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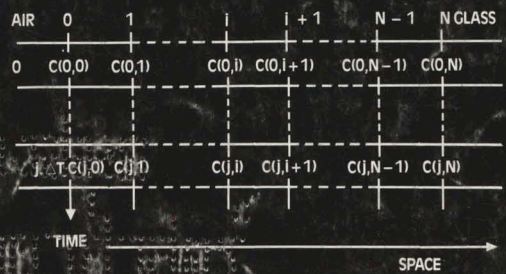
JOURNAL OF COATINGS TECHNOLOGY

March 1987

Modeling the Drying Process of Coatings with Various Layers.



65th Annual Meeting & 5th Paint Industries' Show
Dallas Convention Center • Dallas, Texas
Monday, Tuesday & Wednesday • Oct. 5, 6, 7 1987





UCAR ACRYLIC 522 PASSES THE TOUGHEST WET ADHESION TESTS.

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ACTIV-8 solves drying-process problems by accelerating and stabilizing the drying time of paints and finishes. And now as a result of our latest technology in processing, it is less costly.

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CIBA-GEIGY epoxy resins and the winning battle against VOC's.

has severely limited their use.

A technological award-winner.

Today, however, there's a new epoxy phenol novolac from CIBA-GEIGY that's a veritable breakthrough. This resin is so unique and so much less viscous than its predecessors it's received an IR-100 award as one of the most significant technological developments of the year.

Now, for the first time, you can formulate low-solvent or solvent-free coatings with an epoxy phenol novolac resin.

It's common knowledge that epoxy phenol novolac resins possess outstanding resistance to elevated temperatures as well as to chemicals.

Yet, due to their extremely viscous nature, employing these resins in coatings formulations has required solvent levels as high as 50% by volume. Quite naturally, this

A break with the past.

Called XB 3337, the uniqueness of this extraordinary resin lies in the fact that it possesses three to as much as thirty times lower viscosity than previous commercial EPN resins.

Used with appropriate curing agents, XB 3337 can be





At room temperature, conventional epoxy phenol novolac resins (left) are thick and virtually unmovable. While XB 3337 from CIBA-GEIGY (right) proves its remarkably low viscosity by pouring freely.

formulated without high levels of environmentally objectionable solvents — thereby extending the significant advantages of multifunctional epoxy phenol novolac resins to applications that can most benefit from them. These include chemical processing plants, pipelines, marine structures, pulp and paper mills, refineries, food and beverage processing plants.

High performance with environmental safety.

With the typical properties shown below, XB 3337 is recommended for solvent-free and high solids coatings for ambient temperatures and high temperature service — thereby setting a whole new standard for epoxy phenol novolac resins.

Among its many advantages: low viscosity as compared to other EPN resins; higher functionality than bisphenol A epoxy resins; excellent chemical, heat and solvent

resistance; good mechanical properties. In addition, XB 3337 is also compatible in all proportions with liquid bisphenol A and bisphenol F epoxy resins — providing still other possibilities for formulating solventless and high solids coatings.

To learn more, please call Laura Poulos at 800-431-1900 (in New York, 914-347-4700). Or write Plastics Department, CIBA-GEIGY Corporation, Three Skyline Drive, Hawthorne, New York 10532.

Resin XB 3337: typical properties

Visual Appearance	Clear
Color, Gardner	6 max.
Viscosity at 25°C, cP	30,000 to 50,000
Epoxy Value, eq/100g	0.54-0.58
Weight per Epoxide	173-185
Hydrolyzable Chlorine, %	0.12 max.
Total Chlorine, %	0.4 max.
Pounds per gallon, lb.	10
Volatile content, %	0.1 max.



CIBA-GEIGY

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1315 Walnut St., Phila., PA 19107

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Rolling Along

On this page in the December issue, we recalled the most significant developments and achievements of the FSCT in 1986.

Now—one-quarter into 1987—here's an update on some of those activities.

New Series on Coatings Technology—The fifth and sixth monographs (Coil Coatings—Joseph Gaske; Corrosion Protection by Coatings—Dr. Zeno Wicks) have been published. In the wings are: Mechanical Properties of Coatings—Dr. Loren Hill; Automotive Coatings—Bruce McBane; and Coatings Film Defects—Drs. Percy Pierce and Clifford Schoff. The Series Co-Editors (Drs. Thomas Miranda and Darlene Brezinski) are making great progress with these additions to our literature.

Membership: The 7,000 record was passed in 1986. The gradual growth continues and another 200 will be added to the rolls this year. The five largest Societies are: Chicago, Los Angeles, New York, Southern, and Toronto.

Professional Development Committee: Their selection of "Statistical Process Control" as the subject of their first seminar was an excellent choice. The four sessions in four cities this month were a sellout and another had to be arranged in Chicago to accommodate the demand. George Pilcher's energetic committee is working on development of a Symposium on "Tools for Professional Success in the Coatings Industry" at the FSCT Annual Meeting and Paint Show in Dallas, October 5-7.

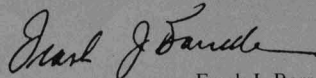
Educational Committee: Joe Vasta's group, and the FSCT Executive Committee, are currently reviewing the draft script of a planned video tape on careers in the coatings industry. When completed, it will be distributed to our Societies for their showing at local high schools. The committee requested—and was granted—an increase in the appropriation (from \$31,000 to \$35,200) for scholarships at six universities for the 1987-88 academic year.

Corrosion Committee: This committee (Jay Austin, Chairman) contracted a "Survey of Accelerated Test Methods for Anticorrosive Coatings Performance" to the Steel Structures Painting Council. SSPC will present a summary report at the Annual Meeting in Dallas.

Spring Week: This year, it will be held in conjunction with the Symposium of the Pacific Northwest Society during the week of April 26, in Seattle. And where better for the seminar (May 1-2) on "Coatings for Wood Substrates." The FSCT thanks the PNW Society (Dennis Hatfield, President) for their fine cooperation in this joint undertaking.

Annual Meeting and Paint Show: The good work of our members will get some deserved recognition through the Annual Meeting Program theme, "People and Technology: Cornerstones of Progress." The Paint Show at the beautiful Dallas Convention Center will be another record breaker.

Like the Mississippi, the FSCT and its good people keep moving right along.



Frank J. Borrelle,
Executive Vice-President

Abstracts of Papers in This Issue

MODELING THE DRYING PROCESS OF COATINGS WITH VARIOUS LAYERS—H.P. Blandin, et al

Journal of Coatings Technology, 59, No. 746, 27 (Mar. 1987)

The drying process for coatings was found to be very complicated, with the following phenomena taking place: the evaporation of the solvent from the surface and the transfer of the solvent through the coating. Solvent transfer was shown to be controlled by diffusion, which obeys Fick's laws under transient conditions, with diffusion dependent upon concentration and with a particular boundary condition with solvent evaporation on the surface. Short tests were successfully used to determine the evaporation rate and diffusivity of the solvent. A model based on an explicit numerical method with finite differences gave not only the kinetics of the weight loss of the coating during drying but also the profiles of solvent concentration developed through the coating. Although the coating shrank during drying, the calculated results were in good agreement with experiments for the kinetics of weight loss, proving the validity of the model. Moreover, the model provided additional information on the profiles of solvent concentration.

GLASS TRANSITION TEMPERATURES OF CROSSLINKED UNSATURATED POLYESTER RESINS AND RESIN MIXTURES—S. Takahashi

Journal of Coatings Technology, 59, No. 746, 33 (Mar. 1987)

Glass transition temperatures (T_g) were measured by a Walker-Steel Swinging Beam Method for crosslinked polymers and the crosslinked polymer mixtures of three unsaturated polyester resins as a function of the hydroxyl group content (Series I), molecular weight of prepolymer (Series II), and degree of crosslinking (Series III).

The glass transition temperatures increase with increases in the hydroxyl value, the molecular weight of prepolymer, and the degree of crosslinking.

All samples of the three series have single glass transition temperatures and broad damping peaks, which show good compatibility.

The T_g of the co-condensation polymer of unsaturated polyesters (copolymer) exhibit the same composition-dependence as those of the component polymer mixtures, with the exception of the Series I polymers, which have a strong molecular interaction by the hydrogen bond.

The T_g of polymer mixtures for Series I cannot be predicted by simple additivity, and are dominated by the component polymer of greater content.

The T_g for Series II and III polymers agree well with the calculated values by the Fox and DiMarzio-Gibbs equations, within experimental errors.

URETHANE ACRYLIC INTERPENETRATING POLYMER NETWORKS (IPNs) FOR COATING APPLICATIONS—Detroit Society for Coatings Technology

Journal of Coatings Technology, 59, No. 746, 43 (Mar. 1987)

IPN coatings were synthesized from a caprolactone extended acrylic urethane, crosslinked by free radical polymerization of pendant double bonds, and a caprolactone extended acrylic resin crosslinked through an isocyanate curing agent. These systems exhibited good weathering resistance and higher tensile strength and adhesive strength than those of their original components. The morphologies of these coatings were determined by means of Thermomechanical Analysis and Scanning Electron Microscopy.

PRODUCTION OF HIGH SOLIDS ACRYLIC COATING RESINS WITH T-AMYL PEROXIDES: A NEW WAY TO MEET VOC REQUIREMENTS—V.R. Kamath and J.D. Sargent, Jr.

Journal of Coatings Technology, 59, No. 746, 51 (Mar. 1987)

t-Amyl peroxides are a new class of commercial organic peroxides. They are very efficient initiators and yield radicals which are poor hydrogen abstractors. As a result, acrylic resins can be readily synthesized with low molecular weight and narrow molecular weight distribution. This enables one to obtain acceptable spray viscosities at high (>75%) solids content, which complies with the decreasing VOC requirements of the coatings industry. Polymerizing typical acrylic monomer combinations for coating applications, we have demonstrated improved performance with t-amyl peroxides over conventional t-butyl peroxides and azonitrile initiators. Performance criteria included resin molecular weight, molecular weight distribution, solids content, solution viscosity, resin color, residual monomer levels, as well as final film properties, such as initial gloss and gloss retention as a function of QUV exposure time.

Our special-purpose polymers make high-solids alkyd coatings air dry in minutes.

It used to take almost half a day to air dry an alkyd enamel. Now our new NeoCryl® DP-200 or DP-201 acrylic modifiers permit high-solids alkyd coatings to dry in minutes, and you get improved flow, leveling and exterior durability as well.

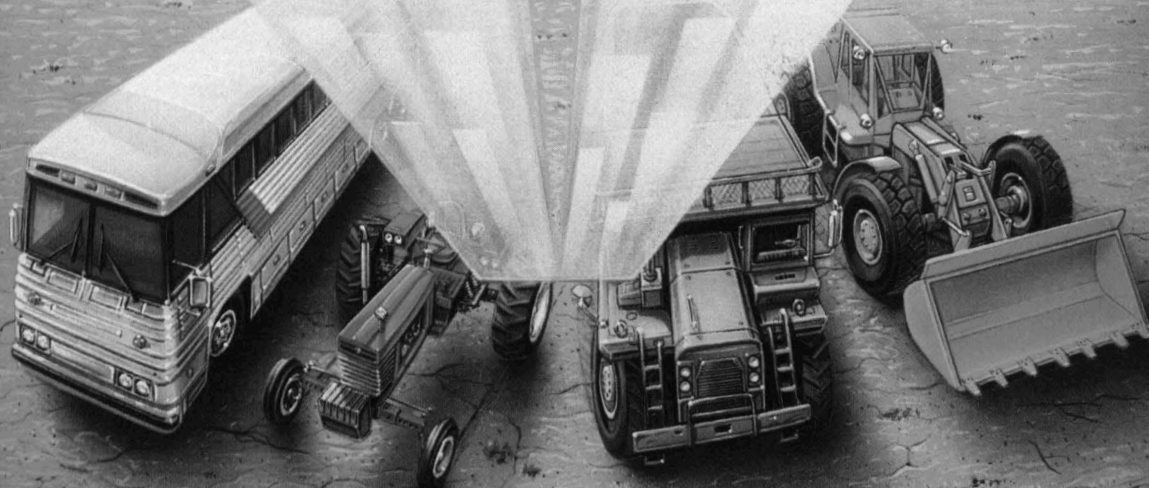
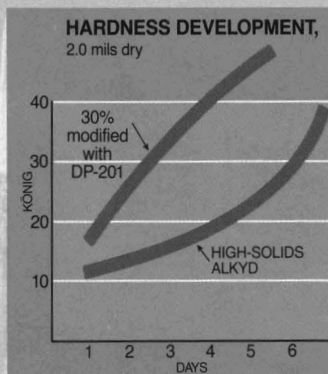
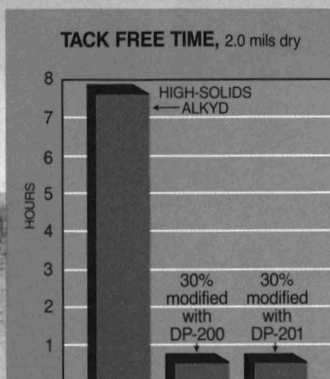
These high-solids, low-viscosity acrylic modifiers for alkyds have little effect on volatile organic compound (VOC) levels, and can be used to modify short-oil, medium-oil and chain-stop alkyds. Suggested uses include coatings for large farm machinery, off-the-road vehicles, construction equipment, railroad engines, trucks, buses and metal furniture.

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**COATINGS
FOR WOOD
SUBSTRATES**

SPRING WEEK '87

Advance Registration and Hotel Reservation Forms

Sponsored by
Federation of Societies for Coatings Technology
and
Pacific Northwest Society for Coatings Technology

April 29–May 2
The Westin Hotel • Seattle, Washington

Featuring
FSCT Seminar on
“Coatings for Wood Substrates”
May 1–2

(See program outline on page 14)

Spring Week Schedule

Wed., April 29 — FSCT Society Officers Meeting
Thur., April 30 — PNW Golf
FSCT Board of Directors Meeting
PNW Evening Social
Fri., May 1 — FSCT Spring Seminar
Sat., May 2 — Seminar until 12:30 pm
PNW Sports Competition
Closing Dinner Dance

United Airlines has been selected as official carrier for Spring Week '87. Discounts will range from 40%-70% off normal round-trip coach fares. To make reservations, phone 1-800-521-4041, and refer to the Federation's account number—7013-D. Be sure to request the lowest fare available.

FEDERATION MEMBERS ONLY—ADVANCE REGISTRATION
for
SPRING WEEK ACTIVITIES
and
SEMINAR ON COATINGS FOR WOOD SUBSTRATES

Sponsored by FSCT and PNWSCT

Thursday, Friday, Saturday, April 30–May 2, 1987
Westin Hotel, Seattle, Washington

Please complete all applicable sections of this form. Mail with check in the correct amount to FSCT at address below. All checks must be payable in U.S. Funds.

Fed. Socs. Coatings Tech.
1315 Walnut St.
Philadelphia, PA 19107

No advance registrations will be accepted after **April 10**. After that date, the Seminar registration fee (including Saturday Dinner-Dance) will be \$135.00. Other fees remain the same.

Membership status is subject to verification by the FSCT Staff. This form and check will be returned to anyone not currently enrolled as a member of the Federation of Societies for Coatings Technology.

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Name _____ Nickname for Badge _____
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Address _____
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Mailing Zone _____ Country _____
Name of Federation Society In Which You Are A Member _____

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HOUSING AT WESTIN HOTEL

The confirmation of your reservation will come to you directly from the Westin, located at 1900 Fifth Ave., Seattle, WA 98111. Phone: 206-624-7400. All reservations will be held until 6:00 p.m. None can be guaranteed after April 6, 1987.

Rates: Single or Double (\$82.00) Suites: Deluxe P & 1 BR (\$350.00)

Check Accommodation Desired: _____ Single _____ Double _____ Suite

Date/Day of Arrival _____ **Day/Date of Departure** _____

Note: All room rates are subject to a state sales tax of 7.9% and city room tax of 5.0%.

SCHEDULE OF FEES FOR FEDERATION MEMBERS ONLY

Check Events Desired	Events	Fee Per Person	Write-In Amount Below
Member			
_____	Seminar on "Coatings for Wood Substrates" Friday and Saturday, May 1-2	\$ 110	_____
_____	Dinner-Dance, Saturday, May 2	Included With Above Fee	_____
_____	Dinner-Social, Thursday, April 30	\$ 25	_____
_____	Golf, Thursday, April 30 (includes lunch)	\$ 30	_____
Spouse			
_____	Spouses Activities	\$ 50	_____
_____	Dinner-Dance, Saturday, May 2	Included With Above Fee	_____
_____	Dinner-Social, Thursday, April 30	\$ 25	_____
	(Enclose Check in This Amount)	TOTAL FEES	=====

NON-MEMBERS ONLY—ADVANCE REGISTRATION
for
SPRING WEEK ACTIVITIES
and
SEMINAR ON COATINGS FOR WOOD SUBSTRATES

Sponsored by FSCT and PNWSCT

Thursday, Friday, Saturday, April 30–May 2, 1987
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1315 Walnut St.
Philadelphia, PA 19107

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Business Affiliation _____ Phone _____
Address _____
City _____ State/Province _____
Mailing Zone _____ Country _____

SPOUSE REGISTRATION

Name _____ Nickname for Badge _____
City _____ State/Province _____ Country _____

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Date/Day of Arrival _____ Day/Date of Departure _____

Note: All room rates are subject to a state sales tax of 7.9% and city room tax of 5.0%.

SCHEDULE OF FEES FOR NON-MEMBERS ONLY

Check Events Desired	Events	Fee Per Person	Write-In Amount Below
	Non-Member		
_____	Seminar on "Coatings for Wood Substrates" Friday and Saturday, May 1-2	\$125	_____
_____	Dinner-Dance, Saturday, May 2	\$ 40	_____
_____	Dinner-Social, Thursday, April 30	\$ 25	_____
_____	Golf, Thursday, April 30 (includes lunch)	\$ 30	_____
	Spouse		
_____	Spouses Activities	\$ 50	_____
_____	Dinner-Dance, Saturday, May 2	Included With Above Fee	_____
_____	Dinner-Social, Thursday, April 30	\$ 25	_____
	(Enclose Check in This Amount)	TOTAL FEES	_____

COATINGS FOR WOOD SUBSTRATES PROGRAM

"REDWOOD—PROPERTIES, USES, PAINTING AND STAINING RECOMMENDATIONS"

Keith Kersell, Technical Services Manager,
The Pacific Lumber Co., San Francisco, CA

"STAINS FOR WOOD SIDING"

Dr. Dale Williamson, Technical Director,
Olympic Home Care Products Co., Seattle, WA

"COATINGS RESEARCH AT THE FOREST PRODUCTS LABORATORY"

Dr. William C. Feist, Project Leader—Wood Surface Chemistry,
U.S. Dept. of Agriculture,
Forest Products Laboratory, Madison, WI

"HARDBOARD SIDING—COMPOSITION AND PROPERTIES. PAINTING RECOMMENDATIONS"

Theodore J. Rieth, Manager, Finishing Tech. Service
Masonite Corp., Towanda, PA

"PLYWOOD—PROPERTIES, USES, AND RECOMMENDED PAINTING PROCEDURES"

Richard Carlson, Associate Scientist,
Research and Development Dept.,
American Plywood Assn., Tacoma, WA

"PAINTING HARDBOARD SIDING"

Stan Vout, Technical Manager for Forest Products Coatings,
Valspar Corp., Minneapolis, MN

"TODAY'S COATING SYSTEMS FOR THE WOOD FURNITURE INDUSTRY"

Robert S. Bailey, Vice-President and General Manager,
Lilly Industrial Coatings, Inc., Indianapolis, IN

"INVESTIGATION OF LATEX STAIN BLOCKING PRIMERS ON WOOD SUBSTRATES"

Fred Marschall, Vice-President of Manufacturing and Research,
DPI Quality Paints, Inc., Clearwater, FL

(Presented on behalf of the Southern Society for Coatings Technology)

"THE MILDEW PROBLEM ON PAINTED WOOD SURFACES"

Michael C. McLaurin, Industry Specialist for Coatings,
Buckman Laboratories, Inc., Memphis, TN

"PRESERVATIVE TREATMENTS FOR WOOD AND COATING TECHNIQUES"

Dr. Alan S. Ross, Manager of Product Development—
Protection Products,
Koppers Co., Inc., Monroeville, PA

"THE RESPONSIBILITY OF THE ARCHITECT"

John Greiner, AIA,
Bellevue, WA

"HOW THE HOME BUILDER CAN HELP TO AVOID PAINT PROBLEMS"

Lester Dow,
Dow/Solberg, Inc., Bellevue, WA

Several Open Forum Sessions will also be featured so that attendees will have an opportunity to question the speakers.

SEMINAR SCHEDULE

Friday . . . 8:45-3:45 Saturday . . . 8:45-12:30

The registration fee includes continental breakfast and lunch on Friday; continental breakfast on Saturday; and copies of the papers.

Preparations Underway for 1987 Annual Meeting And Paint Industries' Show in Dallas

The 1987 Annual Meeting of the Federation will be held in Dallas on October 5-7 at the Dallas Convention Center. The theme of the meeting, "People and Technology: Cornerstones of Progress," will focus on the coatings industry's most valuable resource—people! They provide the creativity and innovation necessary to meet today's challenges. Programming will cover timely issues, including the training of these vital people, as well as technological developments in such areas as coating plastics, manufacturing, and corrosion control. Included in the program will also be the Mattiello Memorial Lecture, Roon Award Papers, Society Papers, and Seminars.

Program Chairman William A. Wentworth, of Jones-Blair Co., Dallas, TX, and his committee are developing a schedule of presentations. Serving on the committee are Richard M. Hille (Vice-Chairman), General Paint & Chemical Co., Cary, IL; John C. Ballard, of Kurfecs Coatings, Inc., Louisville, KY; Gordon P. Bierwagen, Consultant, Homewood, IL; Gretchen McKay, of Milton Hill Associates, Olympia, WA; John Oates, of Troy Chemical Corp., Newark, NJ; A. Gordon Rook, of Nuodex, Inc., Pleasanton, CA; and Clifford Schoff, of PPG Industries, Inc., Allison Park, PA.

Paint Industries' Show

To be held in conjunction with the 65th Annual Meeting, the Paint Show will feature the products and services of the suppliers of the coatings industry. More than 240 exhibitors—utilizing over 62,000 net square feet of space—will be in the Show.

Currently, over 90% of available exhibit space is contracted, and over 6,500 industry personnel are expected to attend. Exhibit hours will be 11:00 to 5:30 on Monday, October 5; 9:00 to 5:30 on Tuesday, October 6; and 9:00 to 3:00 on Wednesday, October 7.

Hotels and Reservations

The Federation co-headquarters will be the Hyatt Regency and the Anatole. Other cooperating hotels are: Dallas Hilton, Sheraton Dallas, Adolphus, Plaza of Americas, Greenleaf, Holiday Inn Down-

savings off Delta's round trip, undiscounted day coach fares for those who travel to the FSCT AM&PS on Delta's domestic system. For travel from Canada, the discount is 30%.

To take advantage of this discount, you must:

- (1) Leave for Dallas between October 1 to 6, 1987.
- (2) Stay no longer than 15 days.
- (3) Purchase tickets at least seven days prior to departure.
- (4) Phone 1-800-241-6760 for reservations. Immediately reference the FSCT file number: U0235. The special fares are available only through this number. If you use travel agents, have them place your reservation through the toll-free number to obtain the same fare advantages. Delta also has a variety of other promotion fares, some of which may represent an even greater savings. When you phone for reservations, ask for the best discount applicable to your itinerary.



DALLAS CONVENTION CENTER

town, and Dallas Plaza. All housing will be processed by the Dallas Convention and Visitors Bureau, which will accept only the official housing form furnished by the Federation.

Special Air Fares

Delta Air Lines, in cooperation with the FSCT, is offering a special discount fare which affords passengers a 40% maximum

Spouse's Program

The opening activity for spouses will be the get-acquainted wine & cheese social, Monday afternoon, October 5, in the Dallas Convention Center. On Tuesday, spouses will tour the mansion and the grounds of beautiful Southfork, home of the Ewing family on the popular TV show, "Dallas." Luncheon will be served in the Anatole Hotel. After lunch, there will be a guided tour of many points of interest in the city and nearby suburbs of Dallas. Continental breakfast will be served in both the Hyatt and Anatole on Tuesday and Wednesday.

Host Committee

William F. Holmes, of DeSoto, Inc., Dallas, heads the Host Committee. Assisting him are these subcommittee chairmen: *Spouses*—Mrs. William F. (Jean) Holmes; *Federation Exhibit*—John F. Rothermel, of Sherwin-Williams Co., Garland, TX; *Information Services*—Noel L. Harrison, of Western Specialty Coatings Co., Grand Prairie, TX; *Program Operations*—T. Leon Everett, of Dan Paint and Coatings Mfg. Co., Dallas; and *Registration Area*—Steve Stephens, of Ribelin Sales, Inc., Garland. The Host Societies are the Dallas and Houston Societies for Coatings Technology.

Student-Authored Manuscript Entries Invited For 1987 A.L. Hendry Award Competition

Prospective student authors are invited to submit manuscript entries in the 1987 Alfred L. Hendry Award competition. Sponsored by the Southern Society for Coatings Technology, the award commemorates the industry contributions of the late Alfred L. Hendry, President of A.L. Hendry & Co., Tampa, FL, and a Past-President of the Southern Society.

The award is a \$1000 cash prize for the best paper on some aspect of coatings technology, authored by an undergraduate student currently enrolled in a college program. The Educational Committee of the

Federation judges the entries and administers the award.

Those wishing to enter the competition must send a letter of intent, along with the title of the proposed paper and a brief abstract, by March 15, to: Hendry Award Competition, c/o FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107. Deadline for receipt of manuscripts at the FSCT office is June 15.

Presentation of the award will be at the 1987 FSCT Annual Meeting in Dallas, TX, October 5-7.

Seminar on Coatings for Wood Substrates Scheduled for May 1-2 in Seattle

In-depth information on the coating of wood and wood products will be presented at a 1½ day seminar, to be held May 1-2, at The Westin Hotel, Seattle, WA.

Jointly sponsored by the Pacific Northwest Society for Coatings Technology and the Federation of Societies for Coatings Technology, the seminar on "Coatings for Wood Substrates" will feature presentations by speakers from both the paint and forest products industries, as well as an architect and a home builder. Discussions will focus on such topics as: properties and potential coating problems of a variety of wood substrates; specific problems, such as painting pressure-treated woods, and mildew growth on painted wood surfaces; characteristics and uses of preservatives; and coating of wood furniture.

Several "open forum" sessions will be featured, at which attendees can question speakers on specific problems, with the unique opportunity to learn potential solutions from the perspective of both coatings manufacturers and wood products suppliers.

Program speakers and their presentations are:

"Redwood—Properties, Uses, Painting and Staining Recommendations"—Keith Kersell, Technical Services Mgr., The Pacific Lumber Co., San Francisco, CA

"Stains for Wood Siding"—Dr. Dale Williamson, Technical Director, Olympic Home Care Products Co., Seattle, WA

"Coatings Research at the Forest Products Laboratory"—Dr. William C. Feist, Project Leader—Wood Surface Chemistry, U.S. Dept. of Agriculture, Forest Products Laboratory, Madison, WI

"Hardboard Siding—Composition and Properties. Painting Recommendations"—Theodore J. Rieth, Mgr., Finishing Tech. Service, Masonite Corp., Towanda, PA

"Plywood—Properties, Uses, and Recommended Painting Procedures"—Richard Carlson, Associate Scientist, Research and Development Dept., American Plywood Association, Tacoma, WA

"Painting Hardboard Siding"—Stan Vout, Technical Manager for Forest Products Coatings, Valspar Corp., Minneapolis, MN

"Today's Coating Systems for the Wood Furniture Industry"—Robert S. Bailey, Vice-President and General Manager, Lilly Industrial Coatings, Inc., Indianapolis, IN

"Investigation of Latex Stain Blocking Primers on Wood Substrates"—Fred Marschall, Vice-President of Manufacturing and Research, DPI Quality Paints, Inc., Clearwater, FL

"The Mildew Problem on Painted Wood Surfaces"—Michael C. McLaurin, Industry Specialist for Coatings, Buckman Laboratories, Inc., Memphis, TN

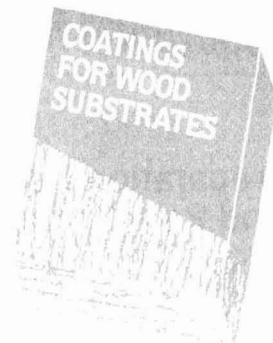
"Preservative Treatments for Wood and Coating Techniques"—Dr. Alan S. Ross, Manager of Product Development—Protection Products, Koppers Co., Inc., Monroeville, PA

"The Responsibility of the Architect"—John Griener, AIA, Bellevue, WA

"How the Home Builder Can Help to Avoid Paint Problems"—Lester Dow, Dow/Solberg, Inc., Bellevue, WA

Registration fee for the seminar is \$110 for FSCT members; \$125 for non-members. After April 10, registration fee will be \$135 for FSCT members; \$150 for non-members. The fee includes complete set of papers presented, continental breakfast, luncheon, and coffee breaks.

The seminar will be a featured part of the Federation's "Spring Week" schedule. Also being held during the week April 29-May 2 at The Westin Hotel are the following events:



April 29—Federation Society Officers Meeting

April 30—Federation Board of Directors Meeting
Pacific Northwest Society Golf Tournament
Society's Evening Social

May 2 —Pacific Northwest Society's Sports Competition
Closing Dinner-Dance

To obtain complete program information and registration/housing forms, contact Federation of Societies for Coatings Technology, 1315 Walnut Street, Suite 832, Philadelphia, PA 19107 (215/545-1506).

"Special Purpose Coatings" Papers Available

Papers presented at the 1986 seminar on "Special Purpose Coatings," sponsored by the Federation of Societies for Coatings Technology in Pittsburgh, PA, May 13-14, are available in limited quantities.

The package includes all 13 presentations made at the seminar. Included are the following:

"Traffic Markings—A General Commentary"—D. R. Miller, Redland-Prismo Corp., Canton, GA

"Aerosol Paints and Coatings"—R. M. Hall, Rust-Oleum Corp., Evanston, IL

"Performance and Cost-Effectiveness of High Solids Maintenance Coatings"—J. P. Wineburg, E. I. du Pont de Nemours & Co., Inc., Philadelphia, PA

"Automotive Refinish Coatings"—R. Allinder, BASF Inmont, Whitehall, OH

"Fire-Retardant Paints"—W. A. Rains, Albi Div. of Stan Chem, Inc., East Berlin, CT

"Introduction to Elastomerics"—T. De Pippo, The Neogard Corp., Dallas, TX

"Evaluating and Predicting Performance of Heavy-Duty Maintenance Coat-

ings"—B. R. Appleman, Steel Structures Painting Council, Pittsburgh, PA

"The Problems of Highway Bridge Maintenance"—D. Spagnoli, Pennsylvania Department of Transportation, Pittsburgh, PA

"High Performance Corrosion-Resistant Coating Systems"—J. J. Bracco, Mobay Chemical Corp., Pittsburgh, PA

"Conducting an Inspection of the Paint Job"—K. Trimber, KTA-Tator Associates, Pittsburgh, PA

"Marine Coatings for Ships and Off-Shore Structures"—J. White, Devoe Marine Coatings Co., Div. of Grow Group, Inc., Louisville, KY

"Coatings for Petroleum Refineries and Petrochemical Plants"—G. Repka, PPG Industries, Inc., Houston, TX

"Special Purpose Coatings for Pulp and Paper Mills"—D. Jones, Southern Coatings and Chemicals Co., Sumter, SC.

Cost of the complete set of seminar papers is \$75. To order, contact Ms. Meryl Cohen, FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107, (215) 545-1506.

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MMA Awards for Notable Achievements Won by Golden Gate and Piedmont Societies

The 1986 MMA Awards for notable achievements by Constituent Societies of the Federation were presented to Golden Gate and Piedmont, in ceremonies at the recent Federation Annual Meeting in Atlanta.

The Awards were established in 1975 by Materials Marketing Associates, Inc., a national marketing group of manufacturers' representatives, to recognize notable Society achievements in the field of education, manufacturing and training procedures, technology, public service, and for other achievements deemed proper and desirable by the MMA Awards Committee. (Society papers presented at the Federation Annual Meeting are not eligible.)

There are three categories of Awards, based on Society membership size; it is not mandatory, however, that an Award be presented to any or all categories each year.

Each winning Society receives \$350 in cash, plus a handsome plaque appropriately engraved.

Excellence of Seminar on VOC Demonstration/Determination

The Golden Gate Society was cited for the excellence of its seminar on Demonstration/Determination of Volatile Organic Compounds in Solvent and Water-Borne Coatings.

This full-day event featured speakers from the Bay Area Quality Management District, who discussed methods and procedures used by that agency in determining VOC in surface coatings and related products, as well as their role in contributing to air quality improvement in the San Francisco/Oakland area.

Educational Contribution Of Polymers Course

The Piedmont Society won an Award for developing and sponsoring an accredited course in polymer chemistry at the University of North Carolina-Greensboro. The course focused on studies of polymer synthesis and structural property relationships of polymers employed in the coatings field.

Funding provided by the Society enabled UNC-G students and Society members to attend the course at a reduced fee.

Principles Governing Awards

The President of any Society wishing to enter the competition must send a letter of intent, no later than March 31, to the MMA Awards Committee Chairman (Felix Liberti, Koppers Co., Inc., 480 Frelinghuysen Ave., Newark, NJ 07114).

A complete description of the Society activity to be considered in the competition must be submitted by the Society President to Chairman Liberti by July 31.

Not eligible for the Awards are Society papers offered for presentation at the Fed-



Materials Marketing Associates (MMA) Awards were presented to the Golden Gate and Piedmont Societies. Shown from left to right: MMA President Art Benton; Robert T. Miller (Golden Gate); Steve Lasine (Piedmont); and Award Chairman Felix Liberti

eration Annual Meeting, and previously submitted entries.

The following are members of the Materials Marketing Associates who sponsored the 1986 MMA Awards: George C. Brandt, Inc., Elmhurst, IL; Carmona Chemical Co., San Francisco, CA; C.D.I., Inc., Portland, OR; Chemroy Chemicals, Ltd., Ontario, Canada; Dorsett & Jackson, Inc., Los Angeles, CA; Horton Earl Co., St. Paul, MN; D.N. Lukens, Inc., West-

boro, MA; Majemac Enterprises, Inc., Clearwater, FL; Matteson-Ridolfi, Inc., Riverview, MI; McCullough & Benton, Inc., Atlanta, GA; Mehaffey and Daigle, Inc., New Orleans, LA; Pioneer Chemical, Inc., Mesquite, TX; Schabel Products Corp., Cleveland, OH; Wm. B. Tabler Co., Inc., Louisville, KY; Van Horn, Metz & Co., Inc., Conshohocken, PA; Walsh & Associates, Inc., St. Louis, MO; and C. Withington Co., Inc., Pelham Manor, NY.

FSCT Announces Availability of Additional Units For Its New Series on Coatings Technology

Publication of additional units in its new Series on Coatings Technology has been announced by the Federation of Societies for Coatings Technology.

Now available are the following monographs:

- “Film Formation”—Zeno Wicks, Jr.
- “Introduction to Polymers and Resins”—Joseph Prane
- “Radiation Cured Coatings”—J.R. Costanza, A.P. Silveri, and J.A. Vona
- “Solvents”—William Ellis
- “Coil Coatings”—Joseph E. Gaske
- “Corrosion Protection by Coatings”—Zeno Wicks, Jr.

Price of the units (prepaid) is \$5.00 each; orders should be addressed to: FSCT, 1315 Walnut St., Suite 830, Philadelphia, PA 19107.

The Series, which will total approximately 35 monographs covering the major areas of coatings technology, will serve as a valuable teaching and training resource for the industry.

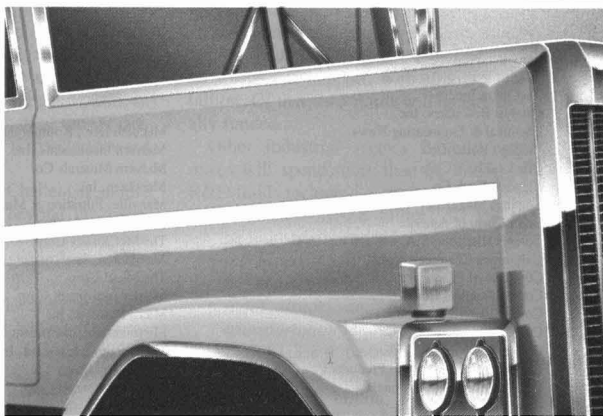
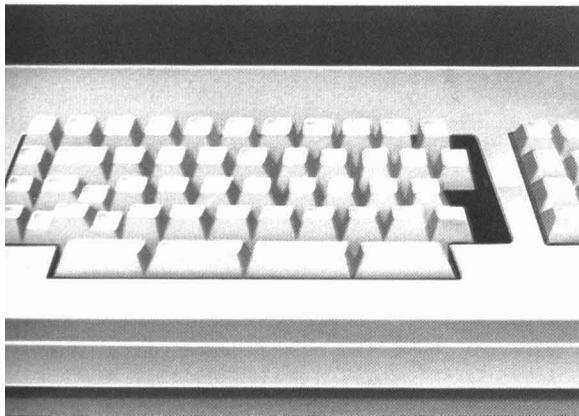
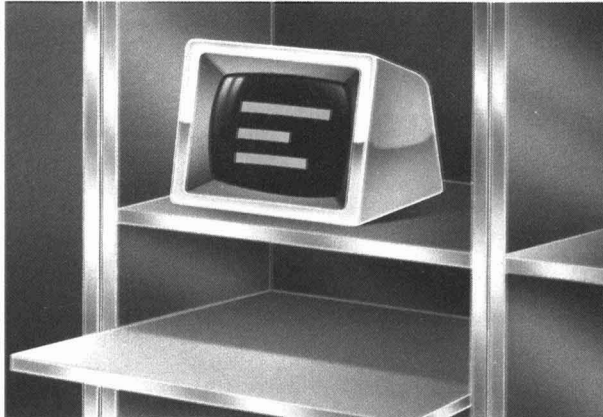
Development of the Series is under the overall direction of an Advisory Board,

whose members assist in selection of authors and review of manuscripts. Dr. Thomas J. Miranda (Whirlpool Corp., Benton Harbor, MI) and Dr. Darlene R. Brezinski (DeSoto, Inc., Des Plaines, IL) are Editors of the Series.

Dr. Miranda, who chairs the Advisory Board, is Chairman of the Federation's Publications Committee and Editorial Review Board, and Technical Editor of the JOURNAL OF COATINGS TECHNOLOGY. Dr. Brezinski is a member of the Publications Committee, the JCT Editorial Review Board, and the Series Advisory Board.

Serving on the Advisory Board with Drs. Miranda and Brezinski are: Dr. Loren Hill (Monsanto Co., Indian Orchard, MA); Dr. Joseph Koleske (Union Carbide Corp., South Charleston, WV); Hugh Lowrey (Perry & Derrick Co., Inc., Cincinnati, OH); Stan LeSota (Rohm and Haas Co., Spring House, PA); Dr. Percy Pierce (PPG Industries, Inc., Allison Park, PA); and Joseph A. Vasta (E.I. du Pont de Nemours & Co., Inc., Wilmington, DE).

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Exhibitors Signed Up for 1987 Paint Industries' Show (As of January 21, 1987)

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Advanced Software Designs
Air Products & Chemicals, Inc.
Alcan Powders & Pigments
C.M. Ambrose Co.
American Cyanamid Co.
American Hoechst Corp.
Applied Color Systems, Inc.
Arco Chemical Co.
Aries Software Corp.
Ashland Chemical Co.
Atlas Electric Devices Co.
AZS Corporation

BASF Corp./Chemicals Div.
Beltron Corp.
Berol Chemicals, Inc.
Blackmer Pump/Dover Resources Co.
BP Chemicals Ltd.
Brinkmann Instruments, Inc.
Brockway Standard, Inc.
BTL Specialty Resins Corp.
Buckman Laboratories, Inc.
Burgess Pigment Co.
Byk-Chemie USA

Cabot Corp., Cab-O-Sil Div.
Calgon Corp.
Cargill, Inc.
CasChem, Inc.
Catalyst Resources, Inc.
Chemical & Engineering News
Chicago Boiler Co.
CIBA-GEIGY Corp.
Clawson Tank Co.
Coatings Magazine
Color Corp. of America
Colores Hispania, S.A.
Columbian Chemicals Co.
Commercial Filters
Cosan Chemical Corp.
Coulter Electronics, Inc.
Cray Valley Products, Inc.
Crosfield Chemicals, Inc.
CUNO Process Filtration Products
Custom Fibers International
Custom Metalcraft, Inc.

D/L Laboratories
Daniel Products Co.
DataLogIX Formula Systems, Inc.
Day-Glo Color Corp.
Degussa Corp.
Diagraph Corp.
Diamond Shamrock Chemicals Co.
Disti, Inc.
Dominion Colour Co.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
Drew Chemical Corp.
DSET Laboratories, Inc.
Du Pont Co., DBE Solvents

E.C.C. America
Eastern Michigan University
Eastman Chemical Products, Inc.
Ebonex Corp.
Eiger Machinery, Inc.
Engelhard Corp.
Epworth Manufacturing Co., Inc.
Erichsen Instruments, Inc.
Exxon Corp.

Fawcett Co., Inc.
Fed. Soc. for Cts. Tech.
Filter Specialists Inc.
Filterite

GAF Corporation
Georgia Kaolin Co., Inc.
Globe Trading Co.
Gorman-Rupp Co.
Grefco, Inc.

Haake Buchler Instruments, Inc.
Halox Pigments, Div. of Hammond Lead Products
Harshaw/Filtral Partnership
Hercules Incorporated
Heubach, Inc.
Hilton-Davis Chemical Co.
Hitox Corp. of America
Hoover Group Inc.

ICI Americas, Inc.
Ideal Manufacturing & Sales Corp.
Illinois Minerals Co.
Interez, Inc.
ITT Marlow Pumps

S.C. Johnson & Son, Inc., Johnson Wax

Kenrich Petrochemicals, Inc.
Kent State University
Kinetic Dispersion Corp.
King Industries, Inc.
KTA-Tator, Inc.

Liquid Controls Corp.
The Lubrizol Corp., Diversified Prods. Group

Macbeth Div., Kollmorgen Corp.
Malvern Instruments, Inc.
Malvern Minerals Co.
Manchem, Inc.
Manville, Filtration & Minerals
Marco Scientific, Inc.
The McCloskey Corp.
McWhorter, Inc.
The Mearl Corp.
Mettler Instrument Corp.
Micro Powders, Inc.
Micromeritics Instrument Corp.
Miller Paint Equipment, Inc.
Milton Roy Co.
Mineral Pigments Corp.
MiniFIBERS, Inc.
Minolta Corp.
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Mixing Equipment Co.
Mobay Corp.
Modern Paint & Coatings
Morehouse Industries, Inc.
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P.A. Industries
Pacific Micro Software Engineering
Pacific Scientific, Instrument Div.
Permethane, Inc.
Pfizer Pigments, Inc.
Phillips 66 Co., Specialty Chems.
Poly-Resyn, Inc.
Polyvinyl Chemicals, Inc.
PPG Industries, Inc.
Premier Mill Corp.

Progressive Recovery, Inc.

Q-Panel Co.

RAABE Corp.
Red Devil, Inc.
Reichhold Chemicals, Inc.
Research Data Access Corp.
Rheometrics, Inc.
Rhône-Poulenc, Inc.
Rohm and Haas Co.
Rosedale Products, Inc.

Sandoz Chemicals Corp.
Semi-Bulk Systems, Inc.
Serac, Inc.
Shamrock Chemicals Corp.
Sherwin-Williams Chemicals Co.
Silverline Manufacturing Co., Inc.
South Florida Test Service, Inc.
Univ. of Southern Mississippi, Polymer Science Dept.
Spartan Color Corp.
Stauffer-Wacker Silicones Corp.
Steel Structures Painting Council
Sun Chemical Corp.

Tammco, Inc.
Tego Chemie Service GmbH
Tekmar Co.
Troy Chemical Co.

Unimin Corp.
Union Carbide Corp.
Union Process, Inc.
United Catalysts, Inc.
Universal Color Dispersions
Unocal Chemicals Div., Unocal Corp.

R.T. Vanderbilt Co., Inc.
Vara International
Viking Pump-Houdaille, Inc.
Virginia Chemicals, Inc.
Viscous Products Magazine

Warren Rupp-Houdaille, Inc.
Wilden Pump & Engineering Co.
Witco Chemical Corp.

Zelan Industries, Inc.

Special Discount Fares Available from Delta To Annual Meeting

Special arrangements have been made with Delta Airlines to offer discounted fares within the U.S. to/from Dallas, TX, for the October 5-7 Annual Meeting and Paint Industries' Show, at the Dallas Convention Center. These special fares are available only when you call the unlisted toll-free number 1-800-241-6760. Be sure to ask for the lowest fare available. You must give the FSCT Convention number, which is: **U0235**

Study Predicts U.S. R&D Funding to Increase \$8.8 Billion

Expenditures in calendar year 1987 for research and development (R&D) in the United States are expected to reach \$127.4 billion, according to the annual Battelle forecast. This represents an increase of \$8.8 billion (7.42%) over the \$118.6 billion the National Science Foundation estimates was to be actually spent for R&D in 1986.

While part of the increase will be absorbed by continued inflation (estimated at 3.0% for R&D in 1987), Battelle forecasts a real increase in R&D expenditures of 4.33%. This is slightly higher than the ten-year average rate of 4.26% in real R&D effort experienced since 1976.

Sources of Funds

Industrial funding for R&D will account for 50.0% of the total. Industrial support is forecast to be \$63.8 billion, up 7.2% from 1986.

Battelle sees an increase of 7.6% in federal support for R&D, with funding expected to be \$59.5 billion. This is 46.7% of total expenditures for 1987.

Funding by academic institutions is expected to be \$2.75 billion (2.2% of the total), and other nonprofit organizations will provide \$1.45 billion (1.1%).

The report notes that during the past decade real industrial R&D support has increased at an average compounded rate of 5.3% per year, while federal support has increased at 3.3% on average. The trend toward increased industrial support has evolved in recent years, since up until 1979 government supported more R&D than did industry.

Performers of Research

Industry will remain the dominant performer of R&D, according to the Battelle report. In 1987, performance by industry is expected to rise to nearly \$94 billion, or 73.5% of all research performed.

This compares with \$14.7 billion (11.5%) for the federal government, \$15.5 billion (12.2%) for academic institutions, and almost \$3.6 billion (2.8%) for other nonprofit organizations.

Federal funding supports research performance in all four sectors. Currently, about one-fourth goes to support R&D conducted by the government itself; slightly more than half goes to industry; almost one-fifth goes to colleges and universities; and the rest, about one-twenty-fifth, goes to other nonprofits.

Industry absorbs almost all of its own funds, either performing the R&D itself or

contracting with other industrial performers. Its contracts and grants to nonprofit organizations are about two-thirds as large as those to colleges and universities. The nonprofit organizations finance both themselves and the academic institutions about equally, and colleges and universities use up all of the funds they originate.

Government Support

Four government agencies dominate the federal R&D scene and are expected to account for 92.7% of total federal R&D funding in 1987, compared to 91.5% of funding in 1986. The make-up of this funding will change significantly in 1987.

The forecast notes that increases in defense spending primarily are directed toward long-term acquisition of major weapons systems, including the Strategic Defense Initiative and advanced aircraft, and R&D necessary to support them. In addition, approximately half of the Department of Energy's budget is directed toward defense.

The tragic loss of the Challenger shuttle has had an impact far beyond the operational aspect of space transportation. The resultant investigations have influenced the entire NASA operation, the orientation of research programs, and the associated budgets. Coupled with total budget measures designed to reduce the federal deficit, NASA programs are expected to increase, but to represent a smaller share of total federal support.

Energy funds will decline for research on energy supply and conservation, but not for energy programs in direct support of national defense and for general science. Stabilization of prices and increased supplies have reduced the apparent short-term urgency for R&D in support of programs on fossil and alternative energy sources. Energy projects involving short-term or low-risk R&D likely will be financed by industry.

The report also anticipates that R&D dollars will continue to support the biological and health sciences areas, although significant cuts in these areas are anticipated. There also will be a continuing de-emphasis on research in the "soft" sciences, including environmental and ecological sciences.

Industrial Support

Industrial support of research is growing in fields related to electronics, communications, sensors, and advanced machinery,

and in those fields most directly influenced by the need for more energy-efficient products and processes.

R&D will be heavily self-funded in manufacturing industries, where on the average, approximately 32.7% of the total will be supported by the federal government. The non-manufacturing industries do relatively little R&D, yet nearly 42% of support for this activity will be provided by the federal government.

As part of the forecast, Battelle also estimated industrial vs federal support for R&D performed by several broad industrial sectors. In 1987, Battelle expects the aerospace industry to retain leadership in total R&D, with performance of approximately \$23.6 billion. Of that, almost 75% will be funded by the federal government.

The electrical machinery and communications industry will have the second largest total R&D support, with almost \$21.3 billion. Of that, two-thirds will be industrially funded.

Other industrial sectors Battelle estimates will spend more than \$1 billion in R&D funds include:

- *chemicals*—\$10.8 billion, 97.1% to be industrially funded.
- *machinery*—\$10.1 billion, 89.7% to be industrially funded.
- *autos, trucks and parts, and other transportation equipment*—\$8.7 billion, 81.3% to be industrially funded.
- *professional and scientific instruments*—\$6.1 billion, 87.8% to be industrially funded.
- *petroleum products*—\$2.4 billion, almost all to be industrially funded.
- *rubber products* (including all other research performed by major rubber companies)—\$1.2 billion, 85.8% to be industrially funded.
- *food & beverage products*—\$1.04 billion, practically all of which is industrially funded.

The report cautions against ascribing too great a significance to the distribution of performance among the major industrial sectors. The classifications, based upon NSF procedures, do not take into account that many of the largest research-intensive companies have a wide spectrum of interests; thus the figures do not truly represent the line-of-business distribution of R&D performance. It is particularly misleading for the steel industry.

The Battelle forecast indicates that industry is taking over short-term R&D pro-

(Continued on page 22)

Battelle Report Focuses on Physical Coating Processes

The results of a major program covering physical coating processes in the United States, Europe, and Japan are now available from Battelle.

The comprehensive investigation, completed by Battelle Frankfurt, includes technical as well as economic data on processes such as vapor deposition, ion plating, sputtering, plasma treatment, and laser treatment. In all, 11 advanced coating processes are evaluated, together with recommended methods for surface modification.

The 1,000-page report provides a comprehensive survey of the technical and economic opportunities that new surface coating methods offer. State-of-the-art processes as well as the technologies of tomorrow and their commercial potential are assessed.

The goal of the program is to provide information and data to aid industrial decision-makers in the development or application of new processes. This applies to companies replacing classic coating methods as

well as those considering diversifying into surface technology.

The report is divided into three volumes. The first is the Management Summary, which highlights key results.

Volume Two contains technical details of the processes and their applications. Volume Three provides detailed descriptions of the status of industrial use, current and potential fields of application, and anticipated future possibilities of commercial use of key processes. Of particular interest to marketing executives in equipment manufacturing firms, market data also includes the types of coating equipment available worldwide, names of equipment suppliers, identification of the significant market segments they serve, and an assessment of competing technologies.

The report is available for DM 25,000 (approximately \$12,500 as of the October,

1986 exchange rate). For more information, contact: Barbara Soloway, Battelle, 505 King Avenue, Columbus, Ohio 43201-2693.

Ottawa Silica Co. Combines With Pennsylvania Glass Sand

Ottawa Silica Co., Ottawa, IL, and Pennsylvania Glass Sand Corp., Berkeley, WV, both subsidiaries of Pacific Coast Resources, recently began operation under the new name of U.S. Silica Co.

Pacific Coast Resources (PCR), also the parent company of United States Borax and Chemical Corp., is owned by Rio Tinto Zinc Inc., a British company with international mining interests.

U.S. R&D Predictions for 1987 (Continued from page 21)

jects and is reacting to the growing pressure from foreign technological competition. While industrial support for R&D has been growing substantially in recent years, Battelle says there are indications that a shift in patterns may be developing. Increased industrial expenditures have resulted from an improved business climate, higher sales and profits, and tax policies. Some shift in performance of industrial R&D is leaning toward a greater percentage being carried out by consortia of industry, both within the universities and in specially created entities. The report cautions, however, that increasing tendencies toward mergers, acquisitions, and so-called "restructuring" efforts can have a significant impact on total R&D expenditures by industry and, by extension, to the future health of U.S. industry.

Costs of R&D

The Battelle forecast also compares the four performing sectors in terms of their relative costs of R&D. Cost increases are associated with general inflation and, to a larger extent, result from increasing sophistication and complexity of research.

During 1987, the overall cost increase for all R&D is estimated to be 3.0%. By sectors, the increases are estimated as government, 4.7%; industry, 2.7%; colleges and universities, 4.6%; and other nonprofits, less than one percent.

From 1972-1986, costs of all R&D, as an average, are estimated to have risen by 170.8%. Increases in the individual performing sectors—over this same time period—are expected to be: federal government, 217.2%; industry, 160.7%; colleges

and universities, 201.3%; and other nonprofits, 151.5%.

Long-Term Outlook

As part of the forecast, Battelle also examined R&D trends during the past and identified what impact they may have on the future.

The report concludes that over the past few years, federal support tended to shift toward more "development" and less basic and applied "research." However, within the category of basic and applied research, there is a small—but perhaps significant—continuing trend toward increasing the basic research component.

In addition, industrial support of basic research is expected to increase, largely through cooperative programs between universities and consortia of industries.

Continental Technical Finishes Purchased by Whittaker Corp.

Whittaker Corp., Los Angeles, CA, has announced the purchase of the business and certain assets of Continental Technical Finishes Corp., Brooklyn, NY.

Continental manufactures industrial coatings used primarily by manufacturers of office furniture, lighting fixtures, appliances, and vending machines. Its business will be integrated with Whittaker's North Brunswick Coatings Div., located in North Brunswick, NJ, also a manufacturer of specialized industrial coatings.

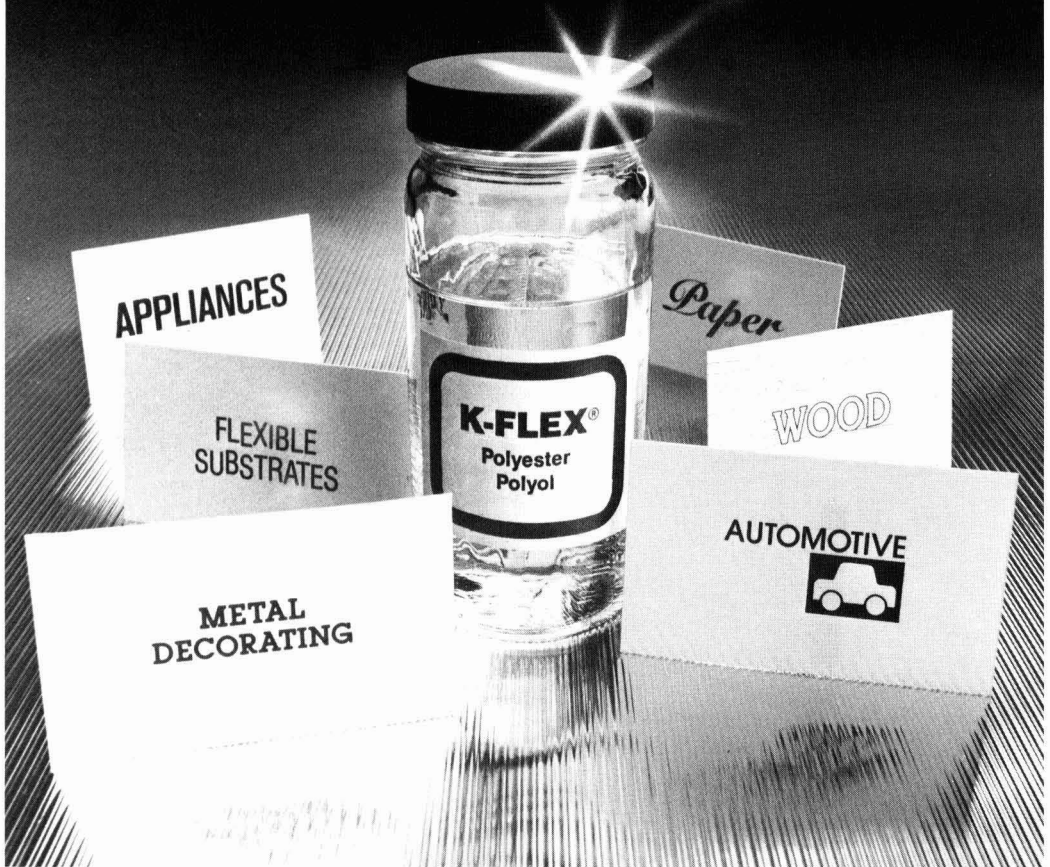
Arco to Acquire Atochem Polyols Plant

Arco Chemical Products Europe, Inc., an international unit of Arco Chemical Co., a division of Atlantic Richfield Co., has announced its intention to acquire the polyols manufacturing facilities of Atochem at Rieme, Belgium. The Rieme facility, which currently has a capacity of 70,000 tons/year, is supported by extensive applications development laboratories in Villers St. Paul, near Paris.

In addition, Arco Chemical International Company, a subsidiary of the Atlantic Richfield Co., has negotiated a letter of intent whereby Atochem will acquire Arco Chemical Iberica, S.A., in Barcelona, Spain.

Both transactions are subject to mutually acceptable contracts and proper approval procedures, and are expected to be completed during the first half of this year.

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Georgia Kaolin announces the development of two new clays as companions to its Hydrite™ kaolins, the industry standard for water-washed specialty clays. These new clays permit smoother, faster dispersion in water based coatings, as well as in traditional non-aqueous paint systems.

The benefits of Hydrite PXH clay include high brightness and controlled particle sizing with a 5+ Hegman grind. The high degree

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COMBUSTION ENGINEERING

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.***

SUBMISSION OF MANUSCRIPTS . . .

. . . 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.

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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 1987 Roon Awards Committee, Gary Gardner, Tnemec Co., Inc., P.O. Box 1749, Kansas City, MO 64141. (For complete details, see "Roon Awards" section of the JOURNAL for January 1987.)

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.

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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.

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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.

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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").

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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.

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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.

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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.

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- (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.

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Modeling the Drying Process of Coatings With Various Layers

H.P. Blandin, J.C. David, and J.M. Vergnaud
University of St.-Etienne*
and
J.P. Illien and M. Malizewicz
Société JIVAL†

The drying process for coatings was found to be very complicated, with the following phenomena taking place: the evaporation of the solvent from the surface and the transfer of the solvent through the coating. Solvent transfer was shown to be controlled by diffusion, which obeys Fick's laws under transient conditions, with diffusion dependent upon concentration and with a particular boundary condition with solvent evaporation on the surface. Short tests were successfully used to determine the evaporation rate and diffusivity of the solvent. A model based on an explicit numerical method with finite differences gave not only the kinetics of the weight loss of the coating during drying but also the profiles of solvent concentration developed through the coating. Although the coating shrank during drying, the calculated results were in good agreement with experiments for the kinetics of weight loss, proving the validity of the model. Moreover, the model provided additional information on the profiles of solvent concentration.

INTRODUCTION

The primary purpose of this study was to determine the effects of the initial composition of the volatile portion of the coating and the film thickness on the solvent loss that occurs after application. A second purpose was to gain a fuller understanding of solvent evaporation when the paint was composed of one layer and several superimposed layers.

The general problem was rather complicated because of the following facts:

(1) The resin dries by solvent evaporation, without chemical reaction. The solvent plays the role of diluent.

(2) The process of drying by solvent evaporation involves a shrinkage of the coating system. At some stages of drying, the coating solidifies, and further shrinkage is constrained by adhesion to the substrate.

(3) The rate of solvent loss depends on two factors: the rate of evaporation of the solvent from the surface, and the rate of solvent transport through the coating.

(4) The rate of evaporation depends on the temperature and agitation of air, and on the nature of the solvent.

(5) Solvent transfer through the coating is controlled by diffusion under transient conditions, with diffusivity often being dependent upon concentration.

(6) The coating might be composed of several superimposed layers.

During the drying process, the solvent, which was at first uniformly distributed through the paint sheet, diffused through the thickness and evaporated from the surface, as shown previously.¹ Thus, the diffusivity of the solvent and its evaporation from the surface provided two areas of interest for controlling the drying process of the paint.^{1,2} However, the evaporation process is controlled by diffusion in the sense that the rate of evaporation depends largely on the rate at which the solute is supplied to the surface by diffusion.

Our purpose was to study the process of solvent loss by considering the evaporation of the solvent from the surface and the diffusion of the solute through the paint. Experimental data was used to obtain a computer model capable of calculating the solvent concentration at various times after depositing any set of initial conditions within the ranges of variation used in obtaining the model. A model described¹ for the evaporation of toluene previously absorbed by rubber sheets was applied to the case at hand; it was based on an explicit numerical method with finite differences and appropriate boundary conditions.

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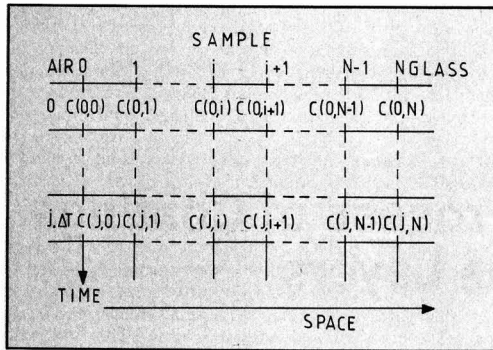


Figure 1—Scheme for the concentration-time references of the numerical analysis

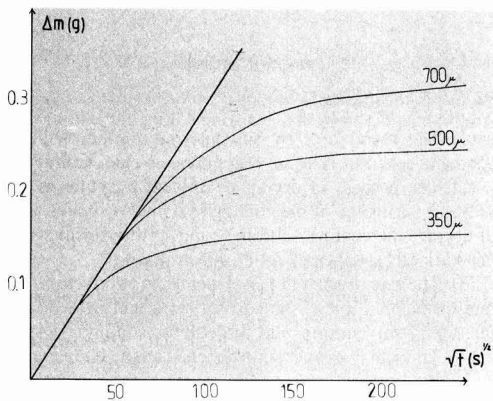


Figure 2—Determination of the diffusivity by using short tests. Solvent weight loss as a function of the square root at time

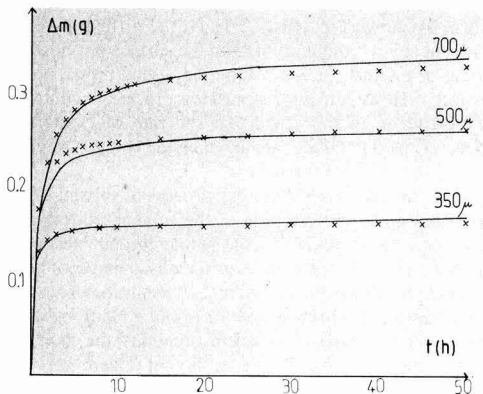


Figure 3—Solvent weight loss as a function of time, for the first layer of the coating. —: experiments O, X, O: theoretical

As shown in previous papers concerned with the transfer of liquids through polymers, these transfers were controlled by diffusion with concentration-dependent diffusivities.²⁻⁴ So, in this work, we tested the validity of a concentration-dependent diffusivity of the solvent through the paint. Moreover, the difficult case of paints made of several superimposed layers was investigated. Some new assumptions were made in this case, especially those concerned with the solvent which migrates from the new layer to the previous dry one according to a definite law.

THEORY

Assumptions

The following assumptions were made: Thin plane sheets of paint were considered to have a one-dimensional diffusion. At the beginning of the evaporation process, the concentration of solvent throughout the sheet was constant. Solvent transfer through the sheet was controlled by diffusion under transient conditions, with a concentration-dependent diffusivity. The rate of solvent evaporation from the surface was either constant or proportional to the surface concentration. Despite the shrinkage of the coating during the process, a frame of reference was fixed with respect to the paint, and the thickness of the coating was assumed to remain constant for calculations.

Mathematical Treatment

The solvent transfer through the coating followed the one-dimensional diffusion equation:

$$\frac{\partial C}{\partial t} = \frac{\partial}{\partial x} \left(D \cdot \frac{\partial C}{\partial x} \right) \tag{1}$$

with the initial conditions that where C is the concentration of the solvent, x is the thickness of the coating film, and t is time.

$$\text{at } t = 0 \quad 0 \leq x \leq L \text{ and } C = C(0,0) = C_{\text{max}} \tag{2}$$

where L is the thickness of the paint and boundary conditions

$$\text{when } t \rightarrow 0, \quad 0 \leq x \leq L \text{ and } C = C(j,i) \tag{3}$$

$$\text{On the top face of the films } x = L \text{ and } C = C(j,0)$$

j and i are integers characterizing time and space, respectively.

Table 1—Conditions for the Preparation Of Two Layer Coatings

Time of Drying (hr)	First Layer		Second Layer	
	Thickness (microns)	Δm (g)	Thickness (microns)	Δm / 2 (g)
1	506	0.136	610	0.336
14	500	0.043	495	0.272
24	510	0.034	600	0.331

Δm1 is the amount of solvent remaining in the first layer at the corresponding time of drying.

Δm/2 is the total amount of solvent in the second layer when the second layer was applied over the first.

Table 2—Diffusivity and Rate of Evaporation of the Solvent

$C(0,0) = 22\%$ in weight $D \times 10^7 = 2.6 \pm 0.2 \text{ cm}^2/\text{s}$
 $F \times 10^5 = 1.1 \pm 0.05 \text{ g}/(\text{cm}^2 \cdot \text{s})$

$$D = 4.4 \times 10^{-7} \cdot \exp - \frac{0.173}{C}$$

The solvent concentration on the face of the coating was not assumed to be zero, as it was very often considered in order to obtain the integration.⁵

The rate of evaporation of the solvent from the surface was considered either as constant, or as proportional to the concentration of the solvent on the surface:

$$F = \frac{F_{\max} \times C(j,0)}{C(0,0)} \quad (4)$$

with F_{\max} being the rate of evaporation at the beginning of the process when the concentration on the surface was $C(0,0)$.

Numerical Analysis

Since no analytical solution could be found for equations (1) and (4), an explicit numerical analysis with finite differences was used for the problem.

As shown in *Figure 1*, the thickness of the coating was divided into N equal increments of space Δx and the time into increments Δt , by concentration-reference planes (j :time; i :space).

The balance for the solvent was written on plane i , and enabled us to obtain the concentration of solvent within the coating:

$$C(j+1,i) = \frac{1}{M} \left[C(j,i+1) + (M-2) \cdot C(j,i) + C(j,i-1) \right] \quad (5)$$

For the coating plane adjacent to the glass plate, we took a thickness of $\Delta x/2$, and obtained for the concentration:

$$C(j+1,N) = \frac{1}{M} \left[2C(j,N-1) + (M-2) \cdot C(j,N) \right] \quad (6)$$

For the coating plane in contact with air, we took a thickness of $\Delta x/2$, and the matter balance as found in a previous paper¹ gave:

$$C(j+1,0) = C(j,0) + \frac{1}{3} \left[C(j,1) - C(j+1,1) \right] + \frac{8}{3M} \left[C(j,i+1) - C(j,i) \right] - \frac{8}{3} \frac{F \cdot C(j,0)}{C(0,0)} \cdot \frac{\Delta t}{\Delta x} \quad (7)$$

The dimensionless number M shown in the above equations is expressed as follows:

$$M = \frac{(\Delta x)^2}{\Delta t} \cdot \frac{1}{D} \quad (8)$$

The amount of solvent remaining in the coating at the time $j \cdot \Delta t$ was obtained by adding the concentrations of solvent in all the planes of the coating:

$$M_j = \left[\frac{3}{8} C(j,0) + \frac{9}{8} C(j,1) + \sum_{i=2}^{N-1} C(j,i) + \frac{1}{2} C(j,N) \right] \cdot \Delta x \quad (9)$$

Nomenclature

- C : concentration of the solvent in the coating
- $C(j+1,i)$: concentration of the solvent at time $(j+1) \Delta t$ and space i
- $C(j,0)$: concentration of the solvent on the coating surface
- $C(j,N)$: concentration of the solvent in the coating next to the glass plate
- D : diffusivity of the solvent
- F : evaporation rate of the solvent
- L : thickness of the coating
- M : dimensionless number expressed by equation (8).
- M_j : loss in weight of solvent at time $i \Delta t$
- M_∞ : loss in weight of solvent at infinite time
- N : Number of increment into which coating is divided
- Δt : increment of time
- Δx : increment of space

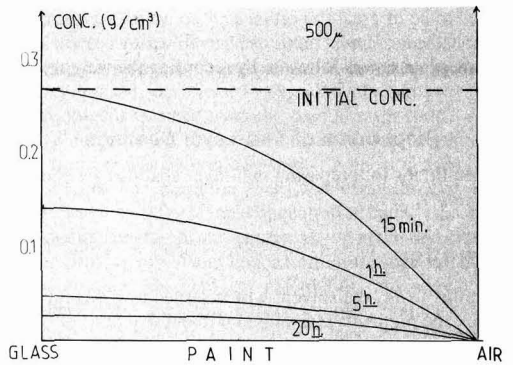


Figure 4—Profiles of concentration of the solvent developed through the thickness of the coating for various times

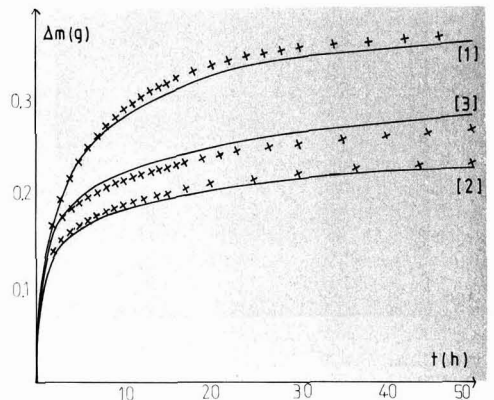


Figure 5—Solvent weight loss as a function of time, drying two-layer coating for the second layer of the coating. —: experiments; X,X,X: theoretical. (1) Drying time of the first layer = one hour; (2) Drying time of the first layer = 14 hours; (3) Drying time of the first layer = 24 hours

EXPERIMENTAL

Materials

The coating used was Fire Retardant Coating PI 248 (JIVAL):

Density: 1.25

Dry extract = 72.4% in weight

- Components:
- Resins = pliolite 10.8
 - Pigment = TiO₂ 6.4
 - Fire retarding agents 55.2
 - Solvents = Xylene + Benzine F 27.6

The coating dried tack free within 8 hr.

The second layer could be applied after 24 hr.

Coating Preparation and Determination Of Weight Loss

Coatings of various thicknesses were applied to glass plates, and then exposed to motionless air at room temperature (20°C). The effect of the agitation of air was found to be of great importance,^{2,6} so we took great care to have the air remain motionless in all various cases. The drying process was followed by recording the weight loss of the coating on a balance.

Preparation of Two-Layer Coatings

Conditions for preparing two-layer coatings are shown in Table 1.

RESULTS

In this work, the solvent which served as a diluent for resins and pigments evaporated without reaction.

After determining the values of the diffusivity and the evaporation rate for the solvent, we studied the transfer of

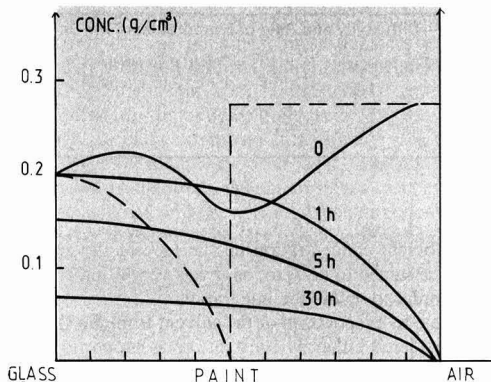


Figure 7—Profiles of solvent concentration through the two-layer coating for various times. Sample 1 with a drying time of one hour for the first layer [experiment (1)]

the solvent through the first layer of the paint, and this knowledge on the profiles of solvent concentration gave us further insight into the drying of the second paint layer.

Measurement of the Diffusivity and Evaporation Rate of the Solvent

Various methods could be used for determining the value of the diffusivity of the solvent,^{1,5} by using the half-time of the desorption process, or the later stage of diffusion. As the diffusivity was found to vary with the concentration of the solvent, we preferred to determine the diffusivity with the help of short tests.⁴ In this case, the amount of solvent transferred in very short times was expressed by a linear relation as a function of the square root of the time

$$\frac{M_t}{M_\infty} = 2 \left[\frac{D \cdot t}{\pi \cdot L^2} \right]^{0.5} \quad (10)$$

where L was the sheet thickness, and D was the diffusivity.

As shown in Figure 2, where the weight loss (or solvent transferred) was plotted vs (time)^{0.5}, the same value for the slope was found at the beginning of the process for coating thicknesses ranging from 300 to 700 microns. The diffusivity was obtained with the help of equation (10) (Table 2).

The evaporation rate was determined at the beginning of the process when the concentration of the solvent on the paint surface was a maximum C(0,0), by considering the slope of the curve expressing the loss in solvent as a function of time.

Very often, the diffusivity proved to be concentration-dependent. In this work, we tested a law previously found for this variation.⁴

Evaporation Process of Solvent For the First Paint Layer

Understanding and predicting the rate of weight loss of the solvent for a paint was found to be of interest in the coating drying process and the end-product performance.

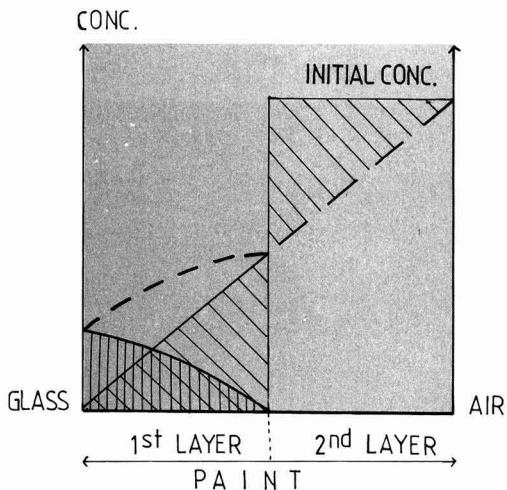


Figure 6—Scheme for the solvent transfer between the two layers during the application of the second layer. Profiles of concentration of the liquid: | | | : remaining in the first layer; // // // : resulting from the liquid transfer; - - - : resulting from the above two contributions

Unfortunately, the problem was rather complex because of the change in volume occurring during the drying of the paint. However, in spite of the shrinkage of the coating, the initial volume of the coating was considered as a frame of reference, with the thickness of the coating being kept constant for calculations.¹

Two results were of interest, the one concerned with the kinetics of the loss in weight corresponding with the evaporation of the solvent, the other with the profiles of solvent concentration through the thickness of the paint.

As illustrated in *Figure 3*, the model previously described gives useful information on the kinetics of the loss in weight for various thicknesses of paint ranging from 350 to 700 microns. A good agreement between experimental and theoretical results was found in this *Figure*. Because the diffusivity is the same for paints of various thicknesses, it was determined by using thin sheets rather than thick ones, thus reducing time-consuming experiments.

To give a further insight into the drying process, we calculated the profiles of solvent concentration through the paint for various times (*Figure 4*). These curves provided information on the drying of the first and second layer of the paint.

Evaporation Process for the Second Paint Layer

Very often coatings are obtained by superimposing several layers. Although this presented a difficult problem, our model was able to study the case at hand by taking into account the evaporation process and diffusion of the solvent through two superimposed layers. This two-layer coating presented two new important parameters: the thickness of each of these layers, and, the time of drying chosen for the first layer.

As shown in *Figure 5*, good agreement was found between experimental and theoretical results for the kinetics of weight loss in the three samples presented in *Table 1*. By varying the drying time for the first layer and

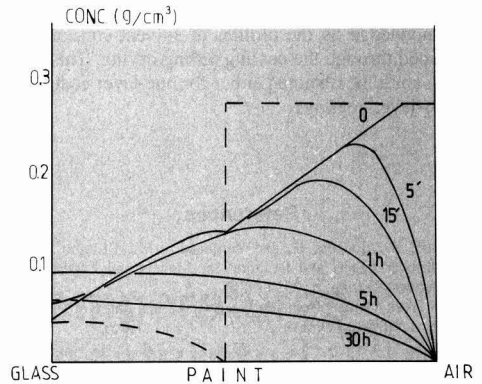


Figure 9—Profiles of solvent concentration through a two-layer coating for various times. Sample 3 with a drying time of 24 hours for the first layer [experiment (3)]

the thickness of the second layer these three samples were made quite different. Curves were obtained by making the assumption, described in *Figure 6*, that an instantaneous solvent transfer from the second layer to the first took place as soon as the second layer was deposited. This transfer was determined so that a linear gradient of the solvent concentration was developed through the paint. The resulting solvent concentration had to take into account the amount of solvent remaining in the first layer.

The profiles of solvent concentration through the two-layer coating obtained by calculation are shown in *Figures 7-9* for each of the three samples. Some solvent concentration profiles were difficult to make. However, comparing profiles made at various times with respect to space gave theoretical kinetics of weight loss which were in good agreement with the corresponding experimental values.

SUMMARY AND CONCLUSIONS

The drying process was found to be rather complicated, being controlled by the evaporation rate of the solvent from the surface and the diffusion of the solvent through the paint. The second parameter concerned with solvent transfer through the coating proved to be of great importance. Drying obeys Fick's laws of diffusion under transient conditions with special boundary conditions. From this point, two problems appeared: one was concerned with the elaboration of a method able to determine easily the diffusivity and evaporation rate, the other with the construction of a model capable of calculating the weight loss and the profiles of solvent concentration at any time.

Short tests using paints of various thicknesses deposited on small glass plates were used successfully for determining either the evaporation rate or the diffusivity of the solvent. The results obtained were accurate and these tests were not time-consuming.

A model based on an explicit numerical method with finite differences was elaborated and tested, providing results in good agreement with experiments for the kinetics of weight loss. Moreover, the model was able to give

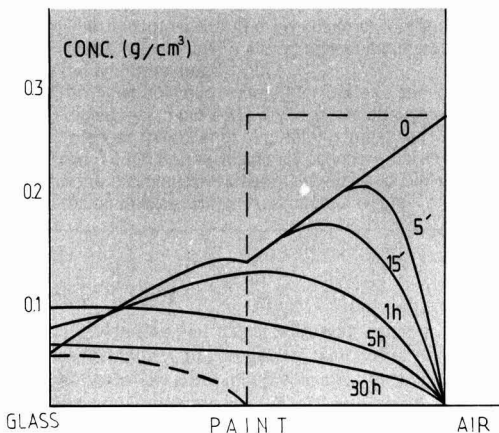


Figure 8—Profiles of solvent concentration through a two-layer coating for various times. Sample 2 with a drying time of 14 hours for the first layer [experiment (2)]

more information on the process, allowing us to obtain new knowledge on the profiles of solvent concentration developed through the coating during drying. This information could be obtained either for one-layer coatings or for two-layer coatings.

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Glass Transition Temperatures Of Crosslinked Unsaturated Polyester Resins and Resin Mixtures

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Glass transition temperatures (T_g) were measured by a Walker-Steel Swinging Beam Method for crosslinked polymers and the crosslinked polymer mixtures of three unsaturated polyester resins as a function of the hydroxyl group content (Series I), molecular weight of prepolymer (Series II), and degree of crosslinking (Series III).

The glass transition temperatures increase with increases in the hydroxyl value, the molecular weight of prepolymer, and the degree of crosslinking.

All samples of the three series have single glass transition temperatures and broad damping peaks, which show good compatibility.

The T_g of the co-condensation polymer of unsaturated polyesters (copolymer) exhibit the same composition-dependence as those of the component polymer mixtures, with the exception of the Series I polymers, which have a strong molecular interaction by the hydrogen bond.

The T_g of polymer mixtures for Series I cannot be predicted by simple additivity, and are dominated by the component polymer of greater content.

The T_g for Series II and III polymers agree well with the calculated values by the Fox and DiMarzio-Gibbs equations, within experimental errors.

INTRODUCTION

Polymer blending and the crosslinking reaction are important techniques for producing materials with special morphologies and desirable mechanical behavior. Since the unsaturated polyesters produced by using these techniques possess many advantages, they have been widely

used in the areas of coatings, adhesives, and castings applications.

The compatibility of polymer mixtures is reflected in the glass transition temperature (T_g).^{1,2} The mechanical and thermal properties of coating films vary drastically at the T_g . The T_g of polymers is closely connected with the drying properties of coatings, the occurrence of internal stress,^{3,4} properties of adhesion,⁴ the cohesive energy density,⁵ the mechanical property, and the crosslink density.⁶ The glass transition phenomenon is one of the most important properties of a polymer.

Various equations have been proposed to describe the T_g of polymer mixtures as a function of the weight fraction of each polymer.⁷⁻¹⁴ However, if there are special interactions among polymer chains, the relation between T_g and the polymer composition is not so simple as to be described by them.

To obtain more accurate T_g predictions, some workers derived the T_g equations which take the sequence distribution of copolymer into consideration.¹⁵⁻¹⁷ The probability of having various linkages may be calculated by using monomer reactivity ratios.^{18,19} To use the sequence distribution- T_g equation, it is necessary to have the T_g of A-B alternating copolymer (T_{gAB}). But the determination of the T_{gAB} value requires complicated techniques, i.e., the preparation of the alternating copolymer of entirely A-B dyad^{20,21} and the multiple regression analysis method,^{17,22} etc. On the other hand, the DiMarzio-Gibbs²³ and other similar relationships^{7,8,24} do not take into consideration the effect of adjacent dissimilar monomer units of steric and energetic rotations in the copolymer backbone. Strictly speaking, this is not the case in many polymers. However, this simplified equation can be applied to some random copolymers of the addition and condensation types. The T_g of copolymers and polymer mixtures can be predicted within a certain extent of

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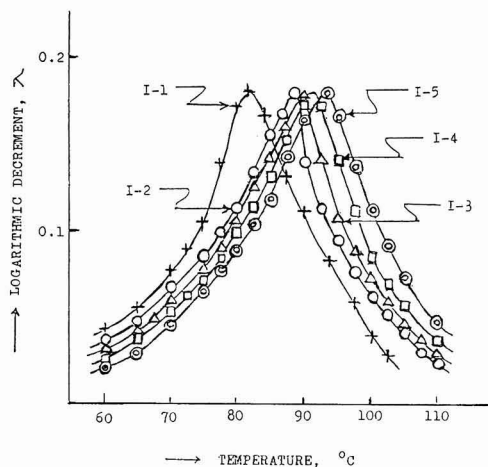


Figure 1—Logarithmic decrement as a function of temperature for Series I copolymers. Legend: (+)—I-1; (o)—I-2; (Δ)—I-3; (□)—I-4; (⊙)—I-5

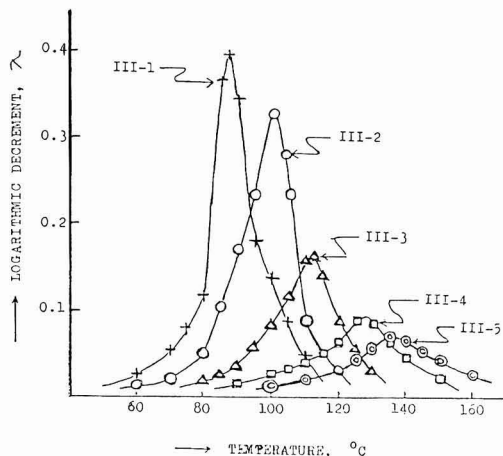


Figure 3—Logarithmic decrement as a function of temperature for Series III copolymers. Legend: (+)—III-1; (o)—III-2; (Δ)—III-3; (□)—III-4; (⊙)—III-5

Table 1—Compositions and Physical Properties Of Series I Copolymers

Sample	I-1	I-2	I-3	I-4	I-5
Compositions (mole)					
1,3-Butanediol	10	9	8	7	6
Trimethylolthane	—	1	2	3	4
Phthalic anhydride	6	6	6	6	6
Maleic anhydride	4	4	4	4	4
Properties of resin solution					
Polyester resin contents, %	67.6	67.0	67.5	67.0	66.3
Styrene monomer contents, %	32.4	33.0	32.5	33.0	33.7
Hydroxyl value	16.6	38.0	61.7	82.6	96.6
Acid number	30.6	29.2	30.9	29.4	29.0
Viscosity	T	U-V	W-X	Z	Z3
Color number	2-3	1	<1	1-2	1
Density, g/cc at 20°C	1.1156	1.1175	1.1192	1.1215	1.1275

Table 2—Compositions and Physical Properties Of Series II Copolymers

Sample	II-1	II-2	II-3	II-4
Compositions (mole)				
Propylene glycol	3	3	3	3
Phthalic anhydride	2	2	2	2
Maleic anhydride	1	1	1	1
Properties of resin solution				
Polyester resin contents, %	66.6	67.0	68.0	67.8
Styrene monomer contents, %	33.3	33.0	32.0	32.2
Hydroxyl value	52.3	45.3	34.2	30.5
Acid number	40.0	33.2	22.4	19.4
Viscosity	P	Q-R	V	X-Y
Color number	1	2	3-4	6
Density, g/cc at 20°C	1.1304	1.1346	1.1399	1.1405

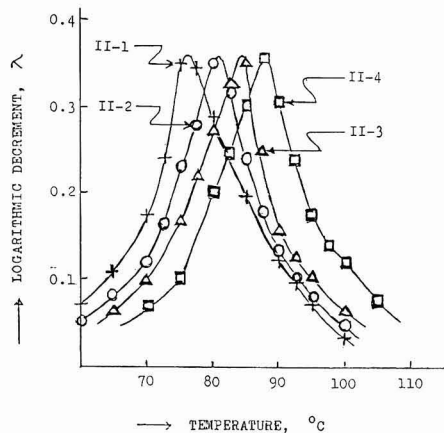


Figure 2—Logarithmic decrement as a function of temperature for Series II copolymers. Legend: (+)—II-1; (o)—II-2; (Δ)—II-3; (□)—II-4

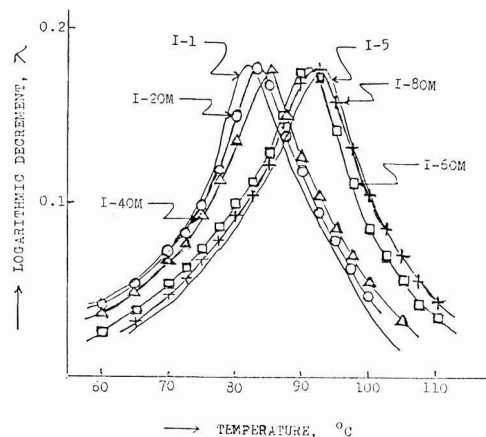


Figure 4—Logarithmic decrement as a function of temperature for Series I polymer mixtures. Legend: (o)—I-20M; (Δ)—I-40M; (□)—I-60M; (+)—I-80M

accuracy without any prior measurements other than those of the homopolymer. Therefore, this theory is useful for the copolymers and polymer mixtures.

In this study, unsaturated polyesters are used as the polymer mixture and copolymer model, and the relationships of the T_g to the chemical structure and the compatibility have been examined. The data are compared with the theoretical prediction of Fox and DiMarzio-Gibbs.

EXPERIMENTAL

Materials

Three series of unsaturated polyesters were prepared varying the hydroxyl group content, the molecular weight, and the functional group content of prepolymer. The compositions and physical properties of the sample of each series are given in Tables 1, 2, and 3.

The Series I polymers were synthesized from two basic acids of 60 mole % phthalic anhydride and 40 mole % maleic anhydride for the acid component and two polyols with varying mole ratios of 1,3-butanediol and trimethylolthane. The carboxyl group content of Series I polymers is the same. Therefore, each sample has the same molecular weight but a different polar group (hydroxyl group) content.

Series II polymers were prepared by polymerizing for various reaction times at a fixed monomer composition. The samples have different molecular weight.

Series III polymers were synthesized from two basic acids, varying the mole ratios of phthalic anhydride and maleic anhydride to propylene glycol. The samples have different functional group contents of prepolymer (different degrees of crosslinking of film). The functional group content of prepolymer increases with the decrease of the phenyl content for Series III samples.

A four-neck flask was charged with raw materials. The flask was fitted with a stirrer, inert gas (CO₂) inlet and outlet, and a thermometer. The flask containing the raw materials was heated to 230°C, using a heating mantle. The reaction temperature was maintained at 230 ± 2°C under CO₂ atmosphere. After the viscosity and acid value of polymers reached the prescribed values, the polymer solids were dissolved in the required amount of styrene monomer.

For sample films, 0.03 wt% of cobalt naphthenate and 1.2 wt% of methyl ethyl ketone peroxide were added as stirring to the unsaturated polyester-styrene solution. The mixed materials were coated on a glass plate using a 0.075 mm film applicator. The coated films were held at 25°C for 24 hours, followed by curing and annealing for eight hours at 50°C and 110°C. In the case of Series III polymer, the films were cured and annealed for eight hours at 50°C and 150°C.

Measurements of Glass Transition Temperature

Logarithmic decrements, λ , were measured by the "Walker-Steel Swinging Beam Method,"²⁵⁻²⁸ based on the same principle as that of the "Herbert Pendulum Hardness Tester"²⁹ over a 20°C to 160°C temperature range. The T_g can be determined from the temperature

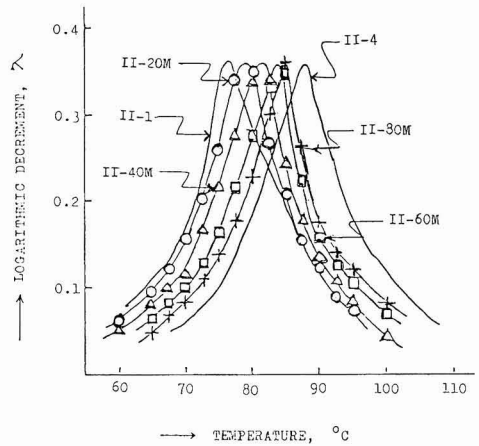


Figure 5—Logarithmic decrement as a function of temperature for Series II polymer mixtures. Legend: (○)—II-20M; (Δ)—II-40M; (□)—II-60M; (+)—II-80M

Table 3—Compositions and Physical Properties Of Series III Copolymers

Sample	III-1	III-2	III-3	III-4	III-5
Compositions (mole)					
Propylene glycol	210	210	210	210	210
Phthalic anhydride	150	140	105	84	70
Maleic anhydride	60	70	105	126	140
Properties of resin solution					
Polyester resin contents, %	60.1	59.8	60.0	60.1	59.9
Styrene monomer contents, %	39.9	40.2	40.0	39.9	40.1
Acid number	23.8	19.8	19.4	17.1	21.4
Viscosity	J-K	I	I	J	O
Color number	1-2	1-2	2-3	1	<1
Density, g/cc at 20°C	1.1143	1.1115	1.1086	1.1063	1.1072

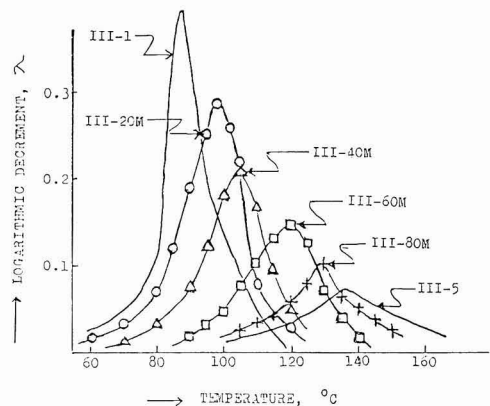


Figure 6—Logarithmic decrement as a function of temperature for Series III polymer mixtures. Legend: (○)—III-20M; (Δ)—III-40M; (□)—III-60M; (+)—III-80M

Table 4—Glass Transition Temperatures and λ_{\max} Values Of Series I Copolymers and Mixtures

Sample	Composition of Mixture wt %		Hydroxyl Value	λ_{\max}	Observed Value	$T_g(^{\circ}\text{C})$	
	I-1	I-5				Calculated Value	
						Using DiMarzio-Gibbs Equation	Using Fox Equation
Copolymers							
I-1	—	—	16.6	0.18	82	—	—
I-2	—	—	38.0	0.18	89	85.0	84.8
I-3	—	—	61.7	0.18	90	88.3	88.2
I-4	—	—	81.6	0.18	92	91.1	90.9
I-5	—	—	96.6	0.18	93	—	—
Mixtures							
I-1	100	0	16.6	0.18	82	—	—
I-20M	80	20	32.6	0.18	83	84.3	84.2
I-40M	60	40	48.6	0.18	86	86.5	86.3
I-60M	40	60	64.6	0.18	92	88.7	88.5
I-80M	20	80	80.6	0.18	93	90.9	90.8
I-5	0	100	96.6	0.18	93	—	—

yielding the maximum value of logarithmic decrement, λ_{\max} .

Values were calculated by the following equation.^{25,30}

$$\lambda = 2.3 \log (\theta/\theta')/2n \quad (1)$$

Where θ is the initial amplitude of the pendulum, θ' is the amplitude to decrease by a specified fraction, 50%, and n is the number of oscillations for this decrease to occur. The amplitude was measured on a circular scale behind the end of one of the arms.

RESULTS

Figures 1-3 show the plots of logarithmic decrement, λ , as a function of temperature for Series I, II, and III copolymers. Figures 4-6 show the plots of λ vs temperature for Series I, II, and III polymer mixtures.

The copolymers and the polymer mixtures for three series show only one T_g and the broad damping peak. For Series I and II polymers, the shape of λ -temperature

curve does not change and only the position of damping shifts with composition. For Series III polymers, the width of damping increases with the increase of the degree of crosslinking.

The T_g and λ_{\max} values for the copolymers and polymer mixtures of Series I, II, and III are listed in Tables 4-6.

DISCUSSION

To discuss the experimental results, we used the Fox and DiMarzio-Gibbs equations.

The Fox equation,⁷ based on the free volume theory, which was originally applied for both copolymers and polymers with plasticizers, is, as follows:

$$T_g = \frac{T_{gA} \cdot T_{gB}}{W_A \cdot T_{gB} + W_B \cdot T_{gA}} \quad (2)$$

where T_g is the glass transition temperature of copolymer, T_{gA} and T_{gB} are the glass transition tempera-

Table 5—Glass Transition Temperatures and λ_{\max} Values Of Series II Copolymers and Mixtures

Sample	Composition of Mixture wt %		Acid Value	λ_{\max}	Observed Value	$T_g(^{\circ}\text{C})$	
	II-1	II-5				Calculated Value	
						Using DiMarzio-Gibbs Equation	Using Fox Equation
Copolymers							
II-1	—	—	40.0	0.36	76	—	—
II-2	—	—	33.2	0.36	81	79.8	79.8
II-3	—	—	22.4	0.36	84	86.0	85.8
II-4	—	—	19.4	0.36	88	—	—
Mixtures							
II-1	100	0	40.0	0.36	76	—	—
II-20M	80	20	35.9	0.36	79	78.4	78.3
II-40M	60	40	31.8	0.36	82	80.8	80.7
II-60M	40	60	27.6	0.36	84	83.2	83.1
II-80M	20	80	23.5	0.36	85	85.6	85.5
II-4	0	100	19.4	0.36	88	—	—

Table 6—Glass Transition Temperatures and λ_{max} Values Of Series III Copolymers and Mixtures

Sample	Composition of Mixture wt %		Functional Group Contents (mole/1000g)	λ_{max}	Observed Value	$T_g(^{\circ}C)$	
	III-1	III-5				Calculated Value	
						Using DiMarzio-Gibbs Equation	Using Fox Equation
Copolymers							
III-1	—	—	0.9	0.40	87	—	—
III-2	—	—	1.05	0.33	100	93.3	92.0
III-3	—	—	1.66	0.17	112	115.6	112.3
III-4	—	—	2.05	0.09	127	128.7	126.7
III-5	—	—	2.31	0.07	137	—	—
Mixtures							
III-1	100	0	0.9	0.40	87	—	—
III-20M	80	20	1.18	0.29	97	98.2	96
III-40M	60	40	1.46	0.21	105	108.7	105.5
III-60M	40	60	1.75	0.15	119	118.6	115.4
III-80M	20	80	2.03	0.10	129	128.1	125.9
III-5	0	100	2.31	0.07	137	—	—

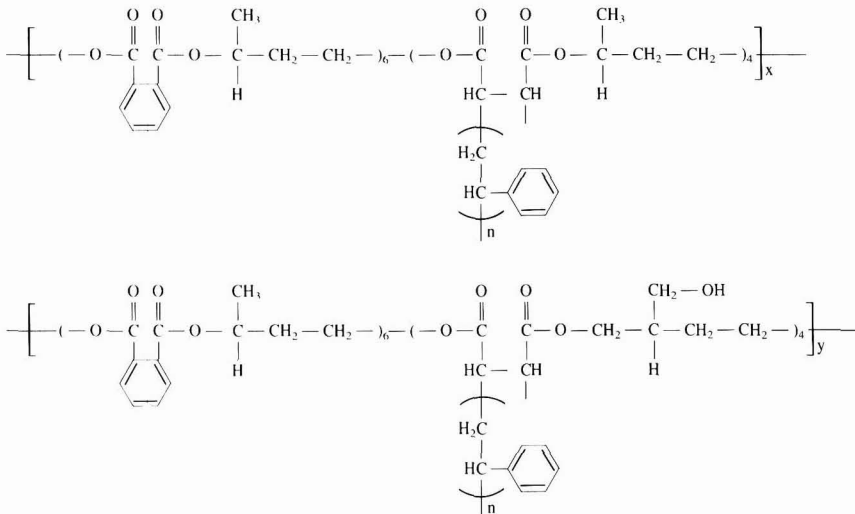
tures of homopolymer A and B, and W_A and W_B are weight fractions of the components A and B of the copolymer, respectively.

The DiMarzio-Gibbs equation²³ can be written as follows:

$$T_g = \frac{T_{gA} + K \cdot (W_B/W_A) \cdot T_{gB}}{1 + K \cdot (W_B/W_A)} \quad (3)$$

$$K = \frac{K_B}{K_A} = \frac{(\alpha_B/M_B)}{(\alpha_A/M_A)} \quad (4)$$

Table 7—Model Structure, Number of Rotatable Bonds per Repeating Unit (α) And Molecular Weight of Repeating Unit (M) of Series I Copolymers



Samples	Model			M	α	K^a
	x	y	n			
I-1 (A)	1.0	0	2.3	2959	105.6	1.03
I-5 (B)	0	1.0	2.6	3198	117.1	

(a) $K = (\alpha_B \cdot M_A) / (\alpha_A \cdot M_B)$

where T_{gA} and T_{gB} are the glass transition temperatures, W_A and W_B are the weight fractions, M_A and M_B are the molecular weight, and α_A and α_B are the number of flexible bonds (or rotatable bonds) per monomer unit (or repeating unit) of the corresponding homopolymers, designated A and B, respectively.

The DiMarzio-Gibbs theory was derived on the basis of assumptions that: (1) the chain stiffness is the main determinant of the glass transition, (2) the configurational entropy is a function of e/kT only, if the molecular weight is large, where e is the stiffness energy of the rotatable chemical bonds of polymer, k is Boltzman's constant, and T is the absolute temperature. The stiffness energy of a bond was related to the energy difference between rotational isomers, and it was assumed that the stiffness energy of an A-B bond is the arithmetic mean of that of an A-A and B-B bond. The DiMarzio-Gibbs theory is not restricted only to polymers with flexible bonds in the chain backbone. It can be applied for materials which are conceptually decomposed into its "monomer unit (or repeating unit)" A and B.

We applied this theory to the crosslinked polymer, and will be content to offer a very simple and somewhat approximate application.

We assumed the model structure of Series I copolymer and calculated the number of rotatable bonds (α) and the molecular weight (M) of the repeating unit. The model structure, and the values of α and M for Series I copolymers are given in Table 7.

The calculated values of T_g by the Fox and the DiMarzio-Gibbs equations for Series I samples are listed in Table 4.

Figure 7 shows the plots of the T_g vs the hydroxyl value of prepolymers for Series I copolymers and polymer mixtures, along with the Fox and DiMarzio-Gibbs equations, which are indicated by a solid line.

The calculated values of T_g by both equations agree well with each other. However, these values differ from the observed values. The relation between the T_g and the copolymer composition shows a convex curve. T_g values observed are higher than the calculated values of T_g . The glass transition temperature increases with the increase of the hydroxyl value of prepolymer. The increment of T_g with the hydroxyl value is due to the increase of intermolecular attraction and the decrease of internal rotation around the chemical bond. The chemical structure of the repeating unit of unsaturated polyesters with hydroxyl group may also form a six-member ring, as in the following conformation:



The ring structure would reinforce the steric hindrance and could increase the T_g of polymer. The effects of hydrogen bonding on the T_g were also found by Jenkins³¹ in the case of an epoxy resin crosslinked by amines.

The polymer mixtures of Series I have a single peak in the logarithmic decrement-temperature curve. The temperature of the damping peak rises with the increase of the weight fraction of component polymer I-5. The values of λ_{\max} and the widths of damping peak are approximately

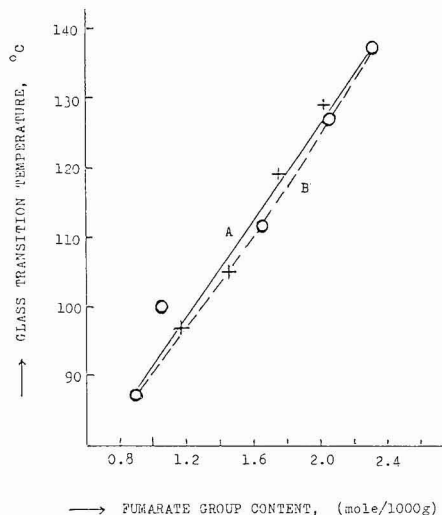


Figure 9—Glass transition temperatures as a function of fumarate group content for Series III copolymers and polymer mixtures: Legend: (O)—copolymers; (+)—polymer mixtures; A—DiMarzio-Gibbs equation; and B—Fox equation

independent of the composition of polymer blends. Therefore, the degree of crosslinking of each polymer is the same and both component polymers, I-1 and I-5, are soluble in one another. However, as illustrated in Figure 7, the T_g -composition curve of the polymer mixtures of Series I shows the "S letter" pattern. The values of the T_g of samples I-20M and I-40M are lower than the calculated values, and T_g values of samples I-60M and I-80M are higher than the values calculated by equations (2) and (3). The T_g of polymer mixtures is dominated by the component polymer, I-1 or I-5, of greater content. It suggests that polymer mixtures of Series I are not necessarily random but are more like a block copolymer in which the I-1 units and I-5 units tend to form long sequences in microstructure and the morphology.

For the copolymer, the heterogeneity of chemical composition comes about because one monomer tends to be more reactive than the other. Thus, at the beginning of the copolymerization reaction, the molecules will be rich in the more reactive monomer, while the molecules formed near the end of the reaction will be rich in the less reactive monomer. The compositions of copolymer are regulated by the monomer reactive ratio, r_1 and r_2 .

The crosslinking of unsaturated polyester is equivalent to the copolymerization of the fumarate groups in the polyester molecule with styrene monomer.^{32,33} Representative values of the reactive ratios for the diethyl fumarate (1) and styrene (2) copolymerization are $r_1 = 0.05 \pm 0.05$ and $r_2 = 0.35 \pm 0.02$.³⁴ Since both r values are smaller than 1, the system possesses an azeotropic point, at which the mole fraction of fumarate calculated by Wall's equation³⁵ is $f_1 = F_1 = 0.395$, where f_1 is the mole fraction of fumarate in feed and F_1 is the mole fraction of fumarate in copolymer. The values of f_1 of samples I-1 and I-5 are 0.30 and 0.28, respectively. In

the composition range of $f_1 < 0.395$, the curing film consists of the crosslinked polyester networks and polystyrene, that is, the polymers I-1 and I-5 are actually more or less microheterogeneous.

This phenomenon looks inconsistent with the compatibility of I-1 and I-5 at first glance, but it is explained as follows. Although the component polymers I-1 and I-5 are heterogeneous in the monomer sequence, i.e., in the microstructure of polymer chains, two component polymers are homogeneously mixed in the scale of segmental size (molecular motion unit) in one another. They have a broad damping peak due to the microheterogeneity in the monomer sequence. However, to know the real structure and morphology for the polymer mixtures of Series I, it must be observed experimentally in more detail.

Figure 8 shows the plots of the T_g vs the acid values of prepolymers for the copolymers and the polymer mixtures of Series II samples.

A solid line represents the DiMarzio-Gibbs and Fox equations. Since the repeating units of chemical structure for Series II samples are the same, we assumed that $K = 1$ in equation (5). T_g values for Series II samples are listed in Table 5.

The T_g of the copolymers agree well with those of the corresponding polymer mixtures. Similar results have been obtained in dilatometry for isopropyl acrylate-isopropyl methacrylate copolymer and homopolymer mixtures³⁶ and in dynamic mechanical measurements for 50/50 mixtures of poly(vinyl acetate) and poly(methyl acrylate) and for a random copolymer containing the two monomers in the same proportion.³⁷

For Series II samples, the T_g increases with the increase of the molecular weight of prepolymer. In this case, the T_g depends on the crosslinking more than the polar group. During the process of the crosslinking reaction, since the functional groups are consumed for molecular growth and for the crosslinking reaction, the degree of crosslinking increases with the increase of the molecular weight of prepolymer. The ends of molecular chain have a high degree of freedom of molecular motion. These reduce polymer-polymer cohesive forces and enhance segmental motions of the polymer. When the concentration of end groups becomes high, the internal rotation around the chemical bonds of the chain backbone begins to occur at a lower temperature.

Figure 9 shows the plots of the T_g vs the fumarate group content (the concentration of functional group) of prepolymer for Series III copolymers and polymer mixtures. The solid line is the DiMarzio-Gibbs equation and the dashed line represents the Fox equation. The model structure, the number of rotatable bonds (α), and the molecular weight (M) of repeating unit for Series III copolymers are given in Table 8. The calculated glass transition temperatures are listed in Table 6.

For Series III samples, the T_g increases and the value of λ_{\max} decreases with the increase of fumarate group content (the increase of the degree of crosslinking). The higher the fumarate group content becomes, the lower the phthalate group content becomes. The crosslinking contribution on the T_g is larger than the phenyl ring structure

contribution. The measured T_g values are in agreement with the T_g values calculated from equations (2) and (3) within experimental error, except for the sample III-2.

CONCLUSION

For Series I polymers, the T_g increases with the increase of the hydroxyl value of prepolymer. The maximum values of logarithmic decrement, λ_{\max} , are approximately constant.

For Series II polymers, the T_g increases with the increase of the molecular weight of prepolymer. The values of λ_{\max} are approximately constant.

For Series III polymers, the T_g increases and the value of λ_{\max} decreases with the increase of the degree of crosslinking.

Samples of three series show single glass transition temperatures and broad damping peaks. The compatibility of polymer mixture is good in the scale of segmental size (molecular motion unit).

The glass transition temperatures of the co-condensation polymers of unsaturated polyesters (copolymers) exhibit the same composition dependence as those of the component polymer mixtures, except Series I polymers which have a strong molecular interaction by the hydrogen bond. The T_g of polymer mixtures for Series I cannot be predicted by the simple additivity and are dominated by the component polymer, I-1 or I-5, of greater content.

The glass transition temperatures for Series II and III polymers agree well with the calculated values by the Fox and the DiMarzio-Gibbs equations within experimental errors.

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The author wishes to thank Professor Dr. Takuhei Nose, of the Tokyo Institute of Technology, for his valuable suggestions.

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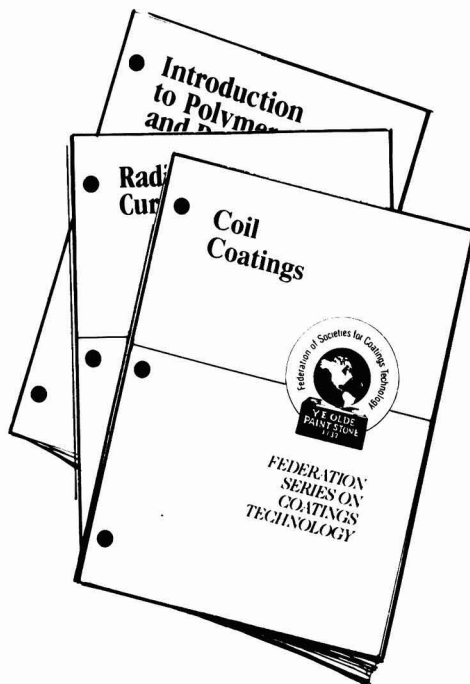
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Urethane Acrylic Interpenetrating Polymer Networks (IPNs) For Coating Applications

M. Tehranisa, R.A. Ryntz, H.X. Xiao, P.I. Kordomenos, and K.C. Frisch
Detroit Society for Coatings Technology
Technical Committee

IPN coatings were synthesized from a caprolactone extended acrylic urethane, crosslinked by free radical polymerization of pendant double bonds, and a caprolactone extended acrylic resin crosslinked through an isocyanate curing agent. These systems exhibited good weathering resistance and higher tensile strength and adhesive strength than those of their original components. The morphologies of these coatings were determined by means of Thermomechanical Analysis and Scanning Electron Microscopy.

INTRODUCTION

Interpenetrating polymer networks (IPNs) are a special kind of multicomponent polymeric material. An IPN is formed when two polymers, each in network form, are combined with at least one polymerized or crosslinked in the immediate presence of the other.¹⁻³ During the past decade, a number of investigators studied the morphology of IPNs, specifically the size and shape of the phase domains and their effect on physical properties.⁴⁻⁶ However, very little work was done to demonstrate the application of these types of polymer alloys in formulating coating systems.

In a previous paper,⁷ novel IPN coatings were prepared from a two-component hydroxy functional acrylic-iso-

cyanate system and an unsaturated urethane modified acrylic copolymer. The morphologies of those IPN coatings, as determined by TMA and SEM, indicated that there was good molecular mixing due to interpenetration between the respective networks. Only one IPN composition showed some phase separation. Both tensile strength and adhesive strength for the IPN coatings exhibited higher values than those of their original components. However, the maximum elongation measured at room temperature for those IPN systems was only 37%, making their use over flexible substrates rather limited.

This paper describes the efforts to improve the flexibility of those first IPN systems and also to determine some of their performance characteristics as automotive topcoats. The mode of preparation of the new IPN systems is again the simultaneous or SIN technique. A schematic representation of the synthesis of these IPNs is shown in *Figures 1 and 2*.

The two networks used to form the IPN systems are P(UA)-1 and P(UA)-2. P(UA)-1 is a self-curing polymer synthesized from butyl methacrylate and hydroxy ethyl acrylate. The hydroxyl groups of this acrylic polymer (I) are reacted with caprolactone monomer to generate flexible side chains (PBHC). The hydroxyl groups of this polymer (PBHC) are then capped with isocyanatoethyl methacrylate to produce an acrylic backbone with pendant flexible side chains carrying double bonds which in the presence of initiators can be crosslinked (P(UA)-1).

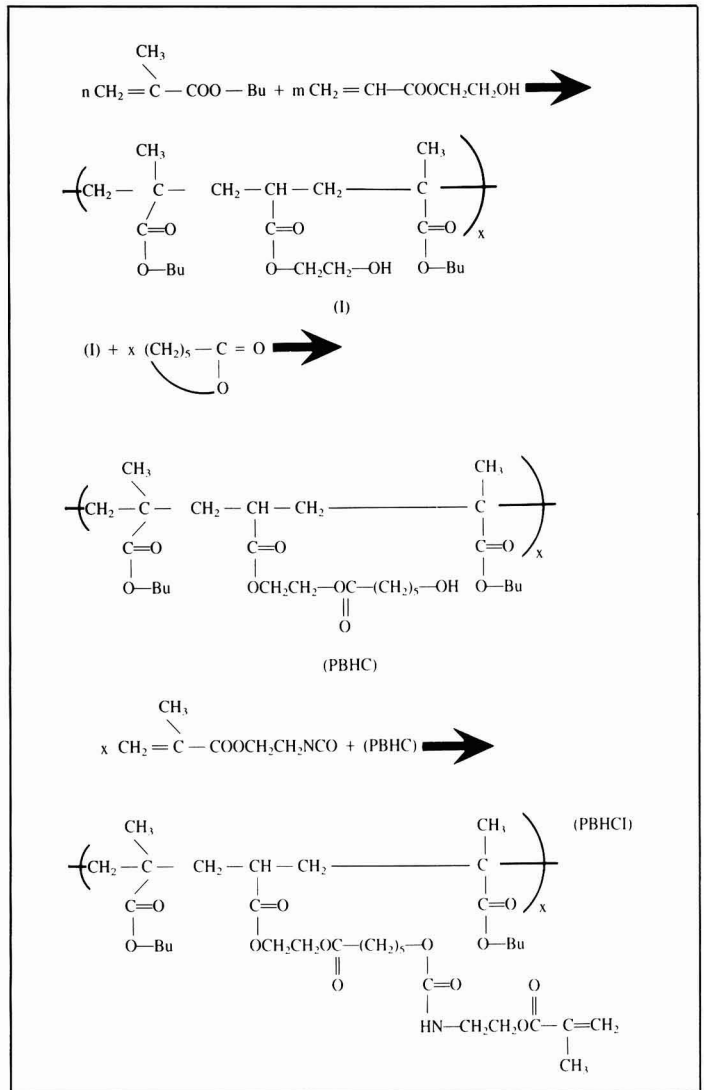
P(UA)-2 is formed by reacting (PBHC) with an isocyanate crosslinker (biuret of hexamethylene diisocyanate).

In both P(UA)-1 and P(UA)-2, the reactive sites for crosslinking are at the end of flexible chains to improve the overall flexibility of the IPN networks.

Presented at the 64th Annual Meeting of the Federation of Societies for Coatings Technology, November 6, 1986, in Atlanta, GA.

This paper won First Prize in the 1986 A.I. Voss American Paint & Coatings Journal Awards at the 1986 Annual Meeting.

Figure 1—Synthesis of PBHCl



EXPERIMENTAL

Raw Materials

The raw materials used in this study are shown in *Table 1*. The isocyanatoethyl methacrylate (IEM) was distilled before use. The solvent was dried by 4A molecular sieve overnight before use. The other materials were used as received.

Synthesis of Hydroxy-Containing Acrylic Copolymer (PBHC)

Into a reaction kettle equipped with a nitrogen inlet, stirrer, reflux condenser, and an additional funnel, were

charged 500 parts of xylene. The xylene was heated to reflux and a mixture of 350 parts of butyl methacrylate (BMA), 150 parts of 2-hydroxy ethyl acrylate (HEA), and 10 parts of t-butyl-perbenzoate (t-BPB) were added over a period of five hours. After the end of the addition, the solution was kept at 140-150°C for another hour and then an additional one part of t-BPB was added to further complete the copolymerization. The reaction mixture was post-reacted for two more hours and was then cooled to room temperature.

Added to the above reaction product were 147 parts of E-caprolactone and 0.022 parts of dibutyl tin oxide (DBTO). The ring opening reaction of E-caprolactone in the presence of DBTO was carried out at 158°-160°C for

four hours under nitrogen with stirring. The reaction product had 1760 cps viscosity at 66% solids content and the number average molecular weight was $M_n = 3841$.

Synthesis of Pendant Double Bond-Containing Copolymers (PBHCl)

Into a reaction kettle, equipped with nitrogen inlet, stirrer, reflux condenser, and thermometer were charged 499 parts of the previously described PBHC copolymer, 155 parts of isocyanatoethyl methacrylate (IEM), 1.31 parts of dibutyl tin dilaurate, and 0.155 parts of hydroquinone. The reaction mixture was kept at 75-80°C for two-three hours until all of the isocyanate was fully reacted as indicated by the IR spectrum. The reaction product was then cooled to RT and the viscosity was measured to be 4630 cps at 72% solids. The number average molecular weight was $M_n = 3942$.

Preparation of IPN Coatings — Preparation of P(UA)-2 Coatings

In a 50% of PBHC solution were added 5% by weight of benzoyl peroxide, 0.03% of 5% CuCl_2 in water, 0.03% of 50% FeCl_3 in water, and 0.2% of n-hexyl mercaptan. The clear films were drawn on glass and steel (bond. 40) panels and were cured at 80°C for 30 min and post-cured for 30 min at 130°C.

Preparation of P(UA)-1 Coatings

In 100 parts of PBHCl solution (50% solids) 18.3 parts of Desmodur L2291A were added. The films of PBHCl were prepared and cured using the same conditions as for PBHC.

Preparation of IPN Coatings

The reactant for P(UA)-1 and P(UA)-2 were mixed at different ratios (Table 2) and films were prepared on glass and steel panels and cured using the same baking schedule as for P(UA)-1 and P(UA)-2.

Testing of Coatings

The tensile strength and elongation at break were measured on an Instron Tensile Tester at a crosshead speed of 2 in./min. The hardness was measured by Shore A. The lap shear strength in tension was measured on an Instron Tester with 3×0.5 in. steel plates lapped 0.5 in. from their edges. The solvent resistance was measured by the double rub method using methyl ethyl ketone and xylene.

The glass transition temperatures (T_g 's) were determined on a Perkin-Elmer TMS-2 Thermomechanical Analyzer (TMA) at a temperature range from -100°C to +100°C at 0.02 mm of penetration range, 60 g of penetrating weight at 10 degrees/min of heating rate.

To determine the morphology, samples were prepared by freeze-fracturing in liquid nitrogen and applying a gold coating of approximately 200 Å. The micrographs were obtained using a Phillips Scanning Electron Microscope Model SEM 505.

Table 1—Raw Materials

Designation	Description	Supplier
HEA	2-Hydroxyethyl acrylate	Rohm and Haas Co.
BMA	Butyl methacrylate	Rohm and Haas Co.
IEM	Isocyanatoethyl methacrylate	Dow Chemical Co.
t-BPB	t-Butyl perbenzoate	Lucidol Corp.
Desmodur®	Biuret triisocyanate	Mobay Chemical Co.
L-2291A	adduct of hexamethylene diisocyanate with water	
T-12	Dibutyltin dilaurate	Air Products
BPO	Benzoyl peroxide	
Ca drier	Calcium naphthenate	Nuodex Inc.
PB drier	Lead naphthenate	Nuodex Inc.
Co drier	Cobalt naphthenate	Nuodex Inc.
Zn drier	Zinc Naphthenate	Nuodex Inc.
—	Xylene	
DMBA	N-benzyl-N,N-Dimethylamine	Hexcel Chemical Products
—	E-caprolactone	Union Carbide Corp.
—	Hydroquinone	
CuCl_2	Copper chloride	Aldrich Chemical Co.
FeCl_3	Ferric chloride	Aldrich Chemical Co.
Tinuvin® 328	Benzotriazole UV absorber	CIBA-GEIGY Corp.
Tinuvin® 440	Hindered amine light stabilizer	CIBA-GEIGY Corp.
Stabilizer	Hindered amine light stabilizer	
Irganox® 1010	Anti-oxidant	CIBA-GEIGY Corp.

Table 2—Composition of Poly (Urethane-Acrylate) IPNS

Material	Description	Composition
P(UA)-1	Poly (BMA-HEA-E-caprolactone-IEM) crosslinked polymer	100%
P(UA)-2	Reaction product of: Poly (BMA-HEA-E-caprolactone) with L-2291	100%
Varying Compositions of Blends of:		
IPN-1	P(UA)-1/P(UA)-2	20/80
IPN-2	P(UA)-1/P(UA)-2	40/60
IPN-3	P(UA)-1/P(UA)-2	50/50
IPN-4	P(UA)-1/P(UA)-2	60/40
IPN-5	P(UA)-1/P(UA)-2	80/20

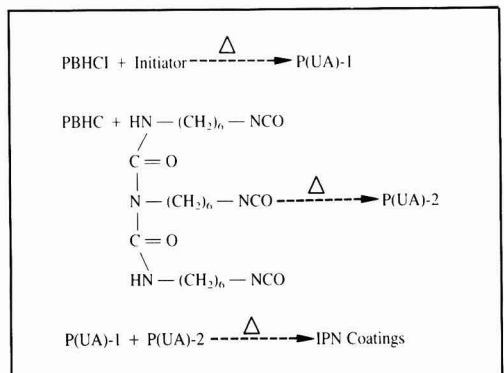


Figure 2—Synthesis of P(UA)-1, P(UA)-2 and preparation of IPN coatings

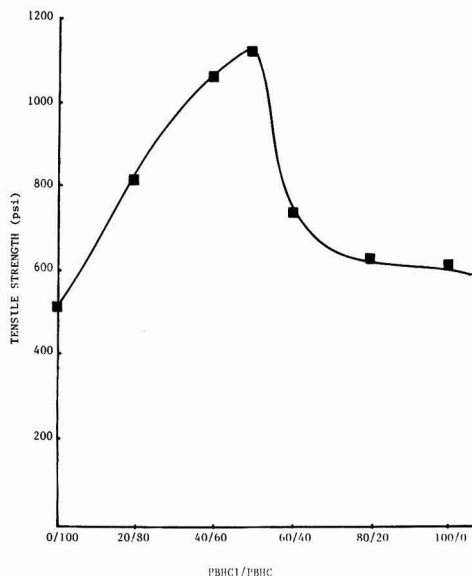


Figure 3—Tensile strength (psi) vs network composition

Preparation of Basecoat/IPN Clearcoat Coatings

The P(UA)-1 clearcoat was formulated as follows: to 100 parts of PBHCl solution (50% solids) were added 52 parts benzoyl peroxide solution (4% in xylene), 0.2 parts N-benzyl-N, N-dimethyl amine, 0.5 parts 6% cobalt naphthenate drier, 0.5 parts 24% lead naphthenate drier, 0.5 parts 6% manganese naphthenate drier, 0.5 parts 8% zinc naphthenate drier, and 0.25 parts polybutyl acrylate. The coating formulation was adjusted to 22 sec #4 FC (80°F) with xylene prior to application.

The P(UA)-2 clearcoat was formulated as follows: to 100 parts PBHC solution (50% solids) were added 0.25 parts polybutyl acrylate and 125 parts xylene. To this mixture was added 30 parts Desmodur L-2291A just prior to spray application.

The IPN-3 clearcoat was prepared by mixing 50 parts of the P(UA)-1 clearcoat coating formulation with 50 parts of the P(UA)-2 clearcoat coating formulation.

The IPN-3-UV clearcoat was prepared in the same manner as the IPN-3 clearcoat with the following exception: 10 parts of the UV absorber/stabilizer solution were

Table 3—Mechanical Properties of IPN Coatings

Composition	P(UA)-1/ P(UA)-2	Ts (psi)	E (%)	Hardness (A)
P(UA)-2	0/100	517	173	35
IPN-1	20/80	821	170	60
IPN-2	40/60	1080	123	69
IPN-3	50/50	1132	75	57
IPN-4	60/40	717	62	66
IPN-5	80/20	640	32	76
P(UA)-1	100/0	619	17	85

Table 4—Adhesive Strength of IPN Coatings to Steel Panels

Composition	P(UA)-1/ P(UA)-2	Lap Shear (psi)	Type of Failure
P(UA)-2	0/100	150	Adhesive
IPN-1	20/80	329	Adhesive
IPN-2	40/60	244	Adhesive
IPN-3	50/50	224	Adhesive
IPN-4	60/40	224	Adhesive
IPN-5	80/20	177	Adhesive
P(UA)-1	100/0	120	Adhesive

added to 100 parts of the IPN-3 mixture prior to spray application. The UV absorber/stabilizer solution was prepared by mixing 10 parts Tinuvin 328, 10 parts Tinuvin 440, and 1.0 part Irganox 1010 in 77 parts xylene.

Basecoat/clearcoat coatings were applied by siphon gun over high solids primed* Bonderite® steel panels. The desired clearcoat coating was applied wet on wet over a high solids polyester basecoat† with the following flashtimes: one minute between basecoat-basecoat applications, three minutes between basecoat-clearcoat applications, and one minute between clearcoat-clearcoat applications. The panels were flashed (at room temperature) for five minutes prior to baking. The panels achieved a cured film thickness of 0.6-0.8 mils on basecoat and 1.7-2.0 mils on clearcoat. The bake schedule of the basecoat/clearcoat coatings was 265°F for 60 minutes.

RESULTS AND DISCUSSION

Mechanical Properties of IPN Coatings

The IPN coatings of varying compositions exhibited better tensile strength than those of their component poly-

*6J141A high solids primer, commercially available from Mt. Clemens Coatings, Inc.
 Bonderite is a registered trademark of the Parker Rust Proof Co.
 †33J2A7DMEWHA high solids basecoat commercially available from Mt. Clemens Coatings, Inc.

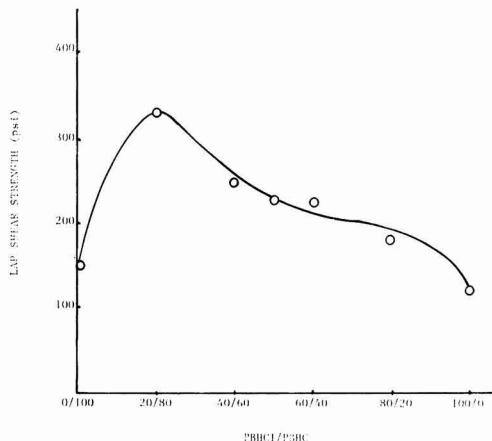


Figure 4—Lap shear strength (psi) vs network composition

mers P(UA)-1 and P(UA)-2, as shown in *Table 3* and *Figure 3*. In particular, the composition P(UA)-1/P(UA)-2 = 50/50 exhibited a maximum value, presumably at a high degree of penetration. Since the hydroxyl-containing copolymer P(BMA-HEA) was prepared by solution polymerization at high temperature and in the presence of relatively high concentration of peroxide, the reaction product possessed a low molecular weight. After reaction with caprolactone and capping with IEM, the reaction product P(UA)-1 had not undergone a great change in molecular weight. As a result, the crosslinked P(UA)-1 possessed a relatively low cohesive energy density and rather poor mechanical properties.

The P(BMA-HEA) extended with caprolactone was reacted with Desmodur L-2291A which contained flexible aliphatic chains. As a result, the crosslinked P(UA)-2 made by reaction of the NCO groups with the OH groups possessed a relatively high cohesive energy density due to the hydrogen bonding capability of the urethane structure. Both hardness and elongation of the IPN coatings exhibited a range of values between those of P(UA)-1 and P(UA)-2 due to the interpenetration between the rigid network of P(UA)-1 and the flexible network of P(UA)-2.

The adhesive strength of IPN films to steel panels is shown in *Table 4*. All IPN coatings exhibited higher lap shear strength than their original components P(UA)-1 and P(UA)-2 (*Figure 4*). All coatings exhibited an adhesive mode of failure.

The solvent resistance of the IPN films to methyl ethyl ketone and xylene ranged between that of the softer free-radically cured P(UA)-1 and the harder isocyanate-hydroxyl crosslinked network of P(UA)-2 (*Table 5*). The higher the P(UA)-2 content in the IPN composition, the better the solvent resistance.

MORPHOLOGY OF IPN COATINGS

Glass Transition Temperatures by TMA

The IPN coatings with varying amounts of P(UA)-1 and P(UA)-2 exhibited only one T_g value which was between the T_g 's of P(UA)-1 and P(UA)-2 (*Table 6*). This implies that interpenetrating polymer networks between P(UA)-1 and P(UA)-2 were formed by segmental mixing. As a result, P(UA)-1 with the rigid acrylic structure gave high T_g values and P(UA)-2 with flexible ureth-

Table 6—Glass Transition Temperature of IPN Coatings (By TMA)

Composition	P(UA)-1/ P(UA)-2	T_g (°C)
P(UA)-2	0/100	-11
IPN-1	20/80	-9
IPN-2	40/60	-6
IPN-3	50/50	4
IPN-4	60/40	7
IPN-5	80/20	13
P(UA)-1	100/0	36

ane structure gave low T_g values. The T_g values of IPN coatings shifted toward the direction of P(UA)-2 with increasing concentration of P(UA)-2.

Micrographs by SEM

As shown in *Figures 5-11*, both components, P(UA)-1 and P(UA)-2, and the IPN coatings with different compositions exhibited only one phase at a magnification of $5000\times$, indicating good molecular mixing due to interpenetration between the networks. In the previous study,⁷ one of the IPN coatings had shown some phase separation. All the IPNs of this study showed no signs of phase separation indicating that the caprolactone extension may have improved the compatibility of the two networks.

PHYSICAL PROPERTIES OF BASECOAT/IPN CLEARCOAT COATINGS

The IPN coating composition of 50% P(UA)-1/50% P(UA)-2 unfortified with UV absorber/stabilizer showed the best ultraviolet durability over high solids polyester basecoat up to 1500 hours exposure in QUV (*Figure 12*). The 50/50 composition was chosen because of all IPNs studied with this mixture exhibited the highest tensile strength with an acceptable elongation and adhesion. The IPN exhibited better weathering properties than either of

Table 5—Solvent Resistance of IPN Coatings

Composition	P(UA)-1/ P(UA)-2	Solvent MEK ^a	Resistance Xylene ^b
P(UA)-2	0/100	P	P
IPN-1	20/80	P	P
IPN-2	40/60	P	P
IPN-3	50/50	P	P
IPN-4	60/40	P	P
IPN-5	80/20	P	P
P(UA)-1	100/0	P	P

^a P = Pass 10 double rubs.

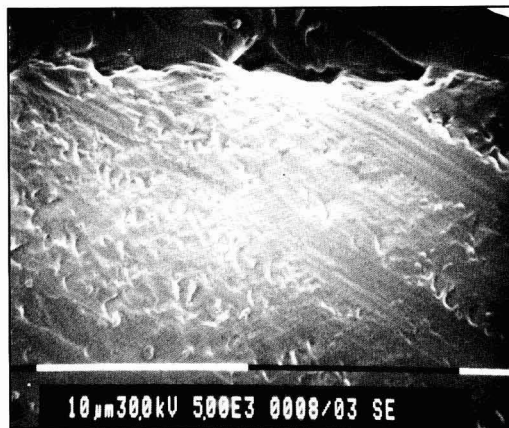


Figure 5—SEM micrograph of P(UA)-2 coating

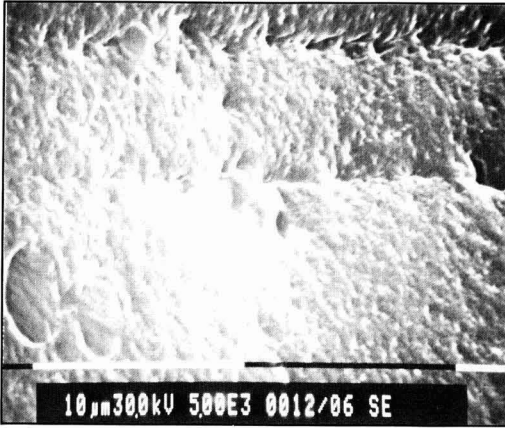


Figure 6—SEM micrograph of IPN-1 coating [P(UA)-1/P(UA)-2: 20/80]

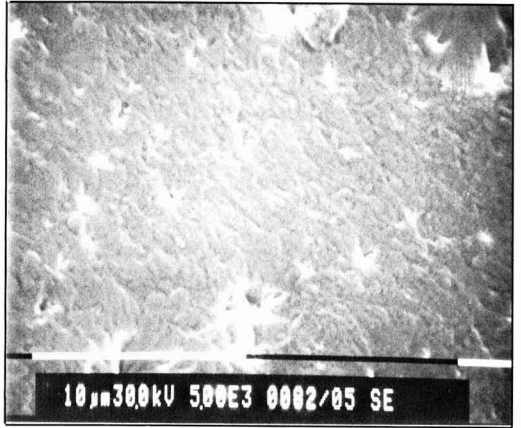


Figure 9—SEM micrograph of IPN-4 coating [P(UA)-1/P(UA)-2: 60/40]

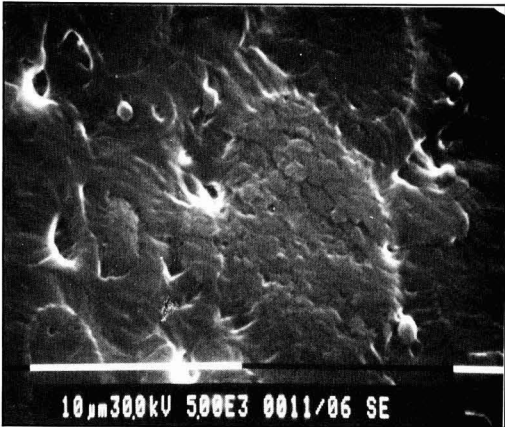


Figure 7—SEM micrograph of IPN-2 coating [P(UA)-1/P(UA)-2: 40/60]

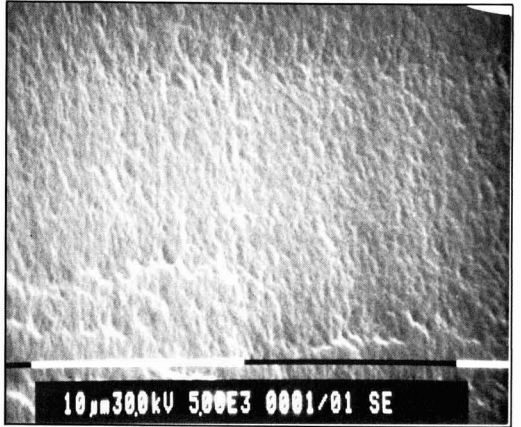


Figure 10—SEM micrograph of IPN-5 coating [P(UA)-1/P(UA)-2: 80/20]

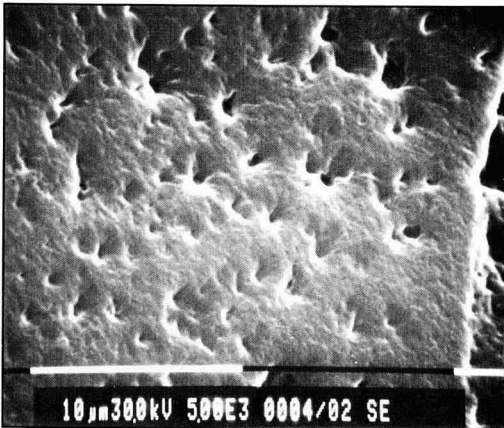


Figure 8—SEM micrograph of IPN-3 coating [P(UA)-1/P(UA)-2: 50/50]



Figure 11—SEM micrograph of P(UA)-1

Table 7—Properties of High Solids Basecoat/IPN Clearcoat Systems

Composition	P(UA)-1/ P(UA)-2	MEK Resistance ^a	Cleveland Humidity ^b	Gravelometer ^c	QUV (Hour)		
					% 20° Gloss Retention		
					500	1000	1500
P(UA)-2	0/100	P	10	2B	98	100	89
IPN-3	50/50	P	10	2B	94	97	100
IPN-3 + UV ^d	50/50	P	10	2B	81	78	76
P(UA)-1	100/1	F	10	2B	81	81	78

(a) 10 double rubs, "P" = Pass; "F" = Fail.

(b) 5 day exposure at 120°F; 10 = no effect from control.

(c) 1 pt. gravel, metal panel.

(d) Fortified with UV absorber/stabilizer package.

its components, P(UA)-1 or P(UA)-2, due to its interpenetrating network structure. However, when the 50/50 IPN coating composition was fortified with a UV absorber/stabilizer package, the durability of the system dropped. This can be attributed possibly to the retardation of the P(UA)-1 free-radical cure by the hydroxyphenyl benzotriazole, Tinuvin 328, and the hindered amine light stabilizer, Tinuvin 440, in the UV absorber/stabilizer solution. The loss of cure in the P(UA)-1 system resulted in loss of interpenetration in the IPN which would make the coating more prone to degradation. The P(UA)-2 coating exhibited better weathering characteristics than the P(UA)-1 due

to the higher crosslink density in the two component P(UA)-2 system than in the one component P(UA)-1 as determined by the MEK resistance. All compositions exhibited acceptable gravelometer results as well as passing the Cleveland Humidity cycle (120°F, 120 hrs) without blistering or darkening (Table 7).

CONCLUSIONS

Coatings based on the novel IPN systems prepared from P(UA)-1, a caprolactone extended acrylic urethane crosslinked by free radical polymerization of pendant double bonds, and P(UA)-2, a caprolactone extended acrylic resin crosslinked through an isocyanate curing agent, exhibited good weathering resistance over high solids polyester basecoat for up to 1500 hours in QUV. The IPN coating compositions also exhibited higher tensile strength and adhesive strength than those of their original components—P(UA)-1 and P(UA)-2. The morphologies of the IPN coatings, as determined by SEM and TMA, indicated that the improved molecular mixing in these IPN's was due to interpenetration between the respective networks.

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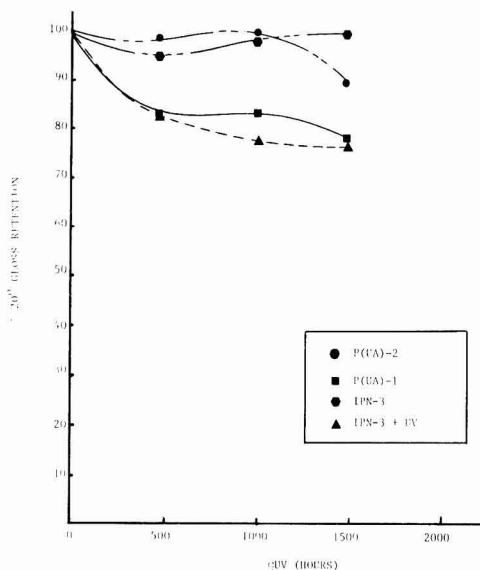


Figure 12—Gloss retention of basecoat/IPN clearcoat coating systems

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Production of High Solids Acrylic Coating Resins with t-Amyl Peroxides: A New Way to Meet VOC Requirements

Vasanth R. Kamath and James D. Sargent, Jr.
Pennwalt Corp.*

t-Amyl peroxides are a new class of commercial organic peroxides. They are very efficient initiators and yield radicals which are poor hydrogen abstractors. As a result, acrylic resins can be readily synthesized with low molecular weight and narrow molecular weight distribution. This enables one to obtain acceptable spray viscosities at high (>75%) solids content, which complies with the decreasing VOC requirements of the coatings industry. Polymerizing typical acrylic monomer combinations for coating applications, we have demonstrated improved performance with t-amyl peroxides over conventional t-butyl peroxides and azonitrile initiators. Performance criteria included resin molecular weight, molecular weight distribution, solids content, solution viscosity, resin color, residual monomer levels, as well as final film properties, such as initial gloss and gloss retention as a function of QUV exposure time.

INTRODUCTION

The primary goal of high solids coatings technology is to increase the solids content while maintaining or even reducing the solution viscosity. The solution viscosity is strongly influenced not only by the polymer molecular weight but by the molecular weight distribution (MWD). A narrow MWD polymer leads to lower solution viscosity. Narrow MWD also provides a more homogeneous crosslinked network in the final bake cycle which improves overall film properties. Narrow MWD results in

freedom from non-functional or mono-functional dimers and trimers which compromise film properties, cause oven condensation, and contribute to sagging.

In the synthesis of high solids, low molecular weight hydroxy-functional acrylic resins, azonitrile initiators are commonly used to obtain narrow MWD. Azonitrile initiators decompose to produce selective radicals which are poor in hydrogen (H)-abstracting ability. The H-abstracting ability of initiator free radicals plays a major role in determining the polymer MWD.

Peroxides derived from tertiary (t) butyl hydroperoxide are not as suitable for high solids acrylic resin synthesis. t-Butyl peroxides decompose to produce radicals which are highly reactive and readily capable of abstracting hydrogen atoms. The use of t-butyl peroxides generally results in polymers with broad MWD and high solution viscosity.

A new class of organic peroxides, t-amyl peroxides, derived from t-amyl hydroperoxide, has recently been introduced commercially.¹

t-Amyl peroxides, in contrast to t-butyl peroxides, decompose to form less energetic, more selective radicals which are poor in H-abstracting ability. As a result, polymers with narrow MWD and low solution viscosity are produced. Reduction of light-sensitive oxygenated end-groups also results with the use of t-amyl peroxides. Thus, these products are extremely well suited for the synthesis of high solids acrylic resins intended for coatings applications.

The performance of t-amyl peroxides compared to conventional t-butyl peroxides and azonitrile initiators under typical polymerization conditions, together with resin characterization and final film properties, is described in the following.

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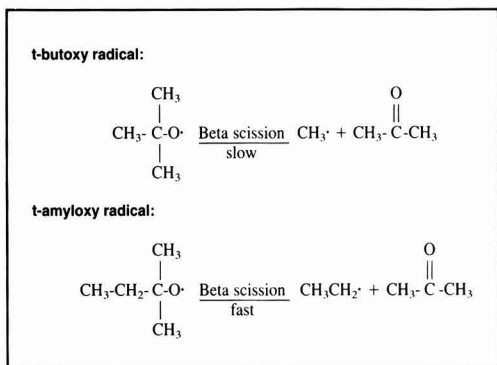


Figure 1—Beta scission

EXPERIMENTAL

Resin Synthesis

The low molecular weight hydroxy-functional acrylic resins, or oligomers, were prepared by free radical solution polymerization. Polymerizations were conducted under nitrogen in a jacketed glass reactor equipped with a stirrer, thermometer, and reflux condenser. Monomers and initiator were combined and metered into the reactor containing solvent at a prescribed temperature over a five hour period. After the monomer/initiator addition was complete, polymerizations were typically continued for an additional hour to reduce residual monomers.

Ingredients used in a typical polymerization were butyl acrylate (BA) (150 g); 2-hydroxyethyl acrylate (HEA) (125 g); butyl methacrylate (BMA) (100 g); methyl methacrylate (MMA) (60 g); styrene (STY) (50 g); methacrylic acid (MA) (15 g); solvent (150 g); and initiator. Solvent(s) and initiator(s) used, along with the resulting polymerization temperatures, are noted when applicable. All monomers contained inhibitors added by the supplier and were used as received without further purification.

Initiators

Comparisons were made on an equal active oxygen basis in the case of peroxide initiators, and on an equivalent basis in the case of azonitrile initiators. The polymerization temperature employed corresponds to the 15 minute half-life temperature (°C) of the initiator, unless otherwise stated (see Appendix 1).

Table 1—Performance Differences: t-Amyl and t-Butyl Peroxides

Initiator	% Solids	M _N	M _w /M _N	M _z /M _N	Viscosity (Poise)	Apha Color
EAPB	77	3700	2.1	3.8	150	20
EBPB	77	4200	2.9	6.9	320	40

Using BA/BMA/STY/HEA at 30/20/30/20 wt ratio with S/M = 0.3 in Exxate® 700 solvent. [I]₀ = 0.0156 moles/100 g monomers. Temperature was 145° and 147°C for Lupersol 533 and 233, respectively.

Table 2—Performance Differences: t-Amyl Peroxides and Azonitrile Initiator

Initiator	% Residual Monomers	M _N	M _w /M _N	M _z /M _N	Viscosity (Poise)	Apha Color
EAPB	0.51	3100	2.0	3.5	150	50
APEH	1.43	4600	2.6	4.8	260	5
AZMB	1.87	6100	3.3	7.1	1,010	60

Using BA/BMA/MMA/HEA/STY/MA at 30/20/12/25/10/3 wt ratio with S/M = 0.3 in Ektapro® EEP solvent. [I]₀ = 5.0, 7.2, and 6.0 parts per hundred parts monomers (pphm) for Lupersol 533, 575, and Vazo®-67, respectively. Temperature was 145°, 104°, and 95°C for Lupersol 533, 575, and Vazo®-67, respectively.

Characterization

Molecular weights were determined by gel permeation chromatography using polystyrene standards. Solids content, residual monomers, color, and viscosity were determined respectively by percent nonvolatile matter (ASTM-D1259), gas chromatographic analysis of monomer(s), Apha color (ASTM-D2849), and Brookfield viscometry at 22°C.

Coating Formulations, Preparation, and Properties

Clear acrylic coating formulations were comprised of the acrylic resin, melamine crosslinking resin, acid catalyst, and reducing solvents (see Appendix 2). Coatings were applied via air spray to untreated aluminum panels and cured at 140°C (284°F) for 20 minutes. Dry film thickness was typically 1.5-2.0 mil.

Cured coatings were aged at room temperature for 24 hours, after which gloss (60°), pencil hardness, and solvent resistance (MEK rubs) were determined. Accelerated weathering was conducted with a QUV weathering tester using an eight hour light cycle (UV-B) at 60°C, and a four hour wet cycle at 50°C. This complies with ASTM Method G-53(84). Exposed panels were inspected at regular intervals for loss in gloss. This was determined by the average of three panel measurements.

RESULTS AND DISCUSSION

Initiator Effects

The dramatic difference in the performance of ethyl 3,3-di(t-amylperoxy)butyrate (EAPB) and its t-butyl analog (EBPB) is illustrated by the results in Table 1. The t-amyl peroxide leads to a much narrower molecular weight distribution and, as a result, final resin solution viscosity is decreased by about 50%. These results are obtained because poor hydrogen abstracting radicals are produced from t-amyl peroxides.¹

t-Butyl peroxides decompose to form a t-butoxy radical. This radical can undergo a beta scission reaction to form a ketone and a methyl radical. The beta scission reaction for t-butoxy radicals is slow and therefore the initiating species is either the t-butoxy radical or the methyl radical. Both radicals are highly reactive and

readily capable of abstracting hydrogen atoms. This leads to chain branching, broad molecular weight distributions, and high solution viscosity.

t-Amyl peroxides decompose to form a t-amylperoxy radical. The unique feature of t-amyl peroxides is the much faster beta scission reaction of the t-amylperoxy radical. The t-amylperoxy radical undergoes a fast beta scission reaction to yield a ketone and an ethyl radical. The relative stability of the initiating ethyl radical minimizes hydrogen abstraction. This decreased tendency toward hydrogen abstraction leads to less long chain branching, giving better control over molecular weight and molecular weight distributions.

This has been substantiated by Million² in analysis of the thermal decomposition by-products from a t-amyl peroxide and a t-butyl peroxide. By measuring the moles of alcohol and ketones formed, Million estimated the B-scission reaction to be about six times greater for the t-amylperoxy radical. This is illustrated in Figure 1.

The selectivity and poor hydrogen abstracting ability of radicals derived from t-amyl peroxides can be further confirmed by comparing their performance against commercial azonitrile initiators. Azonitrile initiators decompose by cleavage of two carbon-nitrogen bonds to produce nitrogen and two alkyl radicals. The initiating alkyl radicals are selective and poor in hydrogen abstracting ability.

The performance of EAPB and t-amylperoxy-2-ethylhexanoate (APEH) was compared against 2,2'-azobis(methylbutyronitrile) (AZMB). This is shown in Table 2. These results clearly show that, with the use of t-amyl peroxide initiators, narrower MWD with concurrent reduction in solution viscosity is obtained. In addition, lower residual monomer(s) and color were also obtained with the use of the t-amyl peroxide initiators.

Polymers with narrow MWD and uniformity in functional groups provide a more homogeneous crosslinked network in the final bake cycle. This improves overall film properties. In the synthesis of hydroxy-functional acrylic resins used in high solids coatings, it is important to reduce the spread in molecular weight and MWD with monomer conversion so that a more uniform functional

Table 4—t-Amyl Peroxides: Activity Range

Peroxide Name	Half-Life Data ^a		E _A (KCal/Mole)
	10 hr	1 hr	
t-Amyl peroxyvalate	54	74	28.1
t-Amyl peroxy-2-ethylhexanoate	75	92	34.7
1,1-Di(t-amylperoxy)-cyclohexane	93	112	34.6
00-t-Amyl 0-(2-ethyl hexyl) monoperoxycarbonate	98	117	36.0
t-Amyl peroxybenzoate	100	121	32.2
Ethyl 3,3-Di-(t-amylperoxy) butyrate	112	132	35.5

(a) 0.2 molar in dodecane.

resin is obtained. Non-functional or mono-functional dimers and trimers can compromise film properties, cause oven condensation, and contribute to sagging. Metering of monomers and initiators to refluxing solvent is frequently employed commercially to facilitate the production of low molecular weight polymers with narrow MWD and uniformity in functional groups.

The effect of metering initiators is shown in Table 3. These results show that, with EAPB as the initiator, there is minimal spread in molecular weight and molecular weight distribution with reaction time. However, with the azonitrile initiator, a small but definite spread in molecular weight and distribution can be seen. This may be due to a possible reduction in kinetic efficiency with increasing reaction viscosity.

Initiator half-life at a given polymerization temperature is also an important parameter for controlling overall process efficiency and product quality. The use of initiators with low half-life temperature at high reaction temperatures is inefficient. At high temperatures, the low half-life initiator decomposes so rapidly that the radicals produced recombine to form non-initiating species. Consequently, fewer radicals are available for efficient chain initiation. This can result in low monomer conversion and high molecular weight production. For optimum initiator efficiency, the initiator should have a half-life of 10-20 minutes at the reaction temperature. Given the broad half-

Table 3—Initiator Effects: Molecular Weight Variation with Reaction Time

Time (hrs)	Initiator: EAPB			Initiator: AZMB		
	% Solids	\bar{M}_N	\bar{M}_W/\bar{M}_N	% Solids	\bar{M}_N	\bar{M}_W/\bar{M}_N
1.0	36	3200	1.8	32	5100	1.9
2.0	52	3400	1.9	46	6500	1.8
3.0	64	3600	2.0	60	6100	2.1
4.0	70	3500	2.0	66	6500	2.2
5.0	74	4000	1.9	72	8000	2.0
5.5	76	3800	2.0	75	7800	2.2

Viscosity: 150 Poise

Viscosity: 310 Poise

Using BA-BMA-STY/HEA at 30/20/30/20 wt ratio with S/M = 0.3 in Exxate[®] 700 solvent. For Lupersol 533 and Vazo[®]-67 temperature was 145[°] and 95[°]C, respectively. [I]₀ = 5.0 and 6.0 phm for Lupersol 533 and Vazo[®]-67, respectively.

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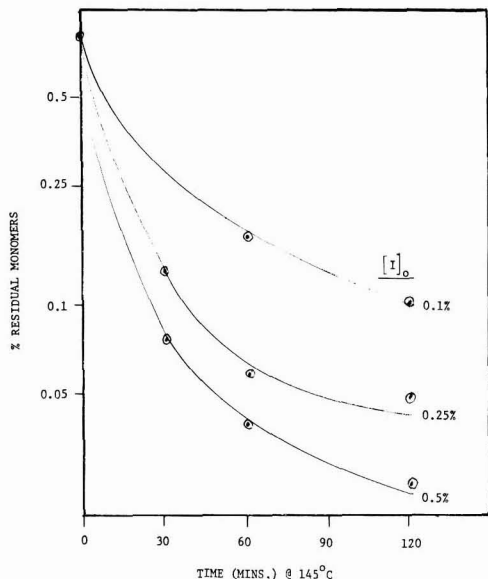


Figure 2—Chaser catalyst: EAPB

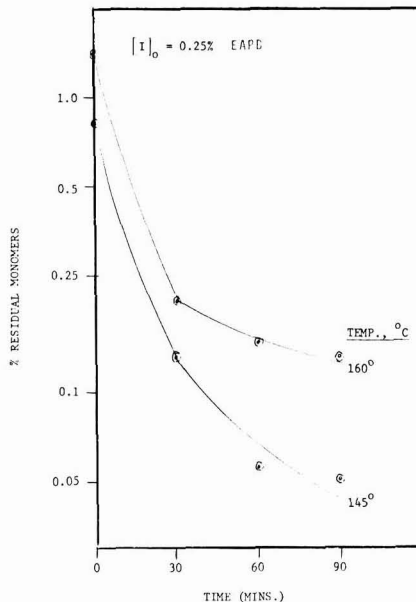


Figure 3—Temperature effect on residual monomer

life range of commercial t-amyl peroxides, it is easy to select an initiator for a specified polymerization temperature. A representative list of t-amyl peroxides and their half-life data is shown in Table 4.

CHASER CATALYST

The “chaser catalyst” is an initiator that is added toward the end of the polymerization reaction to reduce residual monomer concentration to acceptable levels. For high solids acrylic resins, one must be selective in choosing the chaser catalyst such that narrow polymer MWD is maintained as monomer conversion is maximized.

Certain peroxyketal initiators are particularly efficient in reducing residual monomer concentration.³ On this basis, it was expected that EAPB would be an efficient chaser catalyst. The results in Table 5 illustrate the superior performance of EAPB as compared to an azonitrile initiator.

The ability to quickly reduce residual monomer concentration to less than 0.1% is of considerable commercial

importance. It results in reduced total process time while improving overall product quality. Towards this end, initiator concentration as well as reaction temperature have to be taken into account. The results in Figure 2 illustrate that the rate of monomer reduction increases with initiator (EAPB) concentration. However, the results in Figure 3 show that increasing the reaction temperature from 145°C to 160°C leads to substantially higher residual monomer concentration. At 160°C, the half-life of EAPB is too short, making inefficient use of the initiator. For EAPB, a reaction temperature of about 145°C (half-life of 15 mins) is the maximum for optimum efficiency. Using half-life data in dilute solutions, it is possible to predict the optimum reaction temperature for different initiators (see Table 4).

SOLVENT EFFECTS

The effect of solvents and solvent blends on final film properties has been described.^{4,5} However, little if any published literature describes the effect of solvents in the

Table 5—Initiator Performance: “Chaser Catalyst”

“Chaser”	EAPB		AZMB	
	(A)	(B)	(C)	(D)
% Residual Monomers	1.0	<0.1	3.7	1.5
\bar{M}_N	3800	3700	7800	7100
\bar{M}_w/\bar{M}_N	2.0	2.1	2.2	2.3
\bar{M}_z/\bar{M}_N	3.4	3.8	3.8	4.1

(A) and (C) = acrylic resin, Poly(BA/BMA/STY/HEA), at 76% solids in Exxate® 700.
 (B) = (A) + 0.50% Lupersol 533 + 0.5 hr at 145°C.
 (D) = (C) + 0.60% Vazo®-67 + 0.5 hr at 95°C.

Table 6—Solvent Effects on Solution Viscosity

Solvent	B.P. (°C)	\bar{M}_N	\bar{M}_w/\bar{M}_N	\bar{M}_z/\bar{M}_N	Viscosity (Poise)
Mak	153	3800	1.8	2.9	14
Ektapro® EEP	172	3700	1.9	3.0	26
EE acetate	156	3500	2.0	3.4	29
PM acetate	146	4100	1.9	3.2	42

Using BA/BMA/STY/HEA at 30:20/30:20 wt ratio with S.M. 0.3 phr, 5.0 phm Lupersol 533. Temperature was 145°C.

Table 7—Hansen Solubility Parameters^a

Solvent	Total	Non polar (cal/cm ³) ^{-1/2}	Polar	H-Bonding
Mak	9.0	7.9	2.7	3.8
Ektapro [®] EEP	9.1	7.9	1.6	4.3
EE acetate	8.7	7.8	2.3	5.2
PM acetate	8.8	7.8	3.6	5.2

(a) Courtesy of Eastman Chemicals, Inc.

synthesis of low molecular weight acrylic resins for high solids coating applications.

The performance of EAPB in four different solvents is shown in Table 6. The results show that these solvents have minimal effect on polymer molecular weight and MWD. We conclude there is no adverse effect on initiator performance. In view of this, higher boiling solvents can be selected to conduct the polymerization at higher temperatures, along with the use of high half-life temperature initiators. This would facilitate the synthesis of lower molecular weight resins allowing solids content to be increased.

Even though the initiator performance is not effected by choice of solvent, the solvent does affect the resin solution viscosity. This is illustrated in Table 6.

To develop a selection criteria, it is possible to correlate solution viscosity with solubility parameter of the solvent. Solubility parameter as proposed by Hansen⁶ is based on values which fit the equation

$$\delta_t^2 = \delta_d^2 + \delta_p^2 + \delta_h^2$$

where

- δ_t = total solubility parameter;
- δ_d = component due to dispersion forces;
- δ_p = component due to polar forces;
- δ_h = component due to hydrogen bonding.

Hansen's solubility parameters of the four solvents used are listed in Table 7. There appears to be a correlation between resin solution viscosity and the Hansen H-bonding parameter of the solvent. In addition to the H-bonding parameter, the polar forces of the solvent appear to affect the solution viscosity as well.

Therefore, solvent boiling point, H-bonding parameter, and polar forces should be considered for solvent selection. It may be possible to use solvent blends to control boiling point and H-bonding parameter such that higher solids levels can be obtained while maintaining or reducing solution viscosity.

FILM PROPERTIES

To illustrate the effects of initiator on final film properties, coatings were prepared and evaluated using resins initiated with t-amyl peroxides as compared to azonitrile initiated resin.

Using typical clear coat formulations (Appendix 2), higher initial gloss (60°) was obtained for t-amyl peroxide

Table 8—Initiator Effects on Film Properties

Initiator	EAPB	APEH	AZMB
Nonvolatiles (%)	60	55	55
Spray viscosity (cps)	800	350	900
Initial gloss (60°)	192	185	168
VOC (lbs/gal)	3.40	3.84	3.95

Dry film thickness: 1.5–2.0 mil

Hardness: 2H

Solvent resistance: >200 MEK Rubs

initiated resins. This is shown in Table 8. Better gloss retention after QUV exposure was also found, as shown in Figure 4. This result may seem surprising since it has often been thought that peroxide initiators would introduce light-sensitive oxygenated end-groups into polymers. One of the benefits of t-amyl peroxides is the reduction of oxygenated residues.

Another point to note from the results in Table 8 is the spray viscosity of the final film formulation. With APEH initiated resin, spray viscosity was 350 cps at 55% solids as compared to 900 cps for the azonitrile initiated resin at 55% solids. With EAPB initiated resin, the solids content of the formulation could be increased to 60% while reducing the spray viscosity versus that from the azonitrile initiated resin. The ability to go to higher solids spray is a direct result of the lower molecular weight and narrower MWD obtained with the use of EAPB.

It should also be pointed out that other film properties, such as adhesion, impact resistance, flexibility, humidity, stain, detergent resistance, and salt spray resistance were not sacrificed with the use of t-amyl peroxide initiated resins, i.e., when compared with azonitrile initiated resin. This was substantiated by evaluations conducted by Eastman Chemicals, Inc., recording final film properties of resin prepared with EAPB, APEH, and AZMB initiators.

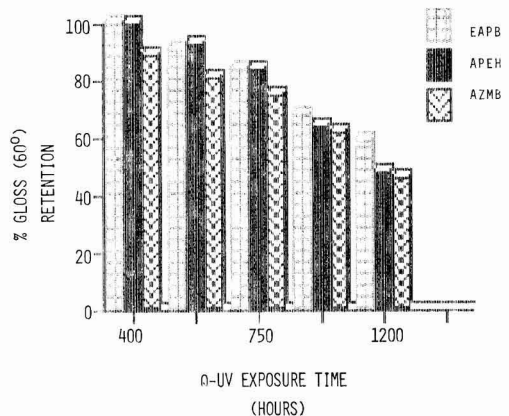


Figure 4—Acrylic clear coatings: initiator effects on gloss retention

SUMMARY

It has been demonstrated that t-amyl peroxides are efficient initiators for the synthesis of acrylic resins with low molecular weight, narrow molecular weight distribution, and high solids contents (75% or greater). The various parameters that need to be considered in the selection of suitable initiator(s) and solvent(s) for the synthesis of desirable high solids acrylic resins with low residual monomer have been described.

Finally, the effects of initiator on final film properties and the better gloss and gloss retention with the use of t-amyl peroxide initiated resins have been illustrated.

Given the broad range of activity of t-amyl peroxides, one can select an initiator or combinations to optimize performance for specific polymerization conditions to produce acrylic resins of superior properties for high solids coatings.

ACKNOWLEDGMENT

The authors wish to thank Garland Sprinkle, Eastman Chemicals, Inc., for final film property data of resins and for his valuable input regarding Hansen solubility parameters of solvents.

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APPENDIX 1
Initiators

Tradename	Lupersol 233	Lupersol 533	Lupersol 575	Vazo® 67
Chemical Name	Ethyl 3,3-di(t-butylperoxy)butyrate (EBPB)	Ethyl 3,3-di(t-amylperoxy)butyrate (EAPB)	t-Amylperoxy-2-ethylhexanoate (APEH)	2,2'-Azobis(Methylbutyronitrile) (AZMB)
MW	292	320	230	192

APPENDIX 1 (Continued)
Initiators

Tradename	Lupersol 233	Lupersol 533	Lupersol 575	Vazo® 67
Half-Life (T _{1/2} °C) ^a				
10 hours	115	112	75	67
1 hour	135	132	92	84
15 minutes	147	145	104	95
Equivalent Weight (phm) ^b	4.6	5.0	7.2	6.0

(a) in Dodecane; in Toluene (Vazo®-67).

(b) phm = parts per hundred parts monomer.

Lupersol is a registered trademark of the Pennwalt Corp., Lucidol Div.

Vazo is a registered trademark of E. I. du Pont de Nemours & Co.

APPENDIX 2

Clear Coatings Formulations

60% Solids	55% Solids
60.0 HSC Resin	55.0 HSC Resin
15.0 Cymel 303	2.4 Ektapro® EEP
8.0 N-Butanol	13.8 Cymel 303
8.0 Aromatic-100	9.3 N-Butanol
8.0 DBE Solvent	9.3 Aromatic-100
0.6 Cycat 4040	9.3 DBE Solvent
	0.5 Cycat 4040
99.6	99.6

Parameters

- (1) HSC resin—75% solids in Ektapro® EEP
- (2) Resin/melamine ratio = 75/25
- (3) Cure catalyst (Cycat 4040) = 1% (WT) binder
- (4) Air spray = Bink's or 50 psi

APPENDIX 3
Chemicals

Cymel 303	—Melamine formaldehyde resin (American Cyanamid Co.)
Cycat 4040	—40% wt solution of p-toluene sulfonic acid in isopropanol (American Cyanamid Co.)
Aromatic-100	—Mixed aromatic hydrocarbons (Exxon Chemicals)
DBE Solvent	—Dibasic esters (Du Pont)
Ektapro® EEP	—Ethyl 3-ethoxypropionate (Eastman Chemicals)
Exxate® 700	—Oxo-heptyl acetate (Exxon Chemicals)
MAK	—Methyl n-amyl ketone
EE Acetate	—Ethylene glycol monoethyl ether acetate
PM Acetate	—Propylene glycol monomethyl ether acetate

Society Meetings

CHICAGO.....NOV.

"VOC Compliant Coatings"

Vince Calder, of S.C. Johnson & Son, Inc., presented a technical talk on "POLYMERS FOR VOC COMPLIANT INDUSTRIAL COATINGS." The second speaker was Rick Braunshausen of The Enterprise Cos., who presented the Chicago Society Technical Committee paper "OVEN VS SHELF STABILITY OF LATEX PAINTS"

EVANS ANGELOS, *Secretary*

CDIC.....DEC.

"Underground Storage Systems"

Environmental Committee Chairman Kenneth Pendleton, of K.A. Pendleton Co., requested the names of two people from each company as contacts for environmental issues.

Two undercover police officers from the Multi Agency Narcotics Unit were the evening's educational speakers. They discussed some of the methods used in apprehending people who sell drugs and held a demonstration of the drugs and drug paraphernalia.

"TOWARDS A MORE RELIABLE UNDERGROUND STORAGE SYSTEM" was the title of the technical presentation given by Chuck Harding, of Clawson Tank Co.

According to EPA regulations, all underground storage tanks must comply with the design characteristics of structural integrity, product compatibility, and corrosion resistance. An EPA damage survey found that structural failure, not corrosion, was the leading cause of defects in leaking tanks. Fiberglass reinforced plastic tanks have the greatest structural problems, with steel generally accepted as being the best to insure structural integrity. When left unprotected, even steel corrodes, said Mr. Harding. The presence and extent of the corrosion depends upon the type of soil and drainage of the water around the tank.

The speaker said one tank which meets all EPA design regulations is the STIP-3 tank. This steel tank has a urethane, coal tar epoxy, or fiberglass reinforced polyester coating. It's electrically sealed from the piping and other sources of grids by the use of zinc or magnesium sacrificial anodes connected to the tank. These anodes re-

verse corrosion and protect the cathode (steel tank).

According to Mr. Harding, in some states and municipalities, secondary containment is mandatory. A double wall steel tank will contain any leaks or overflow in the outer tank, allowing the space between the tanks to be monitored.

The speaker concluded by saying that the EPA has found leaking from pipes to be a larger problem than leaking from tanks.

Q. What's required to take a tank out of service if a problem is suspected?

A. First, run a liquid tightness test and monitor the ground water. If the tank itself is leaking, the preferred method is to remove the tank from the ground, remove any contaminated soil, and back fill with clean soil.

CAROLYN L. TULLY, *Secretary*

LOS ANGELES.....NOV.

"Silicone Chemistry"

A moment of silence was observed for Frank Davis, founder of Frank D. Davis Co., who died recently.

Library Committee Chairman Dana A. Harding, of Pacific Dispersions Co., Inc., reviewed the committee's activities and announced that it has purchased "Corrosion Prevention by Protective Coatings" by Consultant Charles Munger, and "The 1985 Western Coatings Symposium" on cassette.

The evening's guest speaker was Albert J. Milo, Educator member from the Commerce Library. Mr. Milo noted that the library would be updating the Society bibliography and that an extensive amount of governmental materials has been accumulated.

Donald E. Curl, of E.T. Horn Co., gave an update on environmental matters, detailing the El-Rap meeting and the many changes which have taken place since the general election.

Albert Seneker spoke to the audience on the status of the Scholarship Program. He mentioned the quantity of monies in the fund and the requirements for the dissemination of those monies in the form of scholarships for qualifying students pursuing a technical curriculum.

Frank Peter, of the Dunn-Edwards Corp., discussed the status of the Paint Technology Course and noted the decrease in attendance.

The technical speaker was Robert W. Vash, of Byk-Chemie USA. The Cleveland Society member spoke on the "NEW INSIGHT INTO CHEMISTRY OF SILICONES FOR THE COATINGS INDUSTRY."

Mr. Vash talked about silicones in general and reviewed what they are and how they are formed. He noted that silicones are polymers of dimethyl siloxane and their properties are determined by modifications on the polymer used in making the silicone.

PARKER PACE, *Secretary*



MONTREAL SOCIETY OFFICERS AND COMMITTEE CHAIRPERSONS FOR 1986-87 seated (left to right): Society Representative—Horace A. Philipp; L. Issa; President—Jean-Pierre Cote; Vice-President—E.J. Templeton; and Secretary—R. Ferrie. Standing: Planning Committee—V. Pedersen; J. Brunet; L. Kabakian; Special Events Committee—N. Chaif; V. Sharma; and Manufacturing Committee—L. Krivanek



1986-87 NORTHWEST SOCIETY OFFICERS: President—Larry Brandenburger; Vice-President—Joan B. Lamberg; Secretary—Richard W. Karlstad; Treasurer—Mark W. Uglem; and Society Representative—Richard L. Fricker

NEW YORK NOV.

"Hazardous Waste Treatment"

Society Representative Saul Spindel, of D/L Laboratories reported that copies of the highlights of the Board of Directors Meeting held in Atlanta are available at the Society office.

Alfred A. Sarnotsky, of Spraylat Corp., noted the government regulation meeting held earlier in the day and requested that members send their suggestions for future topics to either Richard E. Max, of Standard Coating Corp., Jeffrey C. Kaye, of Maas & Waldstein Co., or himself.

A talk on "THE POTENTIAL OF BIOLOGICAL TREATMENT AS A HAZARDOUS WASTE TREATMENT TECHNOLOGY" was given by Gordon Lewandawski, of the New Jersey Institute of Technology.

Dr. Lewandawski's presentation explored the advantages and disadvantages of biological treatment as a hazardous waste treatment technology. He also included some of the more recent discoveries and applications. A copy of the paper is available at the Society office.

Q. Do you need to incinerate material after it is sterilized (biologically accepted)?

A. You should. The new laws for dumping sludge are to go 106 miles off shore, which increases the cost of barging. This is to encourage incineration.

DAVID PENICHTER, *Secretary*

NORTHWESTERN DEC.

"Diatomaceous Earth Coatings"

Edward C. Ferlauto, of Valspar Corp. gave the technical meeting report and announced that he will accept volunteers for the committee.

The evening's technical speaker was Thomas E. Remmers, of the Manville Corp. The Rocky Mountain Society member spoke on "THE USE OF DIATOMACEOUS EARTH IN COATINGS."

According to Mr. Remmers, diatomite is the skeletal remains of single cell aquatic plants known as diatoms. They extract silica from the water in which they live and the silica is retained in their skeletons when they die. Most of the deposits were formed 15 million years ago and are now mined in California and Nevada.

The three basic classifications of diatomite are natural, calcined, and flux calcined. The coatings industry uses the natural and flux calcined types. Diatomite is used mainly for flattening and reduces gloss by 60° and sheen by 85° uniformly.

The speaker went on to say that diatomite is classified according to physical and chemical properties. Particle size distribution is an important factor in how it functions, with particles under four microns not contributing to flattening. Smaller particle size produces lower oil absorption and reduced flattening efficiency, he stated.

In conclusion, Mr. Remmers said that diatomite produces good intercoat adhesion, good sandability, and fast solvent release.

The evening's second speaker was Frank Wood, the Warden at Oak Park Heights Prison. He discussed the state of Minnesota's prison system and presented some interesting facts and figures.

RICHARD W. KARLSTAD, *Secretary*

PHILADELPHIA DEC.

"Aluminum Pigments"

Technical Committee Chairman William J. Fabiny, of Sermatech International, Inc., submitted a questionnaire to all members requesting suitable topics for upcoming meetings.

The technical presentation was given by Stephen M. Delich, Jr., of Silberline Mfg. Co. He spoke on "ALUMINUM PIGMENTS: PAST, PRESENT, FUTURE."

According to Mr. Delich, the ball mill process for aluminum flake production, discovered by E.J. Hall in the 1930's, is still in use today. Then, with the use of a flow chart, he described the production of aluminum pigments. He stated that aluminum pigments are: corrosion resistant; highly reflective to UV light, visible light, and IR light; chemically resistant due to lamellar geometry; and serve as good moisture and oxygen barriers.

Leafing and non-leafing pigments and the effects of particle size and particle size distribution were discussed by the speaker. He also reviewed formulation guidelines and safety and handling techniques, including storage, handling, and fire fighting.

Mr. Delich concluded his presentation discussing the future of aluminum pigment developments, including stable water systems, high solids pastes, and new pigment types—leafing and non-leafing.

LAWRENCE J. KELLY, *Secretary*

PIEDMONT NOV.

"Dispersion Pilot Plant"

Society President Steve Lasine, of McCullough & Benton, Inc., was presented with an honorary gavel by Martin Feldman, of Nuodex, Inc.

Mr. Lasine reported that the Society received the 1986 Materials Marketing Associates Award in the Class C Division. The award, which consists of an engraved plaque and a cash award, was also won by Piedmont Society in 1982 and 1984. Robert Matejka, of Reliance Universal, Inc., and his work through the Educational Committee was recognized as a major contributing factor for the Society's achievements in this area.

Dave Bosse pointed out that Kent State University is offering short courses of interest and he submitted a list of the courses available.

Information on the 1987 Roon Awards competition and the "Guide to Coatings Courses, Symposia, and Seminars" can be obtained from Mr. Lasine.

Dr. Feldman, of the New York Society, discussed "THE DISPERSION PILOT PLANT—THE SHORTEST DISTANCE BETWEEN THE LAB AND PRODUCTION."

Dr. Feldman presented several examples of formulating lab sample color dispersions. He explained that when formulations are derived in the lab and then put directly into production, many times there is a loss

generated with production time, product loss, equipment down time, etc.

By utilizing a pilot plant, formulations can be proven out by scale up and adjusted if necessary. The speaker gave examples of failures in the pilot plant and some brief cost relationship of pigment loss, color development, etc., which would have been generated in production without the use of a pilot plant.

Dr. Feldman concluded his presentation stating that once products are sealed up from lab to pilot plant and formulations function well, it's reasonably sure production will be virtually trouble-free; thus, saving monies of product losses and production with proper through-put of products.

BARRY F. YORK, *Secretary*

PITTSBURGH.....DEC.

"High Solids Coatings"

President Anthony J. Isacco II, of Puritan Paint & Oil Co., announced that the Technical Committee will give help to those students who received project money from the Society.

Upon acceptance into the Society, Karen Moore, of Watson Standard Co., will become Chairperson of the Environmental Control Committee, it was announced.

The technical presentation was given by Richard Johnson, of Cargill, Inc. Mr. Johnson, a member of the Northwestern Society, spoke on "HIGH SOLIDS COATINGS."

The speaker initially discussed projections for the various types of coatings used in the industrial market and how they have changed over the years. Currently, high solids systems seem to be replacing conventional coatings. The reasons for this include: formulation ease; formulation tech-



OFFICERS AND COMMITTEE CHAIRPERSONS OF THE ST. LOUIS SOCIETY FOR 1986-87: Society Representative—John Folkerts; Environmental Control Committee—E. Joseph Saake; Educational Committee—James Stoffer; Charles L. Grubbs; President—Al E. Zanardi; Vice-President—James N. McDerby, Jr.; Terry Ponce; Secretary—Robert Wagnon; and Membership Committee—Thomas R. Rieser

niques and additives have remained the same; transfer of efficiency is second only to powder coatings; lower VOC; good economics with controlled film thickness; equivalent if not better performance; and new developments and technology.

One of the new technologies is the water extendible high solids resins, where water can replace 20-50% of the solvents. This technology becomes valuable because of the further tightened laws for VOC level.

Mr. Johnson discussed blocked urethane technology, new developments in reactive diluents, and hydrolysis of melamine-formaldehyde polyester films. He followed up with suggestions for formulating high solids coatings. He recommended the use of low oil absorption pigments and fillers when possible and the use of silicas for gloss reduction.

According to Mr. Johnson, problems with high solids coatings remain to be

solved. Telegraphing can be minimized by avoiding water miscible solvents. Modification of surface tension with silicones and other additives can help solve fluidity and air entrapment problems. The use of strong solvents can cause problems with plastic substrates.

In summary, the speaker stated there are more tools available today that will help industry meet the lower VOC restrictions, and high solids technology is one of them.

RICHARD G. MARCI, *Secretary*

WESTERN NEW YORK . . . NOV.

"Associative Thickeners"

John T. McGroarty, of Nuodex, Inc., presented the Nuodex Gavel to Society President Michael L. DePietro, of Spencer Kellogg Products, NL Chemicals/NL Industries.

Secretary Marko Markoff, reported that letters of appreciation were sent to five member companies for their donations to the special education scholarship fund. Twenty-two other member companies were being contacted to participate in the scholarship fund drive.

Paul Makar, of the New York Society, presented a talk on "FORMULATING WITH ASSOCIATIVE THICKENERS."

Mr. Makar's slide presentation covered the advantages and disadvantages of non-cellulosic, cellulosic (HEC), and HEC urethane (HECUR) associative thickeners in nine latex paint systems. He compared physical performance properties such as viscosity stability, paint settling, flow and leveling, sag resistance, and paint roller spatter.

MARKO K. MARKOFF, *Secretary*



OFFICERS OF THE PITTSBURGH SOCIETY FOR 1986-87: Vice-President—Mark Troutman; Treasurer—J. Edward Threlkeld; President—Anthony J. Isacco, II; Society Representative—Raymond C. Uhlig; and Secretary—Richard G. Marci



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**ST. JUDE CHILDREN'S
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Future Society Meetings

Birmingham

(Apr. 2)—MEMORIAL LECTURE FOR E. A. BEVAN "AMINO RESIN DEVELOPMENT"—R. Barrett, B.I.P. Chemicals Ltd.

Chicago

(Apr. 6)—"NEW INSIGHTS INTO THE CHEMISTRY OF SILICONES FOR THE COATINGS INDUSTRY"—speaker from Byk Chemic USA. "HIGH SOLIDS URETHANE COATINGS"—Bernard Taub, Spencer Kellogg Products, NL Chemicals/NL Industries, Inc.

Golden Gate

(Apr. 13)—"VINYL RHEOLOGY MODIFIED SYSTEMS"—Rick Caudwell, Reichhold Chemicals, Inc.
(May 18)—"ADVANTAGES OF PREDISPERSED POLYETHYLENES AND WAXES IN HIGH PERFORMANCE COATINGS"—Elio Cohen, Daniel Products Co.

Los Angeles

(Apr. 8)—"VINYL RHEOLOGY MODIFIED SYSTEMS"—Rick Caudwell, Reichhold Chemicals, Inc.
(May 13)—"ADVANTAGES OF PREDISPERSED POLYETHYLENES AND WAXES IN HIGH PERFORMANCE COATINGS"—Elio Cohen, Daniel Products Co.

New England

(Apr. 16)—"HEALTH ASPECTS OF ISOCYANATES"—Paul Ziegler, Mobay Chemical Corp.

New York

(Apr. 7)—"UPDATE ON POWDER COATINGS"—Sid Harris, Consultant.
(May 12)—"PAST-PRESIDENTS' NIGHT. PAVAC AWARDS PRESENTATION."

Northwestern

(Apr. 7)—Dwayne Siptak, Southern Clay/E.C.C. America and "EFFECTIVE FILTRATION OF INDUSTRIAL COATINGS"—Carney Likens, Commercial Filters.
(May 5)—"COLOR SAMPLING FOR THE PAINT INDUSTRY"—Donald S. Woelfel,

Colwell/General, Inc. and "PURCHASING"—Chuck Gallagher, Valspar Corp.

Pacific Northwest Portland, Seattle, and Vancouver Sections

(Apr. 14-16)—"VINYL RHEOLOGY MODIFIED SYSTEMS"—Rick Caudwell, Reichhold Chemicals, Inc.
(May 19-21)—"ADVANTAGES OF PREDISPERSED POLYETHYLENES AND WAXES IN HIGH PERFORMANCE COATINGS"—Elio Cohen, Daniel Products Co.

Philadelphia

(Apr. 10)—AWARDS DINNER
(May 14)—"EPOXY MASTIC COATINGS"—Orville E. Brown, M.A. Bruder & Sons, Inc.
(June 5)—ANNUAL GOLF OUTING

Piedmont

(Apr. 15)—"CAREER ENHANCEMENT"—Richard Fayssoux, Jr., Eastman Chemical Products, Inc.
(May 20)—"CURRENT DISPERSION MILLING METHOD"—Armin Szatmary, Premier Mill Corp.
(June 17)—"AN INTRODUCTION TO APPEARANCE ANALYSIS"—Richard W. Harold, Hunter Associates Laboratory, Inc.

Pittsburgh

(Apr. 6)—"NEW EPOXY RESINS TECHNOLOGY"—Marcel Gaschke, CIBA-GEIGY Corp.
(May 4)—"IN-STORE COMPUTER MATCHING"—Dennis Dempsey, Color Corp. of America.

Rocky Mountain

(Apr. 6)—"VINYL RHEOLOGY MODIFIED SYSTEMS"—Rick Caudwell, Reichhold Chemicals, Inc.
(May 11)—"ADVANTAGES OF PREDISPERSED POLYETHYLENES AND WAXES IN HIGH PERFORMANCE COATINGS"—Elio Cohen, Daniel Products Co.

St. Louis

(Apr. 21)—MANUFACTURING SEMINAR.
(May 19)—ELECTION OF OFFICERS.
(June 12, 13)—JOINT MEETING WITH KANSAS CITY SOCIETY.

Elections

CHICAGO

Active

- ABE, AMY—Sherwin Williams Co., Chicago, IL.
ALBRECHT, RUDY C. JR.—Accurate Coatings & Dispersions, South Holland, IL.
AMES, WILLIE L.—United Coatings Inc., Chicago.
BAUGHMAN, BARRY—Koch Asphalt Co., Chicago.
BELL, ROBERT P.—Olympic Stain, Batavia, IL.
BOLT, GARY L.—United Coatings Inc., Chicago.
DENNIS, FRANCIS G.—Masonite Corp., St. Charles, IL.
GUPTA, GOVTAM—Sherwin Williams Co., Chicago.
HIGGINS, DANIEL G.—Accurate Coatings & Dispersions, South Holland.
JANIGA, EUGENE R.—Masonite Corp., St. Charles.
JONES, OSBURN B.—O'Brien Corp., South Bend, IN.
KAMYKOWSKI, GREGORY W.—Masonite Corp., St. Charles.
MACDONALD, MICHAEL J.—Masonite Corp., St. Charles.
MARTINEZ, GUSTAVO—Carbit Paint Co., Chicago.
MATHIS, WILLIAM J.—Morton-Thiokol/Bee, Lansing, IL.
MEMON, ABDUL K.—United Coatings Inc., Chicago.
MORAN, DANIEL E.—Rock-Tred Corp., Skokie, IL.
PAIDIPATI, JAITHAR J.—Midwest Lacquer Mfg. Co., Schiller Park, IL.
PORONSKY, CHRISTOPHER J.—Graham Paint & Varnish, Chicago.
REXING, WALTER J.—United States Gypsum, Libertyville, IL.
RIGHIETINI, ROBIN F.—Masonite Corp., St. Charles.
RUDNY, ROBERT P.—Accurate Coatings & Dispersions, South Holland.
VALUKAS, JAMES L.—Accurate Coatings & Dispersions, South Holland.
WESTINK, STEVEN G.—Cellofilm Corp., Chicago.
YAPP, WILLIAM J.—Carbit Paint Co., Chicago.

Associate

- CHRISTMAN, BOB—Monsanto Corp., Rosemont, IL.
DULAK, CHARLOTTE F.—Atlas Electric Devices, Chicago, IL.
EICHMILLER, RALPH M.—Angus Chemical Co., Northbrook, IL.
JONES, JACK F.—SCM Pigments, Naperville, IL.
LATHIE, ROBERT K.—Atlas Electric Devices, Chicago.
LIEBERMAN, ROBERT A.—Occidental Chemical, Naperville.
MACK, MICHAEL L.—Fitz Chemical Corp., Chicago.
MAZZARELLA, TONY R.—AZS Corp., Clarendon Hills, IL.

- McNAMARA, E. TED—Seegott Inc., Solon, OH.
NIKOLA, RAY L.—Harshaw/Filtrol Partnership, Mundelein, IL.
POLAK, JOSEPH J.—Occidental Chemical, Naperville.
ROBINSON, KEITH A.—Du Pont Co., Hoffman Estates, IL.
SACCO, DANIEL L.—Tony Sacco Pigments, Chicago.
SHORT, THOMAS L.—Reichhold Chemicals, Oak Brook, IL.
STANWYCK, D. BRETT—American Cyanamid Co., Mt. Prospect, IL.
SWORDS, MIKE—Maroon Chemical Group, Elmhurst, IL.
VOLINI, FRANK A.—U.S. Movidyn, Chicago Heights, IL.
ZANE, WILLIAM A.—Occidental Chemical, Naperville.
ZAPP, ROBERT S.—Cyprus Minerals, Arlington Heights, IL.

Educator/Student

- AHMED, SHARE U.—DePaul University, Chicago, IL.

LOUISVILLE

Active

- CHANEY, EDWARD N. JR.—Harshaw/Filtrol Partnership, Louisville, KY.
SIMPSON, JAMES U.—Reliance Universal, Louisville.
STEWART, DONALD R.—Interez Inc., Louisville.
STURTZEL, PATRICIA H.—George Whitesides Co., Louisville.

Associate

- BOGGESE, ERIC—William B. Tabier Co., Louisville, KY.
GUNDLACH, EUGENE C.—Maroon Chemical Group, Cincinnati, OH.
VOLINI, FRANK—U.S. Movidyn Corp., Chicago Heights, IL.

MONTREAL

Active

- ATTARMIGROGLU, DIRAN—Sico Inc., Outremont, Quebec.
BORDELEAU, RICHARD P.E.—Toioxide Canada Inc., Sorel, Quebec.
BRIAND, REMI—International Paint, Montreal, Quebec.
CROCHETIERE, RENE—Peintures Can-Lak Inc., Daveluyville, Quebec.
JOSSINET, PHILIPP F.—Chemcraft Sadolin, Princeville, Quebec.
MURRAY, STEVENS—Sico Inc., Outremont.

Associate

- BELISLE, GILLES—National Research Council, Montreal, Quebec.
BEST, WAYNE D.—APCO Industries Co., Montreal.
BRODEUR, GISELE G.B.—Produits Nacan, Boucherville, Quebec.
CHABOT, MARC-ANDRE—Mulco Inc., St. Hubert, Quebec.
DROUIN, MARIE-JOSEE—Hercules Canada Incorporated, Montreal.
HART, JASON G.—Hoechst Canada Inc., St. Laurent, Quebec.
LAVIOLETTE, RICHARD C.—Stanchem, Lachine, Quebec.
LUSSIER, PIERRE—Manville Canada Inc., Pointe Claire, Quebec.
MYERS, ROBERT G.—CDN General Electric, Montreal.
ROACH, ALLAN E.—Stochem Inc., Dorval, Quebec.
ROBERTSON, JOHN D.—Technitrol Canada Ltd., Pointe Claire.

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Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's Market Square, Towson, MD). HELEN KEEGAN, Valspar Corp., 1401 Severn St., Baltimore, MD 21230. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). D.M. HEATH, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ England.

CHICAGO (First Monday—meetings alternate between Como Inn in Chicago and Sharko's West in Villa Park). EVANS ANGELOS, Kraft Chemical Co., 1975 N. Hawthorne Ave., Melrose Park, IL 60160.

CDIC (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; and Nov., Feb. in Dayton). CAROLYN TULLY, Sun Chemical Corp., 4526 Chickering Ave., Cincinnati, OH 45232.

CLEVELAND (Third Tuesday—meeting sites vary). R. EDWARD BISH, Jamestown Paint & Varnish Co., 108 Main St., Jamestown, PA 16134.

DALLAS (Thursday following second Wednesday—Executive Inn. Near Lovefield Airport). BRUCE ALVIN, DeSoto, Inc., P.O. Box 461268, Garland, TX 75046.

DETROIT (Fourth Tuesday—meeting sites vary). JOANNE CEDERNA, BASF Immont Corp., 26701 Telegraph Rd., Southfield, MI 48086.

GOLDEN GATE (Monday before third Wednesday—Alternate between Francesco's in Oakland, CA and Leaning Tower Restaurant in S. San Francisco). ERNEST SOLDAVINI, Nuodex Huls, 5555 Sunol Blvd., Pleasanton, CA 94566.

HOUSTON (Second Wednesday—Look's Sir-Loin Inn, Houston, TX). JAMES TUSING, PPG Industries, Inc., P.O. Box 1329, Houston, TX 77251.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). ROGER HAINES, Tnemec Co., Inc., P.O. 1749, Kansas City, MO 64141.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). PARKER PACE, Behr Process Corp., P.O. Box 1287, Santa Ana, CA 92702.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). LOUIS HOLZKNECHT, Devco Marine Coatings, 1437 Portland Ave., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary).

MONTREAL (First Wednesday—Bill Wong's Restaurant). R. FERRIS, Canbro Ltd., 29 E. Park St., Valleyfield, Que., Canada J6S 1P8.

NEW ENGLAND (Third Thursday—LeChateau Restaurant, Waltham, MA). ROGER WOODHULL, California Products Corp., P.O. Box 569, Cambridge, MA 02139.

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

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). RICHARD KARLSTAD, Ceramic Industrial Coatings, 325 Hwy. #52-South, Osseo, MN 55396. WINNIPEG SECTION (Third Tuesday, Marigold Restaurant)—NEIL WEBB, Phillips Paint Products Ltd., 95 Paquin Rd., Winnipeg, MB, Canada R2J 3V9.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). JOHN DALLER, McCloskey Corp., 4155 N.W. Yeon, Portland, OR 97210.

PHILADELPHIA (Second Thursday—Williamson's, GSB Bldg., Philadelphia, PA). LAWRENCE J. KELLY, Peltz-Rowley Chemicals, 5700 Tacony St., Philadelphia, PA 19135.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood Exit of I-85, High Point, NC). BARRY YORK, Reliance Universal, Inc., P.O. Box 2124, High Point, NC 27261.

PITTSBURGH (First Monday—Montemurro's, Sharpsburg, PA). RICHARD G. MARCI, Royston Laboratories, 128 First St., Pittsburgh, PA 15238.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's Arvada, CO). JEFFREY B. JOHNSON, Sashco, Inc., 1395 S. Acoma, Denver, CO 80223.

ST. LOUIS (Third Tuesday—Salad Bowl). ROBERT L. WAGNON, Mozel Chemical Products Co., 4003 Park Ave., St. Louis, MO 63110.

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; Miami Section—Tuesday prior to Central Florida Section—R. SCOTT MCKENZIE, Southern Coatings & Chemicals, P.O. Box 2688, Sumter, SC 29150.

TORONTO (Second Monday—Cambridge Motor Hotel). LARRY HAM, Stochem Inc., 5200 Dixie Rd., Suite 201, Mississauga, Ont., Canada L4W 1E4.

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

NEW YORK

Retired

VANDERBILT, GEORGE C.—Laurence Harbor, NJ.

PHILADELPHIA

Active

AVILES, JULIO I.—NL Chemicals Inc., Hightstown, NJ.
BARTON, JOAN E.—Reichhold Chemicals, Dover, DE.
GOLDBAUM, RICHARD H.—DuPont Co., Deepwater, NJ.
HARRIS, CAROL L.—Omega Chemical Co., Mickleton, NJ.
LAW, DAVID A.—Triple G Coatings, Riverton, NJ.
MOYERS, HAROLD I.—Classic Paint Co., Penns Grove, NJ.
PFAFF, FREDERICK A.—Stonhard, Inc., Maple Shade, NJ.
SCHINDLER, MARK S.—Stonhard, Inc., Maple Shade.
SHACHAT, NORMAN—Amchem Products Inc., Horsham, PA.
WELP, GARY A.—McCloskey Corp., Wayne, PA.
WHITE, TODD W.—Pennsbury Coatings, New Britain, PA.

Associate

BOZELLI, DONALD V.—Saturn Chemicals, Philadelphia, PA.
KLEPPINGER, E. GLENN—Silberline Mfg. Co., Lansford, PA.
LARGENT, RALPH A.—McCloskey Corp., Philadelphia.
MCLELLAND, THOMAS A.—Chemcentral Corp., Paoli, PA.
PRZYUSKI, STEPHEN S.—Brandywine Packaging, Downingtown, PA.

WESTERN NEW YORK

Active

FOSS, BETTY J.—Pierce & Stevens Inc., Buffalo, NY.
GERLACH, WILLIAM A.—Pratt & Lambert Inc., Buffalo.
HEPP, STEVEN E.—Pierce & Stevens Inc., Buffalo.
MC CALL, DEBORAH A.—NL Chemical/Spencer Kellogg Products, Buffalo.
SUCHAN, SCOTT D.—Pierce & Stevens Inc., Buffalo.
VAN ORDER, CURTIS J.—Pratt & Lambert Inc., Buffalo.

AFFILIATED

GAUTIER, PEDRO—Performance Chemicals Inc., San Juan, Puerto Rico.
NAKANO, SHIRO—Oji Paper Co., Ltd., Nichinan-Shi, Miyazaki-Ken, Japan.
NOMAGUCHI, KANEMASA—Hitachi Chemical Co., Ltd., Ibaraki, Japan.

People

Cavedon Chemical Co., Inc., Woonsocket, RI, has named **Lawrence B. Cohen**, Executive Vice-President. He will take on a variety of international marketing and diverse non-technical activities. Mr. Cohen is a member of the New England Society.

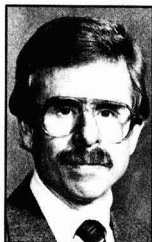
Hercules Incorporated, Wilmington, DE, has appointed **Lonnie U. Haynes, Jr.**, an Account Supervisor for coatings and additives sales in its Technical Marketing Group. Mr. Haynes formerly was Account Supervisor for water-soluble polymers in specialty markets in the midwestern region.

Inolex Chemical Co., Philadelphia, PA, has appointed **Howard L. Brainard**, Marketing Manager, resins and additives. He will be responsible for total product line management for high performance specialty resins and additives developed specifically for use in paints and coatings, plastics, textiles, adhesives, and elastomer applications. In addition, Mr. Brainard will be charged with market development for specialty urethane products.

Wilbur Mardis has been promoted to Director of Technology for Spencer Kellogg Products, NL Chemicals, Inc., Hightstown, NJ. Dr. Mardis will assume responsibility for directing research, development, and technical service programs at the company's Buffalo, NY, laboratories.

Akzo Coatings America, Inc., Troy, MI, has named **Peter A. Scolari**, Associate Director of Manufacturing and promoted **Rosemary Brady** to Director of the Zinc Products and Analytical Lab. Mr. Scolari previously served as Paint Area Manager for the Ford Motor Co.'s paint operations. Ms. Brady, who joined the company in 1979, is a member of the Detroit Society.

James N. McDerby, Jr., Sales Manager of F.R. Hall, Inc., St. Louis, MO, announced that **Thomas W. Hilton** has been appointed Technical Sales Representative and **H. Jeff Laurent** has been promoted to District Sales Manager for the company's Kansas City operations. Mr. McDerby is a member of the St. Louis Society. Mr. Hilton and Mr. Laurent are members of the Kansas City Society.



L.B. Cohen



L.U. Haynes



W.M. Schmidt



L.A. Wigdor

William M. Schmidt has been named Vice-President, Marketing and Strategic Planning for Georgia Kaolin Co., Union, NJ, and the Pulp and Paper Div. of Sprout-Bauer. Mr. Schmidt previously was Director, Corporate Marketing at Combustion Engineering, Inc.

The Board of Directors of Arthur D. Little, Inc., Cambridge, MA, elected **Stephen Rudolph** a Vice-President. Dr. Rudolph, who joined the company in 1976, is Manager of the product technology section of the firm.

Eugene Elzy, President of the Emulsion Polymers Div. of Reichhold Chemicals, Inc., White Plains, NY, has been elected to the Board of Directors of the National Paint and Coatings Association.

Day-Glo Color Corp., Cleveland, OH, announced the promotions of **Larry A. Caughlin** to Vice-President of Marketing and **Terry J. Smith** to Vice President of Sales. Mr. Caughlin joined the company in 1968 and most recently served as Printing Industry Marketing Manager. Mr. Smith previously was District Manager in Houston.

The American Cyanamid Co., Wayne, NJ, has appointed **Douglas L. Esse, Jr.**, Product Manager, specialty monomers for the Process Chemicals Dept. Mr. Esse joined the company in 1981.

PPG Industries, Pittsburgh, PA, announced the election of **Edward J. Mazeski, Jr.**, as Vice-President and Secretary. Mr. Mazeski joined the firm's law department in 1963 and has been Secretary and Associate Counsel since 1976.

Lawrence A. Wigdor has been named President and Chief Operating Officer of Nuodex Inc., Piscataway, NJ, succeeding **Frank X. Dwyer** who becomes Chairman and Chief Executive Officer of the company.

In addition, the Board of Directors announced that **Lawrence Okun** has been promoted from Senior to Executive Vice-President and that **Alex Lietmann** will join Nuodex as an Executive Vice-President.

David M. Setzer has been promoted to the newly created position of Vice-President—Commercial Development at The McCloskey Corp., Wayne, PA. Mr. Setzer will be responsible for acquisitions and mergers, technology licensing, joint ventures, and strategic planning for the company's Specialty Polymers Div.

Colin Campbell has been named Plant Manager and **Larry Lough**, Technical Manager of the Sun Chemical Corp.'s Dispersions Div., Amelia, OH. Mr. Campbell will have complete responsibility for the manufacturing and technical functions at the facility. Mr. Lough will oversee the development of new dispersions, quality and process control, and technical service.

A series of appointments in the Industrial Chemicals & Solvents Division of Ashland Chemical Co., Columbus, OH, has taken place. Named to managerial posts were: **Brian Edwards**—District Manager, Moline, IL; **Bob Baird**—District Manager, Dallas, TX; **Mike Jakovich**—District Manager, Denver, CO; **Steven Ansley**—Branch Manager, Bakersfield, CA; and **Gregory R. Keriazakos**—Branch Manager, Baltimore, MD.

ORDER FORM

Quantity		Price	Total
Journal of Coatings Technology:			
	U.S. and Canada	Europe (Air Mail)	Other Countries
_____ 1 Yr.	\$27	\$55	\$40
_____ 2 Yrs.	51	107	77
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New Federation Series on Coatings Technology (\$5.00 ea.)			
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_____	"Introduction to Polymers and Resins"—J. Prane (7M86003)		_____
_____	"Solvents"—W.H. Ellis (7M86004)		_____
_____	"Coil Coatings"—J.E. Gaske (5M87005)		_____
_____	"Corrosion Protection by Coatings"—Z.W. Wicks, Jr. (5M87006)		_____
Audio/Visual Presentations (Slide/tape except where noted)			
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_____	Laboratory Test Procedures (VHS format)	(\$50)	_____
_____	Federation Training Series on Test Methods	(\$70)	_____
_____	Paint/Coatings Dictionary	(Mbr. - \$30; Non-Mbr. - \$50)	_____
_____	Infrared Spectroscopy Atlas	(Mbr. - \$75; Non-Mbr. - \$100)	_____
_____	Color-matching Aptitude Test Set	(\$400)	_____
Pictorial Standards of Coatings Defects			
_____	Complete Manual	(\$90)	_____
	Individual Standards (\$3 ea., plus \$3 per photo as noted)		
_____	Adhesion (1)	Blistering (4)	Chalking (1)
_____	Checking (1)	Cracking (1)	Erosion (1)
_____	Fillform Corrosion (3)		Flaking (2)
_____	Mildew (3)	Print (1)	Rust (4)
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Intensive Short Courses in Coatings Science Offered by North Dakota State University in June

Three short courses in coatings science will be presented by the North Dakota State University Department of Polymers and Coatings in June. "High Solids Coatings," "Radiation Curable Coatings," and a basic course in "Coatings Science," are intensive, yet informal courses, including discussion sessions held in the evening and opportunities for individual discussions with the faculty.

"High Solids Coatings" will be offered June 3-6, and will be taught at a research level with emphasis on how organic, physical, and polymer chemistry concepts are being applied to practical problems. The course will be taught by Dr. Frank N. Jones, Chair of the Department of Polymers and Coatings; Dr. S. Peter Pappas, Professor of Chemistry and Polymers and Coatings; Dr. Marek W. Urban, Associate Professor of Mathematical Science; and Dr. Loren W. Hill, Adjunct Professor of Polymers and Coatings and a Science Fellow with Monsanto Plastics and Resins.

Topics of discussion include rheology of clear and pigmented coatings, polymers, oligomers, the selection of curing agents and catalysts, analysis of coatings, and properties of coatings films.

"Radiation Curable Coatings," scheduled for June 8-10, will be taught by Dr. Jones and Dr. Pappas. Among the topics to be discussed are: application of UV-EB curing; design considerations for UV curable coatings highlighting interrelationships of light intensity; photoinitiators concentration and film thickness; principles of EB curing; photoinitiators for radical and cationic polymerization; resin design for radiation curable coatings in relationship to

specific applications, including electronics; and recent advances in radiation curing.

"Coatings Science," June 15-26, will offer integrated coverage of the scientific foundations of coatings technology with examples of their application. Focus will be on the chemistry of resins and cross-linkers; physical chemistry governing coatings behavior; coatings formulation and application; low VOC coatings; and current

topics. In addition to Drs. Jones, Pappas, and Urban, the course will be taught by Dr. Zeno W. Wicks, Jr., Professor Emeritus of NDSU.

For additional information, contact Dr. Frank N. Jones, Dr. S. Peter Pappas, or Dr. Marek W. Urban, Polymers and Coatings Dept., North Dakota State University, Fargo, ND 58105.

Book Review

FORMALDEHYDE RELEASE FROM WOOD PRODUCTS

Edited by

B. Meyer, B.A. Kottes Andrews and R.M. Reinhardt

Published by

American Chemical Society
Washington, DC
1986, vii + 240 pages, \$49.95

Reviewed by

P.S. Roy
Whirlpool Corporation
Benton Harbor, MI 49022

This book contains 18 papers presented at the American Chemical Society's Division of Cellulose, Paper, and Textile Chemistry Symposium.

A comprehensive account of work carried out by wood product industries and related research organizations in recent years is outlined in this book. The presentations, in general, cover the formaldehyde emission phenomenon from various wood panel products, measurement techniques, procedures in the laboratory and other appropriate settings, and information related to current regulations and guidelines of formaldehyde emission in the U.S. and Europe.

Chapters One to Four start with an overview of the subject and deal with the phenomenon of formaldehyde emission from particleboard, fiberboard, and soft and

hard plywoods. The next three chapters describe the chemistry of formaldehyde resin compounds, the reaction between cellulose and formaldehyde, and the etherification of the accessible cellulose which results in crosslinking the long-chain polymers with each other, creating a rigid and dimensionally stable structure—the secret of cotton durable press finish. These chapters also explain the mechanism of formaldehyde storage in wood. This reaction is reversible and later releases formaldehyde. Of particular interest were the chemistry and structure reviews of urea-formaldehyde from the colloidal dispersion approach, suggested by T.J. Pratt and his co-workers, rather than from simple condensation chemistry. Chapters Eight and Nine deal with test procedures and Chapter Ten describes the enzymatic methods for trace analysis of formaldehyde. The next six chapters deal with the relationships between formaldehyde release and the amount present in wood products in general. Chapters Fifteen to Eighteen refer to ways of reducing formaldehyde released from wood products, and the environmental and regulatory guidelines for formaldehyde emission.

The presentations in this book are complemented by informative tables, graphs, figures, and photographs. The authors cite a number of relevant references which would be useful for scientists in this field.

This is an excellent collection of information, theories, and test results on the subject. It will be valuable for chemists, principally those involved in the wood product industry, chemical industry, research and educational institutions, and environmental control agencies.

Scandinavian Technologists Will Hold XIIIth Congress In Finland, May 9-11, 1988

Arja Saloranta, President of the Federation of Scandinavian Paint and Varnish Technologists, has announced that the XIIIth Congress of the FSPVT will be held in Helsinki, Finland from May 9-11, 1988. The languages of the Congress will be English, Swedish, Danish, and Norwegian. Papers dealing with an important aspect of paint and varnish technology are invited. Please write to Mrs. Saloranta at: Tikkurila Oy, PB 53, SF-01301 Vanda, Finland.



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This revised and expanded 896-page book (by the Chicago Society for Coatings Technology, 1980) contains a compilation of 1433 spectra, fully indexed, of materials commonly used in the coatings industry. Spectra of many recently marketed materials are included, as well as examples of Fourier transform infrared spectra.

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

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

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Solvent Selection System

A computer-aided solvent selection system aimed at helping paint manufacturers and formulators modify or develop solvent systems is the topic of technical literature. For more information on CASS, contact Dow Communications, The Dow Chemical Co., Midland, MI 48640.

Iron Oxides

An eight-page, four-color guide describes the properties and application of pure synthetic iron oxides. Contained in the brochure are a color index, and the particle size, oil absorption, and hiding power properties of iron oxide pigments. For more information on Mapico[®] synthetic iron oxides, write to Columbian Chemicals Co., Colors & Specialties, P.O. Box 37, Tulsa, OK 74102.

Oxygenated Solvent

A high-boiling oxygenated solvent was introduced in recently released literature. The solvent possesses low toxicity and broad solvent powers. Complete product data and material safety data sheets on Arconate[™] Propylene Carbonate are available from the Marketing Communications Dept., ARCO Chemical Co., 1500 Market St., Philadelphia, PA 19102.

Carbon Blacks

A new product bulletin focuses on the physical and chemical properties and typical applications of industrial carbon blacks. Write to Columbian Chemical Co., Colors & Specialties, P.O. Box 37, Tulsa, OK 74102 for information on Raven[®] furnace blacks.

Antistatic Agents

A paper discusses in detail the relative merits of old and new antistatic agents, applications data, and typical formulations. The literature highlights the new generation of non-blocking antistatic agents for polymer compositions which are soluble in polyolefins, polyesters, and polystyrenes, are stable during processing, and maintain performance without requiring environmental moisture. For a copy of "Ken-Stat[™]—A New Generation of Non-Blooming Agents Based on Combined Neoalkoxy Organometallics," write to Kenrich Petrochemicals, Inc., P.O. Box 32, Bayonne, NJ 07002-0032.

Shipping Container

A semi-bulk shipping and storage container for safe handling of hazardous liquids, including acids, corrosives, and caustics, has been introduced in literature. The container consists of a polyethylene tank enclosed in a heavy-duty fabricated steel frame. Further information on the Poly Jumbo[™] Bin bulk shipping and storage container is available from Clawson Tank Co., 4701 White Lake Rd., Clarkston, MI 48016-0350.

Progressive Pumps

Literature describes progressive cavity pumps and closed piping systems. They provide a method of transporting high viscosity, high solids content materials over long distances and high lifts. The pumps are designed to move a range of materials including dewatered sludges, manufacturing process wastes, and other materials. Further details on the Nemo[®] NESP pumps are available from Netzsch Inc., 119 Pickering Way, Exton, PA 19341-1393.

Precision Flow Instruments

An overview of precision flow instruments is provided in a four-page brochure. Various options for the sensor, electronics, and enclosure are listed along with some sample applications. For a copy of the brochure (No. 5K986), write Intek Inc., 515 Schrock Rd., Columbus, OH 43229-1027.

Corrosion Lining System

A full color, eight-page, technical brochure introduces a lining system engineered for high corrosion resistance, high erosion resistance, and high temperature resistance. The brochure features color photographs, design properties, charts, and data. Further information on Pyroite 7000 can be obtained by contacting D. Keehan, Pyroite Coatings, Inc., P.O. Box 74, Avon, OH 44011.

Mixer-Kneader

Information is available on a mixer-kneader which combines a low-speed anchor blade, an infinitely variable high-speed dissolver blade, and infinitely variable speed double kneading arms operating simultaneously in a single container. Write Netzsch Inc., Grinding and Dispersion Dept., 119 Pickering Way, Exton, PA 19341-1393 for more information.

Centrifuge

Information is available on a micro centrifuge which has acceleration up to 13,000 maximum rpm in 10 seconds. The compact centrifuge weighs 12 pounds and includes dual speed selector, safety lid lock, 10-minute timer, pulse switch, and open lid light. For more details, write Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07762-6001.

Hydroxyl Polyester Resin

A hydroxyl terminated polyester resin that possesses low color and produces polyester/urethane coatings with smooth finishes and low formulated resin is the subject of recently released literature. The resin maintains gloss and mechanical properties at high filler loadings. To receive a technical data sheet that contains information on weathering, filler concentrations, and curing agent concentrations for Arakote[®] 3109, write CIBA-GEIGY Corp., Plastics Dept., Three Skyline Dr., Hawthorne, NY 10532.

Cellulosic Resins

Material safety data sheets are available on two new carboxylated cellulosic resins which exhibit low solution viscosities, adhesion to numerous substrates, and pigment-wetting characteristics. The cellulose resins are available in dry powder domestically and internationally. For additional information and a MSDS on Eastacel[™] 1420 and Eastacel 1412 resins, contact Georgie Wright, Eastman Chemical Products, Inc., Chemicals New Products, Technical Service and Development Div., P.O. Box 431, Kingsport, TN 37662.

Optical Spectrum Analyzers

Details on optical multichannel spectrum analyzers are presented in a product bulletin. The systems consist of a common detector controller/spectral processor and a series of interchangeable linear diode array detection modules. The series is used in spectroscopic applications such as fluorescence, plasma diagnostics, emission spectroscopy, transmission spectroscopy, astronomy, and other applications. For more facts on the Model 1450 series, contact John Zipper, EG&G Princeton Applied Research, P.O. Box 2565, Princeton, NJ 08543-2565.

Digital Viscosity Controller

A product bulletin details a new digital viscosity controller that is programmed at the factory to read out either of two cup sizes selected by the operator. Other features include high and low viscosity alarms, and low solvent and low reservoir alarms. Write Norcross Corp., 255 Newtonville Ave., Newton, MA 02158, for complete information.

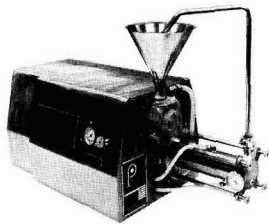
Copolymer Resin

Information is available on a new high solids copolymer resin designed for fast air-dry metal or wood coatings. The vinyl toluene alkyd copolymer is available at 75% nonvolatile in a blend of methyl propyl ketone and xylene. For details on Varcopol 496-75 MPK, contact Rita Frusco, The McCloskey Corp., 7600 State Rd., Philadelphia, PA 19136.

Curing Agent

A low viscosity curing agent designed specifically for use with unmodified liquid epoxy resins for the formulation of solventless high performance coatings is the subject of literature. The modified aromatic amine provides resistance to a variety of commonly used industrial chemicals. A technical data sheet detailing physical properties and chemical resistance testing over a 12-month period is available on Hardener XB 3075 by writing the Plastics Dept., CIBA-GEIGY Corp., Three Skyline Dr., Hawthorne, NY 10532.

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Bench Mills

A product bulletin details bench size small media mills. The mills are interchangeable between either peg-type or disc-type ball agitation systems. They are designed for research, development, and laboratory test applications. Contact the Grinding & Dispersion Dept., Netzsch Inc., 119 Pickering Way, Exton, PA 19341-1393 for information on the LME/LMJ mills.

Technical Products

A four-page technical product brochure features polyurethanes, copolymers, varnishes, and high solid resins for the coatings manufacturer. The brochure provides data on nonvolatile weight, solvent, viscosity, oil type, and uses for the range of products available in the four categories. For a copy of the brochure, contact David Setzer, The McCloskey Corp., 724 W. Lancaster Ave., Wayne, PA 19087.

Test Instruments

A 14-section, 85-page hardbound catalog featuring over 100 physical test instruments is available. Each type of instrument is pictured and described with a listing of accessories, options, test methods, and ordering guide. To obtain a copy of "Gardner Laboratory Physical Test Instruments," contact Gardner Laboratory, Pacific Scientific, Instrument Div., 1100 East-West Highway, Silver Spring, MD 20910.

Environmental Monitoring Instrument

Newly published information focuses on an automatic instrument designed for the analysis of trace organics in environmental monitoring. The instrument provides desorption, inert low volume interface, and optional automatic concentration of samples using cold trap unit to assure efficiency of columns. For more information on the Carlo Erba TDAS 5000, contact Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001.

Glossmeter

Information is available on a glossmeter with instant statistics and print-out. The glossmeter meets international specification criteria without recording figures and without calculations. For details on the Model 401 Statistical Glossmeter, contact Elcometer Inc., 1180 E. Big Beaver, Troy, MI 48083.

Resins Study

Tackifying resins are the subject of a techno-economic multi-client study. The study provides detailed information on: demand, projections, applications, markets, suppliers, end users, technological shifts, and marketing trends for rosin and derivatives, synthetic hydrocarbons, polyterpenes, and other resins. A free brochure with Table of Contents is available from Skeist Laboratories, Inc., 112 Naylor Ave., Livingston, NJ 07039.

Color Guide

A four-page color guide includes descriptions and sample color chips for standard colors in a line of aliphatic and aromatic polyurethane coatings. The guide also provides instructions for pastel mixing and maintenance comparison summaries. To obtain a free copy of bulletin DS-10-7002D and more information on Chemglaze[®] polyurethane coatings, write Lord Corp., Industrial Coatings Div., 2000 W. Grandview Blvd., P.O. Box 10038, Erie, PA 16514-0038.

Labeling Software Programs

A labeling software program that complies with OSHA's Hazard Communication Standard is the subject of a recently released product bulletin. The program will automatically look up hazardous ingredients and determine weight percent, boiling range, specific gravity, flash point, and more. Details on the HMIS Labeling software programs are available from Pacific Micro Software Engineering, 6511 Salt Lake Ave., Bell, CA 90201.

Colorless Solvent

A new solvent for use in water-borne and conventional coatings and inks is detailed in a product bulletin. Ethylene glycol monopropyl ether is a slow-evaporating, low-odor, colorless solvent completely miscible with water over a wide temperature range. The solvent can also provide short drying times because of its evaporation rate. Further information on Propyl Cellosolve[®] solvent can be obtained by writing the Union Carbide Corp., Solvents and Coatings Materials Div., Dept. L4488, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Hydrocarbon Detection

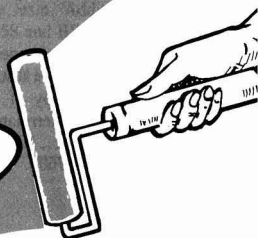
A detection method for volatile hydrocarbons in water is highlighted in recently released literature. The method provides a totally automated procedure for quantitative results at ppb levels and counteracts the broadening of the water peak by allowing water vapors to pass through the cell in the shortest possible time. Information on the ECD-40 Electron Capture Detector is available from Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001.

Zinc Flake Pigment

A new decorative zinc flake pigment for use in corrosion-resistant coatings where a bright, metallic appearance is desired is highlighted in a technical product bulletin. The new zinc flake combines the galvanic protection of zinc with the bright metallic appearance of a flake particle. The pigments are intended for use in solvent based solutions and powder coatings. For more information, write Novamet Specialty Products Corp., 10 Lawlins Park, Wyckoff, NJ 07481.

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**STRODEX MOK-70
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STRODEX P-100**

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dexter Chemical Corporation

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Polymer Vehicles

Two new high slip polymer vehicles offering high gloss, rub, and nonblocking characteristics are described in literature. Both products are based on new patented resin technology which results in high slip polymers in a water-borne polymer system. For details on Joncryl 97 and SCX-616, write Johnson Wax Specialty Chemicals Division, 1525 Howe St., Racine, WI 53403.

Glycol Ethers

Bulletins highlight the use of propylene-based glycol ethers as effective, low toxicity substitutes for E-series products in coating and cleaner applications. The literature offers formulation data and performance comparisons of the glycol ethers and acetates versus ethylene-based products. Copies of the bulletins are available from ARCO Chemical Co., Marketing Communications Dept., 1500 Market St., Philadelphia, PA 19102.

Tester

A new full-color publication describes a device which allows multiple tests on one instrument. For a free copy of "Impact Tester," contact John S. Herrmann, C.W. Brabender Instruments, Inc., 50 E. Wesley St., S. Hackensack, NJ 07606.

Automatic Titrator

The introduction of an automatic titrator with storage, built-in data interface, and a built-in interface for connection of a graphics dot matrix printer is featured in literature. The titrator is designed to perform potentiometric, voltametric, photometric, and Karl Fischer titrations. It has storage capacity for 40 methods and parameters for 20 reagents. More information on the DL40GP is available from Bill Tropia, Sales Promotion Manager, Analytical Instruments, Mettler Instrument Corp., Box 71, Hightstown, NJ 08520.

Grinding Media

A zirconium fortified grinding media for high-speed milling in small media mills is described in recently released literature. Applications include grinding and dispersing of organic and inorganic materials for coatings, pigments, pastes, and chemicals. Samples of Zarsil[®], for lab testing, are available by contacting Robert B. Campanelli, Ferro Corp., Porcelain Plant, 1230 Railroad St., East Liverpool, OH 43920.

Ketone Resins

A 16-page brochure details the properties and primary advantages of a family of ketone resins. Paint applications highlighted include spray coatings, roadmarking paints, and metal, wood or paper lacquers. Contact Nuodex, Inc., A Hüls Co., P.O. Box 365, Piscataway, NJ 08854 for more information.

Tank Calibration System

A volumetric prover for calibration of liquid tanks has been introduced in a data sheet. The prover creates a picture of the tanks' profile and is designed to take into consideration all factors, such as sloped bottoms, horizontal tank irregularities, etc. The system consists of a cart-mounted pump and master flow meter. Contact S.J. Controls, Inc., P.O. Box 91059, Long Beach, CA 90809 for more details.

Macerator

Information is available on an instrument that chops, grinds, and prepares solids, entrained in liquids, for pumping and processing. They are available with capacities from 30 to 300 gpm and can grind organic and inorganic materials down to particle size of $\frac{3}{8}$ inches or less. Write Netzsch Inc., 119 Pickering Way, Exton, PA 19341-1393 for more details.

Chromatography Columns

Design and performance characteristics of cartridge columns are described in a recently published 16-page technical bulletin. Tools and techniques that permit the chromatographer to obtain the maximum utility and lifetime of liquid chromatography columns are addressed. Cost comparisons and care and maintenance of cartridge columns are discussed. To receive a free copy of the technical bulletin LCTB-3, write The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012.

Job Safety Courses

A revised group of self-study industrial training courses are the subject of recently released literature. The courses use modern techniques to help companies train workers in basic safety principles and safe work practices. Each course contains a self-study workbook with an answer key for trainees and a leader's manual explains how to administer the program and teach each course. For more information, contact The Du Pont Co., Safety Services, Barley Mill, P19-1210, Wilmington, DE 19898.

Grind Mills

A product bulletin describes a continuous grind mill and its method of superfine grinding and dispersing. The mills are designed for grinding materials with viscosities between 200 and 60,000 cps with solids content between 10 and 85%. Further details on the Molinex Small Media Mills are available from Grinding and Dispersion Dept., Netzsch Inc., 119 Pickering Way, Exton, PA 19341-1393.

Catalysts Characterization

Information is available on a system to evaluate the performance of supported metal catalysts. The system measures the physical surface structure as well as chemical properties and strength of surface bonds. For additional literature, write Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662-6001.

Pearl Pigment

Information is available on a new pearl pigment that is non-toxic, non-arcing, and non-tarnishing. For additional technical information on Exterior Mearlin Bright Silver, contact The Mearl Corp., 41 E. 42nd St., New York, NY 10017.

Bench Top Sprayer

A pneumatic operated bench top sprayer that can test a batch of paint to ensure that results compare with earlier batches is highlighted in a product bulletin. For more information, contact the Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061-6688.

Adsorption Instrument

An automated physical adsorption instrument is highlighted in a 12-page color brochure. The technical literature uses illustrations, tables, and figures to describe the instrument. For additional details on the Accelerated Surface Area and Porosimetry, contact Micromeritics, One Micromeritics Dr., Norcross, GA 30093-1877.

Product Guide

A recently released 12-page color product guide focuses on thermoplastics, thermosets, elastomers, and suspensions and emulsions. The guide provides general information about the rheological properties of each material. Further details on the "Product Guide" are available from Rheometrics, Inc., One Possumtown Rd., Piscataway, NJ 08854.

Computer Color System

A computer color quality control system designed to check and evaluate the color of incoming, in-process, and outgoing materials is described in literature. The system offers special programs for automotive industry suppliers and has spectral analysis capability. For more information on the ACS 1400, write Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543.

Turbo Dispergator

A turbo-dispergator that disperses, homogenizes, dissolves, and emulsifies materials is highlighted in a recently released technical bulletin. The dispergator operates on the principle of liquid shear and pulsation and features a heavy-duty pre-breaker which partially crushes the material entering the pulsator. Additional information is available from Netzsch Inc., Grinding & Dispersing Dept., 119 Pickering Way, Exton, PA 19341-1393.

Solvent Selector

An updated solvent selector chart which lists 65 active solvents, latent solvents, and diluents is available. The chart contains such information as evaporation rate, formula, viscosity, dilution ratios, specific gravity, flash point, Hansen solubility parameters, and boiling range. The chart also includes tables of denatured alcohol nomenclature. For a copy of the chart (No. M-167L) or additional information, write Eastman Chemical Products, Inc., Coatings Chemicals, P.O. Box 431, Kingsport, TN 37662.

Chemical Additives Study

A technical study which determines the specific chemicals used in more than 20 chemical additive categories is described in literature. The study identifies those forces and technology trends impacting on the chemical industry and its customers, their consumption, producers, and defines the opportunities for better performing additives needed. For a brochure giving complete details on "Chemical Additives for Paints and Coatings," write Hochberg and Co., Inc., Chester Professional Bldg., Chester, NJ 07930.

Color Technology Newsletter

The latest edition of a quarterly newsletter designed to update users and potential users of color control technology on hardware and software advancements and general industry news is available. The four-page issue contains articles on visual color matching techniques. To obtain a free copy of "Prismatics," write Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543.

High-Speed Disperser

An enclosed, continuous, high-speed disperser is described in recently released literature. Fixed or variable speed models are available and explosion-proof controls and process monitoring instruments can be provided. Write Chicago Boiler Co., 1965 Clybourn Ave., Chicago, IL 60614 for information and availability of the Model CD-4 for in-house trials.

Overhead Conveyor System

Overhead conveyor systems are described in detail in a six-page brochure. All standard system components are illustrated and photographs of working systems give ideas for plant production. The brochure is available from Pacline Corp., 10 Falconer Dr., Unit 6, Mississauga, Ontario L5N 3L8 Canada.

Red Pigment

Information is available on a new organic red pigment for industrial coatings which offers lightfastness while allowing the formulator to make a low viscosity and high opacity paint. For a sample of Novoperm Red F2RK-70, contact Rick Campbell, Marketing Manager-Coatings, American Hoechst Corp., 129 Quidnick St., Coventry, RI 02816.

Electrophoresis Instrument

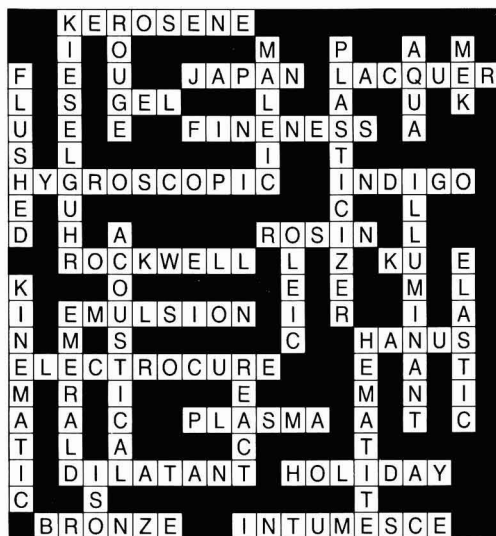
A recently released product bulletin describes a microelectrophoresis instrument that measures the zeta potential and electrophoretic mobility of charged colloids in aqueous and nonaqueous suspensions. For a free introductory brochure on the Zeta-Meter System 3.0, contact Louis Ravina, Zeta-Meter Co. Inc., Dept. 402, 50-17 Fifth St., Long Island City, NY 11101.

Humidity Cabinets

Humidity cabinets are the subject of recently released literature. The corrosion test equipment is designed to meet any constant or cyclic temperature. Details on Models AB6, AB6R, AB7, and AB7R can be obtained from Sheen Instruments Ltd., 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England.

Water Dispersions

Two new aqueous lithol rubine dispersions which provide color strength and stability are described in a recently released product bulletin. One of the dispersions contains no surfactant, while the other contains no resin. Additional information on BS 13458 and BS 13618 is available from CDI Dispersions, 27 Haynes Ave., Newark, NJ 07114-0042.



Solution to February "CrossLinks"

Coming Events

FEDERATION MEETINGS

1988

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

1987

(March)—Seminar on Statistical Process Control. Sponsored by FSCT Professional Development Committee. Scheduled by region: March 2-3—Marriott Hotel, Chicago O'Hare Airport, Chicago, IL; March 9-10—Radisson Hotel, Atlanta, GA; March 16-17—Marriott, Philadelphia Airport, Philadelphia, PA; and March 30-31—Marriott, Torrance, CA.

(Apr. 29-May 2)—Combined Federation Spring Week and Pacific Northwest Society Symposium. The Westin Hotel, Seattle, WA. FSCT Society Officers Meeting on April 29; FSCT Board of Directors Meeting on April 30; Seminar on May 1-2. Concludes with a dinner dance on May 2.

(Oct. 5-7)—65th Annual Meeting and 52nd Paint Industries' Show. Convention Center, Dallas, TX.

1988

(Oct. 19-21)—66th Annual Meeting and 53rd Paint Industries' Show. McCormick Place, Chicago, IL.

1989

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

SPECIAL SOCIETY MEETINGS

1987

(Apr. 1-3)—Southern Society. Annual Meeting. Dutch Inn, Lake Buena Vista, FL. (C. Lewis Davis, 802 Black Duck Dr., Port Orange, FL 32019).

(Apr. 7)—Detroit Society. 12th Annual Focus Conference, Management Education Center, Troy, MI. (Bohdan Melnyk, 26727 Newport, Warren, MI 48089).

(Apr. 7-8)—Chicago Society's Sympo '87 "Risky Business: Technology of Our Times." Knickers, Des Plaines, IL. (William Fotis, The Enterprise Cos., 1191 S. Wheeling Rd., Wheeling, IL 60090).

(Apr. 29-May 2)—Combined Federation Spring Week and Pacific Northwest Society Symposium. The Westin Hotel, Seattle, WA. April 29—FSCT Society Officers Meeting; April 30—FSCT Board of Directors Meeting; PNW Golf; PNW Evening Activities; May 1—Seminar; May 2—Seminar continued; PNW Sports Competition; Dinner Dance.

(May 26-27)—30th Annual Advances in Coatings Technology Conference. NASA's Lewis Research Center, Cleveland, OH. Sponsored by the Cleveland Society. (Stephen J. Damko, Coatings Research Group, Inc., 2340 Hamilton Ave., Cleveland, OH 44114).

(June 12-13)—Joint meeting of St. Louis and Kansas City Societies. Holiday Inn, Lake of Ozarks. (A.E. Zanardi, Thermal Science, Inc., 2200 Cassens Dr., Fenton, MO 63026).

(Apr. 13-15)—Southern Society. Annual Meeting. Charleston, SC. (Scott McKenzie, Southern Coatings Co., P.O. Box 160, Sumter, SC 29150).

(Apr. 28-30)—Pacific Northwest Society. Annual Symposium. Vancouver, B.C., Canada. (Yvon Poitras, General Paint Corp., 950 Raymur Ave., Vancouver, B.C., Canada V6A 3L5).

1989

(Mar. 13-15)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA. (Andy Ellis, NL Industries, Inc., 200 N. Berry St., Brea, CA 92621).

OTHER ORGANIZATIONS

1987

(Mar. 20-25)—The International Paint Industry & Anti-Corrosion Technology Exhibition, Beijing, People's Republic of China. (Sino Trade Promotions, 15A Wing Cheong Commercial Bldg., 19-25 Jer vois St., Central, Hong Kong).

(Mar. 21-22)—Western Decorating Products Show. Long Beach Convention Center, Long Beach, CA. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Mar. 23-24)—"New Specialty Polymer Products Through Interpenetrating Polymers Network (IPN) Technology" Seminar. Colony Square Hotel, Atlanta, GA. (Lisa Sherk, Program Div., Technomic Publishing Co., 851 New Holland Ave., Box 3535, Lancaster, PA 17604).

(Mar. 25-27)—"Radiation Curing" course sponsored by The Center for Professional Advancement, San Francisco, CA. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 26-29)—Colour 87—the International Exhibition for Painting Techniques and Colour Application. Cologne, Germany. (Köln Messe, Postbox 210760, D-5000 Cologne 21, Germany).

(Mar. 30-Apr. 1)—Annual Meeting of the Zinc Institute and the Lead Industries Association, Fairmont Hotel, San Francisco, CA. (Annual Meeting, ZI/LIA, 292 Madison Ave., New York, NY 10017).

(Mar. 30-Apr. 1)—"Adhesion Science and Technology" course sponsored by The Center for Professional Advancement, Chicago, IL. (The Center for Professional Advancement, 46 W. Ferris St., East Brunswick, NJ 08816-0257).

(Mar. 31-Apr. 2)—PaintCon '87. Sponsored by *Industrial Finishing* magazine. O'Hare Expo Center, Rosemont, IL. (PaintCon '87, 2400 E. Devon Ave., Suite 205, Des Plaines, IL 60018).

(Apr. 4-5)—Eastern Decorating Products Show. World Trade Center, Boston, MA. (National Decorating Products Assn., 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Apr. 5-7)—Inter-Society Colour Council. Annual Meeting. "Industrial Problems in Color Science." Barclay Hotel, Philadelphia, PA. (Dr. A. Rodrigues, Du Pont Co., 945 Stephenson Hwy., Troy, MI 48084).

(Apr. 5-10)—ACS, Div. of Polymeric Materials: Science & Engineering, Anaheim, CA. (T. Davidson, Ethican, Inc., Route 22, Somersville, NJ 08876).

(Apr. 6-7)—27th Annual Symposium of the Washington Paint Technical Group. Sponsored by the National Paint & Coatings Association. Marriott Twin Bridges Hotel, Washington, DC. (Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

(Apr. 6-7)—"The Fundamentals of Color" seminar sponsored by Macbeth, a division of Kollmorgen, Corp. Grand Rapids, MI. (Jeanne Dolon or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382).

(Apr. 7-9)—"Bridge and Highway Structures Coatings Inspection" course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Apr. 9-10)—"The Fundamentals of Color" seminar sponsored by Macbeth, a division of Kollmorgen, Corp. Neenah, WI. (Jeanne Dolon or Karen Degnan, Macbeth, Little Britain Rd., P.O. Box 230, Newburgh, NY 12550-0382).

(Apr. 21-23)—"Coatings Specifiers" course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (William Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Apr. 29-May 1)—"Polymers for Electronic Applications" Course sponsored by State University of New York, New Paltz, NY. (Dr. A.V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(Apr. 29-May 1)—26th Annual Marine and Offshore Coatings Conference. Sponsored by the National Paint & Coatings Association. New Orleans Hilton Hotel, New Orleans, LA. (Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

(May 4-6)—"Crosslinked Polymers: Chemistry, Properties and Applications" Course sponsored by State University of New York, New Paltz, NY. (Dr. A.V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(May 6-8)—"High Temperature Polymers: Chemistry, Properties and Applications" Course sponsored by State University of New York, New Paltz, NY. (Dr. A.V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(May 11-14)—Powder & Bulk Solids Conference/Exhibition, O'Hare Exposition Center, Rosemont, IL. (Show Manager, Powder & Bulk Solids Conference/Exhibition, Cahners Exposition Groups, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017-5060).

(May 12-14)—HAZTECH Canada Exhibition and Conference. Toronto International Centre, Mississauga, Ontario. (Beverly Gibson, Exhibition Management Company, 6143 S. Willow Dr., Suite 100, Englewood, CO 80111).

(May 12-14)—"Process Hazards Management" seminar sponsored by the Du Pont Co., Reno, NV. (Du Pont Safety Services, Barley Mill Plaza, P19-1104, Wilmington, DE 19898).

(May 13-15)—"Polymer Blends and Alloys" Course sponsored by State University of New York, New Paltz, NY. (Dr. A.V. Patsis, Chemistry Dept., State University of New York, New Paltz, NY 12561).

(May 18-21)—Surface Coating '87. Chemical Coaters Association. Milwaukee, WI. (CCA, Box 241, Wheaton, IL 60189).

(May 25-27)—Ninth International Conference on Advances in the Stabilization and Controlled Degradation of Polymers. Luzern, Switzerland. (Dr. A.V. Patsis, Institute of Materials Science, State Univ. of New York, New Paltz, NY 12561).

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HIGH SPEED DISPERSION

Produced by the Manufacturing Committee, Montreal Society for Coatings Technology

High speed dispersion is widely used in the manufacture of protective coatings. The show covers theoretical and practical techniques used for dispersion in paint plants. Color slides show laboratory test equipment and plant scale manufacturing procedures. 20 Minutes (60 Slides)\$65

INTRODUCTION TO RESIN OPERATIONS

Produced by the Manufacturing Committee, Toronto Society for Coatings Technology

This presentation has been developed to assist in the selection and training of resin plant operators, and focuses on basic concepts of manufacture and the role of a resin operator. 12 minutes (58 slides)\$65

OPERATION OF A VERTICAL SAND MILL

Produced by the Manufacturing Committee, Kansas City Society for Coatings Technology

This presentation focuses on the basics of operating a vertical sandmill, and has been developed to assist in training plant personnel in the use of this equipment. 14 minutes (73 slides)\$75

A BATCH OPERATED MINI-MEDIA MILL

Produced by the Manufacturing Committee, New York Society for Coatings Technology

This presentation describes the design and operation of a batch operated mini-media mill, and was developed to assist in the training of plant personnel to operate such equipment. 8½ minutes (51 slides)\$60

TRAINING SERIES ON TEST METHODS

Volume II (3 Lessons) Lessons vary from 7 to 11 minutes (79 slides)\$70
(1) A Simple Method to Determine Microbiological Activity—Philadelphia Society; (2) Salt Spray (Fog) Testing Cabinet—Golden Gate Society; (3) Wet Film Thickness Gages—Golden Gate Society.

For additional titles contact:

FEDERATION OF SOCIETIES
FOR COATINGS TECHNOLOGY
1315 Walnut Street • Philadelphia, PA 19107
215-545-1506

(May 28)—Symposium on Automotive Color Design. Jointly sponsored by the Canadian Society for Color and the Detroit Colour Council. Cleary Auditorium, Windsor, Ontario. (William V. Longley, Ford Motor Co., Design Center, 21175 Oakwood Blvd., P.O. Box 2110, Dearborn, MI 48123).

(May 28-31)—Cormaint Asia '87. Conference on Coatings and Corrosion Protection. Jakarta Fair Grounds, Jakarta, Indonesia. Co-sponsored by National Association of Corrosion Engineers. (IIR Exhibitions Pte Ltd., 89 Short St., Singapore 0718).

(May 31-June 5)—Sixth International Meeting on Radiation Processing. Skyline and Holiday Inn Hotels, Ottawa, Ont., Canada. (Mrs. E. Golding, International Meeting on Radiation Processing, P.O. Box 13533, Kanata, Ont., Canada K2K 1X6).

(June 1-5)—“Advances in Emulsion Polymerization and Latex Technology” short course, Lehigh Univ., Bethlehem, PA. (Dr. Mohammed S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh Univ., Bethlehem, PA 18015).

(June 1-5)—“Dispersion of Pigments and Resins in Fluid Media” Course. Sponsored by Kent State University, Kent, OH. (Dr. Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(June 3-6)—“High Solids Coatings” Short Course sponsored by North Dakota State University, Fargo, ND. (Dr. F.N. Jones, Polymers and Coatings Dept., North Dakota State University, Fargo, ND 58105).

(June 8-10)—“Radiation Curable Coatings” Short Course sponsored by North Dakota State University, Fargo, ND. (Dr. F.N. Jones, Polymers and Coatings Dept., North Dakota State University, Fargo, ND 58105).

(June 14-17)—Dry Color Manufacturers' Association Annual Meeting, The Greenbrier, White Sulpher Springs, WV. (Lynn Goodwin, P.O. Box 20839, Alexandria, VA 22320-1839)

(June 15-26)—“Coatings Science” Course sponsored by North Dakota State University, Fargo, ND. (Dr. F.N. Jones, Polymers and Coatings Dept., North Dakota State University, Fargo, ND 58105).

(June 17-19)—“Chemically Modified Surfaces” Conference co-sponsored by Colorado State University and Dow Corning Corp. Holiday Inn, Fort Collins, CO. (Ward T. Collins, Mail Stop C41C00, Dow Corning Corp., Midland, MI 48686-0994).

UNIVERSITY OF MISSOURI-ROLLA 1987 SPRING COATINGS COURSES MARCH 23-MAY 15

March 23-27—“Paint Formulation”

Basic Concepts	Selection of Pigment
Formulating Paint Types	Selection of Additives
Selection of Binder	Principles of Formulation

May 4-8—“Introduction to Polymer Chemistry”

Physical Characterization	Common Condensation
Polymerization Mechanism	Polymers
Methods of Polymerization	Polymers as Used in Coatings
Common Addition Polymers	Surfactant Systems

May 11-15—“Physical Testing of Paints and Coatings”

Background for Testing	Test Lab Organization
Testing & Standard	Job Performance & People
Test Methods	Relationships
Test Applications	New Directions for Coatings
Testing Methods	Professionals
Instrumental Analysis	

For more information, contact the Coatings and Polymer Science Program, Department of Chemistry, University of Missouri-Rolla, Rolla, MO 65401-0249. Tel. 314-341-4419.

(June 17-20)—Oil and Colour Chemists' Association Biennial Conference. Eastbourne, England. (Mr. R.H. Hamblin, Director & Secretary, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex HA0 2SF, England).

(June 22-24)—Fourth Annual International Bridge Conference. Sponsored by the Engineers' Society of Western Pennsylvania. Hilton Hotel, Pittsburgh, PA. (International Bridge Conference, c/o Engineers' Society of Western Pennsylvania, 530 William Penn Place, Pittsburgh, PA 15219).

(July 6-10)—13th International Conference in Organic Coatings Science and Technology. Athens, Greece. (Dr. A.V. Patsis, Institute in Materials Science, State Univ. of New York, New Paltz, NY 12561).

(July 13-16)—SUR/FIN '87 Chicago—International Conference & Exhibit of Electroplating and Surface Finishing. McCormick Place, Chicago, IL. (AESF, 12644 Research Parkway, Orlando, FL 32826).

(July 21-23)—"Process Hazards Management" seminar sponsored by the Du Pont Co., Wilmington, DE. (Du Pont Safety Services, Barley Mill Plaza, P19-1104, Wilmington, DE 19898).

(July 22-26)—Oil and Colour Chemists' Association, New Zealand Div. 25th Jubilee Convention. "Timber—Its Protection and Decoration." Rotorua, New Zealand. (Convention Coordinator, OCCA New Zealand, P.O. Box 5192, Auckland, New Zealand).

(August 6-9)—Oil and Colour Chemists' Association Australia. 29th Annual Convention. West Point Convention Center, Hobart, Tasmania, Australia. (OCCAA, 6 Wilson Ave., Felixstow, South Australia, 5090 Australia).

(Aug. 23-28)—"Copolymerization" Symposium. Sponsored by the Polymer Div. of the Royal Australian Chemical Institute and the Div. of Polymer Chemistry of the ACS. Sydney, Australia. (Prof. D. Tyrell, Polymer Science & Engineering, Univ. of Massachusetts, Amherst, MA 01003).

(Aug. 30-Sept. 4)—American Chemical Society. 194th National Meeting. New Orleans, LA. (B.R. Hodson, ACS, 1155—16th St. NW, Washington, D.C. 20036).

(Sept. 13-18)—"Mechanisms and Measurement of Water Vapor and Liquid Water through Materials" Symposium co-sponsored by ASTM Committees C-16, D-1, D-8, D-10, D-20, and F-2. Philadelphia, PA. (ASTM, 1916 Race St., Philadelphia, PA 19103).

(Sept. 15-18)—XVIIth Congress of AFTPV (French Association of Paint and Varnish Technicians) and Eurocoat. Nice, France. (J. Roire, 5, Rue Etex, 75018 Paris, France).

(Sept. 20-23)—Canadian Paint and Coatings Association. 75th Annual Convention. Four Seasons Hotel, Vancouver, B.C. (CPCA, 515 St. Catherine St. W., Montreal, Que., H3B 1B4 Canada).

(Oct. 14-16)—SURTEC '87 Berlin. International Congress Center, Berlin. (Gabriela Thal, 1625 K St., N.W., Suite 500, Washington DC 20006).

(Oct. 20-22)—"Process Hazards Management" seminar sponsored by the Du Pont Co., New Orleans, LA. (Du Pont Safety Services, Barley Mill Plaza, P19-1104, Wilmington, DE 19898).

(Oct. 22-23)—60th Anniversary Conference of Japan Society of Colour Material, Tokyo, Japan. (Japan Society of Colour Material, 9-12, 2-chrome, Iwamoto-cho, Chiyoda-ku, Tokyo 101, Japan).

(Oct. 28-29)—Tenth Resins & Pigments Exhibition. Penta Hotel, London Heathrow Airport, England. (Polymers Paint Colour Journal, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS, England).

(Nov. 7-11)—10th International Congress on Metallic Corrosion sponsored by Central Electrochemical Research Institute on behalf of International Corrosion Council. Madras, India. (Dr. V.I. Vasu, Chairman, ICMC Organizing Committee, Director CERI, Karaikudi 623006, Tamil Nadu, India).

(Nov. 20-22)—40th Annual Show and Convention of National Decorating Products Assn., McCormick Place, Chicago, IL. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

(Nov. 23-27)—Pacific Corrosion '87—Fifth Asian-Pacific Corrosion Control Conference in conjunction with the 27th Australasian Corrosion Association Conference. Hilton Hotel, Melbourne, Australia. (Bloomsbury Conference Services, P.O. Box 2368, Richmond, 3121, Australia).

(Apr. 5-7)—Electrocoat '88. Drawbridge Inn and Convention Center, Ft. Mitchell, KY. (Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(May)—Surfex '88. Sponsored by Oil and Colour Chemists' Association. Harrogate, England. (Fred Morpeth, P.O. Box 161, Wigan WN2 5TB, England).

(May 9-11)—Federation of Scandinavian Paint and Varnish Technologists. 12th Congress, Helsinki, Finland. (Arja Saloranta, Tikkurila Oy, PB 53, SF 01301 Vanda, Finland).

(June 5-11)—American Chemical Society. 195th National Meeting and Third Chemical Congress of North America. Toronto, Ont., Canada. (B.R. Hodson, ACS, 1155—16th St. NW, Washington, D.C. 20036).

(June 13-17)—International Conference on Composite Interfaces II. Case Western Reserve University, Cleveland, OH. (Professor H. Ishida, General Chairman, ICCI-II, Dept. of Macromolecular Science, Case Western Reserve University, 10900 Euclid Ave., Cleveland, OH 44106-1727).

(June 15-16)—Surfex '88. Oil and Colour Chemists' Association. Harrogate International Conference Center, Yorkshire, England. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex HA0 2SF England).

(Sept. 18-25)—XIXth Congress of FATIPEC. Aachen, Germany. (C. Bourgerly, FATIPEC Secretary General, 76 Blvd. Pereire, 75017 Paris, France).

(Oct. 18-21)—12th World Congress on Metal Finishing. INTERFINISH 88. Palais des Congres, Paris, France. (SEPIC INTERFINISH, 17 rue d'Uzes, 75002 Paris, France).

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'Humbug' from Hillman

I trust that Editor L.A. Hill, of *Surface Coatings Australia*, and his correspondent, William Sharpe, will forgive this very belated, but nonetheless sincere, acknowledgment of their kind references to "Humbug" so many months ago. The delay is partially explained in the comments below.

Mr. Sharpe, obviously impressed by the high scientific standards held by "Humbug," has published some important paint technology terms and formulations with an appropriately historic introduction. I quote the introduction and follow with one of his highly technical definitions. The rest were unhappily obscured by the salt water that seeped into the bottle as it floated across the Pacific.

"Our good patron, Saint Leonardo, once said to his apprentice, Signor Michelangelo, that 'our product keeps on keeping on' on various substrates. Young Michelangelo, undaunted by this remark, spent most of his time spine bashing in the local habitats, whilst his boss, Leonardo, was peddling the miracle products around the countryside.

The following definition was defined by Guillaume von Schaeffer* MBC, OPS, MMVC. †

Spreading Rate (SR) is defined by the area of hindquarters able to spread itself uniformly on a well-padded chair minus the overlap which may occur whilst in upright position. The chronological age of the performer can exert an influence on this property.

SR = Area of hindquarters minus overlap of hindquarters (due to middle age spread).

*Assistant to Michelangelo, successor to Leonardo da Vinci, Esq., who painted a small church in the Seven Hills of Rome, circa 1485.

†MBC—Master of Bucket Chemistry

OPS—Order of Paint Stirrers

MMVC—(Degree obscured as noted above, so chose your own.)

Appropriately, *Association Trends* more recently quoted Andrew Moncur, of the *Manchester English Guardian*, on "Today's English Slangage":

"An Aussie in a cozzie who doesn't know the meaning of a hizzie in a hozzie might feel a shade out of place. About as conspicuous as Liberace at a wharfies picnic, in other words.

"English speakers in England, wishing to overcome the barriers thrown up by a common language will soon be helped to understand: a wharfie is a docker, a hizzie is a hysterectomy, a hozzie is a hospital, a cozzie is a swimming costume and an Aussie is, of course, an Aussie.

"The Australian English Slangage, relatively rarely heard in its full beaut form over here (England)—where it's as scarce as rocking horse manure—is about to be brought home by the BBC.

"That should make the average truckie, taking a perve, with a verandah over his toy shop, as happy as a bastard

on Father's Day. On the other hand, the BBC-TV series dealing with 'the world's most widely-spoken language'—English—could make purists as mad as a gumtree full of galahs.

"(Another glossary: a truckie is a lorry driver, to perve is to gaze lustfully, the verandah in question is a paunch and a galah is a galah)."

N.B.—As an extraordinary service to our readers, "Humbug" looked it up. Galah: a showy Australian cockatoo that is a destructive pest in wheat growing areas.—Here you have your word for today. Use it well!!!!

Mr. Moncur does not spare us. He goes on to quote some stateside "space speak" as developed by NASA. Some examples: "latch integrity—the door's shut; waste management—lavatory; benign environment—safe; dynamic environment—unsafe.

For those who have had enough of overseas wisdom, we now turn to some brilliant comments from our resident sage, Bob Ahlf—

- There's a full moon tonight. Try not to think of it.
- In this world there is a lot more dirty laundry than clean.
- If you don't fit in, buy a bigger size.
- Man does not live by sex alone, he needs a partner.
- Avoid another ice age. Burn fossil fuels.
- If someone hadn't invented clothes, you'd be reading this stark naked.
- Thank you for not saying, "Have a nice day."

Filed under "Fish and Game," Roy Tasse found this as submitted by Joe Stearns—

An Indian's conservation ideas—When a farm journal ran a picture of a deserted farmhouse in a gullied field and offered prizes for the best 100 words or less description, an Indian took honors with this:

"Picture show white man crazy. Cut down trees. Make big tepee. Plow hill. Water wash. Wind blow soil. Grass gone. Buck gone. Papoose gone. No pigs. No corn. No plow."

"Indian no plow land. Keep grass. Buffalo eat grass. Indian eat buffalo. Hide make tepee and clothes. Indian all time eat. No hunt job. Great Spirit provide everything."

—Herb Hillman
Humbug's Nest
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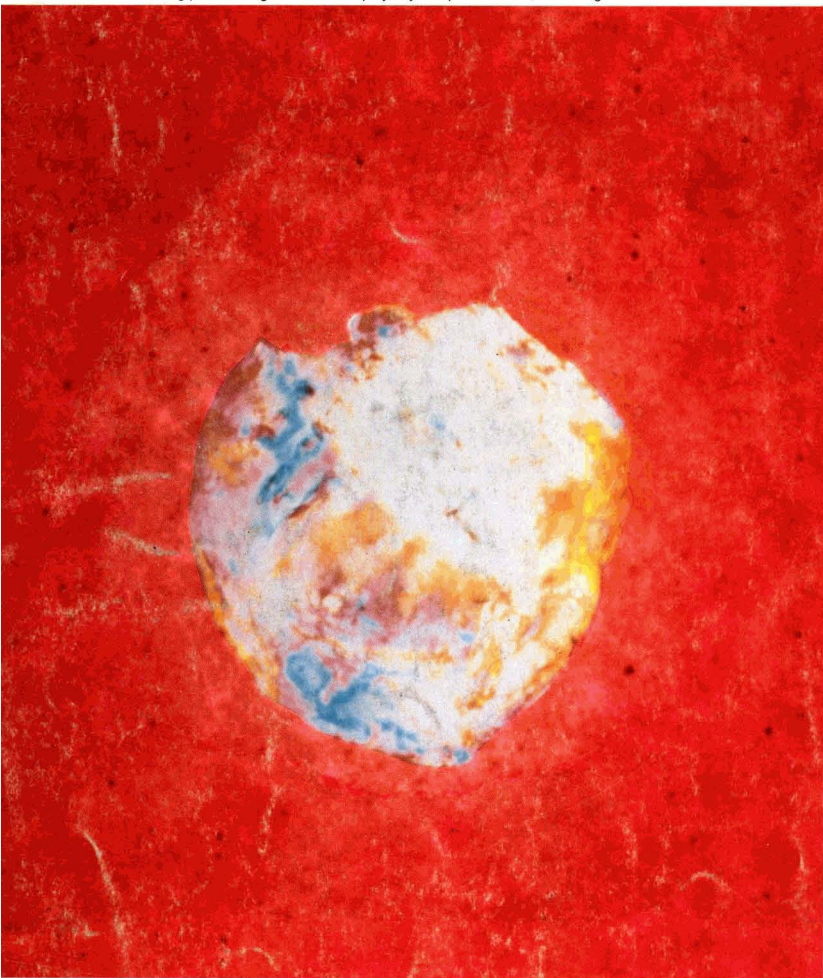
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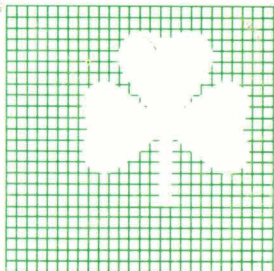
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