microns is the key. To make this technology available to the coatings industry, the near infrared reflectance characteristics of pigments must be determined; however, data on IR reflectance of pigments in coatings is virtually nonexistent. Subcommittee has developed a group of 80 pigment dispersions in an acrylic resin binder; these have been prepared and applied by drawdown over black and white hiding power charts. The spectra at 2 film thicknesses have been measured on 71 of these, from 0.4–2.5 microns using a Beckman DK2A Spectrophotometer. It is planned to make several sets of duplicate colors (one of each set using high IR absorbing pigments and the other with low absorbing pigments) and collect surface temperature data to demonstrate how such IR spectra can be used.

(2) *Correlative Testing*—Round-robin testing is available to any member laboratory wishing to correlate questionable test results. Thirteen firms have volunteered to cooperate in making available 180 instruments for testing; work is currently underway on request from ASTM Committee D01.41 to assist in a Practical Stain Removal Test.

(3) *Intra-Society Coatings Library*—Effort is underway to establish coatings library for use by Society members. To date, three companies are participating, and a list of available books and publications has been distributed to the participants . . . sponsored mini-symposium, "Paint Application Update," in May.

Birmingham

Nearing completion on A/V program on "An Introduction to the Paint Industry," which highlights career opportunities . . . Continuing marketing efforts in

the U.K. on behalf of Federation publications and training aids . . . Working on establishment of award for coatings-related technical papers.

Chicago

Four subcommittee projects currently underway:

(1) *Renewable Resources*—Initial work, which was reported on at 1980 Annual Meeting, is being followed by continuing efforts to develop more potential resources for paint raw materials; additionally, alternate raw materials already identified are being utilized in paint formulations and will undergo test procedures.

(2) *Biocide Polymerization*—Project work is being directed along three fronts: naturally occurring biocides (literature search underway on both natural biocides and enzyme inhibitors), bacteriological anti-fungal toxins (literature search begun on biocides of microbial origin), and biocidal copolymerization (work done in conjunction with PRI Consortium studying polymers with biocidal adducts incorporated into the molecule); Subcommittee plans to present a paper on its work at the 1981 Annual Meeting.

(3) *Water-Borne Anti-Corrosion Paints*—Literature search has been concluded; work confirms that there is no correlation between Salt Fog Cabinet results and actual exposure. Paper being prepared for presentation at 1981 Annual Meeting.

(4) *Shelf vs. Oven Stability*—Subcommittee is collecting data to determine if there is correlation between traditional two weeks to one month in the oven at 125° F (or higher) to any period on the shelf at ambient temperatures . . . Additional project being planned is testing of all types of latex to determine the amount of residual initiator or activator (peroxides, persulphates, etc.) in order to anticipate, or prevent, random, unexplained viscosity loss in latex paints.

Cleveland

Work is underway on study of Effects of Particle Mobility on Rate of Electroless Deposition of Latex on Steel; auto deposition is new water-borne coating technology which simultaneously

pretreats and deposits a latex-based coating on metal surfaces; rate of deposition appears related to migration of latex particles in an electric field set up at the metal surface, and surface charge of latex should have pronounced effect on deposition rate. Objective of project work is to measure surface charge and particle size of model latices and correlate these with observed autodeposition rates; laser doppler spectroscopy will be used to determine mobilities.

Dallas

Efforts continuing on spray-type industrial water-borne product finishes project: Anticipated Problems Related to End-User's Need to Change Over from Solvent Type to Primarily Latex-Bound Coatings; literature search has been completed on major problems encountered, and efforts are now being directed toward investigating typical primer and gloss topcoat systems for such problems as solvent popping, flash points, flow and leveling, foam cratering curing spray application, and mar resistance. Commercial latex-based product finishes (two-quart wet samples of primers or topcoats for metallic substrates), along with application instructions and generic binder description, being solicited for testing . . . Participated in Society symposium on Coatings Related to the Needs Created by U.S. Government Regulations.

Golden Gate

Work continuing on corrosion protection studies. Paper presented at 1980 Annual Meeting reported on review of five commercial water-reducible, non-toxic pigmented anticorrosive primers (supplied by raw material manufacturers), which were compared with two solvent-borne primers conforming to federal specs; these were subjected to salt fog, water immersion, and atmospheric environments. The best "conforming" of these primers has been targeted for further study in exterior exposures. The "conforming" primer and two federal spec primers will be tested over three types of surface preparation, and all primers will be topcoated with a "conforming" water-based aluminum paint that has a California state spec. In short, project is aimed at determining: How good is "conforming" system? How well will the "conforming" primer compare to current solvent systems? How critical is surface prep to performance of "conforming" vs. nonconforming primers? What are exterior exposure findings?

Kansas City

Work on Evaluation of Performance of Coatings on Exterior Hardboard Surfaces continues, but progress has been slowed by loss of several key committee members who have been transferred out of Society; several types of each of five different brands of hardboard have been given two different field-applied primers and two different colors of same type topcoat—all edges were sealed with paraffin to prevent moisture penetration, and no backing was applied. All panels have been put out at Kansas City at a vertical South exposure and will be checked at three-month intervals for signs of discoloration, loss of adhesion, or other film failure. Goal is to identify cause of discoloration, peeling, and generally poor coating performance on exterior hardboards in the midwest, and to develop proper coating recommendations to provide optimum performance over this type substrate.

Los Angeles

Major project currently is study of The Effect of Treated Extenders on Water Vapor Permeability of Coatings. Specifically being studied are the changes in water-vapor permeability produced by various treatments; interest in this work stems from use of silane-treated extenders in rubber elastomers, which has resulted in greatly improved physical properties. Paper being prepared for presentation at 1981 Annual Meeting.

Louisville

Major focus of current activity is project on Reclaiming Energy Value of Coatings Wastes through Pyrolysis, being undertaken in conjunction with University of Louisville. Given a waste product from the manufacture of a coatings system, in the form of wash wastes or off-specification material, distillation recovers the solvent for reuse as a material resource; resulting resin (solution) is pyrolyzed to a liquid fuel for use as an energy resource; and the pigment, char, and other nonpyrolyzable components are removed as a leach-stable solid waste for appropriate disposal. Waste product from a commercial manufacturer of industrial coatings was studied. Following solvent recovery, pyrolysis conditions were varied; two pressures, three temperatures, and three time periods were the independent variables in a factorial experimental design. The mass and volume fractions of solvent, pyrolysis product "fuel," and solids were measured as the dependent variables. The fraction of off-gases was determined by difference. Conclusions are drawn to determine the changes in

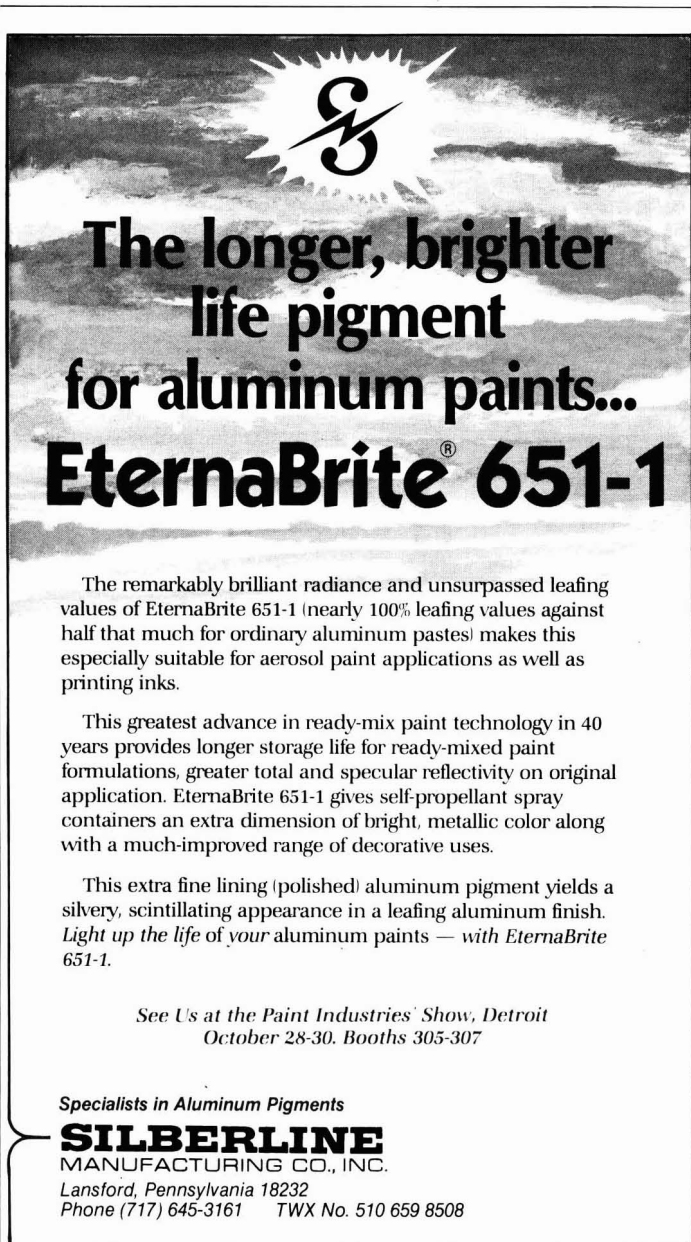
operating conditions necessary to produce the most economically valuable split, within the constraints of the given waste and process; report on the work will be presented in a paper at the 1981 Annual Meeting. . . . Literature search is continuing in anticipation of project on Corrosion Inhibitive Pigments.

Montreal

Two subcommittee projects are currently underway:

- (1) *Adhesion to Latex Paints*—Test

method which seems satisfactory has been developed; this involves spray painting yellow alkyd paint into cold rolled steel panels, then spray painting semi-gloss latex under test. The alkyd substrate is first cured in the oven to simulate an aged paint prior to coating with semi-gloss latex. Screening experiment has been designed (Plackett-Burman) to investigate factors influencing adhesion as well as their significance. Once prime factors were defined, work will begin on full-factorial



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design to study and determine optimum conditions for adhesion of semi-gloss latex paints.

(2) *Rheological Performance*—Objective is to establish a practical correlation between viscosity data and paint performance without resorting to sophisticated rheological methods. Project involves use of Brookfield Viscometer and processing of viscosity data on a time-sharing computer to predict rheological performance. The Casson equation is employed to analyze the data, and the constants obtained are used to correlate rheological properties such as flow, leveling, settling, sagging, application properties, etc. The method can be used for both quality control and development work; preliminary work has been performed, and data obtained appears to be consistent with theoretical assumptions.

New England

Work continues on various aspects of corrosion control—currently being studied is the effects of surfactants in waterborne paints . . . Project being considered for developing computer program that will do all the paint math and that can be used in formulation design; aim is to design a system that can be made available to the coatings industry . . . Considering sponsorship of a seminar on computer application in the paint industry . . . Committee has been approached by University of Lowell Engineering Dept. to help set up research projects for MS-level graduate students.

New York

Project underway to survey coatings industry nationally on type and usage of computers in such areas as inventory, financial/office procedures, formulating, and color matching . . . Considering development of text on Tests and Test Methods—A Practical Compendium for the Paint Chemist, for submission to Federation as an addition to the Series on Coatings Technology.

Philadelphia

Work continues on a number of projects which are in various stages of development:

(1) *Application of the Arrhenius Plot Technique* to the study of data obtained from various evaluations, such as elevated temperature vs room temperature stability of paint systems.

(2) *Flash Point*—study of various systems, such as the effect of high solids on flash point, effect of water/solvent combinations in water reducible systems, and the flammability of such systems.

(3) *HLB Data*—study and determination of HLB numbers for resins and resin solutions.

(4) Development of slide/tape programs on Microbiological Audit of a Paint Plant, and a six-unit presentation on Color . . . Committee sponsoring May seminar titled, "Interfaces Revisited," which updates a similar seminar given 20 years ago . . . Technical Committee has active program subcommittee developing technical presentations at monthly meetings; spring programs featured lectures and actual application demonstrations of new vehicle/paint systems and new methods of application.

Southern

Focus of interest currently is project aimed at developing a "Consumer Guide to the Paint Industry;" objective of the guide is to educate the consumer on quality criteria and an awareness of the limitations of lower-priced products. Initially, the brochure would be circulated to trade paint technical management in the Southeast for certification of authenticity, which would insure that the brochure fairly represents the normal range of quality available and that the representations of the quality tests are accurate; it would then be distributed to a selected number of retail stores with a consumer and merchant feedback questionnaire, to be used to analyze the effect of the brochure and its usefulness. Re-

sults of the survey would be tabulated and a report submitted to the Federation for its consideration in publishing and distributing the brochure.

St. Louis

Project underway on Evaluation of a New Method for Determining Resistance Properties of Coatings. Test will be run on panels containing depressions formed with a standard impact tester. After coatings have been applied and cured, reagents will be placed in the depressions; each test depression will be covered and sealed with a small watch glass, which will be removed periodically and resistance of the film determined.

Toronto

Three subcommittee projects are in various stages of activity:

(1) *Relationship of CPVC to Binder Index*—Continuing literature search and reanalysis of data suggest probability that many of unusual observations noted in work to date are due to normal and random pigment packing configurations of unusual pigments. Further samples of specially classified pigments have been prepared to test the hypothesis at low CPVC's. Paper is anticipated for presentation at 1982 Annual Meeting.

(2) *Latex Wet Adhesion*—Vinyl acetate copolymers have been prepared with varying molecular weights and particle sizes to determine how these parameters affect latex wet adhesion. All materials and formulas are in the hands of cooperating labs, and results are awaited.

(3) *Parameters Affecting Wear Rate in Small Media Mills*—Remaining bench work has been concluded and paper is being prepared for 1981 Annual Meeting in Detroit; results include data on mill media efficiencies and on combinations of media and mill lining types . . . Action has been suspended indefinitely on project to determine flow and sagging by novel instrumentation.

FSCT Offers 1981 Coatings Courses Guide

The 1981 "Guide to Coatings Courses, Symposia, and Seminars," compiled by the Federation Educational Committee, is now available.

Based on information supplied by the Constituent Societies, the Guide lists a variety of coatings educational offerings by geographic region and Society. The Committee updates the listing annually to reflect current programs, curricula, etc.

To obtain free copies of the Guide, write to Educational Committee (Coatings Courses), c/o Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107.

Society Meetings

Birmingham

April 30

G.W. Rothwell, of the Building Research Association, spoke on "THE COATING OF WINDOW FRAMES."

Mr. Rothwell explained how windows account for 6-9% of the capital cost of a building and for 30% of the maintenance costs. When assessing window frames, both of these factors should be considered, stressed Mr. Rothwell. Presently, the trend is towards "maintenance free" frames, i.e., those requiring no repainting during the first 15 years of the building's life.

The purpose of the Building Research Association, explained Mr. Rothwell, is to advise architects and builders on the relative merits of different systems and to provide information on which building regulations could be based.

Using slides, Mr. Rothwell described tests which the B.R.A. has carried out over a nine-year period, using a specially constructed building which presented test frames to both northerly and southerly exposure. The interior of the building was maintained at a high relative humidity. In general, concluded Mr. Rothwell, failures on the south side were due to chalking and cracking and on the north side due to mold growth.

Mr. Rothwell discussed the faults of wooden frames. In some instances, design of the joints or the method of fitting accelerated failure. The putty had often cracked and sometimes the paint system failed. Reasons for coating system failure were given by Mr. Rothwell. For example, the paint might embrittle and so not adapt to aging or grain movement in the timber. Lead primers could give good results, according to Mr. Rothwell, only if maintenance was carried out at four to five year intervals. Presently, the move is towards lead-free systems. According to the tests, prefinished wooden windows in both emulsion and polyurethane were still intact after nine years. Treated woods needed maintenance every two to three years to keep their water repellency, but treatment was much easier and cheaper, explained Mr. Rothwell. Galvanized frames coated in zinc chromate and calcium plumbate primers were satisfactory after nine years, while zinc phosphate failed more quickly.

Aluminum windows coated in polyester powder had presently lasted five years without breakdown. The coating, being durable, showed less installation damage, according to Mr. Rothwell. However, electrostatic application caused variations in film thickness which could lead to difficulties during fitting. Mr.

Rothwell thought that gas bubbles in the coating gave rise to craters and hollows in the film. The blistering which occurred after 1600 hours on accelerated weathering tests was probably associated with these gas bubbles.

Plastic windows have very good durability, but mold growth and surface staining had occurred after nine years, said Mr. Rothwell. A minimum 15 years before maintenance was expected for these frames.

BRIAN ADDENBROOKE, *Secretary*

Cleveland

May 19

Fifteen Past-Presidents attended the Annual Past-Presidents and Spouses' Meeting.

Fred Schwab, of Coatings Research Group, and Helen Skowronska, Consultant, were presented with the Society's Award of Merit.

Helen Skowronska presented 25-year pins to Peter Homich, of Beaver Paint Co., and Sidney Lauren, of Coatings Research Group. Twenty-five year pins were presented in absentia to William Henschel, of Glidden Coatings and Resins, and Herbert Williams, formerly of Sherwin Williams Co.

Ann Downing, of Cleveland Electric Illuminating Co., presented "LIGHT AS A DECORATING TOOL."

Ms. Downing stated that the purposes of lighting are safety, security, and decoration. A blending of both the functional and decorative purposes can be achieved by utilizing three types of lighting: formal, special, and structural, according to Ms. Downing. The three types of lighting were described and examples were given of each.

CARL KNAUSS, *Secretary*

Los Angeles

June 10

Ron Stark, a member of the Los Angeles Society for Coatings Technology and a Vice-President of ASIFA (International Animated Film Society) was the speaker for the meeting. Mr. Stark's program featured the "SEARCH AND RESCUE OPERATION," which focuses on the acquisition, repair, and restoration of all types of animated art work.

Mr. Stark started the program with a slide/tape show which illustrated the activities of the Search and Rescue Team. The voices and cartoons shown in the show were "Rocky the Flying Squirrel" and "Bullwinkle Moose". He explained that for one second of screen action, 24 individual drawings needed to be made, or 1440 pictures per minute; 72,000 for a

15 minute feature length cartoon. These drawings are transferred to a sheet of clear film in order to be photographed. The clear film is called the cel, which is short for celluloid. Celluloid was used until the 1950's. Today cellulose acetate is used which is much less flammable than the old celluloid film. In the production process, there are three ways the drawings can be copied onto a cel, according to Mr. Stark. They include by brush, by pen, or by photocopying the image. After that, the cel is turned over and painted on the back. The colors must be even and without brush marks. The ASIFA laboratory looks more like an artist studio than a conventional laboratory. A layout chart is used to keep track of the colors on the cel. Some cels have as many as 30 to 40 colors. Sometimes it is necessary to remove a color and often they can rebond the paint to the surface of the cel by a method developed at the ASIFA laboratory. After a color key is developed for the cel the repair work is started.

In the tape, Mr. Stark expressed thanks to the paint industry. He explained that many chemists helped discover the methods used in the early days of animation. Many well known cartoon character cels were shown in the tape, many before and after the restoration.

Mr. Stark explained that the paint he is using is a copolymer paint. Paints used in the early days of animation were gum arabic and sugar; these are the paints they often have to restore. They restore mostly the paint on the cels and also the backgrounds that were used for filming the cartoons. They come from all over the world.

Bill "Bullwinkle" Scott, President of ASIFA, was introduced. Mr. Scott started with his "Bullwinkle" voice and quickly changed to "George of the Jungle", "Super Chicken", and changed to "Dudley-Do-Right of the Mounties". He quoted John Hubble of UPA; he said: "Anything that you can image, you can do with animation". He related some of the history of ASIFA, which has branches now in every country that has animation. Also, the value of color control animation was stressed. He said it was Walt Disney who first emphasized the importance of this. A sad part of the history of animation art is that it was not recognized as a lasting art and literally thousands of pieces of animation art work was simply destroyed. ASIFA is trying to stop that from happening.

L. LLOYD HAANSTRA, *Secretary*

Montreal

May 7

On the special occasion of the 50th Anniversary of the Montreal Society, the Past-Presidents Night reflected on the growth and history of the Society.

Honored guests included Federation President William H. Ellis, President-Elect Howard Jerome, Treasurer A. Clarke Boyce, and Executive Vice-President Frank J. Borrelle.

Twenty-five year pins were presented to H. Philipp, K. Delameter, C.G. Whitaker, and P. Morens.

Eight past-presidents reflected on their term as society president. They included R. Grant (1938-39); E.P. Lanthier (1950-51); R.C. MacLean (1952-53); N.N. Brokhurst (1954-55); R.C. Hubbard (1959-60); V.R. Pederson (1960-61); W. Kolanich (1963-64); and H.S. Philipp (1965-66).

B. PAPANBURG, *Secretary*

New York

May 5

Don F. Koenecke, of Exxon International Co., was awarded Honorary Membership in the New York Society.

President Service Awards were presented to Elio Cohen, of Daniel Products Co., Murray Guttenplan, of Purall Paint

Co., and Irwin Young, of Jesse Young Co., for their long and faithful service to the society and to the protective coatings industry.

The 1981-82 officers were elected as follows: President—Donald E. Brody; Vice-President—Ted Young; Secretary—Herbert Ellis; Treasurer—Michael Iskowitz; and Society Representative—Saul Spindel.

"NEW DEVELOPMENTS IN COATINGS TECHNOLOGY" was presented by Joseph Prane.

A review of the current status of technology in the industrial coatings area, emphasizing polymer and binder aspects, was featured. Mr. Prane spoke on the brilliant future for industrial coatings technology to the end of this century and beyond.

With the aid of slides, Mr. Prane discussed the total number of gallons shipped thru 1985 and the newer developments in technology. He explained the different systems of the industry in relation to present and impending material, energy, environmental, and health pressure on the industry. New and improved polymers, coatings, application and curing systems were featured. Included were non-yellowing epoxy and urethane systems, cathodic electrodepo-

sition, autodeposition, high solids coatings, new waterborne coatings, powder coatings, and radiation curable coatings.

TED YOUNG, *Secretary*

Pacific Northwest

May 21

Two slide presentations, prepared by the society, were presented by Mike Griffin, assisted by Barry Lamb. The first presentation featured "THE PEROCITY OF PAINT FILM" while the other depicted "SWARD HARDNESS ROCKER TEST AND EQUIPMENT."

O. SCHMIDT, *Secretary*

Piedmont

June 17

Officers were elected for 1981-82 as follows: President—Jim Albright; President-Elect—Sara Robinson; Secretary—Jim Husted; and Treasurer—Phil Wong.

Frank Zurlo, of Byk-Mallinckrodt, presented a talk entitled "THE SEDIMENTATION ANALYSIS AS A METHOD FOR AN EARLY DETERMINATION OF THE FORMATION OF SETTLEMENTS IN COATINGS SYSTEMS."

With the use of slides, Mr. Zurlo discussed a number of experiments that were designed to lessen the amount of time spent on determining settling characteristics and evaluating wetting agent performance. The experiments were conducted using a dynamometer. This instrument can measure settling as it occurs, surface tension, and can evaluate existing sedimentation quantitatively. According to Mr. Zurlo, the instrument basically consists of three parts: the transducer—converts mechanical movement into electrical impulse; the amplifier—takes impulses and increases them for measurement; and the recorder—makes a permanent record of the impulses.

One of the experiments discussed was how to determine the slow down rate of settling of silica in a polyurethane satin varnish. The dynamometer showed which combination would give the best anti-settling properties when comparing settling rates of particles in combination with wetting and/or suspension aids. Using this instrument as a formulation "tool", efficient levels of wetting and suspending aids can be optimized without overusage of costly raw materials, according to Mr. Zurlo.

In latex systems, Mr. Zurlo explained, the dynamometer can be used to determine settling rates immediately after production, as well as to evaluate the physical properties of sedimentation after storage. A benefit of this analysis, according to Mr. Zurlo, is that use of proper wetting agents can slow down the rate of settling.

Mr. Zurlo explained that the dynamometer can also be employed to not only

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measure gross surface tension in liquids but also the forces involved after maximum surface tension is reached. A benefit of this type of measurement is that it provides information of foam stabilization and foam control.

Mr. Zurlo concluded his discussion by stating that with new instrumentation, such as the dynamometer, the time spent evaluating settling and foam control has been reduced significantly. The coatings chemist, therefore, can optimize levels of dispersing, anti-settling and/or foaming control aids while saving both time and raw materials.

Q. What is the cost of the dynamometer?

A. \$7200 without the Recorder.

Q. What is the output to the Recorder?

A. 5 volts D.C.

SARA ROBINSON, *Secretary*

St. Louis

June 5-6

The St. Louis Society for Coatings Technology hosted the 30th annual joint meeting of the St. Louis and Kansas City societies. The theme was "RESEARCH AND DEVELOPMENT; KEY TO SURVIVAL IN THE EIGHTIES."

Richard K. Hong, of Spencer Kellogg Division of Textron, Inc., spoke on "HIGH SOLIDS COATINGS."

Mr. Hong discussed the use of amino resins in high solids coatings. He said that even without present regulations, the importance of high solids coatings is indicated by high energy costs, falling petroleum reserves, and the costs of solvents. Mr. Hong compared an 80% solids coating with one containing 30% solids in a conventional formula, a 30% solids water-borne type, and a 15% solids nitrocellulose lacquer. Solvent evaporation quantities in each case were 0.20, 2.00, 2.67, and 4.5 gallons, respectively.

In formulating high solids coatings, the following components are important, said Mr. Hong. They include solvent (affects viscosity, application, and percent solids); crosslinking agent (amino resins, epoxy resins, urethanes); catalysts (PTSA, weak acids, and metal salts for low temperature cures); pigments (untreated types with low oil absorption work well); and additives (sag control agents, pigment suspension aids, and surfactants are used).

Mr. Hong discussed costs. The costs of high solids systems can be similar to that of conventional coatings. In an example of white enamels, a 90% high solids cost \$0.737 per square foot while conventional white ran \$0.833 for the same film thickness. In another example, conventional solvent based coatings ran \$.877 per square foot vs \$0.763 and

\$0.864 per square foot for two high solids finishes. Mr. Hong said high solids coatings may cost more per gallon, but they can be applied at equal or lower cost. High solids coatings may not be the answer to our future coatings needs, but they are important now.

Q. No present equipment will apply high solids coatings thin enough to be competitive with conventional types. What do you use?

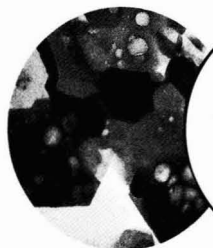
A. We use automatic sprays and electrostatic spray equipment. To get results, operators must be trained well.

Q. How does zinc nitrate effect package stability?

It promotes good package stability. The viscosity of test systems has not increased after six months storage. Humidity resistance is very good while salt spray is poor.

George E. Bruner, of American Cyanamid Co., presented "AMINO RESINS IN HIGH SOLIDS COATINGS."

Stressing the points regarding energy, population expansion, and resources, Mr. Bruner called for more innovative research to deal with coatings problems of tomorrow.



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Going over the reaction process for producing high solids resins, Mr. Bruner said low molecular weight polymers (backbone resin) require more cross-linking. Fully alkylated resins must be kept above pH 7.0-7.5 for shelf stability. They will not react at a high pH or a low temperature. Waterborne amines cure faster with partially alkylated resins.

In choosing the resin to use, Mr. Bruner explained that one must determine how much to use by calculating the resins' molecular weight; then calculate the equivalent weight of the resin. Polyesters will continue to react while acrylics reach a peak based on the func-

tional groups available for the reaction.

According to Mr. Bruner, maximum hardness and curing temperature depend on functional groups. A better understanding of amino functionality helps in obtaining obtaining properties.

Q. How can a fully alkylated resin system be stabilized with amine?

A. A primary alcohol is needed for stability. A polyester or oil-free alkyd modified with tall oil fatty acid can be stabilized for a year if enough alcohol is present.

Q. What polyols are used for fast cure rates?

A. Pentaerythritol polyhydric alcohol modified alkyds.

Q. Can 100% solids be achieved?

A. A system with very little water and no organic solvent is possible.

Q. How do you achieve optimum properties in a 20-30% melamine self condensing system?

A. High molecular weight resins produce hard films. Increasing the melamine content increases gas resistance. In every case, the resin is first selected for the properties most desired.

"PRACTICAL METHODS OF PIGMENT EVALUATION" was presented by Dan Dixon, of Freeport Kaolin Co.

Mr. Dixon suggested that more research is the key to the future of the coatings industry. Coatings research should be presented in more practical terms so that the plant chemist can understand it and apply it to his work, according to Mr. Dixon.

Mr. Dixon explained that he has read many articles regarding Critical Pigment Volume Concentration (CPVC) and has found no agreement among the authors and no easy method to determine CPVC for the plant chemist. He is presently attempting to develop this information.

The CPVC can be determined in any lab by using four basic tests, according to Mr. Dixon. No one test will do the job. The tests include opacity, stain test, tint, and sheen.

One of the projects discussed by Mr. Dixon was an experiment to determine "where does the vehicle or binder go at CPVC?" If this can be determined, said Mr. Dixon, we may be able to put the binder where we want it, i.e., on the surface.

Q. How are photos of various PVC's taken?

A. Electron micrographs are taken at 800 to 1200X.

Q. Compare the papers on CPVC vs the practical approach.

A. A simple set of tests must be used because you do not have all the equipment needed in your lab.

Q. When will you publish your work?

A. After the position of the binder at CPVC is determined.

Terry Bowerman, of Degussa Pigments, spoke on "HYDROPHOBIC AEROSOLS IN INDUSTRIAL PRIMERS."

Mr. Bowerman began his talk with a discussion of hydrophobic silicates for primer applications. These silicates are



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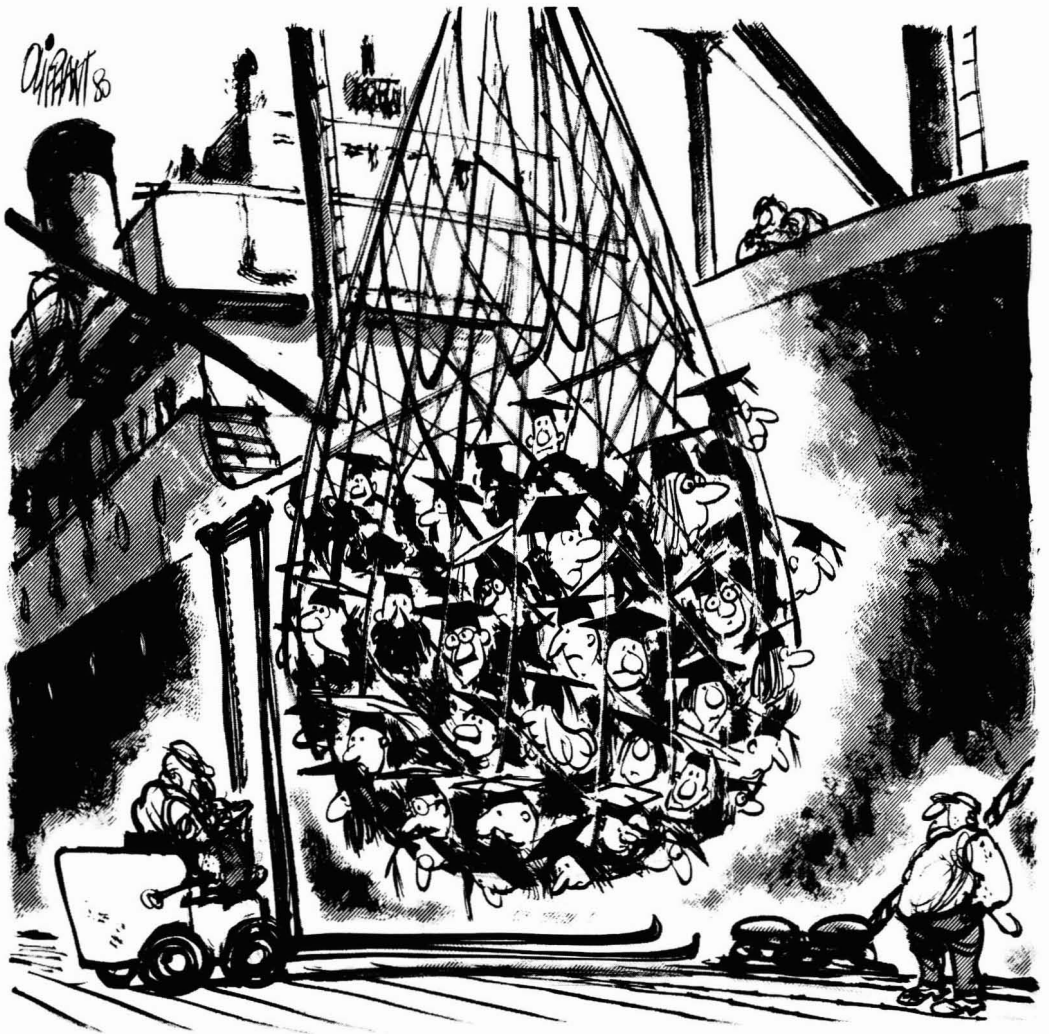
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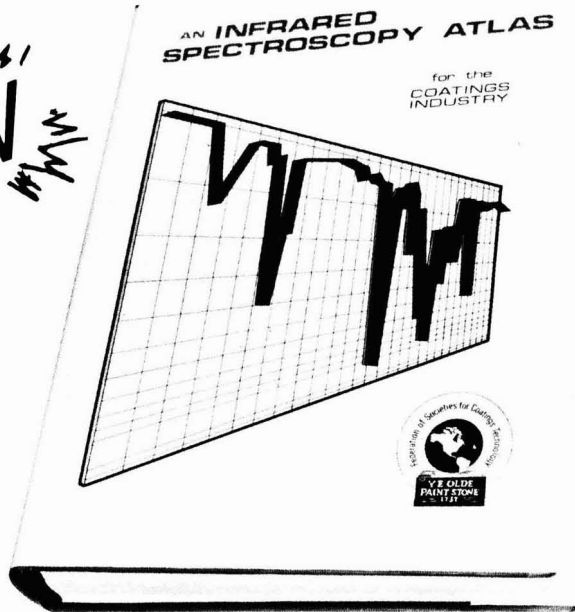
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In a zinc rich primer, less than 2% by weight of the formula covers the zinc particles and prolongs the life of the zinc metal. Water is kept away but not eliminated. The zinc serves its purpose but does not gas, according to Mr. Bowerman.

"IDENTIFYING SURPRISES OR IRREGULARITIES IN WATER-BORNE AND HIGH SOLIDS COATINGS" was presented by William Winters, of Cargill Chemical Products.

Mr. Williams discussed a number of coatings problems and gave the methods for trouble-shooting and the steps to be taken to solve each. He described these properties relative to conventional, water-borne, and high solids systems. Mr. Williams said if this information could be presented in chart form for the production office lab, it would be a handy tool for a manufacturing lab.

JOSEPH J. WROBEL, JR., *Secretary*

Toronto

May 11

Charles A. Garber, of Structure Probe Inc., presented "NEW ELECTRON OPTICAL METHODS FOR SOLVING PROBLEMS IN THE MATERIALS SCIENCES."

Dr. Garber explained the basics of the many analytical instruments available. Some of these analytical instruments, such as X-Ray Fluorescence, will produce charts with peaks which are finger prints of the compound. He stressed that thorough knowledge of the instrument is necessary for proper interpretation.

Examples of pictures taken with a scanning electron microscope were shown. These pictures were not as simple as they appeared to be since certain spots in the picture could easily be misinterpreted by a layman.

The basics of microanalysis were discussed. Dr. Garber said that tiny specific spots on a certain object can be analyzed by focusing electron beams on that particular spot. Layers of unknown compound, only angstroms thick, can be analyzed using the latter technique. Dr. Garber suggested that x-rays should be used for organic matter because the electron beam has the tendency to destroy organic matter.

R. KUHNEN, *Secretary*

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BALTIMORE (Third Thursday—Eudowood Gardens, Towson). JOSEPH D. GUISTO; Lenmar, Inc., 150 S. Calverton Rd., Baltimore, MD 21223.

BIRMINGHAM (First Thursday—Warwickshire County Cricket Club). B. J. ADDENBROOKE, Croda Paints Ltd., Bordesley Green Rd., Birmingham B9 4TE, England.

CHICAGO (First Monday—meeting sites in various suburban locations). JOHN R. INGRAM, DeSoto, Inc., 1700 S. Mt. Prospect Rd., Des Plaines, IL 60018.

C-D-I-C (Second Monday—Sept., Nov., Jan., Mar., May in Columbus; Oct., Dec., Feb., Apr., in Cincinnati, Kings Island Inn). NELSON W. BARNHILL, Inland Div., G.M.C., P.O. Box 1224, Dayton, OH 45401.

CLEVELAND (Second Tuesday—meeting sites vary). DONALD C. DENISON, JR., Hilton Davis Chemical Co., 5254 Berkshire Dr., N. Olmsted, OH 44070.

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

DETROIT (Fourth Tuesday—meeting sites vary). SHEILA G. DRAKE, Grow Chemical Corp., 3155 Big Beaver Rd., Troy, MI 48084.

GOLDEN GATE (Monday before third Wednesday—Sabella's Restaurant, San Francisco). KEN E. TRAUTWEIN, Sherwin-Williams Co., P.O. Box 23505, Oakland, CA 94623.

HOUSTON (Second Wednesday—Sonny Look's, South Main). GEORGE SCHWARTZ, Cook Paint & Varnish Co., P.O. Box 3088, Houston, TX 77001.

KANSAS CITY (Second Thursday—Cascone's Restaurant). MEL BOYER, Patco Coatings Products, 3947 Broadway, Kansas City, MO 64111.

LOS ANGELES (Second Wednesday—Steven's Steak House). EARL SMITH, Spencer Kellogg Div., Textron, Inc., 4220 Long Beach Blvd., Long Beach, CA 90807.

LOUISVILLE (Third Wednesday—Essex House). JOHN LANNING, Porter Paint Co., 400 S. 13th St., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary). JUAN IRAZABAL, Grafex De Mexico, S.A., Calz. Tulychaulco 4615, Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). ERIC TEMPLETON, NL Chemicals Can., Inc., 2140 Sun Life Bldg., Montreal, Que., Can., H3B 2X8.

NEW ENGLAND (Third Thursday—Fantasia Restaurant, Cambridge). N. BRADFORD, BRAKKE, Lilly Chemical Products, P.O. Box 188, Templeton, MA 01458.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). H. ELLIS, D. H. Litter Co., Inc., 116 E. 16th St., New York, NY 10003.

NORTHWESTERN (Tuesday after first Monday—Edgewater Inn). HERBERT DAVIDSON, Spencer-Kellogg Div., Textron, Inc., 525-25th Ave. S.E., Minneapolis, MN 55414.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). WILLIAM SHACKELFORD, Gaco-Western, Inc., P.O. Box 88698, Seattle, WA 98188.

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PIEDMONT (Third Wednesday—Howard Johnson's Coliseum, Greensboro, NC). JAMES E. HUSTED, Mobil Chemical Co., P.O. Box 2438, High Point, NC 27261.

PITTSBURGH (First Monday—Skibo Hall, Carnegie Mellon Univ.). MICHAEL GILLEN, Van Horn, Metz & Co., Inc., 400 Keystone Dr., Carnegie, PA 15106.

ROCKY MOUNTAIN (Monday prior to second Wednesday—Gusthaus Ridgeview, Wheatridge, CO). DONALD SHILLINGBURG, Union Chemical Div. of Union Oil, 1535 W. 13th Ave., Denver, CO 80204.

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SOUTHERN (Gulf Coast Section—Second Tuesday; Central Florida Section—Thursday after third Monday; Atlanta Section—Third Thursday; Memphis Section—Second Tuesday). J.E. GEIGER, Sun Coatings, Inc., 12295 75th St., N., Largo, FL 33540.

TORONTO (Second Monday—Town and Country Restaurant). R. KUHNEN, Tioxide Canada, Inc., 1 Eva Rd., Etobicoke, Ontario, Canada M9C 4Z5.

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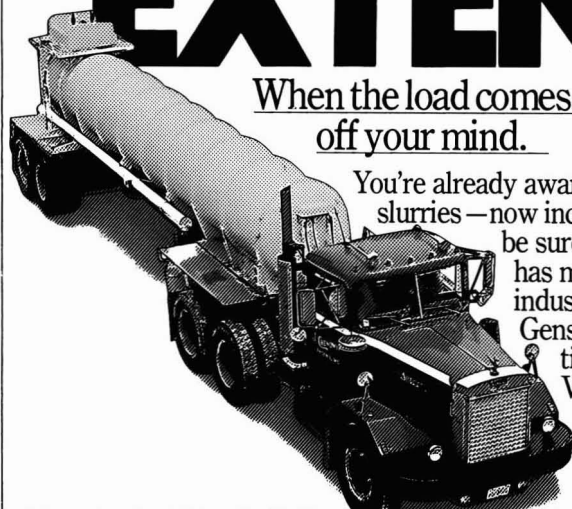
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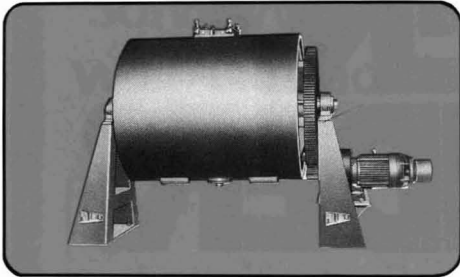
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Callow, L.M. and Scantlebury, J.D.—“Electrochemical Impedance on Coated Metal Electrodes. Part 3: Measurements at Constant Potential”; 140-143.
Smith, F.M.—“Outlook for the Eighties”; 144-155.

Progress in Organic Coatings

Published by Elsevier Sequoia S.A., Lausanne, Switzerland
Vol. 9 No. 1 1981

Wicks, Jr., Z.W.—“New Developments in the Field of Blocked Isocyanates”; 3-28.
Funke, W.—“Blistering of Paint Films and Filiform Corrosion”; 29-46.
Colling, J.H. and Dunderdale, J.—“Durability of Paint Films Containing Titanium Dioxide—Contraction, Erosion and Clear Layer Theories”; 47-84.
Sato, Y.—“Mechanism and Evolution of Protective Properties of Paints”; 85-104.

Double Liaison — Chimie des Peintures (In French)

Published by EREC, 68 rue Jean-Jaures,
92800 Puteaux, France

Vol. 28 No. 304-305 January/February 1981

Van Leberghe, K. and Van Springel, C.—“Improved Silane Method for Preparation of Free Films of Paints and Varnishes. Part IV”; 15-19.
Jobert, R.—“Solubility Parameters”; 29-35.
“Technical Computer Applications in the Coatings Industry”; 36-57.

Vol. 28. No. 306 March 1981

Boutevin, B., Rigal, G., Rousseau, A., Schaeffner, P., Mathieu, D., Phan-Tan-Luu, R.—“Optimization of the Properties of a Coating Based on a Mixture of Aqueous Dispersions and Mineral Extenders”; 17-24.
Soldatos, A.C.—“Hydroxyethyl Cellulose—A Stabilizer for Latex Making”; 25-32.
Roundtable on Solubility Parameters:
Dangel, B.—“Formulation of Solvents by a Graphic Method”; 33-35.
Marron, M.—“Solubility Parameters”; 35-36.

Paint Manufacture

Published by Wheatlands Journals Ltd., 177 Hagden Lane,
Watford WD1 8LW, England

Vol. 50 No. 8 October 1980

Ellinger, M.L.—“R & D Report: Anticorrosion and Marine Paints” (Literature review); 21-23.
Smith, C.A.—“Flame Resistant and Intumescent Paints. Part 2”; 24-25.

Vol. 50 November 1980

Paint Making Machinery Survey and Buyers Guide Issue

Vol. 50 December 1980

Batty, T.K.—“Correlation—Practicalities and Possibilities” (accelerated weathering); 13-16.
Boxall, J.—“Development of Modern Coatings Technology. Part 1: Rubber in Paint”; 25-26.

Vol. 51 No. 1 January/February 1981

Lower, E.S.—“Lauric Acid Esters—A Review. Part 1”; 16-17.

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Meetings/Education

Polymer and Coatings Students Aided By FSCT Scholarship Funding

Currently the Federation offers scholarship monies to five universities which have a curricula in polymers and coatings technologies. These schools are: Kent State University, Kent, OH; North Dakota State University, Fargo, ND; University of Detroit, Detroit, MI; University of Missouri—Rolla, Rolla, MO; and University of Southern Mississippi, Hattiesburg, MS. (See Comment, *August JCT—Ed.*)

The following is a list of Federation scholarship recipients and their present status.

Kent State Univ.

1981 GRADUATE:

Christine L. Menne, I.B.M., Columbus, OH

CURRENT RECIPIENTS:

Janet Domer, N. Canton, OH
Adarsh Krishen, Cuyahoga Falls, OH
Glenn P. Rothhaas, Tallmadge, OH

Daniel Sayre, Kent, OH
Christine Schott, Bolivar, OH

North Dakota State Univ.

1980 GRADUATES:

Steve Jesseph, Celanese, Summit, NJ
Marcia Saylor, Mobil Chemical, Kankakee, IL

1981 GRADUATES:

Myra Harchenko, enrolled in graduate school
Kim Nill, Phillips Petroleum, Bartlesville, OK

1981 GRADUATES (M.S. Degree):

Eugene Anderson, Valspar Corp., E. Moline, IL
Robert Asmus, 3M Company, St. Paul, MN

CURRENT RECIPIENTS:

Gary Asmus, Lakeville, MN
Richard Carlson, Bottineau, ND
Steve Conyne, Bismark, ND

Daniel Falvey, Shoreview, MN
Colleen Hagel, Bismark, ND
Gregory Kaster, Erskine, MN
Tom Murrey, Wilton, ND
Carl Seneker, Anaheim, CA

Univ. of Detroit

1981 GRADUATE:

Iris Franco, Venezuela

CURRENT RECIPIENTS:

Daniel R. Bullock, Inkster, MI
Joseph D. Skornicka, Flushing, MI

Univ. of Missouri—Rolla

1981 GRADUATES:

Karen Kohl, Fenton, MO, enrolled in graduate school
Michael McKinzie, Standard Oil of Ohio, Cleveland, OH

CURRENT RECIPIENTS:

Laura Plyler, Edmond, OK
Garth Studebaker, Neosho, MO

Univ. of Southern Mississippi

1980 GRADUATES:

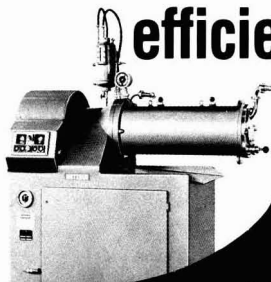
Frederick T. Beard, Jones-Blair Co.
Daniel Chandler, Raychem Corp.
Gary M. Clark, Masonite Corp.
David Entrekin, Celanese Polymer Specialties Co.
James H. Flynn, Dow Chemical Co.
Eric R. George, Raychem Corp.
Richard Leggett, Masonite Corp.
Bryan H. Naderhoff, Dow Chemical Co.
Alan D. Reed, Dow Chemical Co.
Phillip A. Ross, Dow Chemical Co.
Kathy B. Sellstrom, Texaco, Inc.
Hai Nam Tran, Southern Research Institute

1981 GRADUATES:

Roy G. Bosarge, Uncommitted
Leonard J. Bussell, Guardsman Chemical Coatings, Inc.
Rodney W. Culppeper, Temporary University research
Vance Fortenberry, Cities Service Co.
Robin Ann Grannell, Shell Development Corp.
Raymond L. Laakso, Dow Chemical Corp.
Mary Elizabeth Levy, Uncommitted
Patrick R. Nau, Uncommitted
Michael W. O'Rourke, Cities Service Co.
Carol Ann Wagner, Cities Service Co.

(Continued on page 93)

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Eastern Michigan University To Offer Degree in Polymers And Coatings Technology

Starting in September 1981, Eastern Michigan University will offer a four-year curriculum leading to a Bachelor of Science degree in polymers and coatings technology.

This interdisciplinary program, which draws heavily from existing courses in the Department of Chemistry as well as the College of Technology, was developed with the help of an Industrial Advisory Committee representing the polymers and coatings industry, the Federation, and NPCA. The program emphasizes a combination of theory and hands-on, practical experience in the synthesis of polymers and the formulation of coatings and paints.

Highlights of the program include: 37 semester hours in chemistry, including polymer chemistry; 6 semester hours in polymer synthesis as it relates to coatings; 6 semester hours in the formulation of coatings; 3 semester hours in advanced coatings concepts; a three to four month summer cooperative experience in the polymers and coatings industry; and 12 semester hours in management/business, plastics, material analysis, and testing and environmental safety.

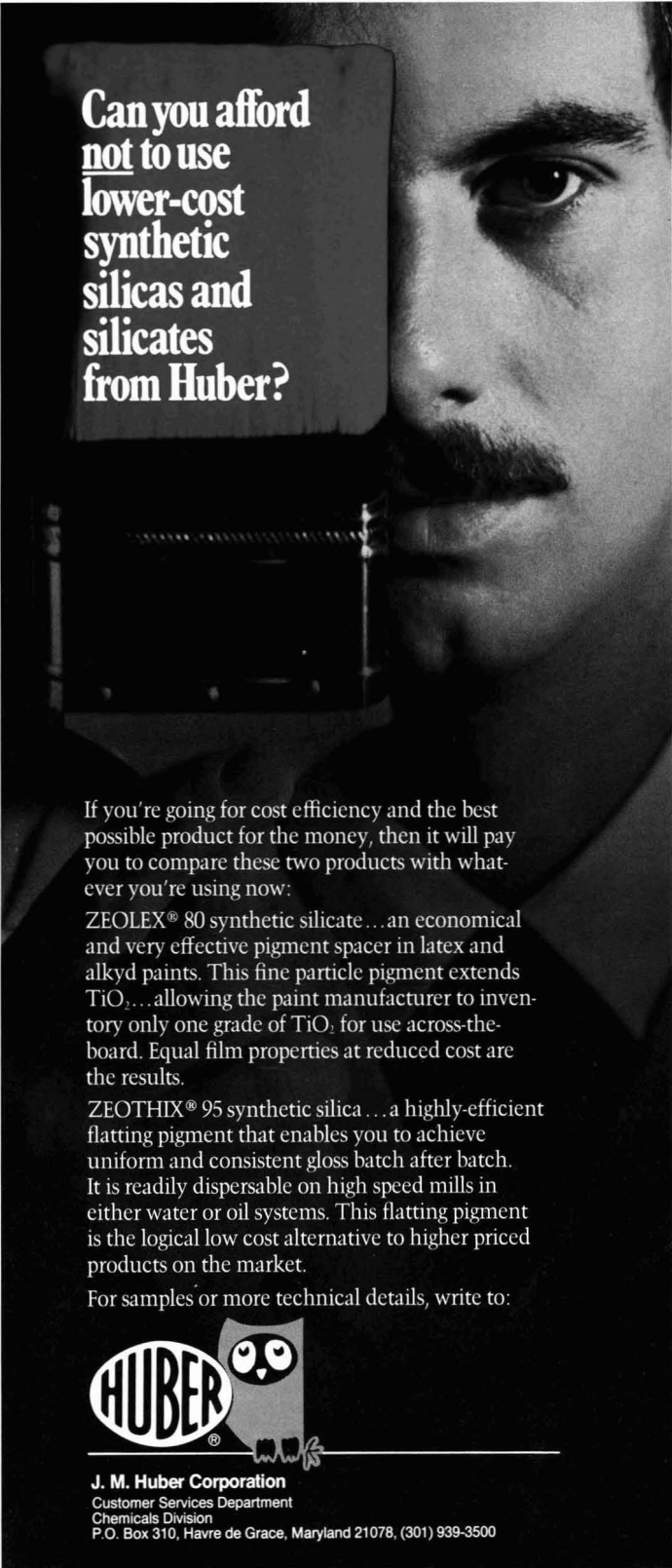
Additional information regarding this program can be obtained by writing: Eastern Michigan University, Program Coordinator, Polymers and Coatings Technology, Department of Interdisciplinary Technology, Sill Hall, Ypsilanti, MI 48197.

(Continued from page 92)

CURRENT RECIPIENTS:

Joni Jo Devitt, Gulf Breeze, FL
Katherine Ann Drozda, Richton, MS
Michael A. Evans, Gautier, MS
Sharon Furukawa, Westminster, CA
Ralph M. Gonzalez, Gulfport, MS
Patricia M. Lewis, Hickory, MS
Alan K. Randall, Lucedale, MS
Donald L. Spiers, McNeill, MS
Gregory L. Wascomb, Columbia, MS
Janis R. Witchen, Pascagoula, MS
Robert H. Bloodworth, Alton, IL
Brian J. Kinkopf, Petal, MS
Glenn K. Daniels, Leakesville, MS
Franklin D. Rector, Palmerdale, AL
Keith B. Sainsbury, Lucedale, MS
Anthony G. Smith, Dyersburg, TN
Jeffrey E. Tinnon, Hattiesburg, MS

For information concerning scholarship availability and application, please contact the Federation headquarters office, 1315 Walnut St., Suite 832, Philadelphia, PA 19107.



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RETEC "In-Plant Color Control" to Be Held Oct. 4-6

"In-Plant Color Control" is the theme for the Regional Technical Conference, Coloring Plastics XV, sponsored by the Color and Appearance Division and the Chicago Section of the Society of Plastics Engineers, Inc., to be held October 4-6, at the Marriott Lincolnshire Resort Hotel, Lincolnshire, IL.

Emphasis of the conference will focus on controllable variables in close tolerance color work. Sessions will discuss realistic problems and solutions that will encompass equipment, instrumentation, and industry trends.

Sessions featured will include the following:

MONDAY, OCTOBER 5

"Color Vision and Visual Examination"—B. Swenholt, Eastman Kodak.

"Color Tolerance Sets as a Quality Control Concept"—H. Marcus, MacBeth Div. of Kohlmorgen.

"The Colorimeter as a Quality Control Tool for the Plastics Fabricator"—L. Griffin, Hanksraft Div., Gerber Food.

"Critical Color Matching—The Compounder Processor Relationship"—R.D. Nice, Reed Plastics.

"Coloring Matching of Automotive

Polypropylene"—W. Longley, Ford Motor Co.

"Custom Binders in Color Masterbatches"—Panel Discussion.

"Precolored Compounds"—H. Gober, Eastman Chemical Co.

"Dry Colorants"—B. Mueller, Accurate Color Co.

"Granular Colorants"—A. Carlson, Ampacet Corp.

"Pellet Concentrates"—L. Campbell, Americhem Co.

TUESDAY, OCTOBER 6

"A Procedure for Color Qualification and Cost Control"—M. Tirpak, Richardson Co.

"Color Qualification in the Closure Industry"—F.E. Welsh and P. Maloney, Owens-Illinois.

"Qualification of Colorants for Continuous Cast Acrylic Sheeting"—F. Alban, U.S.S. Novamont.

"Universal Binders in Color Masterbatches"—Panel Discussion.

"Ethyl-Vinyl Acetate Based Concentrates"—J. T. King, E.I. DuPont de Nemours.

"Freeze Dried Colorants"—D. Klingman, PMS Consolidated.

"Liquid Colors"—J. Snow, Rosemont Industries.

"Color Control in the Vinyl Siding Industry"—W. Wheeler, H.C. Products, Subsidiary of Alcoa.

"Establishing & Controlling Color Tolerances in ABS Polymers"—M. Popa, Western Electric Co.

"First Annual Theme Color Review: Yellow/Orange Group"—Panel Discussion.

"Hi-Performance Organic Yellows & Oranges"—J. Graf, CIBA-Geigy Corp.

"Medium Range Performance Organic Yellows & Oranges"—F. Fasano, American Hoechst.

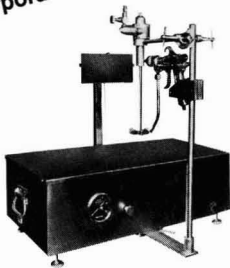
"Inorganic Yellows & Oranges"—J. Dickenson, Harshaw Chemical Co.

"Dyes for Plastics—Yellows & Oranges"—H. Bunge, Mobay Chemical Co.

Advance registration is \$90 for SPE-SPI members and \$95 for nonmembers; on-site is \$105 and \$110 respectively. Registration chairman is Paul Hitchens, DuPont Co., 5725 E. River Rd., Suite 760, Chicago, IL 60631. For more information, contact Robert Swain, Chroma Corp., 3900 Dayton St., McHenry Shores, IL 60050.

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People

Daniel Products Co. has announced the appointment of **Thomas Daquila** as Technical Sales Representative, Jersey City, NJ. Mr. Daquila is a New York Society member.

William L. Kraus has joined Engelhard's Minerals & Chemicals Division as General Manager of its Porocel Corp. in Little Rock, AR. He succeeds **Walter G. Graupner** who has retired.

Austin E. Floyd has been elected Executive Vice-President of Southern Coatings, Inc., a subsidiary of Pratt & Lambert Inc. He will assume responsibility as General Sales Manager for the firm's six sales divisions. Mr. Floyd is a member of the Southern Society.

Michael P. McCarthy has joined The O'Brien Corp. as Midwestern Region Area Manager, headquartered in South Bend, IN. Promoted to Factory Manager for the South San Francisco operations was **Rodney E. Salvi**.

A.R. McInnes, of Pre Finish Metals, Inc., was elected President of the National Coil Coaters Association. **J.R. Pickering**, of Lilly Industrial Coatings, Inc., was re-elected a Vice-President and **James S. Smith**, of Roll Coater, Inc., was elected a Vice-President. Re-elected as Treasurer was **John H. Geyer**, of Amchem Products, Inc.

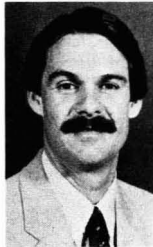
Ralph J. Bellrose has been appointed Market Manager in the Coatings Materials Division of Union Carbide Corp. Appointed Assistant Sales Managers in the Division were **Frank W. Jeffe** and **Bobby J. Poole**.

Michael Kent Hentschel was appointed Manufacturing Manager for the Buckman Laboratories, Inc. operations located at Memphis and Cadet, MO.

Paul F. Orefice, President and Chief Executive Officer of Dow Chemical Co., was elected Chairman of the Board of the Chemical Manufacturers Association. Elected Vice-Chairman was **Louis Fernandez**, Vice-Chairman of Monsanto Co. **William G. Simeral**, Senior Vice-President of E.I. du Pont de Nemours & Co., was elected Chairman of the Executive Committee and **Robert A. Roland** was reelected President of the Association.



T. Daquila



W.L. Kraus



W.A. Major



T.M. Gillis

Silberline Manufacturing Co., Inc. announced the promotion of **W. Anthony Major** to General Manager of Operations for the firm's plants in Decatur, IN, and Lansford, PA.

Ashland Chemical Co. has named **Eugene L. Bulgozdy** Vice-President and General Manager of the firm's Chemical Systems Division. Headquartered in Cleveland, OH, Mr. Bulgozdy will be responsible for the manufacture and marketing of the company's specialty resins, acrylic resins, and specialty phenolic resins.

UPA Technology, Inc., has appointed **Chuck Eppelsheimer**, Sales Engineer for Southern California. He will be responsible for the sales and servicing of the firm's plating and coating-thickness measuring instruments.

Harry R. Keefe has been appointed General Sales Manager, Filtration & Minerals Division of Johns-Manville. Based in Denver, CO, Mr. Keefe will be responsible for sales of filtration and mineral products in the U.S. and Canada.

Also announced by the firm, was the promotion of **Donald L. Dasbach** to General Merchandising Manager. He will be responsible for merchandising the company's filtration and mineral products in the U.S.

Alcolac Inc., Baltimore, MD, has announced several additions to its Sales Department. **H. Dean Warlick** and **Larry Knight** have been named Technical Sales Representatives for the Southeastern Region and Western Region, respectively. Appointed Manufacturers Representative for the State of Florida was **Paul Posten**. **David D. Anderson** was named Southern District Sales Manager based in Houston, TX.

Rohm and Haas Co., Philadelphia, PA, has appointed **Teresa M. Gillis** as Senior Technical Representative in its Polymers, Resins & Monomers North American Field Sales Force. Ms. Gillis will be responsible for the sale of products used in nonwovens, trade sales, and industrial coatings in Columbus, Cincinnati, and Kentucky. She is a member of the Philadelphia Society.

The firm has also announced the promotion of **David M. Watson** as Market Manager—Maintenance & Marine Coatings in its Polymers, Resins & Monomers North America Business Team. Based in Philadelphia, Mr. Watson will assume responsibility for marketing the company's products used in high performance corrosion resistant coatings that provide protection to plants, bridges, drilling rigs, ships, and various onsite applications.

Due to the firm's efforts to expand its capabilities to provide service to its customers in the industrial coatings segment of its Polymers, Resins & Monomers North American business, Rohm and Haas Co. has made the following appointments. **Nicholas Roman** was named Technical Service Manager for general product finishing, transportation, machinery, and equipment. Appointed Technical Service Specialist to assist Mr. Roman was **Nicholas J. Frauenhoffer**. **Michael J. Ellis** has been appointed Market Manager for general product finishing and **Chuck M. Less** was named Market Manager—New Markets for industrial coatings.

Jaegle Paint Co., Inc., Havertown, PA, has announced the promotion of **Joseph E. Dougherty** to Vice-President. Mr. Dougherty joined the firm in 1977 as Sales Manager responsible for marine and heavy industrial sales. He will now assume responsibility for overall sales in all market areas.

Nalco Chemical Co., Oak Brook, IL has announced several appointments in its Specialty Chemicals Group. **Edward J. Mooney** has been named General Manager of the Group. **William J. Holland** was appointed New Coatings Additives District Representative for Indiana and Illinois, and **Phillip R. Coniglio** was named New Coatings Additives Sales Representative for Tennessee, Kentucky, West Virginia, Virginia, and North Carolina.

Albert E. Feucht has been named Manager of Sales and Marketing for The Corrosion Control Division of The Ceilcote Co., Berea, OH. He was previously District Manager for the firm's Trenton, NJ office.

Greg J. Lindner, formerly Executive Vice-President of Algan, Inc., has joined the St. Clair Division of Day-Glo Color Corp., Cleveland, OH, as General Manager.

Dr. Zeno Wicks, Chairman of the Department of Polymers and Coatings at North Dakota State University, has been named the 1981 Fargo Chamber of Commerce Distinguished Professor. This fourth annual \$5,000 Chamber of Commerce honor will be presented at the Chamber's October 20 Annual Meeting, in Fargo, ND. Dr. Wicks will receive the first \$3,000 installment of the three-year award.

Dr. Wicks began his career in 1944 as a Research Chemist with Inmont Corp., Clifton, NJ. Over the years, he served as Director of Central Research Laboratories, Vice-President of Planning and Commercial Development, Group Vice-President, and as a member of the Board of Directors. Most recently he served as Vice-President of Research and Development of Transportation, Building, and Industrial Activities before being named Chairman at NDSU in 1972.

As Chairman and Professor of Chemistry, Dr. Wicks directs his research efforts at the current major technological problems of the coatings industry—a need to reduce energy consumption, solvent emissions, and emissions of possibly toxic by-products into the atmosphere. His research is also concentrated on the development of new types of coatings such as water-soluble industrial baking enamels, ultraviolet cure coatings, low-temperature cure coatings, and high solids coatings.

Dr. Wicks was awarded prizes in the 1975, 1978, and 1980 Roon Award Competition for outstanding technical papers at the Annual Meetings of the Federation of Societies for Coatings Technology. He has also addressed national and international meetings throughout the world and served as a Visiting Lecturer at universities in Germany and Japan.

Dr. Wicks earned his B.S. Degree at Oberlin College, Oberlin, OH in 1941, and his Ph.D. in Organic Chemistry at the University of Illinois in 1944.

Southeastern Steel Container Co. has announced the promotion of **J.R. Jessee, Jr.**, Regional Sales Manager, to Assistant Sales Manager—National Accounts.

The Pigment Division of Sun Chemical Corp. has announced the appointment of **William H. Joos, Jr.** as Technical Sales Representative for Southern California. In his new position, he will assume responsibility for sale of the firm's pigments to the printing ink, coatings, plastics, and other color consuming industries.

The appointment of **William J. Yocum** to the position of Sales Representative of the Ohio Valley was announced by Penn Color, Inc., Doylestown, PA.

SCHOLD

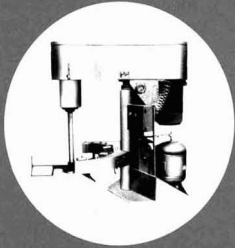
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Sidney B. Levinson, President of D/L Laboratories, New York, NY, was awarded Honorary Membership in American Society for Testing and Materials (ASTM).

Mr. Levinson was cited for his contributions to all phases of the technology of paints and industrial coatings, and his sustained dedication to organization and trade association activities which support the coatings industry. Honorary Membership, one of the most prestigious awards presented by the Society, was awarded to Mr. Levinson for his widely recognized eminence in Society work and his service to ASTM.



S.B. Levinson

A member of ASTM since 1943, Mr. Levinson is the current Chairman of Committee D-1, and is a member of ASTM Committees C-24 on Building Seals and Sealants, and Committee E-36 on Criteria for the Evaluation of Testing and Inspection Agencies.

Mr. Levinson became associated with the D.H. Litter Co. (presently, D/L Laboratories) in 1952. He formed David Litter Laboratories Division in 1953, first as Vice-President and Technical Director, then as President.

In addition to ASTM, Mr. Levinson is a member of the New York Society for Coatings Technology, the Federation of Societies for Coatings Technology, the National Association of Corrosion Engineers, the American Chemical Society, the National Paint and Coatings Association, the Society of Plastics Engineers, the Commercial Development Association, the Washington Paint Technical Group, and the Association of Consulting Chemists and Chemical Engineers.

Mr. Levinson is a certified corrosion specialist with NACE and licensed professional engineer in corrosion. He has been honored by the New York Society for Coatings Technology as the recipient of the Roy H. Kienle Award in 1960, the PaVac Award in 1960, and the PaVac Lecturer Award in 1977. He was also the 1974 recipient of the New York Paint and Coatings Association Paint Pioneer Award.

Mr. Levinson is the author of the painting manual *Paints and Protective Coatings*, published for the U.S. Army, Navy, and Air Force. He also has written many chapters and articles on paints and coatings and has presented over 60 lectures.

A native of Balta, Ukraine, Mr. Levinson received his B.S. degrees in Chemistry and Engineering at City College of New York in 1932, and his M.S. degree in Chemical Engineering in 1933.

Leon S. Birnbaum, consultant in the area of protective coatings, was awarded Honorary Membership in the American Society for Testing and Materials (ASTM).

A member since the 1950's, Mr. Birnbaum was cited for his leadership in developing protective coating systems for use on U.S. Navy vessels and for his sustained dedication to the standardization of marine coatings by use of ASTM standards, military, and federal specifications.

Besides his participation on several ASTM subcommittees, Mr. Birnbaum is also active in the American Chemical Society, the Federation of Societies for Coatings Technology, and the National Association of Corrosion Engineers.

Honorary Membership in the American Society for Testing and Materials (ASTM) was awarded to **Richard S. Hunter**, President of Hunter Associates Laboratory, Inc.



R.S. Hunter

Mr. Hunter was recognized for his professional abilities in solving appearance evaluation problems, for innovative designs of new instruments, and for his leadership in standardization of measurement techniques during more than 40 years of association with numerous ASTM committees.

Mr. Hunter is active in the Optical Society of America, the Inter-Society Color Council, the International Commission on Illumination, the American Association of Textile Chemists and Colorists, the Federation of Societies for Coatings Technology, and the Society of Plastics Engineers.

In 1961, Mr. Hunter was recipient of the ASTM Award of Merit. He has also received awards from the Federation of Societies for Coatings Technology, the Optical Society of America, ISCC, and George Washington University Alumni.

The Washington Paint Technical Group has announced its officers for 1981-82. They include: President—**William Allanach**, International Paint Co.; Vice-President and Program Chairman—**Hing Dear**, Tracor, Inc.; Secretary—**John Montgomery**, National Paint & Coatings Association; and Treasurer—**Dr. Bernard Appelman**, Federal Highway Administration. Dr. Appelman is a member of the Baltimore Society.

Elected to the Executive Board for WPTG were **Rufus Wint**, **Ken Zacharias**, and **Dr. Ted Walton**.

Obituary

Chess O. McCaffrey, 64, of Dar-Tech, Inc., died on May 9. He was a member of the Pittsburgh Society for 28 years.

Dr. Herbert L. Fenburr, Past-President of the Federation, died June 28 at Ohio State University Hospital, Columbus, Ohio, at the age of 67. He retired from Hanna Chemical Coatings Co., of Columbus, in 1976 after more than 38 years with the firm.



H.L. Fenburr

Active in the Federation, Dr. Fenburr served as its President in 1967-68 and as a member of the Board of Directors from 1964-75. He also served as Chairman of the Finance, Investment, and Program Committees. He was President of the Paint Research Institute from 1970-73 and was a Trustee of PRI from 1969-76.

Dr. Fenburr was the Federation's George Baugh Heckel Award winner in 1976 for his many years of outstanding service to the Federation and the coatings industry. He was made an Honorary Member of the Federation in May of this year.

A Past-President of the C-D-I-C Society, he was also a member of the American Chemical Society, the American Institute of Chemists, the New York Academy of Science, and the National Association of Professional Engineers.

Edwin L. Gott, 89, a former president of The Gilman Co., Inc., and a Past-President of the Federation of Societies for Coatings Technology, died on June 14.

In 1944, Mr. Gott was elected President of the Federation (then the Federation of Paint & Varnish Production Clubs). He was also one of the founders of the Southern Society for Coatings Technology and served as its first president in 1937.

A native of Cleveland, OH, Mr. Gott graduated from Oberlin College and Case School of Applied Science. In 1915, he began his career with the Standard Paint & Lead Works as a Chemist and later as Manager of Manufacturing. Mr. Gott was then employed for The Gilman Co. as Manufacturing and Laboratory Manager and later earned the positions of Vice-President and President before his retirement in 1967.

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Literature

Drum Liners

Literature and samples of heavy duty, leakproof drum liners that prevent contamination during in-plant mixing, pumping, and storage are available by contacting CDF Corp., Joseph J. Sullivan, President, Box 212, 50 Cole Pkwy., Scituate, MA 02066.

Catalogue/Index

The 1981 German-English DIN Catalogue/Index has been published by DIN, the German Standards Institute, Berlin, and is available from Heyden & Son, Inc., Philadelphia, PA. This year's catalogue has expanded to two volumes and provides complete details on all DIN Standards presently available. Approximately 23,300 Standards and Draft Standards are catalogued in both German and English. A special information section provides details on all DIN Standards, including over 450 additions. For a constant up-date, monthly supplements to the DIN Catalogue/Index are also available. The 1981 DIN Catalogue/Index, \$63.00, and the monthly updating service and supplements, \$149.00, are available from Heyden & Son, Inc., 247 S. 41st St., Philadelphia, PA 19104.

Vacuum Chamber

A new, low cost vacuum chamber for removing entrapped air and gasses from epoxies, silicones, investment casting materials, and other liquids is featured in recent literature. The vacuum chamber reduces pressure above the surface of liquid materials to permit escape and subsequent pumpout of entrapped air and gasses that would otherwise induce failures after curing. For information, write MV Products, Division of Mass-Vac, Inc., 11 Esquire Rd., North Billerica, MA 01862.

Universal Tester

A detailed technical brochure on a new electronic universal tester, which provides fast, accurate measurement in laboratory, quality control, or production applications, is now available. This dependable and versatile, bench-type instrument measures tension and compression and provides digital readouts up to 500 pounds capacity. For more information, write Testing Machines, Inc., 400 Bayview Ave., Amityville, NY 11701. In Canada, Testing Machines International of Canada Ltd., 6 Ronald Dr., Montreal West, Quebec H4X 1M8.

Kaolins

Literature featuring information on kaolins for the paint industry is now available. A 9×12-inch fold-out describes properties and end-use applications for kaolins. For a copy of "Fine Clays for Industry", write Georgia Kaolin Co., 433 N. Broad St., Elizabeth, NJ 07207.

Recovery Systems

Literature announcing the availability of the KF series activated carbon fiber solvent recovery systems for the control and recovery of gaseous industrial process emission has been published. Information describing the operating principle, which is the adsorption of gaseous solvents into the micro-pores of a patented activated carbon fiber, is featured. For more information, write Systems Division of Met-Pro Corp., 160 Cassell Rd., Harleysville, PA 19438.

pH Monitoring System

New product literature is available describing a pH monitoring system designed for improved technology and simplification in waste water applications. The eight-page brochure provides system performance features and photographs detailing non-isolated and isolated current outputs, alarm modules, preamplifiers, and electrode selections. For a free Bulletin 4213A, contact Beckman Instruments, Inc., Technical Information Services, Process Instruments Div., 2500 Harbor Blvd., Fullerton, CA 92634.

Epoxy

An epoxy polyamide which gives concrete a smooth and glossy surface with resistance to oils and other chemicals is featured in recent literature. Described are the uses of the epoxy polyamide which include concrete, aluminum, steel, and fiberglass pools. For information, write Steelcote Manufacturing Co., 3418 Gratiot, St. Louis, MO 63103.

Horizontal Mill

Literature introducing a horizontal bead mill, used for all finest wet grinding and dispersing operations is available. This system eliminates all bulky Vee belt frameworks and removes the need for any secondary bearings. For information, contact Eiger Machinery, Inc., 113 Idlestone, Schaumburg, IL 60194.

Power Roller

Literature featuring a new power roller designed for the professional painter working in large areas where spray painting is not appropriate is now available. The power roller combines the benefits of spray painting with the controlled coverage afforded by conventional rollers to provide fast, steady application of a wide range of coating materials. For more information, contact Marketing Services Dept., Wagner Spray Tech Corp., P.O. Box 9362, Minneapolis, MN 55440.

Variable Speed Dispenser

A new, two-color, four-page brochure detailing specifications, dimensions, and available options for a variable speed dispenser has been recently published. These models are designed to handle a wide range of medium production applications common to the paint, ink, chemical, and coatings industries. Copies of the brochure are available from Schold Machine Co., 387 105th Terrace N.E., St. Petersburg, FL 33702.

Granule Processing

A unique patented method for obtaining granules that conform to a sharp distribution curve is described in a new illustrated brochure. Unlike other methods, such as grinders, hammer mills, or roll mills, the process employs a series of corrugated rollers arranged in such a way that they crack the material being fed rather than grinding or crushing it. The literature covers six models and illustrates the process used, showing photographically the results that can be obtained. For a free copy, write MCA International, 17W705 Butterfield Rd., Oakbrook Terrace, IL 60181.

ACS Publication

1981-Prismatics, a quarterly publication of Applied Color Systems, Inc., contains articles and information of interest to management and technical personnel involved with industrial color control. The lead article deals with the CIE system of illuminants and observers and points out the importance of a common standard when discussing color measurements. New literature issued by ACS is also highlighted. Included are descriptions of specification sheets on computer programs for production and inventory control and color matching. In addition, color seminars and courses offered on the theory and practice of industrial color control are described, with dates and times listed. For additional information, contact ACS, Princeton Service Center, U.S. Highway One, P.O. Box 5800, Princeton, NJ 08540.

Data Station

This microprocessor-based, programable video display terminal with dual, double-sized, microfloppy disc drives for mass storage and data retrieval is discussed in recent literature. For more information, write Perkin-Elmer Corp., Main Ave., Mail Station 12, Norwalk, CT 06856.

Particle Size Analyzer

This eight-page, color brochure provides instrument specifications, explains the technique of automatic sedimentation using collimated light beam, and supplies operational information. For a copy of form 500/42703/00, write Micromeritics Instrument Corp., 5680 Goshen Springs Rd., Norcross, GA 30093.

Coating Thickness Gauge

A new gauge, designed to simplify the measurement of nonmagnetic dry film coating thickness when applied to any ferrous substrate, is the subject of recent literature. For more information, contact KTA-Tator Associates, Inc., 2020 Montour St., Corapolis, PA 15108.

Filter Cartridge

Literature introducing a long-fiber resin-impregnated cartridge for filtering a wide variety of fluids with viscosities up to 10,000 centipoise, is now available. Described are the features of the cartridge and its advantages including reducing fiber migration in parallel tests, and preventing grooved-surface cracking and breakage, and glued joint failure. Write, Filterite, 2033 Greenspring Dr., Timonium, MD 21093.

Filling Machine

A new automatic filling machine, employing advanced electronics to control fill height, thereby eliminating major drawbacks inherent in machines using conventional fill height control methods, is featured in literature. For information, write Beltron Corp., Megill Rd., Farmingdale, NJ 07727.

Thermosel System

A six-page brochure has been published featuring a thermosel system used for accurate viscosity determinations at temperatures up to 500°F. Features and advantages are detailed, describing the uses of the thermosel system. More information is available from Brookfield Engineering Laboratories, Inc., Dept. NR 37, 240 Cushing St., Stoughton, MA 02072.

Rust-Control Coating

A new water-based, rust-control coating material, designed to be applied to clean, tight, rusty surfaces, has been introduced in recently published literature. For additional information, contact Devco Marine Coatings Co., Division of Grow Group, Inc., P.O. Box 7600, Louisville, KY 40207.

Ceramic Fibers

A new, high surface area ceramic fiber, promoting uniform dispersion and mixing capabilities in a wide variety of applications, has been featured in recent literature. For information, contact The Carborundum Co., Insulation Division, P.O. Box 808, Niagara Falls, NY 14302.

Laboratory Stirrer

Literature featuring a new laboratory stirrer, useful with viscous emulsions, suspensions, etc., is now available. Features and advantages are fully described and detailed. For complete technical details, write Talboys Engineering Corp., Emerson, NJ 07630.

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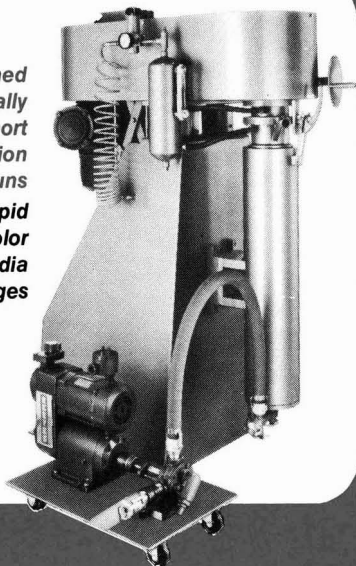
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Coming Events

FEDERATION MEETINGS

(Oct. 28-30)—59th Annual Meeting and 46th Paint Industries' Show. Cobo Hall, Detroit, MI. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1982

(Apr. 29-30)—Spring Meetings. Society Officers on 29th; Board of Directors on 30th. Boston, MA. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(Nov. 3-5)—60th Annual Meeting and 47th Paint Industries' Show. Sheraton Washington Hotel, Washington, D.C. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1983

(Oct. 12-14)—61st Annual Meeting and 48th Paint Industries' Show. Queen Elizabeth Hotel, Montreal, Quebec, Canada. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

(Sept. 23-24)—Montreal and Toronto Societies Joint Symposium on "Coatings Directions for the 80's."

1982

(Feb. 17-19)—Water-Borne and Higher-Solids Coatings Symposium sponsored by Southern Society for Coatings Technology and University of Southern Mississippi—Department of Polymer Science. New Orleans, LA. (Mr. Fred M. Ball, Eastman Chemical Products, Inc., P.O. Box 431, Kingsport, TN 37662).

(Mar. 10-12)—Southern Society Annual Meeting. Hyatt Regency, Savannah, Ga. (Dan Dixon, Freeport Kaolin Co., P.O. Box 337, Gordon, GA 31031).

(Mar. 23-24)—25th Annual Technical Conference of the Cleveland Society for Coatings Technology. Baldwin-Wallace College, Berea, OH.

(Apr. 21-23)—Southwestern Paint Convention, Shamrock Hilton Hotel, Houston, TX.

(May 6-8)—Pacific Northwest Society. Annual Symposium. Vancouver, B.C.

1983

(Feb. 23-25)—16th Biennial Western Coatings Societies' Symposium and Show. Hyatt Regency, San Francisco, CA.

OTHER ORGANIZATIONS

(Sept. 14-16)—Second International Conference on "The Durability of Building Materials and Components." Gaithersburg, MD. (Dr. Geoffrey Frohnsdorf, B348, Bldg. 226, Center for Building Technology, National Bureau of Standards, Washington, D.C. 20234).

(Sept. 14-18)—Semi-Annual "Spray Finishing Technology Workshop." Bowling Green State University and DeVilbiss Co., World Headquarters, Toledo, OH. (Dr. Richard A. Kruppa, Professor, Manufacturing Technology, Bowling Green State University, Bowling Green OH 43403).

(Sept. 20-25)—4th Congress of the Association Internationale de la Couleur, "COLOR 81." International Congress Centre (ICC), Berlin (West), Germany. (Prof. Dr. Heinz Terstiege, (AIC COLOR 81), Bundesanstalt für Materialprüfung (BAM), Unter den Eichen 87, D-1000 Berlin 45, Federal Republic of Germany).

(Sept. 21-22)—"Techniques and Mechanics of Marketing Specialty Chemicals" Short Course. Hilton Plaza Inn, Kansas City, MO (Norma Fleming, Coordinator, Arts & Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401).

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(Sept. 23-24)—"Managing for Innovation in Coatings" Short Course. Hilton Plaza Inn, Kansas City, MO (Norma Fleming, Coordinator, Arts & Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401).

(Sept. 28-29)—Golden Jubilee of Colour in the CIE. The Colour Group (Great Britain). Imperial College, London, England. (Ms. M.B. Halstead, Thorn Lighting Ltd., Great Cambridge Rd., Enfield, Middlesex EN1 1UL, England).

(Sept. 29-Oct. 2)—National Coil Coaters Association's Fall Technical Meeting. Hyatt Regency O'Hare Hotel, Chicago, IL. (Dr. Robert Shuck, NCCA, 1900 Arch St., Phila., PA 19103).

(Oct. 4-6)—"In-Plant Color Control" RETEC, Society of Plastics Engineers, Inc., Color and Appearance Division. Marriott Lincolnshire Resort Hotel, Lincolnshire, IL. (Paul Hitchens, DuPont Co., 5725 E. River Rd., Suite 760, Chicago, IL 60631).

(Oct. 7-9)—"Fundamentals of Adhesion: Theory, Practice and Applications" Course. State University of New York, Institute In Science and Technology, New Paltz, NY. (Dr. Angelos V. Patsis, Director, Institute In Science and Technology, State University of New York, CSB 209, New Paltz, NY 12561).

(Oct. 13-15)—Association for Finishing Processes of the Society of Manufacturing Engineers. "Finishing '81" Conference and Exposition, "Economics, Compliance, and Energy." Cobo Hall, Detroit, MI. (William J. Yeates, Executive Director AFP/SME, One SME Dr., P.O. Box 930, Dearborn, MI 48128).

(Oct. 13-16)—"Formula 81". RAI Exhibition Centre, Amsterdam, Holland.

(Oct. 19-23)—"Scanning Electron Microscopy and X-Ray Microanalysis: Theory and Practice in Materials Science" Course. State University of New York, Institute In Science and Technology, New Paltz, NY. (Dr. Angelos V. Patsis, State University of New York, New Paltz, NY).

(Oct. 25-27)—"Women in Coatings—Meeting the Challenges" Short Course. Detroit, MI (Norma Fleming, Coordinator, Arts & Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401).

(Oct. 26-28)—National Paint and Coatings Association Annual Meeting. Detroit Plaza Hotel, Detroit, MI. (Karen Bradley-Welch, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Oct. 26-29)—"Scanning Electron Microscopy and X-Ray Microanalysis: Theory and Practice in Biology and Medicine" Course. State University of New York, Institute In Science and Technology, New Paltz, NY.

(Nov. 2-4)—American Society for Testing and Materials Committee D-33 on Protective Coating and Lining Work for Power Generation Facilities Meeting. Monteleone Hotel, New Orleans, LA. (ASTM, 1916 Race St., Phila., PA 19103).

(Nov. 2-4)—"Water Soluble Polymers: Synthesis, Structure and Applications" Course. State University of New York, Institute In Science and Technology, New Paltz, NY.

(Nov. 3-4)—Decorating Plastic RETEC, 5th Annual Regional Technical Conference, Society of Plastic Engineers, Decorating Division. Louisville, KY. (Edward S. Stumpek, General Electric, One Plastics Ave., Pittsfield, MA 01201).

(Nov. 3-4)—First World Congress on Protective Coatings Systems for Bridges and Structures. International Hotel, Kennedy Airport, New York, NY. (Norma R. Fleming, Arts and Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401).

(Nov. 4-5)—Fourth Resins & Pigments Exhibition. Hotel Principe & Savoia, Milan, Italy. (Mike Tarrant, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

(Nov. 4-6)—American Society for Testing and Materials Committee, Utilities Nuclear Coating Work Committee Meeting. Monteleone Hotel, New Orleans, LA. (ASTM, 1916 Race St., Phila., PA 19103).

(Nov. 10-12)—"Refresher for Painting Contractors, Maintenance Engineers and Inspectors" Short Course. Hilton Plaza Inn, Kansas City, MO (Norma Fleming, Coordinator, Arts & Sciences Continuing Education, University of Missouri-Rolla, Rolla, MO 65401).

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'Humbug' from Hillman

This month we feature "Sage Words of Wisdom" drawn from the somewhat pompous writings of those who have made their marks in the world. Coming from such wise and successful leaders, the quotes are suitable for carvings on granite.

Imagine, however, if ordinary souls like me, would stop you on the street and casually expound these same grains of philosophical judgement. For instance — (with thanks to Jim Stearns)

Say friend—"Our greatest weakness lies in giving up. The most certain way to succeed is always to try just one more time." (Thomas Edison)

And if that doesn't inspire you to run into the lab and invent the light bulb, how about—

"Keep on going and the chances are you will stumble on something, perhaps when you are least expecting it. I have never heard of anyone stumbling on something sitting down." (Charles F. Kettering)

I can think of a lot of GM cars that must have been a result of stumbling.

Milt Glaser, who got to be President of our Federation by living up to inspirational messages, sent in the following so that all of us might benefit and forge to the top.

"A course of action with no theory behind it is as weak as a theory that has no practical application." (Robert Maynard Hutchins)

and

"The most beautiful thing we can experience is the mysterious. It is the source of all true art and science." (Albert Einstein)

Frankly, that's only one of the items that Al wrote that I can't understand.

The real secret of Milt's march to success, however, follows—

"When in charge—ponder
When in trouble—delegate
When in doubt—mumble
Then refer the whole problem to a coordinating committee for review." (James Boren)

Poetry Corner

(with apologies to H. W. Longfellow, et al.)

Howard Jerome, who prides himself for having the intelligence and self-evaluation to have sold his golf clubs, contributes this stirring ode to "The Dissatisfied Golfer."

Unto a golfer sick with shame
Late one evening the devil came,
And the Old Boy said with his oily leer,
"Why are you sitting grieving here,
What on earth do you want to do
Would you sell your soul for a seventy-two?"

The golfer cried to the grinning Nick,
"For a seventy-two I'd sell it quick."
"Done," said the devil, "put her thar!
Tomorrow you'll shoot the course in par,
Now get to your bed and rest content,
I'll see you later"—and out he went.

True to his bargain the devil kept,
From tee to tee that golfer stepped
Making the short holes and the far
As had been promised to him, in par.
Twice he had putts for a birdie three,
But more than he asked for could not be.

His friends rejoiced, as good friends do
But he shook his head at that seventy-two.
"Once I was stymied by a tree,
There were two short putts I missed," said he,
"And but for the rotten luck that's mine
I'd have shot that course in sixty-nine."

All that is left to be paraphrased
Is that deep in Hades the devil laughed!

Some time ago Fred Schwab sent me a poetic gem. I thought it was terrible. I still think so—

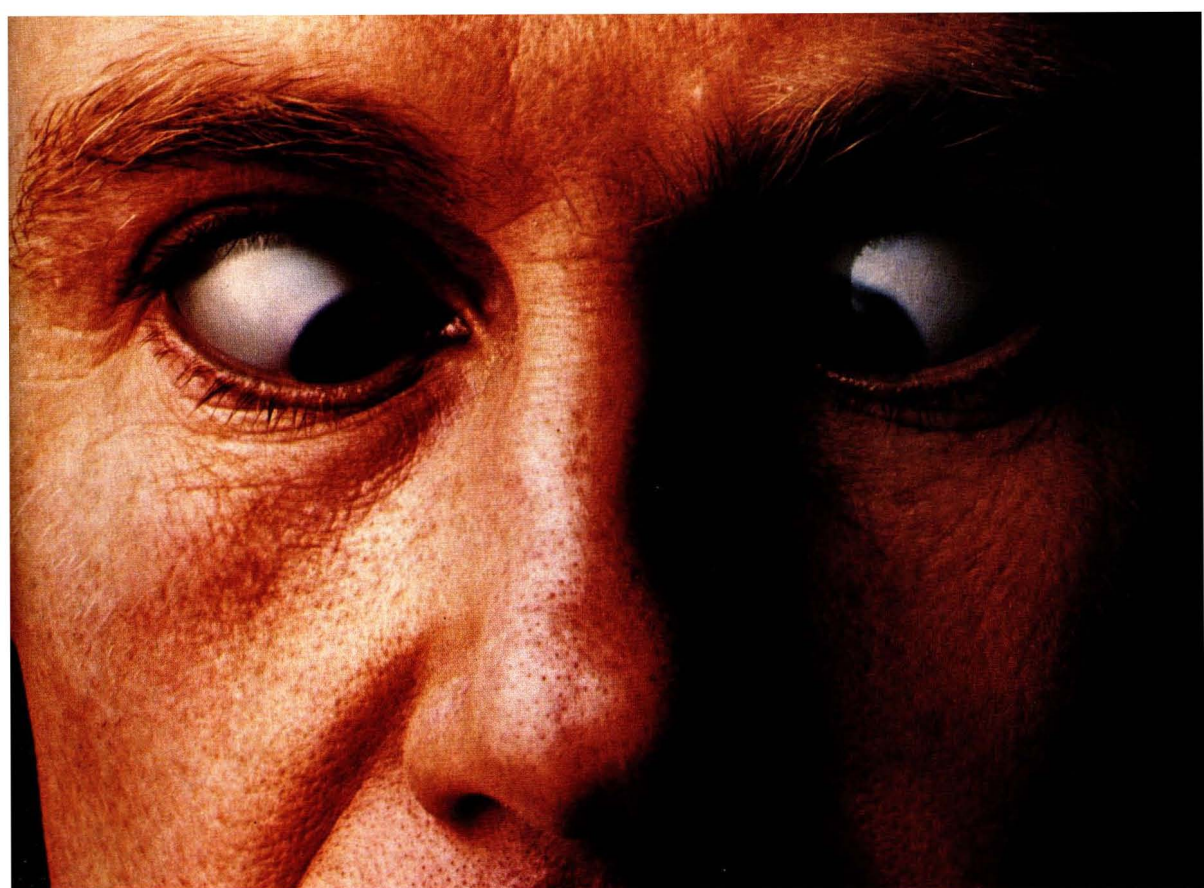
I say there stranger you ever hear tell,
Of that famous paint company, "Cover Well",
Cover Well's gloss was known to keep,
And they piled their profits up in heaps.

Now this went on for quite a spell,
When all of a sudden out broke hell,
And into town came sweet talk'n Pete,
With a supply of raws—his company's meat.

"Which raw do you use in your famous white",
Said Pete in a voice well trained and polite,
"Your No. 10" said loud mouth Dell,
"It gives us a gloss and makes it sell."

Now Pete was honest but bent on sell'n
So he went to Cover Well's competition a-yell'n,
"No. 10 I believe will improve your paint,"
Now Cover Well's piles of profits are faint.

—Herb Hillman



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And since we produce our own polyols and acrylic acid, we're basic in multifunctional monomers.

When you buy Celanese, you're

buying stability. We're also a major producer of intermediates, solvents and monomers for the coatings industry with years of application experience behind us. And our nationwide network of supply and storage terminals assure you product when and where you need it.

So when it's time to evaluate MFEM technology, call Celanese. We'll help you look into the future.

For an applications brochure which also details the safety and handling of multifunctional monomers, write Celanese Chemical Company, Inc., 1250 West Mockingbird Lane, Dallas, Texas 75247. Or call (214) 689-4058.



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