

JCTAX 52 (660) 1-100 (1980)

JANUARY 1980

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

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

Constituent Societies. A Guide for Authors is published in each January issue. The JOURNAL OF COATINGS TECHNOLOGY is available on microfilm from University Microfilms, a Xerox Co., Ann Arbor, Mich. 48106.

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

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Comment

IR Atlas — A Literary Heavyweight

Publication this month of "An Infrared Spectroscopy Atlas for the Coatings Industry" marks the culmination of four years of dedicated volunteer work by a handful of members of the Chicago Society.

The hefty 896-page book is a successor to "Infrared Spectroscopy—Its Use in the Coatings Industry," also produced by the Chicago Society and published by the Federation in 1969, which gained international acceptance and remains a recognized reference source.

The superb new volume contains a compilation of 1433 spectra, fully indexed, of materials commonly used in the coatings industry; spectra of many recently marketed materials are included, as well as examples of Fourier transform infrared spectra. The text includes a fundamental and comprehensive dissertation on the theory of infrared spectroscopy, qualitative analysis, and quantitative analysis, a discussion on instrumentation, as well as a chapter completely devoted to sample preparation for IR analysis. A fully indexed literature survey contains over 1500 references organized into sections, with each section in chronological order.

This impressive book (both in size and content) is a significant contribution to the sciences of infrared spectroscopy and coatings technology, and the Federation is indeed pleased to participate in making it available, and extends sincere thanks to the members of the Chicago Society's Infrared Spectroscopy Committee who brought it to fruition: Chairman John Vandeberg, Dennis Anderson, James Duffer, James Julian, Thomas Sutliff, and Michael Vaickus (all of DeSoto, Inc.), and Richard Scott, of The Sherwin-Williams Co.—TAK

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Abstracts of Papers

EMULSIFICATION OF THERMOSETTING ACRYLIC/ MELAMINE COATINGS—L.G. Curtis

Journal of Coatings Technology, 52, No. 660, 49 (Jan. 1980)

Water-borne coatings that utilize conventional resins, pigments, and application equipment have been developed. The coatings were prepared with water immiscible solvents and water insoluble resins and are easily emulsified with minimum agitation and shear. Application characteristics are outstanding with very rapid dry time and very low cure temperature requirements without external catalysis.

Films produced from the emulsions exhibit very high gloss, hardness, flexibility, and durability. Formulations were prepared that offer higher application solids and less critical application conditons than present solution type water-borne enamels.

FILM EROSION STUDIES OF SILICONE-MODIFIED COPOLYMER PAINTS—W. A. Finzel

Journal of Coatings Technology, 52, No. 660, 55 (Jan. 1980)

Film erosion which can be measured by decrease in film thickness and by weight loss, is useful in precisely quantifying the degree of deterioration of the protective film.

The film erosions of two silicone-modified coating systems, and similar all-organic control coatings, were evaluated after periodic exposure in the Dew Cycle Weather-Ometer®. Both weight loss and decrease in film thickness were found to be acceptable for determining film erosion rates.

Coatings containing silicones had lower film erosion rates than the control coatings, and these rates were inversely proportional to the silicone content.

EVAPORATION BEHAVIOR OF ORGANIC CO-SOLVENTS IN WATER-BORNE FORMULATIONS— R. F. Eaton and F. G. Willeboordse

Journal of Coatings Technology, 52, No. 660, 63 (Jan. 1980)

For binary solutions of a cosolvent and water, the concept of the "critical relative humidity" (CRH) was previously developed. At the CRH value, the water and the cosolvent both deplete from solution in the same relative ratio.

Equations used in the development of the CRH concept are shown to be mathematically equivalent to Fick's First Law of diffusion. The observed initial rates of evaporation of solvents and water are interpreted as diffusion through a stagnant or boundary layer of air above the surface of the evaporating liquid (or coating). The thickness of this stagnant layer, and, thus, the observed evaporation rate, depend not only on the velocity of the air moving over the surface of the liquid but also on the geometry of the sample.

From well known diffusion equations for "desorption" experiments and appropriate literature data for the diffusion of water in polymers, the controlling step in the initial drying stage is shown to be diffusion through a "boundary" or "stagnant" layer above the surface of the solution.

VISCOSITY LOSS IN HYDROXYETHYL CELLULOSE THICKENED LATEX PAINTS CAUSED BY CHEMICAL OXIDANTS: METHODS OF DETECTION—V.L. Irwin and M.M. Williams

Journal of Coatings Technology, 52, No. 660, 71 (Jan. 1980)

Cellulases and chemical oxidants have been reported to cause degradation of the cellulose ether thickeners in latex paints, leading to severe viscosity loss. A number of the methods previously suggested for determining the presence of chemical oxidant-type species in vinyl acrylic latexes and paints are examined to establish the usefulness of these approaches. Three methods, the Acrylamide Gel Test, the Hydroxyethyl Cellulose (HEC) Solution Test and the Oxidation Reduction Potential (ORP) Test, are critically discussed with special emphasis on the correlation of test results with the viscosity stability of the final paints. The ORP Test can be used as the best of the three tests to predict viscosity stability of the final paints. Generally, it was found that vinyl acrylic latexes with ORP values less than +250 mV, as determined by the method described, will yield paints whose final viscosity is stable. A need is expressed for individual case history documentation, due to wide variations in formulations.

EFFECT OF CATALYST STRUCTURE ON THE PROPERTIES OF COATINGS CROSSLINKED WITH HEXA(METHOXYMETHYL)MELAMINE—L. J. Calbo

Journal of Coatings Technology, 52, No. 660, 75 (Jan. 1980)

A study was undertaken comparing several sulfonic acids of varying structure and hydrophobicity as catalysts for promoting the curing reaction between various binder resins and hexa (methoxymethyl) melamine. Dinonylnaphthalene disulfonic acid was found to be particularly effective for producing superior water and detergent resistance properties in such systems. Weight loss studies carried out with model compounds indicate that dinonylnaphthalene disulfonic acid produces less volatiles and may be a better catalyst than p-TSA for controlling selfcondensation of hexa (methoxymethyl) melamine.



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REDERATION Newsletter

"THREE R'S FOR THE EIGHTIES" SELECTED AS THEME FOR 1980 ANNUAL MEETING PROGRAM

The 1980 Annual Meeting of the Federation -- to be held in conjunction with the Paint Industries' Show at the Atlanta Civic Center, October 29-31 -- will have as its theme: "Three R's for the Eighties: Research, Resources, and Regulations."

The theme recognizes that the coming decade looms as a time of stress and challenge. To remain an economically sound producer of increasingly valuable products, the coatings industry must utilize research and ingenuity to cope with the constraints of limited resources and restrictive regulations.

It is anticipated that among the demands of the Eighties will be alternative raw materials based on more plentiful resources, along with innovative recycling methods to minimize hazardous wastes. At the same time, the changing needs of the market place must be researched and accommodated -- a prime consideration, for instance, will be maintaining the supply of dependable anti-corrosive coatings despite changing materials, methods, and surfaces.

Prospective speakers are invited to present original papers on the many and varied aspects of the theme, and are requested to submit abstracts for review to Hugh W. Lowrey, FSCT Program Chairman, c/o Indurall Coatings, Inc., P.O. Box 2371, Birmingham, Ala. 35201. Deadline for receipt of abstracts is March 1.

Assisting Chairman Lowrey in developing the program is a Steering Committee composed of: Thomas J. Miranda (Vice-Chairman), of Whirlpool Corp., Benton Harbor, Mich.; Umberto Ancona, of McCloskey Varnish Co., Philadelphia, Pa.; Fred M. Ball, of Eastman Chemical Products, Inc., Kingsport, Tenn.; Thomas Ginsberg, of Union Carbide Corp., Bound Brook, N.J.; Kenneth A. Kieselburg, of Valspar Corp., Rockford, Ill.; and William Mirick, of Battelle Memorial Institute, Columbus, Ohio.

ROON AWARDS COMPETITION OFFERS \$1,750 FOR PAPERS PRESENTED AT 1980 ANNUAL MEETING

The Roon Foundation Awards will again be offered for the best technical papers presented at the 1980 Annual Meeting of the Federation at the Atlanta Civic Center, October 29-31.

Papers entered in the competition will be eligible for cash prizes totaling \$1,750 donated by Leo Roon. The Awards, and accompanying certificates, will be presented during the Annual Meeting in Atlanta.

Umberto Ancona, Chairman of the Federation's 1980 Roon Awards Committee, stated that the papers submitted in competition for the Awards must: (1) Be of such caliber that they will reflect a step forward in real scientific contribution to the coatings industry; (2) Be directly related to the protective coatings industry; and (3) Shall describe original work not previously published or presented. Papers to be considered for the competition are those by individuals associated with the organic coatings industry, including raw material suppliers and educational institutions.

Prospective entrants in the Roon Awards competition must advise the Chairman (Dr. Umberto Ancona, c/o McCloskey Varnish Co., 7600 State Rd., Philadelphia, Pa. 19136) of their intent by March 1.

SYMPOSIUM IN COLOR AND APPEARANCE INSTRUMENTATION TO BE HELD IN LOUISVILLE, MARCH 24-26, 1981

A Symposium on instrumentation for measuring color and appearance in the coatings industry will be held March 24-26, 1981 at the Executive West, Louisville, Ky. The 2-1/2 day meeting will be sponsored jointly by the Federation, the Manufacturers Council on Color and Appearance, and the Inter-Society Color Council.

The program will be divided between "hands-on" workshop sessions and general oral presentations about gloss and appearance, color difference and quality control, spectrophotometry, and colorant formulation. The format of the program is being designed to offer a "working meeting" environment, and registrants will be invited to bring samples with them.

General program sessions are under the direction of Dr. Robert T. Marcus, of PPG Industries, Inc., who chairs the Federation's Inter-Society Color Council Committee. The workshops and instrument displays are being handled by Charles Leete, Executive Director of the Manufacturers Council on Color and Appearance. All other arrangements for the symposium will be managed by Thomas A. Kocis, Field Director of the Federation.

"INFRARED SPECTROSCOPY ATLAS" WILL BE AVAILABLE IN JANUARY

The "Infrared Spectroscopy Atlas for the Coatings Industry," a monumental work by the IRS Committee of the Chicago Society for Coatings Technology, will be off the press in January and available for purchase at that time.

This greatly revised and expanded book (from the 1969 edition) contains a compilation of 1433 spectra, fully indexed, of materials commonly used in the coatings industry. Spectra of many recently marketed materials are included, as well as examples of Fourier transform infrared spectra.

The text consists of nine fundamental and comprehensive chapters including theory, qualitative and quantitative analysis, instrumentation, IR instrumentation accessories, and sample preparation. A chapter concerning applications contains a comprehensive text which should be invaluable to anyone practicing infrared spectroscopy.

A fully indexed literature survey contains over 1500 references and represents the most complete bibliography published in this type of text. It is organized into sections, such as theory, reviews, instrumentation, experimental techniques, compilation of spectra, and pigment applications, and each section is in chronological order.

896 pages. $8-1/2 \times 11$ in., case bound. \$75.00 to members of the Federation. \$100.00 to non-members. For prepaid orders: add 5% to total amount of order to cover handling and postage. For orders requiring billing: Postage plus 50chandling charge are additional.

NEWS BRIEFS FROM THE SOCIETIES

BALTIMORE--Richard Chodnicki, of Hanline Bros., received 1979 Herman Shuger Memorial Award at November meeting. Merit Awards were presented to R. Bitterlich, W. Cochran, J. Emmerling, W. Horn, J. McCormick, H. Sears, and P. Tewey.....Tentative date for second "Coatings Show" is March 21.....In cooperation with PCA, continuing scholarship awards (\$500) to assist children of Society and PCA members with costs of higher education.....Correlative Testing Subcommittee offers its services to local industry in conducting round robin tests of testing equipment.

BIRMINGHAM--Will mark its 50th Anniversary at a special meeting in June 1980.

CHICAGO--Again contributed \$2,000 in scholarship grants to North Dakota State University....."Additives" to be theme of SYMCO '80, tentatively scheduled for March 26-27.....Coatings Course at Elmhurst was so successful that it will be repeated in 1980-81.

CDIC--November meeting was a plant tour of General Motors plant in Dayton.

<u>CLEVELAND</u>--Matching Fund Program (for contributions to the Paint Research Institute) amounted to \$1355 in 1979 (\$855 from local industry and individuals, and \$500 from the Society).

<u>DETROIT</u>--The October meeting was "Education Night." In attendance were five college professors, eight high school chemistry teachers, and three students who were given awards.....Contributed \$1,000 to the Polymer Institute at the University of Detroit....UD, in cooperation with Society and PCA, will sponsor a 14-week course in "Surface Coatings Technology" beginning January 7.....FOCUS Seminar on "Environmental Challenges to Automotive Coatings" scheduled for May 1 at Michigan State Management Conference Center.

<u>GOLDEN GATE--57</u> students signed up for Paint Course sponsored by Society and PCA at offices of E. T. Horn Co. Volunteer speakers from all phases of the industry will serve as guest lecturers.....Bud Harmon was presented 25-year pin.....Society has established scholarship awards in name of Fred Apfel, 1980 President-Designate who died earlier this year.

KANSAS CITY--Will note 50th Anniversary at special meeting on April 10.....J. C. Leslie, Past-President of both Federation and Society, elected an Honorary Member.

LOS ANGELES--Trev Whittington is conducting successful course in "Paint Manufacturing Technology" at the LA Trade Technical College.

LOUISVILLE--Will sponsor symposium on "Compliance With Government Regulations" and "Hazardous Materials Waste Disposal" on April 14-15....Two courses running at the University of Louisville: "Synthetic Resins" and "Trade Sales and Industrial Paints."

<u>NEW ENGLAND</u>--Provides study grant which permits a member to attend a key coatings seminar or symposium. Maximum award is \$1,000.....Will sponsor "Pigment Dispersion" seminar on January 17. Regular meeting to follow in evening....Membership increased 20% in 1979. <u>NEW YORK</u>--Offering two Coatings Courses: "Fundamentals of Coatings Technology" at New York Community College, with Don Brody as Instructor and "Lab Course for Technicians" with Jeff Kaye as Coordinator....25-year pins were presented to: H. Ashjian, S. D. Barlow, J. D'Amico, M. Bauman, M. Hibner, I. Hyman, D. F. Koenecke, S. M. Liedeker, R. J. Perkel, W. Richter, S. Spiegel, V. J. Tinello, L. H. Schaetzl, G. C. Vanderbilt, and M. Wexler.....Technical Committee working on these projects: Water Soluble Resins, Low Energy Curing, Corrosion Resistance, and Waste Recycling.

PHILADELPHIA--Will celebrate 60th Anniversary at December 13th meeting.....110 attended "Sludge '79" (seminar on liquid/solid waste disposal) on October 18..... Technical Committee meetings continue to feature guest speakers, who have spurred attendance.....Committee has these active subcommittees: Arrhenius Plot, Flash Point, 1980 Seminar, and Audio/Visual Programs.

ROCKY MOUNTAIN--John Delmonico and Gerry Umbreit received 25-year pins.

<u>SOUTHERN</u>--Will serve as Host Society for 1980 Annual Meeting in Atlanta. Heading Host Committee is Berger Justen, of Justen Associates. He will be assisted by these sub-chairmen: Al Hendry, of A. L. Hendry Co.; Thad T. Broome, of Precision Paint Corp.; Duane Smith, of Glidden Coatings & Resins; Pete Decker, of Union Carbide Corp.; and Don Morgan, of Spencer Kellogg Div.

<u>TORONTO--Has</u> dispensed with the company membership fee as a requirement of its By-Laws. Membership now is strictly on an individual basis.

COMING EVENTS

- Jan. 17.....New England Society. Seminar on Pigment Dispersion. Fantasia Restaurant, Cambridge, Mass.
- Mar. 10-22.....Seventh Annual Water-Borne and Higher-Solids Coatings Symposium. Sponsored by Southern Society and University of Southern Mississippi. Hyatt Regency Hotel, New Orleans.
- Mar. 12-14.....Southern Society. Annual Meeting. Terrace Garden Inn, Atlanta, Ga.
- Apr. 14-15....Louisville Society. Symposium on "Compliance With Government Regulations" and "Hazardous Materials Waste Disposal." Marriott Inn, Clarksville, Ind.
- Apr. 14-16.....Southwestern Paint Convention of Dallas and Houston Societies, Hilton Inn, Dallas, Tex.
- May 1.....Detroit Society. FOCUS Seminar on "Environmental Challenges to Automotive Coatings." Michigan State Management Conference Center, Troy, Mich.
- May 1-3.....Pacific Northwest Society. Annual symposium. Marriott Hotel, Portland, Ore.

May 15-17.....Federation Spring Meetings. Society Officers--15th; Executive Committee--16th; Board of Directors--16th and 17th. North Star Inn, Minneapolis, Minn.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

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NO. 83 January 1980

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EPN's	Liquid/Semi - solid	- 2.2-3.6	1700-3500 сР at 52°С	3,000 cP	FDA-conforms to 175.300
Aracast® hydantoins	Liquid/Solid	2	500 cP/95℃	-	non-aromatic , weatherable non-crystallizing, very low viscosity
Araldite [®] PT 810	Solid	3	95°C	· _	non-aromatic, weatherable
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FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY



Fall 1979 Board of Directors Meeting

Thirty-two members attended the Fall Meeting of the Board of Directors of the Federation of Societies for Coatings Technology on October 2, 1979, at the Sheraton Hotel in St. Louis, Mo.

The following were present:

Officers

President Ja	mes A. McCormick
President-Elect	Elder C. Larson
Treasurer	William H. Ellis

Society Representatives

Baltimore Alex Chasan
Birmingham David Heath
Chicago John Vandeberg
C-D-I-C William Mirick
Cleveland Paul Houck
Dallas Carlos E. Dorris
Detroit Harry Majcher
Golden Gate A. Gordon Rook
Houston Willy C.P. Busch
Kansas City For F. Johnson
Los Angeles Gerald L. West
Louisville Joseph A. Bauer
Mexico Tony Pina Arce
Montreal Horace Philipp
New England Charles Aronson
New York S. Leonard Davidson
Northwestern Lowell Wood
Pacific Northwest
Philadelphia I. Richard Kiefer, Ir.
Piedmont James Bohlen
Pittsburgh Edward Vandevort

St. Louis	ι,	•	•	•	•	• •	• •	 	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	. 1	H	OW	/a	rd	J	er	on	ne
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Toronto	•	•	•	•		• •		 		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	ł	٩.	C	la	ırk	e	B	oy	ce

Other Members

John Ballard	. Louisville
Neil S. Estrada	Golden Gate
Thomas J. Miranda	Chicago
John J. Oates	. New York
Willard W. Vasterling	Kansas City

Guests

Jorge Hijuelos (and Mrs. Hijuelos), President of the Mexico Paint and Ink Manufacturers Association.

Larry Thomas, Executive Director of the National Paint and Coatings Association.

Dr. Orin Keplinger and Dr. Raymond R. Myers, President and Research Director of the Paint Research Institute.

The following Past-Presidents of the Federation: Newell P. Beckwith (Detroit); William Dunn (Toronto); Herbert L. Fenburr, (CDIC); Milton A. Glaser (Chicago); Harold B. Gough (Philadelphia); J.C. Leslie (Kansas City); Michael W. Malaga (Cleveland); Robert W. Matlack (Philadelphia); Carroll M. Scholle (Chicago); and Howard G. Sholl (Baltimore). Board members N.S. Estrada, J.J. Oates, and W.W. Vasterling are also Past-Presidents.

John Fitzwater (New England); Carl Fuller (Philadelphia); John Hajnos (Piedmont); Ruth Johnston-Feller (Pittsburgh); Deryk Pawsey (Pacific Northwest); Harry Poth (CDIC); Garmond G. Schurr (Chicago); John A. Stigile (Philadelphia); Gil Sullivan (New England); Sharon Vadnais (Golden Gate); Jan P. Van Zelm (Los Angeles); Dick Warren (Kansas City); and Helmut Zapfe (Toronto).

Staff

Frank J. Borrelle, Executive Vice-President; and Thomas A. Kocis, Director of Field Services and Communications.

Mr. Borrelle called the roll of members and reported all present except the Society Representatives from Rocky Mountain and Western New York. The report of the Spring 1979 Board of Directors meeting was approved as published in the July 1979 JOURNAL OF COATINGS TECHNOLOGY.

Reports of Officers and Staff

PRESIDENT McCORMICK

This report will conclude my year as President of the Federation of Societies for Coatings Technology. It is very pleasing to report to you that our Federation is viable and functioning very well. This convention will once again set a record, for which I commend the highly competent group of professional individuals we are fortunate to recognize as our staff. They do a superb job.

While most Societies take a summer break from normal activities, the Federation must continue to function. Among the diverse activities undertaken during this period, the President's activities were:

(1) The signing of an agreement with the University of Southern Mississippi for development of a coatings correspondence course on surface coatings science and technology.

(2) Meeting in Washington, sponsored by the U. S. Department of Commerce on a cooperative technology program.

(3) Meeting in Paris to form an international committee for coordination and action of technician groups in the coatings industries; included are FATIPEC, FSCT, JSCM, OCCA/UK, OCCA/AUSTRALIA and SLF.

(4) Meeting with members of the Host Committee on the preparation of the 1979 Annual Meeting.

(5) Meeting with the Joint Paint Industry Coordinating Committee.

Post-convention activities will be:

(1) Represent the Federation while attending the Skandinaviska Lackteknikers Forbund meeting in Stockholm, Sweden.

(2) Visit the Birmingham Club.

(3) Represent the Federation at the 1979 Annual Meeting of National Paint and Coatings Association.

Perhaps the most significant achievement for the year of 1979 that will be beneficial to the membership of the Federation was the signing of an agreement with USM to develop a coatings correspondence course. The course will be designed for persons who have the equivalent of junior undergraduate level study and will require a background in general, organic, analytical and physical chemistry, along with the mathematics and physics normally taken in preparation for such courses. The USM faculty will be assisted in the course development by experienced industry people who will serve as an Editorial Board for the Federation, providing technical and practical expertise in given specialty areas. Selection of people and assignments to the Editorial Board have already begun under the watchful eves of John Gordon. Chairman of the Federation Educational Committee. The course is scheduled to be available on or about September 1, 1981.

My most sincere thanks to my fellow officers, Federation staff and the Federation Board of Directors for the opportunity to serve the Federation, and for your cooperation, patience and assistance, without which my term of presidency would not have been so fulfilling. Our Federation is operated by members for the members. Many thanks for a job well done, to committee chairpersons, PRI Trustees and Society Representatives. As long as we all work together for the benefit of the Federation and its members, the future is assured.

Thank you for the privilege of serving as your President.

JAMES A. MCCORMICK, President

PRESIDENT-ELECT LARSON

The second half of this year has been devoted to appointments of Committee Chairmen for the forthcoming year. This task is complete and we look forward to a productive year bustling with activity.

On August 10 I met with the FSCT Executive Committee in St. Louis to discuss the business aspects of the FSCT and to review details of the 1979 Annual Meeting. The following day we met with the St. Louis Host Committee for an up-date on the responsibilities of the Committee members. It was no surprise to find that all is in readiness for an excellent Paint Show and Annual Meeting.

It was a privilege and honor for Margaret and me to represent the Federation at the Annual Meeting of the Canadian Paint Manufacturers Association in Toronto, September 23–26, 1979. This was a fine learning experience as well as another opportunity to share in the gracious hospitality that is so typical of our Canadian colleagues.

The Joint Paint Industries Coordinating Committee, JPICC, held its second semi-annual meeting in St. Louis on September 16 and 17. I share the confidence of the JPICC that 1980 will be another good year for the Paint Industry. We accept the challenges that it will offer.

I pledge to do my best in carrying out the duties of my office in the Federation during the coming year.

ELDER C. LARSON, President-Elect

TREASURER ELLIS

Because of the continuing efficient, effective handling of finances by the Federation Staff, demands on the Treasurer have been minimal since the May Board meeting.

Watching over finances, of course, is a basic and very important responsibility. The financial condition of the Federation is excellent. The books balance, and most items are close to budget. Dictionary sales income is good but somewhat slower than expected. Paint show income promises to be the highest ever.

Paint Research Institute income for the first half of 1979 was only about 35% of the annual budget. Hopefully, the pace and amount will increase in the second half of the year. Expenditures are as budgeted.

In connection with his responsibilities as a member of the FSCT Board and Executive Committee and the PRI Trustees, the Treasurer participated in three recent meetings:

- The Paint Research Institute Trustees meeting, June 21 and 22, in Philadelphia.
- The Federation Executive Committee, August 10, in St. Louis.
- The Annual Meeting Host Committee, August 11, in St. Louis.

At the Executive Committee meeting, charges were voted or increased for three 1980 sources of income:

- Paint show exhibit space—\$25/booth increase.
- Infrared Book—\$75/copy.
- Journal of Coatings Technology Advertising rates-7% increase.

It appears that the Federation financial situation will be as good or better at the end of 1979 as it was at the beginning.

In this final written report to the Federation Board, I would like to express my appreciation for their support and trust.

> WILLIAM H. ELLIS, Treasurer

EXECUTIVE VICE-PRESIDENT BORRELLE

This report will reflect upon Federation and staff activities in 1979. The year promises to be a successful one, as the various items covered in the report will indicate.

There is one point of concern-communications-and this will be touched upon first.

COMMUNICATIONS

Generally speaking, the line of communications from the Societies to the Federation is in need of tightening. Let's review some examples.

Request for Help From NPCA: In June, the Scientific Committee of NPCA approached the Federation for assistance in monitoring state legislation and regulatory activity. Promptly, staff wrote a letter to Society Officers, Society Technical Committee Chairmen, Society Environmental Chairmen, and the Federation Board of Directors and appealed for help in 31 named States. One written reply was received. A reminder letter was sent out on June 29 and there were no replies.

If the Federation and Societies are to earn their place in the coatings industry, the participation has to be greater than in this case.

Society Papers for Annual Meeting: Despite repeated notices and requests for information on status of proposed Society papers, there continues to be a general lack of response which places a burden on the Program and American Paint Journal Award Committees. This year, the number of papers scheduled for presentation at the Annual Meeting went from five to three to eight, all within a week or so, and well beyond the established deadline. Such short notice is an extreme disadvantage for the Program and APJ Awards Committees which continually battle the calendar in order to find time to adequately schedule papers for the program and review them for the awards competition. Both committees welcome as many papers as they can get but deserve, in return, a lot more cooperation than they have been extended.

File of Monthly Meeting Talks: In response to several requests for this type of information, staff prepared a special form whereby Society Program Chairmen can record pertinent details about speakers and their presentations at monthly meetings. The forms are to be completed by the Program Chairmen and submitted to the Federation office where a continuing file will be maintained, and made available upon request.

The forms were released to the Societies in March and since then we have received 19 reports from 10 Societies and no requests for data. Staff will continue this service, hoping that the Societies will show more interest.

We are aware of and appreciate the demands on everyone's time today and also that employment responsibilities take priority over Federation/Society work. But we also have to realize that it is support and input from the Societies that keep the Federation's wheels moving forward. In the future, any important letters for assistance or information on papers from Societies will be "flagged" in some manner so that they will be easily recognized as being an urgent request for a prompt response.

MEMBERSHIPS

The names of 6,527 members were published in the 1979 *Federation Year Book*. Since then, we have received approved applications for 267 more.

Handling of New Memberships: An explanation is in order regarding the handling of new memberships received after June 30.

It is staff practice to neither process nor bill for any new members after June 30. Any received after are held for the new year. These applications are processed to start with the January JCT and it is assumed that their names will be included in the Society's new roster.

For those applications received prior to June 30, our practice is to initiate the JCT membership subscription with the next issue to be published. However, we do not send back issues, unless specifically requested to do so.

Reason for this procedure is the cost of mailing the back issues from the office. The postage and time expense applicable to mailing a back copy separately is at least five times the cost of mailing an issue at the second class rate by our printer each month. An appreciable amount of the dues could be eaten up by these additional charges.

Annual Rosters: Another subject regarding membership concerns the annual rosters submitted to the Federation office. The Federation's 26 Societies are autonomous and, internally, they can have as many or as few categories of membership as they want. However, when dealing on the national level with the Federation, the Societies must conform to the Federation's various classes of membership and submit membership rosters accordingly. Societies are also advised that they must comply with the Federation By-Law that stipulates that the Society Representative to the Board of Directors be an Active member of the Federation.

INDEMNIFICATION

As instructed by the Board of Directors at the May meeting. I have discussed Federation/Society indemnification liability insurance with three local insurance brokers. Two are still studying the matter. The third said that because the Societies are autonomous (meaning that there are really 27 separate organizations involved) a blanket policy to cover both the Federation and the Societies is not possible. More information will be passed along later.

PUBLICATIONS

JCT: Production and advertising matters are satisfactory and in line with the income and expense budgets. Thanks are extended to the Publications Committee (Tom Miranda, Chairman) and the Editorial Review Board for their good service and continuing contributions toward improving the JCT.

Year Book: The 1979 edition was released on April 18. Staff, with good cooperation from the Societies, plans an earlier release of the 1980 YB.

Paint/Coatings Dictionary: Sales are nearing the 1700-copy mark.

Pictorial Standards of Coatings Defects: One hundred copies of the new photographic standards binder were completed in June and 40 copies have been sold.

Newsletter: Four editions were published this year. All were

direct-mailed to key Federation and Society personnel, and, included in the JCT.

Handbook: This 20-page compilation of Federation/Society officers, committee chairmen, etc., was introduced in November 1978. The 1979 version is in process.

Federation Series: Number 27 on "Anti-Corrosive Barrier and Inhibitive Primers" was published in April. Three new ones are being written.

Infrared Spectroscopy Atlas: This revised and expanded 900page book by the Chicago Society contains a compilation of 1433 spectra, fully indexed, of materials used in the coatings industry. The Chicago Society committee has done a superb job preparing the manuscripts and has cooperated closely and promptly with staff in checking proofs and other details. The text and spectra are presently in page-proof form and the book should be available for sale in early 1980.

COLOR-MATCHING APTITUDE TEST

Three hundred sets of the 1978 edition were produced in May 1978 and 130 have been sold.

ANNUAL MEETING AND PAINT SHOW

The 1979 Paint Industries' Show will be the largest in Federation history (about 5,000 net square feet bigger than Chicago 1978):

Paid exhibitors			 •	•	 •		•		•			144
Complimentary exhibitors	s	•	 •		 •		•	•				7
Net Square Feet, Paid											33	,000
Net Square Feet, Comp.		•	 •	•	 •	•	•	•	•	•	1	,000

The program theme, "Progress Through Innovation," brought forth some excellent papers and we commend the Program Committee (Moe Coffino, Chairman) for their fine work. We also extend our thanks to the Host Committee (Howard Jerome, Chairman) which was composed of members of both the St. Louis and Kansas City Societies.

The "sold out" status of all St. Louis major downtown hotels is an indication that attendance will be good and at least up to expectations. Sorry to say, we have experienced some difficulty and confusion with housing in St. Louis—all of which have been beyond our control.

The 1980 exhibit brochure for the Paint Show in Atlanta will be given to all exhibitors in St. Louis.

SOCIETY OFFICERS MEETING

The third annual orientation meeting for Society Officers was held in May and was successful. A report of the meeting was sent to all attendees and the Board of Directors. The May 15, 1980 meeting will be held in Minneapolis.

OFFICERS/STAFF VISITS

Societies visited by the officers and staff during 1978-79 were: Rocky Mountain, Chicago, Philadelphia, Los Angeles, CDIC, Cleveland, Toronto, Montreal, and Piedmont. Executive Committee meetings only were held with Baltimore and St. Louis.

We also attended the West Coast Symposium, Southern annual meeting, Southwestern Paint Convention, and Pacific Northwest Symposium.

At most meetings, the Federation's slide program was shown.

Staff also attended meetings of the Paint Research Institute, Joint Paint Industry Coordinating Committee, and the National Association of Exposition Managers. And, we arranged for and manned a Federation exhibit in the West Coast Show in San Francisco and the Corrosion/79 Show in Atlanta.

The Society visits schedule for 1979-80 was mailed to the

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Societies on August 17. The year will begin with a visit to Houston on December 12.

PAINT RESEARCH INSTITUTE

Staff has been assigned the responsibility to issue and coordinate the distribution of letters of solicitation for contributions to PRI. In addition to the 1978 contributors, we also sent letters to 53 companies with no record of prior contributions. These drew three favorable responses.

INTERNATIONAL COORDINATING COMMITTEE

In the company of President McCormick, I was privileged to represent the Federation at an organizational meeting of the International Coordinating Committee in Paris, France, on June 23, 1979.

The ICC is presently composed of representatives from the: Federation (FSCT); Federation of Associations of Technicians in the Paint, Varnish, Lacquer and Printing Ink Industries of Continental Europe (FATIPEC); Oil and Colour Chemists' Association—United Kingdom (OCCA-UK); Scandinavian Federation of Paint and Varnish Technologists (SLF); Japan Society of Colour Material (JSCM); and Oil and Colour Chemists' Association—Australia (OCCA-Australia).

It was a good meeting, especially from the point of view of the Federation. The Executive Committee had approved a statement of FSCT position regarding the organization and objectives of the ICC. This statement was presented during a deadlock in the discussions and cleared the path for the significant progress that was made. The points outlined in the FSCT statement were adopted and an agreement was signed. The Board of Directors of the ICC will consist of the President and one other representative from each member organization. The volunteer Secretariat for the next three years will be furnished by FATIPEC.

On behalf of the 12 members of staff, I extend sincere thanks to President Jim McCormick, the other officers, Board members, and committee chairmen for their cooperation and service to the Federation throughout the year. It was a pleasure for us to have worked with them.

I also thank the staff members for their reliability, team effort, and professional performance.

FRANK J. BORRELLE, Executive Vice-President

DIRECTOR OF FIELD SERVICES KOCIS

COMMITTEE LIAISON

Educational—Major item of Committee interest currently is assisting in development of coatings correspondence course at the University of Southern Mississippi, initial concern being makeup of Editorial Review Board to work with USM staff. Committee is compiling list of suggested industry people for this effort.

Also being compiled is list of people to assist in revising and updating the Federation series of booklets on coatings technology.

Annual update of "Guide to Coatings Courses" is now underway, and will be published shortly (with condensed version to appear in JCT). Society Educational Committee Chairmen are being asked to provide annual report on educational activities, both current and proposed, for publication in JCT.

Continuing interest of Committee is promoting career opportunities in the coatings industry among high school students; to this end, work is underway on development of package of support material (literature, visuals, etc.) for use by Societies in making presentations to schools in their areas. Program—An excellent lineup of paper presentations for the 1979 Annual Meeting has been developed, geared to the theme, "Progress Through Innovations."

Committee was successful this year in having prospective speakers submit manuscript drafts prior to granting acceptance for presentation; this should assure high level, quality papers.

The Program Committee for the 1980 Annual Meeting, meanwhile, held its organizational meeting September 10, in Chicago, to develop a theme and assign topics for paper solicitations. Follow-up discussions are scheduled to be held during the Annual Meeting in St. Louis.

Manufacturing—Suggested revision of Federation Manufacturing Committee duties has been approved by Executive Committee.

Review of slide/tape programs developed several years ago by Society Manufacturing Committees has been completed, and work is underway on revising and updating for reproduction and distribution. Most recent effort by the Toronto Society, "Introduction to Resin Operations," has been reviewed and will be made available shortly.

Compilation of Society manufacturing activities is currently underway, and will be published in JCT.

Technical Advisory—Follow-up to discussions in Atlanta on March 30 regarding projects for Society Technical Committee efforts has been hampered by problem which developed on the suggested mildew project—testing on fungicides being developed in a PRI-sponsored research undertaking. This research is part of the PRI Mildew Consortium, and reservations have been expressed that Consortium participants would object to this testing; implementation is dependent on appropriate PRI clearance.

Society Technical Committee Chairmen, meanwhile, are being surveyed to update work underway and planned for publication in JCT.

AUDIO/VISUAL PROGRAMS

As noted, the Manufacturing Committee slide/tape production of the Toronto Society, "Introduction to Resin Operations," is being readied for distribution.

Work on Birmingham Club's presentation on "The Setaflash Tester" is in a holding pattern, awaiting receipt of additional material. This is a four-part program: Go/No-Go Method— Ambient to 100° C; Go/No-Go-0° C to Ambient; Definitive Method—Ambient to 110° C; and Definitive-0° C to Ambient. The first has been completed and reviewed. Scripts for the remaining three have been reviewed and approved, but slides and tapes have not been submitted for review.

PUBLICATIONS

Production work on the revised and updated "Pictorial Standards of Coatings Defects" was completed and manual offered for sale in June. Initial response has been quite good, and 40 copies have been sold to date.

Promotional efforts continue on behalf of the "Paint/Coatings Dictionary." Ad has been developed and placed in several industry journals, and notice of publication and order form sent to selected list of librarians.

PRI LIAISON

Assistance was provided in writing and distribution of letters of solicitation for contributions to the Paint Research Institute.

Also handled arrangements for, and attended, Trustees' meeting in Philadelphia, June 21 and 22, and will do likewise for meeting scheduled for November 1 and 2 in San Francisco.

> THOMAS A. KOCIS, Director of Field Services

ARTICLE III—ORGANIZATION PARAGRAPH B, SECTION (1)

Amendments

To By-Laws

The following amendments to the By-Laws of the Federation

were given first reading at the Spring Board of Directors

WHEREAS through an oversight an important duty of the Board of Directors was omitted from this paragraph, and

WHEREAS this duty has been in actual practice for some time, be it

RESOLVED that a new sub-paragraph (f.) be added as follows:

"To serve as the stockholders (or members) of the Paint Research Institute and attend the annual meeting of the stockholders to elect Trustees of PRI."

The balance of this By-Law remains unchanged except that each succeeding sub-paragraph will advance by one letter.

ARTICLE V—COMMITTEES PARAGRAPH A, SECTION (1)

WHEREAS the Society Representatives have requested that the make-up of the Nominating Committee be modified, and WHEREAS the intent of the By-Laws Committee in their revision was to assure representation on the Nominating Committee from the Constituent Societies, be it

RESOLVED that the wording in Article V. Paragraph A. (1) be amended as follows: (proposed change in *italics*)

"The President shall appoint a Nominating Committee consisting of the immediate Past-President or the most recent available Past-President as Chairman; one other Past-President; and three members of the Board of Directors who are not officers, at least two of whom shall be Society Representatives."

The balance of this By-Law remains unchanged.

Adoption of the first amendment was moved by Mr. Dorris, seconded by Mr. Chasan, and so ordered.

Adoption of the second amendment was moved by Mr. Bauer, seconded by Mr. Philipp, and so ordered.

The following amendment to the By-Laws of the Federation was presented for first reading by Mr. Jerome.

ARTICLE III—ORGANIZATION

WHEREAS counsel has recommended that a By-Law be adopted authorizing the Federation to indemnify its officers and directors, and

WHEREAS the Board of Directors at its January 28, 1978 meeting requested the By-Laws Committee to offer a resolution which would provide such a statement, be it

RESOLVED that a new section "F" be added to Article III of the By-Laws which shall read as follows:

"F. INDEMNIFICATION OF DIRECTORS, OFFICERS AND OTHERS

The Federation shall indemnify, to the extent determined by the Board of Directors, any person who, by reason of
serving as a director, officer, employee, or agent of the Federation is made a party to any legal, administrative, investigative or similar proceeding. Indemnification may be against all or a portion of any amounts such person is required to pay (including expenses) as a result of such a proceeding. This right of indemnification shall not deprive such person of any other rights of indemnification to which a person may be entitled and shall inure to the benefit of such person's heirs, executors and administrators."

Upon motion by Mr. Busch, seconded by Mr. Kiefer, this proposed amendment was accepted for first reading. It will be presented for adoption at the Board of Directors meeting of May 16, 1980, in Minneapolis.

Nominations And Elections

The following slate of candidates for Federation Office, 1979–1980, was presented by Nominating Committee Chairman John J. Oates at the May 18, 1979 meeting of the Board of Directors:

President-Elect—William H. Ellis, of the Los Angeles Society (Chevron Research Co.). He is currently Treasurer.

Treasurer—Howard Jerome, of the St. Louis Society (Spatz Vane Calvert Paint Co.).

Society Representative to the Executive Committee (threeyear term)—A. Clarke Boyce, of the Toronto Society (Nacan Products Ltd.)

Society Representative to the Executive Committee (two years—completing the unexpired term of Treasurer Nominee Howard Jerome)—William Mirick, of the C-D-I-C Society (Battelle Memorial Institute).

Members-at-Large on the Board of Directors (2) (two-year term each)—Ruth Johnston-Feller, of the Pittsburgh Society (Industry Consultant) and Colin D. Penny, of the Baltimore Society (Hampton Paint Mfg. Co.).

Past-President on the Board of Directors (two-year term)-Milton A. Glaser, of the Chicago Society (Industry Consultant).

Since a call for further nominations from the floor produced no additional candidates, Mr. Oates moved the election of the proposed slate. Seconded by Mr. Bauer and approved unanimously.

Review of Actions Of Executive Committee

One of the duties of the Board of Directors is to approve or disapprove all actions of the Executive Committee.

The actions of the Executive Committee (at its meeting of May 19, 1979 and August 10, 1979) were included with the minutes mailed previously to the Board of Directors.

The actions reviewed by the Board are as follows:

MAY 19, 1979

That President McCormick and Executive Vice-President Borrelle represent the Federation at the meeting of the International Coordinating Committee in Paris on June 23, 1979. That, in order to provide adequate funding for the travel expenses to Paris, the Liaison Committee budget for 1979 be increased from \$1,500 to \$2,500.

That the revised Federation budget for 1979 therefore become: Income-\$945,500; Expense-\$945,500.

That the Executive Vice-President prepare a statement subject to Executive Committee approval—regarding the Federation's position with respect to the International Coordinating Committee proposals by FATIPEC.

That whenever Morehouse Industries' Golden Impeller Award is to be presented to someone in the coatings industry, provision be made for its presentation during the Manufacturing session at the Annual Meeting.

That the dispositon of income generated by the Federation investment trust fund be reviewed by the Board of Directors.

That the Federation support co-sponsorship of the second "Symposium on Color Appearance and Instrumentation" in 1981.

That President-Elect and Mrs. Elder Larson represent the Federation at the meeting of the Mexico Society for Coatings Technology in Zihuatenejo, Mexico, October 25-27, 1979.

The above actions of the Executive Committee were approved by the Board of Directors.

AUGUST 10, 1979

That the FSCT First Half Statement of Income and Expense be accepted as presented.

That the PRI First Half Statement of Income and Expense be accepted as presented.

That the author of any paper—approved by the Federation for presentation on its behalf at a conference of members of the International Coordinating Committee—be given an honorarium of \$250. (The Board requested that this be amended so as to provide for one paper per year per conference.)

That the Federation President be responsible for reviewing and approving candidate papers and that he appoint reviewers to assist him in the evaluation of the manuscripts.

That the "Union Carbide Coatings Technology Award" be accepted as a Federation-administered award.

That the revised duties of the Manufacturing Committee, as proposed by the Chairman, be accepted.

That any year-end surplus up to the amount of the net income from that year's investment trust fund, be charged to the Finance Committee for appropriate re-investment.

That JCT advertising rates be increased by 8% in 1980.

That Paint Show exhibit rates be increased by 5% in 1980.

That \$75 per copy be the sale price of the new "Infrared Spectroscopy Atlas for the Coatings Industry." (*The Board referred* this matter back to the Executive Committee for the establishment of a member and non-member price.)

The above actions of the Executive Committee were approved, as amended, by the Board of Directors.

During the meeting, contributions to PRI were presented by the Chicago, Dallas, Houston, Kansas City, Louisville, and Piedmont Societies. Contributions were made earlier this year by the Baltimore, CDIC, Cleveland, Detroit, Golden Gate, Montreal, Pacific Northwest, Southern, St. Louis, and Toronto Societies.

In Memoriam

We record, with deep regret, the passing of the following members of the Federation during the last year:

Baltimore

ATHEY, C. BURCH — Athey Paint Co. (Soc. Past Pres.)

MOORE, JOHN C. — Consultant (Soc. Hon. Member) SHINNICK, J. CLENDENIN — Warner Graham Co.

Cleveland

CARSON, MALCOLM E. — Retired HUNTER, RAY — Retired (Sherwin-Williams Co.)

Dallas

PARDEE, CARL N. — Western Specialty Coatings (Soc. Past Pres.)

Detroit

KOSNIK, DONALD — Valspar Corp.

Golden Gate

APFEL, ALFRED — International Paint Co. (Soc. Pres.-Elect)

Houston

SOMERVILLE, GEORGE — Shell Development Co.

Kansas City

BOEHM, CLARENCE — Davis Paint Co.

Los Angeles

DOSTALIK, J. V. — Dostichem GOLD, ALLEN — Ram Chemical WASHBURN, REBECCA — Union Carbide Corp.

Louisville

GRIFFIN, HERB — Celanese Coatings Co. LIEDERMANN JR., FRANK — Celanese Coatings Co. ROSTBERG, ROBERT E. — Devoe & Raynolds Co.

Montreal

GREGORY, F. R. — Sherwin-Williams Co. (Canada) MATEJ, W. — Swing Paints.

New England

HOLMES, WILLIAM R. – Retired (D. H. Litter Co.) (Soc. Past Pres.) PERRY, ROBERT W. – Retired (Kyanize Paints, Inc.) (Soc. Past Pres.)

New York

KOFFER, MANNY — Pyramid Paint Co. SLOANE, LOU — Retired

Philadelphia

MADSON, WILLARD — Retired (duPont Co.) MOORE, JOHN C. — Consultant (Fed. Past Pres.) WOODWARD, GEORGE P. — Retired (Soc. Past Pres.)

Pittsburgh

GERHART, DR. HOWARD L. — Retired (PPG Industries) Coatings Research Institute, Carnegie-Mellon University

Rocky Mountain

MADIGAN, EDWARD J. - Ac-U-Tex (Soc. Past Pres.)

St. Louis

HARLAND, WALTER J. — Lanson Chemical Co. SCHULTE, FRANK T. — Schulte Paint & Lacquer Co.

Southern

FAIRBROTHER, ELDEN M. — Retired (Mobile Paint Co.) (Soc. Past Pres.) FILIPPONE, JAMES J. — Mary Carter Co. JOHNSON, JOHN — Johnson Paint Co. JOCOY, CLARENCE H. — Dixie Div., O'Brien Corp. (Soc. Past Pres.)

Toronto

BUCKLEY, D. — PPG Industries Ltd. CARTER, STU — PPG Industries (Soc. Past Pres.) GREGORY, F. R. — Stone Enterprises, Ltd.

> CARROLL M. SCHOLLE, Chairman, Memorial Committee

Society Business

The Pacific Northwest Society distributed copies of its proposed publication, "In-Plant Materials Handling Sheet." Mr. Filchak, PNW Society Representative, moved that the Executive Committee refer this project to the Federation's Manufacturing Committee for consideration as a Federation-sponsored program. Seconded by Mr. Bohlen and approved. It was understood that the Manufacturing Committee will consult with the NPCA and also review what may have already been done in this area.

There was a long discussion of Active and Associate membership classifications, during which it was learned that eight Societies now permit Associates to hold office and 11 allow Associates to vote on Society matters. Included in the comments were some thoughts about combining the two into one class of membership. No conclusions were reached and no actions were taken.

Committee Reports

A. F. VOSS/AMERICAN PAINT JOURNAL AWARDS

Despite the shorter allotted time for preparing papers, six Societies submitted eight manuscripts—two each from Toronto and New England for the 1979 Annual Meeting. Subjects were limited to research and raw material evaluation. Due to the closeness of scores for the top three papers, it has been decided to award \$200 for first prize and \$150 each for second and third.

The 1979 winners were:

FIRST PRIZE—"Wet Adhesion—Fact and Fiction"—Toronto Society.

SECOND PRIZE—"Evaluation of Inorganic Salts as Flash Rust Inhibitors in an Aqueous Acrylic Coating"—New England Society.

THIRD PRIZE—"Critical Pigment Volume Concentration/Binder Index Relationship. Part I: Observations on the Experimental Determination of CPVC"—Toronto Society.

HORACE S. PHILIPP, Chairman

CORROSION

The Corrosion Committee activities have predominantly been to work closely with the Steel Structures Painting Council. The Federation has sponsored several SSPC projects. The principal project during 1979 has been (PACE) Performance of Alternate Coatings in the Environment. A very comprehensive report was issued August 20, 1979 by SSPC. Many evaluations were made and much was learned from this multi-faceted study, e.g.:

(1) Salt spray evaluations do not always concur with field exposure studies.

(2) None of the substitute pigments performed as well as lead containing pigments or chromates in oil base systems. They were very much equal in performance in vinyl systems.

(3) Certain water-base formulations are nearly as good as the control solvent-thinned vehicle.

(4) Over 10 different abrasives, including a study with wet sandblasting, have been the basis for intensive investigation.

More time is needed to complete this evaluation. Dry sandblasting gave good results; however, several alternate abrasives gave equivalent performance.

A survey is being made to determine the state of the art for low solvent and water-base systems for protecting structural steel. Case histories are badly needed. Many new systems have been proposed.

Surface preparation standards continue to be worked on. New pictorial standards are expected for commercial blast and repainted surfaces.

The comprehensive study on top coats for zinc-rich primers was issued June 15, 1978. These panels are still on exposure. The Federation is a most willing supporter of the SSPC studies, and the corrosion committee is appreciative of all the technical information obtained in this manner.

DEAN M. BERGER, Chairman

DEFINITIONS

Work continues on the second edition of the *Paint/Coatings Dictionary*, which will contain more encyclopedic definitions with a selected updated bibliography for each category. For this we need specialists for each of these categories. We have some volunteers, but we need many more.

Thus far, we have collected about a hundred more definitions for the second edition and we have been keeping the bibliography updated.

> STANLEY LESOTA, Chairman

EDUCATION

It is most pleasing to report that the correspondence course, first proposed while Harry Scott, Cleveland Society, was chairman, has been authorized and is in process. An Editorial Board is ready to work and chapter headings have been outlined. The project has been launched. Now comes the process of fitting-out to be sure the course will fill the needs that have been expressed.

The Steering Committee held a single policy-setting meeting in Louisville, on March 21. Regional meetings were held in Chicago, Boston, and Morro Bay, Calif.

The compilation of special courses, symposia, and seminars has been completed and copies are available from the FSCT offices. This will be kept up-to-date as a continuing project of local Societies' Education Committees.

Our coatings-oriented universities need more students to enroll in their coatings science courses. Each Society is urged to try to find ways to contact high school teachers and students to interest them in Coatings Technology as a career.

Discussion of the status of slide-tape projects in regional meetings has brought suggestions that this effort be discontinued as soon as the current ones are finished. There has been some thought given to upgrading the present units. This will be a matter of concern at the general Education Meeting in 1980.

Volunteers to help review and up-date the Federation Series on Coatings Technology are still needed.

JOHN A. GORDON, Chairman

ENVIRONMENTAL

With the able assistance of the Federation Staff, a newsletter was published and sent to the Federation members to provide them with information on proposed, pending, and existing regulations as they applied to the Coatings Industry. Other items of information were included in the JOURNAL OF COATINGS TECHNOLOGY as they became available.

Due to the longer periods of time taken by the government than had been anticipated to propose and adopt new regulations, there has not been too much information to report and, consequently, the committee has been relatively inactive. The committee plans to continue monitoring regulations so that information can be made available to the membership promptly. Special interest will be paid to actions to be taken by the users of chemical materials to comply with the Toxic Substances Control Act Chemical Substance Inventory and the disposal and recycling of wastes.

Additional efforts will be made to provide a network of members to monitor the activities of the 50 state governments as they involve themselves with implementing the various federal regulations as they would apply to the coatings industry.

If there is a need to provide information to the membership expeditiously on new regulations, a special newsletter will be published. Otherwise the JCT will be used as the vehicle for disseminating information.

> S. LEONARD DAVIDSON, Chairman

INTER-SOCIETY COLOR COUNCIL

At the close of the highly successful Symposium of Color and Appearance Instrumentation, held during March 1978 in Cleveland, members of the Inter-Society Color Council Committee began to talk about a repeat of that effort in 1981, and after encouraging contacts with the Manufacturers Council on Color and Appearance recommended to the Executive Committee of the Federation that a Symposium on Color and Appearance Instrumentation be held in Louisville, Ky. during the spring of 1981.

This year the ISCC Committee has nominated Ruth Johnston-Feller and Dennis Osmer for the Dry Color Manufacturers' Association award for their paper "Exposure Evaluation: Part II—Bronzing."

We have also submitted a nomination to the ISCC for their Macbeth Award.

In my last report I had mentioned the resignation of Dr. James Davidson from the ISCC Board of Directors. Robert F. Hoban was elected to fill the remainder (1979-1982) of Dr. Davidson's term.

> ROBERT T. MARCUS, Chairman

LIAISON

The most important Liaison Committee function during the past year was the meeting of the International Coordinating Committee (ICC) in Paris, France on June 23. President Mc-Cormick and Executive Vice-President Borrelle represented the Federation. From our point of view, the meeting was considered very successful.

At this St. Louis meeting, the following related activities will be held:

(1) A meeting of the Liaison Committee.

(2) A luncheon meeting of the International Coordinating Committee. It is expected that all foreign members will be represented. The Federation delegation will consist of officers and members of the Liaison Committee chosen by the President.

(3) A reception for overseas visitors.

(4) Three foreign papers will be presented at this meeting:

"Hydrogen Bonding—Key to Dispersion?"—Hilton G. Stephen of Kemrez Chemicals, Cheltenham, Victoria, Australia (Australia-OCCA).

"Dispersion of TiO_2 in Water-Borne Industrial Finishes"— J.M. Rackham of BTP Tioxide Ltd., Stockton-on-Tees, Cleveland, England (U.K.-OCCA).

"Application of Photochemistry to Coating Problems"— Claude Loucheux, Universite des Sciences et Techniques de Lille, Villeneuve D'Ascq, France (FATIPEC).

(5) Groups from the U.K. (sponsored by Cray Valley Prod-

ucts Ltd.) and from West Germany (sponsored by *Farbe & Lack*) will be attending the St. Louis meetings and Paint Show and will be visiting coatings related facilities in various parts of the U.S.A.

A meeting of the Working Party on Supported Polymer Films of the Macromolecular Division of IUPAC will be held in Berlin, October 10–11, 1979. A report on the Brussels meeting of November 1978 has just been issued and a shortened copy will be submitted to JOURNAL OF COATINGS TECHNOLOGY for publication as information to our membership. Federation members to the SPF working party of the MMD of IUPAC are Percy Pierce and Milton Glaser.

Official Federation papers will be presented at forthcoming meetings of FATIPEC, SPF, and OCCA conforming to practice of recent years.

In June a survey was made of Committee members regarding liaison activities at the St. Louis meetings. The procedures our doings at this meeting—essentially follow the findings of this survey.

> MILTON A. GLASER, Chairman

MANUFACTURING

The duties of the Committee have been revised to describe better the current objectives of the Committee. This effort was spear-headed by Carroll Scholle of the Steering Committee. The new duties have been approved by the Executive Committee.

A presentation of the status of the Steering Committee and its relationship to the Society Manufacturing Committees was presented to the third ranking Society officers at their spring meeting in New Orleans.

Arrangements are complete for a two hour seminar to be presented at the Annual Meeting in St. Louis. The subject will be "Media Milling."

The Committee assisted the Program Committee by reviewing a paper on "Wiped Film Evaporators," which will be presented at the Annual Meeting.

The Manufacturing Committee of the Toronto Society has prepared a slide-tape titled "Introduction to Resin Operations." This has been reviewed and requires only a minimum amount of editing which will be done by the Federation.

There are five other slide-tape presentations that are being studied for re-submission or otherwise. These were submitted by Kansas City, Houston, Baltimore, Toronto, and New York. The Toronto Society has also submitted a paper on "Tank Cleaning Systems for the Small Paint Plant." This has been published in the September JOURNAL OF COATINGS TECHNOL-OGY. A paper by Len Magnusson on "Equipment Utilization" is being finalized and will be submitted for publication when it is completed.

There were many significant achievements by the Manufacturing Committee of several Societies. These have been in activities such as seminars, special programs, slide-tapes, etc. Those Societies that deserve special mention are Chicago, Houston, Kansas City, Los Angeles, Pacific Northwest, Philadelphia, and Toronto.

> DONALD J. FRITZ, Chairman

METRIC SYSTEMS

Activities were few, as usual, during the summer period. The matter of the physical dimensions of the "hard" metric paint cans still remains unresolved and it is not within our committee's power to speed up progress. It has also severely impeded conversion progress and caused confusion in the Canadian paint industry. CPMA wishes to adopt the new American "hard metric" containers, as was previously reported. But these containers cannot be manufactured until their precise dimensions are known. NPCA's Metric Task Force has not held any further meetings to settle this issue.

A report describing our Committee's past and present activities has been requested by the U.S. Metric Board. Such a report has been forwarded to the Chairman of USMB.

Contributions to JCT's Metric Corner have been continued. Liaison has been maintained with related committees in the coatings field and with the Canadian Metric Commission.

> E. L. HUMBERGER, Chairman

PUBLICATIONS

Assignments to the Publications Committee and the Editorial Review Board for 1980 have been completed. A Vice-Chairman will be appointed this year. The annual meeting of the Publications Committee will include members of the Editorial Review Board and funds for this meeting have been requested.

Manuscript supply is very good. Review procedures have been consistent with maintaining high quality papers and response from the field is positive.

> THOMAS J. MIRANDA, Chairman

PUBLIC RELATIONS

Society Monthly Presentation Report forms were sent to the Society Program Chairmen in the spring. The time was such that reports from the Societies could have been received by the Federation Office for March, April, and May. Approximately one-third of the Societies responded. It is envisioned that better response will be forthcoming in the new year.

The directory of "Talks Available to Constituent Societies" was mailed to all Society Program Chairmen in late June. It contained a total of 36 talks, nine of which have not previously been presented. A few Societies had requested copies before publishing. Comments from Societies since publishing have been very good. This has been most gratifying.

HARRY POTH, Chairman

ROON AWARDS

Ten people had expressed an intent to compete for the 1979 Roon Awards, but only five presented papers. Despite the high quality of the entries, it is quite discouraging to think that bureaucratic red tape or lack of interest prevented a wider participation.

Winners in the 1979 competition were:

FIRST PRIZE (\$900)—"Transfer and Leveling Process and Rheological Design in Water-Borne Reverse Roll Coating Systems"—Takehisa Matsuda and William H. Brendley, Jr., of Rohm and Haas Co., Spring House, Pa.

SECOND PRIZE (\$500)—"Plastic Pigment—A Novel Approach to Microvoid Hiding"—Alexander Ramig, Jr. and F. Louis Floyd, of Glidden Coatings & Resins Div., SCM Corp., Strongsville, Ohio.

THIRD PRIZE (\$300)—"Polyphosphazenes as New Coating Binders"—A. K. Chattopadhyay, R. L. Hinrichs, and S. H. Rose, of DeSoto, Inc., Des Plaines, Ill.

(All of the above papers were published in the November 1979 JCT-Ed.)

UMBERTO ANCONA, Chairman

SPECIFICATIONS

During the past year the committee initiated a procedure whereby the GSA Paint Branch sends copies of proposed new and revised specifications directly to all Societies in the United States for review and comment. The specifications are sent to the Society's Specification Committee Chairman if one has been designated, or to the Society President if no committee is indicated in the year book. This procedure results in more timely transmissions and significantly reduces mailing and handling costs for the Federation.

The committee recognizes the need to improve liaison with Department of Defense specification writing activities, and several members are following up on this.

On February 16, 1979, the General Services Administration issued Federal Property Management Regulations, Temporary Regulation E-59 prescribing policies and procedures for the management of specifications, standards and descriptions for commercial products. Basic policy is, "The Government will purchase commercial off-the-shelf products when such products will adequately serve the Government's requirements, provided such products have an established commercial market acceptability. The Government will utilize commercial distribution channels in supplying commercial products to its users."

Task forces were established to review existing specifications and to determine if commercial item descriptions (CID's) could be developed for off-the-shelf procurement. CID's do not detail all product characteristics to the extent that such characteristics are determined to be inherent in commercial off-the-shelf products. Quality Assurance provisions and test procedures are not included except by reference to industry standards.

The review of GSA paint specifications resulted in very few becoming candidates for commercial item descriptions.

JOHN A.J. FILCHAK, Chairman

TECHNICAL INFORMATION SYSTEMS

Technical Information Systems Committee (TISCO) members continue work on two well established projects: (1) the selection of technical articles suitable for inclusion in the JOURNAL OF COATINGS TECHNOLOGY column entitled *Techni*cal Articles in Other Publications; (2) compilation of the Keyword/Subject Index for the 1979 issues of JCT.

In addition, TISCO members wish to propose the following new projects for consideration of the Publications Committee and Definitions Committee, respectively: preparation of a Subject Index to the Federation Series on Coatings Technology in order to assist readers locate information in these booklets (subject to approval of Publications Committee); and the preparation of a list of new terms to be considered by the Definitions for inclusion in the next edition of the Paint/ Coatings Dictionary, resulting from comparison of terms used in JCT Keyword/Subject Index and entries in Paint/ Coatings Dictionary (subject to approval of Definitions Committee).

In order to fulfill the duty of "working with the Publications Committee and Staff to improve retrieval of information from Journal of Coatings Technology," Technical Information Systems Committee suggests the following: that the TISCO Chairman be invited to attend the meeting of the Publications Committee, during which the topic of information retrieval from JCT as well as other topics of mutual interest can be discussed in some detail.

> HELEN SKOWRONSKA, Chairman

TRIGG AWARDS

The winners of the 1979 awards for the most interesting reports of regular Society meetings are:

FIRST PRIZE (\$100)—Marvin Schnall, of Troy Chemical Corp., Secretary of the New York Society.

SECOND PRIZE (\$75)—Sharon Vadnais, of E. T. Horn Co., Secretary of the Golden Gate Society.

The committee also wishes to acknowledge the high quality of meeting minutes of Jan Van Zelm, Secretary of the Los Angeles Society and Barry Oppenheim, Secretary of the Philadelphia Society, who placed third and fourth, respectively.

> GUS W. LEEP, Chairman

DELEGATE TO IUPAC

The next meeting of the IUPAC Working Group on Supported Films will be held in Berlin on October 10-11, 1979.

Arrangements are being made through Milton Glaser, Liaison Committee Chairman, to publish the minutes of the IUPAC meetings in the JOURNAL OF COATINGS TECHNOLOGY. P. Fink-Jensen has supplied a copy of abbreviated minutes of the Brussels meeting, suitable for submission to JCT (see October JCT--Ed.). The project on "Analysis of Functional Groups in Amino Resins," headed by G. Christensen has made excellent progress and a report will be presented at the meeting.

A number of new projects are under consideration and will be discussed in Berlin.

A possible project is the analysis of latex and/or water-base coatings. P. Fink-Jensen has asked for U.S. leadership in organizing this program. Dr. Glenn Cunningham, of PPG Industries, Inc., is a possible candidate to lead this project.

> PERCY E. PIERCE, Delegate

DELEGATE TO NPCA AND GOVERNMENTAL AGENCIES (Environmental Control)

NPCA has formed an Ad Hoc Committee on Waste Management Policy with the following objectives:

(1) To aid in the formulation of NPCA Policy in conjunction with the Water Quality/Waste Management Task Force on potential litigation of final RCRA regulations.

(2) To aid in the formulation of policy and development of a position in regard to proposed federal legislation on hazardous waste, i.e., Super Fund or amendments to RCRA.

(3) To determine what NPCA and its members should do with respect to past disposal practices.

(4) To determine future NPCA initiatives in the area of waste management.

The NPCA Water Quality/Waste Management Task Force has been charged with developing test protocols to characterize the leachability of water-borne paint wastes and sludges. Several samples have been analyzed by methods currently used. Data has been supplied to EPA to support the request that such waste will not be considered hazardous.

Additional samples are to be tested to provide guidelines for the disposal of water-borne paint wastes and sludges by the industry according to RCRA classifications.

> S. LEONARD DAVIDSON, Delegate

Society Reports

Annual reports from the Societies were presented at the Board Meeting, and complete copies were distributed to every member of the Board. Following are pertinent highlights for 1978-79. Education Committee established Baltimore Coatings Industry Scholarship Award with two winners chosen in 1979... Technical Committee pursuing the following projects: Formulation Data Retrieval; New Infrared Reflectance of Paint Pigments; and Correlative Testing... Held symposium on chromate pigments, CARB-approved resins, government regulations, and innovation-performance chemicals... Continued support given to Paint Research Institute.

Birmingham

History of Club prepared for 50th Anniversary during 1979-80 ... Technical Committee preparing audio/visual presentation, "An Introduction to the Paint Industry"; continued work on "Seta flash" presentations. Initiated sales of FSCT publications in U.K. through Society.

Chicago

Education Committee, jointly with Chicago PCA, provided Coatings Chemist Course for 110 registrants... Held annual Management Development and SYMCO Seminars... Technical Committee projects include: Acid/Base Interaction; Analysis of Coatings; and Accelerated Selection of Mildewcides... Infrared Spectroscopy Committee completed preparation of new edition, "An Infrared Spectroscopy Atlas for the Coatings Industry," which will be published in 1980... Reorganized Manufacturing Committee... Established Environmental Committee ... Joint Education Committee provided scholarships to North Dakota State University, University of Missouri-Rolla, and Elmhurst College.

Cleveland

Held joint meeting with Cleveland PCA on "Living with Government Regulations" ... 22nd Cleveland Society Symposium presented on "Chemistry of Crosslinking Reactions"; "Environmentally-Acceptable Coatings"; "Surface Characterization and Analysis"; "Recent Advances in Raw Materials Technology" ... Awarded two prizes at local Science Fair ... Continued matching funds program for PRI ... Prepared job descriptions for Society officers and committee chairman.

Dallas

Increased active membership by 10%... Held joint program with Houston Society on "The Laboratory/Production Interface"... Co-hosted Southwestern Paint Convention in Houston... Donated \$500 each to PRI and University of Southern Mississippi.

Detroit

Held Focus Seminar on "Recent Advances in Automotive Coatings"... Jointly sponsored course on "Surface Coatings Technology" with University of Detroit Polymer Institute and Detroit PCA.

Golden Gate

Hosted 14th Western Coatings Societies Symposium with over 2,000 registrants attending ... Specifications and Technical Committees collaborated in revising Fed. Spec. TT-P-1511A, presented results at St. Louis Annual Meeting ... Held Manufacturing Seminar, "Mixing Time '79."

Houston

Co-hosted with Dallas Society the Southwestern Paint Convention.

Kansas City

Presented paper at Chicago Annual Meeting . . . Participated in local Science Fair, hosting the winners at May Society meeting.

Louisville

Presented Technical Committee project, "Nonmercurial Mildewcides in Acrylic House Paints," at St. Louis Annual Meeting ... Presented Surface Coating Technology courses at University of Louisville Speed Scientific School.

Mexico

Co-sponsored annual meeting with Mexican Association of Paint Manufacturers in Acapulco... Presented "Seminar in Coatings Technology" at local graduate schools... Completed translation into Spanish of the instructions and advertisements of Color-matching Aptitude Test Set.

Montreal

Held 12th Annual Joint Symposium with Toronto Society ... Donated \$300 to PRI... Education Committee again presented the Introductory Course in Coatings Technology.

New England

Initiated Study Grant program for members wishing to attend technical seminars... Enjoyed 20% increase in meeting attendance... Technical Committee project papers presented at 1979 Annual Meeting.

New York

Education Committee continued its presentation of the one year course, "Fundamentals of Coatings Technology"... Tensession "Laboratory Course for Technicians" was also held.

Northwestern

Held symposium on industrial and trade sales coatings application methods . . . Technical Committee presented paper on water-borne primers at St. Louis Annual Meeting.

Pacific Northwest

Held Society's Annual Meeting and Technical Symposium in Vancouver, with 307 persons registering . . . Changed name of Society's Outstanding Service Award to "James A. Leider, Jr. Outstanding Service Award" in recognition of that individual's 31 years of service and achievement . . . Education activities progressed in all three sections with formal courses being held or new courses in planning stages . . . Manufacturing and Safety Committee completed draft of 200 "In-Plant Material Handling Data Sheets" for hazardous compounds.

Philadelphia

Dictionary Committee saw completion of the "Paint/Coatings Dictionary" following 10 years' effort... Completed revision and updating of "Pictorial Standards of Coatings Defects" ... Presented paper at St. Louis Annual Meeting ... Held joint technical seminar on "Maintaining Quality Under Pressure," with New York Society... Education Committee sponsored course on "Advanced Coatings Technology"; "Color Technology and Computer Color Matching" was also held Active membership increased 8%, associate by 41%... Held joint meeting with Presidents of New York and Baltimore Societies ... Joint Society meetings held with Philadelphia PCA and the Philadelphia Ink Group ... Donated \$500 to PRI.

Piedmont

Contributed \$500 during 1978-79 to research efforts of PRI . . . Increased Society membership by 2% with over 33% attending monthly meetings.

Pittsburgh

Sponsored two \$25 awards at local Science Fair... Technical. Committee working on project concerning "Flash Point Measurement Errors in Water-Base Paints."

St. Louis

Hosted 1979 Annual Meeting . . . Held joint industry night . . . Sponsored two awards in local Science Fair . . . Presented 2nd Annual Gateway Award to Dr. Herman J. Lanson.

Southern

Registered 393 persons at Society's Annual Meeting in March ... Assisted University of Southern Mississippi students with total of 10 scholarships ... Co-sponsored 6th Annual Water-Borne and Higher Solids Coatings Symposium with USM in New Orleans ... Made contributions to USM and PRI ... Reactivated Technical Committee.

Toronto

Celebrated 60th Anniversary ... Society presented two papers at St. Louis Annual Meeting ... Co-sponsored successful courses at George Brown College ... Donated \$500 to PRI ... Manufacturing Committee produced A/V presentation, "Introduction to Resin Operations"... Held joint symposium with Montreal.

Western New York

Education Committee producing audio/visual presentation on "Impact Resistance" . . . Held joint meeting with Buffalo PCA.

The next meeting of the Federation Board of Directors will be held on May 16, 1980, at the North Star Inn, Minneapolis, Minn.

Government and Industry

PACE Report Evaluates Newest Protective Coatings

The Steel Structures Painting Council has issued a report evaluating the new types of steel-protective coatings which have been developed by the paint industry in response to anticipated regulations regarding pollution, health, and safety. In addition to generic composition information, the proprietary identification of those commercial products which performed best to date are disclosed with full permission of the manufacturers.

The report evaluates the durability of coatings using low-solvent compositions to meet air pollution requirements, alternative pigmentations in place of potentially toxic heavy metals, and new surface preparation methods and materials in place of sand blasting. A wide range of coating compositions and surface preparations have been appraised for durability in direct comparison with standard conventional materials in a range of environments as a part of SSPC's project PACE (Performance of Alternate Coatings in the Environment), which it is

conducting under the co-sponsorship of the Federation of Societies for Coatings Technology.

The information should be an invaluable guide in the years ahead when present coatings based on high amounts of volatile organic compounds and potentially toxic ingredients applied over sand blasted steel may no longer be permitted in most parts of the U.S.

Among the new approaches are included: water-borne emulsions; watersoluble resins; high-solids coatings; nonpolluting thinners; phosphates; metaborates; molybdates; zinc-dust; wet sand blasting; new abrasives; and many other variations, all of which are now commercially available.

Copies of the 240-page report are available from the Steel Structures Painting Council, Mellon Institute, Carnegie-Mellon University, 4400 Fifth Ave., Pittsburgh, Pa. 15213. Price is \$35 (\$40 for stereo 3-D version).

NPCA Supports Basic Concept of DOT's HM-126A Proposals

In recent comments to the Materials Transportation Bureau of the Department of Transportation, National Paint and Coatings Association supported MTB's basic concept of a system for identifying hazardous materials during transportation as proposed in Docket No. HM-126A, Display of Hazardous Materials Identification Numbers: Improved Emergency Response Capability. The proposed system would aid personnel in readily identifying the particular hazardous material by marking the container and shipping paper with the United Nations identification number.

Although NPCA supported this basic concept, it objected to the requirement that a UN number be placed on containers having a capacity of 110 gallons or less, asserting that because these containers already bear numerous other markings any additional markings would clutter the container and thus render the markings ineffective. NPCA recommended that the shipping paper rather than the container itself be used in all instances as the primary source of hazard identification.

With respect to MTB's proposal to

require two placards on portable tanks, freight containers, motor vehicles or rail cars (one each for the identification number and the hazard type), NPCA supported a proposal by the Chemical Manufacturers Association to require only one placard with the UN number in the center and the hazard type directly above it. NPCA believes that placarding procedures can be simplified and costs reduced by combining these elements on one placard, and further, that if MTB chooses to adopt a new size placard, reasonable time (preferably five years) be allowed to refit equipment with permanent placard holders.

NPCA supported MTB's concept of a hazardous materials identification manual and recommended that it be distributed to emergency response units one year prior to the rule's compliance date for field testing and evaluation of its effectiveness.

NPCA also urged MTB to incorporate into its proposal a gradual, stepped implementation schedule to assure the program's success and to allow sufficient time for proper compliance at minimal cost.



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True False

□ (1.) Less than four per cent of the U.S. labor force are agricultural workers.

□ (2.) Today, the U.S. ranks third in international trade.

(3.) As productivity increases, our standard of living increases.

□ (4.) When inflation occurs, each dollar we have buys more goods and services.

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GUIDE FOR AUTHORS

INTRODUCTION

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology. Some 6,500 technical men of the paint industry—associated with 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico—make up the membership of the Federation.

The purpose of the JOURNAL is the advancement of knowledge of the formulation and manufacture of paints, varnishes, lacquers, resins, and related coatings. Its worldwide circulation is about 9,000.

Papers should present new or original data of either a practical or scientific nature. *Papers written in a manner which tends to promote proprietary products are specifically not acceptable.* Papers must meet the standards of the JCT Editorial Review Committee and are accepted with the understanding that they are contributed exclusively to the JOURNAL OF COATINGS TECHNOLOGY and that the material has not been published elsewhere.

The JOURNAL OF COATINGS TECHNOLOGY has first rights to the publication of papers presented at the Annual Meeting of the Federation and at local and regional meetings or symposia of the Constituent Societies. These papers, and others, submitted for publication, must be approved by the JCT Editorial Review Committee, which has authority in all matters affecting the acceptance or rejection of papers and other technical material. Manuscripts not accepted for publication will be returned to the author.

MANUSCRIPT COPIES

GENERAL PAPERS: Four complete copies are required. Send to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, Pa. 19107.

CONSTITUENT SOCIETY PAPERS (for presentation at the Annual Meeting): Ten copies of manuscript are required. They should be mailed as directed in this year's "Guide for Speakers."

ROON FOUNDATION AWARD PAPERS: Seven copies of the manuscript must be sent to the Chairman of the Roon Awards Committee. For complete details, see the "Roon Awards" section of the November 1979 JCT.

MANUSCRIPT PREPARATION AND STYLE

In general, follow the "Handbook for Authors" published by the American Chemical Society Publications, 1155 Sixteenth St., N.W., Washington, D.C. 20036.

Manuscript should be typed, double spaced, on $8\frac{1}{2} \times 11$ paper, typing on one side only with at least one-inch margins around all four sides. Indent paragraphs five spaces.

Title

Keep the title informative, yet as brief as possible consistent with defining the subject matter covered in the paper.

Authors

Give complete names and correct company affiliations and addresses of all authors. A photo (glossy 5×7) and brief biographical sketch of each author should be included with the manuscript. Photos should be identified by printing the subject's name on the reverse side, in the margin so as to avoid defacing the photos. Do not clip or staple.

CONSTITUENT SOCIETY PAPERS: Submit names and company affiliations of each member of Technical Committee which prepared paper. Include, if possible, a group photo of committee.

Abstract

A 75-100 word abstract should accompany the manuscript. Avoid exceeding the length, if possible. The abstract, which is published immediately after the by-line and on the abstract pages, should contain an informative, not descriptive, statement concerning the (a) scope, (b) experimental methods, and (c) results or conclusions.

Presentation Data

If the paper has been presented at a monthly or special meeting of a Society for Coatings Technology, or to some other technical group, list the name of the organization and the date of presentation. If someone other than the author presented the paper, this, too, should be noted. Papers presented to associations other than the Federation must be released before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY.

Oral presentations submitted for publication should be rewritten to conform to publication style and format.

Text

This Guide has been prepared in accordance with general publication style, except the type, which is 9 pt. instead of 10 pt. Note the use of subheads. These serve to divide the paper into sections and also to break up the monotonous appearance created by long, continuous lines of type. Use simplicity in word selection whenever consistent with content. Be neither stiff and trite, nor lax, but direct and concise. Include only as much history as necessary to provide background for the particular material covered in the paper.

Metric System

Metric units are to be used wherever applicable and are to be shown in parentheses after the English or other units.

An excellent reference publication for metric conversions is the ASTM Metric Practice Guide (E 380-72) published by the American Society for Testing and Materials, 1916 Race St., Philadelphia, Pa. 19103. A conversion slide, in accordance with E 380-72, is also available.

Tables

Tables should be used sparingly, especially extremely long or wide ones. It is preferred to have tables typed on a separate sheet of paper rather than included in the text. All tables must be referenced in the text, e.g., "see *Table* 1."

Illustrations

Submit original drawings or sharp prints and good, clear glossy photographs. Graphs should be on good quality white, or blue-lined, graph paper. They should not exceed the $8\frac{1}{2} \times 11$ size. Lines or curves should be relatively bold. The ordinate, abscissa, and title should be drawn outside the borders of the graph. Number all illustrations on the back. Captions are usually set in type, so they should be typed all on one separate sheet of paper. All illustrations must be black and white, as color is not acceptable. Slides, also, are not acceptable.

Nomenclature

Follow nomenclature style of *Chemical Abstracts*. Use chemical or common names when meaningful. Where trademarks are helpful for more complete descriptions, show them in footnotes or in an appendix, rather than in the text. If special nomenclature is used, include a nomenclature section at the end of the paper giving definitions and dimensions for all terms.

Equations

These must be typed, or written, clearly. Number each consecutively. If special symbols or Greek letters are used, write out their names in the margin of the sheet at point of first use. Place superscripts^a and subscripts_b accurately.

Summary

The paper should be concluded with a summary which is intelligible without reference to the main text.

Acknowledgment

If used, it should follow the summary.

References

These should appear in numerical order within the text and be listed at end of manuscript in same order. Authors' names may or may not be shown in text with reference numbers. If possible, include titles of articles referenced in the literature. The following is a suggested style for periodicals¹ ² ³ and books:⁴

- Wilkinson, R.F., "Uses for Water-Soluble Trimellitate Resins," Official DIGEST, 35, No. 457, 129 (1963).
- (2) Woo, J.T.K. and Heinert, D.H., "Coatings from Vinyl Isocyanate Monomer," JOURNAL OF COATINGS TECHNOLOGY, 49, No. 632, 82 (1977).
- (3) Hobden, F.W., J. Oil & Colour Chemists' Assoc., 41, 24 (1958).
- (4) Mattiello, J. J., "Protective and Decorative Coatings," Vol. IV, John Wiley & Sons, Inc., New York, 1955.

OTHER INFORMATION

Galley proofs will be sent to the author for checking about six weeks prior to publication.

Reprints may be purchased in quantities of 100 or more. Authors will receive quotations.

Each author will receive a complimentary copy of issue in which his paper is published.

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SPECTRUM '79

Emulsification of Thermosetting Acrylic/Melamine Coatings

Larry G. Curtis Eastman Chemical Products, Incorporated*

Water-borne coatings that utilize conventional resins, pigments, and application equipment have been developed. The coatings were prepared with water immiscible solvents and water insoluble resins and are easily emulsified with minimum agitation and shear. Application characteristics are outstanding with very rapid dry time and very low cure temperature requirements without external catalysis.

Films produced from the emulsions exhibit very high gloss, hardness, flexibility, and durability. Formulations were prepared that offer higher application solids and less critical application conditions than present solution type water-borne enamels.

Tests were conducted on metallic pigmented enamels to determine formulation parameters, such as resin requirements, choice of surfactant, catalysis mechanisms, and control of cure rate. Properly formulated coatings cure as low as 100°C in 10–15 min and offer appearance and weathering properties equal or superior to enamels applied from conventional organic solvents and cured at significantly higher oven temperatures.

INTRODUCTION

Until the 1960's, technological changes within the coatings industry were of an evolutionary nature resulting from a desire of paint producers to continually improve their product line and by the demand of consumers for paint products with improved performance properties. For the most part, both of these stimulating forces can be considered internal and are classic examples of competitive marketing practices associated with growing economic standards. When Los Angeles County adopted Rule 66 in the mid-1960's the factors or forces controlling the development of coatings technology largely became external in nature and have grown almost exponentially as other cities, states, and eventually the United States government, followed suit with numerous anti-pollution regulations, the clean air

acts, and the establishment of the Environmental Protection Agency (EPA).

The overall result of the myriad of regulations and acts has been an almost overwhelming economic impact on the producers of coatings as well as on the users of coating materials as efforts to comply were made and are still continuing.

In the early 1970's, powder coatings seemed to be the ultimate answer to pollution problems, and, indeed, have found acceptance in many sectors of the coatings industry. However, in areas which must bear the brunt of the impact of the various anti-pollution regulations, such as the automotive industry, powder coatings development has dropped to a much lower priority level. The major reason for the decline in interest can be attributed to styling problems encountered with metallic pigmented colors. However, with the advent of smaller passenger cars and reduced metallic colors, powder coatings may again become a viable method of reducing overall organic emissions into the atmosphere.

An equally aggressive effort has been made toward the development of higher solids coatings with many encouraging results. But, the development priority in this area has also declined considerably as a result of many of the same problems encountered in powder coatings, such as styling in metallic colors. Complicated metering equipment for two-package systems and concern for possible toxicological problems associated with urethane chemistry are additional problems.

The third alternative available as a viable method of attaining the ever-increasing stringent standards of ambient air quality is water-borne coatings. In fact, this may be the only choice available to many industrial coatings applicators. A marked degree of success is already in evidence within the automotive industry, with more than one million passenger cars having rolled off the General Motors production lines at Van Nuys and South Gate in California.

WATER-BORNE CATEGORIES

The term "water-borne coatings" includes three basic categories: emulsions, colloidal dispersions, and water soluble systems. Each has distinctive characteristics and is basically classified according to physical size of the

Presented at the 1979 West Coast Coatings Societies Symposium in San Francisco, February 28-March 2, 1979. "Coatings Chemicals Laboratory Bldg. 230, P.O. Box 431, Kingsport, Tenn. 37662.

L.G. CURTIS

Table 1—Thermosetting	Acrylic/Melamine/CAB	Emulsion
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Ingredients	Wt. %
Cymel 303 resin (100%)	10.0
CAB-551-0.01 (100%)	5.0
Acryloid® AT-56 resin ^a (50%)	40.0
Xylene	5.0
Alipal CO-436 emulsifier (58%)	2.4
Morpholine	0.5
Ammonia (28%)	0.5
Water	36.6
	100.0
Formula solids-35 Wt %	
Organic phase solids-65 Wt %	
Percent neutralization-90	
Application—air atomization, 65-70 psig	

Organic water ratio-40/60

(a) Thermosetting acrylic resin, a product of Rohm and Haas Co.

polymer particle. Emulsions normally display a particle size of 0.1 to 1.0μ . Colloidal dispersions which exhibit a translucent appearance have particle sizes in a range of 0.01 to 0.1 μ . Aqueous solutions of polymers are characterized by particles of infinitesimal size, virtually too small to be measured but certainly below 1,000th of a micron.¹

Water-borne coatings in the form of emulsions have enjoyed a phenomenal growth and acceptance since their introduction in the 1940's. Today, over half of the market for exterior trade sales and at least 90% of interior trade sales markets are thermoplastic emulsions of various polymer types.² Although thermoplastic emulsions have continued to enjoy a growing market in trade sales, they are not well suited for many industrial applications where resistance to alkali, acids, and solvents is required; nor do they exhibit the appearance or exterior durability that is required in many applications.

In order to upgrade the performance of emulsion coatings, crosslinkable systems have been developed, with the industry actively continuing an investigation in this area. In a series of articles in the JOURNAL OF COATINGS TECHNOLOGY, Bufkin and Grawe have completed a comprehensive summary of efforts in developing thermosetting or crosslinking emulsions.³

Such crosslinkable emulsions fall into three categories as related to crosslinking mechanisms: homogeneous, interfacial, and final interstitial crosslinking. Homogeneous crosslinking must occur as a result of condensation reactions taking place between functional groups contained within the particle and at the interface between particles as they coalesce. Both interfacial and interstitial crosslinking require that an external crosslinking agent, such as an aminoplast, be added to an emulsion which may or may not contain functional groups. If the emulsion contains reactive groups in the outer shell, interfacial crosslinking will occur. Otherwise, interstitial crosslinking occurs as a result of selfcondensing of the aminoplast resin. In the latter case, the resultant film is basically an encapsulation of thermoplastic particles within a homopolymer matrix.⁴ Analysis

of either interfacial crosslinking or, in particular, interstitial crosslinking would indicate that nonuniformity of the resultant film would occur.

Of the water-borne coatings used today for industrial applications, water-soluble types offer the greatest degree of film uniformity, since all components, including water, cosolvents, and polymers, are in a continuous phase. Such coatings exhibit a high degree of hydration with water, normally accomplished by amine neutralization of a carboxyl group contained on the polymer chain. Once a polymer or solvent has such affinity or hydration properties with water as to form a continuous phase, the water no longer behaves like water; its boiling point is elevated and the release characteristics from an organic mixture change, resulting in increased drying time. In a paint film, this may be evidenced by popping or foaming of the paint film during baking operations.

Most production lines are limited to relatively short baking schedules at elevated temperatures in order to meet production schedules. It is, therefore, desirable to formulate coatings which release water rapidly. This can be accomplished by providing only sufficient hydrating groups to impart stability to a water-borne system without adversely affecting release of water from an applied film. When this is accomplished, many of the problems of popping and foaming often associated with highly hydrated systems, such as water-soluble coatings, can be minimized.

Emulsions are characterized by good solvent release due to larger dispersed particle size and relatively low degrees of hydration. The type of emulsion involved in this study and the subject of this article are oil-in-water systems, using conventional solvent-borne or 100% solid resins, fully formulated with pigments and additives. Simply stated, a solvent-borne enamel, formulated at 65– 75% nonvolatile, was prepared and subsequently combined with sufficient water to form an oil-in-water emulsion. The preparation of a stable oil-in-water formulating restrictions must be observed.

EMULSION FORMULATION AND PREPARATION

Since the oil or dispersed phase of an oil-in-water emulsion has affinity for itself, some mechanism must be utilized to create an interparticle repulsion. This is accomplished by the use of a surfactant or an amine neutralizing agent which creates repulsive, like-charges on the surface of the particle. At the same time, a weak hydrating effect is obtained which creates an affinity of the particle for water, thus imparting suspension stability for this system.

Resin Selection

The acrylic resin shown in *Table* 1 is the major filmformer of the formulation. Consequently, its properties must be considered carefully. The acrylic should be hydroxy-functional and possess carboxyl groups sufficient to impart an acid number of 30-35. Resins with significantly higher acid numbers become solubilized when neutralized by an amine; lower acid number resins require excessive amounts of emulsifiers, which may result in films with water sensitivity. The acrylic resin should have a fairly narrow molecular weight distribution, since it has been observed that very low molecular weight fractions tend to become water soluble when neutralized, resulting in some phase separation. Preferably, the acrylic resin should be prepared in xylene or higher boiling aromatic hydrocarbon solvents in order to maintain maximum hydrophobic properties of the solvent system. Resin solids should be maintained as high as possible in order to minimize volatile organic compounds in the formulation.

The acrylic resin shown in *Table* 1 is a commercial product which satisfies these chemical parameters. In order to minimize volatile emissions, a much higher solids product is desirable, and, during the course of this study, proprietary acrylic resins with 70–75% nonvolatile were successfully tested. However, since these resins were developmental in nature, they are not included in this article.

The selection of aminoplast resins (Table 1) was made with two considerations. Hexamethoxymethyl melamine (American Cyanamid Cymel® 303 type) meets the requirement of being hydrophobic and is supplied at 100% solids, which assists in maintaining high solids in the organic phase. Hexamethoxymethyl melamine is a stable, nonself-condensing resin at ambient temperatures and it assists in solubilizing other polymers in the formulation, such as the cellulose acetate butyrate resin. Other melamine resins were evaluated in this study, including partially methylated water soluble types. However, this type of aminoplast displayed tendencies to cause popping and foaming in the cured film, problems similar to those encountered in water soluble systems. In addition, this approach tended to promote instability of the emulsion, as evidenced by phase separation.

Emulsion formulations prepared with an acrylic resin and an aminoplast as the sole film-former presented some problems during application and curing, such as tendencies to crater, solvent pop, and form excessive film build or "picture-framing" at panel edges. In addition, an unusual problem of inadequate leveling or "puddling" was observed after application and during a low temperature flash-off. Many of these problems have been encountered in solvent-borne coatings and can usually be minimized with the addition of a viscosity control agent, which also functions to maintain an "open" film during solvent evaporation and cure. As shown in Table 1, cellulose acetate butyrate was selected for this purpose. In order to maintain low organic solution viscosity prior to emulsification. CAB-551-0.01 was chosen. This material is a cellulose ester which is soluble in a hexamethoxymethyl melamine/aromatic hydrocarbon mixture. Although very low in molecular weight, this product has sufficient hydroxyl functionality to react with the melamine and maintain the crosslink density of the film. In addition, products of this type are often used as a pigment dispersion medium, particularly for difficult to disperse pigments, such as transparent iron oxides and organic pigments.

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Solvent Selection

The most important requirement of the solvent system used in the emulsion formulation is that water miscibility be avoided. The solvents employed should exhibit a boiling range higher than that of water. Xylene or higher boiling hydrocarbons are the preferred solvent, since these materials are very hydrophobic and are efficient azeotropes, thus facilitating the removal of water from the film during baking.

Certain solvents should be avoided from the standpoint of chemical reactivity. Ketones fall into this category in that possible reaction between the carbonyl groups and neutralizing amines may occur, thus altering the properties of the solubilizing amine.⁵ Evidence of this type of reaction occurring has been indicated by rapid viscosity drop and a downward pH shift in the emulsion.

NEUTRALIZING AMINE SELECTION

The number of amines that are available for the neutralizing of carboxyl groups are too numerous to list or evaluate thoroughly. However, some criteria do exist for simplifying this selection. These include equivalent weights, boiling range, base strength, water miscibility, toxicity, and tendencies to enter into side reactions which may cause discoloration of the cured film. The primary concern is that the amine is effectively removed from the film as quickly as possible. In this respect, a combination of morpholine and ammonia has been found to be an efficient neutralizing agent due to low equivalent weights and it is readily volatilized from an applied film during baking operations. Recent studies have shown that hydroxyl-bearing amines, such as triethanolamine and monoethanolamine, are quite difficult to remove from a film even after exposure to high baking temperatures. For example, infrared (IR) analysis has indicated the presence of large quantities of triethanolamine following a 20 min bake at 300°F (150°C).6

Another consideration of amine selection is its effect on handling, application properties, and emulsion viscosity. Leveling, sagging tendencies, and final film gloss and appearance can be dramatically affected, depending on the choice made. For example, triethylamine was observed to cause severe wrinkling and separation of the film, sometimes referred to as "mud-cracking." Triethanolamine produced smooth, glossy films; however, severe sagging tendencies were observed during applica-

L.G. CURTIS



Figure 1-Differential thermal analysis: Alipal 436 surfactant

tion, and resultant films exhibited poor cure response due to retention of the amine in the film.

EMULSIFYING AGENTS

Water sensitivity of films applied from emulsions may be severely affected by the surfactant used in preparing an emulsion, particularly if an excessive amount is required. Consequently, efficiency must be a factor to consider when selecting an emulsifying agent in order to maintain levels as low as possible. Both nonionic and anionic surfactants were extensively investigated in the course of this study. Nonionic types proved unsatisfactory though, since their use tended to push the emulsion toward a water-in-oil system in the early stage of emulsification and would not invert to the desired oil-in-water types. Anionic types generally did not present this problem and were selected for use; however, many anionic and nonionic compounds such as sodium salts were totally avoided, since it is virtually impossible to remove them from the final film. Other anionic types, such as ammonium salts of strong organic acids, thermally decompose and, consequently, no longer affect water sensitivity of the film. Additionally, the ammonium salts of organic acids are well known active catalysts and have been employed for years in the curing of melamine resins, particularly in the areas of permanent-press type fabrics.7

After consideration of these factors and the extensive evaluation of anionic emulsifiers, Alipal® CO-436 (GAF Corp.), the ammonium salt of sulfated nonylphenoxy poly(ethyleneoxy) ethanol, was selected because of its efficiency and decomposition characteristics. Alipal CO-436 decomposes at approximately 195°F (90°C), releasing sufficient sulfonic acid to convert an applied film. *Figure* 1 is a differential thermal analysis (DTA) curve illustrating the thermal decomposition of the emulsifier. Functioning in this manner, the emulsifier Alipal CO-436 serves as a blocked catalyst, allowing cure temperatures below 250°F (125°C). Since the emulsifier is destroyed during bake, no water sensitive residue remains in the final film.

EMULSIFICATION PROCEDURE

The emulsification of the formulation shown in *Table* 1 involved a three-step process. A premix of the cellulose ester (CAB-551-0.01), xylene, and hexamethoxymethyl

melamine was prepared at a ratio of 25/25/50, respectively. The cellulose acetate butyrate (CAB) and xylene were combined and heated to approximately 215° F (103°C) under agitation until uniformity was obtained. Heat was removed and the melamine added, with stirring continuing until a clear solution was obtained.

In the preparation of polymer solutions, vapors of the organic solvents used represent a potential fire, explosion, or health hazard. The general precautions mentioned in the Flammable and Combustible Liquids Code, NFPA No. 30, should be followed.

Making a cellulose ester slurry in a nonpolar hydrocarbon such as xylene, mentioned in the first step of this procedure, may result in static electricity buildup, which is a possible cause of flash fires. This risk can be reduced by the use of conductive solvents in combination with the hydrocarbon or by the addition of small amounts (5 to 10 ppm) of an anti-static additive. In addition, it is advisable to supply an inert atmosphere over the mix tank when possible.

When a complete solution of CAB/xylene/melamine was obtained, addition of the acrylic resin, emulsifier, and neutralizing amine was made and the resultant formulation cooled to room temperature. The final step of emulsification was accomplished by the slow addition of water with sufficient agitation to maintain a vortex in the mix tank. It is important that the water be added slowly during initial emulsification. After approximately one-fourth of the water has been added, the addition rate may be increased.

PIGMENTATION

Since the formulation shown in Table 1 is essentially a conventional organic system formulated at relatively high solids (65% by wt), conventional pigmenting techniques can be employed. Solid colors were prepared by ball milling the pigment with the acrylic resin. Difficult to disperse pigments, such as carbon black and transparent iron oxide, were dispersed in the cellulose acetate butyrate via two-roll milling operations to form pigment chips. Although solid colors were also prepared in this manner, ease of solution and emulsion stability were vastly improved if ball milling procedures were used. Small quantities of cellulose acetate butyrate pigment chips required for tinting purposes posed no problem in these areas. For metallic systems, pigmentation was accomplished by taking a small portion of the final emulsion and the desired amount of aluminum flake and forming a slurry which was then added to the formulation.

APPLICATION AND ACCELERATED WEATHERING RESULTS

After the emulsification of the formulation was complete, no further reduction was necessary. The emulsion was spray-applied with conventional air atomization, using either suction or pressure feed equipment. Air atomization is suggested since the high velocity air encountered at the spray head physically removes a large portion of the water from the emulsion prior to contact with the substrate. When pressure atomization was employed, much more water was present in the coated surface, thus creating some difficulty in developing the desired film build per application without encountering sagging problems.

Due to relatively low levels of water present in the applied coating when air atomization was employed and because of the rapid water release characteristics of the formulation, problems related to relative humidity were minimized. Application properties were evaluated with relative humidity ranging from 20 to 80% with no significant problems occurring. After application, a twostage bake was used, consisting of a 15-min low temperature bake at 140°F (60°C) followed by a 15 to 20 min bake at 220 to 240° F (105 to 115° C). Coatings formulated, applied, and baked as described exhibited 20° gloss values of 80 to 85 for both solid and metallic pigmented systems. For accelerated weathering tests, a blue metallic formulation was applied to an epoxy-ester primed steel panel and cured in accordance with the previously described cure schedule. For comparison, a similarly pigmented automotive quality nonaqueous dispersion (NAD) enamel and a thermoplastic lacquer were used. The panels were exposed for 1,000 hr in a QUV cyclic weathering device with a cycle consisting of 16 hr ultraviolet light at 155°F (68°C) followed by 8 hr unlighted condensing humidity at 110°F (43°C). Results of this test are shown in Figure 2 with the emulsion coating formulation retaining 59% of the original 20° gloss compared to 36 and 29% for the lacquer and NAD, respectively.

Silver metallic formulations have also shown excellent resistance to humidity with no discoloration or loss of gloss following 48 hr exposure to condensing humidity at 140°F (60°C), substantiating the theory that water sensitive emulsifying agents were no longer present in the film.

SUMMARY

Emulsion coatings have been prepared using conventional thermosetting acrylic resins, melamine resins, and modifying resins, such as cellulose acetate butyrate. Resin and solvent selection were found to be important considerations for development of stable systems. When choosing the acrylic resin, it is important to select one with an acid number between 30 and 35 and with a narrow molecular weight distribution. Preferably, the melamine resins should be supplied at 100% solids and be hydrophobic in nature, such as hexamethoxymethyl melamine. Cellulose acetate butyrate was incorporated in the formulation to improve film leveling and to aid in solvent release.

Solvent selection is important in that the solvent system must be essentially water-immiscible in order to maintain stability of the emulsion. For neutralization prior to emulsification, a combination of ammonia and morpholine offers high efficiency and is easily removed from the film during baking. The emulsifying agent chosen in this study was Alipal CO-436 which is efficient and which also served as a blocked catalyst, decomposing at approximately 195°F (90°C) to release a sufficient

THERMOSETTING ACRYLIC/MELAMINE COATINGS



quantity of sulfonic to effect cure of the film below 250° F (125° C).

Preparation of an emulsion coating was accomplished by preparing a solution of xylene, cellulose acetate butyrate, and hexamethoxymethyl melamine; combining this with the acrylic resin and additives; and finally emulsifying the high solids organic solution (65% by wt) at room temperature by the addition of water.

Pigmentation of the emulsion formulation was accomplished by a conventional method, either ball milling or sand milling the pigments with the acrylic resin. Metallic pigments were added by the preparation of aluminum flake slurries in a portion of the final emulsion. For tinting purposes, difficult to disperse pigments, such as iron oxide, carbon black, and organic pigments, were prepared by two-roll milling in cellulose acetate butyrate and were dissolved in xylene/melamine/CAB premix.

The emulsion formulation has exhibited excellent handling and application characteristics, being applied at relative humidities ranging from 20 to 80% with no problems being encountered even at dry film thicknesses of 5 mils. Curing of the applied film was accomplished in two stages, involving a 15 min bake at 140°F (60°C) and a final bake at 220-240°F (105-115°C). Resultant films exhibited original 20° gloss values of 80 to 85 and retained nearly 60% of the original gloss after 1000 hr accelerated weathering.

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SPECTRUM '79

Film Erosion Studies **Of Silicone-Modified Copolymer Paints**

William A. Finzel Dow Corning Corporation*

The ability of a paint film to withstand weathering is related to its resistance to several environmental factors including sunlight, moisture, and chemicals. These environmental effects can cause paints to fail in a variety of ways. However, film erosion, which can be measured by decrease in film thickness and by weight loss, is useful in precisely quantifying the degree of deterioration of the protective film.

The film erosion of two silicone-modified coating systems, and similar all-organic control coatings, were evaluated after periodic exposure in the Dew Cycle Weather-Ometer®. Both weight loss and decrease in film thickness were found to be acceptable for determining film erosion rates.

Coatings containing silicones had lower film erosion rates than the control coatings, and these rates were inversely proportional to the silicone content.

INTRODUCTION

Protective coatings containing 20% or more silicone possess improved weatherability over similar coatings without silicone. Unless the coating fails by cracking, flaking, or peeling, the ultimate failure will be film erosion until the substrate becomes visible.

Silicone-modified alkyd copolymers have been commercially available to the coatings industry for 25 years. Early work reported by Hedlund¹ indicated their potential. Modification of alkyd resins with silicone reactive intermediates was reported by Brady, Johnson, and Lyons² in detail, and formulations and procedures as well as the properties of silicone-modified alkyd copolymers were described. A second paper by Brady³ noted that the chemical reaction of intermediates with organic resins yields superior products compared to the cold blending of resins.

Several papers⁴⁻⁷ discussed the use of silicone-modified alkyd copolymers in maintenance paints. The concept of total paint protection cost was presented by Byrd.⁸ He showed that the least expensive aspect of most painting programs is the paint itself, and also that siliconemodified alkyds are less costly over the long term.

Examples of silicone-modified alkyd paint usage were reported in articles describing applications involving corrosive salt atmosphere9 and long-life decorative finishes.¹⁰ In both examples, the long life of the siliconemodified paint should result in lower paint program costs.

Silicone-modified saturated polyester (oil-free alkyd) copolymers have become popular in the coil coating industry, where long-term weatherability is required. The silicone component of the coating-in theory-protects the organic portion of the coating vehicle or binder from degredation, thus improving gloss retention and chalk resistant and minimizing color change. The degree of protection is dependent primarily on silicone content. The use of these copolymers in coil coating is described by Cahill¹¹ and Benesch.¹²

Silicone and silicone-modified organic resins often require a five-year minimum of 45° Florida exposure before chalking or visible surface erosion is observed. Therefore, accelerated weathering devices are mandatory in selecting silicone formulations. The Dew Cycle method described by Stieg¹³ proved ideal for the rapid evaluation of coatings based on silicone-modified resins. Standard exposure times vary from 500 to 1,000 hours with up to 3,000 exposure hours on occasion. To achieve some degree of degradation in an XW Filtered Sunshine Weather-Ometer® for the same silicone modified coatings, 10,000 hours exposure would be necessary. The accelerated results given in previously mentioned papers^{7,11,12} were generated from Dew Cycle exposures.

The Northwestern Society for Paint Technology^{14,15} evaluated silicone-modified coating systems with the

Presented at the 14th Western Coatings Societies Symposium in San Francisco, Feb. 28-Mar. 2, 1979. *Technical Service and Development, Midland, Mich. 48640.

Weather-Ometer is a registered trademark of Atlas Electric Devices Co.

Table	1-S	vstems	Eval	uated

SERIES I - MAINTENANCE PAINTS
Soya Oil Alkyd
30% Silicone Alkyd (DC Z-6018)
SERIES II—COIL COATINGS
Saturated Polyester
30% Silicone Polyester (DC 3037)
50% Silicone Polyester (DC 3037)
30% Silicone Polyester (DC Z-6188)
50% Silicone Polyester (DC Z-6188)

Dew Cycle method in an attempt to correlate accelerated testing with actual outdoor weathering. Coatings based on alkyds and silicone-modified alkyds exposed to the Dew Cycle were reported by Vanderheiden in pigment evaluation studies.¹⁶ Seven silicone-modified copolymer and cold-blended resin systems were studied by the Dew Cycle method,¹⁷ and the data was compared with Florida results. A fixed ratio of hours in the Weather-Ometer to years in Florida could not be determined in this study.

The subject of paint film erosion and erosion rate has been studied to a limited extent. Boers¹⁸ evaluated pigment films on glass for weight loss. He indicated that erosion rate measurements could be quantitatively used for studying film degradation.

The erosion rates of several titanium dioxide pigments were studied by Evans and Murley.¹⁹ These tests showed reduced erosion with treated titanium dioxide.

Berg, Jeroz, and Salathe²⁰ compared the rate of erosion of a variety of coatings, both outdoors and in accelerated weathering devices. Color and gloss retention correlation was reported to be good, although the more durable coatings required long exposure times for meaningful data.

Bullett²¹ reported in his paper on paint durability that accelerated weathering tests for weight loss may be preferred over outdoor weathering because of seasonal variations in the latter. Ritler²² concluded that erosion studies do not necessarily correlate with paint chalking or gloss retention. Erosion measurements, however, were thought useful in evaluating a paint ingredient, such as vehicle or pigment.

The purpose of my work was to (1) document-with the use of the "Dew Cycle" Weather-Ometer-improved protection of silicone-modified copolymers over similar organic systems via film erosion rate; (2) compare film erosion data obtained by weight loss and film thickness; and (3) determine the effectiveness of a new silicone intermediate (Dow Corning® 3037) compared to an existing silicone intermediate (Dow Corning® Z-6188).

TEST PROCEDURES

Two series of panels (Table 1) were exposed in the Dew Cycle WOM. Pigmentation, properties, and cure of the coatings are given in the Appendix.

The paints were ball-milled for 16 hr followed by a reduction in viscosity to 30 sec on a Zahn #4 Cup with naphtha mineral spirits for the maintenance paints, and ethylene glycol monoethyl ether acetate for the coil coatings. The paints were applied to 25-mil alodine aluminum panels (Q Panel Company, AL39), with a 6-mil clearance drawdown bar.

The Dew Cycle tests were run in an Atlas XWR Weather-Ometer. The two-hour exposure cycle described in the National Coil Coaters Bulletin No. III was followed. An arc cycle of one hour at 150° F (65° C) black panel temperature and 50% relative humidity was followed by a dark cycle at 85° F (30° C) ambient temperature, 100% relative humidity, and a 50°F (10°C) water spray to the backs of the panels. The panels were inverted every 50 light hours.

The panels were removed from the Weather-Ometer for periodic inspection. They were held under room temperature tap water and lightly rinsed with cheese cloth to remove dirt and loose chalk. The panels were allowed to dry for at least four hours before evaluation.

Weight Loss

The panels were weighed to four decimal places on a Mettler® analytical balance. The initial weight of the coating was obtained by removing the paint from the

> **Table 3—Series I Maintenance Paints** Film Erosion by Film Thickness

> > 1900

1.17

0.17

12.7

0.77

0 24

23.8

2500

1.13

0.21

15.7

0.66

0.35

34.7

3300

1.11

0.23

17.2

0.61

0.40

39.6

4300

1.06

0.28

20.9

0.51

0.50

49.5

1300

1.21

0.13

9.7

0.86

0 15

14.9

Total Hours

Mils Loss

% Loss

Film

Mils

(mils)

Loss

% Loss

0

1.34

30% Silicone Alkyd Film wt. (gms)

Alkyd (No silicone)

1.01

570

1.21

0.13

9.7

0.93

0.08

7.9

Table 2—Series I Maintenance Paints Film Erosion by Weight Loss								
Total Hours	0	570	1300	1900	2500	3300	4300	
30% Sili	cone All	kyd						
Film wt.		•						
(gms)	0.5922	0.5339	0.5150	0.5015	0.4988	0.4859	0.4719	
Film wt.								
loss	-	0.0583	0.0772	0.0907	0.0934	0.1063	0.1203	
% Wt.								
loss	_	9.9	13.0	15.3	15.8	18.0	20.3	
Alkyd (n	o silico	ne)						
Film wt.								
(gms)	0.5247	0.4413	0.3945	0.3571	0.3310	0.2874	0.2414	
Film wt.								
loss	_	0.0834	0.1302	0.1676	0.1937	0.2373	0.2833	
% Wt.								
loss	_	15.9	24.8	31.9	36.9	45.2	54.0	

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SILICONE-MODIFIED COPOLYMER PAINTS



Figure 1-Film erosion by weight loss in maintenance paints







Figure 2—Film erosion by film thickness in maintenance paints



Figure 3—Correlation of weight loss and film thickness data for maintenance paints



Figure 5—Film erosion by film thickness in coil coatings



Figure 6—Correlation of weight loss and film thickness data for coil coatings (DC 3037)

W.A. FINZEL

Total Hours	0	500	1000	1500	2000	3000	4000
50% Sili	cone Po	lyester (l	DC-3037)	U.			
Film wt.							
(gms) Film wt.	0.7218	0.6828	0.6697	0.6578	0.6457	0.6269	0.6076
loss		0.0390	0.0521	0.0640	0.0761	0.0949	0.1142
% wt.							
loss	-	5.4	7.2	8.9	10.5	13.1	15.8
30% Sili	cone Po	lyester ()	DC-3037)				
Film wt.							
(gms)	0.6386	0.6009	0.5805	0.5732	0.5478	0.5246	0.5020
Film wt.							
loss		0.0377	0.0581	0.0654	0.0908	0.1140	0.1366
% wt.							
loss	_	5.9	9.1	10.2	14.2	17.9	21.4
Polyeste	r (no sili	icone)					
Film wt.							
(gms)	0.8306	0.7764	0.7457	0.7118	0.6659	0.5864	0.5088
Film wt.							
loss	_	0.0542	0.0849	0.1188	0.1647	0.2442	0.3218
% wt.							
loss	_	6.5	10.2	14.3	19.8	29.4	38.7

Table 4—Series II Coil Coatings Film Erosion by Weight Loss

panels with solvents after the test was completed, and subtracting the weight of the uncoated panels.

Film Thickness

Each panel was measured in three locations (2, 4, and 6 in. from the bottom of the panel). The instrument used was a Permascope® Type EC-8Ty (Range I). The three measurements were averaged to obtain the single value reported.

Table 5—Series	II Coil Coatings Fi	m Erosion by	Film Thickness
----------------	---------------------	--------------	----------------

Total							
Hours	0	500	1000	1500	2000	3000	4000
50% Silic	one Po	lyester (I	DC-3037)				
Film							
(mils)	1.22	1.07	1.05	1.07	1.05	1.05	1.04
Mils							
Loss	-	0.15	0.17	0.15	0.17	0.17	0.18
% Loss	_	12.3	13.9	12.3	13.9	13.9	14.8
30% Silic	one Po	lyester (I	DC-3037)				
Film		-					
(mils)	1.06	0.91	0.83	0.87	0.84	0.82	0.80
Mils							
Loss		0.15	0.23	0.19	0.22	0.24	0.26
% Loss	-	14.1	21.7	17.9	20.8	22.6	24.5
Polyester	(no sil	icone)					
Film	•						
(mils)	1.42	1.23	1.18	1.17	1.08	0.98	0.83
Mils							
Loss	_	0.19	0.24	0.25	0.34	0.44	0.59
% Loss	_	13.4	16.9	17.6	23.9	31.0	41.5

Total							
Hours	0	500	1000	1500	2000	3000	4000
50% Sili	cone Po	lyester (l	DC Z-618	8)			
Film wt.							
(gms) Film wt.	0.6054	0.5773	0.5672	0.5561	0.5468	0.5284	0.5101
loss	_	0.0281	0.0382	0.0493	0.0586	0.0770	0.0953
% wt.							
loss	—	4.6	6.3	8.1	9.6	12.7	15.7
30% Sili	cone Po	lyester (l	DC Z-618	8)			
Film wt.							
(gms)	0.6043	0.5710	0.5539	0.5329	0.5118	0.4832	0.4579
Film wt.							
loss	_	0.0333	0.0504	0.0714	0.0925	0.1211	0.1464
% wt.							
loss	_	5.5	8.3	11.8	15.3	20.0	24.2
Polyeste	r (No sil	icone)					
Film wt.							
(gms)	0.8306	0.7764	0.7457	0.7118	0.6659	0.5864	0.5088
Film wt.							
loss		0.0542	0.0849	0.1188	0.1647	0.2442	0.3218
% wt.							
loss	-	6.5	10.2	14.3	19.8	29.4	38.7

DISCUSSION OF RESULTS

Data for the two series of coatings is shown in *Tables 2* through 6. *Figures 1* through 11 that follow are based on the tabular data. Paint formulations, properties, and other information concerning the coatings are given in the Appendix.

Series I—Maintenance Paints

The two coating systems in this study were a commercially available soya oil alkyd resin and a siliconemodified soya oil alkyd. The silicone used was Dow Corning Z-6018 intermediate and the silicone content was 30% based on total resin solids. The two panels were exposed for a total of 4300 hr.

Weight loss results are given in *Table 2. Figure 1* provides a graphic display of this data. The siliconemodified alkyd displays a sharp initial rate of film weight loss followed by a more gradual loss with additional exposure. The alkyd film has a much higher rate of loss throughout, reaching 54% at the end of the exposure period.

Film erosion results are shown in *Table 3* and *Figure 2*. Although the first measurement—after 570 hr—shows a greater silicone-alkyd film thickness loss, later measurements indicate the reverse. The weight loss and film thickness data combined in *Figure 3* demonstrates good correlation, especially for the silicone-alkyd coating.

Series II—Coil Coatings

Three coating systems consisting of five different resins were exposed for a total of 4000 hours. Included were a commercially available saturated polyester designed for coil coating applications, two 30% silicone-modified





Figure 7—Film erosion by weight loss in silicone-polyester coil coatings

saturated polyester copolymers, and two 50% siliconemodified saturated polyester copolymers. The silicones used were Dow Corning 3037 and Dow Corning Z-6188 intermediates.

Weight loss data for the control coating and the copolymer coatings compounded with 3037 intermediate are found in *Table* 4. Curves based on this data are shown in *Figure* 4. Improvement in weight loss is approximately proportional to silicone content.

Film thickness data based on the same coating are found in *Table 5* and *Figure 5*. Both the control and 30% silicone-polyester show abnormal values at 1,500 hr. The erosion rate for the 50\% silicone-polyester was found to be very low.

Weight loss and film thickness data are combined in *Figure* 6. Test correlation is best at longer exposures.

The data for the silicone-polyesters containing Z-6188, and the same data for the control polyester, are found in *Table* 6 and *Figure* 7 for weight loss, and *Table* 7 and *Figure* 8 for film thickness.



Figure 8—Film erosion by film thickness in silicone-polyester coil coatings



Figure 9—Correlation of weight loss and film thickness data for silicone-copolymer and control coil coatings

Weight loss and film thickness data for Z-6188 silicone-copolymers and control are combined in *Figure* 9. Test correlation is similar to 3037 silicone-copolymer data.

Film erosion data for Z-6188 silicone-polyester by weight loss are similar to that for 3037 silicone-polyester (*Figure* 10). The 3037 silicone-polyester had slightly less film erosion by weight loss at 30% silicone content. At 50% concentration, the values were almost identical for both silicone-polyesters.

Film erosion data by film thickness were somewhat erratic up to 1,500 exposure hours. Film erosion data for the five resin systems measured by film thickness are shown in *Figure* 11.

Although the film loss rate is higher initially when gauged by film thickness compared to film erosion by weight loss (*Figure* 10), the trend is similar after 2,000 hr exposure. At the end of the exposure, the Z-6188 silicone-polyester had somewhat less film thickness loss. The reverse was found with the 50% silicone-polyester coatings.



Figure 10—Film erosion by weight loss in silicone-polyester coll coatings (Z-6188)



Figure 11-Film erosion by film thickness for five resin systems

SUMMARY

Silicone-modified copolymer paints were found to have lower film erosion rates when compared to commercially available organic paints during exposure in the Dew Cycle Weather-Ometer. Film erosion is related to the weatherability and substrate protection. Silicone and silicone-modified paints should protect substrates for long periods thus permitting longer paint cycles, raw material and energy conservation, and lowering air pollution.

Film erosion tests gauged by film weight loss and film thickness decrease were found satisfactory. The weight loss method was somewhat more stable and possibly less prone to errors, such as brought about by film irregularities. The film thickness method requires a precision instrument and certainty that the same location on the film is tested each time. Several spots on the test coating should be evaluated.

Table 7—Series II Coil Coatings Film Erosion by Film Thickness

Hours	0	500	1000	1500	2000	3000	4000
50% Silic	one Po	lyester (I	DC Z-618	(8)			
Film							
(mils)	0.92	0.81	0.78	0.81	0.80	0.79	0.75
Mils							
loss		0.11	0.14	0.11	0.12	0.13	0.17
% loss	—	12.0	15.2	12.0	13.0	14.1	18.5
30% Silic	one Po	lyester (L	OC Z-618	8)			
Film							
(mils)	1.10	0.98	0.92	0.94	0.89	0.88	0.85
Mils							
loss		0.12	0.18	0.16	0.21	0.22	0.25
% loss	—	10.9	16.4	14.5	19.1	20.0	22.7
Polyester	(No sil	licone)					
Film							
(mils)	1.42	1.23	1.18	1.17	1.08	0.98	0.83
Mils							
Loss	_	0.19	0.24	0.25	0.34	0.44	0.59
% Loss	—	13.4	16.9	17.6	23.9	31.0	41.5

Little difference exists between the two intermediates designed for silicone-modified polyesters and coil coatings. Their film erosion rates are largely proportional to the silicone contents of the paint films.

Although one purpose of the study was to compare commercially available organic vehicles with typical silicone-modified organic vehicles, some variables were different and could affect film erosion rate. The organic vehicle compositions were unknown but designed specifically for either maintenance paints or coil coatings. The maintenance paint formulation was the same for each paint. The coil coating aminoplast type and content as well as cure were designed to achieve optimum properties as suggested by the supplier.

Field test applications have demonstrated the superiority of silicone-modified organic coating systems over the same generic organic coating systems as measured by gloss retention, chalk resistance, and color retention. Film erosion rate tests as described could be an additional tool in the continuing search for laboratory test methods that would help predict the relative exterior weatherability of coatings.

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APPENDIX

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SERIES I-PAINT FORMULATION

	Weight
TiO ₂ (R -960) ^a	. 20.1
Ramapo® Green (GP-755D) ^a	. 0.9
Yellow Iron Oxide (YLO-4088) ^b	. 2.1
Lampblack	. 0.1
Thixcin [®] R ^c	. 0.3
Resin (60%)	. 64.5
Naphthol spirits 66/3 ^d	. 9.8
PMO-30 ^e	. 0.6
Manganese naphthenate (5%)	. 0.2
Calcium naphthenate (5%)	. 0.4
Cobalt Octoate (6%)	. 0.4
Anti-skinning agent	. 0.1
Dow Corning® 11 paint additive ^f	. 0.5

	Copolymer	Organic
% Solids	62.2	62.2
Pigment/Binder	61/100	61/100
Viscosity (See #4 Zahn)	57	40
Lb/Gal	9.0	9.1
Cure	Air Drv-14	davs

SERIES II-PAINT FORMULATION

	Weight	
	Copolymer	Organic
TiO ₂ (R-960) ^a	19.0	19.8
Shepherd Blue #3 ⁸	4.8	4.9

Diatomaceous earth 7.6	7.9
Magnesium silicate 1.9	1.9
Copolymer (50%) 64.3	_
Organic (70%) —	42.8
Dowanol [®] EEA ^h —	17.0
Uformite [®] MM-83 ⁱ 2.1	_
Cymel [®] 301 ^j	5.3
1010 Catalyst ⁱ —	0.1
Dow Corning® 11 Paint Additive . 0.3	0.3
100.0	100.0
% Solids 67.1	69.8
Pigment/Binder 98/100	98/100
Viscosity (Sec #4 Zahn) 57	40
Lb/Gal 9.0	9.1
2007 75 Sec /	75 Sec /
50%-75 Sec./	500° F
Cure	500 1
50%-75 Sec./	

550°F

(a) E. I. duPont de Nemours & Co., Inc.
(b) Pfizer, Inc.
(c) Baker Castor Oil Co.
(d) American Mineral Spirits Co.
(e) Tray Chemical Corp.
(f) Dow Corning Corp.
(g) Shepherd Chemical Co.
(h) Dow Chemical Co.
(i) Rohm and Haas Co.
(j) American Cyanamid Co.

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SPECTRUM '79

Evaporation Behavior Of Organic Cosolvents In Water-Borne Formulations

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For binary solutions of a cosolvent and water, the concept of the "critical relative humidity" (CRH) was previously developed. At the CRH value, the water and the cosolvent both deplete from solution in the same relative ratio.

Equations used in the development of the CRH concept are shown to be mathematically equivalent to Fick's First Law of diffusion. The observed initial rates of evaporation of solvents and water are interpreted as diffusion through a stagnant or boundary layer of air above the surface of the evaporating liquid (or coating). The thickness of this stagnant layer, and, thus, the observed evaporation rate, depend not only on the velocity of the air moving over the surface of the liquid but also on the geometry of the sample.

From well known diffusion equations for "desorption" experiments and appropriate literature data for the diffusion of water in polymers, the controlling step in the initial drying stage is shown to be diffusion through a "boundary" or "stagnant" layer above the surface of the solution.

INTRODUCTION

Stringent anti-pollution rules and rising prices of petroleum-based materials have spurred the coatings industry to look at water-based coatings as an alternative to existing solvent-based coatings technologies. A coating which is up to 80% water initially, appears to have many advantages. However, the relatively high surface tension, unusual solubility behavior, and variable, humiditydependent, evaporation rate of water create significant technical problems. Formulation of the water-based coating with the proper cosolvent (or cosolvent mixture) can surmount most of the problems encountered with water-based systems. Once the polymer (either water soluble or water dispersed) for the coating is chosen, the formulator must choose not only the proper cosolvent(s), but also the correct concentration.

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For a water soluble polymer, the cosolvent will help keep the polymer in solution as the drying process proceeds. For a latex type coating, the cosolvent will act as a fugitive plasticizer. This allows the discrete latex particles to coalesce into a continuous film, then, as the cosolvent evaporates completely, to form a rigid polymer barrier to protect the substrate.

In this work, some previous equations governing evaporation are reviewed and the quantitative drying process explored.

Basic Equations

In previous papers,^{1,2} the following equation was proposed for the rate of loss of a given component by evaporation:

$$\frac{\mathrm{d}W_{i}}{\mathrm{d}t} = \mathrm{AR}_{i}^{\mathrm{V},\mathrm{T}}\left(\gamma_{i}X_{i}-\rho_{i}\right) \tag{1}$$

where: i = refers to the component

- W_i = weight
 - t = time
 - A = vapor/liquid interfacial area
 - $\mathbf{R}_i^{V,T}$ = rate of evaporation of pure i (ρ_i = 0), i.e. flux
 - γ_i = activity coefficient
 - X_i = mole fraction
 - ρ_i = relative vapor saturation
 - $(\rho H_2 O = \%$ relative humidity/100)

The temperature dependence of the rates of evaporation of the pure components is calculated according to the Gardner equation:

$$\mathbf{R}_{i}^{\mathbf{V},\mathrm{T}} = \mathbf{K}_{i}^{\mathbf{V}} \cdot \mathbf{T}^{1/2} \cdot \mathbf{P}_{i}^{\mathrm{T}}$$
(2)

where: K_i^v = mass transfer coefficient at wind velocity V

- T = absolute temperature
- P_i^T = vapor pressure of pure i

The wind speed dependence of the mass transfer coefficient is given by:

$$\mathbf{K}_{i}^{V} = \mathbf{K}_{i}^{O} + \frac{\mathbf{V}}{\alpha_{i}\mathbf{V} + \beta_{i}}$$
(3)

Presented at the 1979 Western Coatings Society Symposium, San Francisco, February 28-March 2, 1979.



Figure 1—Critical relative humidities of fast solvents (25°C, 0 mph) as a function of concentration

where: V = wind speed (mph)

 $\alpha_i, \beta_i =$ wind speed coefficients for the mass transfer coefficient

It was empirically found, for water and n-butyl acetate, that evaporation rate (25°C, water adjusted to 0% relative humidity) could be correlated to wind speed by:

$$\mathbf{R}_{i}^{V,25^{\circ}C} = \mathbf{R}_{i}^{O,25^{\circ}C} + \frac{V}{\mathbf{A}_{i}^{25^{\circ}C}V + \mathbf{B}_{i}^{25^{\circ}C}}$$
 (4)

where: A_i^T, B_i^T = wind speed coefficients for the rate.

These equations were used to investigate water/cosolvent evaporation and "wet" stage coating drying phenomena







Figure 3—Critical relative humidities of slow solvents (25°C, 0 mph) as a function of concentration

as a function of wind speed, relative humidity, and temperature. From that study, the concept of Critical Relative Humidity (CRH) evolved.

Critical Relative Humidity

The importance of humidity control in the drying of water-borne formulations is well known. Changes in relative humidity can change the rate of drying, as well as the composition of the "tail" volatiles remaining in the film.

To address this important consideration, the concept (CRH) was conceived.¹ CRH is defined as that relative humidity necessary to allow the drying to occur so that the concentration of organic cosolvent in water remains unchanged throughout the drying process. When the drying air is drier than the CRH, water flashes off faster to leave a cosolvent-enriched "tail". Conversely, if the drying air is wetter than the CRH, the contained cosolvent flashes off in preference to water.

For practical convenience, one can consider three groups of cosolvents having low, intermediate, and high CRH values, as illustrated by the following examples:

GROUP I	CRH (at 20 vol. %)
Methyl Ethyl Ketone Isopropanol	
GROUP II Propoxypropanol (Propasol® P) Butoxyethanol (Butyl Cellosolve®)	25% 74%
GROUP III Ethoxyethoxyethanol (Carbitol® Solvent)	93%

Under the usual conditions of drying, cosolvents in Group I flash off quickly to leave a water enriched "tail".

Propasol, Cellosolve, and Carbitol are registered trademarks of Union Carbide Corp.

Conversely, Group III cosolvents remain as "tail" solvents and function as coalescing aids. Cosolvents in Group II can function either way depending upon drying conditions. As reported previously, the CRH of a cosolvent depends upon concentration and drying air velocity.¹

Figures 1, 2, and 3 depict the Critical Relative Humidities for fast, intermediate, and slow evaporators, respectively.

In this study, physical factors such as size and shape of the container which affect water and cosolvent absolute evaporation rates will be discussed. These observations will be considered in terms of "boundary layer" or "stagnant air" effects. Some preliminary observations will be discussed in terms of diffusion controlled or "dry stage" evaporations.

EXPERIMENTAL

Evaporation experiments were conducted in a miniature plexiglass wind tunnel.¹⁻² The previous design was further modified by replacing the 6" long by $\frac{1}{4}$ " diameter straws with two bunches of 4.3" by 0.12" diameter straws (*Figure* 4). This modification appeared to further reduce velocity gradients over the diameter of the plexiglass tube. Effective wind velocity was measured approximately $\frac{1}{4}$ " above the sample with an Alnor Thermo Anemometer wind speed indicator. Wind speed was controlled by a variac connected to the wind tunnel fan.

Weight changes during the evaporation experiments were continuously monitored with an electronic, digital top loading balance. The analog signal from the balance was fed to a chart recorder. A D.C. "bucking" voltage was combined with the output of the balance to effectively null the D.C. signal voltage generated by the sample holder. Sensitivity was 30.65 millivolts/gm, with a maximum total load of 160 gm. This apparatus was used to measure evaporation for both flat draw-down samples and from various containers. Relative humidity was measured with a Bacharach Instrument Co. humidity gauge. Laboratory temperature was $24 \pm 1^{\circ}$ C.

Relative Evaporation Rates

In the coatings industry, the rate of evaporation of a pure solvent is usually expressed in terms of a relative evaporation rate (RER) of the solvent compared to that of a standard, often n-butylacetate. The rate of the standard is defined^{3,4} as either 100 or 1. Experimentally,



Figure 4—The wind tunnel apparatus used for these studies

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RER's can be determined in a special evaporometer apparatus⁵ or simply by measuring the time it takes for a constant weight to evaporate from a dish under specified conditions; for example, the time it takes 0.5 gm of a nonhydroscopic solvent to evaporate from a 28.8 cm² dish at 25°C and 50% relative humidity in an enclosed space.

Although the experimental conditions vary quite substantially from one experimental apparatus to another, the relative rates agree very well when the different techniques are compared. However, as is shown, the absolute rate of evaporation in gm/cm^2 sec can vary significantly from one experimental set to the next. More importantly, it is the absolute evaporation rate (or solvent flux) which more quantitatively determines the amount of solvent evaporated in a spray booth or the actual solvent load in an oven.

Absolute Rates, Flux Equations

The theoretical rate of evaporation (flux) of a solvent is often expressed by equation (5), which is Fick's First Law of diffusion.⁷⁻⁸

$$Flux = \frac{gm}{cm^2 sec} = D \frac{\Delta C}{\Delta x}$$
(5)

D = Vapor diffusion coefficient of the solvent.

$$\frac{\Delta C}{\Delta x}$$
 = Concentration gradient.

The vapor phase diffusion coefficient, D, may be calculated from empirical equations⁶ or measured experimentally.

It should be noted that equation (1) is another form of Fick's First Law. The quantity in equation (1) $dWi/A \cdot dt$, is simply the flux of solvent. Making this substitution, equation (1) becomes:

$$D \frac{\Delta C}{\Delta x} = R^{V,T} (\gamma_i X_i - \rho_i)$$
 (5a)

The mass transfer coefficient, R, is now seen to be defined by a diffusion coefficient, D, divided by a distance or

R.F. EATON and F.G. WILLEBOORDSE



Figure 5—Physical model for evaporation

thickness parameter, Δx . The latter parameter is considered to be a measure of the effective thickness of a stagnant air layer, or boundary layer, above the surface of the evaporating liquid. Thus, evaporation experiments can be used to calculate either an effective mass transfer coefficient, R, or the effective thickness of the boundary layer above the surface of the coating, Δx . Ultimately, either R or Δx is an adjustable parameter used to make the observed flux equal the concentration difference.

For diffusion of a solvent into air, the diffusion coefficient for the solvent can be calculated approximately using the following equation:

$$D_{s} = 0.0043 \frac{T^{3/2} \left(\frac{1}{M_{1}} + \frac{1}{M_{2}}\right)^{1/2}}{P \left(\overline{V_{1}}^{1/3} + \overline{V_{2}}^{1/3}\right)^{2}}$$
(6)

 $T = temperature \circ K$

M_i = molecular weight of air

V1 = molar volume of air

 M_2 = molecular weight of the solvent

 \overline{V}_2 = molar volume of solvent

P = total pressure

Alternatively, an experimentally determined diffusion coefficient can be used.

For water evaporating at 25°C and 0% relative humidity, the maximum theoretical rate of evaporation is $6.7 \times 10^{-6}/\Delta x \text{ gm/cm}^2 \text{ sec } (D = 0.26 \text{ cm}^2/\text{sec})$ where Δx is the thickness of the boundary layer in centimeters.



Cooling and contamination of the liquid surface can be significant factors affecting the net rate of evaporation.⁷ For a given liquid, the boundary layer thickness Δx above the surface directly affects the observed rate of evaporation (*Figure 5*), even in the presence of surface cooling and contamination.⁸

To investigate this "stagnant" or boundary layer effect, a series of evaporation experiments was run with cylindrical containers of different heights placed in the wind tunnel evaporometer. To eliminate humidity effects, acetone was used instead of water. The area of the sample was 28.8 cm²; 5.0 g of acetone was placed in the container. Only the evaporation for the first 0.1 g was used for the calculation of the evaporation rate. Heights of the container are the distances from the top of the container to the surface of the liquid. Figure 6 is a plot of apparent mass transfer coefficient (gm/m²min) vs. the height of the container in cm with no air circulation. As expected from equation (5), the apparent flux should decrease as the "stagnant" space above the liquid surface increases. The apparent thickness of the stagnant or boundary layer can be calculated from equation (5). Figure 7 is a plot of calculated boundary layer thickness vs. actual height of the container. For the taller containers, the apparent boundary layer thickness is approximately 65% of the actual height.

It was difficult to run the evaporation of acetone from a flat plate with this apparatus. However, evaporation data for drawdowns of latexes on a flat plate vs. the evaporation rate for a latex in a 1.68 cm high container indicates that water in the drawdown evaporated 5.6 times faster than water in the 1.68 cm high container (at the same relative humidity). For acetone, the evaporation rate for the 1.68 cm container is 29 gm/m² min. Thus, the estimated rate for the evaporation of acetone from a flat plate in the wind tunnel at 0 mph is $[5.6 \times 29] = 162$ gm/m² min. The apparent boundary layer height for a flat plate is then obtained from equation (5) and is 0.25 cm.

With no air circulation, the evaporation rate of a solvent (or water) can vary by a factor of 65 by going from a flat surface to a 7.6 cm high container.



Figure 7—Apparent boundary layer height vs container height

Effect of Wind Velocity

As previously shown, increasing the air circulation increases the rate of solvent evporation.¹⁻² The increase in evaporation rate with increased air flow is due to a decrease in the boundary layer thickness above the surface.⁹ Figure 8 is a plot of evaporative flux (gm/m^2 min) vs. wind speed for acetone evaporating from aluminum containers of various heights. As expected, evaporative flux increases with an increase in wind velocity or a decrease in container height. The effect of height appears to be most pronounced at the lower wind velocities.

Thus, the absolute rate of solvent evaporation can depend tremendously on the shape of the sample. From a practical standpoint, a cosolvent formulation which performs in a typical laboratory drawdown evaluation may be inadequate when used, for example, in an interior can coating.

Boundary Layer vs Diffusion Control of Evaporation

The coating drying process is very similar to a "desorption" experiment¹¹ which is often used to measure diffusion coefficients of gases and vapors in polymer films. Typically, a polymer film is suspended in a container from a quartz spring or electronic microbalance. The solvent vapor is then introduced and the polymer imbibes the vapor until either an equilibrium swelling is reached or the polymer dissolves. The source of solvent vapor is then removed and the sample is allowed to lose or "desorb" the solvent into either air or a vacuum. Although a diffusion coefficient can be measured for the sorption process, it is the desorption process which is analogous to



Figure 8—Acetone mass transfer rates vs wind velocity for different container heights

the drying of a coating. During the desorption experiment, the rate at which solvent leaves the swollen polymer is used to calculate the diffusion coefficient. Diffusion coefficients are often calculated from desorption data in two ways. (For drying of latexes, the situation is complicated by diffusion of water along channels around the latex particles which are not coalesced.¹²

Initial Rate Analysis

For desorption, equation (7) relates weight of the swollen polymer at time t, (W(t)), to the diffusion coefficient, D:

$$\frac{\mathbf{W}_{o} - \mathbf{W}(t)}{\mathbf{W}_{o} - \mathbf{W}_{\infty}} = \mathbf{4} \cdot \left(\frac{\mathbf{D} \cdot \mathbf{t}}{\pi \cdot \mathbf{L}^{2}}\right)^{1/2}$$
(7)

Wo = initial weight of swollen polymer

 W_{∞} = weight of "dry" or completely desorped sample

W(t) = total weight of swollen polymer at time t

- L = thickness of polymer film
- t = time

Thus, a plot of $(W_o - W(t))/W_o - W_\infty)$ vs. $t^{1/2}/L$ is a straight line with a slope of: $4(D/\pi)^{1/2}$ for values of $(W_o - W(t))/W_o - W_\infty$ up to 1/2. Although equation (7) is only strictly true for a diffusion coefficient which is independent of concentration, plots of $(W_o - W(t))/W_o - W_\infty)$ vs. $(t^{1/2}/L)$ may still be linear, even if the diffusion coefficient depends drastically on concentration. In this case, the diffusion coefficient is then understood to be an "average" diffusion coefficient, D.¹³

Late Time Diffusion Coefficients

For concentration independent diffusion coefficients at values of $(W_{\circ} - W(t))/W_{\circ} - W_{\infty}$) greater than 0.5, the following simplified equation is used to calculate diffusion coefficients for desorption experiments:

$$\log \frac{W_{\infty} - W(t)}{W_{\infty} - W_{0}} = (\log 8/\pi^{2}) - \pi^{2} D(\frac{t}{L^{2}})$$
(8)

Thus, a plot of log $(W_{\infty} - W(t)/W_{\infty} - W_{\circ})$ vs. t/L^2 is a straight line with a slope equal to $-(\pi^2 D)$. Even if D is concentration dependent, graphical plots of equation (8) near the end of the evaporation may still yield straight lines giving an "average" diffusion coefficient D.

Simplified Model for Drying

Equation (7) suggests that if \overline{D} is known or could be reasonably guessed, this equation could be used to compute the weight, W (t), of solvent (or water) remaining in the coating at least for values of $(W_o - W(t))/(W_o - W_\infty)$ up to 1/2. The value for thickness L used in equation (7) in a normal desorption experiment would be the thickness of the polymer film. For a coated panel, because of symmetry, the coating thickness X is 0.5 (L). Thus, the value of L in equation (8) is replaced with 2X. The coating on a panel is one half the thickness of an equivalent film, the values of W(t), W_o and W_∞ for the coating are also half of those found in a film. Investigation of equation (7) shows this factor of 1/2 cancels out and equation (9) results:

$$\frac{W_{o} - W(t)}{W_{o} - W_{\infty}} = \frac{4}{\pi 0.5} \left(\frac{Dt}{4X^{2}}\right)^{1/2}$$
(9)

The weight at any time is:

$$(W_{o} - W(t)) = \frac{2 \cdot (W_{o} - W_{\infty})}{X} \sqrt{\frac{Dt}{\pi}}$$
(10)

The rate of loss of the solvent due to diffusion during the desorption experiment can be calculated by dividing equation (10) by the actual area of the coating, A, and taking the derivative with respect to time.

D-Flux =
$$\frac{1}{A} \left[\frac{d}{dt} \qquad (W_o - Wt) \right]$$
 (11)

$$= \frac{-1}{A} \frac{(W_{\circ} - W_{\infty})}{X} - \sqrt{\frac{D}{\pi t}}$$
(12)

Similarly for equation (8):

D-Flux (late) =
$$\frac{2(W_{\infty} - W_{\circ})D}{AX^2} \exp \frac{-\pi^2 Dt}{4X^2}$$
 (13)

To simplify the mathematics, X is assumed to be constant.

Thus, in principle, an appropriate value for \overline{D} when substituted into equation (12) will yield the diffusive flux, the amount of solvent per unit time, per unit area, which the coating is capable of supplying to the surface during the drying process. The rate at which this amount of solvent can be removed from the surface depends on the boundary layer effects discussed previously (i.e., the evaporative flux). If the diffusive flux is greater than the evaporative flux, the slow step during drying is evaporation, and the net rate of evaporation is controlled by boundary layer and thermodynamic effects as expressed in equation (1), and in the subsequent discussion of wind speed effects. If the surface evaporation cannot remove the solvent from the wet coating as fast as diffusion would supply solvent to the surface, then the concentration distribution of solvent throughout the coating would be constantly rearranging to accommodate the apparent high level of solvent at the air/coating interface. The consequences of this will be discussed later.

At some critical volume fraction during the evaporation process, the diffusive flux will equal the evaporative flux. At later times, the rate of diffusion controls the rate of coating drying. Here, the diffusive flux is less than the calculated evaporative flux. The internal diffusion mechanism cannot supply solvent to the surface as fast as the evaporative mechanism might remove it. For a given shape of container, the evaporative flux of a solvent can be calculated from equation (1). To calculate the diffusive flux via equation (12), an estimate of the diffusion coefficient \overline{D} is needed.

Diffusion Coefficients and Free Volume Theory

In the previous discussion, it was necessary to have a value for the solvent (or water) diffusion coefficient to calculate the diffusive flux. Previous work¹⁴ on diffusion of water in hydrophilic polymers showed the diffusion coefficient for water in the polymer depended on the volume fraction of water in the polymer. Water could act as a solvent/plasticizer for the polymer. Thus, water would contribute an amount of "free volume" to the polymer/water system. The diffusion coefficient for the



Figure 9—Calculated sorption isotherm for water/PEG 400

water would depend on the size of the diffusion molecule and the "free volume" of the polymer solvent system. At constant temperature, the diffusion coefficient for water can be expressed using equation (14).

$$D = D_o \exp - V * \left(\frac{1}{V_f^o} - \frac{1}{V_f^o}\right)$$
(14)

- D = diffusion coefficient of water in the polymer
- D_o = self diffusion coefficient of water in water, 2.44 × 10⁻⁵ cm²/sec.
- V* = is related to the size of the diffusing (water) molecule
- V_f^o = is the total free volume of the solventpolymer system
- $V_{f,1}^{\circ}$ = is the free volume of pure water

The total free volume V_{f}^{c} is the sum of the free volume contributions from the polymer and water.

$$V_{f}^{\circ} = \phi_{1} V_{f,1}^{\circ} + \phi_{2} V_{f,2}^{\circ}$$
(15)

 ϕ_1 = water volume fraction

 ϕ_2 = polymer volume fraction ($\phi_1 + \phi_2 = 1$)

V_{f,1}° = free volume of pure water

 $V_{f,2}^{o}$ = free volume of pure polymer

Combining equations (14) and (15) and simplifying:

$$\ln D/D_{\circ} = \beta \gamma (1 - \alpha)/(1 + \alpha \gamma)$$
(16)

$$\gamma = (1 - \phi_{1})/\phi_{1}$$

$$\alpha = V_{f,2}^{\circ}/V_{f,2}^{\circ}$$

$$\beta = V \bullet / V_{f,1}^{\circ}$$

The values for α and β were found to be 0.5 and 4.5, respectively, for water in polymers. Although the free volume approach is simplistic,¹⁵ it provides a method to calculate the diffusion coefficient for water over the entire concentration range using essentially two parameters, α and β .

Indeed, this approach is not limited to water. Literature data¹⁰ for the diffusion of methanol, ethylene glycol monomethyl ether, chlorobenzene, and cyclohexane in poly(vinyl acetate) show diffusion coefficients whose dependence on concentration is similar to this data on





diffusion of water in various hydrophilic polymers. If the volume fraction of solvent is known, for a binary solvent/polymer solution, a value for the diffusion coefficient can be calculated with equation (16).

A series of evaporation studies was conducted in 1.91 cm \times 28.8 cm² containers. The model polymer was poly(ethylene oxide) glycol, PEG-400 (Carbowax 400®). This material is not normally used for coatings, but is a well characterized polymer. Five grams of a 40 weight % solids solution of PEG-400 in water was placed in the pan for evaporation studies (volume fraction solids is 0.38).

The *evaporative* flux of water can be calculated theoretically for equation (1). (The polymer is nonvolatile).

$$E flux = R^{v} (\gamma_{1} X_{1} - \rho)$$
(1)

 ρ = relative humidity/100

- γ₁ = activity coefficient of water
- $X_1 = mole fraction$
- R^v = apparent mass transfer rate value corrected for wind speed effects

The thermodynamic activity of water, a_w , in the polymer/water solution is $(\gamma_1 X_1)$. The quantity a_w may be calculated from Flory-Huggins polymer solution theory.¹⁷ (The Wilson Equation^{1,2} could also be used):

$$\ln(\mathbf{a}_{*}) = \ln\phi_{1} + (1\frac{1}{X})(1-\phi_{1}) + \chi_{12}(1-\phi_{1})^{2}$$
(17)

 ϕ_1 = volume fraction of H₂O

Carbowax is a registered trademark of Union Carbide Corp.

Table 1—Values used for Flux Calculation

D Initial	Volume	Fraction	D Final		
(cm ² /sec × 10 ⁶)	Initial	Final	(cm ² /sec × 10 ⁸)	%RH/100	
2.4	0.62	.24	4.8	0.65	
2.4	0.62	.21	3.3	0.6	
2.4	0.62	.12	0.77	0.4	



K = ratio of molar volumes of polymer to water

 χ_{12} = Flory-Huggins interaction parameter in this case χ_{12} is assumed to be 0.44⁽¹⁶⁾

(The quantity χ_{12} can also be calculated from solubility parameters but these χ values are not as accurate as an experimental χ_{12} value).¹⁸ Equation (17) can be used to calculate the equilibrium uptake (sorption isotherm) of water of PEG-400, *Figure* 9.

It should be pointed out that this simplified equation tacitly assumes that χ_{12} is a constant, independent of concentration. However, χ_{12} is often found to be concentration dependent.¹⁹

The diffusive flux may be calculated for the initial and final stages of evaporation from equations (12) and (13) respectively. W_{∞} may be calculated from Equation (17), knowing a_w , χ_{12} and X. ϕw final is read from Figure 9 for the relative humidity in which the experiments were carried out. The values used for the calculations are given in Table 1.

Equation (17) was used to calculate the apparent diffusive flux for the initial part of the drying process. Apparent evaporative fluxes were calculated via equation (1) using equation (17) to calculate water activities together with previously published¹ vlaues for the wind speed coefficients. Table 2 shows the apparent fluxes $(gm/m^2 min)$ for the initial stage of evaporation calculated from the equations.

Thus, diffusion⁴ could supply water to the surface, initially, at up to 288 gm/m² min. However, evaporation can only remove the water at the rates indicated. Thus

Table 2—Fluxes	s for	Initial	Stage	of	Evaporat	ion
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		Flux (g		
Wind Speed (mph)	ρ (R.H./100)	Diffusive (at 1 sec)	Evaporative	Experimental
0	.65	288	0.78	1.0
1.5	.60	263	4.2	3.7
3.0	.40	253	8.1	8.6
initial drying of these systems is evaporation limited. In reality, material does not accumulate at the polymer surface, the diffusive transport is limited by an "effective concentration" gradient at the surface. (See reference 9, p. 34 for a rigorous mathematical approach.)

If the initial phase of drying is limited by evaporation, then equation (1) should adequately account for the water loss. *Figures* 10 and 11 are plots of weight loss vs. time for the 0 and 3 mph experiments compared to the calculated curves. The fit of the predicted curve to the experimental curve is good. This was expected, given the success of previous work on predicting drying curves.^{1,2}

For 3/4'' high metal containers, the wind speed equation is in error for wind speeds less than 0.5 mph. Evaporative fluxes at 0 and 0.5 mph are approximately the same (*Figure* 6). The predicted curve for 0 mph has been adjusted for this anomaly.

Diffusion of Cosolvent From Latex Particles

Previous work²⁰ showed that organic cosolvents can function as coalescing aids, i.e., fugitive plasticizers, for latex based coatings. The relative effectiveness of the cosolvent as a coalescing aid depends, among other things, on how much cosolvent partitions into the polymer phase. The relative amount of cosolvent within the latex particle depends on the concentration of the cosolvent in the aqueous phase and the cosolvent partition coefficient.

During the drying process, the relative concentration of cosolvent in the aqueous phase will depend on its Critical Relative Humidity (CRH) value, wind speed and temperature. If the cosolvent is evaporated at its CRH, the concentration of cosolvent within the latex particle will not change during evaporation. If the relative humidity is less than the CRH the *relative* concentration of cosolvent in the aqueous phase will increase; thus, more cosolvent will partition into the latex phase. If the relative humidity is greater than the CRH, cosolvent in the aqueous phase will deplete due to evaporation. Thus, to maintain equilibrium, cosolvent in the latex particle will migrate into the aqueous phase.

The rate of migration (desorption) will depend on the diffusion coefficient of the cosolvent in the latex particle, the local concentration gradient created by the evaporation of cosolvent from the aqueous phase, and liquid/solid boundary layer resistance occurring at the particle/solution interface. Although estimates for diffusion controlled efflux of cosolvent from the latex particle can be made from existing data, ^{10,14} the magnitude of the boundary layer effect in an unstirred latex is difficult to quantitatively estimate. If liquid/solid boundary layer effects are negligible, preliminary calculations indicate that diffusion from the latex particle is not rate limiting.

CONCLUSIONS

Approximate values for both diffusive and evaporative fluxes during the "wet" and "dry" stages of film drying can be estimated from simple kinetic equations presented here and known equilibrium sorption properties of the coating polymer.

In the wet stage evaporation of a water-borne coating, the controlling step is diffusion through a static layer at the film/air interface. This boundary layer impedes net transport of vapor from the liquid to the surroundings. In the later part of the drying of a coating, diffusion through the coating is the rate determining step. Transport through the boundary layer is relatively rapid compared to diffusion through the coating.

Variables, such as the geometry of the container and the rate of air flow over the coating are, important factors in the evaporation process since they change the boundary layer.

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SPECTRUM'79

Viscosity Loss in Hydroxyethyl **Cellulose Thickened Latex Paints Caused by Chemical Oxidants:** Methods of Detection

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Cellulases and chemical oxidants have been reported to cause degradation of the cellulose ether thickeners in latex paints, leading to severe viscosity loss. A number of the methods previously suggested for determining the presence of chemical oxidant-type species in vinyl acrylic latexes and paints are examined to establish the usefulness of these approaches. Three methods, the Acrylamide Gel Test, the Hydroxyethyl Cellulose (HEC) Solution Test and the Oxidation Reduction Potential (ORP) Test, are critically discussed with special emphasis on the correlation of test results with the viscosity stability of the final paints. The ORP Test can be used as the best of the three tests to predict viscosity stability of the final paints. Generally, it was found that vinyl acrylic latexes with ORP values less than +250 mV, as determined by the method described, will yield paints whose final viscosity is stable. A need is expressed for individual case history documentation, due to wide variations in formulations.

INTRODUCTION

It has been shown that certain bacteria (e.g., pseudomonas) can attack the cellulosic thickeners in vinyl acrylic latex paints, possibly resulting in odor problems and loss of paint viscosity.^{1,2} In 1976, it was reported that another possible contributing factor to viscosity loss in HEC-thickened latex paints was chemical oxidants originating from the latex as excessive residual polymerization initiators.³ Three tests were suggested for detecting the presence of residual oxidant

in the latex; the Acrylamide Gel Test, the HEC Solution Test, and measurements of ORP. This paper presents a critical examination of these three methods of detection of chemical oxidants in latexes and HEC-thickened latex paints with a special emphasis on the correlation of test results with the final paint viscosity stability.

METHODOLOGY

Acrylamide Gel Test

The Acrylamide Gel Test was performed as follows: 10 ml of the emulsion sample was added to 50 ml of a 25% (w/w) aqueous acrylamide solution in an Erlenmeyer flask. This flask, under gentle agitation, was placed in a boiling water bath. Measurement of the time for the acrylamide monomer to polymerize (called the gel time, and due to presence of peroxidic initiator introduced by the emulsion) was taken to be indicative of the presence or absence of residual catalyst.

Hydroxyethyl Cellulose (HEC) Solution Test

The HEC Solution Test was performed as follows: a 2% (w/w) aqueous HEC (molecular substitution, M.S. = 2.5, viscosity type so that 1% solution ~2000 cps, Brookfield RVF, #4, 20 rpm) test solution was added to the emulsion to form a ratio of 80 parts emulsion:20 parts HEC solution. This material was thoroughly mixed and placed in a controlled, elevated temperature environment. After four days at 43.3°C, viscosity was measured and percent decrease calculated, relative to the viscosity of the original test solution. Severe viscosity loss was taken as an indication of the presence of chemical oxidants. The HEC test solution had been preserved with a mercury preservative to eliminate viscosity loss due to

Presented at the 1979 Western Coatings Societies Symposium, San Francisco, February 28-March 2, 1979.

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biological origins. Biological assay (plate counts) was not available due to lack of facilities.

Measurements of the Oxygen Reduction Potential (ORP) of Latex and Latex-Containing Paints

This procedure involves: immersing a certain electrode combination in a polymer latex, allowing a thermodynamic equilibrium to be reached, and reading a millivoltage on a standard pH meter.

APPARATUS AND REAGENTS: (Typical example of equipment and chemicals)

(1) pH meter capable of reading \pm 700 mV (minimum); similar to Fisher 13-637-15.

(2) Standard platinum reference electrode, similar to Fisher 13-639-115.

(3) Standard calomel reference electrode (with saturated KCl sleeve junction) similar to Fisher 13-639-52.

(4) pH Buffer, pH=4 (Phthalate Buffer), similar to Fisher SO-B-98.

(5) Quinhydrone, reagent grade, similar to Fisher 217.

(6) Deionized water.

(7) Nitric Acid, concentrated.

(8) KCl for saturated solution (filling solution).

Initial Treatment of ORP Electrodes

CALOMEL REFERENCE ELECTRODE: As received, this may be filled with visible (macroform) and invisible (microform) KCl crystals. These crystals *must* be removed prior to ORP determinations. Empty the saturated KCl solution from the electrode via the filling hole. Flush the Calomel electrode (internally) with copious quantities of deionized water to dissolve completely the macro (visible) KCl crystals. Fill the electrode with additional deionized water and immerse in a beaker of deionized water for about two days. This

should dissolve out the micro-sized KCl crystals which may be trapped in the ceramic porous plug. When ready to make ORP determinations, empty the deionized water from the Calomel electrode and fill with a saturated (~4M) KCl solution, leaving the filling sleeve down so that the electrode is vented to the atmosphere. When finished with a series of the determinations, the sleeve can be raised to cover the filling hole and retard evaporation of the filling solution. This cleaning procedure should not have to be repeated, unless evaporation of the KCl filling solutions leads to more visible (macro) KCl crystals. Since the thermodynamic equilibrium which needs to be established across the electrode pairs depends a great deal on a controlled, reproducible flow of electrode filling solution (with counter current ion flow) through the ultrafine pores at the tip of the electrode, it has been found that reproducible ORP readings are quite difficult to obtain with an even partially KCl crystal-clogged frit.

PLATINUM INDICATING ELECTRODE: As received, this electrode may have organic greases on the surface, and/or may have electrode potential distorting gases in the electrode. To counteract this, soak the platinum wire portion of the electrode in warm, 55°C, concentrated nitric acid for approximately 2 min, swirling the acid gently. Condition this newly cleaned electrode by soaking in a saturated KCl solution for about two days. During this conditioning period, electrode response may be erratic. Further conditioning may be required, and this may be accomplished by dipping the electrodes in a polymer latex followed by thorough washing with deionized water. When ready to make ORP determinations, rinse the electrode with deionized water and proceed with the remainder of the method. The drastic cleaning procedure may be repeated at intervals of approximately three weeks, or when electrode response becomes erratic, but conditioning of the acid-cleaned

		HEC			Paint Viscosity Stability (KU)		
Sample Description	Gel Test (Gel Time in sec)	Test (% Loss in Viscosity)	ORP- Latex (mV)	ORP- Paint (mV)	Initial	Aged 2 Weeks 52° C	Aged 1 Month 52° C
Control Latex							
(vinyl-acrylic)	155	34	+220	+65	94	96	97
Control plus 0.05% persulfate	148	93	+360	+65	94	93	93
Control plus 0.1% persulfate	122	92	+370	+65	94	91	89
Control plus 0.2% persulfate	116	95	+450	+80	90	86	83
Control plus 0.1% meta bisulfite	165	26	+185	+70	93	95	96
Control plus 0.1% persulfate	110	85	+140	+80	94	95	95
and 0.15% meta bisulfite							
Control plus 0.2% persulfate and 0.3% meta bisulfite	91	91	+150	+70	90	90	90
Control plus 0.1% MEHQ ^a	212	25	+205	+90	94	95	96
Control plus 0.1% TSPP ^b	355	30	+195	+80	94	96	97
Control plus pH = 5.0	185	32	+190	+80	94	95	95
Control plus pH = 7.5	900	36	+120	+70	92	94	95

Table 1—Test Results Correlated with Final Viscosity Stability

(a) Methyl Ether Hydroguinone

(b) Tetra Sodium Pyrophosphate

platinum electrode with a KCl solution need not be repeated.

Preparation of Saturated Quinhydrone Solution And Meter Standardization

(1) Place about 100 ml of pH=4 Buffer in a beaker.

(2) Add about 0.5g of quinhydrone, stir for 5 min until no more will dissolve. (This provides a saturated solution of quinhydrone, i.e., there should be excess quinhydrone floating on top of the liquid).

(3) Set up the pH meter to read 0 to +700 mV.

(4) Immerse the electrodes in the saturated quinhydrone solution and turn on the meter.

(5) Wait 3-5 min for the reading to stabilize, then read the meter. The value for this standardizing solution should be +210 mV. If it is not, adjust the standardization control to this value. (Some older pH meters cannot be adjusted. In this case, record the value determined on the standard and always report it with the sample data.)

(6) Record the reading; turn off meter.

(7) Remove electrodes and rinse clean with deionized water (several times).

The standardization solution should be prepared daily (or whenever a series of determination is to be run on a given day). The solution will deteriorate unpredictably with time. One standardization per day should be adequate, but the procedure may be repeated at the end of a series of samples to verify meter calibration stability. Drift from the established value of +210 mV is taken as an indication that the electrodes are in need of a cleaning procedure. All measurements should be made at a temperature which is as consistent as possible, preferably between $22-25^{\circ}$ C. This will help minimize possible electrode drift due to nonlinear temperature response of the electrode pair.

Actual Measurement of ORP on Emulsions

Immerse the clean, dry electrodes in the test sample and turn on meter. After waiting 5 min for the meter reading to stabilize, record the reading in mV (including sign of charge). Strive for a consistent time of reading. Although some drift of values may occur, especially with higher viscosity products, usually the 5 min delay period will allow attainment of equilibrium.

After the determination of ORP is made, switch off the meter, remove and discard the test sample, and immediately immerse the electrodes in a well agitated container of water until they are clean. Remove electrodes, rinse well with deionized water, and blot dry with soft tissues. Proceed with the next sample.

DISCUSSION OF RESULTS AND LIMITATIONS

Acrylamide Gel Test

A trend was observed between added chemical oxidant concentration and the time to failure in this test (gel time). However, there was no apparent relationship between gel time and final paint viscosity stability. This test is considered unreliable. The measurement of the actual point of gellation is a subjective determination, and extraneous materials, such as pH adjusters or dispersants, can alter the polymerization characteristics of the test solution of acrylamide monomer.

The Acrylamide Gel Test was run on samples of a vinyl acrylic latex, both neat and deliberately adulterated with various chemical compounds. Paints were then made from these latexes and the paint viscosity stability was monitored for more than one month, both at room temperature and in the accelerated aging environment, 52°C. The gel times, shown in Table 1, are the average of at least three separate measurements. As can be seen, post addition of persulfate, an oxidant, to the latex shortened the gel time. However, only at high levels of persulfate is any significant indication of paint viscosity instability seen. A post-added excess of metabisulfite, a reductant, did not significantly change the gel time, and no viscosity decrease in the final paint was seen. When combinations of oxidant/reductant were added to our control latex, gel times were reduced in a manner similar to oxidant addition only, yet no significant viscosity loss was seen upon accelerated aging. Additions of a known radical inhibitor (methyl ether of hydroquinone), a commonly used dispersant (tetrasodium pyrophosphate), or of sufficient base to raise the latex pH from 3.5 to 7.5, all yielded longer gel times than the control. Paints from all of these latexes were viscosity stable.

HEC Solution Test

No workable correlation has been established between amount of viscosity lost by a HEC Solution/latex blend and that lost by paint made with the latex. During investigation of the HEC Solution Test, some viscosity losses of ~90% were encountered, but paints made with these same latexes were stable. The only clear cut example of this test actually predicting paint viscosity loss was with a latex containing a deliberate post addition of 0.2% persulfate. This sample suffered a 95% viscosity loss during the HEC Solution Test and the final paint lost a significant amount of viscosity during accelerated aging.

Additions of excess reductant to the latex reduced the viscosity loss during the HEC Solution Test, and also provided viscosity stability to paint made from the sample. On the other hand, addition of both oxidant and reductant in the latex caused the HEC Solution Test to show 85–90% losses, but the paints made from these latexes were stable in viscosity.

As is evident from the data in *Table* 1, the HEC Solution Test is not a good method for predicting the final paint stability for a given latex. Not only is the test time consuming, requiring a minimum of four days to complete, but the test results are subject to interpretation errors (i.e., how much viscosity loss, compared to our standard, can be tolerated?)

Latex ORP Measurements

A general trend was observed in this work: ORP values in excess of +300 to +350 mV tended to produce paints with poor viscosity stability. This, however, was not completely clear, as the addition of a number of substances to the latex tended to shift the ORP, while not harming the final paint stability (*Table* 1).

Our work has shown that a latex with a high, positive ORP valve (in excess of +300 to +350 mV), due to the pressure of large concentrations of oxidizing species, will yield paints whose viscosity stability is poor. Latexes whose ORP is in the region of $\sim+50$ to $\sim+250$ mV have the greatest probability of being formulated into viscosity stable paints.

We have found that vinyl-acrylic latexes whose ORP (as received) is <-50 mV, generally, should not be a source of oxidative degradation for the HEC thickener species. However, bacteriological action may be present (yielding by-products which degrade HEC), resulting in viscosity loss in the final paints. Extremely high negative ORP values can signify gross microbiological contamination or the presence of large concentrations of strong reducing agents. Little possibility of oxidative degradation of HEC thickener can be expected here.

The latex ORP measurements are best performed on the raw latex, as received from the supplier, before any compounding ingredients are added to it. This data was gathered using one particular base resin in only one standard screening formulation typical of commercial flat interior paint formulas. The complex interaction of different latex types and differing formulation ingredients and techniques will need to be examined on an individual case-by-case basis to determine the accepted values to be expected.

Paint ORP Measurements

No correlation was found between the ORP of the latex and the ORP of the paint made from the latexes as seen in Table 1. This may be due to a dilution effect (the latex is used only to about 25% of the total paint) or, more likely, to the incorporation of various compounding ingredients in the paint. These materials, including bases, inert salts, buffers, dispersants (both simple salts and polymeric substances), etc., tend to mask the latex ORP. Another problem with making ORP measurements on paints is insuring that the electrode couple has reached equilibrium. Reaching equilibrium can take as long as 30 min for very viscous, or highly salt-modified paint formulations. A second serious drawback is that the ORP fluctuates widely during the first 24-36 hr after the paint has been made. After this equilibration period the measurements are reproducible. This may be due to insolubility of the compounding ingredients in the paint, and a "localization" of these ingredients around the electrodes. The equilibrium ORP values, however, do not correlate well with paint viscosity stability. This is taken as evidence of the very complex nature of ORP in systems of this type.

SUMMARY

A trend was observed between the concentration of chemical oxidants in the latex and the gel time during the Acrylamide Gel Test. However, no such relationship was apparent between gel time and final paint viscosity stability because too many of the common paint formulation ingredients either retarded or accelerated the polymerization of acrylamide monomer, the basis for this test. In addition, the end point (actual time that the solution sets to a gel) is a subjective (operator dependent) measurement, subject to wide variations.

No good correlation could be established between viscosity loss of the HEC-thickened latex in the HEC Solution Test and paint viscosity stability. Factors strongly affecting this method could be the presence of oxidant in the HEC Test Solution itself, either through contamination or *in situ* generation; biological attack of the thickener, even though supposedly preserved with a mercury compound; and/or thermal degradation of the thickener, perhaps theough chain scission. Again, operator subjectivity in determining just how much viscosity loss is acceptable becomes a problem.

In contrast, it has been found that ORP measurements on the latex (as received) can be used as a guideline to predict viscosity stability of the final paints. This method is rapid and reproducible. If a case history or data base of ORP is established for each type of latex used and for all aqueous paint ingredients, deviations from the norm will signal the need for closer investigation. By doing this, differences in manufacturing processes can be accommodated, yielding useful data about optimal ORP range (for each latex and formulation) vs final paint viscosity stability.

It was found that a vinyl acrylic latex (as received) whose ORP is in the range of +50 to +250 mV has the greatest likelihood of being formulated into a viscosity stable paint (provided that the possibility of a biological degradation of the HEC thickener is minimized or avoided).

ACKNOWLEDGMENTS

The authors gratefully acknowledge the paint formulation work and testing of H. H. Griffin and L. M. Scacciaferro, of the Coating Applications Group, Celanese Polymer Specialties Co., without whose help this project could not have been completed. We also wish to acknowledge the information provided in private communication by M. Goll, of Cosan Chemical Corp. and Dr. H. Winters, of Fairleigh Dickinson University.

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Effect of Catalyst Structure On the Properties of Coatings Crosslinked with Hexa (methoxymethyl) melamine

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A study was undertaken comparing several sulfonic acids of varying structure and hydrophobicity as catalysts for promoting the curing reaction between various binder resins and hexa (methoxymethyl)melamine. Dinonylnaphthalene disulfonic acid was found to be particularly effective for producing superior water and detergent resistance properties in such systems. Weight loss studies carried out with model compounds indicate that dinonylnaphthalene disulfonic acid produces less volatiles and may be a better catalyst than p-TSA for controlling self-condensation of hexa (methoxymethyl) melamine.

INTRODUCTION

Pressured on two fronts by reduced energy supplies and tighter anti-pollution regulations, the coatings industry must reformulate its products to meet both today's requirements and tomorrow's needs. Regulation and deregulation are two words which appear frequently in the paint formulators' handbook. Two emerging technologies, water-borne coatings and high solids finishes, are an outgrowth of these impending changes. Both of these new technologies rely on new products and methods which, for the most part, represent a departure from conventional ideas. For example, the use of high solids, low molecular weight binders which can be crosslinked with monomeric crosslinking agents such as hexa(methoxymethyl) melamine (HMM) Figure 1, in the presence of acid catalysts to produce tough, solvent resistant films offers a possible solution to the twin requirements of lower energy and reduced emissions. Typically, a strong sulfonic acid such as p-toluene sulfonic is used to catalyze the reaction between the hydroxyl and/or carboxyl functionality of the binder and the methoxymethyl group of the crosslinking agent. Although studies have appeared

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on the mechanisms involved in the crosslinking reaction of HMM with hydroxyl and carboxyl functional compounds,^{1,2} little is known about the specific role of the catalyst.

An important deterrent to the broader acceptance of acid catalyzed coatings for low temperature application has been that at moderate to high catalyst levels the resulting films are water sensitive and suffer from reduced water resistance properties.³ Recently issued patents, ^{4,5} however, show that this is no longer the case. High molecular weight dinonyl- and didodecylnaphthalene disulfonic acids were found to be superior catalysts compared to equivalent levels of p-toluene sulfonic acid with respect to water and detergent immersion tests in alkyd/HMM and acrylic/HMM coatings. Based on these results, studies were initiated to investigate the effects of changes in catalyst structure on the film properties of HMM crosslinked films.

EXPERIMENTAL

All studies were conducted on clear finishes to eliminate the possibility of any pigment-catalyst interaction. All films were applied with wire wound rods to panels placed upon a Bird vacuum plate.

The weight loss studies were determined by curing films in aluminum weighing dishes of 6.0 cm diameter. A freshly prepared mixture containing polyol, crosslinking agent, and catalyst was transferred to the tared weighing dish by means of a syringe. The syringe containing the mixture was weighed before and after the transfer to the weighing dish. Control of sample size at approximately 0.2 g was important for obtaining reproducible results. The dishes were placed in a forced-draft convection oven and cured under different conditions. After curing, the dishes were placed in a desiccator and allowed to cool to room temperature before reweighing. The difference between the coating weight after curing and the theoretical solids of the initial mixture was taken as the weight loss due to curing.

Presented at the 14th Western Coatings Societies Symposium in San Francisco, Feb. 28-Mar. 2, 1979.



Figure 1—Hexa(methoxymethyl)melamine

Detergent Resistance

The detergent tests were run by immersing the panels in a $165^{\circ}F(74^{\circ}C)$ solution of 1% Tide. Panels were visually evaluated at 24 hr intervals and notations made as to the frequency and size of blisters.

Salt Spray Resistance

Tests were run in accordance with ASTM procedure B117-73 on scribed panels. At the end of the exposure period the panels were rinsed with deionized water and patted dry with a paper towel. After a 10 min air dry the scribes were taped and the tape rolled several times to insure good surface contact. The tape was then pulled briskly at a 90° angle from the scribed surface and the panels evaluated.

Water Immersion Tests

The water immersion tests were carried out in a 50°C deionized water, constant temperature bath unless otherwise indicated. Panels were removed at three-hour inter-

n Properties
80/20
50
Xylene/IPA
72/28
. 1.0 mil.
Bonderite® 100
0.6% p-TSA
0.9% DNNDSA
30 min/120° C (248° F)
DSA p-TSA

Pencil hardness	H-2H	H-2H
Double MEK rubs	100*	100*
KHN ₂₅	8.5	7.9
Rev. impact, in. lb	12	6
Crosshatch adhesion, % loss	0	0
Water resistance, 24 hr, 165° F		
Blisters	V. Few	Few
Appearance	No Change	Rusted
60° Gloss ret. %	97	91

Acryloid is a registered trademark of Rohm and Haas Co.; Cymel, American Cyanamid Co., Bonderite, Parker Div.—Oxy Metal Industries Corp.



Figure 2—Detergent test of acrylic/HMM on zinc phosphated steel (1% Tide, 74 °C, 24 hr exposure)

vals and examined for rusting and blistering. The panels were rinsed with deionized water, patted dry with a paper towel and air dried 10 min before examining.

Table 2—Hig	h Soli	ds Acr	ylic/H	MM	
Acryloid OL-42				360	
Cymel 303				155	
FC®-430 Surfactant				1.7	
2-Ethoxyethyl acetate				14	
Butyl acetate				30	
2-Ethoxy ethanol				74	
Catalyst, % acid on Solids				1% n-T	SA
				1.5% D	NNDSA
Conductivity, μ mho cm ⁻¹					
p-TSA				0.33	
DNNDSA				0.16	
Resin/Cro	sslinke	er = 6	5/35		
% Nonvol	atile	= 7	0		
Viscosity,	Brook	field = 1	80 cps		
Viscosity S Brookfield,	Stability #2 Spi	/ @ 50° indle @	C., cps 30 rpm		
	Initial	5 da.	7 da	. 21 da.	28 da.
DNNDSA	180	421	522	912	1275
p-TSA	180	1020	1382	4300	Gel
No catalyst	180	345	418	625	660

FC Surfactant is a registered trademark of the 3M Company.

Materials

The hexa (methoxymethyl) melamine used in this study was commercial grade Cymel®303 from American Cyanamid Co. The sulfonic acids were all commercially available products:

Methane sulfonic acid, 70% Pennwalt Corp.
p-Toluene sulfonic acid, High Para.
Jim Walters Resources
Dodecylbenzene sulfonic acid Witco Chemical
Dinonylnaphthalene sulfonic acid King Industries
Dinonylnaphthalene disulfonic acid King Industries

Whenever comparisons were made between or among different catalysts, adjustments were made in catalyst additions to yield the same equivalent acidity, i.e., the same number of sulfonic acid groups, in each case. No attempts were made to optimize catalyst concentration for any of the systems studied. Such a study was considered to be beyond the scope of this investigation.

RESULTS AND DISCUSSION

Initially, direct comparisons were made between p-toluene sulfonic acid and dinonylnaphthalene disulfonic acid in a standard solvent acrylic/HMM coating vehicle (Table 1). The catalyst additions are given as the percentage acid solids on total resin solids, acrylic binder plus melamine, and were added as alcoholic solutions. Adjustments for the differences in equivalent weights, 172 for p-TSA and 270 for DNNDSA, required approximately a 50% excess of DNNDSA over p-TSA to give the same degree of acidity. Despite this apparent handicap, the DNNDSA was decidedly superior in water and detergent resistance properties. Presumably, this result was due to the increased hydrophobicity of the alkylated naphthalene disulfonic acid. Further testing for detergent resistance, however, produced a somewhat unexpected result, as can be seen in Figure 2. The detergent resistance for DNNDSA was much better at the lower bake of 120°C than at 175°C. The reverse behavior was observed for p-TSA, which is in line with published results for the relationship between cure schedule and detergent resistance of triazine crosslinked electrocoatings.^{6,7} The much improved detergent resistance at lower bake schedules and higher catalyst levels for DNNDSA catalysis is contrary to what is normally observed for alkoxymethyl triazine crosslinking agents. At all cure temperatures the water and detergent resistance for DNNDSA was better than p-TSA. At higher bake temperatures, however, the difference became marginal, albeit still in favor of DNNDSA.

High catalyst loadings would also be expected to seriously detract from salt spray resistance properties. A formulation based on a high solids acrylic resin and HMM is given in *Table* 2. Salt spray results for this system cured 30 min at $120^{\circ}C$ ($248^{\circ}F$) can be seen in *Figure* 3. The loss of adhesion at the film-substrate interface is much more pronounced with p-TSA and evidently responsible for the poor corrosion resistance. In addition, viscosity stability of this system with DNNDSA was found to be far superior to p-TSA (*Figure* 4). Similar



Figure 3—Salt spray test of HS acrylic/HMM on zinc phosphated steel (240 hr exposure; cure: 30 min @ 120 °C)

observations were not limited to high solids solvent acrylics but also appeared in epoxy/melamines, polyesters and acrylic emulsion/methylated urea coating systems.

One is tempted to suggest that these observations are all a result of the differences in water solubility of the two catalysts, p-TSA being very soluble and DNNDSA only 10-15% soluble in water. Recent studies⁸ conclude that organic films act as semi-permeable membranes. Therefore, diffusion control of moisture across the coating barrier is critical and trace amounts of hydrophilic contaminants, either on the surface of the substrate or in the film itself, can cause blistering. If this be the case for catalyzed coatings, then catalysts which are more



Figure 4—Stability test of HS acrylic/HMM



Figure 5—Sulfonic acids

hydrophobic than DNNDSA might be expected to demonstrate even better water resistance properties. Accordingly, other sulfonic acids, both hydrophilic and hydrophobic, with significant differences in chemical structure, were chosen for evaluation of their effects on film property characteristics.

The sulfonic acids studied were methane sulfonic acid. p-toluene sulfonic acid, dodecylbenzene sulfonic acid, dinonylnaphthalene sulfonic acid, and dinonylnaphthalene disulfonic acid (Figure 5). Molecular weights and solubility properties are given in Table 3. A commercially available, hydroxy functional, high solids saturated polyester from Ashland Chemical, Aroplaz® 6025, was crosslinked with hexa(methoxymethyl) melamine (Table

able of roperties of outfollie Acia	٢a	able	3-Pro	perties	of	Sulfonic	Acids
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Acid	Mol Wt g/mol	Solubility in Water, 25° C
MSA	96	Complete
p-TSA	172	Complete
DDBSA	326	Complete
DNNSA	460	Insol.
DNNDSA	540	10%

	Parts
Aroplaz®6025 Al-80	
Cymel 303	
n-Butanol	111
2-Ethoxyethyl acetate	
Methyl ethyl ketone	111
Byk®-300	
	1486
Resin/Crossl	inker = 75/25
% Nonvolatil	e = 70
Viscosity, cps	$3, 25^{\circ}C = 340$
Catalyst Addition	% Acid on Total Solids
MSA	0.56
p-TSA	1.00
	1.80
DDBSA	1.00
DDBSA DNNSA	2.86

Aroplaz is a registered trademark of Ashland Chemical Co.; Byk is a registered trademark of Byk-Mallinckrodt.

4). Catalyst additions were adjusted to yield the same degree of acidity for each acid. A second, but minor objective of the study was to determine minimum cure temperature and catalyst level. Film properties are given in Table 5 for a cure schedule of 30 min at 121°C(250°F) and a catalyst level equivalent to 1.0% p-TSA on total resin solids. Higher catalyst levels produced poorer film properties without significantly reducing cure temperatures. At lower catalyst levels, higher bake temperatures were required to achieve similar properties, an example of which can be seen in Table 6A. Salt spray results are given in Table 6B.

Several points in the data deserve comment. In the formulation tested, methane sulfonic acid appeared to develop the best hardness, but films were very brittle and sensitive to catalyst levels. There was also severe flash rusting of the panels and the water resistance of MSA was the poorest of the catalysts tested. Dodecylbenzene

Table 5—HS Polyester/HMM Film Properties

Cure: 30 min./121°C (250°F) Catalyst level: Equivalent to 1.0% p-TSA Film Thickness: 1.0 mil. Substrate: Untreated steel

	MSA	p-TSA	DDBSA	DNNSA	DNNDSA
Pencil hardness	F/H	F/H	HB/F	HB/F	F/H
Double MEK rubs	90	70	50	20	70
Hardness, Knoop, 25	11.1	9.2	8.6	5.5	8.6
Crosshatch adhesion,					
% loss	5	0	100	20	0
Rev. impact, in. lb	40	80	40	110	110
Water soak, 50°C, 6 hr					
	V. Heavy	Light			
Appearance	Rust	Rust	NC ^a	NC	NC
Pencil hard.	В	HB/F	2B/B	HB/F	F/H
Rev. impact, in. lb	10	20	10	40	80
(a) NC = No change					

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Table 6A-HS Polyester/HMM Film Properties

Cure: 30 min./135°C (275°F) Catalyst level: Equivalent to 0.5% p-TSA Film Thickness: 1.0 mil. Substrate: Untreated steel

	MSA	p-TSA	DDBSA	DNNSA	DNNDSA
Pencil hardness	H/2H	F/H	F/H	HB/F	F/H
Double MEK rubs	110	75	40	35	75
Hardness, Knoop, 25	12.1	9.0	8.5	7.0	8.8
Crosshatch adhesion,					
% loss	0	0	0	0	0
Rev. impact, in. lb	80	120*	60	80	120^{+}
Water soak, 50°C, 6 hr					
	Light	Edge			
Appearance	Rust	Rust	NCa	NC	NC
Pencil hard.	HB/F	HB/F	HB/F	HB/F	F/H
Rev. impact. in. lb	20	40	40	60	100
(a) NC = No Change					

Table 6B—HS Polyester/HMM Salt Spray Test ASTM B117-73, 240 hr. Zinc Phosphated Steel Cure: 30 min. at 275° F (135° C) Catalyst Level: Equivalent to 0.5% p-TSA

Creepage, mm./Blister

MSA	3.0/8
p-TSA	1.5/9
DDBSA	2.0/9
DNNSA	0.5/9*
DNNDSA	1.0/9

sulfonic acid (DDBSA), at the catalyst levels tested, exhibited slightly lower cure than either p-TSA or DNNDSA. The low impact resistance recorded for DDBSA appeared to result from poor adhesion to the substrate since the film was easily fractured and lifted from the surface. The C12 group of dodecylbenzene sulfonic acid is linear and compounds of this type are normally referred to as detergent sulfonates. Their surfactant-like properties are most likely responsible for poor adhesion to bare steel by contributing to the formation of a monomolecular layer of sulfonate between film and substrate. The substituent nonyl groups in both DNNSA and DNNDSA, on the other hand, are highly branched. Neither of these compounds are very efficient surfactants or emulsifiers. In fact, salts of dinonylnaphthalene (mono) sulfonic acid are effective demulsifiers.9 These structural factors may help contribute to substrate wetting and adhesion and thus greatly reduce edge lifting and impact popping under conditions of high humidity exposure.

The results obtained with the oil-soluble sulfonic acid, DNNSA, were somewhat perplexing. Water and corrosion resistance were good but the cure and hardness were very poor. The resistance properties with DNNSA, however, were still considered inferior to those obtained with the disulfonic acid, DNNDSA. All indications are that DNNSA (mono acid) failed to DR. LEONARD J. CALBO is Marketing Manager for King Industries, Inc., Norwalk, Conn. He holds the B.S. Degree in Chemistry and a Ph.D. Degree in Organic Chemistry as well as an M.B.A. Degree. Dr. Calbo has published four papers dealing with organic synthesis, amino resins, and electrodeposition and holds four patents in the field of amino resin synthesis and electrodeposition.



generate a sufficient cure response and crosslink density as evidenced by its low solvent resistance. Consequently, the hydrophobicity of the catalyst, i.e., its lack of water solubility, must be combined with sufficient ionization potential and acid strength to catalyze the cure and produce an adequate crosslink density.

Comparison of p-TSA and the disulfonic acid shows the two catalysts to exhibit similar properties except for dramatic differences in water resistance. The loss in impact resistance following the water immersion test was significant. DNNDSA did not show the precipitous drop which the other catalyst showed and, overall, gave the best combination of film properties.

A general comparison of film properties for the HS polyester/HMM coating described in *Table* 4 is presented in *Table* 7. A relative rating is used to point out the strengths and weaknesses of each catalyst. Thus far, evidence has been presented which suggests that factors such as the hydrophobic nature of the catalyst, catalyst structure and acid strength may all have some influence on film properties. To determine precisely how, by what mechanism and in what proportions these factors affect film properties became the objective of the next series of experiments.

Crosslinking vs. Self-Condensation

Although a comprehensive discussion of the mechanisms involved in the crosslinking and self-condensation reactions of HMM may be beyond the scope of this paper, some brief comments relating to the role of catalysts in these competing reactions would be relevant and

Table 7—C HS I Cure Catalyst I	omparis Polyeste : 30 min evel: Equ	son of Se er/HMM at 250°F uivalent to	ulfonic A Coating (121°C) (1.0% p-	Acids in	
	MSA	p-TSA	DDBSA	DNNSA	DNNDSA
Hardness	5	4	2	1	3
Flexibility	1	3	2	3	5
Adhesion	2	4	1	3	5
Water resistance	1	2	3	4	5
Properties after					
water soaking	1	3	1	3	5
Package stability	1	3	2	5	4
Corrosion resistance .	1	3	2	5	4
Rating: 5 best, 1 worst.					





germane to the topic. The curing of highly etherified triazine resins like hexa(methoxymethyl)melamine has been depicted as following a somewhat different pathway than that attributed to conventional butylated resins.¹⁰ The latter types, because of the high levels of N-methylol

 $(-N - CH_2OH)$ and -NH groups present, exhibit a much greater propensity to self-condense. Self-condensation reactions of melamine and urea resins generally contribute to surface hardness of the film and such properties as tack and print resistance, stain resistance, etc. Too much self-condensation, however, produces some distracting side effects: Film embrittlement, lower solvent resistance, durability, package stability, flexibility, and adhesion. The N-methoxymethyl groups of hexa-(methoxymethyl)melamine reportedly do not self-condense.10 Based upon an analysis of the volatile byproducts, it was concluded that the rate of crosslinking of carboxyl groups with HMM was approximately 20 times faster than the self-condensation reaction.1 Primary hydroxyl groups would react at an even faster rate. More recently however, Biethan and co-workers^{2,11,12} studied the crosslinking reaction apart from self-condensation and came to somewhat different conclusions. In a detailed investigation, changes in infrared spectra, hardness, extractables, and weight loss of hydroxy terminated polyester/HMM systems were monitored along with corresponding changes in baking temperature. The hydroxyl/methoxymethyl ratio (-OH/-CH2OCH3) varied from 1/1.5 to 1/2 and 1/3 while the catalyst level was constant at 0.5% p-TSA on solids. They observed that the transetherification (crosslinking) reaction was essentially complete after 60 min at 90°C with the -OH absorption band reduced to 5% of its original intensity. Also, the observed weight loss agreed with the calculated amount of methanol produced by crosslinking. At 130°-160°C, the absorption band for the methoxymethyl group had disappeared and was accompanied by a corresponding increase in -OH and -NH absorption. Further heating resulted in loss of formaldehyde, further self-condensation and proton catalyzed degradation promoted by the presence of residual water. Under vacuum

conditions, the corresponding increase in -OH and -NH absorption was absent with the -OH content steadily decreasing and the methoxymethyl absorption reaching a constant value. Based on their findings, the authors proposed the reaction pathway illustrated in *Figure* 6. The critical difference between this mechanism and the one proposed by Saxon and Lestienne¹ is the role of water in the self-condensation process. In addition, it was demonstrated that under normal curing conditions self-condensation can become very competitive with crosslinking, even for fully etherified melamines.

A significant finding of the study was the separation between the crosslinking and self-condensation processes for primary hydroxyl containing resins and HMM. When the reaction sites were either secondary hydroxyls or carboxyl groups, this separation was not feasible. Evidently the self-condensation process becomes even more competitive and a distinction between the two processes cannot be made. The potential for crosslinking in any given system, therefore, can be expected to be influenced by the nature and ratio of the reactants, i.e., the $-OH/-CH_2OCH_3$ ratio, the type of amino resin used, i.e., fully or partially etherified, the baking conditions, and the amount and type of catalyst used. For a state-ofthe-art review on amino resin chemistry the work of Seidler and Stolzenbach¹³ should be consulted.

Weight Loss Studies

A series of experiments were initiated to determine if the observed differences between p-TSA and DNNDSA were somehow related to possible differences in the crosslinking and self-condensation reactions. Hexa(methoxymethyl)melamine was heated alone and in combination with very reactive, nonvolatile, low molecular weight polyols in the presence of the two sulfonic acid catalysts. The weight losses which resulted from curing were obtained by subtracting the solids residue obtained after curing from the theoretical solids. Two polyols were chosen for study: a bisphenol A-ethylene oxide adduct (Dow Chemical, XD-8025) of approximately 500 molecular weight with primary hydroxy groups, and trimethylolpropane (Celanese Chemical).

Table 8—Weig	ht Loss Studies: 30 min Cure HMM and
Polyol/HMM	Systems, Catalyst Level: 1.0% p-TSA,
	1.5% DNNDSA on Solids

-	weight Loss, %											
System	нмм	XD-8025/HMM	TMP/HMM									
Weight ratio	_	65/35	50/50									
Mole ratio												
$-OH/CH_3OCH_2$		1/2.1	1/0.7									
93°C (200°F)												
p-TSA	—	10.1	9.5									
DNNDSA	_	8.8	8.3									
$\Delta, \%$	-	-12.9	-12.6									
107°C (225°F)												
p-TSA	_	12.2	12.1									
DNNDSA	—	10.4	10.2									
$\Delta, \%$	—	-14.7	-15.7									
121°C (250°F)												
p-TSA	6.4	13.5	13.9									
DNNDSA	4.5	12.0	12.1									
$\Delta, \%$	-29.7	-11.1	-12.9									
150°C (302°F)												
p-TSA	7.2	_	16.2									
DNNDSA	5.9	_	13.9									
$\Delta, \%$	-18.1	—	-14.2									

The weight ratio for the polyether-polyol, XD-8025, and HMM was set at 65/35 which corresponded to a $-OH/CH_2OCH_3$ molar ratio of 1/2.1. For the TMP/HMM vehicle the weight ratio was set at 50/50 producing a -OH/-CH₂OCH₃ ratio of 1/0.7. The presence of excess hydroxyl would suppress self condensation and favor transetherification. Preliminary film testing indicated that the ratios chosen for each of these systems gave optimum cure and hardness. Catalysts levels were set at 1.0% p-TSA and 1.5% DNNDSA on total solids. Solids content for the three systems were adjusted so that a thin, even film was obtained after the coating mixture was transferred to the aluminum weighing dishes and baked. For the HMM system and the TMP/HMM vehicle, the initial solids were adjusted to 50% with methyl ethyl ketone. With the polyether polyol/HMM study, the initial solids were 95%, the only volatile present being introduced during the catalyst addition.

The weight loss results presented in *Table* 8, can more accurately be defined as the chemical losses resulting from curing. At the catalyst level tested, the weight losses were less with dinonylnaphthalene disulfonic acid than with p-toluene sulfonic acid. The self-condensation of HMM under these conditions does not produce any significant volatiles until 121°C and is obviously much slower than the reaction with primary hydroxyls which show significant cure even at 93°C. Prolonged heating of HMM with catalyst, at 100°C will exhibit some weight loss. However, such losses on prolonged heating could result from volatization of HMM and not necessarily selfcondensation. With the polyether-polyol, XD-8025, and HMM, sizeable quantities of volatiles are given off at 93°C. The observed value of 8.8% for DNNDSA agrees well with the theoretical value of 8.4% calculated for the expected methanol loss. Working with a $-OH/-CH_2OCH_3$ ratio of 1/2 and a catalyst level of 0.5% p-TSA, Biethan² reported a loss of 7.8% against a calculated value of 6.9% for a 60 min cure at 90°C. In our studies, the observed weight loss with 1.0% p-TSA was 10.1% at 93°C. The difference, Δ , between p-TSA and DNNDSA for the linear polyether-polyol/HMM vehicle was approximately 13% at 93°C, 15% at 107°C, and 11% at 121°C. Similar differences were observed with the branched polyol, TMP, even under conditions of excess hydroxyl.

For the self-condensation of HMM, DNNDSA gives off substantially less volatiles than p-TSA: 30% less at 121° C, falling to 18% at 150° C. Taken together, the results may be interpreted as follows: (1) DNNDSA does not catalyze the self-condensation of HMM to the same extent as p-TSA; or, (2) DNNDSA is a weaker catalyst than p-TSA and, therefore, cannot be expected to produce the same quantity of reaction volatiles.

The previously cited differences in film properties, and also those obtained with XD-8025 and HMM, *Table* 9, would tend to support the theory of less self-condensation with DNNDSA. At the lower cure temperatures, coreaction with hydroxyl groups is favored over selfcondensation. As the cure temperature is increased, the rate of reaction is increased with the rate of selfcondensation also increasing, perhaps at a faster pace, until, at high cure temperatures the two competing reactions become nearly equivalent. Thus, DNNDSA, will yield superior resistance properties at low bake schedules by suppressing the self-condensation reaction more effectively than p-TSA. It may also suppress the subsequent proton catalyzed degradation process more effectively than p-TSA.

Table 9—Polyether—Polyol/HMM^a Resin/Crosslinker: 65/35 Substrate: Untreated aluminum

Film Thickness: 1.0 mil.

1.0% p-TSA	1.5% DNNDSA
2/3H	H/2H
100*	100^{+}
9	25
D4	M8
D4	M8
2/3H	H/2H
100*	100*
7	18
D6	None
D6	M8
	1.0% p-TSA 2/3H 100' 9 D4 D4 2/3H 100' 7 D6 D6

(a) U.S. Patents 3,960,983 and 3,950,202.



Figure 7—Possible reaction mechanisms for HMM crosslinking

The assumption that DNNDSA may actually be a weaker or less efficient catalyst than p-TSA needs amplification. Published pK values¹⁴ for methane sulfonic acid (0.7), benzene sulfonic acid (0.7), p-toluene sulfonic acid (0.7), and naphthalene sulfonic acid (0.57)does not support this contention. Complete dissociation of the sulfonic acid groups are expected at low concentrations. Additional complexities exist for the disulfonic acid, DNNDSA, because theory would predict a pK₁ value of less than 0.7 and a pK₂ value greater than 0.7. Dissociation of the second proton would be hampered by the reduced ability of the naphthalene nucleus to support a second negative charge. Unfortunately, laboratory attempts to determine pK1 and pK2 values for DNNDSA thus far have not been satisfactory.

At 121°C, a temperature typically suggested as the lower limit for obtaining satisfactory properties with HMM, the difference in reaction volatiles between p-TSA and DNNDSA is 30% for the self-condensation reaction vs. 11-13% for crosslinking. Previously published studies^{15,16} indicated that the

rate determining step for crosslinking with N-alkoxymethyl groups was generation of a carbonium ion, $-N-CH_2^+$ via a conventional S_N^+ mechanism. However, such a proposal does not adequately explain the observed differences in curing rates between mercapto, -SH, hydroxyl, - OH, and carboxyl, - COOH, functional groups with amino resins.¹⁷ If the nucleophilic attack on the carbonium ion occurred after the rate determining step, then it would have little or no effect on cure rate. Recent studies¹⁸ now claim that both crosslinking and self-condensation reactions of melamine resins proceed via a bimolecular displacement S_N^2 reaction (Figure 7). The rate of cure would then be dependent on both the nature of the group leaving melamine and the nucleophiles of the binder resin. If these reactions are truly bimolecular, than steric effects exerted by the reacting species and the catalyst may be influential in deciding

which of the reaction pathways, i.e., crosslinking or selfcondensation, would be kinetically favored. Additional mechanistic studies and a greater knowledge of the structure of the transition state in going from reactants to products would be helpful in clarifying this question.

Mechanistic interpretations aside, one must also consider a physical interpretation of the data. Melamine resins, being weak bases, may actually buffer the catalyst. The strength of the acid, therefore, may not be as important a factor as the compatibility of the acid catalyst with the individual binder components, especially during the phase changes which occur during film formation. Depending on its compatibility, or lack of it, with the binder components, the acid catalyst may be attracted to the polar metal substrate and could possibly accumulate at the interface. Thus, a localizing effect of catalyst may occur during phase change at the polymer/ metal interface which undoubtedly would contribute to premature film failure. The forces of attraction at the interface between the acid catalyst, the coating and the substrate might then be more easily broken or displaced by penetrating water molecules resulting in a premature loss of adhesion.

The disulfonic acid, DNNDSA, being more hydrobic than p-TSA, would also be expected to be more compatible and may actually promote interaction between the two reacting phases: the polar, amino resin phase and relatively non-polar alkyd phase. Derivatives of DNNDSA, in particular, the disodium salt, are extremely effective hydrotropes for promoting the solubility and coupling of two dissimilar phases. By promoting a better interaction between the reactants during the critical stages of film formation when solvent and reaction by-products are driven off, DNNDSA would not be expected to accumulate at the polymer/ metal interface to the same extent as p-TSA. The accumulation of polar groups at the interface can only provide an easier access for water to reach the surface.

A greater or more efficient mixing of the catalyst along with the reactive components may also have the effect of limiting the self-condensation process of the amino resin and increasing the crosslink density. Subsequent microphases formed with DNNDSA would be expected to be smaller than those produced with p-TSA.

The salt spray data presented in Table 6B would lend support to the supposition of better phase mixing and catalyst compatibility. The most hydrophilic, least hydrophobic catalyst, methane sulfonic acid, MSA, gave the most severe loss of adhesion, as evidenced by the creepage from the scribe line. As expected, the most hydrophic catalyst, dinonylnaphthalene (mono) sulfonic acid, DNNSA, showed the best salt spray resistance even though it had the lowest cure response. Being oil soluble, DNNSA would prefer the non-polar phase. The low ionization potential and acid strength of this compound, however, does not generate sufficient catalytic activity to promote the needed curing reactions, whether it be crosslinking or self-condensation. Additional investigation of this product would seem warranted, however, especially for high temperature applications, e.g., coil coating, where corrosion protection and overbake resistance are important characteristics.

SUMMARY AND CONCLUSIONS

Film properties of coatings crosslinked with hexa(methoxymethyl)melamine can be strongly influenced by the choice of acid catalyst. Several factors relating to catalyst structure have been identified as having an effect on performance properties: i.e., hydrophibicity, acid strength, and surface activity.

A unique disulfonic acid, dinonylnaphthalene disulfonic acid, offers a combination of all three properties to provide coatings which are highly resistant to water and detergent solutions even at low bake temperatures. Based on the data obtained, it is suggested that DNNDSA may be a more effective catalyst than p-TSA for controlling possible self-condensation of HMM, either by exercising stricter kinetic control of the transition state in going from reactants to products and/ or by promoting a better mixing of the reactants before and during the critical phase transformation from solution to fused film. Being more compatible in non-polar media, the DNNDSA would disperse itself more uniformly throughout the film and, therefore, not accumulate at the polymer/metal interface to the same extent as p-TSA.

Additional studies are planned which hopefully will isolate these phenomenon and permit a better understanding of the complex processes involved during film formation.

ACKNOWLEDGMENTS

Much appreciation and gratitude is extended to Michael Berman and Benjamin Sallard, Jr. for compiling the data and assisting in the laboratory evaluation.

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HORACE S. PHILIPP American Paint and Coatings Journal Award

is serving his second term as chairman of this committee. He received the B.S. and B.A. Degrees from Sir George Williams University. Mr. Philipp is a Senior Chemist with Sherwin-Williams Co., of Canada Ltd. A Past-President of the Montreal Society, he served as its Technical Chairman, Secretary, and Program Chairman. For ten years, he was also Chairman of the Federation Membership Committee.





ROBERT T. MARCUS Inter-Society Color Council

is a Research Associate at PPG Industries' Coatings and Resins Div. Research Center where he is in charge of the Color Science Research Group. He received the B.S. Degree in Physics in 1968 and the Ph.D. Degree in Chemistry in 1974 from Rensselaer Polytechnic Institute. Dr. Marcus is President of the Pittsburgh Society. He is serving his second term as Chairman of this committee.

CARROLL M. SCHOLLE Memorial

is a Past-President of the Federation and the Chicago Society. He received the Society's Outstanding Service Award in 1963 and the Federation's Distinguished Service Award in 1967. Mr. Scholle is now retired, having been associated with Sherwin-Williams Co. and Jewel Paint and Varnish Co. in the Chicago area. A graduate of the University of Dayton, he retired as a Lieutenant Colonel in the U.S. Army Reserve in 1965.





UMBERTO ANCONA Roon Awards

is Technical Director and Vice-President of McCloskey Varnish Co. A native of Italy, he received the M.S. Degree from Columbia University and the Doctor Degree from the University of Milan. Mr. Ancona is a Past-President of the Philadelphia Society and has served as Chairman of its Technical Committee. His previous Federation activities include serving as Chairman of the Trigg Awards, the Program Awards, the A.E. Voss/American Paint Journal Award Committee, as well as participating on the Publications Committee. He is presently a member of the Program Committee.

AL SENEKER Trigg Awards

is a Senior Scientist for Ameron Corporate Research. He obtained a A.B. Degree from Greenville College, Illinois and a M.S. Degree in Synthetic Organic Chemistry from the Calif. Institute of Technology. Mr. Seneker is President of the Los Angeles Society and has served as Secretary, Treasurer, and Vice-President of the Society. He is also serving on the Metric Systems and APJ Awards Committees.





DONALD J. FRITZ Manufacturing

is Technical Director for Superior Varnish & Drier Co. He holds a degree in Chemical Engineering from Drexel University. Mr. Fritz is a Past-President of the Philadelphia Society and a recipient of its Liberty Bell Award. His Federation activities include Chairmanship of the Golden Anniversary Meetings Committee, and service on the Host, By-Laws, Corrosion, and Program Committees.

RUTH M. JOHNSTON-FELLER Bruning Award

is a consultant to CIBA-GEIGY Pigments Dept., where she formerly managed the Coating and Colorimetry Dept., and to the Center for Research in Materials for the Artist and Conservator at the Mellon Institute of Research of Carnegie-Mellon University. Mrs. Johnston-Feller is a member and former Chairman of the Federation's Inter-Society Color Council Committee. She also serves on the Publication Committee, the Editorial Review Board, as a member-at-large of the Board of Directors, as a member of the Board of Trustees of the Paint Research Institute, and is a former member of the Finance Committee.





W. THOMAS COCHRAN MMA Awards

is serving his second term as chairman of this committee. He is Technical Director for Bruning Paints. In addition to serving as Past-President of the Baltimore Society, Mr. Cochran has acted in the capacity of President-Elect, Secretary, Education Chairman, and Membership Chairman. A former member of the Hospitality, Constitution, and By-Laws Committees, he has served on the Host Committee and will co-chair the Baltimore Trade Show.

STANLEY LESOTA Definitions

is Senior Chemist for Rohm and Haas Co. A member of the Philadelphia Society, he was recently recognized for his contribution to the Federation's **Paint/Coatings Dictionary.** In 1979, Mr. LeSota received the George Baugh Heckel Award and the first Union Carbide Award for the Philadelphia Society. He was also the recipient of the Liberty Bell Award of the Society. Mr. LeSota has been active in the Publications, Program, Roon Award, and Technical Advisory Committees.





JOHN J. OATES Liaison

is Technical Sales Manager for Troy Chemical Corp. President of the Federation for 1977–1978, he has also served as President of the New York Society. He has been active in almost every Society committee, was Council Representative from 1972-74, and received the Society's PaVaC and Kienle Awards. In the Federation, Mr. Oates was Treasurer (1975-1976), Chairman of the By-Laws, Annual Meeting Host, and Annual Meeting Program Committees, and served on the Board of Directors. C O M \bigvee

Society Meetings

Birmingham

A. Saunders, of Shell Chemical Co, spoke on "THE INTERACTION BETWEEN ENERGY AND THE CHEMICAL INDUSTRY."

Intended as an aid to management forecasting, Mr. Saunders' presentation offered scenarios mapping out the world supply and demand for energy. Three alternatives were presented. Starting with an illustration of how the economic growth rate for the 1970's had diverged from the predicted curve from the past trend for 1960-74, Mr. Saunders presented a rather pessimistic view of the future.

Predicting a cut-back in industrial investment and other effects of an apparently unavoidable recession, Mr. Saunders also warned of overcapacity due to fall in demand. A shift of investment to coal and nuclear power can be expected in the U.K., he said. The problems he examined included the lead time and environmental constraints which will require a strong political resolve.

The implications for the chemical industry discussed by Dr. Saunders involve rising costs of base feedstocks. In addition, there will be a slow-down in investment in new ideas, he said. In Europe, there will be increased competition from overseas such as with cheap chemical imports from the U.S. and Eastern bloc. He further cited the prospect of increased competition from the Middle East and OPEC countries.

Q. What about water and gravity as sources of energy?

A. Hydroelectric power is very important but one tends to be skeptical about wind, solar, wave power, etc., where the costs are enormous and the returns are so small that they are not feasible during this century.

Q. What about the Eastern bloc running out of oil themselves and the collaspe of western economies affecting OPEC?

A. There are pessimistic forecasts for Eastern Europe supplies. The Middle East is more likely to cut off supplies to the west due to the political element. The OPEC countries, such as Iran, Iraq, etc., are no longer dependent on the west and can adopt a selfish approach.

B. ADDENBROOKE, Secretary

Golden Gate

Oct. 15

The MMA Award plaque and a check for \$350 was presented to the Society in recognition of its work in the West Coast Symposium.

Sharon Vadnais, Secretary for 1978-79, was awarded second place in the Federation's Trigg Award competition, for her excellent preparation of the minutes of the Society meetings.

Dr. Robert Washburn, of Rohm and Haas, spoke on "RECENT UPDATES IN LATEX BASED PRIMERS FOR ALL SUR-FACES."

According to Dr. Washburn, recent advances in the design of latex polymers and pigment dispersants make it possible to formulate latex primers with good performance on problematical surfaces, especially metallic substrates and staining woods. Various types of failures on these substrates were described. Dr. Washburn illustrated the performance of model latex paints which overcome these deficiences.

D. L. MAZZONE, Secretary

Los Angeles

Nov. 14

Frank Zurlo, of Byk-Mallinckrodt, spoke on "Synopsis of the Dyno-METER."

Mr. Zurlo discussed the problem of sedimentation and the resulting formation of settlement in heterogeneous systems as pigmented liquid coatings. Various measuring methods, ranging from qualitative testing by hand to a very complicated testing by radioactive scanning, produced only limited useable results, he explained.

Mr. Zurlo described a method introduced by Dr. W. Papenroth in 1967 which offered a scientific, reproducible, empirical recording of sediment formation. This method was discussed in detail during the 1968 and 1972 FATIPEC Congresses in Europe. Further publications revealed other applications of the test for short-term classification of sediments.

As explained by Mr. Zurlo, the next task, using these results, was to develop a technique which shows an early detection and thereby allows corrective action to prevent formation of settling. The method, incorporating a Dynometer sedimentation analysis instrument, he continued, allows us to determine sedimentation while it is occurring rather than after if has occurred. Therefore, it would be possible, using the sedimentation velocity after time of production, to determine the type and nature of the sedimentation after extended periods of time, he said.

Q. Does magnetism affect the reading regarding settling in iron oxide tape formulations?

A. Some very positive results have been obtained when working with iron oxides in magnetic tape formulations. From all indications, the magnetism does not affect the readings on the Dynometer.

Q. What is the cost of the instrument and how can the average paint company justify its purchase?

A. We can certainly discuss cost, but it is easy to economically justify purchase of this instrument. By fine tuning a system and maximizing the efficiency and amounts of wetting and suspending agents, sizable raw material scannings can be had; certainly enough to justify purchase by a medium sized coating manufacturer.

Q. Does the quality of dispersion apply to the settling of the same formula?

A. Yes, the quality of dispersion will affect settling characteristics. If you disperse better with better equipment and technology, you will get better antisettling. That characteristic will be picked up by the Dynometer. In this way, you evaluate different production methods and raw materials you can determine which is going to give you better anti-settling characteristics.

ROMER JOHNSON, Secretary

Montreal

Nov. 7

A moment of silence was observed in memory of F.M. O'Dea, Past-President of the Society, who died recently.

Walter Kolanitch, Education Chairman, announced that a 15-week introductory course in Coatings Technology, sponsored by Sherwin-Williams, is scheduled in January.

Paul W. McCurdy, of Reichold Chemicals, Inc., spoke on "CONVERSION COATING ENAMELS—ENERGY SAVERS."

Mr. McCurdy defined low bake enamels as those systems which can be cured at 175-200°F in a reasonable time. Energy savings of 33 to 50% can be made when curing temperatures are reduced from 15 min at 300° F to 15 min at 200° F, he said.

Mr. McCurdy discussed two basic types of catalysts—phosphoric and sulfonic. He mentioned that the amount of catalyst needed depends on the type of alkyd and amino resins used, their respective ratio, curing temperature, and the type and amount of pigment used.

Typical problems with catalyst systems specified by the speaker include cure response on can aging, and viscosity and gloss stability on can aging. Viscosity increase can be controlled to a large extent, he continued, by the inclusion of free alcohol, with butanol and isobutanol as the most effective. Mr. McCurdy concluded with recommendations for alkyd—short soya semi-oxidizing alkyd of the low viscosity type; and amino urea or melamine 30% of the total resin solids.

R. KUHNEN, Secretary

New York

Oct. 9

President Sid Rubin, of Greenpoint Paint and Varnish Co., announced that the Society received the MMA Award for its educational activities and that Marvin Schnall, of Troy Chemical Corp., was presented with the Federation's Ernest Trigg Award for furnishing the best minutes of Society meetings.

Members present at the meeting who were awarded 25-year pins were: John D'Amico, Leo H. Schaetl, Vincent J. Tinello, George C. Vanderbilt, and Marvin Wexler.

Paul W. McCurdy, of Reichhold Chemicals, Inc., spoke on "CONVERSION ENAMELS, ENERGY SAVERS."

Conversion, or catalyzed, enamels provide one means of coping with the accelerating concern with energy availability and cost. According to Mr. McCurdy, utilization of such coatings can result in appreciable savings in energy consumption by allowing sizable reductions in baking temperatures.

Stability proves to involve much more than controlling the viscosity increase; maintenance of catalyst effectiveness and of enamel gloss overshadow viscosity control, he continued. While in the past such limitations would have been a prohibition to the employment of a catalyzed system at all, there are currently available catalysts that allow the formulation of even one-package enamels. Mr. McCurdy examined all of the enamel ingredients which have a bearing on performance, including ureas, alkyds, and catalysts. Achievement of one-package system is possible and practical, he said, by careful formulation and selection of a suitable catalyst.

DON BRODY, Secretary

Oct. 9

Northwestern

President Al Heitkamp, of Cargill, Inc., was presented with the Tenneco Gavel by Dick Brand, of Tenneco Chemicals Co., Inc.

Don Emch, 1978-79 Technical Committee Chairman, was honored with the first place Program Award for the presentation of a Society paper "in the best form and manner" at the Federation's 1979 Annual Meeting.

Bill Stewart, of Tenneco Chemicals Co., Inc., spoke on "LATEX PAINT SPOIL-AGE—PLANT HOUSEKEEPING."

Mr. Stewart reviewed the basic principles involved in the spoilage of latex paints, and the corrective actions that experience has shown to be effective. Latex paints with no bacterial growth inhibitors added will eventually lose viscosity, and the paint will be "spoiled," he said. More common, however, is the



CHICAGO BOILER COMPANY

1965 N. CLYBOURN AVE. • CHICAGO, ILLINOIS 60614 (312) 348-8250 • TWX 910 221 0329 • CABLE: CHIBOCO paint that is partially inhibited, resulting in fermentation and the development of CO₂ pressure in the can. Actual contamination, often caused by dust in the atmosphere as well as from the use of tap water instead of sterilized water, can be avoided. Methods for doing so were described by the speaker.

Q. Do mercurials kill enzymes, or precipitate them?

A. Certain levels of heavy metals will precipitate enzymes. More metal is required to accomplish precipitation than is normally used in paint.

G. DALE ERNST, Secretary

Northwestern

Nov. 6

Edward M. Antonucci, of Drew Chemical Corp., spoke on "FLASH RUST INHIBITION IN WATER-BASED PAINTS."

Mr. Antonucci explained that flash rusting appears on a metal substrate any time after the metal is treated to one or two hours after application of coatings. While reviewing the basic process of corrosion, he discussed the difference in the electromotive potential between two cells on the metal substrate. There is a cathode and an anode, he continued, with a measurable flow of electrons to the cathode. Flash rusting, which occurs between the metal and coatings, is called crevice corrosion.

Mr. Antonucci related that the results of investigations of materials that might have potential as additives to control this rusting have been negative. Materials which had potential theoretically were tested, but did not work when put into practice. He concluded that products now available commercially as flash rust inhibitors are not effectual in most paint systems. Yet, since many of the problems associated with inhibition have been identified, Mr. Antonucci expressed the hope that the on-going development program will lead to more successful conclusions.

G. DALE ERNST, Secretary

Philadelphia

Oct. 11

A moment of silence was observed in memory of John Linetti who died recently.

At the Annual Meeting, the first Union Carbide Award was received by the Society for its outstanding contributions to the advancement of coatings technology. Stanley LeSota was the recipient of the George B. Henkel Award for his efforts in promoting the Federation's interests.

Gil Cain, Industrial Safety Consultant, spoke on "PRACTICAL SAFETY PRO-GRAMS IN PAINT PLANTS."

MATTHEW J. HANRAHAN, Secretary

Philadelphia

Nov. 8

Dr. Ronald S. Bower, of Shell Chemical Co., spoke on "THE NEW GENERATION OF LOW VISCOSITY, WEATHERABLE ÉPOXY RESINS."

Dr. Bower mentioned that these low viscosity, weatherable epoxy resins offer such properties as excellent gloss retention, and are non-yellowing on exterior exposures-features usually missing from conventional bis-phenol Aepichlorhydrin polymers. He compared these new epoxies and other resin types, demonstrating that their weathering properties are equal to or better than some acrylic resins. Other features mentioned by Dr. Bower were their broad compatibility with other resins, and solubility in aliphatics, such as mineral spirits.

MATTHEW J. HANRAHAN, Sectetary

Piedmont

Oct. 17

Vagn Pedersen, of Tioxide of Canada Ltd., spoke on "TITANIUM DIOXIDE PRINCIPLES, PROPERTIES, AND PER-FORMANCE '

Mr. Pedersen cited titanium dioxide as the major white pigment, chosen above all others because it best refracts light. The types of titanium dioxide discussed were anatase and rutile, with rutile preferred for its strong absorption of UV. He stated that studies have proven that titanium dioxide can hide substrates at a pigment volume concentration of 10%, lower than is usually used in the industry, but the usual 20 to 25% is best. After discussing how titanium dioxide is made, Mr. Pedersen explained how it is treated to obtain different grades.

JIM ALBRIGHT, Secretary

Nov. 20

Oct. 16

Piedmont

Bill Benton, of Monsanto Textile Co., spoke on "THE CHEMICAL FACTS OF LIFE."

Mr. Benton's presentation was focused upon encouraging people to become more aware of chemicals in their lives. Augmented by a film, "Chemicals—A Matter of Balance," the speaker emphasized the need to balance the risks and benefits of chemicals.

JAMES ALBRIGHT, Secretary

Rocky Mountain

Dr. Robert Washborne, of Rohm and Haas, spoke on "RECENT UPDATES IN LATEX-BASED ALL SURFACE COAT-INGS."

In his presentation, Dr. Washborne explained how new advances in latex

polymer emulsions and additives can offer latex products with good performance on problem substrates, such as metallic surfaces and staining woods. STEPHEN CROUSE, Secretary

Rocky Mountain Nov. 12

A moment of silence was observed in memory of Dr. Willard Madson who died recently.

Frank Zurlo, of Byk-Mallinckrodt, spoke on the "SYNOPSIS OF THE DYNO-METER."

Mr. Zurlo mentioned some of the advantages of the dynometer sedimentation analysis instrument. He said that the instrument has the capacity to rapidly determine settling, to measure degree of a settled condition, and to measure interfacial tensions between liquids.

STEPHEN CROUSE, Secretary

St. Louis

Ed Lyszczek, of Air Products and Chemical Co., spoke on "SURFYNOL HYDROPHOBIC SURFACTANTS."

JOHN KEMPER, Secretary

Oct. 16

Western New York Oct. 9

Society President Thomas E. Popovec was presented with the traditional gavel by Mr. Connie Sisk, of Tenneco, Inc.

Douglas Grossman, of the Q-Panel Co., spoke on "ACCELERATED WEATH-ERING USING THE QUV MACHINE."

Mr. Grossman stated that the main concepts in the design of the QUV were that the largest effect of weathering comes from light of 280-320 nanometers wavelength coupled with surface wetness. The surface wetness results more from dew condensation than from precipitation, he said.

It has been found that in most places where panels were exposed, there was surface moisture on the panels 30-50% of the time. Mr. Grossman related that the water on the panels was free of dissolved salts, but saturated with dissolved oxygen.

In the QUV, acceleration of weathering is obtained by using intense UV light, constant exposure, high humidity, and higher than ambient temperature. Mr. Grossman concluded by explaining that no simple correlation exists between the QUV and natural weathering.

JAY A. ROBEY, Secretary

Future Society Meetings

Baltimore

(Mar. 20)—Manufacturing Committee Seminar on "WASTE MANAGE-MENT"

(Apr. 17)—Educational Committee program

(May 15)—Technical Steering Committee program on "WATER-BORNE COATINGS"

Chicago

(Feb. 4)—"EMULSION POLYMERIZA-TION TECHNIQUES"—speaker from Rohm and Haas Co.; "LATEX PAINT FORMULATION USING CPVC DETER-MINATIONS"—Ken Hesler, of DeSoto, Inc.

(Mar. 3)—Society Manufacturing Committee Program; and "INTERFACIAL CHEMISTRY IN CORROSION-INDUCED PAINT ADHESION LOSS"—Ray Dickie, of Ford Motor Co.

(April 7)—Society Technical Committee Program; and "EVAPORATION BE-HAVIOR OF ORGANIC CO-SOLVENTS IN WATER-BORNE COATINGS"—R. F. Eaton, of Union Carbide Corp.

C-D-I-C

(Feb. 11)—"AN OVERVIEW AND UP-DATE OF MILDEW RESEARCH SPON-SORED BY PRI"—John Schmitt, of Ohio State University.

(Mar. 10)—Society Technical Committee Program.

(Apr. 14)—"NEW CONCEPTS IN THE FORMULATION OF GLASS LATEX COAT-INGS"—John Bax, of Pacific Scott Bader, Inc.

(May 12)—"MISCIBILITY CHARAC-TERISTICS OF SOLVENT/WATER MIX-TURES"—Larry Culver, of Eastman Chemical Co.

Cleveland

(Feb. 19)—"WATER REDUCIBLES, COATINGS FOR CORROSION PROTECTION"—Speaker to be announced.

(April 15)—Plant Tour—Davies Can Co.

(Mar. 18)—"WASTE DISPOSAL AND THE ENVIRONMENT"—Speaker to be announced.

(May 20)—"PAINTING AND DECORAT-ING FROM THE FEMALE POINT OF VIEW"—Spouses' Night.

Detroit

(Jan. 22—"SALT FOG TESTING"—R. Van Doern, of NL Chemicals.

(Feb. 26)—"CONVENTION OF 1981" —F.J. Borrelle and T.A. Kocis.

(Mar. 25)—To be announced. (Apr. 22)—"DEFOAMING AGENTS"

-Arlene Reich, of Air Products.

Louisville

(Feb. 20)—"FOAM-RELATED AS-PECTS OF WATER-REDUCIBLE AL-KYDS"—Richard M. Thornton, of Nalco Chemical Co.

(Mar. 19)—"PLANT SAFETY"—Gil Kane, of Hercules Incorporated.

(Apr. 16)—FSCT SLIDE PRESENTA-TION—Federation Officers.

Montreal

(Feb. 6)—"A SAFETY PROGRAM DE-SIGNED FOR THE PAINT PLANT"— Manufacturing Committee Presentation. (Mar. 5)—JOINT MEETING with the

Quebec Paint Industries Association. (Apr. 2)—Speaker to be announced.

(May 7)—"GOVERNMENT SPECIFI-CATIONS IN THE PAINT INDUSTRY"—Joe Roberge, of B.N.Q., and Frank Eadie, of C.G.S.B.

Northwestern

(Feb. 5)—Federation Officers Visit. (March 4)—Annual Symposium.



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Technical Articles in Other Publications

Compiled by the Technical Information Systems Committee—H. Skowronska, Chairman

Deutsche Farben-Zeitschrift (Defazet) (in German)

Published by Edition Lack und Chemie, Elvira Moeller GmbH, Karl-Benz-Strasse 11, Postfach 11 68, 7024 Filderstadt 1

Vol. 33 No. 8

August 1979

- Kossmann, H. and Florus, G.—"Adhesion of Dispersion Coatings on Alkyd Resin Coatings"; 240-245.
- Audykowski, T. and Schmid, R.—"New Thermosetting Epoxy Resin Systems for the Formulation of Full-body Industrial Coatings"; 246-251.
- Lauterwasser, L. and Ondratscheck, D.—"Systematic and Objective Quality Control in the Manufacture of Raw Materials for Coatings"; 252-259.
- Sczyslo, S.—"Corrosion-resistant Systems for Steel Bridges on Highways"; 260-271.

Herrmann, E.- "Pigment Analysis"; 272-274.

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- Rausch, W.—"Chemical Surface Treatment for Automotive Parts before Paint Application"; 292-296.
- Saatweber, D.—"EPC Electrodeposited Coatings with Cationic Powder Suspensions"; 296-299.
- Zorll, U.—"Climatic Effects on the Mechanical Behavior of Protective Coatings in Multi-layered Structures"; 300-309.
- Danner, M. and Bohn, W.—"Color Tone Equalization/Matching as the Object in Refinishing"; 310-312.
- Krewinkel, H.W.—"Color Determination by Means of the ACC System"; 312-315.

Polymer Preprints

Papers presented before American Chemical Society Division of Polymer Chemistry, Washington, D.C.

Vol. 20 No. 2

September 1979

Polypeptides and Proteins

Evolution of polypeptides and origin of life (6 papers)

Medical use of polypeptides (6 papers)

Primary sequence and structure in proteins (5 papers)

New methods for determining aspects of polypeptide and protein structure (6 papers)

Branched Polymers (24 papers)

- Characterization of Macromolecules by ESR and NMR Techniques ESR studies of synthetic polymers (6 papers) ESR and NMR studies of biochemical systems (5 papers)
 - Dynamic and structural NMR studies of synthetic polymers in
- solution (6 papers)

Solid state NMR (6 papers)

Special Topics in Polymer Chemistry (93 papers)

- Macromolecular Secretariat Water in Polymers (Abstracts only) Structure of water (4 abstracts)
 - Association of water in synthetic polymers (7 abstracts)
 - Water interactions with natural and synthetic fibers (6 abstracts) Natural and effect of water-polymer interactions (7 abstracts) Water - surface interactions (6 abstracts)
 - Interaction of proteins with water (4 abstracts)

Supplementary aspects of water - polymer interactions (8 abstracts)

Note: Information regarding the price and availability of this preprint volume is available from Dr. Frederick Dammont, Beckton Dickinson Co., Rutherford, N.J. 07070

Journal of the Oil and Colour Chemists' Association

Published by Oil and Colour Chemists' Association, Priory House, 967 Harrow Road, Wembley, Middlesex, HAO 2SF England

Vol. 62 No. 7

- Huxtable, D.J. and Pickering, F.G.—"Paint Extenders Based upon Naturally Occuring Aluminum Silicates (China Clays)"; 233-238.
- DuPlessis, T.A. and DeHallain, G.—"Electron-Beam Curing of Coatings"; 239-245.
- Van Westrenen, W.J.—"Modern Developments in Aqueous Industrial Coatings"; 246-255.

van der Meer-Lerk, L.A. and Heertjes, P.M.—"Mathematical Model of Growth of Blisters in Varnish Films on Different Substrates"; 256– 163.

Farbe und Lack (in German)

- Published by Curt R. Vincentz Verlag, Schiffgraben 41-43, Postfach 6247, 3000 Hannover 1, Germany
- Vol. 85 No. 9
- September 1979

July 1979

- Ueki, K.—"Paint Research in Japan"; 729-732. Lincke, G. and Immenroth, R.—"Interaction Between Colour Zinc
- Dust and Polished Iron Plate in the Presence of N/10 Salt Solutions"; 733-744.
- Schmid, E.V.-"Coil Coating of Light Alloy"; 744-748.
- Svoboda, B., Hajkova, B., Vladyka, J., and Bogumska, I.—"Powder Coating Mixes with Various Curing Times"; 749-756.
- Athey, R.D., Jr.—"Chemical Factors which Affect Water-Based Coating Viscosities"; 757-759.
- Brushwell, W.—"New Studies on Corrosion Protection and Adhesive Power of Varnishes"; 760-761.
- German Standard Draft DIN 5033 Part 5: Colorimetry by Visual Matching; 762.
- German Standard Draft DIN 53218: Testing of Paints, Varnishes and Similar Coating Materials; Visual Comparison of the Colour of Paint Coatings 763-764.

Double Liaison—Chimie des Peintures (in French)

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

- Vol. 26 No. 286 June 1979
- Bernelin, D.—"Elasticity Modulus Measurement of a Thermosetting Powder Paint"; 25-28.
- Boillon, R.—"Some Aspects of High Solid Paints Formulation"; 31-40.
- Dauvillier, J.—"Research on Oil Soluble Formophenolic Resins Reactions. Part 4"; 45-52.

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- Lombardo, F.—"Titanium Dioxide; Investments and Prospects"; 15-23.
- Dauvillier, J.—"Research on Oil Soluble Formophenolic Resins Reactions"; 24-31.

Please consult the Union List of Series or New Series at your nearest public or college/university library for the location of listed periodicals in American libraries.

Rolla Schedules 1980 Short Courses; Program Expands to California

The Continuing Education Department of the University of Missouri-Rolla will sponsor its 1980 series of Paint Short Courses, scheduled from February 25 to November 21. For the first time, the university will expand its program to include cities other than Rolla and St. Louis. To accommodate participants from the West Coast, the 30th Short Course for Painting Contractors and Maintenance Engineers will be presented in San Mateo, Calif., on Feb. 25-19.

These intensive, week-long programs will be directed by John A. Gordon, Jr., Adjunct Professor of Chemistry at Rolla. He will be assisted by lecturers experienced in various fields of paint production and use.

(Feb. 25-29, Nov. 10-14)—"Refresher for Maintenance Engineers, Contractors, and Paint Inspectors"—Designed to inform students of new developments in the field of maintenance coatings, paint application methods, cost estimation, and government regulations, this course will stress the painting of various surfaces and structures encountered by the painting contractor. Also presented are methods of application to meet specifications in an economical way and an examination of paint jobs in the field to assure that these specifications are being met. Cost of the course is \$235.

(Mar. 3-7, Aug. 18-22)—"Introductory Short Course on Composition of Paints"—Through lecture, audio-visual presentations, and classroom demonstrations, participants will be introduced to the history of paint, the materials used in coatings manufacturing, and some simple formulating techniques. Designed for newcomers, this course also will offer explanations of the equipment used to make and test modern protective coatings. Fee for the class is \$235.

(Mar. 10-14, Aug. 25-29)—"Basic Quality Control Short Course"—Emphasis will be placed on proper quality measurements of paints in the process of manufacture. Topics covered in this laboratory/lecture course include good incoming raw material testing, the role of the quality assurance laboratory in the manufacturing process, the importance of accurate finished product testing, the growing problem of product liability, and the new restrictions of toxic substances control and waste disposal. Cost of the course is \$235. (Mar. 31-Apr. 4, Sept. 8-12)—"Introduction to Paint Formulation"—This lecture and laboratory course will feature sections on calculating coating formulas for performance, economics, method of manufacture, and compliance with growing numbers of government regulations. Sensible limitation of inventory complexity and the use of most readily available raw materials will be stressed. The cost of the course is \$325.

(Apr. 7-11, Sept. 15-19)—"Advanced Chemical Coatings Workshop"—Emphasizing vehicle systems for coatings in a regulated industry, this workshop will examine new systems under test, their availability for marketing, and advantages/disadvantages of each system. With open discussions and private conversations with experienced lecturers who will present recent progress in their special fields of interest, focus will be placed on vehicles for industrial finishes to meet regulatory demands that are becoming more and more restrictive. The cost of the workshop is \$235.

(Nov. 17-21)—"Job Estimating Workshops for Painting Contractors"—Study will include blueprint reading, specifications, quantity take-offs, and pricing structures. The class will work from actual plans in as near a real-life situation as possible. Class cost is \$325.

For additional information, or to register, contact Norma Fleming, Extension Div., University of Missouri-Rolla, 501 W. 11th St., Rolla, Mo. 65401; or for technical information, contact John A. Gordon, Chemistry Dept., U. of Mo.— Rolla, Rolla, Mo.

NACE Schedules Corrosion Education Courses for Feb.

Three continuing corrosion education seminars are scheduled for February 1980 by the National Association of Corrosion Engineers (NACE). The courses offered in these seminars cover a variety of topics such as cathodic protection, protective coatings, corrosion inhibitors, materials selection, and design factors. The courses provide practical information for personnel interested in learning to prevent and control corrosion in various industries and environments.

The NACE Basic Corrosion Course provides basic information on corrosion of metals, deterioration of nonmetals, electrochemical phenomena, elementary chemistry, and information on practical methods currently used to control corrosion.

The Corrosion Prevention by Cathodic Protection Course provides information on the theory of cathodic protection and its application. Important areas covered are environments, soils, types of corrosion, chemical, electrical, and electrochemical factors, surveys, protective coatings, groundbed design, and interference.

The Corrosion Prevention by Coatings Course provides instruction and training for engineers who make practical use of protective coatings in corrosive environments.

The first seminar will be held Feb. 17-22, at the University of Alabama in Tuscaloosa, Ala. The Corrosion Preven-

tion by Cathodic Protection course will be offered.

In Minneapolis, Minn. two courses will be offered concurrently Feb. 17-22. The courses, NACE Basic Corrosion Course and Corrosion Prevention by Cathodic Protection, will be held at the Holiday Inn Downtown.

The third seminar will be held Feb. 24-29, in San Diego, Calif. The courses to be offered concurrently, the NACE Basic Corrosion Course, Corrosion Prevention by Cathodic Protection, Corrosion Prevention by Coatings, will be presented at the Holiday Inn Embarcadero.

Each of the NACE courses is presented in a 34-hour (4½-day) seminar with final examination. The registration fee for each NACE Education Course is \$350 (\$300 to NACE members) and includes NACE textbooks, study guides, selected NACE standards, chapter exams and answer keys, lunch, and refreshment breaks each day the course is in session.

For further information on the course offered in Tuscaloosa, Ala. contact Ray Hollub, Director, Division of Continuing Engineering Education, University of Alabama, P.O. Box 2967, University, Ala. 35486.

For further information on any of the other NACE courses, or an extended schedule of courses, please contact: Education Department, NACE Headquarters, P.O. Box 218340, Houston, Tex. 77218.

Hazardous Waste Disposal/Handling Is Topic of New England Symposium

The New England Society for Coatings Technology will present a symposium on Hazardous Waste, Feb. 21, 1980, at the Fantasia Restaurant, Cambridge, Mass.

Beginning after lunch, speakers will discuss the "Legislative Industry Overview." The panel will consist of: Dennis Huebner, of the Solid & Hazardous Waste Program, EPA, Region I; Dr. Anthony D. Cortese, of the Dept. of Environmental Quality Engineering, State of Massachusetts; Peter Schneider, of New England Regional Commission; and Robert Nelson, of National Paint and Coatings Association.

Discussing an "Overview of Treatment and Disposal" will be Robert B. Pojasek, of Energy Resource Co., Inc.

The topic, "Disposal-Off Premises" will feature speakers, Donald L. Corey,



of Recycling Industries, Inc.; Dr. Sam Lee, of Earthline/SCA; and Myron H. Smith, of Solvents Recovery Service of New England.

"In-Plant Handling and Treatment" will be discussed by (Incineration) George Finn, of NuWay Industries; (Scheduling, Collection, and Recycling) Al Dade, of E.I. du Pont de Nemours & Co., Inc.; and (Pretreatment) George S. McTavey, of Cosan Chemical Corp.

Further information may be obtained from Robert G. Modrak, Benjamin Moore & Co., 49 Sumner St., Milford, Mass. 01757.

Birmingham Society Symposium To Examine England's Paint Regs

The Birmingham Paint, Varnish and Lacquer Club will present a Symposium on the topic, "Effect of Current Legislation in the U.K. Paint Industry," May 15, 1980, at the Birmingham Metropole Hotel, Birmingham, England.

Scheduled speakers include the following: J. Bharier, of International Paint Co. Ltd.; K.E. Robbins, of H.S.E. Chemicals Group; M.J. Levete, of the Paintmakers Association of Great Britain Ltd.; and R. Allen, of W. Canning Materials Ltd.

Additional information is available from Symposium Secretary David M. Heath, Arthur Holden & Sons Ltd., Bordesley Green Rd., Birmingham, B9 4TQ, England.

Deadlines Announced For Society Papers

Societies planning to submit papers in competition for the A. F. Voss/American Paint and Coarings Journal Awards in 1980 should advise the AFV/AJCJ Awards Committee of their intentions to participate by May 1, 1980. The announcement was made by Committee Chairman Horace S. Philipp.

Papers must be received at the Federation headquarters office \underline{no} later than July 30 to be eligible for the 1980 competition.

Notification of intent to compete should be sent to Horace S. Philipp, c/o Sherwin-Williams of Canada Ltd., P. O. Box 489, Montreal, Quebec H3C 2T4, Canada.

People

Dr. Arthur M. Bueche, Senior Vice-President of Corporate Technology of the General Electric Co. has been selected as the 1980 Gold Medalist of the American Institute of Chemists. The award, originated in 1926, is presented annually to the person who has stimulated activities of service to the science of chemistry, the profession of chemist, or chemical engineer in the U.S.

Robert A. Woodard has been appointed Director of Advertising and Sales Promotion for Ashland Chemical Co., Columbus, Ohio. He will direct advertising, sales promotion, and marketing activities for the company's six operating divisions and international subsidiaries.

Raymond H. Jones has joined Henkel Corp. as Vice-President, Operations. In his new position, Mr. Jones will be responsible for manufacturing in the company's plants in Charlotte, N.C.; Huboken, N.J.; Saugus, Mass.; Hawthorne, Calif.; Chicago, Ill.; and Oak Creek, Wisc.

The Flecto Company, Inc., Oakland, Calif., has named **Roger Taylor** Vice-President of Operations. He has served as Plant Manager for the company for over 11 years.

Drew Chemical Corp., Boonton, N.J., has promoted **James N. Tanis** to Senior Consultant of its Consulting and Technical Services. In his new position, he will continue to support field sales, both nationally and internationally.

Meanwhile, Peter A. Thomas has been promoted to Senior Technical Associate of the firm.

Robert G. Landis has been appointed Technical Director of DeSantis Coatings, Inc., Willoughby, Ohio. He will contribute 18 years of experience in both laboratory and plant supervision of industrial coatings and product finishes manufacturing. Mr. Landis is a member of the Cleveland Society.

Witco Chemical Corp. has appointed Chris J. Mocek Director of Product Management for the surfactants product group of its Organics Division. He will be headquartered in Houston, Texas.

Hobart L. Overocker has been appointed Vice-President, Manufacturing, of the Coatings Group of Dutch Boy, Inc., Baltimore, Md.





W. P. Ellis

Wayne P. Ellis, Manager of industry standards for the H.B. Fuller Co., Spring House, Pa., has been elected President for a one-year term for the American Society for Testing and Materials (ASTM).

Associate Vice-President for Research at the Tennessee Technological University, Manchester, Tenn., William A. Goodwin, was elected to a two-year term as Vice-President of the organization. Other nominees elected to three-year terms on the Board of Directors are: Gladys Berchtold, of Standards Labs in Charleston, W. Va.; Robert L. Booth, of the Environmental Protection Agency's Environmental Monitoring and Support Lab. in Cincinnati, Ohio; W. Kenneth Davis, of the Bechtel Power Corp. in San Francisco, Calif.; Frank W. Kunz, of Ford Motor Co. in Taylor, Mich.; William M. Mueller, of the Colorado School of Mines in Golden, Colo.; and Lendell E. Steele, of the U.S. Naval Research Lab. in Washington, D.C.

Spencer-Kellogg Div. of Textron, Inc., Buffalo, N.Y. has promoted **Richard M. Benton** to the position of Manager of Applications and **Richard K. Hong** to Application Supervisor.

Ralph S. Chancey, President of The Standard Manufacturing Company Ltd. was elected President of Coatings Research Group, Inc. He succeeds Robert B. Gregory, President of Cowman-Campbell Paint Co., who served during the 1978-79 term. Mr. Chancey is a member of the Montreal Society.

Other officers elected for 1979-80 are: Vice-President—**Daniel J. Haley, Jr.**, of Finnaren & Haley, Inc.; Secretary—R **Dwight Weed**, of Durako Paint & Color Corp.; and Treasurer—**Hiram P. Ball**, of Ball Chemical Co. Both Mr. Weed (Detroit Society) and Mr. Ball (Pittsburg Society) are active in the Federation.





D. R. Hanlon R. Dickinson

Three key appointments have been announced by M&T Chemicals Inc., Rahway, N.J. They are: **Dennis R. Hanlon**, General Manager of the Industrial Chemical Div.; Eric A. Meace, Director of Marketing and Sales for the Plating Div.; and Jay G. Kaplan, Senior Vice-President of Operations.

Randall J. Dickinson has been appointed Account Manager for E.T. Horn Co., La Mirada, Calif. A member of the Los Angeles Society, he will be involved primarily in the coatings, ink, and adhesive areas in southern Calif.

Air Products and Chemicals, Inc., Allentown, Pa., has appointed Michael J. Taylor Account Manager of the Polymer Chemicals Sales Dept.

Cook Paint and Varnish Co., Kansas City, Mo. has appointed **Warren O. Manley** Director of Research and Quality Control. Mr. Manley, a member of the Kansas City Society, joined Cook in 1947. He succeeds **Paul Westfall**, who has retired following a career of 40 years with the company.

In a series of managerial appointments. Sun Chemical Corp. Pigments Division, of Cincinnati, Ohio, has named Edward J. Wood—Director of Sales and Marketing; Arthur B. Finn—National Sales Manager; William E. Bready— Eastern Regional Sales Manager; and Dale Stahl—Midwestern Sales Manager

Also announced are the following appointments in the Manufacturing and Engineering organization of the firm: **Paul W. Klein** has been named Director of Manufacturing; **Ronald L. Marino**— Operations Manager at Cincinnati; **Edwin Faulkner**—Operations Manager at Rosebank and Newark; **David Thompson**—Production Manager of the Cincinnatit facility; and **David W. Foulkes**—Traffic Manager.

Four members of the National Association of Corrosion Engineers (NACE) were selected by the Board of Directors to receive the 1979 Citations of Recognition for Outstanding Contributions. Given public recognition for their noteworthy performance were William A. Campbell, President of Cameng Services, Ltd., Alberta, Canada; Robert L. Chance, Senior Research Scientist in the Physical Chemistry Dept. of General Motors Research Labs., Warren, Mich .: John M. Cieslewicz, Corrosion Metallurgist for the Ampco Metal Div., Ampco-Pittsburgh Corp., Milwaukee, Wisc.; and George P. Gladis, Assistant Manager in Product Engineering and Development Dept., Carpenter Technology Corp., Union, N.J.

Three new staff appointments have been announced by the Chemical Manufacturers Association. Washington. D.C. Juliane Harvey will assume the responsibilities of Special Projects Administrator, Technical Dept. She formerly served as Environmental Supervisor at du Pont Co.'s titanium dioxide facility in Gulfpost, Miss. Georgene Savickas, formerly associated with the National Paint and Coatings Association, has been appointed to the newly created position of Director of Meetings and Conventions. Filling the position of Legislative Representative for Energy and Transportation Matters, Government Relations Dept. is W. Alan Woodford. Mr. Woodford served for five years with the office of General Counsel for the Appalachian Regional Commission.

Kerr-McGee Chemical Corp., Oklahoma City, Okla. has named W.W. Young to the position of Executive Vice-President. He will assume responsibility for all chemical manufacturing and forest products operations for the company.

H.R. Lefebvre has joined Lawson Chemical Products Co., Torrance, Calif., as Vice-President of Sales and Marketing. His responsibilities will include the development and implementation of sales and marketing programs designed to promote the company's private label aerosol coatings and specialty chemical lines on a nationwide basis.

The Hilton-Davis Chemical Co., Cincinnati, Ohio, has named **Donald C. Denison, Jr.** a Sales Representative for the Pigment Div. In this new position, his duties will include calling on customers in the paint, plastics, and printing ink industries in northern Ohio, western Pa., and N.Y. Mr. Denison is a member of the Cleveland Society. In a series of executive appointments, United States Gypsum Co., Chicago, Ill., has named Robert J. Day—Executive Vice-President and a Director; Harry M. Stover—Executive Vice-President; John R. Anderberg—Senior Vice-President of Marketing; and Stanton T. Hadley— Group Vice-President, Industrial Group. Andrew J. Watt and Benjamin F. Bailar will continue as Executive Vice-Presidents of the corporation.

The Sherwin-Williams Co. has established a Materials Management Group to handle the purchasing, production planning, and inventory control functions of the division. The group will be headed by James E. Hilyard, recently appointed Vice-President and Director. Assisting Mr. Hilyard will be Jack F. Clifford, Division Director of Purchasing.

The Association of Finishing Processes of the Society of Manufacturing Engineers (AFP/SME) has named Horace H. Homer President for 1979-80. Mr. Homer is a retired Senior Scientist from GTE Sylvania, Danvers, Mass. He succeeds Richard K. Anderson, of the 3M Company, St. Paul, Minn.

Dr. Albert C. Zettlemoyer, Provost and Vice-President of Lehigh University, has been chosen President-Elect of the American Chemical Society (ACS) in a mail ballot of the Society's members in the U.S. and abroad. Holding the title of University Distinguished Professor of Chemistry at Lehigh and recognized for his numerous important contributions to the surface and colloid chemistry and to ink technology, he will head the Society's 118,000 chemists and chemical engineers starting in 1981. He will also serve on the Board of Directors for three years beginning Jan. 1, 1980.

Honors accorded Dr. Zettlemoyer include the 1957 Federation Mattiello Award, the Kendall Award from the American Chemical Society, the American Institute of Chemists Honor Scroll, the Voight Award from the Graphic Arts Industry, the Hillman Award from Lehigh, and the Ault Award from the Printing Ink Industry.

One of the founders of the National Printing Ink Research Institute and the Center for Surface and Coatings Research at Lehigh, he has been a consultant to several governments and has lectured widely in the U.S., U.S.S.R., China, Japan, and Europe.

Drew Chemical Corp. has promoted three men on the Consulting and Technical Services Staff. Karl W. Herman has been promoted to Senior Consultant; Jeffrey R. Townsend has been appointed Consultant; and Thomas D. Dishinger has been named Senior Technical Associate. Dr. Wouter Bosch, Dean Emeritus, University of Missouri-Rolla, was a guest lecturer for the 33rd Advanced Chemical Workshop at UMR on October 22, 1979. His lecture, "Coatings, Past, Present, and Future," drew on his forty-five years of experience in the coatings industry in Holland and the U.S. Dr. Bosch, a member of the St. Louis Society, was presented with a plaque recognizing his contributions to education in the industry.

W.P. Joyce has been named Quality Assurance, Product Control Manager in the Trade Sales Dept. of DeSoto, Inc., Des Plaines, Ill. He will be reponsible for the product control for the Sears product line.

In addition, Stanley S. Briedis was named Director of Quality Assurance for the Chemical Coatings Div. of DeSoto. Both men are members of the Chicago Society.

Hercules Incorporated has appointed three new worldwide business center directors: R.G. Fajans-Resins; D. James MacArthur-Rubber and Specialty Chemicals; and Keith T. Smith-Paper Chemicals.

Fred Walworth, Executive Vice-President and Technical Director for Spokane-based Columbia Paints, was elected to succeed KWAL Paint's, Denver, Board Chairman Harold Weinberg, as President of Color Guild Associates, Phoenix, Arizona.

Other officers selected for two-year terms are: Vice-President—John DeHart, of DeHart Paint Co.; Treasurer-Terry Turner, of Frank W. Dunn Co.; and Secretary—Tom Goldman, of Iowa Paint Manufacturing Co.

NL Industries, Inc. has elected Jack B. St. Clair to its Board of Directors. Mr. St. Clair recently retired as President of Shell Chemical Co., Executive Vice-President for Products, and a Director of Shell Oil Co.

Buckman Laboratories, Inc., Memphis, Tenn. has elected **Dr. John D. Para** to its Board of Directors. At the same time, the company's Board gave its Chairman, **Robert H. Buckman**, the added responsibility of serving as President of the firm. These corporate changes were made following the recent death of **Dr. John D. Buckman**, who served as the firm's President since 1971.

Max R. Adam has been appointed Manager of Trade Sales Quality Assurance of Pratt and Lambert, Buffalo. He will be responsible for interrelating with the sales, manufacturing, and technical departments of the firm. Daniel Products Co., Jersey City, N.J., has promoted **Ramon Pineiro** to Vice-President, Research and Development. Mr. Pineiro is a member of the New York Society, for whom he has frequently lectured on the subject of pigment dispersions part of the Society's course on basic coatings technology.

Witco Chemical Corp., New York, N.Y. has appointed Norman Jacobson manager of Technical Service and Paul E. Laura Manager of Product Development for its Sonneborn Div. Both men will be based at the company's New York offices.

Rohm and Haas Co., Philadelphia, Pa. has assigned **David Moffat** to the position of Product Specialist for industrial coatings. In this position, he is responsible for general product finishing markets in the company's Polymers, Resins, & Monomers—North America business team. Mr. Moffat is a member of the Toronto Society.

Additional appointments announced by Rohm and Haas, business team are: **Eugene T. Gilbridge**—Market Area Manager and Jack E. Fellerman—Senior Technical Representative.

Andy Pesez has joined Ribelin Distributors, Inc., Houston, Tex., as Branch Manager of the Houston office and warehouse complex. Prior to this position, he was the National Manager of Custom Service and Warehousing for General Electric Silicones, Waterford, N.Y.

Steve Hightower has joined the Dallas sales group of R.B. Patterson and Company, Inc. He will be responsible for sales in Oklahoma and West Texas, as well as the Dallas-Fort Worth metroplex.

Kirt Smith has been appointed Polymer Applications Specialist in the research and development laboratory of Freeport Kaolin Co., a division of Freeport Minerals Co., New York, N.Y. Mr. Smith was formerly associated with PPG Industries, where his experience included research in unsaturated polyesters, container coatings.

Dr. Donald V. Kinsman has been promoted to Manager, Fatty and Dibasic Acids Research for Emery Industries, Inc., Cincinnati, Ohio. He will be responsible for the development of new and improved uses for fatty acids and dibasic acids.

Air Products and Chemicals, Inc., Allentown, Pa., has named **Chris T. Law** to Eastern Regional Sales Manager of Polymer Chemicals. In his new position, he will be responsible for polymer chemical sales in the Eastern U.S. and Canada.

Obituary

Herbert H. Hass, 68, Past-President of the Kansas City Society, died on November 9, 1979. He retired in 1976 from the position of Production Manager of Pratt & Lambert, Inc., after 47 years of service. Dr. John D. Buckman, 39, President of Buckman Laboratories, Inc., Memphis, Tenn., died suddenly on November 6, 1979. He received the Ph.D. Degree in Organic Chemistry from Vanderbilt University in 1966. His work in the research laboratories of Buckman resulted in more than 25 patents for chemical products or applications of products. Mr. Buckman had served as President of Buckman since 1971.



C. J. OSBORN CHEMICALS, Inc.

820 SHERMAN AVENUE, PENNSAUKEN, N. J. 08109





Elections

BALTIMORE

Active

- CHODNICKI, RICHARD C.-Hanline Bros. Inc., Baltimore, Md.
- DUNN, LARRY D .- Duron Paint Co., Inc., Beltsville, Md.
- HENRY, RICHARD J .- Dutch Boy Paint, Inc., Baltimore.
- HUBICKI, WANDA S .- Comm. of Va. Dcls., Richmond, Va.
- KEEGAN, HELEN-Valspar Corp., Baltimore.
- MCLAURIN, MICHAEL C.-The O'Brien Corp., Baltimore.
- PULLEN, RAY LEE-Valspar Corp., Baltimore.
- TRENKLE, MARTIN A.-Dominion Paint Mfg. Co., Virginia Beach, Va.

Associate

- MCCLOSKEY, RICHARD D.-Valspar Corp., Baltimore, Md.
- MILLER, ROY-Kerr McGee Chemical Corp., Belair, Md.
- MITCHELL, THOMAS W.-Tenneco Chemicals Co., Baltimore.
- PREUSSE ALLYN B.-Reichhold Chemical, Inc., Medford, N.J.
- SMITH, WILLIAM A.-Eastman Chemical Corp., Newark, De.

CHICAGO

Active

- ABBOTT, AUSTIN C. JR-Sherwin-Williams Co., Chicago, Ill.
- BALL, DAVID A.-Mobil Chemical Co., Kankakee, Ill.
- BATTON, GREGORY-DeSoto, Inc., Des Plaines, Ill.
- BEIL, ROBERT I.-Ni-Chem. Inc., Chicago.
- BERG, THOMAS R.-The O'Brien Corp., South Bend, Ind.
- BERS, KENNETH D.-DeSoto, Inc., Des Plaines.
- BLAHA, RICHARD-Dutch Boy Paints, Chicago.
- BOWNAN, JOHN A.-Rust-Oleum Corp., Evanston, Ill.
- BURKE, MARGARET MARIA-Standard T Chemical Co. Inc., Chicago Heights, Ill.
- BURNS, LARRY-Bee Chemical Co., Lansing, 111
- CASSON, JOSEPH L.-W. C. Richards Co., Blue Island, Ill.
- CATENA, JR., DANIEL W. -Standard T. Chemical Co., Inc., Chicago Heights.
- CONTI, RONALD S .- Bee Chemical Co., Lansing.
- CUMMISFORD, ROBERT G.-Krause Milling Co., New Berlin, Wisc.
- CZAKKA, THOMAS-Amoco Chemicals Corp. Naperville, Ill.
- DAHM, DONALD B.-Illinois Bronze Powder & Paint Co., Lake Zurich, Ill.

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- DOMINGO, ROLANDO C.-DeSoto, Inc., Des Plaines.
- DONOVAN, MARCELLA G.-DeSoto Inc., Des Plaines.
- DURKIN, THOMAS J.-Standard T Chemical Co. Inc., Chicago Heights.
- ECONOMOS, PATRICIA—Dupli-Color Products Co., Elk Grove Village, Ill.
- FISCHER, ANNELIESE-The O'Brien Corp., South Bend.
- FORTUNAK, RICHARD C. JR.-O'Brien Corp., South Bend.
- GLUCHMAN, DENISE-Dexter-Midland Div., Waukegan, Ill.
- INDIHAR, JOSEPH F.-The O'Brien Corp., South Bend
- KEATON, LARRY B.-Dutch Boy Paints, Chicago.
- KHAN, MAZHER-Pre-Finish Metals, Inc., Elk Grove Village.
- KURZ, CLARK J.-Mobil Chemical Co., Kankakee.
- LAT, GERONIMO E.-United States Gypsum Co., Des Plaines.
- LESTARGE, KEVIN J.-DeSoto, Inc., Des Plaines.
- LESSER, MARY E. DeSoto, Inc., Des Plaines. LIN, SHIOW CHING-DeSoto, Inc., Des
- Plaines.
- LYNCH, RICHARD J.-Valspar Corp., Rockford. Ill.
- MCALPIN, STANLEY L.-Dupli-Color Products Co., Chicago.
- MEMON, ABDUL K .- United Coatings, Inc., Chicago.
- MUELLER, HERMANN-Lawter Chemicals Inc., Northbrook, Ill.
- MURRAY, KEVIN P.-Bee Chemical Co., Lansing.
- NOWICKI, ROMAN J.-United Coatings, Inc., Chicago.
- PASTERNACK, GEORGE-DeSoto, Inc., Des Plaines.
- PATEL, BABU R.-Midwest Products, Chicago.
- PATEL, NATU-Standard T Chemical Co. Inc., Chicago Heights.
- PENNANEN, HANNU-Pre-Finished Metals, Inc., Elk Grove Village.
- PISKE, CHARLES A.-Midwest Synthetics, Rockford.
- PISZYNSKI, EDWARD S.-Hydrosol, Inc., Cicero, Ill.
- RACHAPUDY, HEMALATHA-Jordan Paint Mfg. Co., Forest Park, Ill.
- RESKOR, EDWARD-Sun Chemical Corp., Northlake, Ill.
- RIDDICK, WAYNE T.-Amoco Chemicals Corp., Naperville.
- SCHWEIKART, JAMES W .- Standard T Chemical Co. Inc., Chicago Heights.
- SHAFER, MARTHA J.-Rust-Oleum Corp., Evanston.
- SIPLA, ROBERT J.-Hydrosol Inc., Cicero. STEPHEN, MATTHEW T.-Iowa Paint Mfg.
- Co., Inc., Des Moines, Iowa.
- STRENGE, WILLARD L.-DeSoto, Inc., Chicago Heights.

- SULLIVAN, RICHARD E.-Premier Paint & Varnish, Elk Grove Village.
- TANNER, TERRY R.-Glidden Coatings & Resins Div., Chicago.
- VINSON, HENRY T.-Standard T Chemical Co. Inc., Chicago Heights.
- WALCER, CHUCK-K.J. Quinn Co., Inc., Buffalo Grove, Ill.
- WALLACE, JAMES R.-General Paint & Chemical Co., Cary, Ill.
- YAPP, WILLIAM J.-Rust-Oleum Corp., Forest Park.
- YODER, CHARLES O.-Abitibi Corp., Middlebury, Ind.

Associate

- BADER, GORDON H.-Spencer-Kellogg, Des Plaines, Ill.
- BRACKEN, DAVID J.-T.H. Hilson Co., Geneva, Ill.
- CAREY, WENDEL W.-Harshaw Chemical Co., Hinsdale, Ill.
- FRANCE, TOM-BASF Wyandotte Corp., Palatine, Ill.
- GOGEK, JACK L.-Union Chem. Div. of Union Oil of Calif., Schaumburg, Ill.
- GALLUM, LAWRENCE E.-Endura Coatings, Gurnee, Ill.
- HARRIS, BRUCE R.-Stepan Chemical, Northfield, III.
- LAWRENCE, RONALD A .- Union Oil Co. of California, Rolling Meadows, Ill.
- MENZIES, PAUL G .- CIBA GEIGY Corp., Oak Brook, Ill.
- MOELLER, RAYMOND J.-Daniel G. Herelev Co., Chicago, Ill.
- SCARPELLI, GEORGE-Harshaw Chemical Co., Hinsdale.
- SEREMET, JOSEPH-Byk-Mallinckrodt, East Chicago.
- SHAFFER, GARRY L.-Calcium Carbonate Co., Quincy, Ill.
- SOUDERS, RONALD J.-Jensen-Souders & Associates, Inc., Itasco, Ill.
- THORNTON, RICHARD M.-Nalco Chemical Co., Oakbrook.
- THORSTAD, JAMES A .- Drew Chemical Corp., Chesterton, Ind. TYGETT, DAVID—Alcan Ingot & Powder,
- Chicago.

C.D.I.C.

Active

- BLIZZARD, DAVID L .- Talsol Corp., Cincinnati, Ohio
- BRUGGER, TERRY L.-PPG Industries, Inc., Delaware, Ohio
- BUTLER, JAMES-PPG Industries, Inc., Delaware. Associate

WILSON, JAMES D.-NL Chemicals, Middle-

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burg Heights, Ohio

DALLAS

Active

- BUSE, MARK—Texas Refinery Corp., Fort Worth, Tex.
- CURRENS, THOMAS B.—DeSoto, Inc., Garland, Tex.
- GIBSON, JR., HENRY C.—Mono Chem. Corp., Atlanta, Tex.
- LINDSTROM, MERLIN R.—Phillips Petroleum Co., Bartlesville, Okla.

Associate

- ARCHER, CARL D.—American Cyanamid Co., Dallas, Tex.
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Book Review

MANUAL OF COATING WORK FOR LIGHT-WATER NUCLEAR POWER PLANT PRIMARY CONTAINMENT AND OTHER SAFETY-RELATED FACILITIES

Prepared by ASTM Subcommittee D01.43 On Coatings For Power Generation Facilities 1979 (188 Pages)

Reviewed by Dr. Darlene Brezinski DeSoto, Inc. Des Plaines, III.

This manual, prepared by an ASTM subcommittee on Coatings for Power Generation Facilities, is intended as a guide and reference source for all concerned with coating work for primary containment and other safety-related facilities in light-water nuclear power plants.

Chapter one describes types of commercial light-water nuclear reactors and establishes the need for coating work in the primary containment structure. The relationship of coating work to the Engineered Safety Systems (ESS) is also detailed. The manual is primarily directed at recommended requirements for specific phases of coating work as indicated by the following chapter headings: coating system selection, quality assurance, inspection, painters qualification, certification and training, safety and environmental control, surface preparation, verification of coating materials. coating application, coating repairs for continuous coating operations, topcoating of cured coatings, and inspection and maintenance in operating plants (licensed)

The book, written in ASTM format, provides an excellent guide for utility owners, architects, engineers and construction people, nuclear steam supply

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system manufacturers, coating manufacturers and applicators, inspection agencies and R&D laboratories. The inclusion of numerous descriptive photographs, in addition to many examples of data and record keeping forms and checklists, is a valuable asset to this manual. A complete reference guide is also appended.

It should be noted that this manual is applicable for surveillance and maintenance for coating work for the life of the plant, in addition to addressing the requirements for new structures.

CORROSION INHIBITORS Recent Developments

Author J.S. Robinson Noyes Data Corp. Park Ridge, N.J. 1979, \$42.00

Reviewed by John Nelson Whirlpool Corp. Benton Harbor, Mich.

This book contains an in-depth, thorough review of recently issued patents. The patent area covered includes inhibitors for circulating water systems, including municipal water supplies; for oil well and refinery operations, including acidic gas treatments; for buildings and structural materials, including marine structure; for fuels and lubricants, including metal working fluids; and for both organic and inorganic treatments for metal surfaces. The text organizes the patents into the listed categories, explains the need in each category, and shows how the patent meets that need. Over 250 patents are discussed. For keeping up on what is occurring and what is being used in corrosion inhibitors, this book is a must. It is an excellent piece of work on compiling patents into an organized and understandable format.



Journal of Coatings Technology

Coming Events

FEDERATION MEETINGS

1980

(May 15-17)—Federation Spring Meetings. Society Officers—15th; Executive Committee—16th; Board of Directors— 16th and 17th. North Star Inn, Minneapolis, Minn. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107).

(Oct. 28)—Federation Board of Directors Meeting. Hyatt Regency Hotel, Atlanta, Ga. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107).

(Oct. 29-31)—58th Annual Meeting and 45th Paint Industries' Show. Atlanta Civic Center, Atlanta, Ga. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107).

1981

(Mar. 24-26)—"Symposium on Color and Appearance Instrumentation." Jointly sponsored by Federation of Societies for Coatings Technology, Manufacturers Council on Color and Appearance, and Inter-Society Color Council. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, Pa. 19107).

SPECIAL SOCIETY MEETINGS

1980

(Mar. 10-12)—Seventh Annual Water-Borne and Higher-Solids Coatings Symposium. Hyatt Regency Hotel, New Orleans, La. Sponsored by Southern Society and University of Southern Mississippi. (Dr. George Bufkin, Dept. of Polymer Science, University of Southern Mississippi, Southern Station, Box 276, Hattiesburg, Miss. 39401).

(Mar. 12-14)—Southern Society. 44th Annual Meeting and Convention. Terrace Garden Inn, Atlanta, Ga.

(Mar. 25-26)—Chicago Society, SYMCO '80, "Additives." Fountain Blue, Des Plaines, III. (Dennis Socha, U.S. Gypsum Co., 1000 E. Northwest Highway, Des Plaines, III. 60016).

(Apr. 14-15)—Louisville Society Spring Symposium, "Compliance with Government Regulations" and "Hazardous Materials Waste Disposal." Marriott Inn, Clarksville, Ind. (M. Joyce Specht, Porter Paint Co., Corporate Office, 400 South 13th St., P.O. Box 1439, Louisville, Ky. 40201).

(April 17-19)—Dallas and Houston Societies. Southwestern Paint Convention, Hilton Inn, Dallas, Tex.

(May 1)—Detroit Society FOCUS Seminar. "Environmental Challenges to Automotive Coatings." Michigan State Management Conference Center, Troy, Mich. (G. Sastry, Chrysler Corp., Chemicals Div., 5437 W. Jefferson, Trenton, Mich. 48183).

(May 1-3)—Pacific Northwest Society Annual Symposium. Hilton Hotel, Portland, Ore.

(May 15)—Birmingham Society Symposium, "Effect of Current Legislation in the U.K. Paint Industry." Metropole Hotel, Birmingham, England. (D.M. Heath, Arthur Holden & Sons Ltd., Bordesley Green Rd., Birmingham, B9 4TQ, England).

(Oct. 7—Cleveland Society Manufacturing Committee Symposium, "Formulation for and Utilization of Pigment Dispersion Equipment." Cleveland Engineering and Scientific Center, Cleveland, Ohio. (G. Dubey, Cambridge Coatings, Inc., 5461 Dunham Rd., Cleveland, Ohio 44137).

1981

(Mar. 4-6)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, Ca.

OTHER ORGANIZATIONS

(Feb. 4-6)—Inter-Society Color Council. Williamsburg Conference, Williamsburg, Va. (Dr. Fred W. Billmeyer, Secretary, ISCC, Rensselaer Polytechnic Institute, Troy, N.Y. 12181).

(Feb. 25-Apr. 11)—Paint Short Courses at University of Missouri-Rolla. Painting Contractors and Paint Inspectors—Feb. 25-29; Composition of Paints and Coatings—Mar. 3-7; Quality Control—Mar. 10-14; Fundamentals of Paint Formulation—Mar. 31-Apr. 4; Chemical Coatings Workshop—Apr. 7-11. (Norma Fleming, Continuing Education, University of Missouri-Rolla, 501 West 11th St., Rolla, Mo.).

(Mar. 3-7)—"CORROSION/80," sponsored by National Association of Corrosion Engineers. Palmer House, Chicago, III. (Membership Services Dept., NACE Headquarters, P.O. Box 986, Katy, Tex. 77450).



(Mar. 4-6)—National Association of Corrosion Engineers. Materials Performance and Corrosion Show. Palmer House, Chicago, III. (NACE, P.O. Box 986, Katy, Tex. 77450).

(Mar. 23-28)—Div. of Organic Coatings and Plastics Chemistry Symposiums and Spring Meeting of American Chemical Society, Houston, Texas. (American Chemical Society, 1155 16th St., N.W., Washington, D.C. 20036).

(Mar. 25-27)—Society of Manufacturing Engineers Workshop on Radiation Curing in the Graphic Arts. Ramada O'Hare Inn, Chicago, III. (Susan E. Buhr, Technical Division, Society of Manufacturing Engineers, One SME Drive, P.O. Box 930, Dearborn, Mi. 48128).

(April 20-22)—Inter-Society Color Council. Annual meeting. Downtown Holiday Inn, Rochester, N.Y. (Dr. Fred Billmeyer, Secretary, ISCC, Rensselaer Polytechnic Institute, Troy, N.Y. 12181).

(May 5-8)—Society of Plastics Engineers, 38th Annual Technical Conference (ANTEC). New York Hilton, N.Y. (Rod Ellis, SPE, 656 W. Putnam Ave., Greenwich, Conn. 06830).

(May 12-16)—"Coatings and Polymer Characterization" Short Course. Kent State University, Kent, Ohio. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, Ohio 44242).

(May 19-23)—Dispersion of Pigments and Resins in Fluid Media" Short Course. Kent State University, Kent, Ohio. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, Ohio 44242).

(June 1-6)—"Polymer Blends and Composites" Short Course. Lehigh University, Bethlehem, Pa. (Ms. Jone Svirzofsky, Lehigh Univ., Materials Research Center, Coxe Lab. 32, Bethlehem, Pa. 18015).

(June 2-13)—Basic Coatings Science Course. North Dakota State University, Fargo, N.D. (Dr. Zeno W. Wicks, Jr., Polymers and Coatings Dept., NDSU, Fargo, N.D. 58105).

(June 8-13)—XVth Congress of FATIPEC. RAI Congress Centre, Amsterdam, Netherlands. "Activities of the Coatings Industry in the Framework of Ecology, Energy, and Economy Problems." (Congress Secretary is C. Kork, Oostenrijklaan 43, Haarlem, Netherlands).

(June 15-18)—Dry Color Manufacturer's Association Annual Meeting. The Greenbriar, White Sulpher Springs, W.Va. (J.L. Robinson, Dry Color Manufacturers' Association, Suite 100, 117 North 19th St., Arlington (Rosslyn) Va. 22209).

(June 16-20)—"Adhesion Principles and Practice for Coatings and Polymer Scientists" Short Course. Kent State University, Kent, Ohio. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, Ohio 44242).

(June 16-27)—Advanced Coatings Science Course, North Dakota State University, Fargo, N.D. (Dr. Zeno W. Wicks, Jr., Polymers and Coatings Dept., NDSU, Fargo, N.D. 58105).

(June 25-27)—"Interpenetrating Polymer Networks" Short Course. Lehigh University, Bethlehem, Pa. (Ms. Jone Svirzofsky, Lehigh Univ., Materials Research Center, Coxe Lab. 32, Bethlehem, Pa. 18015).

(July 14-18)—"Sixth Annual International Conference in Organic Coatings Science and Technology," Athens, Greece. (Angelos V. Patsis, State University of New York, CSB Building, Room 209, New Paltz, N.Y. 12561).

(Sept. 23-25)—Association of Finishing Processes of the Society of Manufacturing Engineers, 5th International Conference and Exposition on Radiation Curing. Park Plaza Hotel, Boston, Mass. (AFP/SME, Technical Administrator, Society of Manufacturing Engineers, One SME Drive, P.O. Box 930, Dearborn, Mich. 48128).

(Sept. 30-Oct. 2)—The Metals Society, International Conference, "Production and Use of Coil-Coated Strip." Metropole Hotel/National Exhibition Centre, Birmingham England. (T.L. Hughes, The Metals Society, 1 Carlton House Terrance, London SW1Y 5DB).

(Oct. 13-15)—Society of Plastics Engineers National Technical Conference, "Coloring of Plastics; Update of 'The Law and You'." RETEC sponsored by the Baltimore Section and Color and Appearance Div. Baltimore Hilton Hotel, Baltimore, Md. (Robert C. Foley, Society of Plastics Engineers, 656 W. Putnam Ave., Greenwich, Conn. 06830).

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