jct JOURNAL OF COATINGS TECHNOLOGY

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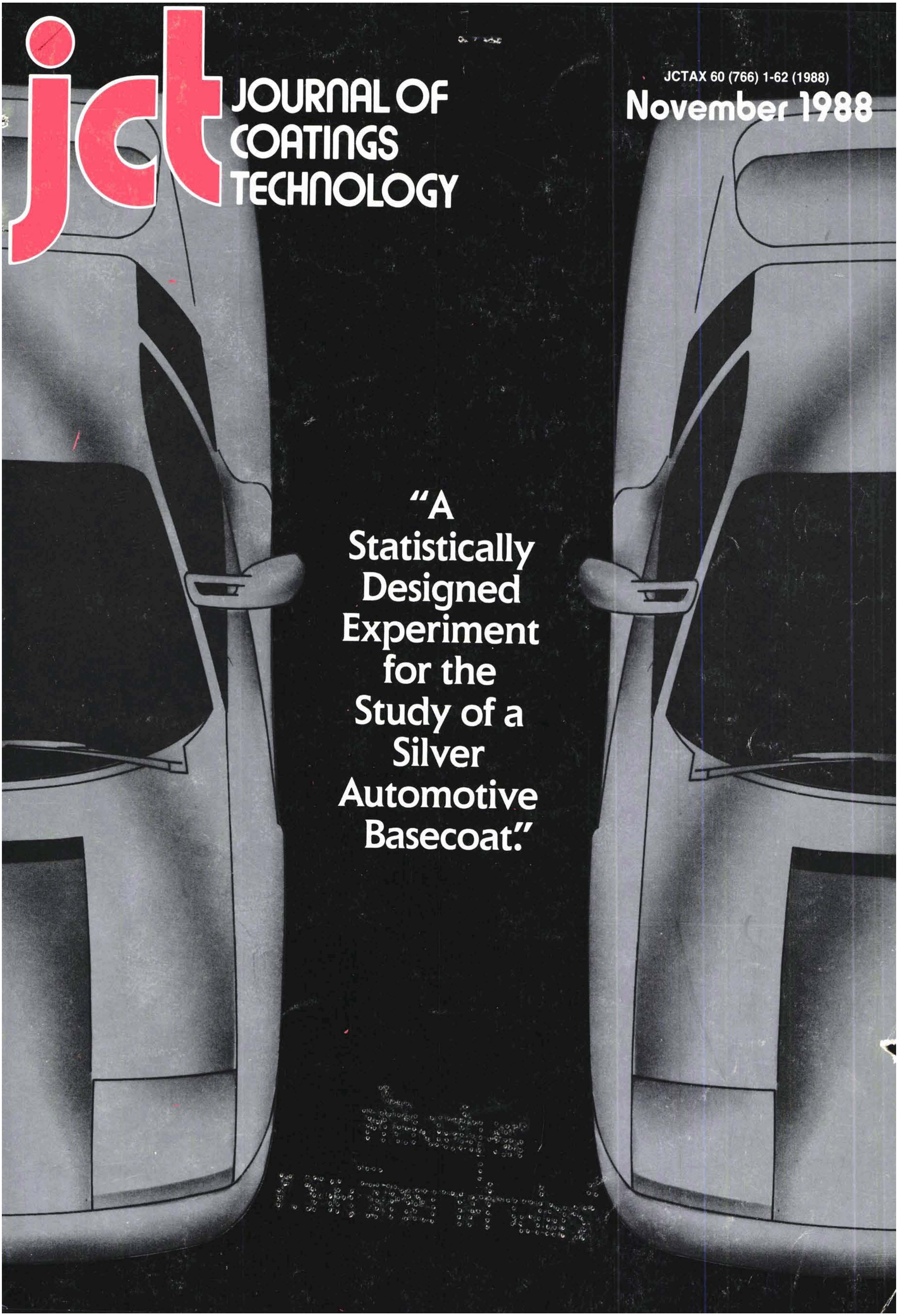

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NOVEMBER 1988

jct JOURNAL OF COATINGS TECHNOLOGY

VOLUME 60 NUMBER 766

Federation of Societies for Coatings Technology

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Comment

Professional Development: Looking Back and Moving Ahead

As the outgoing Chairman of the Professional Development Committee, it quite naturally gives me a sense of both pride and pleasure to look back over the past two years at what the Committee has accomplished, and at how well its projects have been received. The successful workshops on SPC Level I in 1987 were sold-out in 1988, and will be offered again in 1989 in Chicago, Philadelphia, and Toronto. The new SPC Level II courses were extremely well-received this year, and will also be repeated in 1989, in Chicago and Philadelphia. The symposium, ''Tools for Professional Success in the Coatings Industry,'' was presented at the 1987 Annual Meeting, and was subsequently published in the August, 1988, *JCT*. The Committee's presentation at this year's Annual Meeting, ''Advanced Topics in Coatings Research'' featured work-in-progress, and successfully explored the ''cutting'' edge in four different areas of coatings science.

Based upon the needs clearly defined by the Committee's 1986 Membership Survey, a major two-day symposium entitled ''Modern Analytical Resources: The Coatings Chemist's Ally,'' will be presented during the Federation's 1989 Spring Week in Los Angeles. This symposium will be aimed at non-specialists, and will focus on how analytical techniques can be used to assist in the solution of everyday coatings-related problems.

Not all has been rosy, however. This year's series of workshops on ''Project Management for the Bench Chemist'' met with extremely high approval ratings in the follow-up survey (100% felt that they benefitted, and 96% would recommend the workshop to others), but was compromised by very disappointing attendance figures. Because of the considerable potential benefit of this workshop to Society members, the Committee is not prepared to abandon the concept, and hopes to present it—possibly in an altered format—in 1989.

These are only a few of the areas in which the Professional Development Committee is currently active in its attempts to assist Society members in furthering their technical education. The success of the Committee's efforts, however, depends upon the support of each and every Society member. This is your Committee: if you inform it of your needs, and support its activities, you will profit as a result. In the words of W. Edwards Deming, ''it is so simple.''

George R. Pilcher
Professional Development
Committee Chairman

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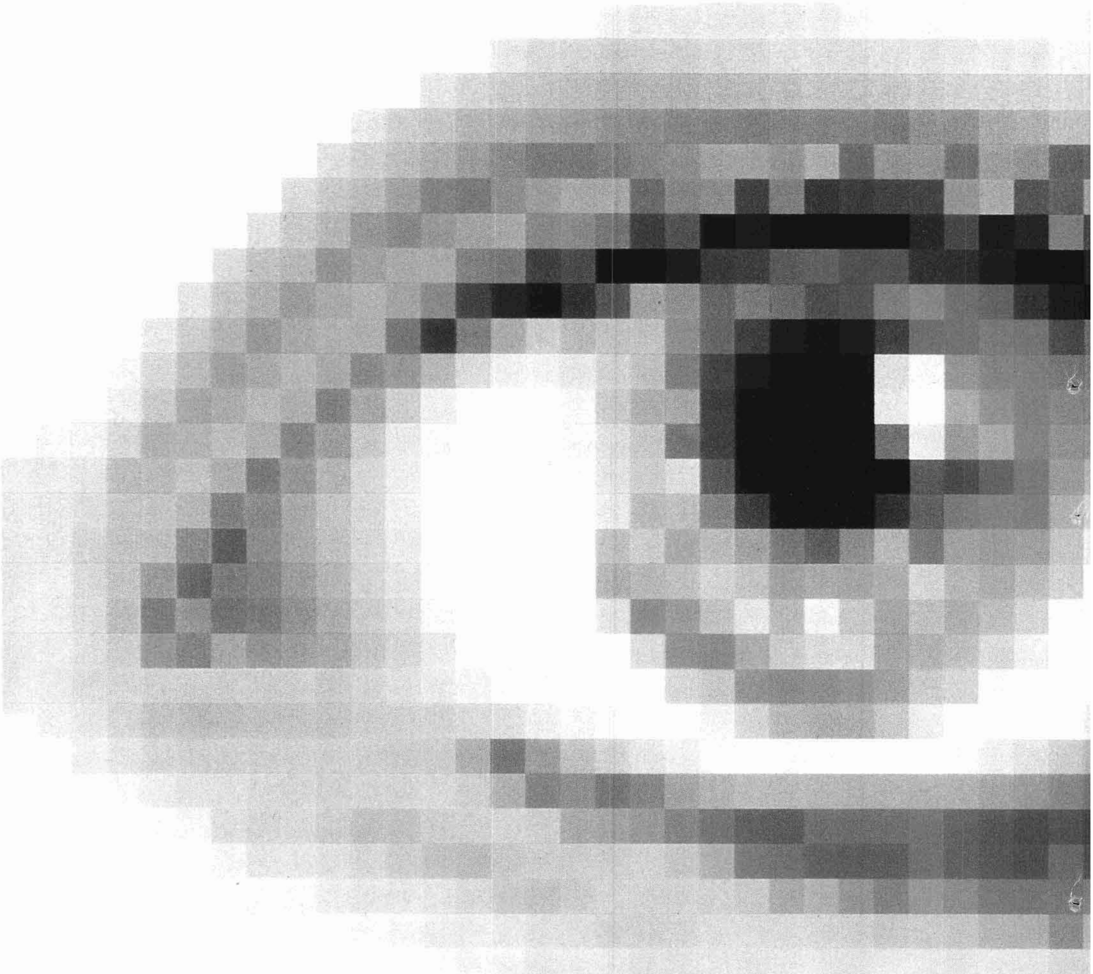

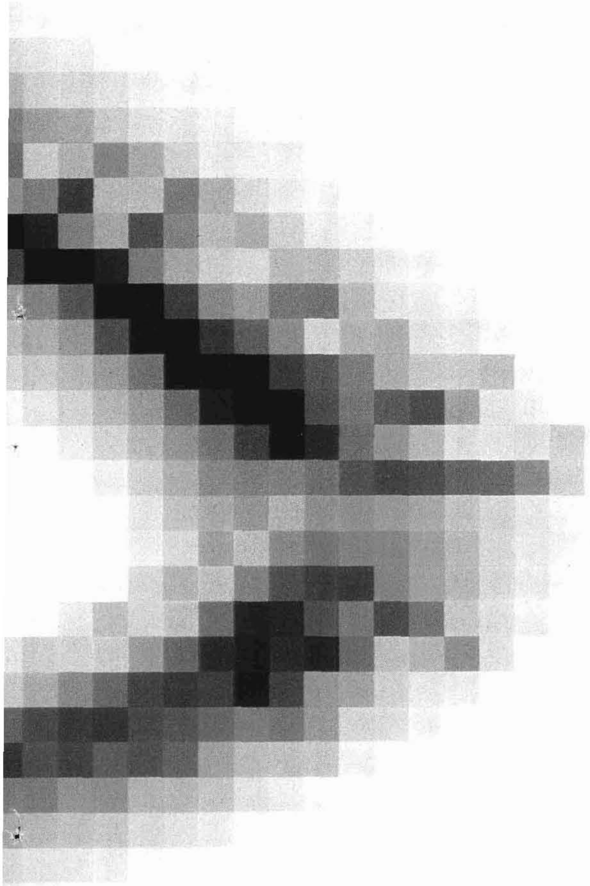

Abstracts of Papers in This Issue

A STATISTICALLY DESIGNED EXPERIMENT FOR THE STUDY OF A SILVER AUTOMOTIVE BASECOAT—M. Broder, P.I. Kordomenos, and D.M. Thomson

Journal of Coatings Technology, 60, No. 766, 27 (Nov. 1988)

A two-level full factorial design experiment was used to study four variables (ingredients) in a silver high solids automotive basecoat. A brief description of the methods used in the design, such as the calculating matrix, replications, and randomization is given. Although many responses were measured in the original experiment, only the results and analysis of the specific appearance property of distinctness of image are discussed in this paper. A functional basecoat with excellent appearance and physical properties was the end result achieved.

CURE BEHAVIOR AND FILM PROPERTIES OF TWO-COMPONENT ACRYLIC URETHANE COATINGS—T. Nakamichi and M. Ishidoya

Journal of Coatings Technology, 60, No. 766, 33 (Nov. 1988)

Aliphatic isocyanates are commonly used in highly durable two-component urethane coatings as a hardener. The influences of cure temperature, content of carboxylic acid, and dibutyl tin dilaurate on the reaction of a biuret of hexamethylene diisocyanate with acrylic polyol in the film state are reported. The catalytic effect of carboxylic acid was clearly observed in this study. Since the isocyanate groups do not react completely under ordinary cure conditions, film properties were influenced by the extent of reaction of isocyanate groups. Tensile properties and weathering properties of these systems are reported as a function of the extent of reaction.

JCT DECEMBER 1988
Post-Convention Issue

On October 19-21, the Annual Meeting and Paint Industries' Show of the Federation of Societies for Coatings Technology was held at McCormick Place, Chicago, IL. Complete coverage of this important event will be published in the December 1988 issue of the JOURNAL OF COATINGS TECHNOLOGY. Follow-up features will include articles on exhibitors, with emphasis on products and special booth features; photo displays of award-winning booths; as well as a complete review of important Annual Meeting and Paint Show happenings.

INFLUENCE OF POST TREATMENT STORAGE ON THE SURFACE CHEMISTRY OF PLASMA OXIDIZED POLYMERS—H.S. Munro and D.I. McBriar

Journal of Coatings Technology, 60, No. 766, 41 (Nov. 1988)

X-ray photoelectron spectroscopy (XPS) and contact angle measurements were used to monitor the changes in surface chemistry of plasma oxidized polyetheretherketone (PEEK) and a polysiloxane acrylate during post treatment storage. As expected, decay in the hydrophilicity occurred during the first seven days post treatment. However, after 16 days, a brief recovery was observed, dependent on polymer and storage condition. The changes in the contact angle were related to the XPS data and showed that the recovery in hydrophilicity was due to reorganization occurring in a 20 Å region within the outermost 50 Å of the sample.

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James E. Geiger, of the Southern Society, Elected 67th President of the Federation

James E. Geiger, founder and President of Sun Coatings, Inc., Largo, FL; President of Chemex Chemicals & Coatings Co., Inc., Tampa, FL; and President and Chairman of the Board of Penn Paints, Inc., Sanford, FL, became the 67th President of the Federation of Societies for Coatings Technology on October 21, 1988, at the Federation's Annual Meeting in Chicago, IL.

John C. Ballard, of Kurfees Coatings, Inc., Louisville, KY, was named President-Elect and Kurt F. Weitz, of Indusmin, Toronto, Ont., Canada was elected Treasurer.

J.E. Geiger

President Geiger

Mr. Geiger most recently was President-Elect of the Federation. He served as Treasurer of the Federation (1986-87), is a member of the Executive Committee, and sits on the Board of Directors. Currently, Mr. Geiger is Chairman of the Office Building Committee and a member of the Finance Committee. He served as a member-at-large on the Board of Directors from 1984 to 1986 and was the Annual Meeting Host Committee Chairman in 1986. Mr. Geiger also was a member of the Educational, Professional Development, and Investment Committees, and Secretary-Treasurer of the Coatings Industry Education Fund in 1987. He is a Past-President of the Southern Society (1984-85) and served as Chairman of the Society's Finance and Nominating Committees. Mr. Geiger graduated from Northern Illinois University and is a member of the University of Southern Mississippi Industrial Advisory Committee. He has been in the coatings industry for 30 years.

President-Elect Ballard

Mr. Ballard is Vice President for Research and Development at Kurfees Coatings. He served as Treasurer of the Federation (1987-88), is a member of the Executive Committee, and sits on the Board of Directors. Mr. Ballard served as a member-at-large on the Board of Directors from 1978 to 1980. He also is a member of the Finance and Mattiello Lecture Committees, an Ex Officio member of the Professional Development Committee, and Secretary-Treasurer of the Coatings Industry Education Fund. Mr. Ballard was Chairman of the Federation's Paint Show Exhibits' Awards Committee from 1985-1987 and the Annual Meeting Program Committee. He is a Past-President of the Louisville Society (1976-77). Mr. Ballard is a graduate of the University of Louisville and has been in the coatings industry for 31 years.

Treasurer Weitz

Mr. Weitz is Manager—Technical Support for Indusmin, a Division of Falconbridge Limited. He has served on the Executive Committee since 1985 and has been the Toronto Society Representative to the Board of Directors since 1981. In addition, Mr. Weitz served on the Roon Award Committee for six years and was a member of the Finance Committee. He is a Past-President of the Toronto Society (1974-75). Mr. Weitz graduated from the University of Toronto and has served the coatings industry for 31 years.

Executive Committee

Thomas E. Hill, Manager—Technical Service Department, Pratt & Lambert, Inc., Buffalo, NY, has been elected to a three-year term as Society Representative to the Executive Committee. Mr. Hill has been a member of the Executive Committee since 1987 and has been the Western New York Society Representative to the Board of Directors since 1983. He is a member of the Finance and Paint Show Exhibits' Awards Committees. Mr. Hill received his technical education from West Virginia University and his business education from the State University of New York at Buffalo. He has been in the coatings industry for 20 years.

Richard M. Hille, Marketing Manager, General Paint & Chemical Co., a Division of Cotter & Co., Cary, IL, has been elected to serve a one-year term as Society Representative to the Executive Committee to fill the unexpired term of Mr. Weitz. Mr. Hille was a member-at-large on the Board of Directors from 1985 to 1987 and currently is the Chicago Society Representative on the Board. He is the Chairman of the 1988 Annual Meeting Program Committee and serves on the Finance and Professional Development Committees. Mr. Hille was Chairman of the Annual Meeting Host Committee in 1984 and the Manufacturing Committee from 1985 to 1987. He was President of the Chicago Society (1980-81) and was active on the Society's Technical, Educational, and Manufacturing Committees. Mr. Hille graduated from the University of Kansas in 1968 and has been in the coatings industry for 20 years.

Board of Directors

John J. Oates, retired from Troy Chemical Corp., Newark, NJ, in 1988, and a Past-President of the Federation (1977-78) and the New York Society (1961-62), has been elected to serve a two-year term on the Board of Directors as Past-President Member. Mr. Oates is a member of the Planning, Educational, and Paint Show Exhibits' Awards Committees. In addition, he served on the Board of Directors and was Chairman of the By-Laws, Annual Meeting Host, and Annual Meeting Program Committees. Mr. Oates was the New York Society Council Representative from 1972 to 1974 and received the Society's PaVaC and Roy Kienle Awards. A graduate of the City College of New York, he has been in the coatings industry for 37 years.

Elected to serve two-year terms as Members-at-Large on the Board of Directors are George R. Pilcher, of Hanna Chemical Coatings Corp., Columbus, OH, and Patricia Shaw, of Davlin Coatings Inc., Berkeley, CA.

Mr. Pilcher is Corporate Technical Director of Hanna Chemical Coatings, a subsidiary of Reliance Universal, Inc., and has been a member of the Professional Development Committee since 1985 and Chair-

Continued on Page 16

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1988-89 Committee Chairmen Appointed by President Geiger

Chairmen of the 31 committees of the Federation of Societies for Coatings Technology for 1988-89 have been named by President James E. Geiger. A complete roster of all committees will be published in the 1989 FSCT Year Book.

An asterisk (*) indicates re-appointment for 1988-89.

A.F. Voss/American Paint & Coatings Journal Awards—Patricia Shaw, of Davlin Coatings, Inc., Berkeley, CA.*

Annual Meeting Host—Thad T. Broome, of J.M. Huber Co., Macon, GA.

Annual Meeting Program—George R. Pilcher, of Hanna Chemical Coatings Co., Columbus, OH.

Armin J. Bruning Award—Ralph Stanziola, Consultant, Neshanic Station, NJ.*

By-Laws—Fred G. Schwab, of Coatings Research Group, Inc., Cleveland, OH.*

Corrosion—Jay Austin, of Halox Pigments, Hammond, IN.*

Educational—Sidney Lauren, Nashua, NH.*

Environmental Affairs—Robert E. Minucciani, of Glidden Co., San Francisco, CA.*

FSCT Building (Ad Hoc)—James E. Geiger, of Sun Coatings, Inc., Largo, FL; Chemex Chemicals & Coatings Co., Inc., Tampa, FL; and Penn Paints, Inc., Sanford, FL.

Finance—Deryk Pawsey, of Rohm and Haas Canada Ltd., Vancouver, B.C., Canada.

George Baugh Heckel Award—Deryk Pawsey.

Inter-Society Color Council—Ralph Stanziola.*

Investment—Neil Estrada, Consultant, Los Altos Hills, CA.*

Liaison—Carlos Dorris, of Jones-Blair Co., Dallas, TX.

Manufacturing—Joseph Walton, of Jamestown Paint & Varnish Co., Jamestown, PA.*

Joseph J. Mattiello Memorial Lecture—Loren W. Hill, of Monsanto Chemicals Inc., Springfield, MA.

Membership Services—Horace S. Philipp, Ottawa, Ont., Canada.*

Memorial—A. Clarke Boyce, of Nacan Products Ltd., Brampton, Ont., Canada.*

Nominating—Deryk Pawsey.

Paint History—Joseph H. Boatwright, Consultant, N. Ridgeville, OH.*

Paint Industries' Show—John Lanning, of Porter Paint Co., Louisville, KY.*

Planning—Colin D. Penny, of Hampton Paint Mfg. Co., Inc., Hampton, VA.

Professional Development—Richard J. Himics, of Daniel Products Co., Jersey City, NJ.

Publications—Thomas J. Miranda, of Whirlpool Corp., Benton Harbor, MI.*

Definitions Subcommittee—Stanley LeSota, of Rohm and Haas Co., Springhouse, PA.*

Roon Awards—Richard Eley, of Glidden Co., Strongsville, OH.

Society Speakers Awards—S. John Mitchell, of Manders Paints Ltd., Clwyd, Wales.

Technical Advisory—John E. Hall, of Tioxide Canada Ltd., Sorel, Que., Canada.*

Technical Information Systems—Helen A. Skowronska, Cleveland, OH.*

Trigg Awards—Joseph L. Mascia, Campbell Chemical Co., Pittsburgh, PA.*

* * *

Delegates to Other Organizations

International Union of Pure and Applied Chemistry—Raymond B. Tennant, of Carrs Paints Ltd., Birmingham, England.*

National Association of Corrosion Engineers—Jay Austin.*

National Paint & Coatings Association and Government Agencies—Robert E. Minucciani.

National Paint & Coatings Association Scientific Committee—John E. Hall.

Steel Structures Painting Council—Jay Austin.*

FSCT Announces 1989 Schedule of Seminars On Statistical Process Control for Coatings

A repeat of the popular series of introductory and intermediate-level seminars on Statistical Process Control for the Coatings Industry, conducted by Dr. Peter J. Hunt, President of Productivity Management Consultants, Madeira Beach, FL, has been announced by the Federation.

The seminars, to be held at regional locations during March 1989 under the auspices of the Federation's Professional Development Committee, present Statistical Process Control (SPC) methods for application to coatings manufacturing and related areas (e.g., chemical, pigments) which employ a batch process.

The introductory (Level I) two-day seminar will be held in Philadelphia, March 6-7; Chicago, March 13-14; and Toronto, March 20-21. Programming focuses on: identifying appropriate product and machine variables to measure; plotting and interpreting SPC control charts; evaluating process capability; and implementing an SPC system.

The intermediate (Level II) three-day seminar will be held in Philadelphia, March 8-10; and Chicago, March 15-17. This seminar stresses the practical application of statistical techniques to answer management questions (such as the reliability of the test equipment), statistical differences between procedures, and the use of correlated variables to control and/or predict outcomes.

For further information, contact the Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, PA 19107 (215) 545-1506.

Jim Geiger Elected President of FSCT

Continued from Page 14

man since 1986. He is Vice-Chairman of the 1988 Annual Meeting Program Committee, a member of the A.F. Voss/*American Paint & Coatings Journal* Awards Committee, and a Trustee of the Coatings Industry Education Fund. Mr. Pilcher was Chairman of the Cleveland Society Education Committee and was active on the Technical Committee. He presented the keynote address at the 1988 Washington Paint Technical Group's 28th Annual Symposium. A founding chairman of the ACS Roy W. Tess Award in coatings, Mr. Pilcher graduated from the College of Wooster and has served the coatings industry for 18 years.

Ms. Shaw is Technical Director for Davlin Coatings and has been a member of the A.F. Voss/*American Paint & Coatings Journal* Awards Committee since 1986 and currently is serving as Chairman. She was President of the Golden Gate Society (1986-87) and acted as Chairman of the Technical and 20th Biennial Western Coatings Symposium & Show Committees. In addition, Ms. Shaw was Chairman of the Los Angeles Society Technical Committee from 1981-82. She received the Golden Gate Distinguished Service Award in 1985. Ms. Shaw is a graduate of the University of California and has been in the coatings industry for 14 years.

Regulatory UPDATE

NOVEMBER 1988

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by Roy F. Weston, Inc., Washington, D.C.

OSHA Considers Generic Exposure Monitoring Standard — The Occupational Safety and Health Administration (OSHA) is evaluating the feasibility and usefulness of a generic standard on exposure monitoring for employees exposed to toxic substances. The generic standard would address a particular health risk rather than a particular substance. See 53 Federal Register 37591 (Sept. 27, 1988).

One potential use of a generic exposure monitoring standard would be in connection with the Z-tables of 29 CFR 1910.1000. The Z-tables provide exposure limits for several hundred substances but currently include no requirements for monitoring of employee exposure. Another use of the generic standard would be to simplify development of future rules that, where necessary, would contain exposure monitoring provisions.

OSHA is seeking comments and data on the value of exposure monitoring; the feasibility of developing standardized criteria to determine when and what workplace exposure monitoring is necessary; and the effectiveness of existing OSHA exposure monitoring requirements and other topics.

Commends are due in quadruplicate by December 27, 1988, at Docket Officer, Docket No. H-029, Room N2625, Occupational Safety and Health Administration, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-7894.

For further information, contact James Foster, Director, Office of Information and Consumer Affairs, Room N3647, Occupational Safety and Health Administration, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8148.

OSHA Considers Generic Medical Surveillance Programs — The Occupational Safety and Health Administration (OSHA) is evaluating the feasibility and usefulness of a generic standard on medical surveillance programs for employees exposed to toxic substances or hazardous physical agents. The generic standard would address a particular health risk rather than a particular substance. See 53 Federal Register 37595 (Sept. 27, 1988).

OSHA is considering use of a generic medical surveillance standard in connection with the Z-tables of 29 CFR 1910.1000. The Z-tables set exposure limits for hundreds of substances but include no provision requiring medical surveillance for employees exposed in excess of the limits. OSHA is considering whether adoption of medical surveillance requirements applicable to Section 1910.1000 may be warranted. In connection with the development of criteria for workplace medical testing, OSHA is evaluating the effectiveness of medical monitoring and surveillance requirements in existing OSHA standards.

OSHA is seeking comments and data on the value of workplace medical monitoring and surveillance; criteria that OSHA may use to determine when and what medical intervention is appropriate; the effectiveness of medical surveillance and monitoring requirements in existing OSHA standards; the scope and application of the generic standard; categorization and generic application by health effects or by chemical type; economic feasibility; and provisions which should be considered for inclusion in a generic medical surveillance program.

Comments are due in quadruplicate by December 27, 1988, at Docket Officer, Docket No. H-031, Occupational Safety and Health Administration, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-7894.

For further information, contact James Foster, Director, Office of Information and Consumer Affairs, Occupational Safety and Health Administration, U.S. Department of Labor, Room N-3647, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8148.

EPA Gets New Wire Enamel Solvent Test Data — EPA has received new test data on ortho-cresols used as wire enamel solvents, automotive cleaners, and organic intermediates in manufacturing phenolic resins and phosphate esters. See 53 Federal Register 37644 (Sept. 27, 1988).

The test data describe a mutagenicity test on ortho-cresol in the in vitro transformation of certain cells assay in the presence of a rat liver cell activation system. The test data was submitted in accordance with final test rules under the Toxic Substances Control Act.

For further information, contact Michael M. Stahl, Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, U.S. EPA, Room EB-44, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-1404.

DOT to Move Hazardous Material Shipping Cross-Reference — The Department of Transportation's (DOT) cross-reference of hazardous materials identification numbers and proper shipping names will appear in a different location as a result of a change in DOT's Hazardous Materials Regulations. The cross-reference will appear as an index immediately following the table of contents to Part 172 in the 1989 edition of Title 49, Code of Federal Regulations. The cross-reference now appears as Appendix A to Subpart B in Part 172.

The DOT's Research and Special Programs Administration made the change by final rule effective September 30, 1988, to allow cross-reference updating without the cost and effort associated with publication in the Federal Register. See 53 Federal Register 37576 (Sept. 27, 1988). Updates will be published annually in the Code of Federal Regulations.

For further information, contact Jacquelyn F. Smith, Standards Division, Office of Hazardous Materials Transportation, 400 Seventh Street, S.W., Washington, D.C. 20590, (202) 366-4488.

MEKO Proposed for Health Effects Testing — EPA is proposing that manufacturers and processors of methyl ethyl ketoxime (MEKO), test for oncogenicity, mutagenicity, developmental toxicity, reproductive effects, neurotoxicity, and pharmacokinetics. MEKO is sold primarily as a non-reactive anitskinning agent in alkyd surface coatings and paints. EPA estimates the annual production and import volume of MEKO to be more than five million pounds. More than 900,000 commercial painters may be routinely exposed to MEKO according to EPA.

EPA proposed the MEKO testing rule (See 53 Federal Register 35838, Sept. 15, 1988) in response to the Interagency Testing Committee's (ITC) recommendation to consider MEKO for health effects testing. See 51 Federal Register 41417 (Nov. 14, 1986). The ITC's rationale for health effects testing was based on concern over widespread use of MEKO and the potential for human exposure; the lack of a no-effects level for blood effects demonstrated in animal studies; and the absence of data on MEKO's oncogenic potential.

In addition to proposing the health effects testing, EPA is proposing to add a new test guideline for pharmacokinetics testing. The new guideline would be used for developing chemical specific rules under Section 4 of the Toxic Substance Control Act and its implementing regulations, 40 CFR Part 799. The new guideline would be the test standard for MEKO.

Comments are due in triplicate by November 14, 1988 at Docket Control Number OPTS 42099, TSCA Public Docket Office, (TS-793), Room NE-G004, Office of Toxic Substances, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460. If persons request an opportunity to submit oral comments by October 31, 1988, EPA will hold a public meeting in Washington, D.C. To schedule an oral presentation, call the TSCA Assistance Office at (202) 554-1404. For further information, contact Michael M. Stahl, Acting Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, Room EB-44, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-1404.

EPA Issues Underground Storage Tank Rules — EPA has finalized its regulations for underground storage tanks containing hazardous substances or petroleum. See 53 Federal Register 37082 (Sept. 23, 1988). The regulations apply to substances defined as hazardous under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund). They do not apply to substances regulated as hazardous waste under subtitle C of the Resource Conservation and Recovery Act. The new regulations establish measures for new and existing underground storage tank systems to prevent, detect, and cleanup releases from these systems.

Among the regulations' requirements are secondary containment with interstitial monitoring for all new or upgraded hazardous substance tanks unless an alternate release detection method is approved by EPA. Release detection at existing tank systems must be phased in over a five year period based on the age of the tank. Monthly release detection or a combination of annual tightness testing with monthly inventory control is required for substandard existing tank systems until they are upgraded. Tank owners and operators must report suspected releases and must follow measures for corrective action in the event of a tank system leak. The regulations take effect December 22, 1988, except for provisions that apply to tank vendors.

The regulations were first proposed in 1987. See 52 Federal Register 12662 (Apr. 17, 1987). The proposal was later supplemented to address four areas of the proposed technical requirements. See 52 Federal Register 48638 (Dec. 23, 1987). The final regulations differ from the original proposal by providing for more frequent tightness testing of existing tanks without corrosion protection during the 10 year upgrade period; less frequent monitoring of new and upgraded tanks until they are 10 years old; a gradual phase in of leak detection based on age; and more stringent requirements for pressurized piping. For further information, contact the RCRA/Superfund Hotline at (800) 424-9346.

House Approves Drug Bill with Chemical Diversion Provisions — The U.S. House of Representatives has passed the Omnibus Drug Initiative Act of 1988 which includes provisions for the control of chemical diversion for illicit drug manufacturing. A similar bill, S. 2852, has been introduced in the Senate.

The House bill, H.R. 5210, would affect the distribution, receipt, sale, and import or export of common industrial chemicals that are also essential to illicit drug manufacture. Among the essential chemicals covered by the bill are acetone; benzyl chloride; 2-butanone (methyl ethyl ketone); and toluene. Buyers of listed essential chemicals would provide sellers with a certificate of lawful use which the seller would send to the government within 15 days of the transaction. Notice of plans to import or export listed essential chemicals would be required 15 days before the transaction. Exceptions to the bill's requirements are provided for transactions with certain regular customers, for transactions in certain chemical mixtures, and in listed chemicals contained in lawfully marketed drugs.

For more information, contact the Crime Subcommittee of the House Judiciary Committee, 207 Cannon House Office Building, Washington, D.C. 20515, (202) 225-1695.

EPA Releases Waste Action Agenda — EPA has released its draft response to the nation's solid waste management dilemma, calling for manufacturers to produce products that result in waste of lower quantity and toxicity. Among the objectives identified by EPA's Municipal Solid Waste Task Force, which produced the Action Agenda, are more source reduction activities by manufacturing industry and citizens and an increase in corporate, government, and individual recycling. "The Solid Waste Dilemma: An Agenda for Action," is available from EPA at no charge by calling the RCRA Hotline at (800) 424-9346.

Comments on the draft Agenda for Action are due in duplicate by November 21, 1988, at Docket No. F-88-SWDA-FFFFF, RCRA Docket Information Center, U.S. EPA, (OS-305), 401 M Street, S.W., Washington, D.C. 20460.

The "Background Document for the Solid Waste Dilemma: An Agenda for Action," PB88-251137, is available from the National Technical Information Center, (NTIS), 5285 Port Royal Road, Springfield, VA 22161.

SUMMARY CALENDAR OF REGULATORY ACTIONS

November 14, 1988	Comments due to EPA on proposed rule for MEKO health effects testing. (See this issue.)
November 21, 1988	Comments due to EPA on Solid Waste Management Action Agenda. (See this issue.)
December 22, 1988	EPA's hazardous substance and petroleum underground storage tank regulations take effect. (See this issue.)
December 27, 1988	Comments due to OSHA on generic exposure monitoring standard. (See this issue.)
December 27, 1988	Comments due to OSHA on generic medical surveillance program standards. (See this issue.)

ASTM Observes 90th Anniversary During Celebration; Standard Practice for Testing Paint to Be Revised

The American Society for Testing and Materials (ASTM), Philadelphia, PA, observed its 90th anniversary during a special celebration held at their Annual Business Meeting in Baltimore, MD, on June 29.

ASTM was organized on June 16, 1898, when 20 men met at the Engineers Club in Philadelphia. The group's mission was to harmonize knowledge of materials and to write standards based on this knowledge which would ensure uniformity of product.

ASTM has 30,000 members who are organized into 140 technical standards-writing committees. Standardization activities now include energy, the environment, consumer products, health care, and computerized systems. Over 8,500 ASTM standards are published each year in the 67-volume "Annual Book of ASTM Standards."

In other news, ASTM has announced that Subcommittee D01.27 on Accelerated Tests for Paints and Related Coatings has approved a major revision of ASTM D 822 Standard Practice for Operating Light and Water Exposure Apparatus (Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products. D01.27 is a subcommittee of ASTM standards-writing Committee D-1 on Paint and Related Coatings and Materials.

D 822 will be revised to describe the use of filtered open flame carbon arc devices only to conduct tests. A new practice will be written to describe testing these materials with the enclosed carbon arc devices. Since each device can produce different types and rates of degradation, this activity will benefit all who reference D 822 without specifying the carbon arc device to be used.

All interested parties are welcome to participate in the revision and drafting of the new document. For more information, contact Warren Ketola, 3M Co., Bldg. 553-1A, 3M Center, St. Paul, MN 55144-1000 or David Bradley, ASTM, 1916 Race St., Philadelphia, PA 19103.

Ball Corp. Forms Venture With Onex Corp. of Canada

The formation of a joint venture between Ball Corp., Muncie, IN, and Onex Corp., Toronto, Ont., Canada recently transpired. The transaction allows Ball Corp. to acquire the Canadian-based Onex Packaging Inc., a subsidiary of Onex Corp.

Onex Packaging has nine manufacturing plants throughout Canada and produces metal containers for the food, soft drink, beer, household, and industrial markets.

The acquisition of Onex Packaging, a metal container packaging company, is effected through an amalgamation of the firm and a newly formed joint venture company in which Onex Packaging shareholders are offered $11 (Canadian) for each of the outstanding shares, as well as those under option. Ball and Onex Corp. are equal shareholders in the new private enterprise.

In addition to its 50% ownership in the new company, to be known as Ball-Onex Packaging Corp., Ball assumes management responsibility and provides technical assistance to the operation.

EPA Holds Public Hearing on Benzene Emissions; Stephen Rose, of Dow, Testifies on Behalf of CMA

A revealing testimony for controlling hazardous air pollutants was given at the Environmental Protection Agency (EPA) public hearing on September 1. Stephen Rose, Manager for Air Regulatory Activities, Dow Chemical U.S.A., testified on behalf of the Chemical Manufacturers Association (CMA), Washington, D.C.

Mr. Rose said the only feasible regulatory approach for controlling hazardous air pollutants is one that allows the agency to set standards for each substance on case-by-case basis. The hearing was called by EPA to hear public comments about its proposed rule governing emissions of benzene.

Mr. Rose talked about how society defines a level of risk, the limitations of various methodologies used in risk evaluation, the risk evaluation approaches, and calculated risk versus actual risk. He stated that the standard-setting process should not only qualify uncertainties but quantify them as well.

The comments by Mr. Rose dealt with the generic issues involved in determining safe, acceptable levels of risk. Other witnesses addressed the specific approaches to setting standards for benzene emissions.

Arco Begins Construction Of New Butanediol Plant

Groundbreaking ceremonies were held recently for a new 75 million pound per year butanediol and derivatives facility at Arco Chemical Co.'s Channelview, TX complex. Arco will utilize a hydroformylation process licensed from Kuraray Co., Ltd., Osaka, Japan, for producing 1,4 butanediol from allyl alcohol.

Scheduled for completion during the first quarter of 1990, the facility will also produce derivatives tetrahydrofuran (THF), n-methyl pyrrolidone (NMP), as well as 2-methyl, 1,3 propanediol (MPD) and ally alcohol.

Farbe + Lack to Award Prize For Innovative Paper

Curt R. Vincentz Verlag publishers announced that the Editors of *farbe + lack* magazine will award an annual prize for the outstanding scientific paper to appear in the technical journal beginning in 1989.

The prize of 2500 Deutsch Marks (approximately $1300) will be presented to a paper which describes scientific advance in research, development, or application of paints, lacquers, adhesives, or sealants and associated raw materials and machinery. Selection and judging will be conducted by a panel of six experts, including Professor Dr. Lothar Dulog, FPL.

For more information and the Call for Papers, write The Editors, *farbe + lack*, Postfach 6247, D-3000 Hannover 1.

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21

Specialty Coatings Division Formed by Dexter; Responsible for Powder Coating Formulations

The Dexter Corp., Waukegan, IL, has created a new Specialty Coatings Division as part of a comprehensive reorganization of its operations.

The new division is a combination of the General Industrial and Coil Coatings Groups in Dexter's Midland Division which is divided into two self standing operating divisions. The other division is the Dexter Packaging Products Division.

Operations of the new Specialty Coatings Division are directed primarily toward the North American and European markets. Richard J. Krause, Vice President and General Manager—U.S., and Anton Vissers, President and Director General—Europe, are in charge of each geographical unit. Both report to Albert Paolini, President—Specialty Coatings and Encapsulants Group.

According to Mr. Krause, Dexter's new Specialty Coatings Division is responsible for supplying eight individual markets with coil, liquid, powder, and radiation cured coatings. He also stated that an important new responsibility of the division is to administer, manufacture, and market revolutionary new powder coating formulations. The formulations are being produced under the name Evodex™ in accordance with a joint venture between Dexter and Evode plc of England.

The division has four U.S. manufacturing centers and licensees in Australia, New Zealand, and Spain.

Modernization Underway At Magnesium Elektron Plants

Magnesium Elektron Ltd., a division of Alcan Chemicals, is in the process of a $30 million modernization and expansion of zirconia and zirconium chemicals production facilities in Manchester, England, and Flemington, NJ.

The refurbishing project is designed to increase the combined capacity of the Manchester and Flemington plants by one-third. Work is ongoing at the New Jersey plant with the implementation of a process improvement plan designed to increase production capacity. Modern operating and control technology will further enhance plant capabilities.

DSET and Heraeus Acquire Subtropical Test Facility

DSET Laboratories, Inc., Phoenix, AZ, and Heraeus, Inc., S. Plainfield, NJ, have acquired the former General Motors Test Facility in Homestead, FL.

The 8.7-acre test facility has a grass-covered test area, office and laboratory buildings, and an eight-foot high security fence system surrounding the entire property. The site is the most southerly located full-service outdoor weathering laboratory in the U.S. The location provides a high annual total ultraviolet radiation level and an extended time-of-wetness.

Everglades Testing Laboratory, Inc. (EvTL), DSET's subtropical weathering site located near Homestead, FL, is relocating to the newly acquired facility.

Exxon Chemical Co. and Japanese Rubber Co. Form Joint Ethylene-Propylene Venture

An ethylene-propylene rubber joint technology development agreement has been signed by Exxon Chemical Co., Houston, TX, and Japan Synthetic Rubber Co., Ltd.

Both parties have agreed to jointly develop new process technology and will consider establishing a joint venture ethylene-propylene rubber manufacturing company in Japan to commercialize the technology.

The two companies also have established an ethylene-propylene rubber supply arrangement. Under the arrangement, Exxon will produce several of the Japan-based company's ethylene-propylene rubber grades in its plants for Japan Synthetic Rubber sales to customers primarily in the U.S. Under a similar agreement, Japan Synthetic Rubber will produce several Exxon ethylene-propylene rubber grades in its plants for Exxon sales principally in the Asia Pacific region.

Exxon and Japan Synthetic Rubber also are joint venture partners in the manufacturing of butyl, chlorobutyl, and bromobutyl rubber.

Joint Radiation Cure Venture For RTZ Chemicals and UCB

RTZ Chemicals and UCB have signed a letter of intent to jointly form a company which will develop, produce, and distribute specialty chemicals used in radiation curable formulations (ultra violet/electron beam). The joint venture is subject to approval by both Boards of Directors.

The new company will consist of a worldwide organization with operating subsidiaries in the U.S. and Europe, and licensees in the Far East. The U.S. subsidiary results from an affiliation between the RTZ Chemical owned Interez, Inc., Louisville, KY, and Radcure Specialties, Inc., Norfolk, VA, which is a U.S. operation of UCB. The European company will be based on the current operations in radiation cure of the Specialty Chemicals Division of UCB, Drogenbos, Belgium.

Battelle Subsidiary Formed For Treatment of Wastes

Battelle, Columbus, OH, has formed a new company, Geosafe Corp., Kirkland, WA. The Battelle subsidiary treats buried hazardous chemical wastes.

Geosafe uses technology originally developed by Battelle for the U.S. Department of Energy and markets and conducts hazardous waste cleanup activities using a process called in situ vitrification (ISV).

The process destroys or immobilizes hazardous waste in place using heat to melt the contaminated soil. The cooled material forms a hardened block of glass impervious to natural elements, animals, and plants. Organic materials are destroyed by temperatures that reach 3600°F. Inorganic materials are incorporated into the glass block.

Merger Agreement Terminated By PPG Industries, Inc.

PPG Industries, Inc., Pittsburgh, PA, has exercised its right to terminate the merger agreement which it had entered on August 19 with Grow Group, Inc., New York, NY. The announcement was made on September 6.

The option granted PPG by Grow Group to purchase shares of Grow's authorized but unissued common stock also was terminated.

JOURNAL OF COATINGS TECHNOLOGY

GUIDE FOR AUTHORS

GENERAL

The JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology for its membership of approximately 7,000 in 26 Constituent Societies in the United States, Canada, Great Britain, and Mexico. The JOURNAL is devoted to the advancement of knowledge in the science and technology of surface coatings, the materials comprising such coatings, and their use and performance.

The Editors invite the submission not only of regular research papers, but also *Open Forum* comments on subjects of relevant interest, and *Letters to the Editor*. All manuscripts will be assumed to be original work and to have been unpublished elsewhere; not under consideration for such publication; not copyrighted; and to have been submitted for appropriate clearance by the organization with which the author is affiliated if such clearance is necessary. Authors are obligated to reveal any exceptions to these conditions at the time a manuscript is submitted.

The JOURNAL OF COATINGS TECHNOLOGY has first right to the publication of papers presented at the Annual Meeting of the Federation and at local or regional meetings or symposia of the Constituent Societies. ***Papers in which proprietary products or processes are promoted for commercial purposes are specifically non-acceptable for publication.***

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. . . for the Journal

Technical Papers: Four complete copies should be sent to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

If a submitted paper consists of the text of a presentation made previously to a monthly or special meeting of a Society for Coatings Technology, or to another technical group, the name of the organization and the date of the presentation should be given. If someone other than the author of the paper made the presentation, this information, too, should be noted. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the JOURNAL OF COATINGS TECHNOLOGY.

Papers originally composed for oral presentation may have to be revised or rewritten by the author to conform to the style suitable for written publication.

Open Forum: Three complete copies should be sent to the Open Forum Editor, at the address listed above.

The same general rules as given for technical papers should be followed in the preparation of an Open Forum manuscript. However, the subject may be informally approached. Topics may be nontechnical in nature, dealing with any aspect of the coatings industry.

Letter to the Editor: The JOURNAL will consider for publication all correspondence relevant to the coatings industry and to the contents of the JOURNAL. When a letter concerns an article appearing in the JOURNAL, the original author is usually given an opportunity to reply.

. . . by Constituent Societies For Annual Meeting Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to the Editor at the address listed above.

. . . for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1989 Roon Awards Committee, Richard Eley, The Glidden Co., 16651 Sprague Rd., Strongsville, OH 44136. (For complete details, see "Roon Awards" section of the JOURNAL for January 1989.)

MANUSCRIPT PREPARATION

In general, authors are advised to use the "Handbook for Authors" published by the American Chemical Society as a guide to the preparation of manuscripts (ACS, 1155 Sixteenth St., Washington, D.C. 20036). Another excellent reference work is "How to Write and Publish a Scientific Paper" by Robert A. Day (ISI Press, 3501 Market St., University City Science Center, Philadelphia, PA 19104).

Manuscripts should be typed with double spacing on one side of 8½ × 11 inch (22 × 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

The title should be as brief and informative as possible. Selection of titles that are key word-indexable is a helpful and recommended practice.

Authors' Biographies and Photographs

Give complete names, company or institutional affiliations, and brief biographical sketches of all authors. If available, submit a 5 × 7 inch (13 × 18 cm) black-and-white photograph with glossy or smooth high sheen surface, for each author. See later section on photographs for further details.

Abstracts

A 75–100 word abstract must be part of the manuscript, and should be a concise description of the key findings or teachings of the work described in the paper. The abstract should not repeat the title or include reference numbers, nor should it duplicate the Conclusion or Summary.

Text

The headings and sub-headings in this Guide illustrate their use to divide the text into sections to improve readability for comprehension, and to break up typographical monotony; they may be used as a model for preparation of the text of a manuscript for publication. The text should *not* be presented as an alphanumeric outline.

Only as much review as is necessary should be given to provide an introduction to the subject; the main burden for extensive background should be placed on the list of references.

Standard scientific and technical terminology should be used to convey clear and unambiguous meaning, but the use of technical jargon or slang should be avoided. Authors should bear in mind that the JOURNAL has an international audience, for many of whom English is a second, not native, language. Use of regional idioms or colloquialisms should be avoided. The use of obscure abbreviations is also discouraged. When appropriate, abbreviations should be made in parenthesis immediately following first mention of the term in the text, and then used alone whenever necessary.

Recent issues of the JOURNAL should be consulted for desired style and technical level.

Metric System

Metric system units should be used wherever applicable with the equivalent English units shown afterwords in parentheses. The ASTM Metric Practice Guide, E 380-72 (American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103) is a convenient reference.

Tables, Graphs, and Drawings

Tables, rather than descriptive text, should be used only when they are genuinely helpful. They should be proportioned in accordance with the height and width limitations of the JOURNAL'S pages. Each table should be typed on a separate sheet, rather than included in the text, and appended to the manuscript. Each table should be numbered and have a descriptive caption. Tables should be referenced in the text (e.g., "See Table 1").

In numerical data in tables, numbers less than one should have a zero before the decimal point.

Graphs should be on good quality white or non-photographic blue-lined $8\frac{1}{2} \times 11$ inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a *copy* of the original graph. Graph captions and legends should also be typed on a separate sheet for typesetting.

Graphs should not be used if they merely duplicate the data given in tables, or vice versa.

Drawings should conform to the guidelines given for Graphs and should be proportioned to fit the height-to-width ratio of the JOURNAL'S pages and columns.

Photographs

All photographs should be sharp, clear, black-and-white prints no larger than 8×10 inches in size. Photos should be clearly labeled on the reverse side, taking care not to mar the image.

Color prints and slides are unacceptable.

When illustrations are secured from an outside source, the source must be identified and the Editor assured that permission to reprint has been granted.

Nomenclature

Whenever possible, generic names should be used in preference to trade names. When trade names must be used to avoid ambiguity, and the name is a registered trademark, the symbol R, in a circle or parentheses, should be given immediately following, and the manufacturer listed as a footnote. In general, trade names should be used only in footnotes or in an appendix, rather than in the text.

If special nomenclature is used, include a nomenclature table giving definitions and dimensions for all terms.

Nomenclature of chemical compounds should conform to the style of *Chemical Abstracts* and the IUPAC rules.

Equations

These must be typed, or written clearly, with equations numbered sequentially in parentheses to the right. If Greek letters are used, write out their names in the manuscript margin at the first point of use. Place superscripts^{a} and subscripts$_{b}$ accurately. Avoid the use of superscripts in a manner that can lead to their interpretation as exponents.

Summary

The paper should be concluded with a summary which is intelligible without reference to the main text. The summary may be more complete than the abstract, listing conclusions drawn from the text. A well written summary can serve to inspire the busy reader to turn back to the paper, to read it thoroughly.

Acknowledgment

If used, it should follow the summary.

References

These should be listed in the numerical order in which they are cited in the text, and should be placed at the end of the manuscript. Names of authors may or may not be shown in the text with reference numbers. If possible, include titles of articles referenced in the literature. The following are examples of acceptable reference citations for periodicals[1,2,3], books[4] and patents.[5]

(1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official* DIGEST, *36*, No. 475 (Part 1), 839 (1964).

(2) Davidson, H.R., "Use and Misuse of Computers in Color Control," JOURNAL OF COATINGS TECHNOLOGY, *54*, No. 691, 55 (1982).

(3) Stephen H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, *65*, No. 5, 191 (1982).

(4) Patton, T. (Ed.), "Pigment Handbook," Vol. 1, John Wiley & Sons, Inc., New York, 1973.

(5) Henderson, W.A., Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

OTHER INFORMATION

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

Offprints may be purchased in quantities of 100 or more. Authors will receive price quotations. Each author will receive a complimentary copy of the JOURNAL issue in which his or her paper was published.

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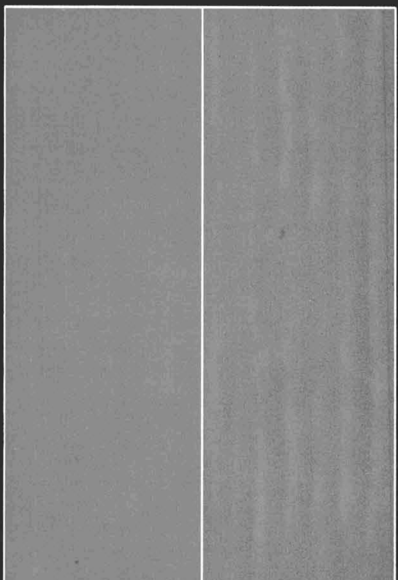

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A Statistically Designed Experiment for the Study of a Silver Automotive Basecoat

Mara Broder, Panos I. Kordomenos and David M. Thomson
Mt. Clemens Coatings, Incorporated*

A two-level full factorial design experiment was used to study four variables (ingredients) in a silver high solids automotive basecoat. A brief description of the methods used in the design, such as the calculating matrix, replications, and randomization is given. Although many responses were measured in the original experiment, only the results and analysis of the specific appearance property of distinctness of image are discussed in this paper. A functional basecoat with excellent appearance and physical properties was the end result achieved.

INTRODUCTION

Most coatings have to meet rigorous appearance and physical property standards. Unfortunately, many changes made in formulations to optimize one property degrade others. Paint systems are complex in their composition and should be studied with a methodology which will show potential interactions between ingredients. Recent reviews of coating literature illustrate the increasing use of statistics in analysis and design of experiments.[7-11]

A two-level full or fractional factorial design experiment is well suited to deal simultaneously with several factors which may have interdependent or interrelated effects. A "one factor at a time" method, wherein one factor is changed while the remaining variables are held constant, would require many times the experimental runs to achieve the precision of a factorial experiment. If the effects are not additive, a designed experiment can also detect and estimate interactions.

Presented at the Fall 1987 Meeting of the American Chemical Society Division of Polymeric Materials: Science and Engineering, in New Orleans, LA and published in the Proceedings Vol. 57. This work is reprinted with the permission of the ACS.
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Of increasing importance in the automobile industry is the use of basecoat/clearcoat coatings.

A high solids basecoat/clearcoat automotive enamel consists of a pigmented basecoat (which provides color and adhesion) and a clear topcoat (for gloss and durability). The clearcoat is applied over the basecoat before the curing stage, leading (in the case of well formulated basecoats), to good color and excellent appearance.

The objective of this study was to determine the effect that four ingredients of a silver basecoat had on the appearance of the system.

EXPERIMENTAL DESIGN

Four variables in a silver high solids basecoat were investigated by a two-level full factorial design as to their effect on a specific basecoat/clearcoat appearance property called distinctness of image (DOI).

The main ingredients of the basecoat were:

Pigment:	Aluminum; % pigment = 11.0%
Resin:	A hydroxy functional urethane modified polyester (prepared according to U.S. patent 4,533,704, Example 1)
Crosslinker:	A fully alkylated mixed ether melamine resin (Cymel® 1161, American Cyanamid)
Catalyst:	Amine blocked paratoluene sulphonic acid (Nacure® 2500X, King Industries)
Modifying Agent:	Cellulose acetate butyrate carboxylate (XAB), (Eastacel® 1420, Eastman)
Rheological Control Agent:	Aluminum stearate gel: 6% Witco® #18 in xylene/isopropanol.

The main ingredients of the clearcoat used over all the tested basecoats were:

(1) Acrylic resin: A hydroxy functional resin at 60.0% weight solids (Mn = 1500)
butyl methacrylate/hydroxy ethyl acrylate/acrylic acid = 58/40/2

Table 1 — Calculating Matrix

Code	Variables A	B	C	D	DOI Readings Run 1	Run 2	Average DOI
1	−	−	−	−	63.8	73.0	68.40
a	+	−	−	−	77.6	77.8	77.70
b	−	+	−	−	68.8	77.2	73.00
ab	+	+	−	−	76.5	85.7	81.10
c	−	−	+	−	72.9	82.1	77.50
ac	+	−	+	−	77.2	82.1	79.65
bc	−	+	+	−	77.7	87.8	82.75
abc	+	+	+	−	84.5	88.5	86.50
d	−	−	−	+	60.6	59.5	60.05
ad	+	−	−	+	64.9	62.0	63.45
bd	−	+	−	+	72.7	75.4	74.05
abd	+	+	−	+	73.3	73.7	73.50
cd	−	−	+	+	64.9	69.7	67.30
acd	+	−	+	+	76.3	70.0	73.15
bcd	−	+	+	+	76.0	80.9	78.45
abcd	+	+	+	+	75.9	76.0	75.95

(2) A fully alkylated mixed ether melamine (Resimene® 755, Monsanto)

(3) An amine blocked acid (Nacure® 2530, King Industries)

(4) A rheological control agent to prevent sagging (Microgel prepared according to Example 1 of U.S. patent 4,425,450)

(5) UV absorber/hindered amine

(6) % Weight solids = acrylic/melamine/sag control agent/catalyst/UV/Hals = 54.5/40/2/0.5/2/1.

DESIGN PARAMETERS

The variables chosen and their ranges were estimated from previously conducted experiments.

Variable "A"	Percent polyester by weight of polyester/melamine	50%	70%
Variable "B"	Percent cellulose acetate butyrate carboxylate	15%	30%
Variable "C"	Percent aluminum stearate	1%	3%
Variable "D"	Percent acid catalyst	0.25%	0.5%

EXPERIMENTAL PROCEDURES

The formulations were coded by two methods:

(1) Transforming equations to designate the low level of the variable as (−1) and the high level as (+1). These equations take the form:

$$X = \frac{\text{(variable level)} - \text{(average of high + low level)}}{\frac{1}{2}\text{(high level} - \text{low level)}}$$

(2) Assigning the lower case letter to the high level of each variable. For example, the 70% polyester, 15% XAB, 3% aluminum stearate, and 0.25% acid were coded + − + − and ac.

A calculating matrix (*Table 1*) was set up in standard order (alternating plus and minus signs for the first column, then alternating pairs, groups of four, and finally two groups of eight).[1]

There are four main effects: (a, b, c, d); six two-factor interactions: (ab, ac, bc, ad, bd, cd); four three-factor interactions: (abc, abd, acd, bcd); and one four-factor interaction: (abcd).[2]

An assumption of linearity between the two end points of the ranges was made.

The 16 basecoats were produced and applied in a random order by computerized spraymation to a specific film build (0.7-0.8 mils). The standard clearcoat was applied over each basecoat after a three-minute flash time at 1.7-1.9 mils. The panels were cured in a horizontal position for 17 min at 130°C (266°F). The 16 basecoats were resprayed giving replicates. Randomization was used so as to avoid unknown systematic changes from affecting the results, i.e., changes in humidity and temperature over the time of spraying the first panel and the sixteenth panel.

Replication was used to provide an estimate of the experimental error within the experiment and increase the value of the tests of statistical significance.

All basecoats were sprayed at the same viscosity. Volume solids were measured as a dependent variable.

The responses of the dependent variable (DOI) were measured by a Hunter Dori-Gon Meter D47-6.

CALCULATIONS

The actual DOI readings of the replicated runs are shown in: *Table* 1 (note the difference in readings of the replicated experiment) and *Table* 2. The latter shows an example of calculating the average main effect of moving from 15% XAB to 30%. This table illustrates that the change is carried out with all possible combinations of the other variables.

A quicker way of calculating effects was developed by Yates[3] and is shown in *Table* 3 (Yates Algorithm). The averages (YBar) are considered in successive pairs. The first eight entries in Column 1 are obtained by adding the pairs together. The next eight are the result of subtracting the top number from the bottom number. Column 2 is obtained from Column 1, etc. Dividing the results of the first line of Column 4 by 16, and the rest of the lines by eight, gives the effects. Note that the effect shown in Line 1 is the grand average DOI.

Table 2 — Average Main Effect of B

b − 1	=	73.00	−	68.40	=	+ 4.60
ab − a	=	81.10	−	77.70	=	+ 3.40
bc − c	=	82.75	−	77.50	=	+ 5.25
abc − ac	=	86.50	−	79.65	=	+ 6.85
bd − d	=	74.05	−	60.05	=	+14.00
abd − ad	=	73.50	−	63.45	=	+10.05
bcd − cd	=	78.45	−	67.30	=	+11.15
abcd − acd	=	75.95	−	73.15	=	+ 2.80
						+58.10[a]

(a) +58.10/8 = +7.2625 units of DOI.

Table 3—Yates Algorithm

Trts	YBar	(1)	(2)	(3)	(4)	Effect	Sum of Sqr	Effect/2
1	68.4	146.1	300.2	626.6	1192.5	74.53125	8878.516	37.265625
a	77.7	154.1	326.4	565.9	29.5	3.6875	54.390625	1.84375
b	73.0	157.15	271.05	23.3	58.1	7.2625	210.97563	3.63125
ab	81.1	169.25	294.85	6.2	−11.9	−1.4875	8.850625	−0.74675
c	77.5	123.5	17.4	20.1	50	6.25	156.25	3.125
ac	79.65	147.55	5.9	38	−11	−1.375	7.5625	−0.6875
bc	82.75	140.45	2.85	0.4	−6	−0.75	2.25	−0.375
abc	86.5	154.4	3.35	−12.3	−1.6	−0.2	0.16	−0.1
d	60.05	9.3	8	26.2	−60.7	−7.5875	230.28063	−3.79375
ad	63.45	8.1	12.1	23.8	−17.1	−2.1375	18.275625	−1.06875
bd	74.05	2.15	24.05	−11.5	17.9	2.2375	20.025625	1.11875
abd	73.5	3.75	13.95	0.5	−12.7	−1.5875	10.080625	−0.79375
cd	67.3	3.4	−1.2	4.1	−2.4	−0.3	0.36	−0.15
acd	73.15	−0.55	1.6	10.1	12	1.5	9	0.75
bcd	78.45	5.85	−3.95	2.8	−14.2	−1.775	12.6025	−0.8875
abcd	75.95	−2.5	−8.35	−4.4	−7.2	−0.9	3.24	−0.45

Table 4—Sum of Squares of Errors (SSE)

Treatments	Y1	Y2	(Y1 − Y2)/2	Squared
1	63.8	73.0	−4.60	21.1600
a	77.6	77.8	−0.10	0.0100
b	68.8	77.2	−4.20	17.6400
ab	76.5	85.7	−4.60	21.1600
c	72.9	82.1	−4.60	21.1600
ac	77.2	82.1	−2.45	6.0025
bc	77.7	87.8	−5.05	25.5025
abc	84.5	88.5	−2.00	4.0000
d	60.6	59.5	0.55	0.3025
ad	64.9	62.0	1.45	2.1025
bd	72.7	75.4	−1.35	1.8225
abd	73.3	73.7	−0.20	0.0400
cd	64.9	69.7	−2.40	5.7600
acd	76.3	70.0	3.15	9.9225
bcd	76.0	80.9	−2.45	6.0026
abcd	75.9	76.0	−0.05	0.0025
				142.5900[a]

(a) SSE (142.59 × 2) = 285.18.

Table 5—ANOVA Table

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	Fo	F(.05)1,16
a	54.390625	1	54.390625	3.0515815	4.49
b	210.97563	1	210.97563	11.83677	—
c	156.25	1	156.25	8.7663932	—
d	230.28063	1	230.28063	12.919875	—
ab	8.850625	1	8.850625	0.4965636	—
ac	7.5625	1	7.5625	0.4242934	—
ad	18.275625	1	18.275625	1.0253524	—
bc	2.25	1	2.25	0.1262361	—
bd	20.025625	1	20.025625	1.123536	—
cd	0.36	1	0.36	0.0201970	—
abc	0.16	1	0.16	0.0089768	—
abd	10.080625	1	10.080625	0.5655726	—
acd	9	1	9	0.5049442	—
bcd	12.6025	1	12.6025	0.7070622	—
abcd	3.24	1	3.24	0.1817799	—
Error	285.18	16	17.82375	—	—
Total	1029.4844	31	—	—	—

Table 6—Diagnostic Check[5]

Row	P	×	1	C[a]	DOI	Fitted	Residual
1	−	+	−	−	68.80	78.83	−10.03
2	+	−	−	−	77.60	71.57	6.03
3	−	−	+	+	64.90	70.23	−5.33
4	+	+	−	−	76.50	78.83	−2.33
5	+	−	+	−	77.20	77.82	−.62
6	−	+	−	+	72.70	71.24	1.46
7	+	+	+	+	75.90	77.49	−1.59
8	+	+	−	+	73.30	71.24	2.06
9	+	−	−	+	64.90	63.98	.92
10	+	+	+	−	84.50	85.08	−.58
11	−	−	−	−	63.80	71.57	−7.77
12	−	−	+	−	72.90	77.82	−4.92
13	−	+	+	+	76.00	77.49	−1.49
14	+	−	+	+	76.30	70.23	6.07
15	−	+	+	−	77.70	85.08	−7.38
16	−	−	−	+	60.60	63.98	−3.38
17	+	+	−	+	73.70	71.24	2.46
18	+	−	−	−	77.80	71.57	6.23
19	−	+	−	+	75.40	71.24	4.16
20	−	−	−	−	73.00	71.57	1.43
21	−	+	−	−	77.20	78.83	−1.63
22	+	−	−	+	62.00	63.98	−1.98
23	−	+	+	+	80.90	77.49	3.41
24	+	−	+	−	82.10	77.82	4.28
25	−	−	−	+	59.50	63.98	−4.48
26	+	−	+	+	70.00	70.23	−.23
27	+	+	+	+	76.00	77.49	−1.49
28	−	+	+	−	87.80	85.08	2.72
29	+	+	−	−	85.70	78.83	6.87
30	−	−	+	+	69.70	70.23	−.53
31	+	+	+	−	88.50	85.08	3.42
32	−	−	+	−	82.10	77.82	4.28

(a) P = Polyester level; X = XAB level; 1 = Aluminum stearate level; and C = Catalyst level.

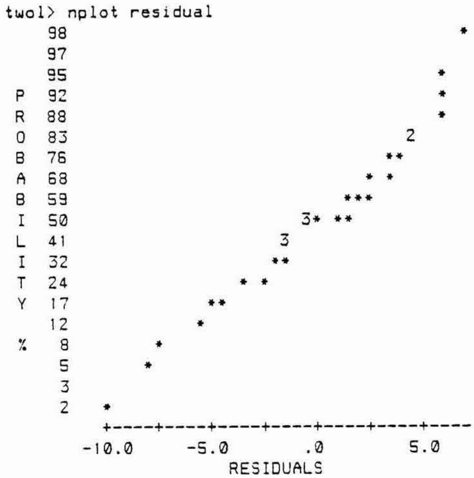

Figure 1—Residuals plotted on normal probability chart

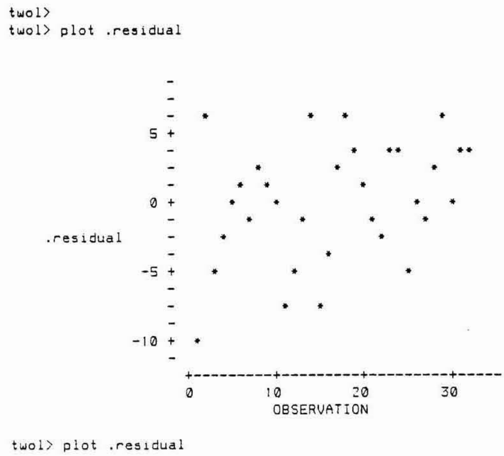

Figure 2—Residuals plotted in order in which they were run

twol> effects

	Effect	Std Error Effect	t-Ratio
Average	74.53	.75	99.87
POLYESTER (p)	3.69	1.49	2.47
XAB (X)	7.26	1.49	4.87
AL.STEARATE (l)	6.25	1.49	4.19
CATALYST (c)	-7.59	1.49	-5.08
pX	-1.49	1.49	-1.00
pl	-1.38	1.49	-.92
pc	-2.14	1.49	-1.43
Xl	-.75	1.49	-.50
Xc	2.24	1.49	1.50
lc	-.30	1.49	-.20
pXl	-.20	1.49	-.13
pXc	-1.59	1.49	-1.06
plc	1.50	1.49	1.00
Xlc	-1.78	1.49	-1.19
pXlc	-.90	1.49	-.60

S = 4.22 with 16 d.f.

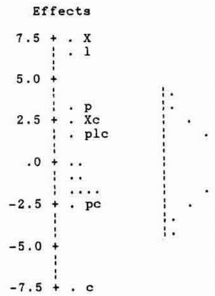

Figure 3—Effects and interactions in relation to Reference t distribution

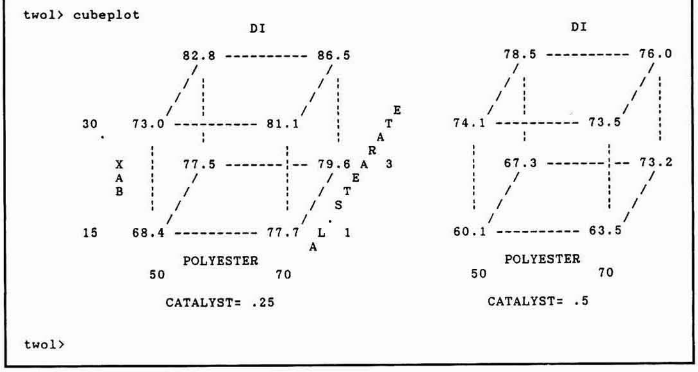

Figure 4—Cubeplot of DOI readings

The effects which are significant can be determined by estimating the amount of variation within (*Table* 4) and between treatments (*Table* 5). *Table* 5, the analysis of variance table (Anova),[4] shows the results of dividing the mean squares of the sources of variation by the mean square of error.

The sources of variation that have an F value equal to or greater than 4.49 are the significant effects and correspond to the variables B, C, and D. Variable A and the effects of two and higher level interactions are not significant.

RESULTS

The results shown in *Table* 4 are: (1) The average main effect of moving from 15% XAB to 30% is to increase DOI by 7.3 units; (2) The average main effect of moving from 1% aluminum stearate to 3% is to increase DOI by 6.3 units; and (3) The average main effect of moving from 0.25% acid to 0.5% is to decrease DOI by −7.6 units.

Analysis of the Results

EMPIRICAL MODEL: A review of *Table* 5 (Anova) and *Table* 3 (Yates) suggests that all the effects can be explained by experimental error except for the grand average (74.53), B (+7.26), C (+6.25), and D (−7.59). If we assume that the relationship between the mean value of DOI and variables B, C, and D is approximated by a straight line, then an empirical model can be written with the form: Predicted DOI = Grand Average DOI + ½ the significant effects. (Note that −1 and +1 are two units apart.)

$$\text{Predicted DOI} = 74.53 + (7.26/2 + 6.25/2 - 7.59/2)$$
$$= 74.53 + 3.63B + 3.13C - 3.79D$$

For each formulation in the calculating matrix, a value can be obtained by multiplying the appropriate signs. For example, Formulations a and b are coded + − − −, and − + − −. Since only B, C, and D are significant, multiply as follows: 74.53 + (−)3.63 + (−)3.13 − (−)3.79.

Predicted DOI for Formulation a = 71.56, and,
for Formulation b = 78.83.

We can then compare the predicted values with the actual experimental values (*Table* 6). The differences are the residuals and the diagnostic checks on them are very important in assigning statistical significance to the results.

Figure 1 shows that the residuals plotted on a normal probability chart give an approximate straight line which goes through zero.[5]

Figure 2 shows the residuals (from *Table* 6) plotted in the order in which they were run. This is to see whether there was any time trend influence on the results. None was seen in this experiment.[5]

As many diagnostic checks as possible should be done. The checks on the residuals in this experiment led to a high level of confidence in the Anova.

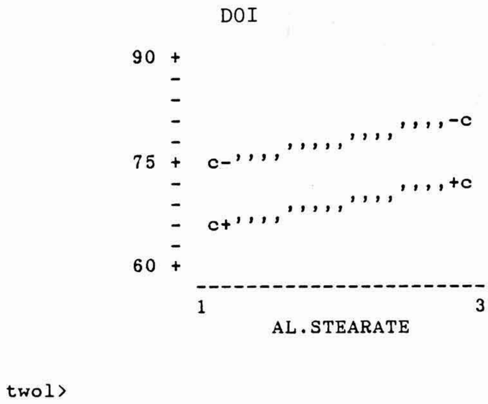

Figure 5—Interaction comparison between aluminum stearate and catalyst

COMPUTER PROGRAMS

Many programs are now available to carry out the steps necessary for a two-level designed experiment. A more visual presentation of the data and analysis is shown in *Figures* 3 and 4.[5]

Figure 3 shows the effects and interactions in relation to a Reference t distribution

X = XAB
l = aluminum stearate,
p = polyester level,
c = catalyst.

Figure 4 is a cubeplot of the DOI readings (a three-dimensional representation of changes as the levels of the variables move).

Figure 5 is an interaction comparison between aluminum stearate and catalyst. If there was an interaction effect, the lines would touch or cross each other.

DISCUSSION

While the effects of the cellulose acetate butyrate carboxylate and aluminum stearate level might not surprise experimenters familiar with basecoat/clearcoat formulations, the effect of catalyst level might. One would think that a faster curing basecoat (higher acid) would prevent sink-in of the clearcoat, leading to a better DOI. One hypothesis was that the catalyst reacted with the aluminum stearate, lessening its effect. A review of the data (*Figure* 4 and *Table* 5), however, shows that there were no interaction effects between variable 1 and variable c. The use of a statistically designed experiment in this case prevented investigation in the wrong direction.

The appearance of a basecoat/clearcoat system is dependent on the clearcoat formulation as well. A designed experiment to optimize the clearcoat led to the answer of the catalyst effect. A matching of the cure rates of the two coats was found necessary.

CONCLUSION

A functional basecoat with excellent physical properties and appearance was formulated with the use of statistical design.

SUMMARY

A two-level full factorial design experiment was used to study the effects on distinctness of image of varying levels of four ingredients in an automotive silver basecoat. Specifically, the effect of the polyester/melamine ratio, the cellulose acetate butyrate carboxylate level, the aluminum stearate level, and the paratoluene sulphonic acid level, on DOI was measured.

It was found that three of the four variables affected distinctness of image as their level changed. As the level of the cellulose acetate butyrate carboxylate, and the aluminum stearate increased, the DOI increased. A decrease in DOI occurred as the level of the acid catalyst was increased.

The analysis of the results indicated that the effects of these three variables were statistically significant.

After further designed experiments to optimize the clearcoat formulation, an automotive silver basecoat/clearcoat with excellent appearance and physical properties was produced.

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Cure Behavior and Film Properties of Two-Component Acrylic Urethane Coatings

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Aliphatic isocyanates are commonly used in highly durable two-component urethane coatings as a hardener. The influences of cure temperature, content of carboxylic acid, and dibutyl tin dilaurate on the reaction of a biuret of hexamethylene diisocyanate with acrylic polyol in the film state are reported. The catalytic effect of carboxylic acid was clearly observed in this study. Since the isocyanate groups do not react completely under ordinary cure conditions, film properties were influenced by the extent of reaction of isocyanate groups. Tensile properties and weathering properties of these systems are reported as a function of the extent of reaction.

INTRODUCTION

Two-component urethane coatings consisting of polymer polyol and isocyanate compounds are widely used in plastics, wood, and metal coatings due to the advantages of low-cure temperature and good film properties. Recently, two-component urethane coatings have become the object of attention in the automobile coatings field. In automotive coatings, especially topcoats, aliphatic isocyanates must be used to achieve highly durable film performances.

Isocyanate groups show high reactivity with active hydrogen compounds and water. Many papers have been published on the reaction mechanisms of aromatic isocyanates and the catalytic effect of metal compounds and amines.[1-6] However, the reactivity of aliphatic isocyanates and the influence of catalyst on reactivity have not been fully explored,[7,8] especially concerning the reaction in the coating film state.[9] Also, little is known of the catalytic effect of carboxylic acid for the aliphatic isocyanate systems.

The influences of carboxylic acid and tin catalyst on the reaction of a biuret of hexamethylene diisocyanate with acrylic polyol are reported. The relationship between film properties and the extent of the reaction of isocyanate groups also are reported in this study.

EXPERIMENTAL

Samples

Three types of acrylic polyols, A, B, and C, were synthesized by conventional radical polymerization (*Table* 1). These polyols were designed to have the same calculated glass transition temperature (T_g), hydroxyl number, and similar molecular weight, but different acid numbers from 0 to 20 mg KOH/g. The nonvolatile contents of these polyols are 60 wt % in xylene/butyl acetate (2/1) mixed solvent. Molecular weights of these polymers were measured by gel permeation chromatography (Toyo Soda Co., Ltd., Type HLC-827) with polystyrene standards as shown in *Table* 1.

A biuret of hexamethylene diisocyanate (HMDI) as shown in equation (1) (Desmodur N from Bayer) was used as a hardener. The NCO equivalent weight of this material was measured by the butyl amine method.

$$\begin{array}{rl} & O=C-NH-(CH_2)_6-NCO \\ & \quad\;\, | \\ OCN-(CH_2)_6- & \quad\;\, N \\ & \quad\;\, | \\ & O=C-NH-(CH_2)_6-NCO \end{array} \qquad (1)$$

Acrylic polyols were mixed with the hardener in the mole ratio of OH/NCO = 1.0. Dibutyl tin dilaurate (DBTDL) of 0, 0.005, 0.015, and 0.025 wt % solids (corresponding

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Table 1—Acrylic Resin Samples

Resin	Monomer Composition[a] (wt %) MMA	BMA	BA	HEMA	AA	Molecular Weight Mw	Mn	T_g Calc. (°C)	Properties Hydroxyl Number (mg KOH/g)	Acid Number (mg KOH/g)
A	40.0	22.6	21.8	15.6	0.0	21400	8560	30	67.3	0.0
B	40.0	21.0	22.4	15.6	1.0	20200	8420	30	67.3	7.8
C	40.0	18.4	23.4	15.6	2.6	20100	8550	30	67.3	20.0

(a) MMA: methyl methacrylate; BMA: n-butyl methacrylate; BA: n-butyl acrylate; HEMA: 2-hydroxyethyl methacrylate; and AA: acrylic acid.

to 0, 1.03×10^{-4}, 3.08×10^{-4}, and 5.13×10^{-4} mol/kg) was incorporated when necessary, then cured at given baking conditions.

Analytical Methods

The extent of reaction in the isocyanate groups was measured by the thin film method of infrared spectroscopy (Japan Spectroscopic Co., Type A-102). The cure temperature range was from 60 to 120°C. The change in the absorbance ratio of the isocyanate band at 2270 cm^{-1} to the hydrocarbon band at 2960 cm^{-1} was observed for calculating the extent of reaction.

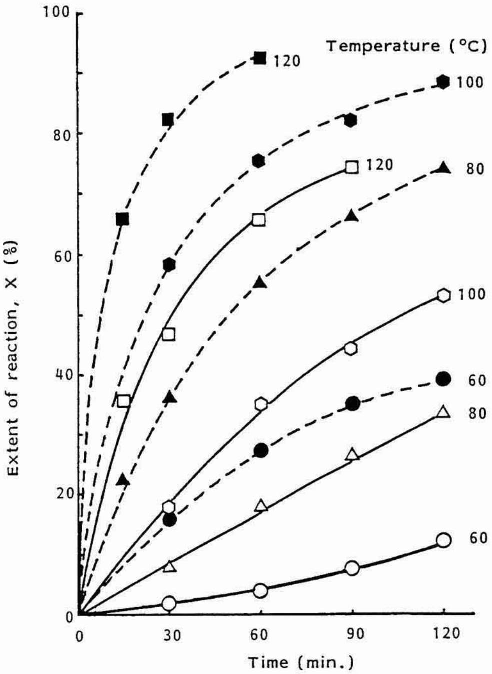


Figure 1—Extent of reaction of isocyanate groups for resin A and B systems without DBTDL as a function of cure temperature. (——): resin A and (---): resin B

Free films were prepared by spraying the coatings on the polytetrafluoroethylene film and then removing them for measurement of the dynamic mechanical and tensile properties. The film thickness of free films is about 50μm. The T_g was determined by applying the peak temperature of the loss modulus on dynamic mechanical measurements (Toyo-Boldwin Co., Rheovibron DDV-EII). A tensile test apparatus (Toyo-Boldwin Co., Type UTM-2) was used for measuring Young's modulus and tensile strength under the following conditions: sample length of 4 cm, deformation speed of 10%/min, and temperature at 20°C.

For the accelerated weathering test, basecoat/clearcoat type silver metallic coatings were prepared on the electro-immersion primed and surfacer coated steel panels. Film thicknesses of basecoat and clearcoat were about 15 and 35μm, respectively. The sunshine weathermeter (Suga Test Instrument Co., Ltd.) was used for the accelerated weathering test of these samples and gloss value and color difference were measured during the weathering. The operation conditions of a sunshine weathermeter are: a light source of sunshine carbon arc, water spray for 12 min/60 min, and black panel temperature of 63°C.

RESULTS AND DISCUSSION

Reactivity of a Biuret of HMDI

The influence of cure temperature on the extent of reaction of NCO groups for resin A and B systems without DBTDL is shown in *Figure* 1. The solid lines indicate resin A system having no acid number and the dashed lines indicate resin B system having an acid number of 7.8. The influence of DBTDL content on the extent of reaction of resin A system cured at 80°C is shown in *Figure* 2. In *Figure* 3, the influence of DBTDL content on the extent of reaction of resin B system cured at 80°C is shown. This figure also shows a comparison of resin A, B, and C systems without DBTDL. From these figures, it is clearly observed that the carboxylic acid shows strong influence on the reactivity of HMDI and the extent of reaction rapidly increases with carboxylic acid content in the systems without DBTDL. It is also observed that the catalytic effect of DBTDL on the reactivity in resin A system is much greater than that of resin B system.

Reactions of aromatic isocyanates with alcohol in solution have been reported by many people,[1–6] and we know

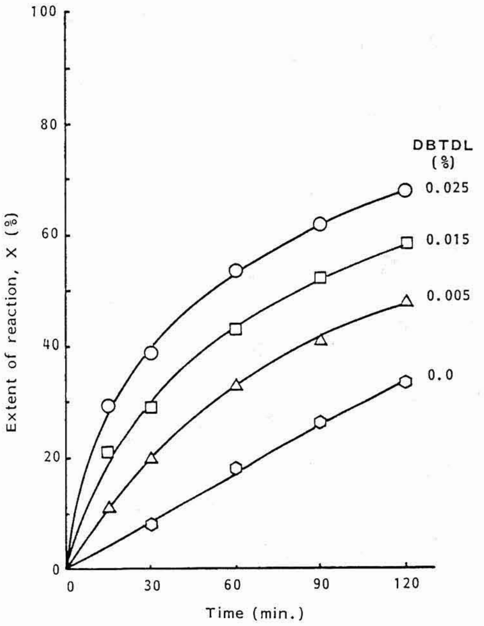


Figure 2—Influence of DBTDL content on the extent of reaction for resin A system at 80°C

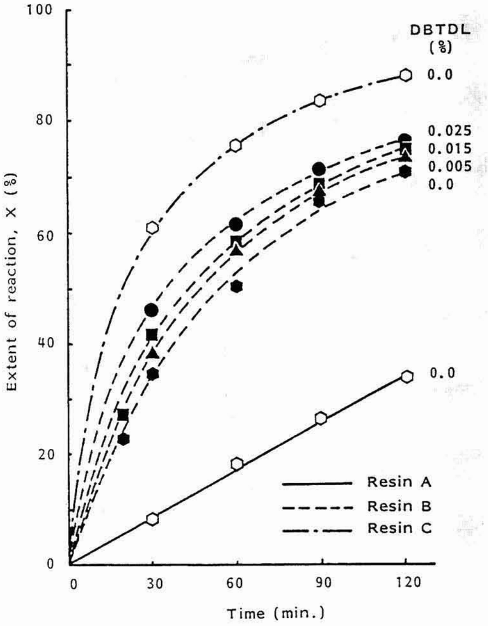


Figure 3—Influences of carboxylic acid content (resin A, B, and C systems without DBTDL) and DBTDL content for resin B system on the extent of reaction at 80°C

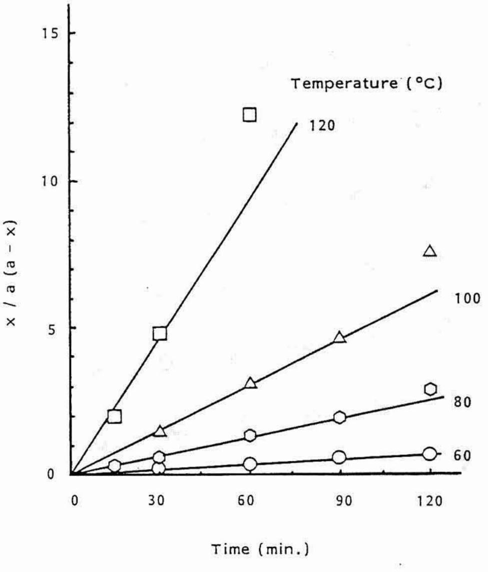


Figure 4—Relationship between x/a (a-x) and t for resin B system with different cure temperatures

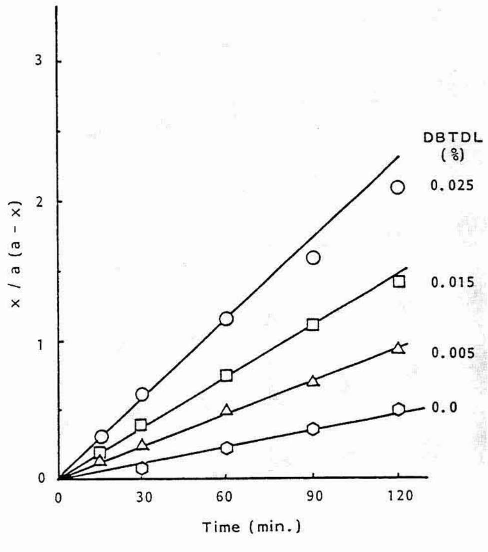


Figure 5—Relationship between x/a (a-x) and t for resin A system with different DBTDL contents at 80°C

that the reaction kinetics follow the second order reaction. However, very few papers have been published on the reaction of aliphatic isocyanates, especially the reaction of polyisocyanate with polymer polyol in the wet film state.[9]

In the second order reaction,

$$-\frac{dx}{dt} = k\,(a - x)\,(b - x) \qquad (2)$$

where a and b equal the initial concentration of NCO and OH, x equals the number of moles of a or b reacted, and k equals the rate constant. When the NCO/OH is 1.0 (a = b),

$$-\frac{dx}{dt} = k\,(a - x)^2 \qquad (3)$$

Integration of equation (3) gives

$$kt = x/a\,(a - x) \qquad (4)$$

Typical examples of the relationship of equation (4) are shown in *Figures* 4 and 5. *Figure* 4 shows the influence of cure temperature on resin B system without DBTDL, and *Figure* 5 shows the influence of DBTDL content on resin A system cured at 80°C. All the samples tested in this study fit the second order reaction. The rate constant, k, can be calculated from the slope of the lines.

It is not uncommon that the deviation to downward from a linear line takes place with the advance of the reaction as shown in *Figure* 5, but upward deviation was observed in *Figure* 4. This phenomena could be caused by an allophanate reaction of isocyanate with urethane groups at rather high temperatures. However, the cure time of coatings is usually less than 30 min, so it is possible to calculate the rate constant from the slope at the initial stage.

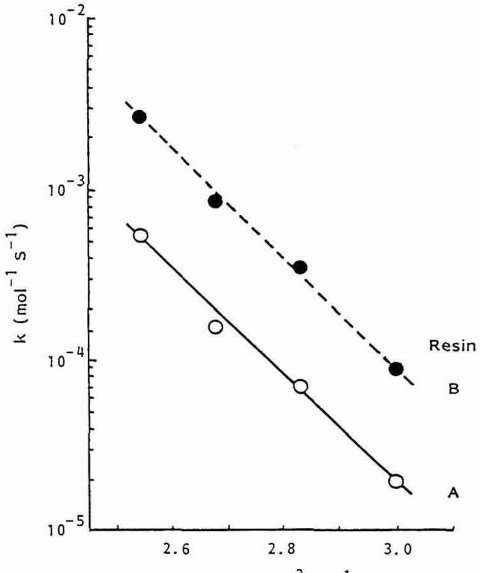


Figure 6—Arrhenius plots for resin A and B systems without DBTDL

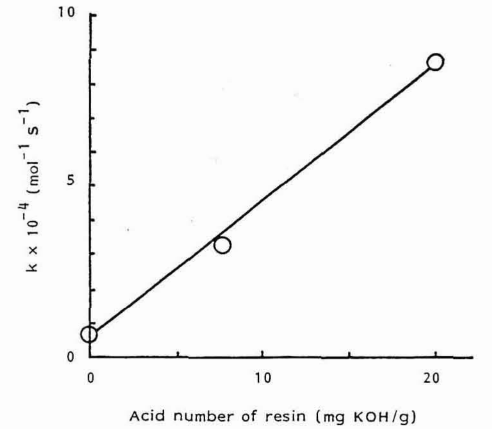


Figure 7—Influence of acid number of resin on the rate constant at 80°C

The Arrhenius plots for resin A and B systems without DBTDL are shown in *Figure* 6. The rate constant of resin B system is about five times greater than that of resin A system when the systems do not include DBTDL. The activation energies for resin A and B systems were 14.4 and 14.7 kcal/mol, respectively. These values are considerably higher than the value of 8.2 kcal/mol reported by Bauer for the reaction of a biuret of HMDI with a high solids acrylic polyol.[9] However, activation energies of 11.0 kcal/mol for the reaction of HMDI with polyethylene adipate in the solution[10] and 13.9 kcal/mol for the first isocyanate group in p-xylylene diisocyanate with ethanol[11] were reported. Also, it is well known that the reactivity of isocyanate groups greatly depends on the solvent used.[3,12,13] For example, Onodera[3] reported that the rate constants for the reaction of phenyl isocyanate with butanol in toluene and in methyl ethyl ketone at 20°C are 82×10^{-4} and 3.0×10^{-4} l/mol·min. Since the polarity or electron donation capability[13] of the medium greatly affects the reaction rate, it can be presumed that the differences in resin compositions may affect the activation energies.

Catalytic Mechanism of Carboxylic Acid

The catalytic effect of carboxylic acid on the reactivity of isocyanate with polyol was reported.[14,15] However, some people believe that carboxylic acid acts as an anticatalyst, and the quantitative discussion on the catalytic effect of carboxylic acid has not been fully explored. Heiss, et al.[14] and others[11,15] mentioned that a small amount of acidic compounds just neutralize the basic materials and act as an anti-catalyst, especially in aromatic isocyanate systems. However, an adequate amount of

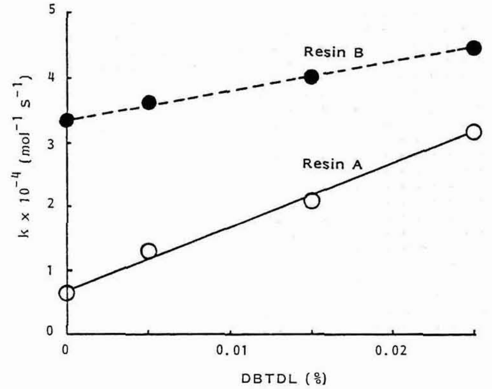


Figure 8—Influence of DBTDL content on the rate constant at 80°C

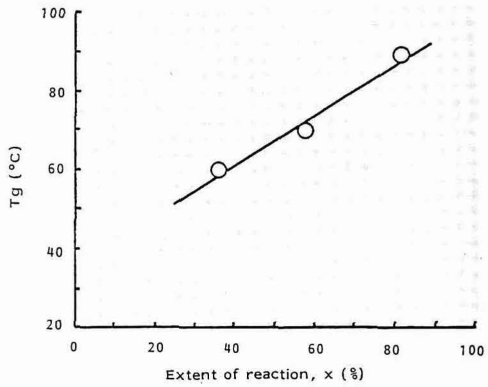
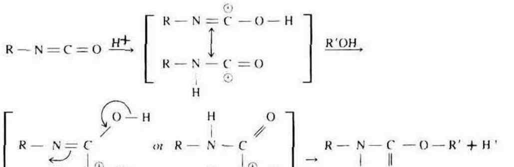


Figure 9—Influence of the extent of reaction on the T_g of cured films in resin B system

acidic compounds, such as sulphonic acid, inorganic acid, phosphate ester, oxyacid, and carboxylic acid have a catalytic effect on urethane reactions.

The influence of carboxylic acid on the reaction of isocyanates with polyols was clearly observed in this study. It was also clearly observed that the solution viscosity increased rapidly with increasing carboxylic acid content, as seen in the results by Kleine, et al.[15] The viscosities of the 40% solutions in xylene/butyl acetate (2/1) reached 1.5 times the initial viscosity at 25°C in 1 hr for resin A system, and 4 hr for resin B system. However, the viscosity of resin C system increased only about 1.1 times after 8 hr. The linear relationship between the rate constant at 80°C and acid number of the resin is shown in *Figure* 7. The rate constants for resin B and C systems are about five times and 13 times greater than resin A system. The catalytic effect of carboxylic acid may be explained in the following scheme. Proton attacks the oxygen or nitrogen of an isocyanate, then the oxygen of alcohol attacks the carbon of the isocyanate.

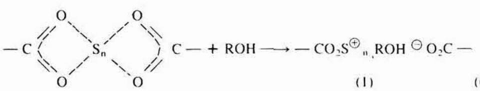


(5)

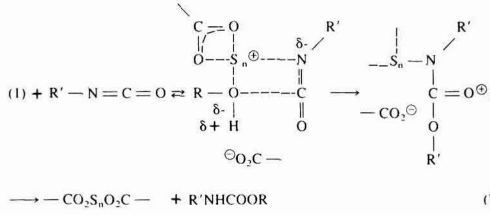
In *Figure* 7, not only the catalytic effect of carboxylic acid, but also the reaction of isocyanate with carboxylic acid must be taken into consideration.[16–18] We know, however, that the rate of this reaction is lower than in amine and alcohol[11,18] due to the weaker nucleophilicity of the hydrogen in carboxylic acid. For example, Morton, et al.[18] reported the rate constants for the reactions of phenyl isocyanate with butanol, butyric acid, and water at 80°C are 27.5×10^{-4}, 1.56×10^{-4}, and 5.89×10^{-4} l/mol·sec, respectively. This means that the ratio of the rate constant for the butanol system and the butyric acid system is 17.6 : 1.0. Furthermore, the mole ratios of NCO/(COOH + OH) for resin B and C systems are 1/1.10 and 1/1.26, respectively. This means that the results in *Figure* 7 cannot be explained by stoichiometrical point of view.

The influence of DBTDL content on the rate constants at 80°C for resin A and B systems is shown in *Figure* 8. The increase in the rate constant with DBTDL content in resin B system was considerably lower than that of resin A system. This phenomenon suggests that there are some interactions between carboxylic acid and DBTDL which inhibit the catalytic effect of DBTDL.

Various mechanisms of tin catalyst on the reaction of isocyanate with alcohol were proposed.[19–24] Recently, however, Wongkamolsesh and Kresta[24] reported that the hydroxyl group of alcohol or polyol solvates the DBTDL and forms the carboxylate anion first, then the isocyanate forms a complex with it as shown in equations (6) and (7).



(6)



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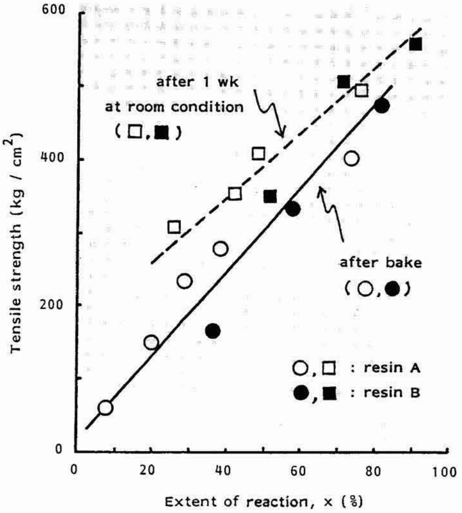

Figure 10—Influences of the extent of reaction and storage conditions on the tensile strength of cured films

They also observed that the disassociation of the DBTDL was inhibited by the presence of lauric acid. (The mole ratio of COOH/DBTDL for resin B system with 0.025% DBTDL is 270/1.) Therefore, the inhibiting effect of carboxylic acid on the catalytic effect of DBTDL may be explained by the inhibition of the disassociation of DBTDL.

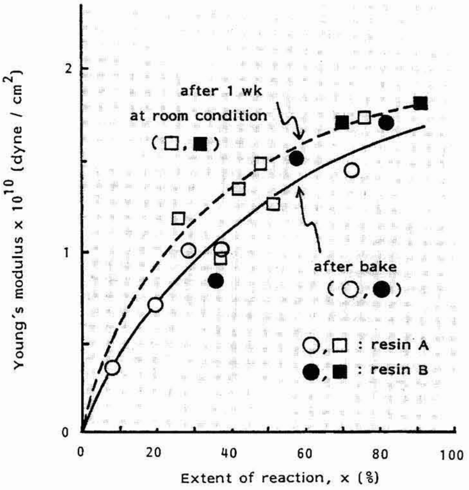

Figure 11—Influences of the extent of reaction and storage conditions on Young's modulus of cured films

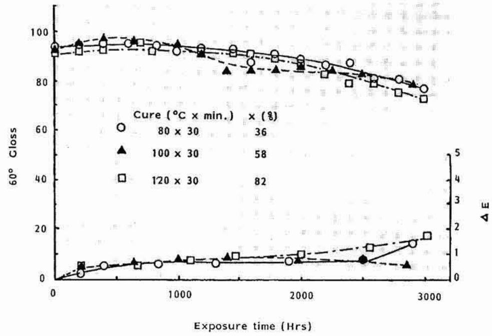

Figure 12—Accelerated test results for resin B system as a function of the extent of reaction

Film Properties

An example of the influence of the extent of reaction of isocyanate groups on the T_g of cured films is shown in *Figure* 9. After baking, free films were immediately tested by dynamic mechanical measurements. T_g increased with increasing crosslinking. Since the T_g of film after baking is usually higher than room temperature, the reaction between functional groups of polymers at ambient temperature would be restricted by the poor chain mobility.

Tensile strength and Young's modulus also depend on the extent of reaction as shown in *Figures* 10 and 11. From these figures, much difference between resin A and B systems can not be seen. However, film storage conditions before testing have an influence on the physical properties of films. Higher tensile strength was observed for the samples which were baked and then stored for one week in room conditions (75% relative humidity at 23°C) compared with the samples which were just baked when we compared the samples of the same extent of reaction

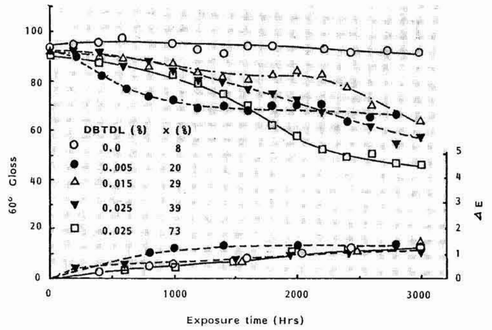

Figure 13—Accelerated test results for resin A system as a function of the extent of reaction

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of isocyanate groups. This result suggests that part of the residued isocyanates after baking may react with water during storage to form urea bond which shows a higher T_g and a more rigid property than urethane bond.

The influence of the extent of the reaction on accelerated weathering of metallic coatings in resin B system is shown in *Figure* 12. The extent of reaction was controlled by baking conditions, and the test started after storing the samples for one week at room conditions. We can not see any differences in gloss and color difference among these samples. This result means that the contents of urethane and urea bonds do not affect the weatherability of metallic coatings.

In the case of the resin A system, the extent of reaction was controlled by DBTDL content and baking conditions. There is a trend toward lower gloss with increasing DBTDL content, as shown in *Figure* 13. Takahashi, et al.[25] and Osawa, et al.[26] reported that trace amounts of tin compounds strongly accelerate the degradation of methacrylic resin and polyester urethane resin. This result may be caused by the influence of alkyl radicals from DBTDL and/or by the acceleration of the decomposition of hydroperoxide by tin during weathering.

The systems without DBTDL in *Figure* 13 show the best results on weathering, but at least 40% of the extent of reaction is necessary to get chemical resistance and mechanical properties, and to prevent blocking of films after baking. Therefore, it is better to control the extent of reaction by carboxylic acid, not by DBTDL.

CONCLUSION

The catalytic effect of carboxylic acid and DBTDL on the reaction kinetics of two-component acrylic urethane coatings was discussed. The reaction of a biuret of HMDI with an acrylic polyol in the film state followed the second order reaction, and the temperature dependency of the rate constants fit the Arrhenius equation.

It was clearly observed that carboxylic acid shows a strong catalytic effect on the reactivity of isocyanate groups and the rate constant increases with increase in carboxylic acid content for the system without DBTDL. Therefore, the mechanism of catalysis of carboxylic acid was proposed. However, the catalytic effect of DBTDL on the reactivity of isocyanate groups was inhibited by carboxylic acid. This phenomena may be caused by the inhibiting effect of carboxylic acid on the solvation of hydroxyl groups to the DBTDL to form carboxylate anion.

The influence of the extent of reaction on the mechanical properties of cured films was also discussed. It was observed that the mechanical properties were clearly dependent on the extent of reaction. Accelerated weathering test results by sunshine weathermeter showed that the extent of reaction does not affect the weatherability of two-coat metallic coatings, but the presence of DBTDL lowers the gloss retention.

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Influence of Post Treatment Storage On the Surface Chemistry Of Plasma Oxidized Polymers

H.S. Munro and D.I. McBriar
University of Durham*

X-ray photoelectron spectroscopy (XPS) and contact angle measurements were used to monitor the changes in surface chemistry of plasma oxidized polyetheretherketone (PEEK) and a polysiloxane acrylate during post treatment storage. As expected, decay in the hydrophilicity occurred during the first seven days post treatment. However, after 16 days, a brief recovery was observed, dependent on polymer and storage condition. The changes in the contact angle were related to the XPS data and showed that the recovery in hydrophilicity was due to reorganization occurring in a 20 Å region within the outermost 50 Å of the sample.

INTRODUCTION

The oxygen discharge treatment of polymers has been extensively reported, particularly in studies on improving wettability and adhesive properties. Much is known about the immediate changes produced in a variety of substrates, such as polyethylene,[1] polymethylsiloxane,[2] and poly (ethylene terephthalate),[3] and by a number of treatment techniques, including corona discharge[4] and both radio frequency[5] and microwave[6] plasmas. These treatments have been studied by a variety of techniques such as FTIR, contact angles, surface derivitization, and x-ray photoelectron spectroscopy (XPS). Work has also been done on the changes in surface chemistry that take place with post treatment storage.[7] However, such studies have tended to concentrate on relatively long-term effects.

These studies have shown that, after the initial treatment, there is an increase in the contact angle (with water) which tends to level off to a plateau value after about a week.

It has been suggested that this contact angle increase is due to a combination of two processes. One involves the rotation of surface polar groups into the bulk of the material to reduce the surface energy[8] when the surface is stored in a nonpolar medium such as air. The other is due to the migration of low molecular weight, polar fragments, produced by the treatment, into the bulk.[9]

In this work, we have utilized contact angle measurements and XPS to follow changes in surface chemistry of two oxygen plasma modified polymers, polyetheretherketone (PEEK) and a siloxane acrylate, during storage in both air and water.

EXPERIMENTAL

Materials

The contact lenses used were Boston IV, a siloxane acrylate material, consisting of a polymethylmethacrylate backbone with siloxane groups replacing a portion of the methyl esters (*Figure* 1). The lenses were supplied ground and polished to commercial standards by Cambridge Precision Ltd., and had a contact angle measured with distilled water of 83° ± 3°.

This paper was presented at the Spring Meeting of the American Chemical Society Division of Polymeric Materials: Science and Engineering, on April 7, 1987, in Denver, CO.
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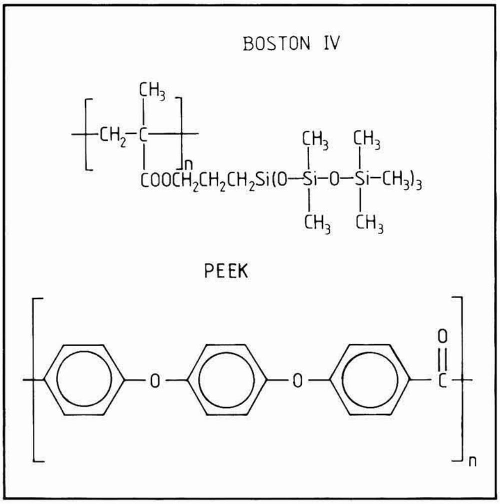

Figure 1—Structures of Boston IV and PEEK

PEEK, with a thickness of approximately 100 μm, was supplied by I.C.I. plc and had a contact angle of 87° ± 2°.

Plasma Treatment

Samples were placed on a glass slide in a Polaron E2000 Plasma Asher/Etcher. Contact lenses were treated with a 20 W oxygen plasma for 45 sec at a pressure of 0.4 mbar of oxygen. The lenses were then removed from the reactor; some were stored in air and others were stored in distilled water.

Samples of PEEK were cut and placed in the reactor such that the upper surface could readily be identified. They were treated with an oxygen plasma at 5 W for 20 sec using an oxygen pressure of 0.4 mbar. The samples were then removed and stored in either air or water.

The plasma treatment conditions were chosen to give the lowest contact angle immediately after treatment for each material.

Contact Angle Measurements

Contact angle measurements were performed using the sessile drop technique[10] and distilled water of surface tension 67.5 mN/m. Samples that had been stored in water were removed and allowed to dry in air before their contact angles were measured.

X-Ray Photoelectron Spectroscopy

Core level spectra for the C_{1s}, O_{1s} and Si_{2p} regions were recorded on a Kratos Scientific Instruments ES300 electron spectrometer using $Mg_{K\alpha}1,2$ x-rays. Peak fitting and area ratios for the spectra were obtained using the software of a DS300 data station. Samples were attached to the probe tip using double sided Scotch tape. Electron take-off angles of both 30° and 60° were used to investigate the vertical homogeneity of the treatment since the escape depth of the photoelectrons is less at 60° than at 30°. This gives sampling depths at 30° of ≈40Å and ≈25Å for carbon and oxygen, respectively, and of ≈25Å and ≈15Å at 60°. The C-H component of the C_{1s} core level spectrum at a binding energy of 285 eV was used to correct for sample charging. Component analysis of the C_{1s} spectra was accomplished using gaussian peaks at known component binding energies, with constant full width at half maximum height and thus, peak height as the one variable.

As with the contact angle measurements, samples stored in water were allowed to dry in air before being run.

RESULTS AND DISCUSSION

Immediately after oxygen plasma treatment, the Boston IV contact lenses and PEEK had contact angles with water of 42° and 4.2°, respectively. These initial changes produced by the plasma can be seen in the XPS data as an increase in the oxygen-carbon ratio; a detailed study of the precise nature of these changes will be the subject of a further publication.[11] The materials studied show the overall expected behavior for oxygen plasma treated polymers, in that the initially enhanced hydrophilicity of the modified surface decays on storage in both air and in water. However, they also show some completely unexpected features (*Figures* 2 and 3).

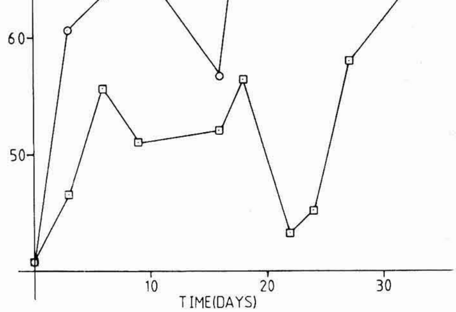

Figure 2—Variation of the contact angle with time for treated Boston IV lens material. (○ = stored in water; ⊡ = stored in air)

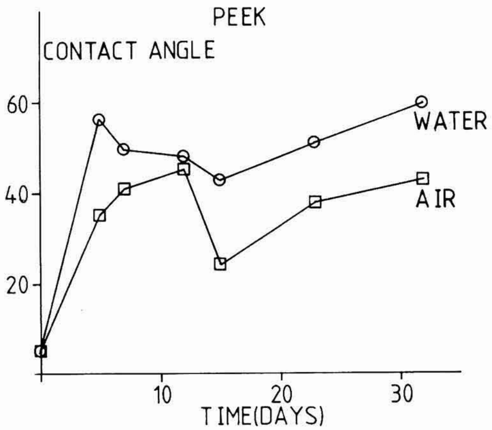

Figure 3—Variation of the contact angle with time for treated PEEK

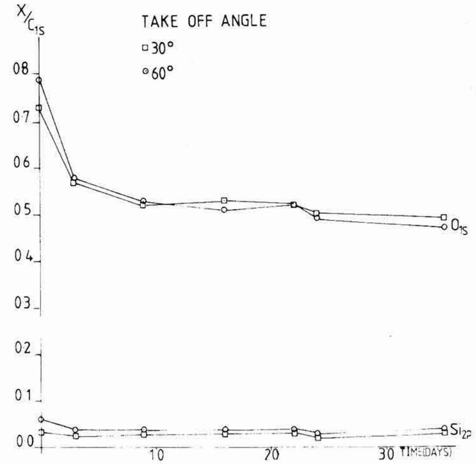

Figure 4—Variation of the elemental ratios of modified contact lens material stored in water

The contact angle rose with time and reached a plateau after approximately six days. The difference in the contact angle between six days and at 35 days was relatively small. However, in the case of the lens material stored in water, after 16 days the surface appeared to become more hydrophilic for a short period as evidenced by the decrease in the contact angle shown in *Figure* 2. Similar changes in the contact angle occurred after 16 days in air for PEEK (*Figure* 3).

For water-stored lens material, the contact angle changes can be associated with changes in the XPS data obtained at an electron take-off angle of 60°, as shown in *Figure* 4 and *Table* 1. Over the first few days the contact angle rose rapidly. This loss of hydrophilicity correlated with the reduction in the oxygen content of the surface as indicated by the O_{1s}/C_{1s} area ratio (*Figure* 4). As the change in the contact angle leveled out into a plateau region, the overall oxygen content of the surface ceased to drop and reached an essentially constant level. There was no change in the overall elemental composition corresponding to the decrease in contact angle at 16 days. The depletion in oxidized functionalities from the surface during the initial storage period as suggested by the O_{1s}/C_{1s} data was confirmed by the changes in the component contributions to the C_{1s} core level spectra (*Table* 1). Decreases in the intensities, relative to moieties not directly bonded to oxygen, of the C-O, >C=O, and O-C=O components were observed over the first six to seven days of storage. During the 12-18 day period, an increase in the proportion of carbon bound to oxygen, particularly of carboxylate (O-C=O) and carbonyl

Table 1—Components of the C_{1s} Envelope for Modified Lenses Stored in Water

Time (days)	CH	Take-Off Angle 30° C-O	C=O	O-C=O
0	64	16	9	11
3	69	15	7	9
9	61	20	7	12
16	56	24	6	14
22	65	23	2	10
24	64	25	1	10
35	64	19	6	10

Time (days)	CH	Take-Off Angle 60° C-O	C=O	O-C=O
0	65	17	6	12
3	65	22	6	7
9	66	23	4	7
16	54	24	9	13
22	67	21	3	9
24	66	24	1	9
35	64	19	7	10

Table 2—Components of the C_{1s} Envelopes for Modified Lenses Stored in Air

Time (days)	CH	Take-Off Angle 30° C-O	C=O	O-C=O
0	64	16	9	11
3	65	16	10	9
9	65	16	4	15
16	55	22	11	12
22	54	27	8	11
24	88	10	1	1
35	85	9	2	4

Time (days)	CH	Take-Off Angle 60° C-O	C=O	O-C=O
0	65	17	6	12
3	63	16	5	16
9	57	21	7	15
16	59	21	7	13
22	54	27	7	12
24	89	9	1	1
35	84	12	2	2

(>C = O) groups, was evident and corresponded to the decrease observed in the contact angle data during the same interval. Beginning with the 18th day, the nature of the C_{1s} envelope was essentially the same as that for the 9-12 day period. Between 9-18 days, the overall O_{1s}/C_{1s} and Si_{2p}/C_{1s} area ratios remained constant.

The initial rise in the contact angle measurement can be considered to be the result of the migration of highly polar surface fragments produced by the plasma into solution or the bulk polymer, with a possible contribution from other reorganization processes such as reorientation, of the polymer chains in the surface. Impetus for this process was derived from the decrease in surface energy which results from the lowering of the polarity of the surface. The decrease in the contact angle at 16 days, however, was contrary to this driving force and must have been caused by some other process within the sample. At the 16 day point, if migration was occurring, a compositional change might have been expected to occur throughout the surface, which would have been expected to result in a change in the elemental ratios. This was not the case, so the increase in the proportion of carbonyl functionalities, which corresponded with the sudden increase in hydrophilicity, may be seen as evidence of reorientation. This assumes, however, that the number atom density of the surface, which affects the core level signal intensity, remains constant. A consideration of the XPS data recorded at an electron take-off angle of 30° shows similar trends to those observed at 60° over the first 20 days of storage (*Figure* 4). However, the changes in the proportions of the carboxylate and carbonyl functionalities (*Table* 1), are less pronounced. This indicates that the effect, observed at 16 days, may be concentrated in the uppermost region of the surface. The spectra recorded at a take-off angle of 60° sample the outermost 25Å. The signal from this region is included in the spectra recorded at a take-off angle of 30°, which samples the outermost 40Å. Thus, the changes observed at 16 days in the 30° take-off angle data may result from signals from top 25Å diluted by signals originating from a greater depth.

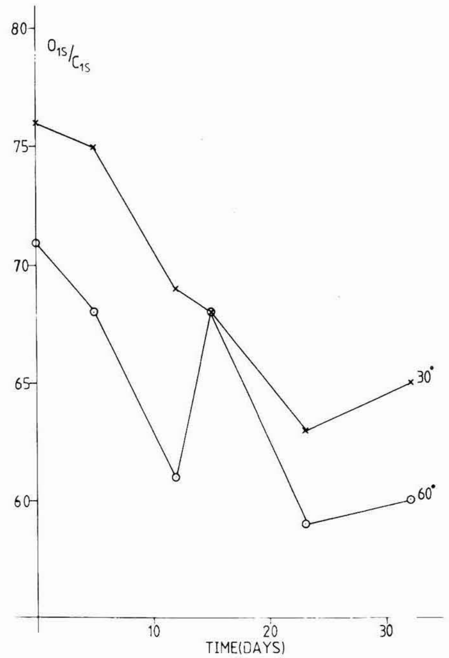

Figure 6—Variation of the elemental ratios of modified PEEK stored in air

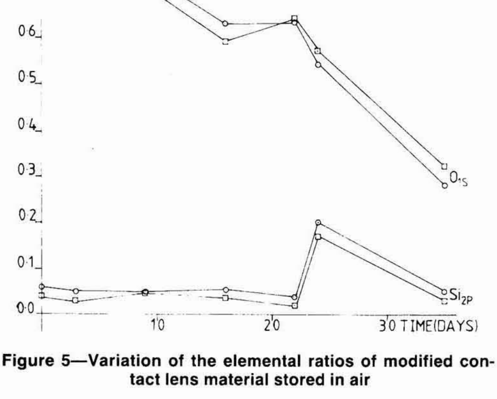

Figure 5—Variation of the elemental ratios of modified contact lens material stored in air

In the case of the air-stored lens material, the initial increase in the contact angle was again mirrored in the reduction in the overall oxygen content. However, there was no definite plateau region and the oxygen content of the surface fell throughout the period of study as the contact angle continued to increase. There was no contact angle decrease at 16 days and changes corresponding to those observed for storage in water in the top 25Å were not apparent in the XPS data at a take-off angle of 60° (*Table* 2). However, similar changes to those for water-stored lens material at a take-off angle of 60° were observed at a take-off angle of 30°. As before, the elemental ratios did not change, but the nature of the C_{1s} envelope does suggest that the same process that was observed in the case of water storage in the top 25Å did occur in air-stored lens material between 25 and 40Å. Since these changes were not observed at a take-off angle of 60°, a change in contact angle was not anticipated.

The differences in the depth at which the changes in the surface chemistry for water- and air-stored lenses are

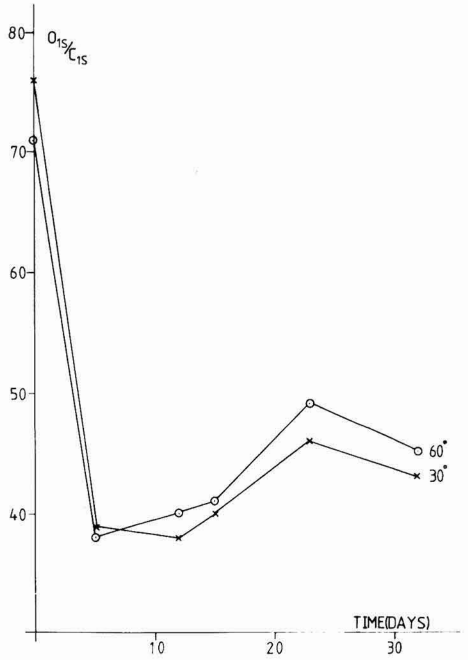

Figure 7—Variation of the elemental ratios of modified PEEK stored in water

observed can be explained by the way in which material is lost from the surface of the sample. During plasma treatment, the highly reactive gas, in conjunction with modification of the chemistry of the surface, can also break up the polymer chains into relatively low molecular weight material. In the water-stored lens, the extent to which the surface layer can be removed, into solution and by migration and reorientation into the bulk, is far greater than in air storage where only the latter processes will occur. The XPS and contact angle data suggest that the removal of the outermost modified layer occurs during water storage and brings the region, in which the reorganization occurs, to a depth that can influence the contact angle.

Such a removal of surface material by washing with water has been observed before[3] and would also explain why the water-stored material appeared to lose more of the modification than that stored in air, as evidenced by the overall lower contact angles for air-stored samples.

The change which occurred in the case of air-stored lens material at 22 days appears to be associated with a reorganization of silicon containing species, and may well be due to migration as the elemental ratios are affected throughout the surface and "subsurface" of the material, as shown in *Figure* 5. At this point, there is a large increase in the amount of silicon in the surface as shown by the Si_{2p}/C_{1s} area ratio and there is also an increase in the O_{1s}/C_{1s} area ratio.

The initial changes in the contact angles of the PEEK samples follow similar trends to those observed for lens material and can be correlated with the changes in the elemental ratios (*Figures* 6 and 7). Air-stored PEEK shows a decrease in the contact angle at 16 days (*Figure* 3) and the XPS spectra, at a take-off angle of 60°, show changes resembling those seen for water-stored lens material at 60° at this point (*Table* 3). In contrast, PEEK stored in water shows only slight changes in surface chemistry for the 12-18 day region and there is no change in the contact angle over this period.

An explanation for the difference in behavior of air- and water-stored PEEK can be readily suggested from a consideration of the C_{1s} envelopes for PEEK, untreated, immediately after treatment, and after five days storage in water (*Figure* 8). It is immediately apparent that the spectrum of the sample stored in water is very similar to that of the untreated material. This suggests that the modified surface layer of PEEK has been almost completely removed by the water and, thus, few changes in the contact angle, resulting from the plasma treatment, would be expected on prolonged storage.

In the case of both lens material and PEEK, the process that occurs after 16 days produces similar changes in the

Table 3—Components of the C_{1s} Envelopes of Modified PEEK Stored in Air

		Take-Off Angle 60°				
Time (days)	CH	C-O	C=O	O-C=O	CO_3	$\pi \rightarrow \pi^*$
0	59	20	6	10	4	1
5	59	21	6	8	3	3
12	67	19	3	7	2	2
15	58	19	11	9	2	1
23	60	22	6	7	2	3
32	60	21	7	8	1	3

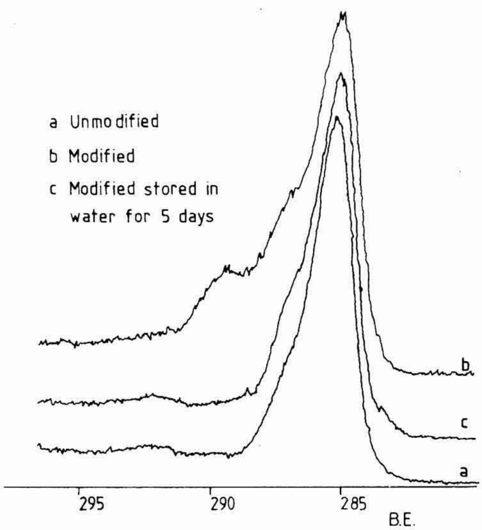

Figure 8—C_{1s} envelopes of unmodified, modified, and modified and water-stored PEEK

nature of the surface chemistry, although the structures of the untreated polymers are very different. In the lens material, the effect does not result in a change in the elemental ratios, suggesting that it may be a reorientation process. There is an elemental ratio change when this effect is observed for PEEK, indicating that a migration phenomenon may be involved. It is possible that the migration of small, polar fragments from the surface of the material results in an incompatibility between these fragments and the less polar subsurface layers, thus providing a driving force for a reorganization process which enables the compatibility between the bulk and the modified surface to be maximized.

The data discussed shows that the aging process of a modified material is dependent on the material, the treatment, and the storage conditions. It also shows that a dynamic reorganization (reorientation and/or migration) can occur at some time after the treatment, which can significantly affect its surface properties at that time. The actual nature and driving force of this process is not yet fully understood and will be the subject of further investigation.

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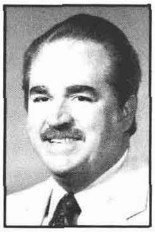
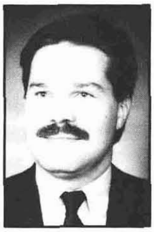
People

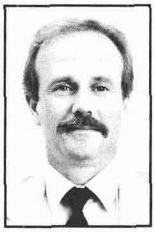
Robert J. McCaffrey has been appointed to the position of Process Control Manager for Akzo Coatings Inc., Troy, MI. In his new position, he will manage the process engineering program throughout the company's U.S. coatings operations. Mr. McCaffrey is a member of the Chicago Society.



R.J. McCaffrey



P.S. Bening



W. Reynolds

E.C. Karl

P. Scott Bening has been named Sales Manager for Halox Pigments Division of Hammond Lead Products, Inc., Pittsburgh, PA. Mr. Bening most recently served as Accounts Manager for the company.

Staffing of the Chemicals Division of Hüls America Inc. has been announced. **Barry C. Arkles** will assume the position of Vice President and General Manager of Silanes and Silicones; **Avron B. Magram** has been named Vice President and General Manager of Plastic Additives and Lubricants.

In addition, the firm has also announced the following appointments: **Andreas E. Meinz**—General Manager, Specialties and Fine Chemicals; **Robert J. Morlino**—General Manager, Organic Intermediates; **William R. Peterson, Jr.**—General Manager, Microelectronic Chemicals; and **Robert Lance**—Works Manager for the Mobile plant.

Richard D. Wintermute has joined the Analytical Services Group of the Midland Division of The Dexter Corp., Waukegan, IL, in the position of Analytical Research Associate.

The appointments of **Valentino J. Tramantano** and **Mukesh G. Jain** as Research Chemists for acrylic emulsions for ICI Resins US have been announced.

The firm has also named **Stephen Lustig** Director of Marketing. He will be located in Wilmington, MA, and will have responsibility for all marketing activities to customers in the adhesives, coatings, automotive, and graphic arts industries.

Frank H. Romanelli has been appointed President of the Petrochemical Division of Cain Chemical Inc. He will be in charge of the company's line of olefins and aromatics, and ethylene oxide and derivatives businesses.

NL Chemicals, Inc., Hightstown, NJ, has promoted **William Reynolds** to Supervisor, Technical Service. A member of the Philadelphia Society, Mr. Reynolds will assume responsibility for the technical service laboratory support for rheological additives sold to the coatings and ink industries in the U.S., South America, and the Far East.

The Petroleum and Industrial Dyes Group of Morton Chemical Division, Morton Thiokol, Inc., Chicago, IL, has promoted **Peter Heffron** to Group Leader, Dyes Process Research and Development. His new responsibilities include providing technical support to the product area on existing production processes, providing support to the Dyes Research Group, and working with the company's pilot plant in Ringwood, IL.

Michael Hinton has been promoted to Group Leader, Dyes Research and Development for Morton Chemical. He will be involved in the research and development of new dye products including those for ink, plastic, and automotive applications.

Other promotions announced by the firm are: **Alfred H. Isenberg** to Vice-President, Packaging Adhesives & Coatings, North America and **Alan F. Hume** to Regional Director for the Far East.

Unocal Polymers, Unocal Corp., Schaumburg, IL, has appointed **Hayden Simmerson** to the post of Senior Applications Chemist, Paper, at the firm's Technical Service Center in Charlotte, NC. A 15-year veteran of the paper industry, he has experience at both the mill level and in a technical service capacity with other industry suppliers.

Erhard C. Karl has joined SC Johnson Wax as Director of Sales, North American Region for Specialty Chemicals. He will manage the sales force and the customer service/order editing functions, and will be based in corporate headquarters in Racine, WI.

Croda Inks Corp. has announced the promotions of **Thomas D. Hentschel** to the position of Executive Vice President at its Niles, IL, headquarters, and **James May** to Vice President of Operations, based in Atlanta, GA.

Eastman Chemical Products, Inc., Kingsport, TN, has announced the following appointments in its Chemicals Division: **Fred A. Buehler**—Product Specialist; **William Reginald (Reggie) Bonnevie**—International Marketing Specialist; **Harris N. Stephens, Jr.**—International Marketing Specialist; **E.J. Sacksteder, Jr.**—New Products Representative; and **John H. McKinley**—Manager, National Distributors.

J.M. Huber Corp., Chemicals Division, Havre de Grace, MD, has announced the following appointments: **Bernard D. Brown**—Customer Service Section of the Marketing Department; **Jerry D. Wagner**—Computer Specialist; and **Bruce D. Heider**—Human Resources and Safety Manager.

Also, J.M. Huber's Clay Division, Macon, GA, has named **David T. Palm** Sales Representative in the Marketing Department. In this new position, Mr. Palm will be responsible for sales of the firm's products in British Columbia, Mexico, and West Coast states.

Donn D. McDonald has been named Vice President of Marketing for DataLogiX Formula Systems, Inc., Valhalla, NY. In his new capacity, Mr. McDonald will be responsible for overseeing all of the company's advertising, public relations, and marketing activities.

In addition, DataLogiX has appointed **Thomas E. Donofrio** to Vice President of Sales for the Central region. He will be responsible for overseeing all sales-related support functions for the company's central sales region, comprised of the 17 central states.

Russell L. Crane has been elected Vice President of Corporate Human Resources for PPG Industries, Pittsburgh, PA. He succeeds **Richard B. Parran,** who has retired.

PPG's Chemicals Group has announced the following appointments in its silica products marketing organization. **Michael H. McGarry** has been named Marketing Development Manager. Succeeding Mr. McGarry as Silica Sales Specialist and Account Representative in Charlotte, NC, is **Michael E. Gilchrist.** Mr. McGarry is a member of the Piedmont Society.

The Sonneborn Division of Witco Corp., New York, NY, has appointed **F. Raymond Angus** as Director of Safety, Health, and Environmental Affairs for its manufacturing facility at Trainer, PA. He joined Witco in 1974 and subsequently held several technical and production positions for the firm.

Harris Halpert has joined Angus Chemical Co., Northbrook, IL, as Product Manager. In this newly-created position, he will be responsible for the derivative products and will assist in strategic planning and marketing of all the nitroparaffin and derivative products of the company.

Chemical Manufacturers Association (CMA), Washington, D.C., has elected the following officers: **Robert C. Forney**—Chairman of the Board; **H. Eugene McBrayer**—Vice Chairman of the Board; **Robert D. Kennedy**—Chairman of the Executive Committee; and **Robert A. Roland**—(re-elected) President.

In addition, **Merck & Co., Inc., Quantum Chemical Corp.,** and **The C.P. Hall Co.,** were each presented a Lammot du Pont Safety Award, sponsored by CMA, for their outstanding safety records.

The appointment of **John Tsirovasiles** as Technical Sales Representative has been announced by Sanncor Industries, Inc., Leominster, MA. Mr. Tsirovasiles brings many years of experience in the coatings industry to his new position.

Nalco Chemical Co., Naperville, IL, has elected **E.J. Mooney, Jr.** as a Director. With 19 years of experience with the company, Mr. Mooney serves as Executive Vice President, U.S. operations.

In addition, the firm has also announced two changes in its Water Treatment Chemicals Group. **John C. Grier** has been promoted to Refining Industry Manager. He replaces **Jim D. Griebel** who has been named Regional Sales Manager for the western region.

Jean M. Bremer has been named Education Director for the American Oil Chemists' Society in Champaign, IL. She will direct development and presentation of educational programs for the AOCS.

In a series of appointments, Inolex Chemical Co., Philadelphia, PA, has named **Howard L. Brainard**—Vice-President, Sales; **Richard R. Smith**—Vice-President, Finance; **Laurence R. Smith**—Marketing Manager, Personal Care Products; **Eric Zimmermann**—Marketing Manager, Industrial Products; and **Daniel M. Sell**—Human Resources Manager.

Ashland Chemical Co., Dublin, OH, has announced the appointment of **David J. D'Antoni** as President of the firm. In addition, he will serve as Senior Vice President of Ashland Oil, Inc. He succeeds **J.A. (Fred) Brothers** as Ashland Chemical President. Dr. Brothers was elected Senior Vice President and Group Operating Officer of Ashland Oil.

Paul W. Morris has been elected Vice President, Information Services, for Quantum Chemical Corp., New York, NY. He was formerly General Manager of MIS for ICI Americas Inc.

William Katz has been appointed Director of Analytical Labs for Perkin-Elmer, Physical Electronics Division, Eden Prairie, MN. In his new position, Dr. Katz will be responsible for the operation of all Physical Electronics commercial laboratories of the firm.

Seibert-Oxidermo, Inc., Romulus, MI, has announced the appointment of **Richard More** to the position of Vice President, Sales. His previous experience includes 14 years in engineering, manufacturing, and marketing at General Motors.

Akzo Chemicals Inc., Chicago, IL, has announced the following appointments within its Fluid Cracking Catalysts Group: **M. Edward Morrison**—Vice President and General Manager; **Jack Garrett**—General Manager; **James E. Williams**—Technical Services Manager; and **J.W. Wilson**—Sales Manager.

J. Garvin Van Doren, Jr. has been appointed Manager of GE Silicones' Consumer Programs Operation. In his new capacity, Mr. Van Doren will head the sales and marketing efforts for the firm's consumer business worldwide.

Obituary

Daniel G. Jarvie, retired owner and President of Jarvie Paint Manufacturing Co., Seattle, WA, died on August 13. He was 71 years old.

Mr. Jarvie was graduated from the University of Washington at Seattle with a degree in Chemistry. He sold Jarvie Paint Manufacturing Co. 10 years ago and, following his retirement, had served as a Consultant to the coatings industry.

His contributions to the industry included serving as President of the Pacific Northwest Society, of which he was named an Honorary Member. He also served as President of the Puget Sound Paint and Coatings Association, and served on technical committees for the Paint and Decorating Contractors of America, the Steel Structures Painting Council, and the National Association of Corrosion Engineers.

Future Society Meetings

Birmingham

(Dec. 1)—"Ken Owen Memorial Lecture: Statistical Process Control"—A. Lesley, Ford Motor Co.

(Jan.12)—"Recent Advances in Metal Can Interior Coatings"—R.H. Good, Holden Surface Coatings.

(Feb. 2)—"Powder Coatings: Polyurethane or Polyester?—Dr. Kreuder, Bayer A.G.

(Mar. 2)—"Coil Coating"—G.C. Simmons, Becker Paints U.K. Ltd.

(Apr. 6)—"Zinc Phosphate (An Anticorrosive Pigment)"—Keith Chater, I.S.C. Alloys Ltd.

(May 4)—60th Annual General Meeting.

Golden Gate

(Jan. 16)—"Modified S/B Latexes to the Rescue for Meeting VOC Limitations and Still Produce Quality Coatings"—John A. Gordon and Violet Stevens, Dow Chemical , Francesco's Restaurant.

(Feb.17)—Joint Meeting with Golden Gate PCA. Holiday Inn.

(Mar. 6)—"High Solids and Solventless Silicone Resin Based Paints for Various Coating Applications"—Bill Saad, General Electric Silicones, Francesco's Restaurant.

(Apr. 17)—"Rheological Measurements as a Guide to Additive Performance"—Marvin Schnall and James Jodrey, Troy Chemical, Holiday Inn.

(May 15)—"Carbon Blacks—Pigments for Coatings, Production, Properties, Application, Dispersion"—Maria Nargiello, Degussa Corp., Francesco's Restaurant.

(June 19)—"Manufacturing Committee Program. Holiday Inn.

Houston

(Dec. 14)—Speaker to be announced.

(Jan. 11)—"Hitox—Past, Present, and Future"—Jack Dittmar, Hitox Corp.

(Mar. 8-10)—Southwestern Paint Convention. Dallas, TX.

(Apr. 12)—"New Developments in Vinyl Resins"—Tom Ginsberg, Union Carbide Corp.

(May 10)—Speaker to be announced.

Kansas City

(Jan. 12)—Manufacturing Night. "Inerting in Coatings Plants: Economics and Safety"—Gary Halpern, Neutronics, Inc.

(Feb. 9)—"Update on Hardboard Siding—Technical Committee Research"—Steve Bussjaeger, Davis Paint Co.

(Mar. 9)—Hallmark Card Tour, Leavenworth, KS.

(May 11)—Education Night.

Los Angeles

(Jan. 12)—"Modified S/B Latexes to the Rescue for Meeting VOC Limitations and Still Produce Quality Coatings"—John A. Gordon and Violet Stevens, Dow Chemical.

(Mar. 1)—"High Solids and Solventless Silicone Resin Based Paints for Various Coating Applications"—Bill Saad, General Electric Silicones.

(Apr. 12)—"Rheological Measurements as a Guide to Additive Performance"—Marvin Schnall and James Jodrey, Troy Chemical Corp.

(May 10)—"Carbon Blacks—Pigments for Coatings, Production, Properties, Application, Dispersion"—Maria Nargiello, Degussa Corp.

New England

(Nov. 17)—"Inerting in Coatings Plants: Economics and Safety"—Gary S. Halpern, Neutronics, Inc.

(Jan. 17)—Joint Meeting with New England PCA. "The Economy—Scoring the Fourth Quarter of 1988 and Forecast of 1989"—Staff Economist, Du Pont Co.

(Feb. 16)—"Crowding and Spacing Titanium Dioxide Theory and Example"—Rebecca W. Craft, Du Pont Co.

(Mar. 16)—"Computer Controlled Production Plant for Idustrial Paints"—Pius Eigenmann, Buhler-Miag, Inc.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Snyder's Willow Grove, Linthicum, MD). GARY MORGERETH, McCormick Paint Works, 2355 Lewis Ave., Rockville, MD 20851.

BIRMINGHAM (First Thursday—Strathallen Hotel, Birmingham, England). D.A.A. WALLINGTON, Ferro Drynamels Ltd., Westgate, Aldridge, West Midlands, England WS9 8YH.

CDIC (Second Monday—Sept., Dec., Mar. in Columbus; Oct., Jan., Apr. in Cincinnati; and Nov., Feb., May in Dayton). W.E. "BUDDY" WHITLOCK, Ashland Chemical Co., P.O. Box 2219, Columbus, OH 43216.

CHICAGO (First Monday). KARL E. SCHMIDT, Premier Paint Co., 2250 Arthur Ave., Elk Grove Village, IL 60007.

CLEVELAND (Third Tuesday—meeting sites vary). RICHARD J. RUCH, Kent State University, Dept. of Chemistry, Kent, OH 44242.

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). RHONDA MILES, Union Carbide Corp., 2326 Lonnecker Dr., Garland, TX 75041.

DETROIT (Second Tuesday—Ukrainian Cultural Center, Warren, MI). LIANA CALLAS ROBERTS, A.T. Callas Co., 1985 W. Big Beaver, Suite 308, Troy, MI 48043.

GOLDEN GATE (Monday before third Wednesday—Alternate between Francesco's in Oakland, CA and Holiday Inn in S. San Francisco). JACK DUIS, Pacific Coast Chemical, 2424 Fourth St., Berkeley, CA 94710.

HOUSTON (Second Wednesday—Look's Sir-Loin Inn, Houston, TX). MICHAEL G. FALCONE, International Paint (USA) Inc., 17419 Little Shoe Ln., Humble, TX 77396.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). MARK ALGAIER, Hillyard Chemical, P.O. Box 909, St. Joseph, MO 64501.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). JAMES D. HALL, Sinclair Paint Co., 6100 S. Garfield Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). JAMES SIMPSON, Reliance Universal, Inc., Resins Div., 4730 Crittenden Dr., P.O. Box 37510, Louisville, KY 40233.

MEXICO (Fourth Thursday—meeting sites vary). GERARDO DEL RIO SEC, G.B.W. De Mexico, S.A., Poniente 116 No. 576, Nueva Industrial Vallejo, 02610 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wongs Restaurant, Montreal). ROBERT BENOIT, NL Chemicals Canada Inc., 4 Place Ville-Marie, Ste. 500, Montreal, Que., H3B 4M5 Canada.

NEW ENGLAND (Third Thursday—Sheraton, Lexington, MA). ARTHUR LEMAN, Samuel Cabot Co., 100 Hale St., Nebt, MA 01950.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). ROGER P. BLACKER, Whittaker, Clark & Daniels, Inc., 1000 Coolidge St., So. Plainfield, NJ 07080.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). TERRY STROM, Ti-Kromatic Paints, Inc., 2492 Doswell Ave., St. Paul, MN 55108. WINNIPEG SECTION (Third Tuesday—Marigold Restaurant, Winnipeg). EDWIN R. GASKELL, Guertin Bros. Coatings & Sealants Ltd., 50 Panet Rd., Winnipeg, MB, R2J OR9 Canada.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday following second Wednesday; SEATTLE SECTION—the day after Portland; BRITISH COLUMBIA SECTION—the day after Seattle). JOHN BERGHUIS, NL Chemicals Canada Inc., 3450 Wellington Ave., Vancouver, B.C., V5R 4Y4 Canada.

PHILADELPHIA (Second Thursday—Williamson's GSB Bldg., Bala Cynwyd, PA). CHRISTOPHER H. HUHN, Loos & Dilworth, Inc., 61 E. Green Ln., Bristol, PA 19007.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). GARY L. WATERS, Sadolin Paint Products, Inc., P.O. Box 669, Walkertown, NC 27051.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). CAROL STORME, Valspar Corp., 2000 Westhall St., Pittsburgh, PA 15233.

ROCKY MOUNTAIN (Monday following first Wednesday—Holiday Inn North, Denver, CO). BRUCE REHMANN, Komas Paint, 1201 Osage St., Denver, CO 80204.

ST. LOUIS (Third Tuesday—Salad Bowl, St. Louis, MO). TERRY GELHOT, Rockford Coatings Co., 1825 Avenue H, St. Louis, MO 63125.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). JAMES R. SALISBURY, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). GERRY PARSONS, DeSoto Coatings Ltd., 895 Rangeview Rd., Mississauga, Ont., L5E 3E7 Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). MARKO K. MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.

Northwestern

(Feb. 7)—"NEW PRODUCTS FOR DEFOAMING AND FOR ADDITIVES FOR TRADE SALES AND INDUSTRIAL PAINTS"—Chuck D'Amico, Ultra Additives.

Pacific Northwest—Portland, Seattle, & Vancouver Sections

(Nov. 15-17)—"RADIATION CURING"—John Guarino, Radcure Co.

(Jan. 17-19)—"MODIFIED S/B LATEXES TO THE RESCUE FOR MEETING VOC LIMITATIONS AND STILL PRODUCE QUALITY COATINGS"—John A. Gordon and Violet Stevens, Dow Chemical.

(Mar. 7-9)—"HIGH SOLIDS AND SOLVENTLESS SILICONE RESIN BASED PAINTS FOR VARIOUS COATING APPLICATIONS"—Bill Saad, General Electric Silicones.

(Apr. 18-20)—"RHEOLOGICAL MEASUREMENTS AS A GUIDE TO ADDITIVE PERFORMANCE"—Marvin Schnall and James Jodrey, Troy Chemical Corp.

(May 16-18)—"CARBON BLACKS—PIGMENTS FOR COATINGS, PRODUCTION, PROPERTIES, APPLICATION, DISPERSION"—Maria Nargiello, Degussa Corp., Portland Motor Inn.

Philadelphia

(Dec. 8)—"ISOCYANATE—FREE ALTERNATIVES TO TWO-PACKAGE URETHANES"—Eric Percy, Cray Valley Products, Inc.

(Jan. 12)—JOINT MEETING WITH PHILADELPHIA PCA.

(Feb. 9)—"CORRELATION OF QUV TESTING TO EXTERIOR DURABILITY"—Douglas Grossman, Q-Panel Co.

(Mar. 9)—"NEW APPROACHES TO EVALUATING PERFORMANCE OF INDUSTRIAL MAINTENANCE COATINGS"—Bernard Appleman, Steel Structures Painting Council, Pittsburgh, PA.

(Apr. 29)—AWARDS NIGHT.

(May 11)—"ASTM METHODS FOR VOC DETERMINATION"—Hiroshi Fujimoto, Inmont Corp.

Rocky Mountain

(Jan. 9)—"MODIFIED S/B LATEXES TO THE RESCUE FOR MEETING VOC LIMITATIONS AND STILL PRODUCE QUALITY COATINGS"—John A. Gordon and Violet L. Stevens, Dow Chemical.

(Feb. 27)—"HIGH SOLIDS AND SOLVENTLESS SILICONE RESIN BASED PAINTS FOR VARIOUS COATING APPLICATIONS"—Bill Saad, General Electric Silicones.

(Apr. 10)—"RHEOLOGICAL MEASUREMENTS AS A GUIDE TO ADDITIVE PERFORMANCE"—Marvin Schnall and James Jodrey, Troy Chemical Corp.

19th Biennial Western Coatings Societies' Symposium And Exposition Slated for March 14-16, 1989

The Disneyland Hotel and Convention Center, in Anaheim, CA, will be the site of the 19th Biennial Symposium and Show, which is jointly sponsored by the Los Angeles, Golden Gate, Pacific Northwest, and Rocky Mountain Societies, on March 14-16, 1989. This year's theme is "Leadership Through Technology," with an emphasis on the importance of the western United States as a member of the vital Pacific Rim economy.

With expected attendance of over 3,000 registrants, the event is being billed as the largest regional paint industry show, second only to the FSCT's international Annual Meeting and Paint Industries' Show.

Exhibitors who have contracted space to date include: Advanced Coatings Tech.; Advanced Software Design; Allied Environmental Management; Aqualon; Amoco Chemicals; Arco Chemical Co.; Armenco Engineering Co.; Ashland Oil, Inc.; Beltron Corp.; Berol Chemicals Inc.; Bohlin Reologi, Inc.; Brookhaven Instruments; Buckman Laboratories; Byk-Chemie USA; Cargill Inc.; Catalyst Resources, Inc.; Chicago Boiler; CIBA-GEIGY Corp.; Colloids Inc.; Color Corp.; Colorgen; Cyprus Industrial Minerals; Daniel Products; Davis Colors; Day Glo Color Corp.; Disti Inc.; Dow Chemical, U.S.A.; Du Pont; E.C.C. America; E. T. Horn Company; Eastman Chemical Products; Eiger Machinery; Electronic Liquid Fillers; Engelhard Corp.; Enviropro; Exxon USA/Exxon Chemical; Fawcett Co. Inc.; Grace/Davison Chem. Div.; Halox Pigments; Harrison & Crossfield (Pacific); Henkel Corp.; Heubach; Hoechst Celanese Corp.; ICI Resins US; Ideal Manufacturing & Sales; Illinois Minerals Co.; Ind. Finishing Magazine; Indusmin Inc.; Interez; J. M. Huber Corp./Chem. Div.; J. R. Elliott, Inc.; John K. Bice; Johnson Wax; Liquid Controls Corp.; Lipscomb Chemical Co.; Malvern Minerals Co.; Manchem, Inc.; Miller Paint Equipment; Mobay Corp.; Modern Paint & Coatings; Morehouse Industries; Myers Engineering; NL Chemical; Netzsch Incorporated; Nuodex Inc.; Pacific Coast Drum Co.; Pacific Micro Software Eng.; Pacific Scientific; Pfizer Inc. MPM Div.; Pico Chemical Corp.; Polyvinyl Chemical; Premier Mill Corp.; P W K Corp.; R. T. Vanderbilt Co.; Recyclene Products Inc.; Red Devil Inc.; Reichhold Chemicals; Rohm and Haas Co.; Rosedale Products; Samson Chemical Co.; Shell Oil Co.; Stauffer Wacker Silicones; Stay & Day Div. O.T.V.; TCR Industries; Tammsco, Inc.; Texaco Services; The Lubrizol Corp.; The McCloskey Corp.; Trans Western Chemicals; U. S. Silica Company; Union Carbide Corp.; Union Process Inc.; United Catalyst, Inc.; Universal Color Dispersion; Unocal Chemicals Div.; Van Waters & Rogers; Velsicol Corp.; Vorti-Siv Div.; W. R. Grace Co.; Woller Cook & Missmore; Yuba Silica; and Zeelan Industries.

Serving as General Chairman for the Symposium and Show is Andrew R. Ellis, of NL Chemicals. Assisting Mr. Ellis are: *Co-Chairman*—Melinda K. Rutledge, of Allo Colour Co.; *Entertainment Chairman*—Richard C. Sutherland II, of E.T. Horn Co.; *Technical Chairman*—Martin F. Balow, of Frazee Industries; *Publicity Chairman*—Lee W. Foster, of Mobay Corp.; *Publications*—Ronald R. Elliott, of J.R. Elliott Enterprises; *Exhibits Chairman*—John A. Guerra, of Major Paint Co.; *Registration*—James A. Dye, of Trans Western Chemical; and *Secretary Treasurer*—Geneva H. Wells, of H.M. Royal Co.

More information can be obtained by contacting Chairman Ellis at NL Chemicals, 231 E. Imperial Highway, #221, Fullerton, CA 92635.

RadTech International Sponsors Workshop on UV/EB Curing

RadTech International will be holding a one-day workshop on November 14, 1988, at the Adam's Mark Hotel, Philadelphia, PA. An introduction and overview of the industrial use of ultraviolet and electron beam (UV/EB) curing in industrial applications for coatings, inks, and adhesives will be provided. The workshop is intended for executives evaluating a new process commitment; production and quality control personnel from companies using UV or EB; formulators developing new coatings, ink, and adhesive systems; and others in this specialty area.

For information on housing and registration, write to RadTech International, 60 Revere Dr., Ste. 500, Northbrook, IL 60062.

CALL FOR PAPERS
Pacific Northwest Spring Symposium
May 4-6, 1989 Portland, Oregon

The Pacific Northwest Society for Coatings Technology invites all interested persons to submit papers for presentation at its annual Spring Symposium, May 4-6, 1989 in Portland, Oregon. Papers relating to any developments of raw materials, processes, or equipment for coatings manufacturing are solicited.

A synopsis of the proposed talk should be submitted by December 1, 1988 to John Westendorf, Cordano Chemical Co., Inc., 3322 N.W. 35th Ave., Portland, OR 97210. For additional information, please contact John Westendorf, Chairman of the Symposium Technical Committee at (503) 228-8369.

Course on Surface Science Offered by Univ. of Florida

The Center for Surface Science and Engineering at the University of Florida, Gainesville, FL, is offering its annual short course on Surface Science and Technological Applications on March 20-24, 1989.

The course is designed to provide knowledge of fundamentals and technological applications of surface science to industrial scientists and engineers. It will consist of lectures, laboratory experiments, and problem solving sessions.

For more detailed information, contact Prof. Dinesh O. Shah, Director, Center for Surface Science and Engineering, University of Florida, 419 Chemical Engineering Bldg., Gainesville, FL 32611.

AESF and EPA to Sponsor Environmental Program During Week-Long Activities, January 23-27

An exhibit and an environmental conference co-sponsored by the American Electroplaters and Surface Finishers Society (AESF) and the U.S. Environmental Protection Agency (U.S. EPA) are the anchor events to "AESF Week," January 23-27, 1989, at the Orlando Twin Towers, Orlando, FL. The AESF/EPA Conference will create a forum through which members of the surface finishing industry can learn firsthand about government regulations and their impact, and can gain information about new technologies from the industry case histories presented. Also held in conjunction with the Conference, will be an exhibit of over 70 companies.

Program highlights include: "The 10th AESF/EPA Conference on Environmental Control for the Metal Finishing Industry"; "Aerospace Symposium"; "Electrocomposite Short Course"; "Training Course in Electroplating & Surface Finishing for Electronic Applications"; "Brush Plating Seminar"; and "Waste Treatment Simplified Short Course."

For details on all of the programs offered during AESF Week, contact AESF, 12644 Research Parkway, Orlando, FL 32826-3298.

International Conferences Slated in May and July 1989

The 11th international conference on "Advances in the Stabilization and Controlled Degradation of Polymers" will be held on May 24-26, 1989, in Luzern, Switzerland, and the 15th international conference on "Organic Coatings Science & Technology" is scheduled for July 10-14, 1989, in Athens, Greece.

The purpose of the conferences is to bring together scientists, engineers, and educators in an international forum to discuss recent research and development. Approximately 15 leading researchers from various countries are invited to present lectures on topics of high current interest selected by the Scientific Committee.

Papers are being accepted for presentation at the meetings. Abstracts (one page) should be submitted no later than January 1, 1989. Papers forwarded for publication in the proceedings of the conference must be submitted no later than March 1, 1989.

For more information, contact Professor Angelos V. Patsis, Director, Materials Research Laboratory, CSB 209, State University of New York, New Paltz, NY 12561.

Federation of Societies for Coatings Technology
presents

SPRING WEEK '89

May 16-19
Los Angeles Airport Marriott • Los Angeles, CA

Featuring
FSCT Seminar on
"Modern Analytical Resources: The Coatings Chemist's Ally"

Spring Week Schedule
May 16—FSCT Spring Seminar
May 17—Seminar Continues
May 18—FSCT Society Officers Meeting
May 19—FSCT Board of Directors Meeting

(Seminar presented under the auspices of the Professional Development Committee)

Resin System

Introduced in technical literature is a silicone-based resin blend system for paints and coatings. The resin family offers a solventless, 100% silicone formulation, with high thermal performance (to 1200°F in the cured state). In addition, the material has negligible volatile organic compound (VOC) emissions at room temperature and can be formulated to comply with the Environmental Protection Agency (EPA) and Occupational Safety & Health Administration (OSHA) regulations. Further information on the TRIPLUS™ resin family, contact GE Silicones, Inquiry Handling Service—PR #COAT-1-V-88, 260 Hudson River Rd., Waterford, NY 12188.

Sealer Finish

A 12-oz spray sealer finish, designed for rust protection on metal tools and railings, and as a clear sealer for wood, slate, and cement surfaces, is detailed in a new product release. For information on Valspar's Val-Oil Spray, write Specialties Div., Valspar Corp., 1191 S. Wheeling Rd., Wheeling, IL 60090-5794.

Copolyester Resins

A line of copolyester resins for the powder coatings industry is introduced in technical literature. In a powder coating operation, the resins are mixed with pigments and a curing agent, given a positive charge, and sprayed onto a grounded metal surface. The positive charge adheres the powder to the metal surface. Then, the surface is baked in a 300° to 400° oven, forming a coating that is reportedly hard and durable. For more information, contact Barry Cristea, Goodyear Polyester Div., 1144 E. Market St., Akron, OH 44316.

Color Brochure

A new edition of a firm's color brochure describing their various products available to artists, designers, scientists, engineers, and others responsible for the management of color is being offered. The 12-page illustrated brochure details basic and special collections of color standards, disk colorimetry, educational materials, color vision tests, textile color communications systems, and technical services. Copies of the literature can be obtained from Munsell Color Group, Macbeth, 2441 N. Calvert St., Baltimore, MD 21218.

Gloss & Reflection Instrument

A six-page brochure detailing a multiangle glossmeter and reflectometer system is available upon request. The system displays the current reading and statistical data; stores up to 999 readings; and information and statistics can be downloaded to a printer or computer. Write to Paul N. Gardner Co., Inc., The Gardner Bldg., 316 N.E. First St., Pompano Beach, FL 33060, for more information.

Powder Spray Booth

A powder spray booth with a product opening of 48″ × 48″ is the subject of new literature. The unit is compact, with the entire booth being only 60″ wide × 40″ deep × 84″ tall. For technical information on the Solidspray™ MB482C Powder Spray Booth, write Volstatic, Inc., P.O. Box 6150, Florence, KY 41022-6150.

Specialty Additives

A range of specialty additives designed to improve the performance of plastics and polymers are among the products listed in a technical bulletin. Focus is given to a series of organic titanates, as well as fluorochemical intermediates and surfactants. The titanates range from the highly reactive orthoesters to stable chelate derivatives and are intended for use as curing agents in plastics, coupling agents for composites, curing and adhesion promotion agents in mold release coatings, and surface modification agents for coatings on plastics.

The intermediates and surfactants are suggested for use in plastics to lower the plastics' surface energy. Additional properties include oil and water repellancy, lubricity, low thermal conductivity, high electrical resistivity and low refractivity. For copies of the bulletin, write: Du Pont Co., Chemicals & Pigments Dept., Room B-15303, Wilmington, DE 19898.

Newsletter

An eight-page newsletter which focuses on microchromatography has been published. The newsletter discusses the use of a company's instruments with techniques like high resolution gas chromatography, supercritical fluid chromatography, and high pressure liquid chromatography. For a free copy of this publication, write Carlo Erba Instruments Newsletter, c/o HBI, Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001.

Water Soluble Polymers

A four-page color brochure introducing 12 water soluble polymers that also function as adhesives, film formers, gellants, rheology modifiers, and suspending agents in a wide range of industries has been published. Product properties, characteristics, applications, selection criteria, and availability data are illustrated. For specific information on these polymers, contact A. E. Staley Mfg. Co., New Product Development, Water Soluble Polymers, 2200 E. Eldorado St., Decatur, IL 62525.

Microbial Control Program

Details are obtainable upon request on a microbiocide microbial control program which eliminates problems that stem from microbial growth in all types of cooling water systems. For more information, contact John R. Stinger, Manager, Marketing Communications, Drew Industrial Div., One Drew Plaza, Boonton, NJ 07005.

Spectrophotometer

A full-color brochure presenting a high-quality, high-performance color spectrophotometer for research, quality control, and production control applications is available. The brochure describes the capabilities and components of the instrument's symmetrical double-beam optical system. Contact Milton Roy Co., Analytical Products Div., Dept. 6682, 820 Linden Ave., Rochester, NY 14625, for a copy of the brochure on Match Scan® 2 Spectrophotometer.

Viscometer Selection Guide

Literature describes a viscometer selection guide which has been developed to assist those people responsible for selecting viscosity control systems for flexographic and rotogravure printing and coating operations in general. Copies of the Viscometer Selection Guide may be obtained by writing Norcross Corp., 255 Newtonville Ave., Newton, MA 02158.

Solvent Free Dispersions

A new series of solvent free dispersions designed to help meet the need of the paint and coatings industry is introduced in a technical data sheet. These free flowing dispersions have multiple reactive sites on the backbone of the polymer allowing for a variety of coating applications. Write Robert F. Sharrock, Hilton Davis Co., 2235 Langdon Farm Rd., Cincinnati, OH 45222-1801, for more information on Poly-tone and Poxy-tone colorants.

Laminating Ink System

An ink system for use on saran coated polyester adhesive laminated to polyethylene, such as meat wraps and other deli and dairy prepackaged products, has been introduced in technical literature. In press runs, the ink reportedly has low solvent retention and high bond strength. For more information on the LeBond II system, contact Croda Inks Corp., 7777 N. Merrimac Ave., Niles, IL 60648-3490.

Large Capacity Mill

A 560-liter capacity horizontal mill with a product volume capacity of 280 liters, reportedly the largest mill available for production of raw materials and pigments, is being introduced in technical literature. The product features a "smooth start" advantage for all media. Contact Netzsch Incorporated, 119 Pickering Way, Exton, PA 19341-1393, for more information on the Molinex Horizontal Mill (LME 500K).

Air Release Agents

Technical information introducing four air release agents designed to reduce or eliminate air bubbles from castings and coatings systems prior to cure has been released. These materials are reportedly effective in solvent-based, water-based, and 100% solids systems. For information on Airout, Super Airout, D-Air, and X-Air agents, contact Furane Products, 99 Cook St., Lincoln, RI 02865.

Coating Thickness Gauges

Technical bulletins are available on two digital dry film coating thickness gauges for use on ferrous and nonferrous substrates in conformance with ASTM, DIN, British Standards, SSPC, and ISO standards. Information is obtainable on Models 717F and 717N thickness gauges by contacting F. Rueter, Marketing Manager, Zorelco Ltd., P.O. Box 25500, Dept. C-24, Cleveland, OH 44125-0500.

Explosion Proof Scales

Technical literature is being introduced on an explosion proof scale. Through the use of quartz filling technology, the company has eliminated the bulky and expensive housing normally associated with explosion proof products. The large stainless steel platform (12" × 9") covers a cast aluminum enclosure. For more information on the I12000s-X scale, contact Sartorius Scale Div., 11 Kripes Rd., P.O. Box 1091, East Granby, CT 06026.

Carbon Black

A six-page technical report listing over 50 carbon black forms and grades specially developed for use in a broad range of printing inks, plastics, and coatings is available. Also included in the bulletin is a discussion of carbon black properties and their significance. Individual copies of Technical Report S-136 may be obtained from Cabot Corp., Special Blacks Div., 950 Winter St., P.O. Box 9073, Waltham, MA 02254.

Discontinuity Testing of Protective Coatings

Procedures for detecting discontinuities that can cause failure in coatings and linings are given in a new standard by the National Association of Corrosion Engineers (NACE). Information on Standard RPO188-88 is obtainable by writing to NACE, P.O. Box 218340, Houston, TX 77218.

Label Printing

An expanded line of electronic label printing systems is described in a new full-color product brochure. The brochure describes information and specifications on the software, computers, and range of printing technologies available. For more information, contact Mark Bjerkestrand, Label Systems Product Manager, Diagraph Corp., 3401 Rider Trail South, St. Louis/Earth City, MO 63045.

Adhesion Promoters

Technical information is available on adhesion promoters which reportedly impart adhesion promotion to all metals, elastomers, plastics (including PE & PET film), primers, mortar, and a variety of other substrates. Write to Cavedon Chemical Co., Inc., P.O. Box 329, Woonsocket, RI 02895, for samples and literature on Cavco Mod APG-1, APG-2, and APG-3 adhesion promoters.

Electromagnetic I.D. Probe

A hand-held electromagnetic I.D. probe which measures plating/coatings thicknesses of critical aerospace and aircraft safety maintenance components is being introduced in literature. For additional information, write Chris Horvath, CMI International, 2301 Arthur Ave., Elk Grove Village, IL 60007.

Wet Film Thickness Gauge

A direct reading wet film thickness gauge for measuring the thickness of paints, inks, adhesives, gel coatings, and many other products is being introduced in literature. Measurement is accomplished on any type of flat or curved coated surface. Write UV Process Supply, Inc., 4001 N. Ravenswood, Chicago, IL 60613, for technical information on the Con-Trol-Cure Wet Film Thickness Gauge.

Vinyl Acrylic

A new high performance vinyl acrylic emulsion has been introduced in literature. The product reportedly offers scrub resistance, stain resistance and cleansability, as well as enamel holdout and dye stain resistance. For more information on 76 RES 3083, write: Unocal Chemicals Div., Unocal Corp., 1345 N. Meacham Rd., Schaumburg, IL 60196.

Solution to October's *"CrossLinks"*

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact FSCT, 1315 Walnut St., Philadelphia, PA 19107 (215-545-1506).

1989

(May 16-19)—Federation "Spring Week." Seminar on the 16th and 17th; FSCT Incoming Society Officers Meeting on the 18th; FSCT Board of Directors Meeting on the 19th. Los Angeles Airport Marriott, Los Angeles, CA.

(Nov. 8-10)—67th Annual Meeting and 54th Paint Industries' Show. Rivergate, New Orleans, LA.

1990

(Oct. 29-31)—68th Annual Meeting and 55th Paint Industries' Show. Convention Center, Washington, D.C.

1991

(Nov. 4-6)—69th Annual Meeting and 56th Paint Industries' Show. Convention Center, Toronto, Ontario, Canada.

SPECIAL SOCIETY MEETINGS

1989

(Feb. 1-3)—Southern Society 16th Annual Water-Borne and Higher-Solids Coatings Symposium. New Orleans, LA. (Dr. Gordon L. Nelson, Chairman, Dept. of Polymer Science, University of Southern Mississippi, Southern Station Box 10076, Hattiesburg, MS 39406-0076).

(Mar. 14-16)—Western Coatings Societies' 19th Biennial Symposium and Show. Disneyland Hotel and Convention Center, Anaheim, CA. (Andrew R. Ellis, NL Chemicals, 231 E. Imperial Highway, Suite 221, Fullerton, CA 92635).

(Apr. 5-7)—Southern Society. Annual Meeting. Hyatt Regency Westshore, Tampa, FL.

(May 4-6)—Pacific Northwest Society. Annual Symposium. Portland Marriott, Portland, OR. (John Daller, McCloskey Corp., 4155 N.W. Yeon, Portland, OR 97210).

OTHER ORGANIZATIONS

1988

(Nov. 16-17)—ASTM Coordinating Committee Meeting on Flashpoint. API, Washington, D.C. (Earl Sullivan, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Nov. 28-Dec. 1)—"Introduction to Coatings Technology." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(Nov. 28-Dec. 3)—Materials Research Society Fall Meeting, Symposia, and Exhibition. Boston, MA. (MRS, 9800 McKnight Rd., Ste. 327, Pittsburgh, PA 15237).

(Nov. 29-30)—ACS Color Seminar. Greenville, SC. (Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543).

(Nov. 29-Dec. 1)—"Inspection of High Performance Coatings" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Dec. 3-9)—Chemtech China '88. China International Exhibition Centre, Beijing, China. (SHK International Services Ltd., 22/F., 151 Gloucester Rd., Hong Kong).

(Dec. 5-9)—"Fundamentals of Chromatographic Analysis." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(Dec. 6-8)—"Getting into Compliance with Environmental Regulations for Paints and Coatings Facilities," Short Course sponsored by Continuing Education in Engineering, a division of UC Berkeley Extension. New Orleans, LA. (Continuing Education in Engineering, UC Berkeley Extension, 2223 Fulton St., Berkeley, CA 94720).

(Dec. 12-14)—Winter National Plant Engineering and Maintenance Show and Conference. Anaheim Convention Center, Anaheim, CA. (Conference Director, National Plant Engineering and Maintenance Conference, 999 Summer St., P.O. Box 3833, Stamford, CT 06905).

1989

(Jan. 15-18)—ASTM Committee D-1 Meeting. Fort Lauderdale, FL. (David Bradley, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Jan. 23-27)—The American Electroplaters and Surface Finishers Society's Annual Winter Meeting. Orlando Twin Towers, Orlando, FL. (AESF, Central Florida Research Park, 12644 Research Pkwy., Orlando, FL 32826).

(Jan. 24-26)—"Bridge/Highway Structures Coatings Inspection" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Feb. 1-5)—International Symposium on Industrial Metal Finishing. Karaikudi, India. (Central Electrochemical Research Institute, Karaikudi-623 006, Tamil Nadu, India).

(Feb. 19-22)—"Principles of Adhesion" Short Course and 12th Annual Meeting of The Adhesion Society. Marriott Hotel, Hilton Head Island, SC. (Don Hunston, National Bureau of Standards, Polymers Div., Gaithersburg, MD 20899).

(Feb. 28-Mar. 2)—"Level II—Industrial Maintenance Course" sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 13-17)—Color '89. Sixth Congress of the International Color Association (AIC). Centro Cultural San Martín, Buenos Aires, Argentina. (Color '89, Grupo Argentino del Color, c/o División Optica, Inti, C.C. 157, 1650 San Martín (BA), Argentina).

(Mar. 14-16)—"Inspection of High Performance Coatings" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 20-24)—"Surface Science and Technological Applications." Second Annual Short Course sponsored by the University of Florida, Gainesville, FL. (Dinesh O. Shah, Center for Surface Science & Engineering, University of Florida, 425 Chemical Engineering, Gainesville, FL 32611).

(Apr. 8-9)—Eastern Decorating Products Show sponsored by the National Decorating Products Association. World Trade Center, Boston, MA. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Apr. 11-14)—"Advances in Corrosion Protection by Organic Coatings" Symposium. Christ's College Cambridge, England. (David Scantlebury, Corrosion and Protection Centre, UMIST, P.O. Box 88, Manchester, U.K. or Martin W. Kendig, Rockwell International Science Center, Thousand Oaks, CA 91360).

(Apr. 11-14)—International Surface Finishing '89. Sponsored by International Institute of Surface Finishing. Metropole Hotel, Brighton, England. (Secretary, The Institute of Metal Finishing, Exeter House, 48 Holloway Head, Birmingham B1 1NQ).

(Apr. 23-28)—"7th International Meeting on Radiation Processing." Noordwijkerhout, The Netherlands. (E. Franken, 7th International Meeting on Radiation Processing, P.O. Box 4240, 6710 EE Ede, The Netherlands).

(Apr. 24-26)—"Crosslinked Polymers: Chemistry, Properties, and Applications" Short Course sponsored by State University of New York at New Paltz. Hotel Thayer, West Point, NY. (Angelos V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(Apr. 24-28)—"Applied Rheology for Industrial Chemists." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(Apr. 24-29)—Materials Research Society Spring Meeting, Symposia, and Exhibition. San Diego, CA. (MRS, 9800 McKnight Rd., Ste. 327, Pittsburgh, PA 15237).

(May 1-4)—Society of Manufacturing Engineers' International Conference. Cobo Hall, Detroit, MI. (Violet Greco, SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121-0930).

(May 8-12)—"Dispersion of Pigments and Resins in Fluid Media." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 22-26)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 24-26)—11th International Conference on "Advances in the Stabilization and Controlled Degradation of Polymers." Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, CSB 209, State University of New York, New Paltz 12561).

(May 29-31)—3rd International Conference on "Crosslinked Polymers." Luzern, Switzerland. (Angelos V. Patsis, Institute in Materials Science, State University of New York, New Paltz, NY 12561).

(June 11-14)—Dry Color Manufacturers' Assoc. Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (Tracy Kruisselbrink, DCMA, Ste. 202, 206 N. Washington St., P.O. Box 20839, Alexandria, VA 22314).

(June 21-23)—Oil and Colour Chemists' Association Biennial Conference. Grosvenor Hotel, Chester, England. (Mr. Christopher Lacey-Day, Director, OCCA, Priory House, 967 Harrow Rd., Wembly, Middlesex HA0 2SF, England).

(June 28-30)—"Chemically Modified Oxide Surfaces" Symposium. Holiday Inn, Midland, MI. (W.T. Collins, Mail Stop C41C00, Dow Corning Corp., Midland, MI 48686-0994).

(July 10-14)—15th International Conference on "Organic Coatings Science and Technology." Athens, Greece. (Angelos V. Patsis, Institute in Materials Science, CSB 209, State University of New York, New Paltz 12561).

(Aug. 3-6)—31st Annual Convention of the Oil and Colour Chemists' Association Australia. Fairmont Resort, Leura, New South Wales. (Peter Parsons, Tioxide Australia P/L, 2A/6 Tooronga Terrace, Beverly Hills, NSW, Australia 2209).

(Sept. 25-30)—American Chemical Society. 196th National Meeting. Los Angeles, CA. (B.R. Hodson, ACS, 1155—16th St. NW, Washington, D.C. 20036).

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Advertisers Index

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'Humbug' from Hillman

For those of our readers who have been waiting with bated breath for more of Dr. Peter Lewis' philosophical calling cards, here goes—and you can breathe easier now—

- Your career goes on while you make other plans.
- Midnight snacks make you a well-rounded person.
- Write illegibly. Your notes won't incriminate you.
- No dissatisfied customer is allowed to leave our premises.
- If you really loved me, you would have married someone else.
- Take things as they come, if you can handle them that fast.
- Beaches are like attics. You never know what will turn up in trunks.
- Trial marriage is dangerous. It could lead to the real thing.

One of the poetic gems discovered by Harold Werner in *The Homesteader*:

Oh, where are the playmates of yesterday?
The fellows we knew at school.
Oh, what has become of the studious one?
And where, oh where, is the fool?

Oh, what has become of the orator,
Whose passion was to recite?
And the bashful kid who could speak no piece,
Unless he succumbed to some fright.

Oh, what has become of the model boy,
Who was always the teacher's pet?
And where, oh where, is the tough young nut,
The one we can never forget.

The studious one, so we have been told,
Is driving a cab these days.
The fool owns stock in a bank or two,
And a railroad that always pays.

The orator that we knew so well
Is a clerk in a dry goods store.
While the bashful kid we knew has been
In Congress two years or more.

The model boy has been behind bars
For stealing a neighbor's cow.
And you ask what has become of the tough young nut?
Oh, he's a bishop now.

(Old poem by J.W. Johnson)

Several Marines were talking about how far in the hills they had lived before enlisting.

"When I enlisted in the Marine Corps," said one, trying to outdo the others, "my daddy rode down with me to the train station in his horse and wagon. When we got there, he asked, 'How long you going' to be in the Marines, son?'

"Three years," I told him. "Well," says Dad, "I might as well wait here for you. There ain't no sense in making two trips."

—The Lion

This is absolutely the last, well maybe the next to last, variation of the story of the dishonest, overthinning house painter who, "in his success cared little for the hundreds of customers he had cheated." You can blame this variation on David Minasian.

Finally, the painter died and his unscrupulous practices left little doubt as to which world in the hereafter he would find himself. Now, being singed in the fires of hell, he pleaded with the devil to release him from his damnation.

"Please, oh please, Satan," he would cajole, "if I had known what life down here was like, I would never had done what I did."

Finally, his pleas became such an annoyance, Satan decided to give him a second chance. "All right," he relented, "you can go back to earth for just one week and if you can convince just one of your former colleagues to stop watering down the paint, I will release you from hell."

It was not easy. The contractor frantically covered his territory only to find that the dishonest contractors were so happy with their wealth that they cared little about eternity. With his time almost up, he finally found one man who became so terrified with his description of hell that he fell on his knees and pleaded with the contractor.

"Tell me, tell me what should I do?"

"REPAINT YOU THINNER," replied the contractor.

The error of youth is to believe that intelligence is the substitute for experience. The error of age is to believe that experience is a substitute for intelligence.

—The Lion

—Herb Hillman
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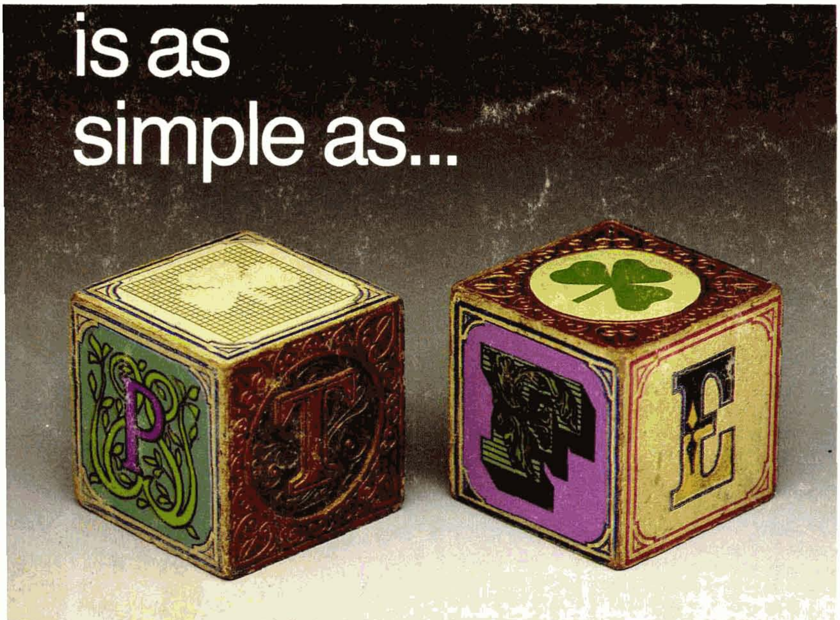

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Coatings Application	Desired Performance Qualities	PTFE Product
Container, solvents	can mobility and spin-neck abrasion resistance	SST-3D
Container, water	can mobility and spin-neck abrasion resistance	SST-3H
Ultra-thin clears	abrasion resistance with clarity retention	FluoroLUBE-A
Coil, protective	corrosion inhibition and falling sand resistance	SST-2SP5
Coil, decorative	taber abrasion and metal-mark resistance	FluoroSLIP 515
Powder coating	durability	FluoroSLIP 525
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