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February 1986

jct JOURNAL OF COATINGS TECHNOLOGY

64th Annual Meeting & 51st Paint Industries' Show
FSCT 1986
Georgia World Congress Center
• Atlanta •
November 5, 6, 7, 1986

From Tung Oil to Group Transfer Polymerization

1985 Keynote Address

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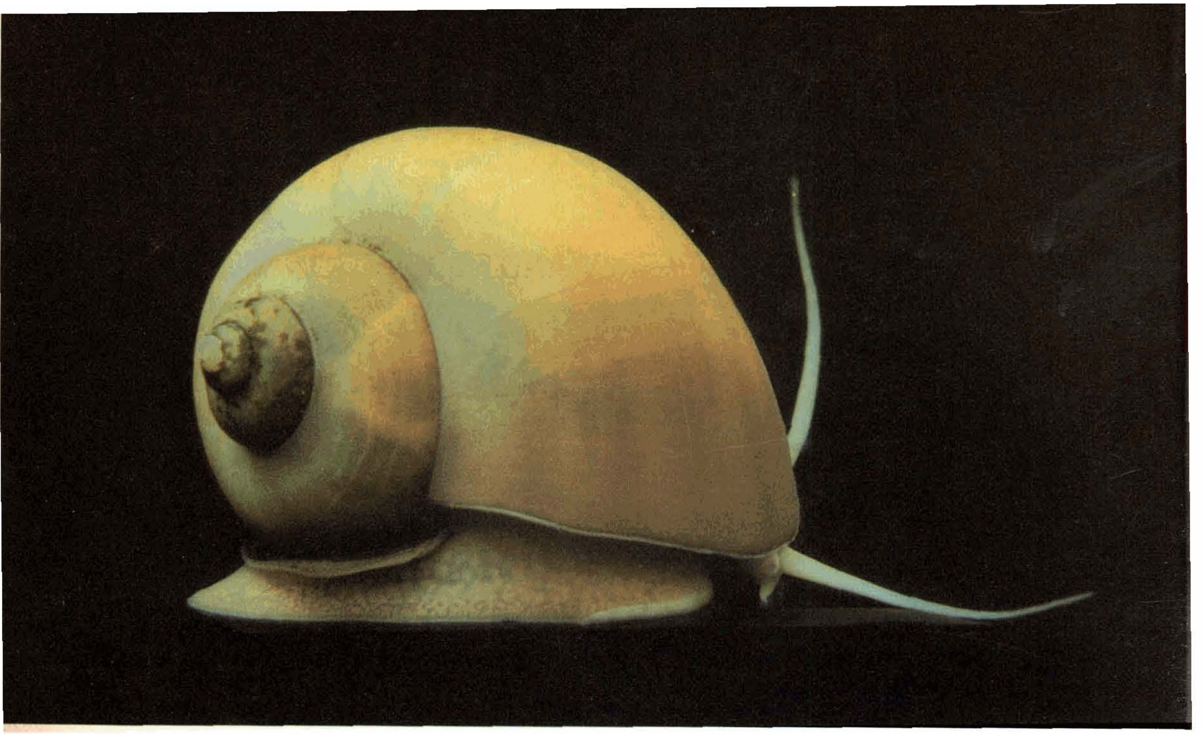

FEBRUARY 1986

jct JOURNAL OF COATINGS TECHNOLOGY

VOLUME 58 NUMBER 733

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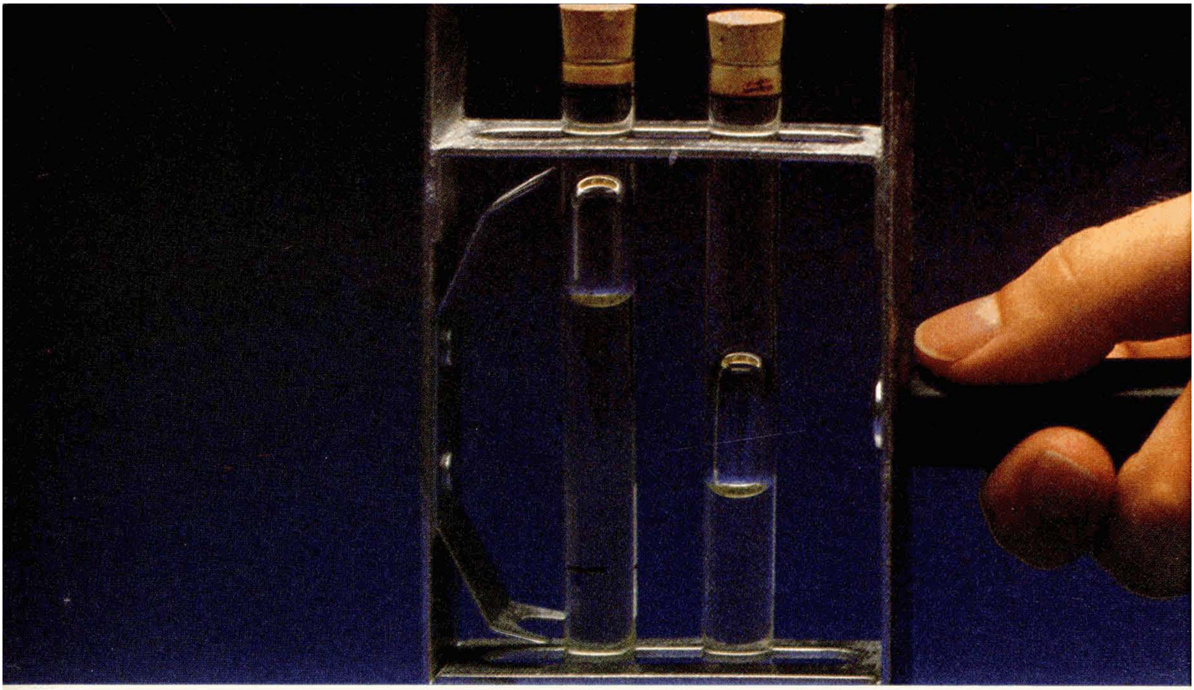

CIBA-GEIGY epoxy resins and the winning battle against VOC's.

With their lower viscosity, these two unique epoxy resins significantly decrease your need for solvent or diluent.

Their names are Araldite® XU GY 281 and Araldite XU GY 308. Two new products from the leading supplier of specialty resins and hardeners. Two new products you will want to use to decrease the volatile organic content (VOC) of the high performance coatings you formulate for heavy duty service in such applications as petroleum refineries, tank linings, pulp and paper mills, industrial plants and the like.

These new epoxy resins from CIBA-GEIGY for low VOC coatings let you maintain high performance without adding unnecessary solvents or diluents.

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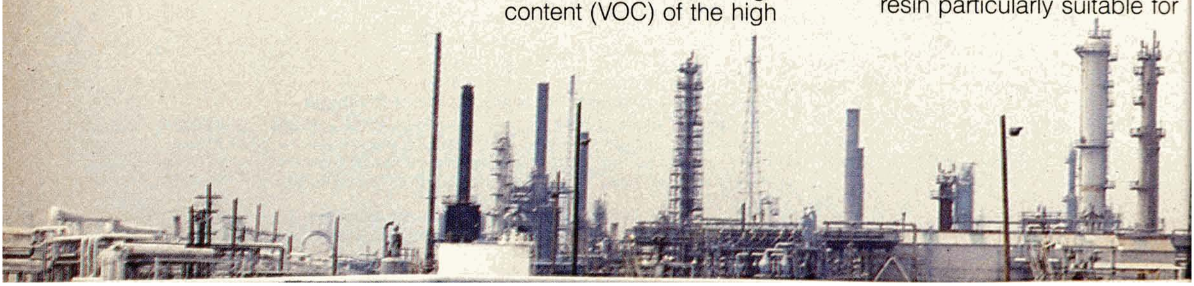
Adding solvent to a coating formulation can have a negative performance effect. Adding diluents can increase cost. The low viscosity of Araldite XU GY 281 and Araldite XU GY 308 reduces the need for solvents or diluents, and provides you with another major victory in the battle to solve the VOC problem.

Araldite XU GY 281 is an unmodified bisphenol F epoxy resin particularly suitable for



Gardner Bubble Tube Viscosity Test. On left: diglycidyl ether of bisphenol F resin (CIBA-GEIGY Araldite® XU GY 281). On right: diglycidyl ether of bisphenol A resin.

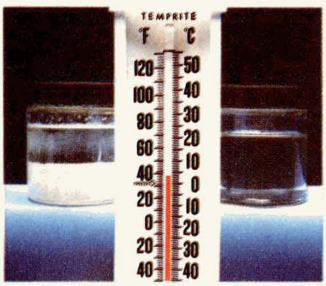
ventless and high solids atings and linings requiring perior chemical and rosion resistance. It also s outstanding resistance to vents, excellent mechanical perties and conforms to 5.300 of the FDA Register.

XU GY 281 Typical Properties

al Appearance	Clear
r, Gardner	3 max.
osity, cP @ 25°C	5,000-7,000
ght per Epoxide	159-172
olyzable Chlorine	0.2 max.
ile Content, %	0.2 max.
nds per gallon	10

extra added attraction.

Araldite XU GY 308 is our cond new low viscosity uid epoxy resin. It has all major properties of Araldite GY 281. And one that's que. That uniqueness is its istance to crystallization der normal conditions, king it easy to handle and cess. As you are well are, most low viscosity, pure xy resins change to a waxy e solid if left unused at low temperatures. That means heat must be applied before using. And heating a 55-gallon



Clear epoxy resin (right), Araldite XU GY 308, resists crystallization at low temperatures.

drum or a whole tank car is no easy task. Araldite XU GY 308's resistance to crystallization can, therefore, save you time, energy and money.

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JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., PA 19107

THE JOURNAL OF COATINGS TECHNOLOGY is published monthly by the Federation of Societies for Coatings Technology at 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

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	U.S. and Canada	Europe (Air Mail)	Other Countries
1 Year	$27.00	$ 50.00	$ 37.00
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The JOURNAL OF COATINGS TECHNOLOGY has first rights to the publication of papers presented at the Annual Meeting of the Federation and at local and regional meetings of the Federation's Constituent Societies.

A Guide for Authors is published in each January issue.

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

Comment

Specialization = Special Opportunities

Historians label periods in humankind in terms relating to significant achievements, therefore, Stone Age, Age of Reason, the Industrial Revolution, etc. It is not too unreasonable, then, to assume that, in the future, this present period may become known as the beginning of the Age of Specialization.

With increasing technology, man assures himself of an increasingly complex supply of products—and an increasing knowledge of the capabilities and limitations of those products. Specializations now abound in many industries and professions. From medicine to finance, from manufacturing to transportation, the specialist is becoming the rule rather than the exception.

Historically, the coatings industry has grown with the need to decorate and protect these products with architectural and industrial (OEM) coatings. Some products, however, demand the special attention of Special Purpose Coatings, a specialty which is the fastest growing segment of the coatings industry.

Information on special purpose coatings is, for the most part, lacking in several areas. That is why the Federation chose this topic as its theme for the fourth FSCT Seminar, to be held May 13 and 14 at the Sheraton Square Hotel, Pittsburgh, PA.

Presentations will discuss the three largest segments of special purpose coatings, Traffic Paints, Auto Refinishes, and Heavy-Duty Maintenance Paints, as well as Aerosols, Fire Retardant Coatings, and Marine Coatings among others.

Complete information on the Seminar can be found on page 14 of this issue, or by calling Federation headquarters.

Although consulting three medical specialists to cure bunions may cause a headache, this coatings specialty may be worth pursuing.

Robert F. Ziegler,
Editor

Abstracts of Papers in This Issue

EFFECT OF POLYESTER CARBOXYL AND HYDROXYL END GROUP BALANCE IN ISOCYANATE CURING POWDER COATINGS—J.J. McLafferty, et al.

Journal of Coatings Technology, 58, No. 733, 23, (Feb. 1986)

The balance of hydroxyl and carboxyl end groups in polyesters for urethane powder coatings is a parameter which can significantly affect curing characteristics and performance of the coatings. Reaction kinetics of these functional groups with aromatic and aliphatic isocyanates are reviewed. The practical effect of the functional group balance at a nominal reactive number is studied in a standard catalyzed powder formulation based on a resin series with caprolactam blocked isocyanate curatives. Resin viscosities and Tg are compared and flow behavior and gel times of laboratory prepared compounds are evaluated. Properties of the cured coatings are also examined.

SUSPENSION INTERACTION OF PIGMENTS IN SOLVENTS: CHARACTERIZATION OF PIGMENT SURFACES IN TERMS OF THREE-DIMENSIONAL SOLUBILITY PARAMETERS OF SOLVENTS—K.M.A. Shareef, et al.

Journal of Coatings Technology, 58, No. 733, 35 (Feb. 1986)

Pigment-solvent interaction has been studied in terms of suspension behavior of four inorganic pigments in 33 individual solvents which have their solubility parameters ranging from 7.82 to 23.5 $(cal/cc)^{1/2}$. The data on settling rate of pigments in the solvent are used for estimating the interaction between them. Four types of interactions were classified on the basis of suspension behavior of pigments in solvents. A computer program written in FORTRAN IV has been used for plotting the spherical volume of suspension of the pigment. The data of partial solubility parameters of solvents in which the pigment had long time suspension, short time suspension, or swelling are used in the computer program for the surface characterization of pigments. The partial and total solubility parameters of pigments are derived from the computerized data.

COMPOSITION AND DISSOLUTION RATE OF ANTIFOULING PAINT BINDERS (SOLUBLE TYPE) DURING THEIR IMMERSION IN ARTIFICIAL SEA WATER—C.A. Giudice, et al.

Journal of Coatings Technology, 58, No. 733, 45 (Feb. 1986)

In this paper the authors have studied the changes produced in the binder composition of soluble type antifouling paints, due to the neutralization reactions carried out between alkaline ions and acid components of binders, both during the pigment dispersion and the sea water immersion.

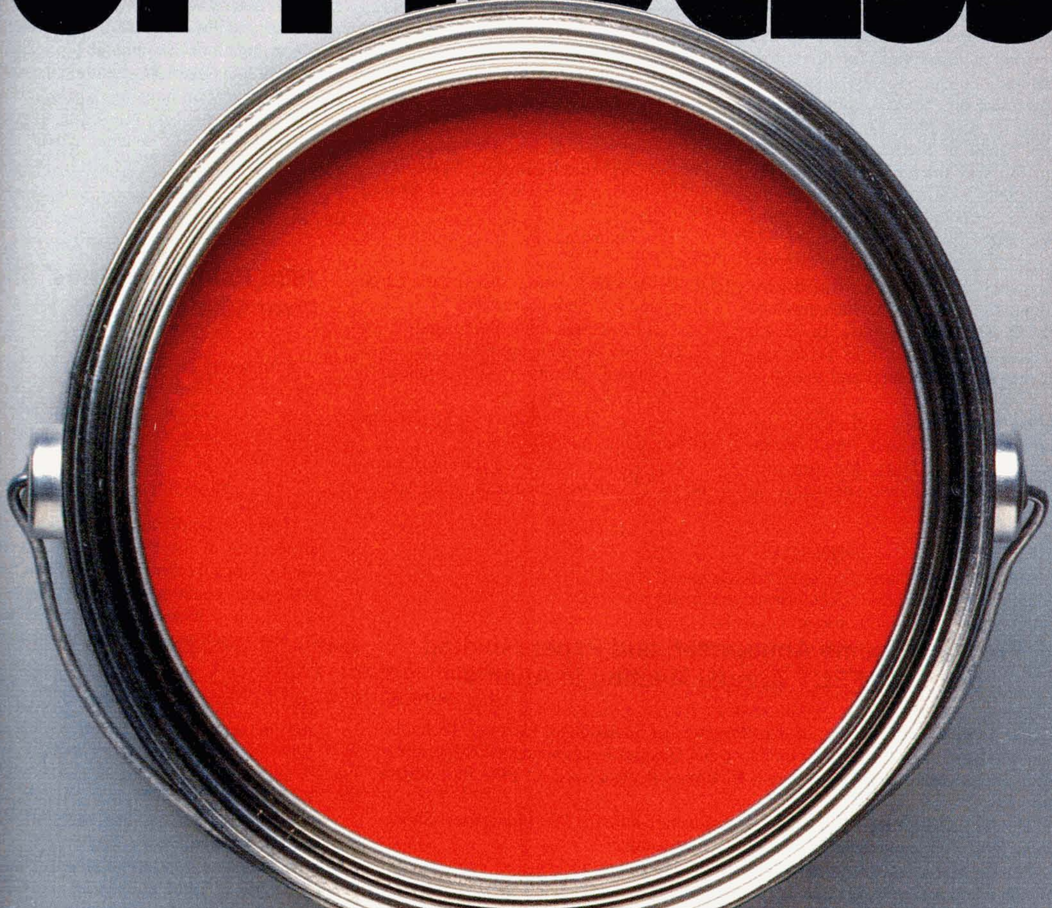
Different variables were considered: binder composition, WW rosin/chlorinated rubber ratio, depth in the film, and immersion time in artificial sea water.

Paints were prepared by dissolving the resins and the plasticizer in the solvent mixture and after that pigments were dispersed in the vehicle using a ball mill with porcelain jars.

The amount of free resinic acids and metallic resinates was determined on the just manufactured binders (before pigment dispersion), on binders extracted from the paints (immediately after paint preparation) and finally on binders after sea water immersion. The total content of divalent cations present in the binder films was also determined.

Additionally, the influence of the mentioned changes in the binder composition on its dissolution rate was studied.

ELIMINATION OF PROCESS



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FSCT Seminar On Special Purpose Coatings Will Be Held On May 13 & 14 In Pittsburgh

In-depth information on a variety of paint and coating types, formulated for specific applications, will be presented at a 1-1½ day seminar sponsored by the Federation of Societies for Coatings Technology.

The seminar on "Special Purpose Coatings," to be held May 13 & 14, at the Sheraton Hotel at Station Square, Pittsburgh, PA, will feature presentations by knowledgable industry speakers on the application, inspection, performance, and generic composition of these products.

Special Purpose Coatings is a category so designated by the U.S. Census Bureau to distinguish them from Architectural and Industrial (OEM) Coatings. In recent years, growth of these coatings has far surpassed that of Architectural and Industrial types.

Seminar programming will include discussions on Traffic Paints, Auto Refinishes, and Heavy-Duty Maintenance Paints—the three largest segments—as well as Aerosols, Fire Retardant Coatings, Marine Coatings, and coatings specifically designed for various aftermarket applications.

Among the featured presentations will be the following:

—Coatings Designed for Bridge Maintenance

—Application and Performance of Present-Day Auto Refinishing Systems

—Design and Performance of Aerosol Coatings

—Conducting and Inspection of the Paint Job

—Marine Coating Systems for Large Ships and Off-Shore Structures

—Properties and Performance of Heavy-Duty Maintenance Coating Systems

—Traffic Paints—Their Application and Performance Properties

—Uses and Performance of Fire Retardant Paints and Mastics

Registration fee is $125 for FSCT members; $155 for non-members. After May 1, registration fee is $165 for everyone. The fee includes complete set of papers presented, continental breakfast, luncheon, coffee breaks, and bus transportation to the airport at conclusion of the seminar.

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

Program Theme Announced and Papers Invited For 1986 FSCT Annual Meeting in Atlanta

The 1986 Annual Meeting of the Federation of Societies for Coatings Technology will have as its theme, "Compliance and Quality: Recognizing the Opportunities," it was announced by Program Chairman Percy Pierce, of PPG Industries, Inc.

The Annual Meeting will be held in conjunction with the Paint Industries' Show at the World Congress Center, Atlanta, GA, November 5-7.

The theme focuses on emerging technologies (such as water-based, high-solids, and powder coatings) which are helping the industry meet regulatory requirements. Increased awareness and understanding of potential physiological and toxicological effects of coatings and their raw materials have spurred development of these technologies, which are also responding to increased expectations of quality products, processes, methods, and attitudes.

Prospective speakers are invited to present original papers on the theme and its various aspects, and are requested to submit abstracts (150 to 200 words) for review to: Percy Pierce, PPG Industries, Inc., R&D Center, P.O. Box 9, Allison Park, PA 15101.

Deadline for receipt of abstracts is March 1.

Assisting Chairman Pierce in the program development is a Steering Committee composed of: William A. Wentworth (Vice-Chairman), Jones-Blair Co., Dallas, TX; Granville D. Edwards, Shell Chemical Co., Houston, TX; Loren W. Hill, Monsanto Polymer Products Co., Springfield, MA; Thomas Hill, Pratt & Lambert, Inc., Buffalo, NY; George R. Pilcher, Hanna Chemical Coatings Co., Columbus, OH; Ralph Stanziola, Color Consultant, Bridgewater, NJ; and Robert Thomas, PPG Industries, Inc., Barberton, OH.

1986 Paint Industries' Show Over 50% Sold Out

With nearly 11 months remaining before the 51st Paint Industries' Show, to be held November 5-7 at the World Congress Center in Atlanta, Georgia, 119 companies have signed up to participate, contracting for over one-half of the booth space available.

Held in conjunction with the 64th Annual Meeting of the Federation of Societies for Coatings Technology, the Paint Show is the largest coatings manufacturing industry exhibit of its kind. Nearly 6,000 industry personnel are expected to attend the event.

Exhibitors will feature products and services used in coatings formulation and manufacture. Prospective exhibitors may apply for space by contacting the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107; or call, 215-545-1506, for information.

Companies who have applied for exhibit space are as follows:

Aceto Chemical Co., Inc.
Air Products & Chemicals, Inc.
C.M. Ambrose Co.
Angus Chemical Co.
Anker Labelers Corp.
Applied Color Systems, Inc.
Atlas Electric Devices Co.
AZS Corp.
BASF Wyandotte Corp.
Beltron Corp.
Brinkmann Instruments
Brockway Standard, Inc.
Brookfield Eng. Laboratories, Inc.
Burgess Pigment Co.
Byk-Chemie USA
Cabot Corp.
Cab-O-Sil Div.

(continued on page 16)

Proposed Amendments to Federation By-Laws

SECOND READING
Dues Change for Society Honorary Members

The following amendment to By-Laws Article VIII was given first reading at the October 6, 1985 meeting of the Federation Board of Directors. It will be presented for adoption at the meeting of May 16, 1986, in Pittsburgh.

WHEREAS under the current dues structure a Society Educator or Retired Member (annual Federation dues of $10.00) could be elected as a Society Honorary Member with the resultant increase in dues to $20.00, a penalty of $10.00 incurring in the process, be it

RESOLVED that By-Laws Article VIII Sections A and D be amended as follows:

BY-LAWS ARTICLE VIII
Dues

A. ACTIVE AND ASSOCIATE MEMBERS

Each Constituent Society shall pay to the Federation office annual dues of twenty dollars ($20.00) in U.S. funds per capita for each Active and Associate Member of the Constituent Society.

D. RETIRED AND SOCIETY HONORARY MEMBERS

Each Constituent Society shall pay to the Federation office annual dues equal to one-half the amount established for Active Members, for each Retired and Society Honorary Member of the Constituent Society.

SECOND READING
Revisions in the Procedure for Nominating Individuals For Federation Honorary Membership

The following amendment to By-Laws Article I was given first reading at the October 6, 1985 meeting of the Board. It will be presented for adoption at the meeting of May 16, 1986, in Pittsburgh.

WHEREAS the Federation Executive Committee has requested that the procedure for the nomination and election of Federation Honorary Members be revised, be it

RESOLVED that the following By-Laws and Standing Rules be amended as follows:

BY-LAWS ARTICLE I
Membership

A. CLASSES OF MEMBERSHIP

(3) Federation Honorary Membership: Any member or former member of a Constituent Society who has rendered signal service to the Federation or the industries served by the Federation in such a manner as to aid the accomplishment of the Objectives of the Federation, may be eligible for Federation Honorary Membership.

TABLED
Standing Committees

The following amendments to By-Laws Article V and Standing Rules Article VIII were tabled at the October 6, 1985 meeting of the Board.

BY-LAWS ARTICLE V
Committees

B. STANDING COMMITTEES: OTHER COMMITTEES

The President shall appoint the following Standing Committees; By-Laws, Educational, Finance, Planning, Membership Services, Professional Development, and Publications. The President shall also appoint any other Committees which may be required to conduct the business of the Federation.

STANDING RULES ARTICLE VIII
Committees

B. DUTIES OF COMMITTEES SHALL BE:

(ADD)

PLANNING

The Planning Committee shall:

(1) Make plans for personnel requirements of the Federation.
(2) Investigate future activities that the Federation can undertake to advance the Coatings Industry.

(ADD)

PROFESSIONAL DEVELOPMENT

The Professional Development Committee shall consist of nine voting members, appointed for three year terms, one third of which expire each year. Ex-officio members shall consist of the current Chairman of the Educational and Technical Advisory Committees, the Treasurer, and a staff member. The Chairman of the Committee shall be appointed for a two year term. Membership on the Committee, and the holding of office, is subject to a two term limit. All appointments shall be made by the President.

The duties of the Professional Development Committee shall be to:

(1) Provide for the professional development of the technical staff of the coatings industry through such continuing education activities as short courses, seminars, speakers bureaus, and financial support of academic speakers for local Society meetings.
(2) Provide for the attraction of technical talent into the coatings industry, by supporting such activities as local society-university interactions; encouragement of co-op and summer employment for college students and professors; and participation in recruiting presentations around the country.
(3) Keep the Executive Committee apprised of issues relating to professional development as may arise from time to time, and offer recommendations for action, as the Committee may deem appropriate.

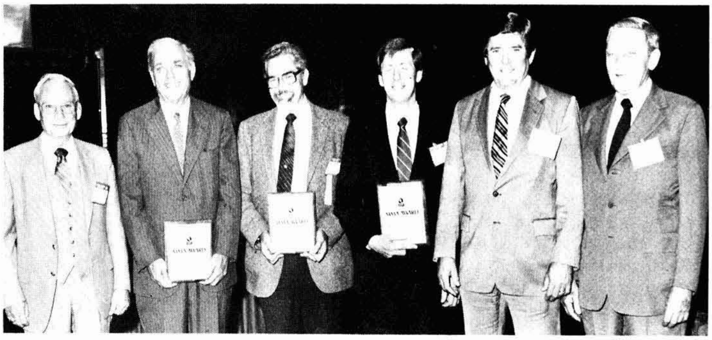
Detroit, Golden Gate, and St. Louis Societies Win MMA Awards for Notable Achievements

The 1985 MMA Awards for notable achievements by Constituent Societies of the Federation were won by the Detroit, Golden Gate and St. Louis Societies. Presentation of the Awards was made at the recent Annual Meeting in St. Louis.

Established in 1975 by Materials Marketing Associates, Inc., a national marketing group of manufacturers' representatives, the Awards recognize notable Society achievements, exclusive of Society papers presented at the Federation Annual Meeting, which are not eligible.

There are three categories of Awards, based on size of Society membership.

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



Plaques are displayed by representatives of the winning Societies in the Materials Marketing Associates (MMA) Awards competition for 1985: Al Zanardi (St. Louis), Barry Adler (Golden Gate), and Bob Feisel (Detroit). Flanking them are MMA Awards Committee Chairman Vic Willis (left) and James D. Boggess, of Wm. B. Tabler Co., Inc., President of MMA. At far right is C.G. Peterman, MMA Exective Director. The winners were cited in ceremonies at the Awards Luncheon during the Federation Annual Meeting in St. Louis.

Excellence of Color Matching Course

The Detroit Society was cited for the excellence of its automotive enamel color matching course. This seven-week evening course, was designed to teach the fundamentals of color matching and color control, and combined lectures and "hands-on" demonstrations. Students were taught formulation principles, sprayout, and matching, and how to develop straight shade and metallic automotive refinishing lacquers.

(continued on page 18)

1986 Paint Industries' Show Over 50% Sold Out

(continued from page 14)

Calgon Corp.
  Div. of Merck & Co., Inc.
Canada Talc Ltd.
Cargill, Inc.
Celanese Specialty Resins
Clawson Tank Co.
Color Corp. of America
Cook Resins & Additives
Cosan Chemical Corp.
Cray Valley Products, Inc.
Daniel Products Co.
Datalogix Formula Systems, Inc.
Degussa Corp.
University of Detroit
Diamond Shamrock Chemicals Co.,
  Process Chemicals Div.
Disti, Inc.
Dow Corning Corp.
Draiswerke, Inc.
Drew Chemical Corp.
DSET Laboratories, Inc.
Du Pont Company
Eastern Michigan University
Eastman Chemical Products, Inc.
Elektro-Physik, Inc.
Elmar Industries, Inc.
Engelhard Corp.
Epworth Manufacturing Co., Inc.
Exxon Corp.
Federation of Societies for Coatings Technology
Floridin Co.
Globe Trading Co.
Goodyear Tire & Rubber Co.
Gorman-Rupp Co.
Grefco, Inc.
  Dicaperl & Dicalite Depts.
Haake Buchler Instruments, Inc.
Halox Pigments
  Div. of Hammond Lead Products
Hitox Corp. of America
Hockmeyer Equipment Corp.
J.M. Huber Corp.
Nuodex/Huls
ICI Americas, Inc.
Illinois Minerals Co.
Indusmin
Kenrich Petrochemicals, Inc.
Kent State University
King Industries, Inc.
KTA-Tator, Inc.
Letica Corp.
Lorama Chemicals, Inc.
The Lubrizol Corp.
Macbeth Div. of Kollmorgen Corp.
Magnesium Elektron, Inc.
Manville
McWhorter, Inc.
Micro Powders, Inc.
Micromeritics Instrument Corp.
Miller Paint Equipment, Inc.
Milton Roy Co.
Mineral Pigments Corp.
Minolta Corp.
University of Missouri-Rolla
Mobay Chemical Corp.
Modern Paint & Coatings Magazine
Monsanto Co.
Myers Engineering
Neville Chemical Co.
NL Chemicals/NL Industries, Inc.
North Dakota State University
NYCO
P.A. Industries
Penn Color, Inc.
Pennsylvania Glass Sand Corp.
Pfizer, Inc., MPM Div.
Phillips Chemical Co., Catalyst Resources, Inc.
Poly-Resyn, Inc.
PPG Industries, Inc.
Premier Mill Corp.
Q-Panel Co.
Reeco
Reichhold Chemicals, Inc.
Rheometrics, Inc.
Rohm and Haas Co.
Roper Pump Co.
Russell Finex, Inc.
Sandoz Chemicals Corp.
Schold Machine Co.
Semicro Corp.
Shamrock Chemical Corp.
Shell Chemical Co.
Silberline Manufacturing Co., Inc.
South Florida Test Service
A.E. Staley Manufacturing Co.
Sun Chemical Corp., Colors Group
Tammsco, Inc.
Tego Chemie Service GmBH
Union Carbide Corp.
Union Process, Inc.
United Catalysts, Inc.
Universal Color Dispersions
R.T. Vanderbilt Co., Inc.
Viking Pump — Houdaille, Inc.
Virginia Chemicals, Inc.
Witco Chemical Corp.
  Organics Div.
Zeelan Industries, Inc.

(continued from page 16)

Development of Course For Coaters/Suppliers

The Golden Gate Society won an Award for developing a course for the Bay Area Coaters Association, a group of specialty producers primarily serving microcomputer/electronic instrument manufacturers. Major factor in establishing this course was imposition of stringent VOC regulations on miscellaneous metal parts coatings by the Bay Area Air Quality Management District; this program enabled Association members to catch up quickly on general coatings technology and prepare for compliance.

Establishing Award To Recognize Accomplishments Of Non-Degreed Technicians

The St. Louis Society was recognized for establishing an awards competition for non-degreed laboratory technicians, to recognize their accomplishments and provide funds for continuing education.

Entrants were provided with booklets from the Federation Series on Coatings Technology for study, then took a supervised written examination based on questions developed from the booklets. A total of $500 was shared by three winners, each of whom also received an appropriately engraved plaque, presented at a regular Society monthly meeting.

Principles Governing Awards

The MMA Awards recognize notable achievements in the field of education, manufacturing procedures, technology, public service, and other achievements deemed proper and desirable by the Awards Committee.

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.

The following are members of the Materials Marketing Associates who sponsored the 1985 MMA Awards: George C. Brandt, Inc., Elmhurst, IL; Carmona Chemical Co., San Francisco, CA; Horton Earl Co., St. Paul, MN; D.N. Lukens, Inc., Westboro, MA; Majemac Enterprises, Inc., Clearwater, FL; Matteson-Ridolfi, Inc., Riverview, MI; McCullough & Benton, Inc., Atlanta, GA; Mehaffey and Daigle, Inc., New Orleans, LA; 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.

Committee Activities

ENVIRONMENTAL CONTROL

OSHA Proposed Rulemaking to Expand Employee Coverage of "Right-to-Know"

The November 27, 1985 issue of the *Federal Register* contains a Federal OSHA advance notice on their proposed rulemaking on expansion of employee coverage for the OSHA 1910.1200 "Hazards Communications," commonly called the "right-to-know" law.

The purpose of the notice (pp. 48794-48796) is to reopen the record developed for the Hazard Communication, which reveals that while there is considerable information concerning worker exposure to hazardous chemicals in industries other than manufacturing, there is very little information regarding current practices of employers in those industries, or the applicability of the provisions as presently drawn when considering the diverse types of workplaces that may be encountered.

It may be remembered that the current Federal OSHA 1910.1200 specifically covers only SIC (Standard Industrial Classification) codes 20-39, which is the manufacturing segment of American industry. OSHA's rationale for coverage of the "right-to-know" for this group only is that while "manufacturing constitutes 30% of total employment, its employees account for more than 50% of the chemical source illnesses and injuries that are reported each year." Although employees in many industries are exposed to hazardous chemicals, OSHA has determined that the need for hazard communication programs to alleviate the risks of such exposures was greatest in the manufacturing sector. In addition, since the chemicals are developed and produced in the manufacturing sector, the hazard information has to be generated there first, regardless of which other industries are covered. OSHA goes on to say that "the producers of the chemicals are in the best position to ascertain the hazards, and to pass that information on to their customers using the materials."

While OSHA's philosophy sounds reasonable the United States Court of Appeals for the Third Circuit changed the rules. As part of their opinion in "United Steelworkers of America v. Auchter" 763 F. 2d 728, the Court acknowledged that "Section 6(g) clearly permits the Secretary (of OSHA) to set priorities for the use of the Agency's resources, and to promulgate standards sequentially," the Court found that OSHA "failed" to explain "why coverage of workers outside the manufacturing sector would have seriously impeded the rulemaking process" or "why it is not feasible for the same standard to be applied in other sectors where workers are exposed to similar hazards." 763 F. 2d at 738.

Therefore, the purpose of the November 27 notice is to re-open the record to collect specific information in these areas so that the Agency can respond to the Court's direction. The comment period is rather short (60 days) and the OSHA questions are specific to those areas where information is lacking. OSHA requests that respondents address the following questions, keying each response to the number of the question it applies to, and to provide as much substantive data as possible. All written comments in response to this notice must be received by February 25, 1986, in quadruplicate, addressed to the Docket Officer, Docket No. H-022D, Room N3670, Occupational Safety and Health Administration, 200 Constitution Avenue NW, Washington, DC 20210.

The questions are as follows:

(1) Please indicate the industry or industries to which the information applies (by SIC Code if possible).

(2) What is the current industry practice regarding hazard communication? Do employers generally have written hazard communication programs? Are containers labeled? Are material safety data sheets available for the hazardous chemicals? Are employees trained regarding the hazards and appropriate precautionary measures?

(3) What are the costs associated with the aspects of hazard communication that are currently implemented in the industry? Please indicate by specific activity if possible, i.e., cost for training, labels, etc. Based on the present provisions of the Hazard Communication Standard, what additional costs are estimated to be incurred if the standard were extended to your industry?

(4) If OSHA extended the provisions of the Hazard Communication Standard to this industry as written, what problems might arise in obtaining or transmitting hazard information? (For example, are there special problems associated with the agricultural industry or small businesses?) What solutions to these problems can you suggest that would still result in employees getting the information they need?

(5) Does this industry have fixed work sites? If not, is there some central point where information could be made accessible?

(6) Does this industry have transient workers? What current practices are used to ensure such workers are apprised of the hazards they may encounter on the site? Is there training or information specific to the types of jobs performed?

(7) To what extent are hazardous chemicals purchased from retail distributors? How is information obtained about these chemicals when purchased from these types of establishments? Do the retail distributors provide hazard information? Are manufacturers contacted directly for the information? If so, has this been a successful approach? Are employees exposed to the chemical involved without receiving information about the specific hazards? How is a determination made regarding the appropriate protective measures to be implemented in this situation?

(8) Are "consumer products" used in this industry in a manner that results in different exposure levels than would be encountered in consumer usage? What types of products are these? How is hazard information obtained for these products?

(9) Is this industry subject to state-initiated "right-to-know" laws? What has been the industry's experience under such state laws? Are there particular provisions that have been difficult to implement in this industry? If so, what alternative provisions are suggested to ensure employees receive the necessary information? To what extent is the industry complying with the state laws?

(10) The standard includes an exemption for "articles". There have been many questions regarding this exemption, and apparent confusion about the application of the provision as written. Does the "article" definition and exemption in the current rule apply to products produced or used in your industry? If so, has it been difficult to apply the definition to these products? What suggestion do you have for modifying or clarifying the definition and exemption to address these difficulties?

(11) The Hazard Communication Standard exempts wood and wood products,

(continued on page 22)

Underground Storage Tank Notification Set for May 8 by EPA

In the November 8, 1985 Federal Register, the Environmental Protection Agency published a notification form to be used by owners of underground storage tanks that store or have stored petroleum or hazardous substances. Under Section 9002 of the Resource Conservation and Recovery Act (RCRA), these owners are required to notify designated State or local agencies of the existence of their tanks.

Section 9002 requires owners of the underground storage tanks used to store or dispense regulated substances on or after November 8, 1984, to make notification by May 8, 1986, and to provide information on the age, size, type, location, and use of each tank. Owners who bring underground storage tanks into use after May 8, 1986 must notify within 30 days of bringing the tank into use and provide information on the age, size, type, location, and use of such tanks. Section 9002 also imposes requirements on owners of underground storage tanks which were taken out of operation after January 1, 1974, but remain in the ground. Owners of these tanks must notify by May 8, 1986, and provide information to the extent known on the date the tank was taken out of operation, and the size, type, and quantity of substances left stored in the tank on the date it was taken out of operation.

The EPA states that the primary purpose of this notification program is to locate and evaluate underground tanks that store or have stored petroleum or hazardous substances. They expect that the information industry will provide is based on reasonably available records, or in the absence of such records, from knowledge, belief or recollection.

Below are anticipated questions from the regulated community with the EPA providing the answers:

(1) *Who must notify?* Section 9002 of RCRA, as amended, requires that, unless exempted, owners of underground tanks that store regulated substances must notify designated State or local agencies of the existence of their tanks. Owner means: (a) in the case of an underground storage tank in use on November 8, 1984 or brought into use after that date, any person who owns an underground storage tank used for the storage, use, or dispensing of regulated substances, and (b) in the case of any underground storage tank in use before November 8, 1984, but no longer in use on that date, any person who owned such tank immediately before the discontinuation of its use.

(2) *What tanks are included?* Underground storage tank is defined as any one or combination of tanks that (1) is used to contain an accumulation of "regulated substances," and (2) whose volume (including connected underground piping) is 10% or more beneath the ground. Some examples are underground tanks storing: (1) gasoline, used oil, or diesel fuel; and (2) industrial solvents, pesticides, herbicides or fumigants.

(3) *What tanks are excluded?* Tanks removed from the ground are not subject to notification. Other tanks excluded from notification are:

1. Farm or residential tanks of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes;
2. Tanks used for storing heating oil for consumption use on the premises where stored;
3. Septic tanks;
4. Pipeline facilities (including gathering lines) regulated under the Natural Gas Pipeline Safety Act of 1968, or the Hazardous Liquid Pipeline Safety Act of 1979, or which is an interstate pipeline facility regulated under State laws;

5. Surface impoundments, pits, ponds, or lagoons;
6. Storm water or waste water collection systems;
7. Flow-through process tanks;
8. Liquid traps or associated gathering lines directly related to oil or gas production and gathering operations;
9. Storage tanks situated in an underground area (such as a basement, cellar, mineworking, drift, shaft, or tunnel) if the storage tank is situated upon or above the surface of the floor.

(4) *What substances are covered?* The notification requirements apply to underground storage tanks that contain regulated substances. This includes any substance defined as hazardous in section 101 (14) of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), with the exception of those substances regulated as hazardous waste under Subtitle C of RCRA. It also includes petroleum, e.g. crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60° F and 14.7 psi absolute).

(5) *Where to notify?* The completed notification forms should be sent to your individual states' official agency in charge of underground storage tanks.

(6) *When to notify?* 1. Owners of underground storage tanks in use or that have been taken out of operation after January 1, 1974, but still in the ground, must notify by May 8, 1986. 2. Owners who bring underground storage tanks into use after May 8, 1986 must notify within 30 days of bringing the tanks into use.

Penalties: Any owner who knowingly fails to notify or submits false information shall be subject to a civil penalty not to exceed $10,000 for each tank for which notification is not given or for which false information is submitted.

A copy of the official EPA notification form is shown opposite. Most of the states have opted to use the EPA form. Those states who have developed their own version of the underground tank notification form are as follows: California, Connecticut, Delaware, Florida, Guam, Iowa, Louisiana, Maine, Minnesota, New Jersey, North Dakota, Ohio, South Carolina, Vermont, Washington, Wisconsin. If your are in doubt about your particular state, call the environmental protection office in your region.

JOYCE SPECHT ST. CLAIR,
Chairman, Environmental Control Committee, and Industry Representative on the Kentucky OSHA Standards Board

APPENDIX I to §280.3

Notification for Underground Storage Tanks

FORM APPROVED
OMB NO. 2050-0049
APPROVAL EXPIRES [illegible]

STATE USE ONLY
I.D. Number
Date Received

INSTRUCTIONS

Please type or print in ink all items except "signature" in Section V. This form must by completed for each location containing underground storage tanks. If more than 5 tanks are owned at this location, photocopy the reverse side, and staple continuation sheets to this form.

Indicate number of continuation sheets attached ☐

I. OWNERSHIP OF TANK(S)

Owner Name (Corporation, Individual, Public Agency, or Other Entity)
Street Address
County
City | State | ZIP Code
Area Code | Phone Number
Type of Owner *(Mark all that apply ☒)*
☐ Current ☐ Former ☐ State or Local Gov't ☐ Federal Gov't (GSA facility I.D. no. ______) ☐ Private or Corporate ☐ Ownership uncertain

II. LOCATION OF TANK(S)

(If same as Section 1, mark box here ☐)
Facility Name or Company Site Identifier, as applicable
Street Address or State Road, as applicable
County
City (nearest) | State | ZIP Code
Indicate number of tanks at this location ☐
Mark box here if tank(s) are located on land within an Indian reservation or on other Indian trust lands ☐

III. CONTACT PERSON AT TANK LOCATION

Name (If same as Section I, mark box here ☐) | Job Title | Area Code | Phone Number

IV. TYPE OF NOTIFICATION

☐ Mark box here only if this is an amended or subsequent notification for this location.

V. CERTIFICATION (Read and sign after completing Section VI.)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete.

Name and official title of owner or owner's authorized representative | Signature | Date Signed

Owner Name (from Section I) ______ Location (from Section II) ______ Page No. ___ of ___ Pages

VI. DESCRIPTION OF UNDERGROUND STORAGE TANKS *(Complete for each tank at this location.)*

Tank Identification No. (e.g., ABC-123), or Arbitrarily Assigned Sequential Number (e.g., 1,2,3...)	Tank No.	Tank No.	Tank No.	Tank No.	Tank No.
1. Status of Tank *(Mark all that apply ☒)* Currently in Use	☐	☐	☐	☐	☐
Temporarily Out of Use	☐	☐	☐	☐	☐
Permanently Out of Use	☐	☐	☐	☐	☐
Brought into Use after 5/8/86	☐	☐	☐	☐	☐
2. Estimated Age (Years)					
3. Estimated Total Capacity (Gallons)					
4. Material of Construction *(Mark one ☒)* Steel	☐	☐	☐	☐	☐
Concrete	☐	☐	☐	☐	☐
Fiberglass Reinforced Plastic	☐	☐	☐	☐	☐
Unknown	☐	☐	☐	☐	☐
Other, Please Specify					
5. Internal Protection *(Mark all that apply ☒)* Cathodic Protection	☐	☐	☐	☐	☐
Interior Lining (e.g., epoxy resins)	☐	☐	☐	☐	☐
None	☐	☐	☐	☐	☐
Unknown	☐	☐	☐	☐	☐
Other, Please Specify					
6. External Protection *(Mark all that apply ☒)* Cathodic Protection	☐	☐	☐	☐	☐
Painted (e.g., asphaltic)	☐	☐	☐	☐	☐
Fiberglass Reinforced Plastic Coated	☐	☐	☐	☐	☐
None	☐	☐	☐	☐	☐
Unknown	☐	☐	☐	☐	☐
Other, Please Specify					
7. Piping *(Mark all that apply ☒)* Bare Steel	☐	☐	☐	☐	☐
Galvanized Steel	☐	☐	☐	☐	☐
Fiberglass Reinforced Plastic	☐	☐	☐	☐	☐
Cathodically Protected	☐	☐	☐	☐	☐
Unknown	☐	☐	☐	☐	☐
Other, Please Specify					
8. Substance Currently or Last Stored in Greatest Quantity by Volume *(Mark all that apply ☒)* a. Empty	☐	☐	☐	☐	☐
b. Petroleum Diesel	☐	☐	☐	☐	☐
Kerosene	☐	☐	☐	☐	☐
Gasoline (including alcohol blends)	☐	☐	☐	☐	☐
Used Oil	☐	☐	☐	☐	☐
Other, Please Specify					
c. Hazardous Substance	☐	☐	☐	☐	☐
Please Indicate Name of Principal CERCLA Substance					
OR Chemical Abstract Service (CAS) No.					
Mark box ☒ if tank stores a mixture of substances	☐	☐	☐	☐	☐
d. Unknown	☐	☐	☐	☐	☐
9. Additional Information (for tanks permanently taken out of service) a. Estimated date last used (mo/yr)	/	/	/	/	/
b. Estimated quantity of substance remaining (gal.)					
c. Mark box ☒ if tank was filled with inert material (e.g., sand, concrete)	☐	☐	☐	☐	☐

EPA Form 7530-1 (11-85) Reverse | Page 2

NBS Accredits Paint Testing Laboratories

The National Bureau of Standards (NBS) has a new program for accrediting laboratories that test paints and coatings and related products. NBS was requested to establish this program by the International Coalition for Procurement Standards (ICPS) which believes that the quality of paints and coatings purchased by local governments will be assured if those products are tested in an accredited laboratory.

NVLAP now has one commercial paint testing laboratory accredited and two others have applied and are in the process of evaluation. Requirements for NBS accreditation of paint testing laboratories by local government purchasing officials is beginning. The County of Bergen (New Jersey) Purchasing Department is requesting that bidders on contracts to supply paint to the County have samples tested by an NBS accredited laboratory. The County has the right to take random samples of paint products from the awarded vendor during the contract period for testing by the accredited laboratory.

Accreditation by NBS is available to both commercial testing laboratories and in-house quality assurance laboratories. To become accredited a laboratory must first submit an application and fees to the National Voluntary Laboratory Accreditation Program (NVLAP). NBS accredits laboratories for specific test methods and the annual fee is based on the number of methods selected by the laboratory. More than 120 test methods are available and the fees range from a minimum of $2,175 to a maximum of $2,975 even if all of the test methods are selected. The fees cover the costs of an on-site assessment of the laboratory before initial accreditation and on a two-year schedule thereafter.

Accreditation is granted to the laboratory after the on-site assessment by a technical expert, correction of any deficiencies in procedures, equipment, facilities, or documentation noted by the assessor, and technical review of the application documents by NVLAP staff. Accredited laboratories must participate in the proficiency testing program offered by Collaborative Testing Services. Accredited laboratories receive a Certificate and Scope of Accreditation from NBS which certifies that the laboratory has been found competent to perform the test methods listed. Accreditation by NBS has no direct bearing on the accuracy or precision of data supplied by an accredited laboratory to clients or vendors.

Although it seems slow in coming, requirements for NBS accreditation are bound to increase. Independent and in-house laboratories should consider NBS accreditation as a means for demonstrating the quality of their test data and quality of their products to clients and purchasing officials. Those interested in further information on the NBS accreditation program for paint testing laboratories should write to: Wiley A. Hall, NBS-NVLAP, Gaithersburg, MD 20899.

OSHA Proposed Right-to-Know Rule

(continued from page 19)

such as lumber and paper, from coverage. Although these products may be flammable or combustible, this potential hazard is considered to be unmistakable, and provision of information for this type of hazard was thought to be unnecessary. OSHA did not intend that this exemption include "wood dust," a substance for which the American Conference of Governmental Industrial Hygienists has established exposure limits, but some have interpreted it that way. Would it be appropriate to clarify that the "wood and wood products" exemption does not apply to "wood dust"? What problems might result from this clarification, i.e., is there any situation where coverage of wood dust would not be appropriate?

(12) The rule includes a "floor" of hazard chemicals, that is, it incorporates by reference several lists of chemicals and states that the substances on these lists are to be considered hazardous in all situations. Nuisance dust appears on all these lists. Since any dust can be considered a nuisance dust in some situations, OSHA further clarified this coverage in its compliance directive on the rule (CPL 2-2.38) by stating that only those dusts listed by the American Conference of Governmental Industrial Hygienists in the nuisance particulate appendix of its annual Threshold Limit Value publication would be covered by the Hazard Communication Standard. Would it be appropriate to remove nuisance dust from the chemicals covered by the standard as a health hazard? Are there situations where labels, material safety data sheets, and training would be useful to employees exposed to these chemicals?

Joyce Specht St. Clair,
Chairman, Environmental Control Committee, and Industry Representative on the Kentucky OSHA Standards Board

Battelle to Study Stability of Organic Coatings

A study is being proposed by Battelle to develop practical and theoretical data for rapidly predicting the stability of organic coatings. Such coatings represent a $10 billion industry. They have generated interest worldwide for a wide range of uses in conventional and exotic environments.

Results of Battelle's study, to be supported on a group basis, will help developers:

- Determine the autooxidative stability of organic coatings at early stages of weathering
- Improve the performance of coatings by providing a rapid screening of new polymers or additives for improving weatherability
- Design raw materials that can enhance the performance of coatings
- Design coatings for specific applications
- Expand their fundamental knowledge of film deterioration at a molecular level.

The goal of Battelle's study is to develop a method or series of methods that will rapidly determine a coating's susceptibility to autooxidative degradation, follow degradation as a function of exposure time, relate it to changes in performance during exposure, and determine the effect of additives of degradation.

In conducting the study, Battelle experts will collect data and conduct field interviews with specialists in polymer and coating weathering. They then will select candidate early-detection techniques for laboratory evaluation, conduct exposure studies, and rank the candidate techniques.

Cost of the 19-month study is $18,500 per company. More information may be obtained from Richard J. Dick, Battelle's Columbus Division, 505 King Avenue, Columbus, Ohio 43201-2693.

Effect of Polyester Carboxyl and Hydroxyl End Group Balance In Isocyanate Curing Powder Coatings

John J. McLafferty, Peter A. Figlioti, and Louis T. Camilleri
Ruco Polymer Corporation*

The balance of hydroxyl and carboxyl end groups in polyesters for urethane powder coatings is a parameter which can significantly affect curing characteristics and performance of the coatings. Reaction kinetics of these functional groups with aromatic and aliphatic isocyanates are reviewed. The practical effect of the functional group balance at a nominal reactive number is studied in a standard catalyzed powder formulation based on a resin series with caprolactam blocked isocyanate curatives. Resin viscosities and Tg are compared and flow behavior and gel times of laboratory prepared compounds are evaluated. Properties of the cured coatings are also examined.

INTRODUCTION

Polyester resins for powder coatings are predominantly hydroxyl terminated, saturated oligomers which give thermoset polyurethanes when cured with crosslinking polyisocyanates. Typically, the isocyanate is in a blocked form which deblocks and becomes available for curing when the coating is baked. The overall curing reaction is represented in *Figure* 1. Since isocyanates can react with any active hydrogen compound, we should be aware that a "polyurethane" is likely to contain more than just the true urethane link. Examples of the various linkages possible with isocyanates are shown in *Figure* 2.

Compositional variations in polyesters, isocyanate crosslinkers, blocking agents, and catalysts are numerous and are widely reported in the literature. These basic classes of urethane formulating ingredients all play key roles in the processability of coatings, and in the performance of cured polymers. The polyester component is particularly important since it is the major constituent of the finished polyurethane matrix. Therefore, the tailoring of polyester structures is essential to achieving desired powder coating properties in cost-effective formulations. Polyester key variables are: (1) backbone composition, (2) molecular weight, and (3) overall functionality of functional groups.

Polyesters used in urethane powder coatings are derived from a variety of multifunctional alcohols and carboxylic acids, which undergo condensation polymerization through the esterification reaction (shown in *Figure* 3). Such resins are end-capped in both hydroxyl and carboxyl groups. The ratio between these functional groups in the finished polyester depends upon the stoichiometry between glycol and acid reactants in the polyester cook.

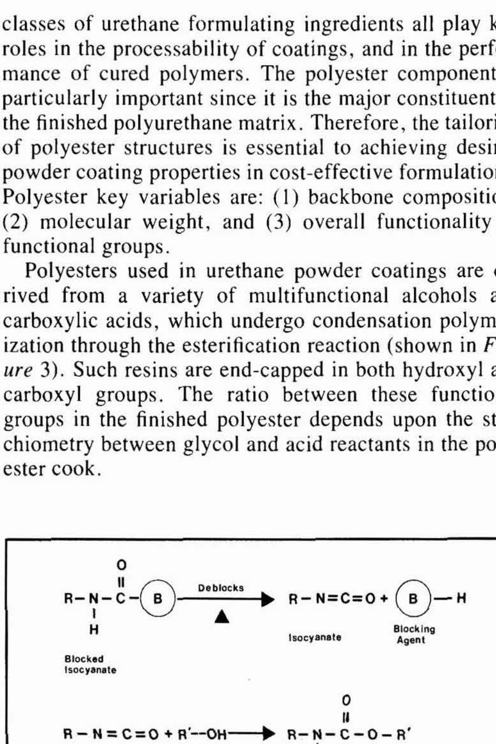


Figure 1—Curing reaction of polyester powder coating resins with blocked isocyanates

Presented at the 63rd Annual Meeting of the Federation of Societies for Coatings Technology, St. Louis, MO, October 8, 1985.

* Hicksville, NY 11802.

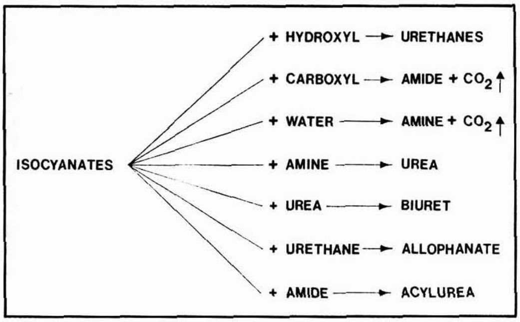


Figure 2—Reactions of isocyanates

Polyurethane coatings are normally based on resins which are essentially completely capped with hydroxyl groups, but as a practical matter, some residual carboxyl functionality is present, either by design or as an inherent characteristic of a particular resin. This carboxyl content is important to the urethane chemist because of its reported acid catalysis[1] of isocyanate reactions, and because the reaction of carboxylic acids and isocyanates can result in crosslinking through amide linkages.[2]

Another factor to weigh when developing resins is the potential for acid catalyzed hydrolytic degradation of the coating. Hence, the balance between hydroxyl and carboxyl end-groups is a factor which might significantly affect coatability, bake cycles, and overall performance characteristics. This study attempts to elucidate the practical effects of varying polyester end-group balance of one model polyester composition while holding reactive number constant. We chose to evaluate this series in a simple unpigmented powder coating formulation, thus avoiding complex interactions which can arise when many formulating ingredients are present. The kinetics of the pertinent isocyanates with a representative glycol and carboxylic acid were also studied to facilitate interpretation of the powder coating test data.

EXPERIMENTAL

The kinetics of the isocyanate reaction with both carboxylic acids and hydroxyl groups has been reported in the literature.[3] For this work, we measured the relative reaction rates of the specific functional groups which occur in the powder coating resin systems we studied (*Figure* 4).

Our method involved reacting the active hydrogen bearers with aliphatic isophorone diisocyanate (IPDI) and also with the aromatic toluene diisocyanate (TDI) in a solvent, M-Pyrol,® at 100°C. The rate of NCO consumption was tracked by "wet" analysis. A correction for M-Pyrol reactivity (moisture content) was determined on a blank which consisted of the isocyanate and M-Pyrol. The results of the rate study are shown in *Figure* 5. The data are generally consistent with results reported by others.[4]

(1) The reaction of IPDI with isophthalic acid (IPA) barely proceeds both with and without stannous octoate (SnOct) catalysis.

(2) The IPDI/neopentyl glycol (NPG) reaction rate was slow without catalyst, but rapid when catalyzed with SnOct.

M-Pyrol is a registered tradename of GAF Corporation.

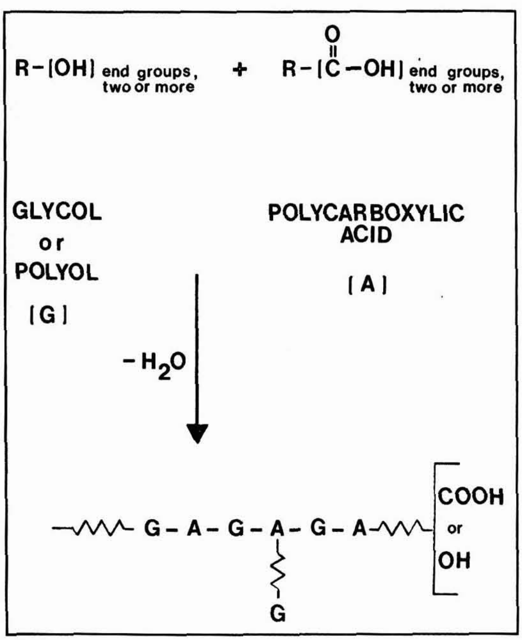


Figure 3—Polyesterification

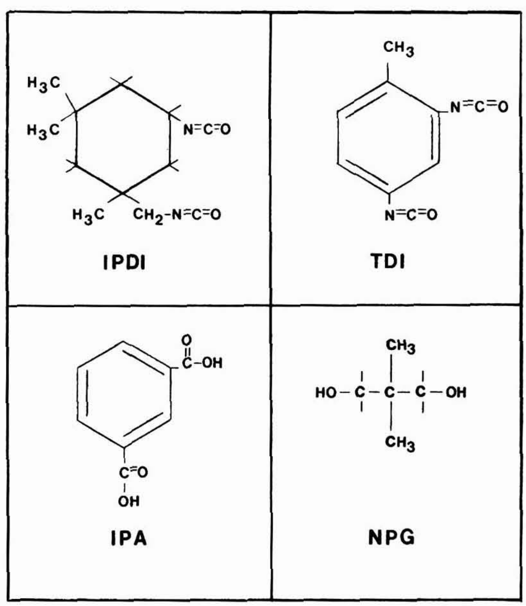


Figure 4—Reactants used in the kinetics study

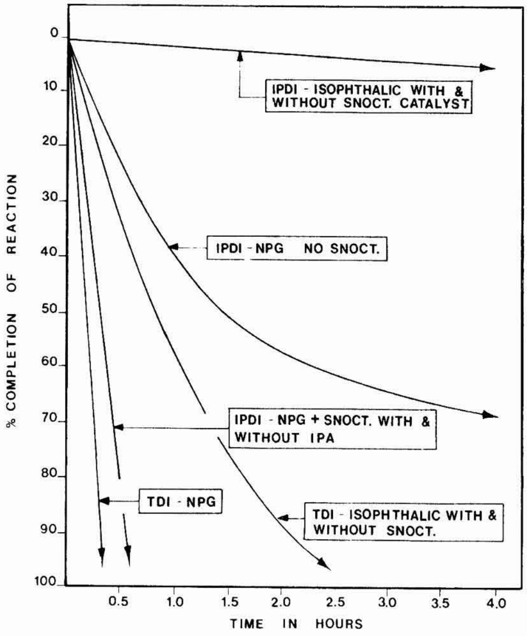


Figure 5—Relative reaction rates of isophthalic acid and NPG with TDI and IPDI at 100°C [50% solids in M-Pyrol]

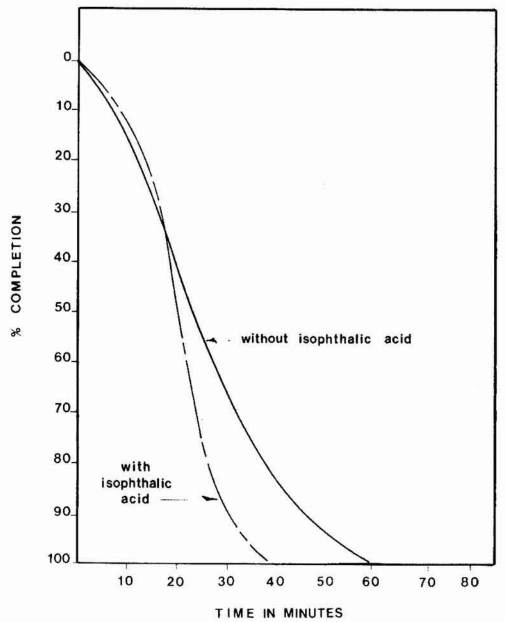


Figure 6—Kinetics of IPDI/NPG reaction catalyzed with 0.03% T-9 at 100°C [50% solids in M-Pyrol]

(3) Isophthalic acid did not further accelerate the reaction of NPG with IPDI in the presence of 0.3% SnOct. At one tenth the level of SnOct, a rate enhancement was achieved in the presence of a catalytic amount of carboxylic acid. (*Figure* 6).

(4) The TDI/NPG reaction rate was extremely rapid.

(5) TDI and IPA reacted at a moderate rate which was not accelerated by SnOct.

Resin Formulations

In formulating the resins, we chose to limit functionality to 2.5 so that isocyanate crosslinker effectiveness would become more evident in the cured coating. Similarly, the resin's reactive number was held to about 60 so that high isocyanate demand would be less likely to overwhelm the polyester end groups' effects on crosslink density and rate.

The basic resin composition and the properties of each resin are shown in *Table* 1. *Acid numbers* range from about 2 to 25, while overall *reactive number* (hydroxyl plus acid number, see *Table* 2) is about 60. We relate these two resin properties through the parameter "R-Acid" which we use as the "X" axis of the data plots in this paper. R-Acid represents the concentration of those resin end-groups which are carboxylic, expressed as a percent of total resin end groups. The term R-Acid is simply a ratio of resin acid number to resin reactive number multiplied by 100.

Modaflow III is a registered tradename of Monsanto Co.

Powder Formulation

A simple, unpigmented powder coating formulation was selected to highlight potential resin effects. No antioxidants or UV absorbers were employed.

Resin selection:	Five acid #/reactive # ratios
Curative selection:	Two types used
Modaflow III®:	Constant 1.0 pph
Benzoin:	Constant 0.3 pph
Stannous octoate:	Constant 0.3 pph (catalyst)
Stoichiometry:	Two levels—one based on hydroxyl and the other on reactive number.

Curative level was based on both hydroxyl number stoichiometry (which is normally used by the powder coating industry) and reactive number stoichiometry since we expected the carboxyl-isocyanate reaction to be significant in higher acidity systems. The curatives selected were from two distinctly different classical types

Table 1—Polyester Resins Studied

Model Composition: **Terephthalic Acid**
Neopentyl Glycol
Trimethylol Propane

Resin Number	1	2	3	4	5
OH #	56.5	51.9	49.6	41.8	36.8
Acid #	1.6	6.8	10.9	17.4	24.4
Reactive #	58.1	58.7	60.5	59.2	61.2
R-Acid	2.8	11.6	18.0	29.4	38.9
Glass Trans., °C	60.9	62.6	63.0	63.5	62.2
Viscosity, 200°C	2400	2700	2400	2900	2400

Table 2—Term Definition

Name	Abbreviation	Description
Hydroxyl Number	OH #	mg KOH = to OH / grams specimen
Acid Number	AC #	mg KOH = to COOH / grams specimen
Reactive Number	RN	OH # + AC #
R-Acid	AC # × 100 / RN	COOH as percent of total resin end groups

representative of those commercially available in the industry. Comparisons of crosslinking behavior of the two curatives can only be made in the most general way because they differ in functionality as well as the isocyanate type employed, i.e., aromatic vs aliphatic.

For a description of the isocyanate curatives used, see *Table* 3.

Isocyanate Curatives Employed

Stannous octoate catalyst was incorporated due to its wide use in the industry, being recognized as one which does not unfavorably influence weathering. However, due to the inherent instability of SnOct, we expect some catalytic activity to be lost during extruder processing of the compounds and storage of the powders. The catalyst level was at the low end of the range used in the powder coating industry, chosen so as not to overpower differences between resins. Modaflow III and Benzoin were selected as flow and leveling agents.

Coating Preparation

Individual batches were premixed in a high speed mixer, then extruded by compounding extruder. The cooled chips were pulverized in a hammer mill and the powder then sieved through a 170 mesh screen. The powder was electrostatically sprayed onto Bonderite™ 1000 treated unpolished panels (4″ × 6″ × 20 gauge) and baked for 10 min at 400°F for NT-1 (aromatic) systems, and 15 min at 400°F for NI-2 (aliphatic) systems. Coating thickness ranged between 1.8 and 2.2 mils. Deblocking temperatures for the curatives are in the region of 300-360°F, well below the baking temperature. Deblocking is therefore asssumed to be complete during baking, and is not considered a significant variable in this study.

Bonderite is a registered tradename of Parker Co.

Table 3—Isocyanate Curatives Employed

Code	Type and Description	Equivalent Weight
NT-1	Aromatic crosslinker, E-caprolactam blocked polyfunctional adduct of toluene diisocyanate	271
NI-2	Aliphatic crosslinker, E-caprolactam blocked polyfunctional adduct of isophorone diisocyanate	280

Table 4—Test Methods

Substance	Test	ASTM Ref. No.
Spray Powder	Gel time	D-3451
	Pellet flow	Modified D-3451
Cured Film	Salt spray (fog)	B-117
	QUV weathering	G-53
	Taber abrasion resistance	Ruco modified test
	Solvent resistance	Ruco Test
	Pencil hardness	D-3363
	Tape adhesion test	D-3359
	Gardner impact resistance	D-2794
	Conical mandrel bend	D-522
	Specular gloss, 60°	D-523

Performance Evaluation

Information on the test methods used is given in *Table* 4. Detailed data on pencil hardness, conical mandrel, initial gloss, tape adhesion, salt spray resistance, and resistance to abrasion will be omitted since no significant differences relating to resin acid number and curative stoichiometry were noted (*Table* 5). Substantial effects in gel time, pellet flow, solvent resistance, QUV weathering, and Gardner impact were revealed and are presented in a series of graphs (*Figures* 7-11).

Gel Time and Pellet Flow

Figures 7 and 8 show the relationship between gel time and pellet flow vs R-Acid for the two isocyanates studied, each formulated for reactive number and hydroxyl stoichiometry. In those systems based on aliphatic crosslinker, NI-2 (*Figure* 7), there is a rapid decrease in gel time and pellet flow as the acidity increases above negligible levels. We believe this effect is amplified because the SnOct catalytic activity has been significantly lessened during powder processing.

This acid catalysis of gelation was confirmed through another experiment in which the acid number of resin #1 was effectively increased from ~2 to ~7 by adding adipic acid directly to the powder formulation. Gel time dropped from 250 seconds to 145 seconds in that experiment. Pellet flow data followed the gel time pattern, but with a less intense response to acid catalysis.

Table 5—Testing Showing No Differences with Changing R-Acid

Salt spray (FOG)	All pass. No blistering. Less than 1/16″ creepage after 500 hours exposure
Pencil hardness	All are "H" lead hardness
Taber abrasion	All lost less than 20 mg after 300 cycles using CS 17 wheel, 1000 gm load
Tape adhesion	No differences observed
Conical mandrel	All pass 1/8 inch bend
Specular gloss	All 60 deg initial readings were 100

Since the curves in *Figure* 7 for hydroxyl and reactive number based stoichiometries are essentially superimposed, we can conclude that the reaction of IPDI with carboxyl is very slow compared to urethane formation and does not substantially alter compound and flow characteristics.

Figure 8 suggests that the faster reacting aromatic curative, NT-1, is not responsive to the catalytic influence of carboxyl groups, as evidenced by essentially zero slopes in the low R-Acid range. But in the high R-Acid range where the compounds were formulated on reactive number the curves diverge, strongly suggesting that the NCO/COOH curing reaction is occurring. The divergence is more pronounced for gelation than for pellet flow, reflecting the more vigorous rate of amide formation at the higher temperature used in the gel test (400°F) vs pellet flow (300°F).

Solvent Resistance

Unlike the gelation data, which indicates the early effects of the dominant reactions on processability, the performance evaluations on cured coatings reflect the totality of reactions occurring. Our solvent resistance testing was most revealing in this regard. Solvent resistance studies were first conducted using a conventional MEK rub test. This test was too severe, causing all coatings to soften and lose gloss. A more sensitive method was developed using blends of a strong solvent, Arcosolve PM Acetate®, which attacked all coatings, and a diluent, isopropanol, which attacked none. Each panel was given a five minute exposure to a profile of solvent blends. We noted which mixtures caused a failure on each coating, and plotted the results in *Figure* 12. The test revealed that the reactive number stoichiometry with TDI based crosslinker gives good solvent resistance, independent of the acidity. This indicates that crosslinking was comparable throughout the R-Acid series, and that the carboxyl groups were sufficiently reactive towards aromatic NCO to enter into the cure.

When the TDI crosslinker stoichiometry was based on hydroxyl number, the solvent resistance fell off at the high acid numbers reflecting the stoichiometric shortage of crosslinker vs total resin end-group content. However, we detected no difference in solvent resistance at acid numbers below about 14 (R-Acid 25), indicating that crosslink densities were comparable in these specimens.

The solvent resistance for the IPDI cured series indicate a somewhat different response to acid number. Crosslinking is shown to be slightly less than complete in the lowest acidity range, probably due to slower reaction in the absence of sufficient acid catalysis. The peak solvent resistance in the R-Acid range of about 8-14 reflects the best cure. At both stoichiometries, the poorest performance was observed at the highest acidity, indicating low crosslink density due to unreacted carboxyl groups even in the presence of available isocyanate. Divergence of the reactive number stoichiometry curves from horizontal shows the extent to which carboxyl and isocyanate groups fail to react. Only a small degree of crosslinking is attributed to the carboxyl/isocyanate reaction here. This is shown by the extent to which the reactive number based

Arcosolve PM Acetate is a registered tradename of Arco Chemical Co.

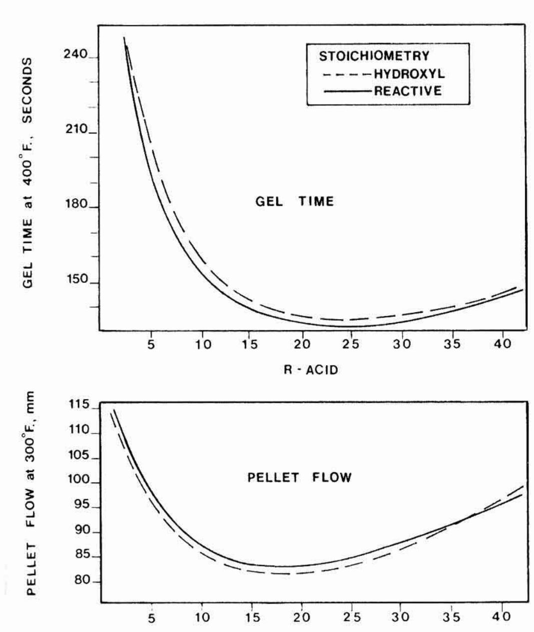


Figure 7—Gel times and pellet flow using (aliphatic) crosslinker NI-2

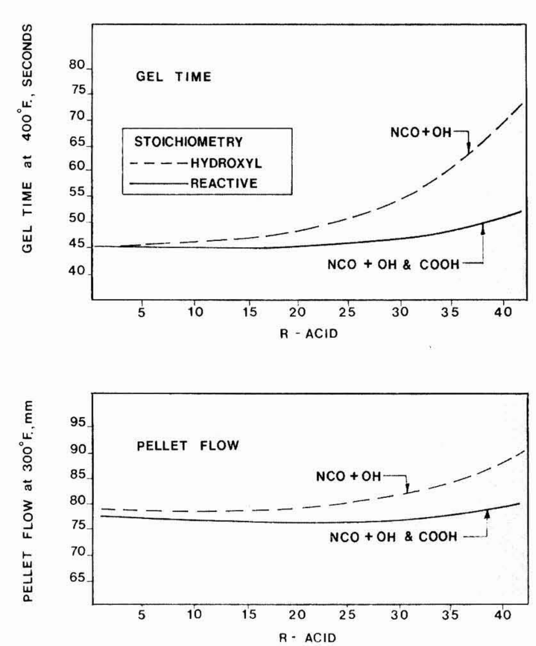


Figure 8—Gel times and pellet flow using (aromatic) crosslinker NT-1

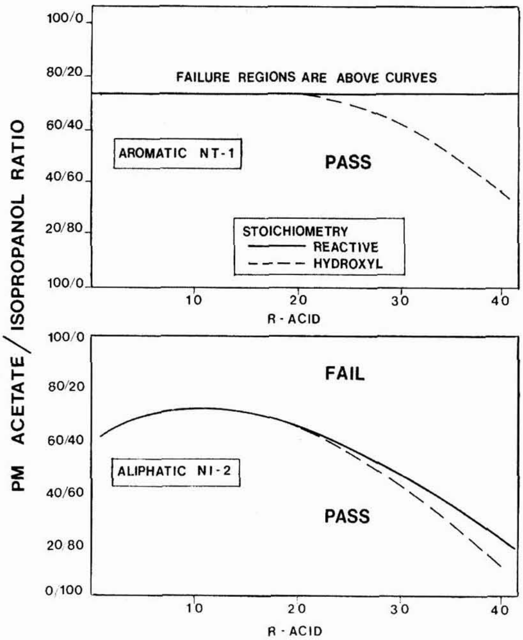


Figure 9—Solvent resistance vs R-acid for TDI and IPDI cured powder coating systems

curve is offset from the hydroxyl based curve. This behavior may not be the same with other catalysts.

QUV Weathering

The QUV exposure results showed all resins to behave smilarly in the non-discoloring aliphatic crosslinked formulations. Good gloss retention (no chalking) was observed throughout the series. On the other hand, the aromatic NT-1 cured coatings all yellowed severely and, as shown in *Figure* 13, exhibited significant loss of gloss. Gloss retention was greater in the mid R-Acid region while distinctly poorer performance was seen in the high R-Acid formulations. This was more pronounced at reactive number stoichiometry, which generally showed slightly more dulling with increased isocyanate content. The classically severe UV yellowing associated with aromatic isocyanates was evident throughout. No rationale for the observed greater chalking at highest acidities is offered since the specific chemical interactions relating to this behavior have not been investigated here.

Gardner Impact

Gardner impact results for all *reactive numbered-based formulations* were 160 inch-pounds, forward and reverse, regardless of acidity (*Figure* 14). Although our kinetics study has shown that the reaction between IPDI and carboxyl is extremely slow, the high impact results even at high acid number indicate that some crosslinking reaction other than urethane formation has taken place. However, impact resistance for formulations based upon hydroxyl stoichiometry was adversely affected by increasing R-Acid which results in a lowering of crosslinker concentration. The performance drop-off is more severe with the slower reacting aliphatic isocyanate. The difference in impact between the 160 inch-pounds achieved in all reactive number formulations and the values for hydroxyl stoichiometry formulation at high R-Acid represents the extent to which extra (non-urethane) crosslinks have occurred in formulations based on reactive number.

In summary, the five areas of performance reflecting R-Acid differences are presented in *Figure* 15.

Testing Summary

A comprehensive rationale for relating resin hydroxyl content and the role of acid end groups as both catalyst and reactant is:

1) Gel time and pellet flow are dependent upon the early curing reaction associated with hydroxyl content, whereas coating performance is a function of the ultimate crosslink density which depends on a combination of all isocyanate reactions occurring.

2) The catalytic action of acid and SnOct combined gives the fastest reaction of hydroxyl and isocyanate. The aliphatic isocyanate is inherently slow and benefits the most from acid catalysis.

3) Chalking of the aromatic isocyanate based system shows some relationship to resin acidity, but apparently not to crosslink density. We refer to the less crosslinked aliphatic system's QUV results which indicate no chalking after 500 hr exposure.

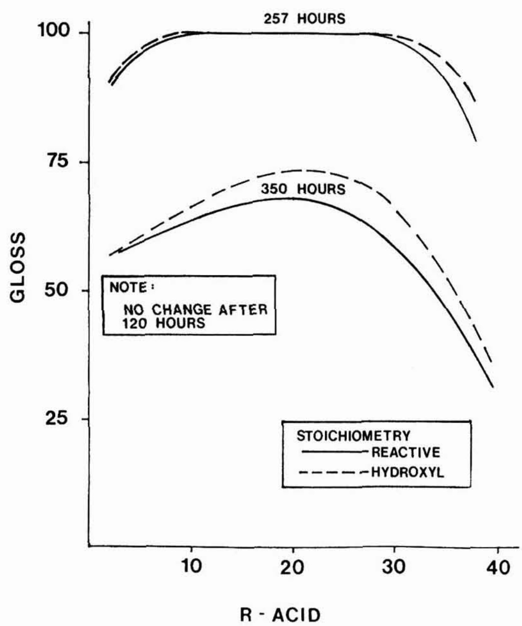


Figure 10—Powder coatings with aromatic curative NT-1 specular gloss retention after QUV testing

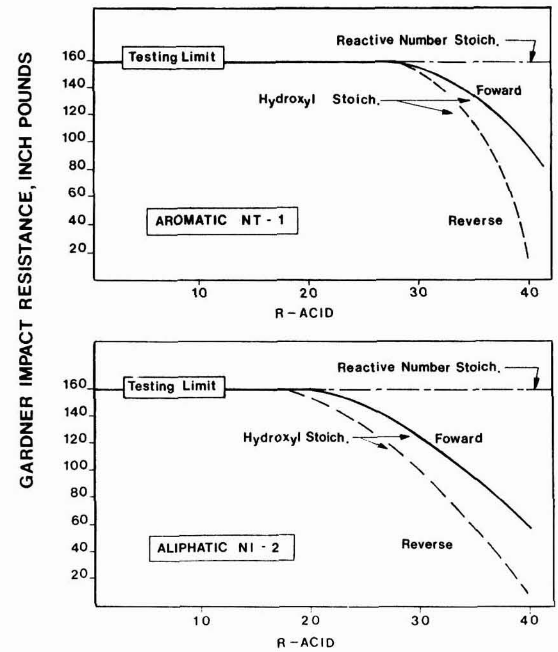


Figure 11—Gardner impact for NT-1 and NI-2 based coatings (testing limit 160 in. lbs)

4) Of all the performance tests conducted, Gardner impact and especially the solvent resistance tests give data which most correlates with resin acidity and its effect on coating crosslink density. To maximize both impact and solvent resistance, a powder coating resin should be formulated to reactive number stoichiometry. But even when so formulated with aliphatic crosslinker, at high R-Acid, solvent resistance decreases, indicating that ultimate crosslink density is not achieved. Thus, although acid acts as a urethane catalyst, it does not significantly react to form amides with the aliphatic isocyanate. The slower reacting aliphatic isocyanate would require special attention to catalysis and stoichiometry at high R-Acid levels.

CONCLUSION

While recognizing that the compositional scope of materials and coatings studied is very limited, the general trends observed may be pertinent in resin design and powder coating formulating. Although we feel that much more study is indicated for specific resin compositions and reactive numbers, the balance of polyester carboxyl and hydroxyl end groups has been shown to significantly affect the curing reactions and resultant coating performance. By relating the variables, acid number and hydroxyl number, to each other through the parameters such as R-Acid, greater control of resin reactivity is likely to result. In applying R-Acid as a parameter, we see that inordinately high R-Acid values must be avoided, particularly with aliphatic curatives. From a practical standpoint, it should be possible to optimize parameters such as R-Acid for commercial resins to achieve more reliable polyurethane coating performance.

Table 6—Acid Number Effect on Performance

IPDI (Aliphatic) System	
	< ---- Decreasing - < Acid Number > - Increasing ---- >
Gel time	Long ----> Short
Pellet flow	Long ----> Short ----> Long
Solvent resistance	Fair ----> Good ----> Poor
QUV resistance	< ------ Excellent ------ >
Gardner impact	Excellent on RN stoichiometry Excellent to poor on OH stoichiometry
TDI (Aromatic) System	
Gel time	Short on RN stoichiometry Short to moderate on OH stoichiometry
Pellet flow	Short on RN stoichiometry Short to moderate on OH stoichiometry
Solvent resistance	Good on RN stoichiometry Good to poor on OH stoichiometry
QUV	Characteristic chalking and yellowing, Poorest at high acid
Gardner impact	Excellent on RN stoichiometry Excellent to poor on OH stoichiometry

ACKNOWLEDGMENTS

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63rd ANNUAL MEETING KEYNOTE ADDRESS

From Tung Oil To Group Transfer Polymerization

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E.I. Du Pont de Nemours & Company, Incorporated*

INTRODUCTION

Addressing this group on the 50th Anniversary of the Paint Industries' Show is of special importance to me since the majority of my career has been with the coatings industry. My work over the years at Du Pont has exposed me to all facets of the industry, from research to production to marketing and management. I welcome the challenge of summarizing the major coatings advances of the past half century and the challenges facing us today and tomorrow.

Technology is the force that has moved the field of coatings from being virtually a "black art" only 100 years ago, with formulations existing only in the heads of those in the industry, to being a highly sophisticated science where innovations such as Group Transfer Polymerization permit scientists to put molecules exactly where we want them on the polymer chain.

Technology is also the force that has moved us from a simple paint mill in Boston in 1692 to the 9 billion dollar industry of some one thousand U.S. paint companies that we are today. Competition between these companies, plus technology, are what will drive us into the future and determine our economic viability as an industry as we face challenges not only to improve our products, but to resolve critical environmental and safety issues.

HISTORICAL PERSPECTIVE

To put today's technology in perspective, a brief review of some of the many advances in finishes over the years might be helpful.

The use of finishes and coatings—protective and decorative—is older than recorded history. Cro-Magnon cave paintings are believed to be at least 20,000 years old and the Bible says that Noah was instructed to paint the ark "within and without with pitch."

The use of oil-based varnishes was well understood and documented by the end of the 11th century in Europe, and varnishes based on linseed oil were still being used extensively on "horseless" carriages in this country through the early 1900's.

Yet, even with such a legacy, science had scarcely touched the paint industry prior to World War I. Formulations were jealously guarded as "trade secrets" passed down by word of mouth from one varnish maker to another. Chemists, when they were employed by paint manufacturers, generally were used for control work, with no real talent being devoted to paint formulation and research.

Appearance and the ability to protect a surface were the key properties looked for in a coating material in the early 1900's. Environmental considerations were virtually nonexistent. Lacquers of that period, for example, were of exceptionally low solids content, with solvents forming about 95% of the product. But, as the best available materials, they found a ready market as protective coatings for brass beds, lamps, artificial leather, and even the mantles of early gas lights.

The 1920's saw the development of a more focused, scientific approach to paint composition and manufacture. Paint companies embarked on programs to make paint manufacture a precisely controlled chemical process, rather than a "rule of thumb" business. The first major product to come out of this research was "Duco"* nitrocellulose lacquer. This was based on familiar tech-

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*Product of E.I. Du Pont de Nemours & Co., Inc.

nology since Du Pont's earliest days when nitrocellulose was used to develop smokeless powder.

The relatively high solids content of nitrocellulose lacquer provided a fast-drying film of superior durability and gloss. The impact of these finishes on the automobile industry in particular was tremendous: It reduced finishing time from days to hours and provided finishes that would stand up for years instead of months. Perhaps more than any other single factor, nitrocellulose lacquer enabled the automobile industry to develop the concept of its modern assembly line.

During the 1930's, Wallace Carothers conducted extensive studies on macro-molecules. His invention of nylon was an outgrowth of these studies. Paul Flory, the reknowned authority on polymerization mechanisms, has contributed to the understanding and manufacture of polymers for the plastics and coatings industries.

The first significant commercial use of latices—polymers dispersed in water—was for the manufacture of synthetic rubber based on styrene and butadiene during World War II. This effort resulted in the quick development of water-based paint. These paints not only had less odor, but were also much easier to apply and clean up. Moreover, as a result of their reduced solvent content, they were safer to use and manufacture.

Epoxy resins, developed in the late 1940's (by Devoe-Raynolds Paint Co. and CIBA Chemical Co.), forever changed the coatings industry as they provided finishes that could withstand very harsh, corrosive environments. As a result, new markets, particularly industrial, opened up and became fertile ground for the coatings industry.

The 1950's brought electrostatic spraying, an efficient, cost-effective way to apply paint. Light-fast pigments of this era, when used in conjunction with acrylic lacquers, permanently changed the look of the automobile. For the first time, cars were being coated with glamorous, highly durable finishes. The acrylic lacquer technology provided the first metallic finishes with their two-tone effect . . . an effect which today, three decades later, remains highly valued by consumers.

Another major breakthrough was anodic electrodeposition of aqueous coatings developed by George Brewer, of the Ford Motor Co. and Glidden Paint Co. When PPG pioneered the design and commercialization of cathodic electrodeposition of coatings, it revolutionized the industry. These methods of application improved the corrosion resistance of automobiles and industrial equipment and at the same time provided the environmental benefit of reducing volatile organic compounds.

Polyurethane coatings, introduced in the 1960's, signaled yet another advance in ambient-curing coatings technology. This technology stems back to the 1940's when Otto Bayer and his co-workers at I.G. Farben developed the first urethane coatings. That discovery eventually provided coatings systems which had three to four times the service life of traditional alkyd and vinyl coatings. Polyurethanes accelerated a trend which continues to drive the industry today . . . the trend towards high performance coatings . . . that is, higher priced coatings which have better performance and appearance properties than conventional finishes, with resulting higher value in use.

The current appeal of base coat/clear coat systems provides another example of the industry's focus on high performance coatings. Base coat/clear coat technology originated in Europe, was adopted by the Japanese, and is now being introduced in this country. The popularity of the base coat/clear coat system rests on the fact that the wet-look appearance is excellent. But the development of this system in the U.S. was particularly difficult since U.S. environmental regulations required lower solvent content while the market demanded very high aesthetics, more easily achieved at lower solids.

Automobile manufacturers are now adopting high solids base coat/clear coat systems in the U.S. for both metallic and solid colors. These finishes have, in large part, set the performance standards for today's worldwide automotive industry. The trend towards base coat/clear coat systems is expected not only to continue, but to accelerate.

TODAY'S ADVANCES

That's a quick overview of how we got to where we are today. Needless to say, many other major advances have been made over the years—many of them by some attending this meeting. And I have no doubt that new advances will continue to come from the vast technological expertise present at today's session. As in the past, technology will be productive for us in the future. But an important question we must address today deals with how well we manage and direct this technology.

Can we harness the expertise that has brought us so far so fast and use it to continue growing and, more importantly, to resolve key issues facing our industry? There really is no choice; we must if we wish to survive, let alone grow. Here are a few examples of the research needed to meet the challenges facing our industry.

The trend towards the use of plastics in automobile manufacture is well along in the U.S. and is moving into the rest of the world. As a result, there is an increased need for coating systems which can be used on both the flexible plastic and rigid metal sections of cars. Obviously, the best way to expedite this process is to bring together technologies in engineering plastics and performance finishes.

At Du Pont we combined our expertise in these areas last June when we opened our new Corporate Automotive Development Center in Troy, MI. An application facility is currently under construction there that will allow us to further test new coatings on polymeric body parts under simulated customer assembly line conditions.

Key to the success of coatings for engineering plastic substrates is the development of new methods to cure paints at lower temperatures. For example, a recently developed vapor phase curing technology permits the rapid curing of finishes at room temperature and on oven-sensitive substrates such as plastic, wood, and aluminum.

One of the most important benefits of paint, of course, is protection. So, there is an ongoing challenge to develop tougher, more durable paints—finishes, for example, that can withstand long-term attack by weather, particularly ultra-violet exposure. The industry is increasing its

John P. McAndrews

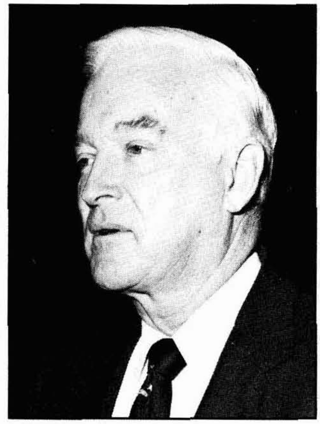
John P. McAndrews joined the DuPont Co. in 1947 as a Chemical Engineer at the Marshall Laboratory in Philadelphia. Over the next 10 years he rose through technical and supervisory roles to the position of Manager of the laboratory in 1957.

In 1960 he was appointed Manager of the Flint, MI, sales development laboratory and in 1962 became Assistant Sales Manager for automotive fabrics and finishes in Detroit. Later that year, Mr. McAndrews was named Director of the Fabric Sales Div. and the following year was made Assistant Director of Marketing of the Automotive and Industrial Products Div.

In 1964 he was named General Sales Manager of the Consumer Products Div. of the Fabrics and Finishes Dept.

Mr. McAndrews was named Director of Marketing for Remington Arms in 1966 following a transfer and attained the positions of Vice-President, Director, Executive Vice-President, and President.

He was named Vice-President, Finishes and Fabricated Products Dept. in 1982, and assumed his present position, of Group Vice-President, in 1983.



understanding of the mechanism by which sunlight breaks down structures, and then using this knowledge to develop entirely new systems, inherently more resistant to ultra-violet attack.

Another important aspect of protection is corrosion resistance. For example, applications on off-shore oil platforms require the toughest of coatings. Millions of dollars in research effort have been spent to improve corrosion resistance. This effort is beginning to pay off, through the development of a new and improved ambient-curing coating system based on a chloropolyethylene elastomer.

A much higher performance and environmental requirement—the protection of smokestack chimney liners for industrial plants—has spurred the development of a new ambient-curing fluoroelastomer coatings system.

I mentioned earlier the development of water-based paints, primarily for interior uses. Rohm and Haas, Du Pont, and others are moving this technology from out of the home into tougher exterior environments. For example, GM's Saturn is expected to have the first commercial application of the new water-borne systems.

Fundamental scientific breakthroughs for our industry didn't end with Carothers and Bayer. I'm continually amazed how scientists such as yourselves continue to generate basically new technologies that few of us ever thought about a generation ago. Earlier, I mentioned Group Transfer Polymerization (or GTP)—a fifth fundamental way of making polymers discovered by Du Pont two years ago. For our industry, GTP means a method of engineering polymer architecture to obtain specific characteristics in our finishes. The expected result is the development of high solids coatings with novel aesthetics and improved processing and end-use applications.

CONCERNS FOR TOMORROW

Paints for varied substrates. . .coatings that are highly corrosion resistant, with outstanding weatherability properties. . .finishes with higher gloss based on water, entirely new aesthetics—these are but a few of the many technological challenges facing the coatings industry this decade and next. . .but the biggest. . .and by far the most critical challenge—and I say critical because I believe our future as an industry in large measures hinges on it—is the ability to manufacture coatings that meet increasingly stringent environmental and safety standards.

The perception of the paint industry in the eyes of the American people is in danger of deteriorating. In recent months we have witnessed one sensational media story after another in which our products have been depicted as direct threats to the safety of the people using them—from a *Wall Street Journal* article on potential reproductive problems caused by overexposure to glycol ethers in paint to an NBC Nightly News segment on solvent toxicity.

As many of you here know, our science doesn't often support the fabric of these stories and the perceptions they can create. But we, as an industry and as individual companies and as individuals, need to respond to problems real *or* perceived.

Our industry must get the issue of paint toxicity into proper perspective in the public's eye or we will never have the opportunity to operate at our full potential—and it won't matter if we *are* successful in making super coatings which are corrosion resistant, highly durable, and even more glamorous.

As I see it, there are several actions the industry can begin to undertake aimed at preempting and alleviating public concern.

First and perhaps most important, we need to become better communicators. What I mean by this is that we must support and extend efforts already begun by our trade groups to do a better job of communicating the steps we have taken to produce safer, more environmentally acceptable paints. We need to point out that as far back as the late 1960's we began to intensify our efforts to develop coatings with lower solvent content. Millions of dollars were spent to increase our understanding of high solids coatings. As a result, a high percentage of all finishes on the market today are based on high solids technology, with the solvent content of solvent-based coatings having been reduced from 95% in the early 1900's to less than 50% today, and we are continuing to search for ways to reduce it even further.

In addition, we need to point to the fact that as we have increased our knowledge of the toxicity of chemicals in paint, we have reformulated our products often with more expensive, yet safer substitutes. We have frequently done so not as a result of government regulations, but out of concern for the safety of those making and using coatings products. Good examples of this are the actions many companies took in the early 1970's to remove lead, benzene, and other substances from their products when the dangers of these chemicals became apparent. This reformulation program was undertaken by the industry several years before government regulations mandating such actions were issued.

And the issue of glycol ethers provides yet another example. Reformulation programs were launched by many companies when toxicological data showed that at certain exposure levels, glycol ethers caused reproductive problems in animals. The industry undertook such programs even though in the 40 years that glycol ethers have been widely used in paints, thinners, and a variety of consumer and industrial products there has been no evidence that the substances cause reproductive problems in humans. In the case of glycol ethers, we really have "gone the extra mile" in terms of safety.

VISIONS OF THE FUTURE

From a purely economic standpoint taking such action is not easy. However, I firmly believe we must continue to act upon new toxicity information as it becomes available, if we want to maintain our long-term economic health as an industry. Moreover, we need to be proactive in our search for safer products—in other words, not wait for the next negative toxicity report to come out. Let's keep looking for products that are not only safer but economical to produce...products that will make those toxicity reports obsolete by the time they are made public.

My second recommendation is that we develop an aggressive safety education program...a program that emphasizes the fact that paint, like any other chemical substance, needs to be treated with respect. Again, this process is already underway through our trade associations, but as individual companies, we need to support and extend these efforts.

Paint products can indeed be used safely...but safe use means reading the label and following the instructions. Driving a car blindfolded would be foolish. So is painting without adequate ventilation or proper respiratory protection and, I believe, we have an obligation to communicate this fact more clearly to our customers and to the public. We need to provide accurate, reliable information about the myths and realities of the potential health hazards associated with overexposure to paint and to communicate this information in ways that are convincing to the public.

Third, we must rebut swiftly and forcefully accusations and actions against our products that have no scientific basis. We must fight back hard against unjustified criticism whether it comes in Congress, in the press, in the regulatory agencies, or in the courts. This is the only way the American paint industry will retain its leadership and credibility.

Finally, so we do not appear to be only reacting to government reports on toxicity, let's consider establishing a blue ribbon panel of health experts, toxicologists, representatives of the industry, the union and the regulatory agencies. This concept is now being discussed within our trade groups in Washington. The purpose of such a panel would be to get ahead of the game and study emerging health issues and make recommendations on studies that should be undertaken. Such a body would anticipate problems and lead efforts to solve them.

So, as we celebrate the 50th Anniversary of the Paint Industries' Show, let us commit ourselves to directing and managing the vast resources of the coatings industry to meet the diverse needs of the many groups and people associated with our products—from consumers to manufacturers to the regulators and professional painters. Let us commit ourselves to devoting more of our time, not less, to the explanation of our policies, our safety procedures and the technology we are developing to manufacture even safer, more environmentally acceptable high performance coatings. Let us commit ourselves to devote more attention than in the past, not less, to the impact of our actions on public thinking. I know from my many years associated with the coatings industry that our industry has the talent, the resources, and the ability to succeed on each of the challenges confronting it—and I have no doubt that it will.

Suspension Interaction of Pigments in Solvents: Characterization of Pigment Surfaces In Terms of Three-Dimensional Solubility Parameters of Solvents

K.M.A. Shareef[†], M. Yaseen[†], M. Mahmood Ali[‡], and P.J. Reddy[‡]
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Pigment-solvent interaction has been studied in terms of suspension behavior of four inorganic pigments in 33 individual solvents which have their solubility parameters ranging from 7.82 to 23.5 $(cal/cc)^{1/2}$. The data on settling rate of pigments in the solvent are used for estimating the interaction between them. Four types of interactions were classified on the basis of suspension behavior of pigments in solvents. A computer program written in FORTRAN IV has been used for plotting the spherical volume of suspension of the pigment. The data of partial solubility parameters of solvents in which the pigment had long time suspension, short time suspension, or swelling are used in the computer program for the surface characterization of pigments. The partial and total solubility parameters of pigments are derived from the computerized data.

INTRODUCTION

Knowledge about compatibility and miscibility of solvent-solvent, polymer-solvent, and polymer-polymer systems is useful in designing paint formulations. This could be achieved to a greater extent provided the data on solubility parameters and other physical parameters of the main components, i.e., resin, solvent, and pigment, are available.

Solubility parameters, the square root of cohesive energy density (CED), a function of inter-molecular forces, are usually expressed as:[1]

$$\delta^2 = CED = \frac{\Delta E}{V} \qquad (1)$$

Here, V is molar volume and ΔE, the energy of vaporization, includes energies arising from the modes of interactions, i.e., dispersion forces (ΔE_d), polar forces (ΔE_p), and hydrogen bonding forces (ΔE_h):

$$\Delta E = \Delta E_d + \Delta E_p + \Delta E_h \qquad (2)$$

or

$$\frac{\Delta E}{V} = \frac{\Delta E_d}{V} + \frac{\Delta E_p}{V} + \frac{\Delta E_h}{V} \qquad (3)$$

or

$$\delta^2 = \delta_d^2 + \delta_p^2 + \delta_h^2 \qquad (4)$$

Symbols, δ_d, δ_p, and δ_h represent the partial solubility parameters due to dispersion, polar, and hydrogen bonding forces, respectively.

The total solubility parameter, δ, can be located in a three-dimensional system as a fixed point with the help of δ_d, δ_p, and δ_h as coordinates. Data on physical properties like: dipole moment, dielectric constant, and internal pressure are used for calculating the partial solubility parameters.[2-8] Knowledge of these parameters helps in understanding the interaction phenomena which are responsible for the stability of the paint dispersion.

In a paint, the resin has more affinity towards the pigment. The solvent used in the formulation should have "good" interaction with the resin. In such a system, the resin is adsorbed preferentially on to the pigment particles and the solvent covers the adsorbed layers of resin. If pigment-solvent interaction is greater or equal to that of pigment-resin, the solvent competes for the preferential

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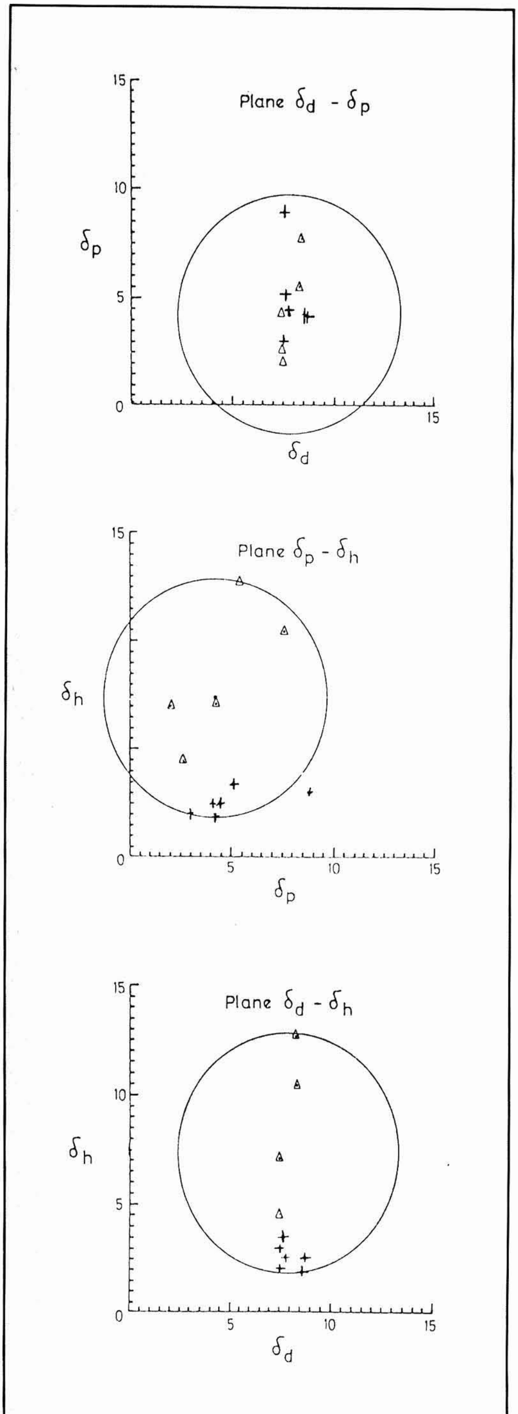

Figure 1—Spherical volume of suspension for α-Fe_2O_3— projected in 3 planes. Parameters derived from SVS algorithm: δ'_d = 7.87; δ'_p = 4.20; δ'_h = 7.35; δ' = 11.60. Radius of sphere = 5.50. Key: + = Long time suspension; Δ = Short time suspension

interaction with the pigment. Consequently, this leads to instability of the dispersion.

PIGMENT-SOLVENT INTERACTION

The Toronto Society for Paint Technology[9] classified pigments in different groups on the basis of their suspension behavior in various solvents and placed pigments like titanium dioxide in alcohol and ether alcohol groups, red iron oxide in ketone group, and phthalocyanines in ketone and ester groups. Sorensen[10] characterized pigment surfaces in terms of electron acceptor or donor concept and recommended that for a good paint dispersion, pigment and solvent should have similar acidic/basic nature, while the resin should have opposite characteristics.

Hansen[11] studied the pigment-solvent interactions by taking into account the solubility parameters of those solvents in which the pigment remained suspended and suggested a procedure for calculating their solubility parameter values. Eissler, *et al.*[12] used multiple regression analysis for estimating the effect of surface treatment on solvent-pigment interaction with the help of partial solubility parameters of solvents. In a recent study based on capillary bed liquid rise method, solid-liquid contact angle was used as a measure of estimating the energy of interaction between the pigment and solvent.[13]

The work described in this paper was undertaken with the objective of studying the pigment-solvent interactions and determining the solubility parameters of four inorganic pigments.

EXPERIMENTAL

Pigments

The following commercial pigments sieved through Prufsieb DIN 4188 (MW, 63 μm) were used for studying their interaction with individual solvents:

(1) Synthetic red iron oxide $\alpha - Fe_2O_3$
(2) Synthetic yellow iron oxide, $\alpha - Fe_2O_3 \cdot H_2O$
(3) Zinc oxide, ZnO
(4) Chrome yellow, $PbCrO_4$

The reason for selecting these pigments is that they are used extensively in the paint industry for their excellent technical properties like chemical resistance, bleed resistance, light fastness, ease of dispersibility, and good compatibility.

Solvents

Thirty-three solvents (mostly of analytical reagent grade) having solubility parameters ranging from 7.82 to 23.5 $(cal/cc)^{1/2}$ were used in this study. The values of solubility parameter (δ) and of the partial parameters (δ_d, δ_p and δ_h) of these solvents are listed in *Table* 1.

Procedure

About 0.25 g of a pigment were taken in a conical flask and heated at 120°C in an oven for six hours. 25 mL of a solvent (at room temperature) were added to the flask while the pigment was hot and the mouth of the flask was covered with tin foil. Identical experiments were carried out using the same pigment with the other 32 solvents. The flasks were shaken for about 18 hours on an electrically driven shaker (Lewkin Ltd., India). The pigment suspensions were transferred to stoppered 25 mL graduated cylinders, which were later kept in a cabinet, conditioned at 26 ± 1°C. The suspension behavior of the pigment in individual solvents was observed visually, at intervals of 0.5, 1, 2, 4, 6, 12, 18, and 24 hours and afterwards for every 24 hours.

SUSPENSION BEHAVIOR OF PIGMENT IN SOLVENT

It is considered to be instantaneous settling when the pigment is found to settle in the solvent within 30 minutes to a suspension volume of 1-3.5 mL. In solvents, in which the pigment takes more than 24 hours to settle, the suspension behavior is termed as long time suspension. When pigment settles within 24 hours, it is called short time suspension.

Pigments, yellow iron oxide, and zinc oxide, in certain solvents, became solvated and remained suspended and

Table 1—Solvents

Code No.	Solvent	Solubility Parameter[a] δ $(cal/cc)^{1/2}$	Partial Solubility Parameter δ_d	δ_p	δ_h
1	White mineral spirits . .	7.82	7.82	0	0
2	Cyclohexane.	8.18	8.18	0	0
3	Methyl isobutyl ketone	8.57	7.49	3.00	2.00
4	Ethyl propionate.	8.74	7.64	2.74	3.29
5	n-Propyl acetate	8.74	7.61	2.75	3.29
6	Xylene	8.80	8.65	0.50	1.50
7	Ethyl benzene.	8.80	8.70	0.30	0.70
8	Toluene	8.91	8.82	0.70	1.00
9	Ethyl acetate.	9.10	7.44	2.60	4.50
10	Benzene	9.15	8.95	0.50	1.00
11	Chloroform.	9.21	8.65	1.50	2.80
12	Methyl ethyl ketone . . .	9.27	7.77	4.40	2.50
13	Tetrahydrofuran	9.52	8.22	2.80	3.90
14	Acetophenone	9.68	8.55	4.20	1.80
15	Acetone	9.77	7.58	5.10	3.40
16	Cyclohexanone.	9.88	8.65	4.10	2.50
17	Dichloro methane.	9.93	8.91	3.10	3.00
18	1,4 Dioxane	10.00	9.30	0.90	3.60
19	Diacetone alcohol	10.18	7.65	4.00	5.30
20	Butyl cellosolve	10.24	7.80	3.10	5.90
21	tert-Butyl alcohol	10.61	7.45	2.04	7.00
22	Aniline	11.04	9.53	2.50	5.00
23	iso-Butyl alcohol	11.12	7.40	4.26	7.10
24	n-Butyl alcohol	11.30	7.81	2.80	7.70
25	Ethoxy ethanol . . . . (cellosolve)	11.88	7.85	4.50	7.00
26	Acetonitrile	11.90	7.50	8.80	3.00
27	Dimethyl formamide . .	12.14	8.52	6.70	5.50
28	Methacrylic acid	13.11	11.52	2.60	5.70
29	Methanol	14.28	7.42	6.00	10.90
30	Ethanol amine	15.48	8.35	7.60	10.40
31	Ethylene glycol	16.30	8.25	5.40	12.70
32	Glycerol	21.10	8.46	5.90	14.30
33	Water	23.50	6.00	15.30	16.70

(a) δ-Values for most of the solvents were taken from Hansen's work.[14]

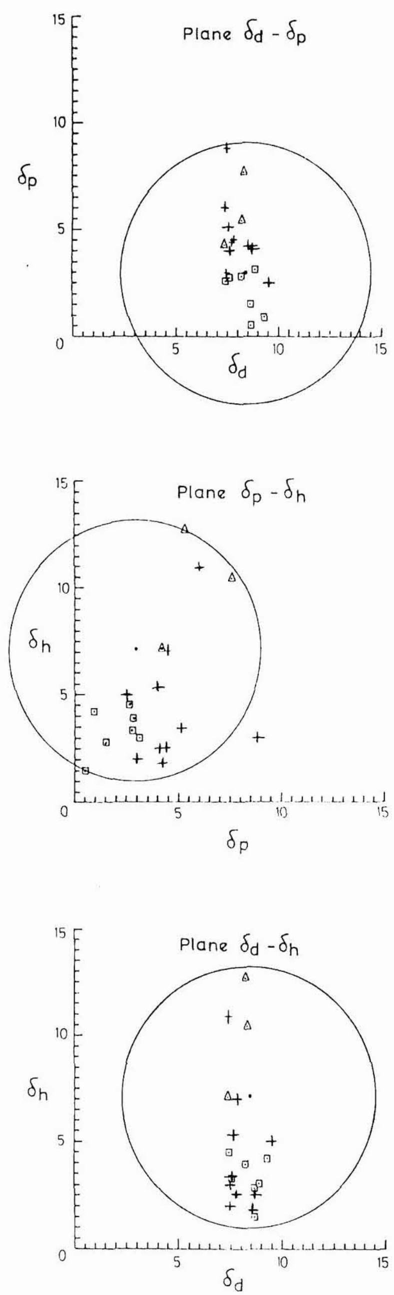

Figure 2—Spherical volume of suspension for α-$Fe_2O_3 . H_2O$ — projected' in 3 planes. Parameters derived from SVS algorithm: δ'_d = 8.45; δ'_p = 2.95; δ'_h = 7.10; δ' = 11.42. Radius of sphere = 6.12. Key: + = Long time suspension; Δ = Short time suspension; □ = Swelling

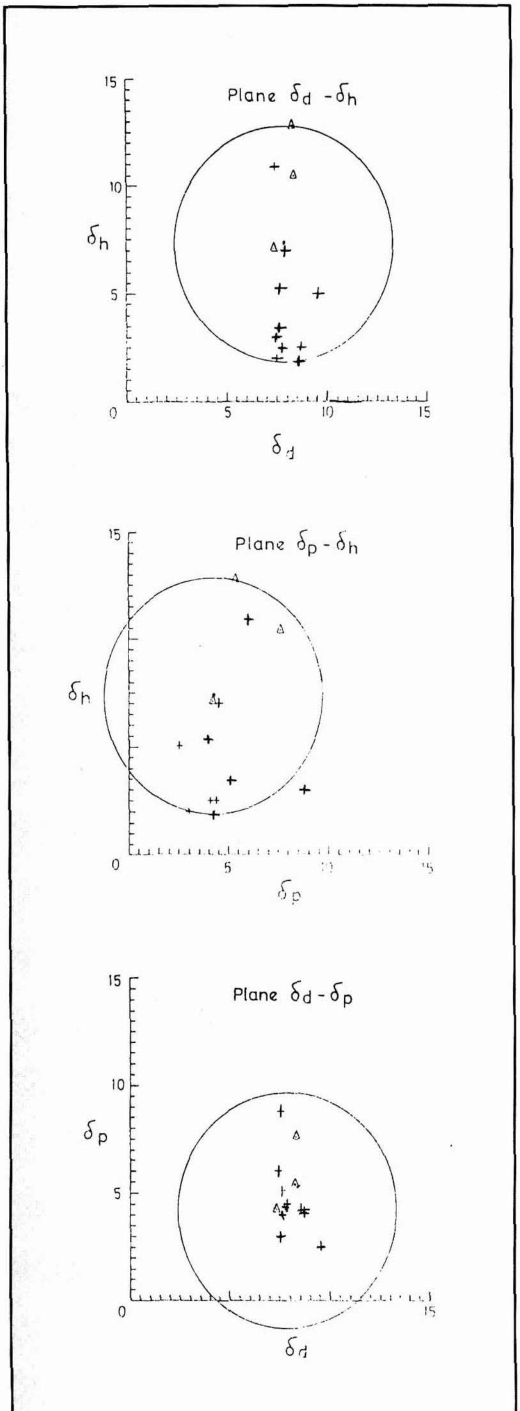

Figure 3—Spherical volume of suspension for α-$Fe_2O_3 \cdot H_2O$ — projected in 3 planes. Parameters derived from SVS algorithm: δ'_d = 7.87; δ'_p = 4.20; δ'_h = 7.35; δ' = 11.60. Radius of sphere = 5.50. Key: + = Long time suspension; Δ = Short time suspension

occupied about 10 mL in a 25 mL volume of suspension even after a week. This suspension behavior is attributed to swelling of the pigment in a solvent. Pigments in glycerol formed a paste-like suspension; hence it is not considered.

COMPUTER PROGRAM FOR PLOTTING THE SPHERICAL VOLUME OF SUSPENSION

The interpretation of pigment-solvent interactions and characterization of pigment surface were done by a method similar to that suggested by Hansen.[11] In his method, Hansen considered solvents which had good interaction with the pigment and expressed the surface characteristics of pigments in terms of the three-dimensional solubility parameters (δ_d, δ_p, and δ_h) of solvents. He determined the spherical volume of suspension for pigments from the three-dimensional plots of these sub-parameters, and suggested the following equation for calculating, R_{As}, the distance between center of sphere and the point representing solvent:

$$R^2_{As} = 4(\delta d_s - \delta d_o)^2 + (\delta p_s - \delta p_o)^2 + (\delta h_s - \delta h_o)^2 \quad (5)$$

Here, the subscripts s and o to the sub-parameters correspond to that of solvent and pigment, respectively. The above equation for the condition of interaction is based on the assumption that the distance between center point of sphere and the point representing the solvent, R_{As}, should be less than the distance between the center point and the boundary of the sphere R_{Ao}.

A computer program for plotting spherical volume of suspension and determining the three-dimensional solubility parameters of pigments has been written taking into consideration the basic principles of Hansen's approach.

Problem Statement

The three-dimensional coordinates of N points, which represent the solvents having suspension interaction with a given pigment, are known. It is required to find the center and radius of the sphere whose volume is minimum and which encloses all the given points.

Method of Solution

Let the number of points in the three-dimensional space forming the cluster be N, having coordinates of δ_d, δ_p, and δ_h, representing the axes X, Y, and Z, respectively. The distance D_{ij} between two points P (x_i, y_i, z_i) and Q (x_j, y_j, z_j) is determined by the following equation:

$$D_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2 + (z_i - z_j)^2} \quad (6)$$

There are $\frac{N(N-1)}{2}$ number of all possible distances between any two points constituting the given cluster. A pair of points with maximum separation distance is selected from N points. These two points are assumed to form the ends of the diameter and the radius of interaction sphere is denoted by C_R.

$$C_R = \frac{D_{ij}\,(\max)}{2} \quad (7)$$

The coordinates of the center of this sphere are given below:

$$C_x = \frac{x_i + x_j}{2} \quad (8)$$

$$C_y = \frac{y_i + y_j}{2} \quad (9)$$

$$C_z = \frac{z_i + z_j}{2} \quad (10)$$

The points in three-dimensional space are shown in three separate plots as projections in XY, XZ, and YZ planes, respectively. The sphere of interaction is projected as circles in planes $\delta_d - \delta_p$, $\delta_d - \delta_h$ and $\delta_p - \delta_h$ (*Figures* 1-6).

FORTRAN Implementation

The computer program is written in FORTRAN IV for plotting the spherical volume of suspension of a pigment using TEKTRONIX-4014-1 graphics terminal plot-10 graphics software. Hard copies of the plots are obtained on TEKTRONIX-4662 plotter attached to the terminal. SPERRY UNIVAC V77/800 system has been used as the host computer.

The computer program listing with instructions is available from authors and it can be obtained on request.

RESULTS

The suspension volume of pigments in individual solvents was observed starting after half an hour of suspension, but for convenience only those observed after four and 24 hour intervals are reported in *Tables* 2 to 5. The surface characterization of red iron oxide and chrome yellow pigments was done with respect to solvents in which they have long time and short time suspension. But in the case of yellow iron oxide and zinc oxide, the solvents in which the pigments remained in suspension due to their swelling were also included. The data on δ_d, δ_p, and δ_h of such solvents are fed into the computer program for plotting the spherical volume of suspension. The spherical volume of suspension for the pigments plotted as circles are projected in three planes $\delta_d - \delta_p$, $\delta_d - \delta_h$, and $\delta_p - \delta_h$ (*Figures* 1 to 6). The parameters δ_d', δ_p', δ_h' derived from the computer program as the three-dimensional coordinates of center of the sphere, are the partial solubility parameters of the pigment. The values of these parameters along with the radius of sphere, C_R, and δ' of pigment are listed in each figure and are also reported in *Table* 6.

DISCUSSION

Synthetic Red Iron Oxide

This pigment is found to have good interaction with ketonic group solvents, as it remained suspended in them for a period of over 48 hours. It also has fairly good interaction with acetonitrile, ethyl acetate, t-butyl alco-

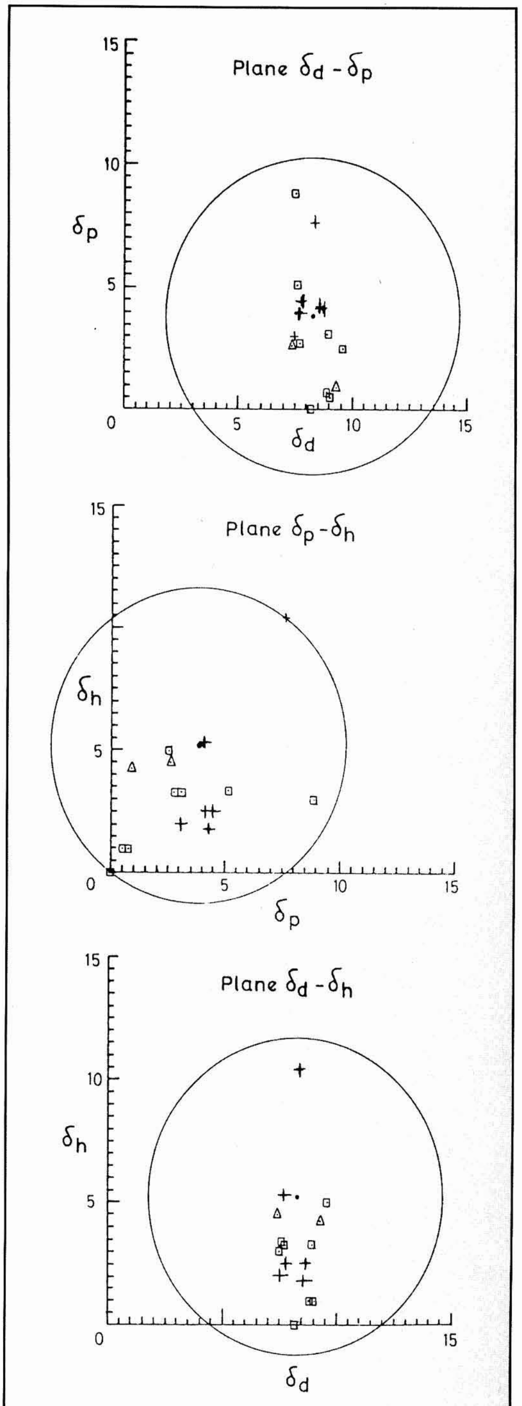

Figure 4—Spherical volume of suspension for ZnO — projected in 3 planes. Parameters derived form SVS algorithm: δ_d' = 8.27; δ_p' = 3.80; δ_h' = 5.20; δ' = 10.48. Radius of sphere = 6.44. Key: + = Long time suspension; Δ = Short time suspension; □ = Swelling

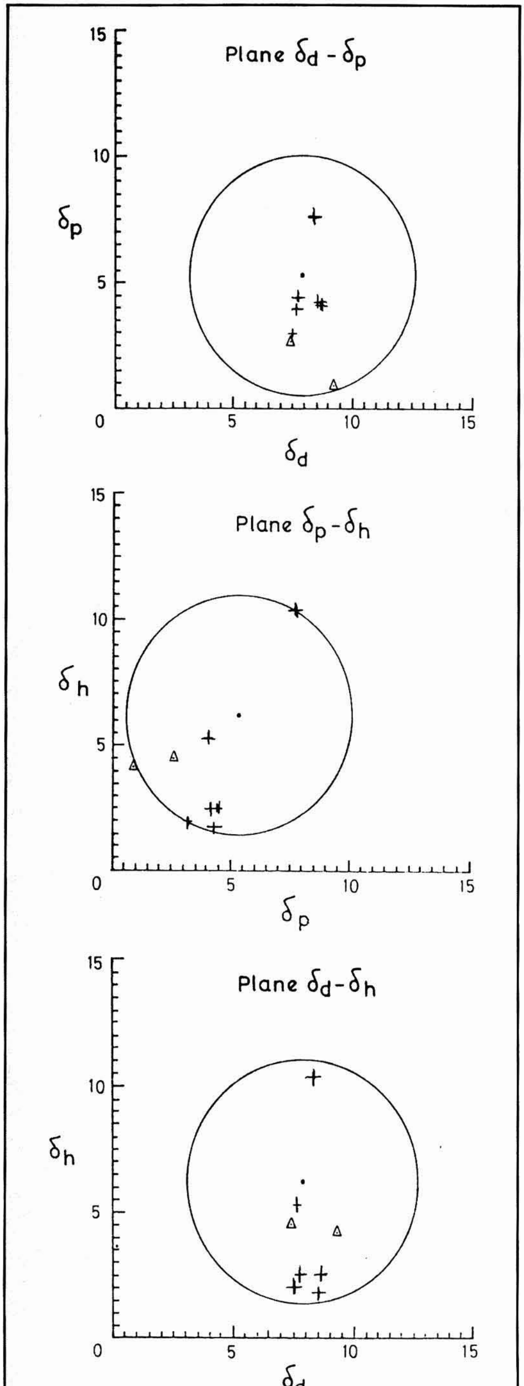

Figure 5—Spherical volume of suspension for ZnO — projected in 3 planes. Parameters derived from SVS algorithm: $\delta'_d = 7.92$; $\delta'_p = 5.30$; $\delta'_h = 6.20$; $\delta' = 11.37$. Radius of sphere = 4.81. Key: + = Long time suspension; Δ = Short time suspension

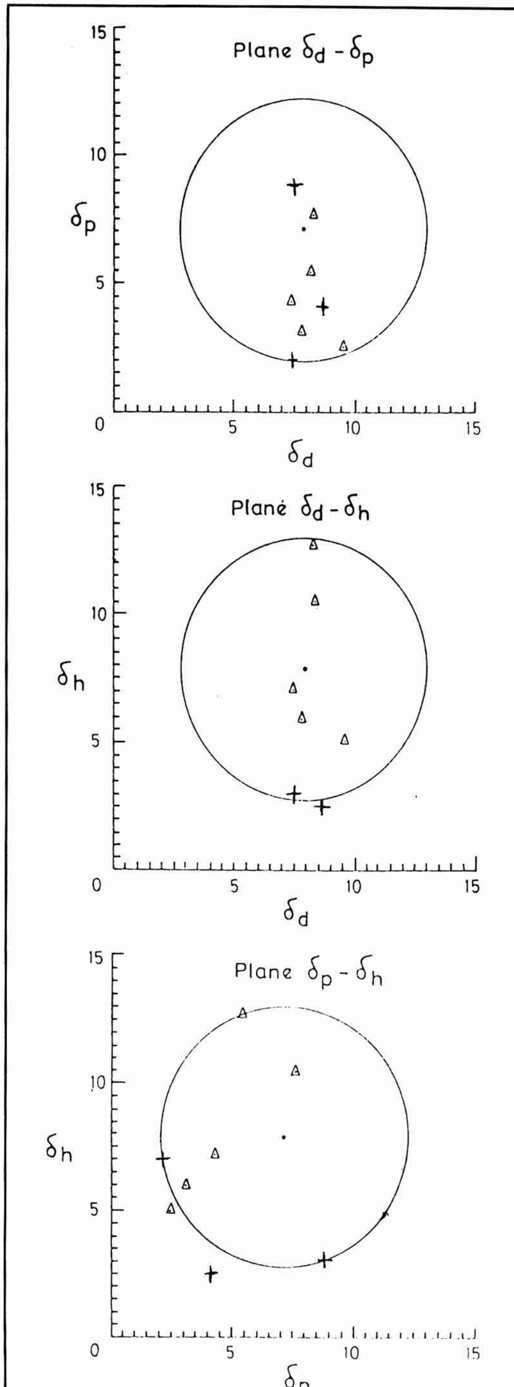

Figure 6—Spherical volume of suspension for Pb CrO_4 — projected in 3 planes. Parameters derived from SVS algorithm: $\delta'_d = 7.88$; $\delta'_p = 7.10$; $\delta'_h = 7.85$; $\delta' = 13.19$. Radius of sphere = 5.15. Key: + = Long time suspension; Δ = Short time suspension

Table 2—Suspension Volume of Red Iron Oxide Pigment In Different Solvents After Intervals of 4 and 24 Hours

(Volume of Medium of Suspension = 25 mL)

Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]
	4 hr	24 hr			4 hr	24 hr			4 hr	24 hr	
1	2.5	2.5	A	12	22.5	18.0	B	23	23.0	1.5	C
2	2.5	2.5	A	13	1.5	1.5	A	24	1.5	1.5	A
3	23.5	21.5	B	14	23.5	23.0	B	25	1.5	1.5	A
4	1.5	1.5	A	15	22.5	15.0	B	26	23.0	18.0	B
5	1.5	1.5	A	16	24.0	21.5	B	27	1.5	1.5	A
6	2.5	2.5	A	17	1.5	1.5	A	28	Reacted with pigment		
7	1.5	1.5	A	18	1.5	1.5	A	29	1.5	1.5	A
8	1.5	1.5	A	19	2.5	2.5	A	30	22.5	1.5	C
9	11.0	1.5	C	20	1.5	1.5	A	31	22.5	1.5	C
10	2.5	2.5	A	21	22.5	1.5	C	32	Paste-like suspension		
11	2.5	2.5	A	22	1.5	1.5	A	33	1.5	1.5	A

(a) A = Instantaneous settling; B = Long time suspension; C = Short time suspension.

hol, iso-butyl alcohol, ethanol amine, and ethylene glycol (*Table* 2). Since these solvents are polar in nature and may have "damped" the pigment surface so it acquires the charge distribution in their presence.[11] This may result in creating an interaction between pigment and solvent; consequently, the pigment remains suspended in such solvents for some period of time.

Sorensen[10] suggested the use of acid-base concept in characterizing the pigment-solvent interactions in the suspended state. Ketones, in which red iron oxide showed long time suspension, are basic in nature and the solvents, ethyl acetate, t-butyl alcohol, isobutyl alcohol, ethanol amine, and ethylene glycol, in which red iron oxide has short time suspension, are amphoteric in nature. From the suspension behavior of pigments in these solvents the surface of red iron oxide pigment could be characterized to be amphoteric in nature with slight predominance of acidic characteristics.[10]

The parameters derived from the plots of spherical volume of suspension (SVS) for red iron oxide ($\alpha-Fe_2O_3$) in *Figure* 1 are $\delta_d' = 7.87$, $\delta_p' = 4.20$, $\delta_h' = 7.35$, and $\delta' = 11.60$, and radius of interaction sphere, $C_R = 5.50$. The values of these parameters indicate the magnitude of non-polar interaction (dispersion forces), polar interaction, and hydrogen bonding forces. The interaction of pigment with solvents may be greater when at least two of the sub-parameters of solvents fall fairly close to those of the pigment.

Synthetic Yellow Iron Oxide

Yellow iron oxide pigment showed long time suspension interaction in 10 solvents and short time suspension in three solvents. Among the 13 solvents, five have ketonic groups, four have alcohol groups, three have amine groups, and the remaining one, i.e., diacetone alcohol,

Table 3—Suspension Volume of Yellow Iron Oxide Pigment In Different Solvents After Intervals of 4 and 24 Hours

(Volume of Medium of Suspension = 25 mL)

Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after		Nature of Suspension Behavior[a]
	4 hr	24 hr			4 hr	24 hr			4 hr	24 hr	
1	3.0	3.0	A	12	22.5	18.0	B	23	22.5	10.0	C
2	1.5	1.5	A	13	7.5	7.0	D	24	3.5	3.5	A
3	23.0	15.0	B	14	23.5	21.0	B	25	24.6	23.0	B
4	10.5	10.5	D	15	21.5	12.5	B	26	24.0	18.0	B
5	8.5	8.5	D	16	24.5	22.0	B	27	3.0	2.5	A
6	12.0	12.0	D	17	16.5	16.5	D	28	3.0	3.0	A
7	3.5	3.5	A	18	7.5	7.0	D	29	23.0	17.5	B
8	1.5	1.5	A	19	25.0	23.5	B	30	22.5	3.4	C
9	6.5	6.5	D	20	3.0	2.5	A	31	22.4	6.6	C
10	1.5	1.5	A	21	1.5	1.5	A	32	Paste-like suspension		
11	13.5	13.0	D	22	24.5	23.0	B	33	6.0	6.0	D

(a) A = Instantaneous settling; B = Long time suspension; C = Short time suspension; D = Swelling.

Table 4—Suspension Volume of Zinc Oxide Pigment In Different Solvents After Intervals of 4 and 24 Hours

(Volume of Medium of Suspension = 25 mL)

Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]
1	2.5	2.5	A	12	23.5	15.0	B	23	1.5	1.5	A
2	4.0	4.0	D	13	1.5	1.5	A	24	1.5	1.5	A
3	23.5	19.0	B	14	24.0	22.0	B	25	1.5	1.5	A
4	4.0	4.0	D	15	5.5	5.5	D	26	4.0	4.0	D
5	3.0	3.0	A	16	24.0	23.0	B	27	2.0	2.0	A
6	2.0	2.0	A	17	5.0	5.0	D	28	3.0	3.0	A
7	2.5	2.5	A	18	21.0	1.5	C	29	1.5	1.5	A
8	4.0	4.0	D	19	23.5	22.5	B	30	23.0	21.0	B
9	18.0	1.5	C	20	2.5	2.5	A	31	1.5	1.5	A
10	4.0	4.0	D	21	2.0	2.0	A	32	Paste-like suspension		
11	3.0	3.0	A	22	5.6	5.6	D	33	3.0	3.0	A

(a) A = Instantaneous settling; B = Long time suspension; C = Short time suspension; D = Swelling.

contains both ketonic and alcohol groups. Since yellow iron oxide ($\alpha - Fe_2O_3 \cdot H_2O$) contains Fe_2O_3 units, it has good interaction with ketonic solvents, and also with alcohol and amine type of solvents because of the water of hydration in its structure. This pigment remained suspended for over a week in diacetone alcohol, because of the presence of both ketonic and alcohol groups in it. Apart from long time and short time suspension interactions, yellow iron oxide has also exhibited swelling in eight solvents and in water (*Table* 3).

The solubility parameter of yellow iron oxide was derived in two ways, i.e., in one case the data of solvents in which the pigment has long time suspension, short time suspension, and swelling were fed into the computer program. In the other case, only the data of solvents in which the pigment has long time and short time suspension, were entered. The values of parameters obtained in the two cases are:

Case (I) —

$\delta'_d = 8.45$, $\delta'_p = 2.95$, $\delta'_h = 7.10$, $\delta' = 11.42$ and $C_R = 6.12$

Case (II) —

$\delta'_d = 7.87$, $\delta'_p = 4.20$, $\delta'_h = 7.35$, $\delta' = 11.60$ and $C_R = 5.50$

The values of solubility parameters (δ') of pigment in the two cases do not differ much from each other but the subparameters, δ'_d and δ'_p, have differences in their value. This is because the solvents in which the pigment had swelling have greater values for their non-polar interaction parameter (δ_d) and fairly low values for their polar interaction.

The swelling of the pigment indicates its state of wetting and loosening of structure in the solvent. It is of advantage to include the solvents in which the pigment has swelling along with other solvents for characterizing the pigment in terms of its partial solubility parameters.

Zinc Oxide

This pigment has long time suspension in six solvents (four ketones, diacetone alcohol, and ethanol amine), and short time suspension in ethyl acetate and 1, 4 dioxane. It also showed swelling in eight other solvents (*Table* 4). According to Sorensen's classification[10] the surface of zinc oxide pigment can also be characterized to be amphoteric in nature with a slight predominance of acidic characteristics.

The parameters of zinc oxide derived from the spherical volume of suspension computer program are:

Case (I), considering the long time and short time suspensions as well as suspension due to swelling:

$\delta'_d = 8.27$, $\delta'_p = 3.80$, $\delta'_h = 5.20$, $\delta' = 10.48$ and $C_R = 6.44$

Case (II), considering only long time and short time suspensions:

$\delta'_d = 7.92$, $\delta'_p = 5.30$, $\delta'_h = 6.20$, $\delta' = 11.37$ and $C_R = 4.81$

Unlike the case of yellow iron oxide, the value of solubility parameter (δ') of zinc oxide pigment obtained in Case (I) is lower than that of Case (II). This is because zinc oxide exhibits swelling in solvents whose partial parameter, δ_p and δ_h, have lower values than of those in Case (II).

Chrome Yellow

Among the 32 solvents, chrome yellow exhibited long time suspension in three solvents, i.e., cyclohexanone, t-butyl alcohol, and acetonitrile, and short time suspension in five solvents, i.e., butyl cellosolve, aniline, isobutyl alcohol, ethanolamine, and ethylene glycol. These solvents are amphoteric in nature, i.e., they have proton donating and accepting tendencies.[10]

The parameters of this pigment obtained from SVS program are:

$\delta'_d = 7.88$, $\delta'_p = 7.10$, $\delta'_h = 7.85$, $\delta' = 13.19$ and $C_R = 5.15$

Unlike the case of other pigments, the polar interaction parameter (δ'_p) of $PbCrO_4$ pigment is very high, i.e., 7.10 $(cal/cc)^{1/2}$. Due to the higher values of δ'_p and amphoteric nature of its surface, chrome yellow pigment settled instantaneously in many of the solvents.

Table 5—Suspension Volume of Chrome Yellow Pigment In Different Solvents After Intervals of 4 and 24 Hours

(Volume of Medium of Suspension = 25 mL)

Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]	Solvent Code No.	Suspension Volume in mL after 4 hr	24 hr	Nature of Suspension Behavior[a]
1	1.5	1.5	A	12	1.5	1.5	A	23	23.0	1.5	C
2	1.5	1.5	A	13	1.5	1.5	A	24	1.5	1.5	A
3	1.5	1.5	A	14	1.5	1.5	A	25	1.5	1.5	A
4	1.5	1.5	A	15	1.5	1.5	A	26	22.5	18.5	B
5	1.5	1.5	A	16	24.0	12.5	B	27	1.5	1.5	A
6	1.5	1.5	A	17	1.5	1.5	A	28	1.5	1.5	A
7	1.5	1.5	A	18	1.5	1.5	A	29	1.5	1.5	A
8	1.5	1.5	A	19	1.5	1.5	A	30	24.0	1.5	C
9	1.5	1.5	A	20	23.5	1.5	C	31	22.0	1.5	C
10	1.5	1.5	A	21	24.5	23.5	B	32	Paste-like suspension		
11	1.5	1.5	A	22	23.0	1.5	C	33	1.5	1.5	A

(a) A = Instantaneous settling; B = Long time suspension; C = Short time suspension

INFLUENCE OF PARTICLE SIZE OF PIGMENT AND VISCOSITY OF SOLVENT ON SUSPENSION BEHAVIOR

To see the effect of particle size on suspension behavior, red iron oxide pigment particles retained on sieves having aperture (MW) 63, 32 and 20 μm, were suspended individually in solvents selected from those listed in *Table* 1. It was found that variation in the size of pigment particles does not influence the suspension behavior of the pigment in a solvent. The factors responsible for keeping a pigment in suspended state in a particular solvent are: characteristics of pigment surface, interaction of solvent with the pigment, and closeness of partial solubility parameter values of pigment and those of the solvent.

The viscosity of a solvent is found not to have significant influence on the suspension behavior of pigment particles. For example, red iron oxide, yellow iron oxide, zinc oxide, and chrome yellow pigments settled instantaneously in solvents having fairly high viscosities (cyclohexanone 1.06 cp, butyl cellosolve 2.00 cp, ethoxy ethanol 2.05 cp, aniline 4.40 cp). On the other hand, they had long time suspension in solvents which have fairly low viscosities (acetone 0.35 cp, methyl ethyl ketone 0.42 cp, methyl isobutyl ketone 0.59 cp, methanol 0.59 cp). Hansen[11] also observed similar features while studying the suspension of pigments in various solvents.

PIGMENT-RESIN-SOLVENT INTERACTIONS

It is found that the commonly used solvents in paint industry, such as mineral spirits and xylene, have poor interaction with the pigments. But common experience shows that a reasonable degree of dispersion exists in paints containing these solvents. This is because the pigment-resin interaction predominates over pigment-solvent interaction. Consequently, this favors the preferential adsorption of resin layers onto the pigment particles and results in a stable dispersion. Apart from this the commonly used vehicles also contain dispersing agents which overwhelm the settling tendencies of their solvent components.[9]

The data on solubility parameters of pigments, resins, and solvents help in selecting suitable ingredients for a paint formulation. The functions of ingredients such as dispersing agents and rheology control agents used for improving the dispersion and stability have not been discussed in this paper. These aspects provide a good scope of work and may be discussed in future publications.

Table 6—Parameters of Pigments Derived From the Spherical Volume of Suspension Computer Program

Pigment	No. of Solvents Considered in the Program	Partial Solubility Parameter δ_d	δ_p	δ_h	Solubility Parameter δ	Radius of Sphere C_R
Synthetic red iron oxide	11	7.87	4.20	7.35	11.60	5.50
Synthetic yellow iron oxide	21	8.45	2.95	7.10	11.42	6.12
Synthetic yellow iron oxide	13	7.87	4.20	7.35	11.60	5.50
Zinc oxide	16	8.27	3.80	5.20	10.48	6.44
Zinc oxide	8	7.92	5.30	6.20	11.37	4.81
Middle chrome yellow	8	7.88	7.10	7.85	13.19	5.15

CONCLUSIONS

(1) The surface characterization of four inorganic pigments has been done in terms of the partial solubility parameters of solvents which exhibit some interaction and the pigment remains suspended in them for a certain period of time.

(2) Pigments, synthetic red iron oxide, synthetic yellow iron oxide, and zinc oxide may have amphoteric surface characteristics with a slight predominance of acidic nature.

(3) Chrome yellow pigment exhibits amphoteric nature in its suspension behavior.

(4) In the computer program written for the spherical volume of suspension, the partial solubility parameters of solvents which have some interaction with pigment are used for deriving the three-dimensional and prime solubility parameters of pigments.

(5) Solubility parameters of four inorganic pigments derived from the computer program are found to be greater than that of some solvents used commonly in paint industry (such as xylene and mineral spirits).

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Composition and Dissolution Rate of Antifouling Paint Binders (Soluble Type) During Their Immersion in Artificial Sea Water

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CIDEPINT-Research and Development Center for Paint Technology*

In this paper the authors have studied the changes produced in the binder composition of soluble type antifouling paints, due to the neutralization reactions carried out between alkaline ions and acid components of binders, both during the pigment dispersion and the sea water immersion.

Different variables were considered: binder composition, WW rosin/chlorinated rubber ratio, depth in the film, and immersion time in artificial sea water.

Paints were prepared by dissolving the resins and the plasticizer in the solvent mixture and after that pigments were dispersed in the vehicle using a ball mill with porcelain jars.

The amount of free resinic acids and metallic resinates was determined on the just manufactured binders (before pigment dispersion), on binders extracted from the paints (immediately after paint preparation) and finally on binders after sea water immersion. The total content of divalent cations present in the binder films was also determined.

Additionally, the influence of the mentioned changes in the binder composition on its dissolution rate was studied.

INTRODUCTION

Efficient antifouling paints are formulated with toxicants which are leached from the film surface in contact with sea water, thus controlling fouling attachment.[1-4]

Antifouling paints of the soluble matrix type are based on sea water soluble resins, such as WW rosin (gum rosin). The main component of the WW rosin is abietic acid. The molecule of abietic acid has two carbon-carbon ($-C=C-$) double bonds and one carboxylic group ($-COOH$).[5] Its instability is due to the former, while the acid group is responsible for the reaction with sodium and potassium ions giving soluble compounds or with calcium and magnesium ions, forming alkaline resinates of lesser solubility in the sea water than the original rosin resin.[6-8]

In soluble matrix antifouling paints, the binder characteristics have a significant influence on film bioactivity. Usually toxicants, such as cuprous oxide, dissolve faster than the binder,[9] so the binder dissolution rate controls the bioactive material release.

The factors affecting matrix dissolution rate are: chemical characteristics, type and content of acid, and neutral resins present in its composition and some mechanical properties of the film (i.e., abrasion resistance).

Considerations must be made regarding the pigment dispersion conditions, the storage time of the final product, and the aging of the applied film on substrates submerged in sea water, such as ships hulls, offshore platforms, etc.

The fundamental aim of this paper was the evaluation of the changes produced in the binder composition of antifouling paints prepared in the laboratory, during artificial sea water immersion, and their influence on binder dissolution rate.

STUDIED VARIABLES

WW Rosin/Chlorinated Rubber Ratio

Three WW rosin/chlorinated rubber (grade 10) ratios were selected (2/1, 1/1, and 1/2) in order to obtain binders with different free acidity and dissolution rate. In every case, chlorinated rubber resin was plasticized with 42% chlorinated paraffin (70/30 resin/plasticizer ratio, w/w).

* (CIC-CONICET), 52 entre 121 y 122, 1900 La Plata, Argentina.

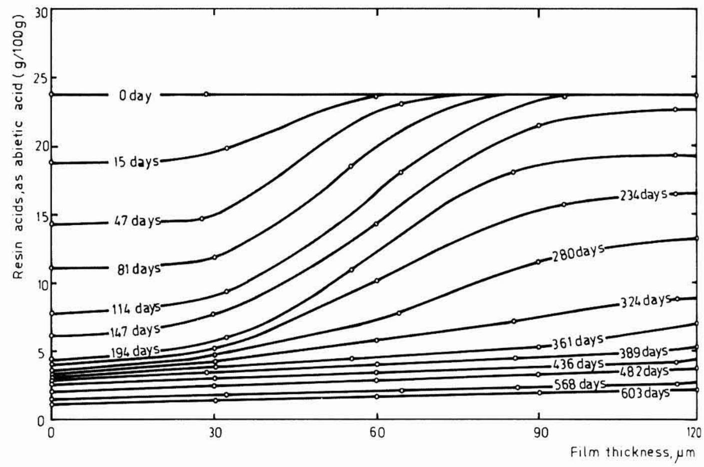


Figure 1—Content of free resinic acids in the binder film (2/1 rosin/chlorinated rubber ratio, w/w)

Depth in the Binder Film

The changes of film composition during the immersion in artificial sea water (ASTM D-1141/75[10]) were assessed for different layers, that is at different depths. For this purpose, the film was uniformly abraded with a Taber Abraser Equipment[11]; different loads and abrasives were employed for obtaining depths of 30, 60, 90, and 120 μm, measured from the surface of the film.

Immersion Time in Artificial Sea Water

To evaluate the changes produced in the binder film during the immersion in artificial sea water,[10] its dissolution rate and composition were periodically determined.

EXPERIMENTAL

Manufacture of Samples

The manufacture of vehicles was made by dissolving WW rosin in the solvent mixture (toluene-xylene 1/1 ratio by weight) and then adding under constant agitation the chlorinated rubber resin (grade 10) and 42% chlorinated paraffin.

Paints were prepared by incorporating calcium carbonate (37.7% by weight on the solids of the paint) and zinc oxide (3.1% by weight) in the vehicle. These pigments were dispersed for 21 hours and then cuprous oxide was added to the porcelain ball mill (3.3 liters capacity) and dispersed for three hours. Operative conditions of the employed equipment were described in previous papers.[12-13]

Later on, pigments (cuprous oxide, zinc oxide, and calcium carbonate) and resinates of the divalent cations (Ca^{2+} and Zn^{2+} coming from calcium carbonate and zinc oxide, respectively, and Cu^{2+} produced by the reaction $2\ Cu^{1+} \rightleftarrows Cu^{0} + Cu^{2+}$ were separated by centrifugation.

Solids removed from paints were treated with n-butyl alcohol in order to dissolve the alkaline resinates formed during pigment dispersion and the remainder resinous material corresponding to the binder.

The solution was placed in vacuum, dried, and the solids were incorporated to the liquid of the initial centrifugation. Thus, this liquid (vehicle) contains the non-saponifiable products and the free resinic acids from rosin, the chlorinated rubber and the plasticizer, plus the metallic resinates formed during paint preparation.

LABORATORY TESTS

Both just manufactured vehicles and those extracted from paints were applied with a Bird applicator on acrylic plates which were previously sandblasted (maximum roughness Rm = 40 μm). Dry films of approximately 120 μm were obtained. The panels were placed in a desiccator to constant weight and then submerged in vertical position in artificial sea water, thermostatically controlled (20 ± 2°C). Tests were duplicated for each immersion period.

To determine the binder acidity due to free resinic acids, a few milligrams of binder were dissolved in a neutral mixture of ethyl alcohol and toluene (1/1 ratio by weight). Then the solution was titrated with N/100 sodium hydroxide, using phenolphtalein as an indicator.

The amount of metallic resinates present in the binders was calculated from the acidity originated by their hydrolysis.

A neutral mixture of toluene and n-butyl alcohol (1/1 ratio by weight) was added to a few milligrams of dry film to dissolve the whole of binder components. Then a N/100 hydrochloric acid solution was incorporated in excess and the sample was shaken. After that, two phases were obtained. In the aqueous phase (separated by decantation after several washes) a back titration was carried out with a N/100 sodium hydroxide solution, using phenolphtalein as an indicator.

Thus, the alkaline solution was useful for evaluating the remaining hydrochloric acid. The difference between the incorporated acid and that remaining corresponded to that consumed by the metallic resinates.

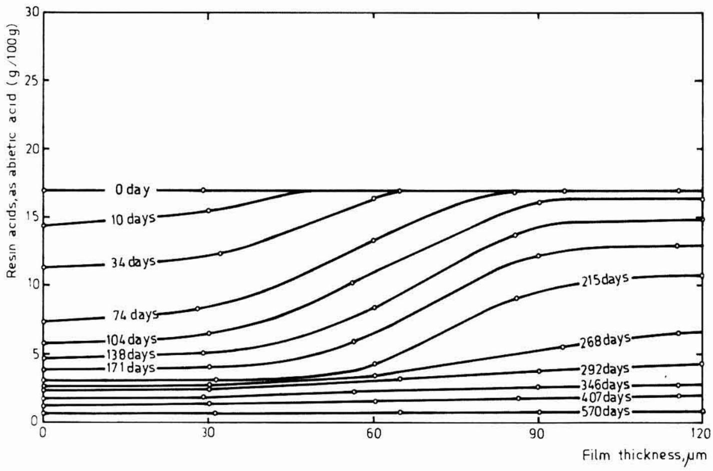


Figure 2—Content of free resinic acids in the binder film (1/1 rosin/chlorinated rubber ratio, w/w)

Additionally, the total content of divalent cations present in the binder film was determined by using EDTA (disodium salt of the ethylene diamine tetra acetic acid) and eriochrome black as an indicator. This non-specific method allowed the evaluation of the total content of divalent cations. The results were expressed in grams of Ca^{2+} per 100 g of binder.

To determine the binder dissolution rate, the panels were extracted from the artificial sea water, washed with distilled water, and placed in a dissicator to constant weight. Then, the dissolved mass per unit area was calculated for each experimental period. The difference between two consecutive values corresponded to the immersion period under consideration. Thus, it was possible to calculate the binder dissolution rate.

RESULTS AND DISCUSSION

In the original WW rosin resin, the amount of non-saponifiable material was determined by weighing, since it did not dissolve in a neutralized toluene-ethyl alcohol mixture (1/1 ratio by weight). A value of approximately 17.1% by weight of non-saponifiable material was determined in the residual solid.

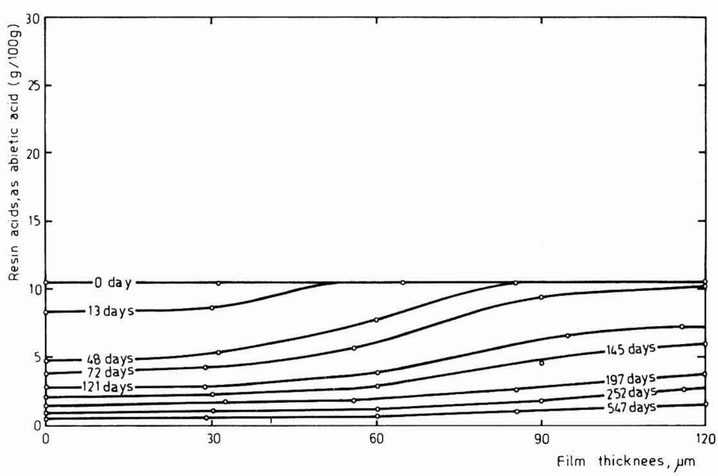
The amount of rosin free resinic acids (abietic acid, dextro-pimaric acid, levo-pimaric acid, etc.) was calculated from its acid value (155 mg KOH/g); the value obtained was 83.3%, expressed as abietic acid on rosin.

With regard to the other components of the experimental binders, it is important to mention that the chlorinated rubber and the chlorinated paraffin were previously neutralized with calcium oxide in a ball mill. In this way they had a negligible acid value.

Just manufactured binders (before pigment dispersion) showed acid values consistent with the rosin content of each composition. Thus, for instance, binders with 2/1, 1/1 and 1/2 rosin-chlorinated rubber ratios, showed, respectively, resinic acids content of 48.4, 34.2, and 21.5%, expressed as abietic acid on binder solids.

However, in binders extracted from the paints (imme-

Figure 3—Content of free resinic acids in the binder film (1/2 rosin/chlorinated rubber ratio, w/w)



diately after pigment dispersion) a significant reduction (about 50%) in the content of free resinic acids, due to the neutralization reactions, was determined. In this case, the values were, respectively, 23.8, 16.8, and 10.7%, also expressed as abietic acid on binder solids.

The films corresponding to the testing binders, supported on an acrylic plate and submerged in artificial sea water, showed a significant variation in the concentration of free resinic acids during immersion, as a function of the film depth considered (*Figures* 1, 2, and 3).

In the case of the binder with the 2/1 rosin/chlorinated rubber ratio, the content of resinic acids decreased rapidly in the film surface and more slowly in the inner layers. After 12 months (361 days) and after 20 months (603 days) the values were located between 3.09-7.02% and 1.10-2.17%, respectively.

The binder with the 1/1 ratio showed qualitatively similar evolution in the resinic acids content, although analogous concentrations were reached more rapidly. After approximately nine months immersion (268 days) the resinic acids content ranged between 2.72-6.81%, while after 19 months (570 days) was practically uniform in the film (0.60-1.00%).

In the case of the binder with the 1/2 ratio, the concentration of free resinic acids decreased more rapidly during immersion; thus, for instance, after 18 months immersion (547 days), the content in the outer binder layer was 0.44% and at a depth of 120 μm it was 1.3%.

Concerning rosin acidity due to metallic resinates, the obtained acid values were practically negligible. Similar results showed just manufactured binders (before pigment dispersion).

Metallic resinates content in the binders extracted from paints was, respectively, 23.9, 17.0, and 10.7%, expressed as abietic acid, for the samples with 2/1, 1/1, and 1/2 ratios rosin/chlorinated rubber.

After immersion, in the case of the first two ratios, a significant initial increase of the metallic resinates con-

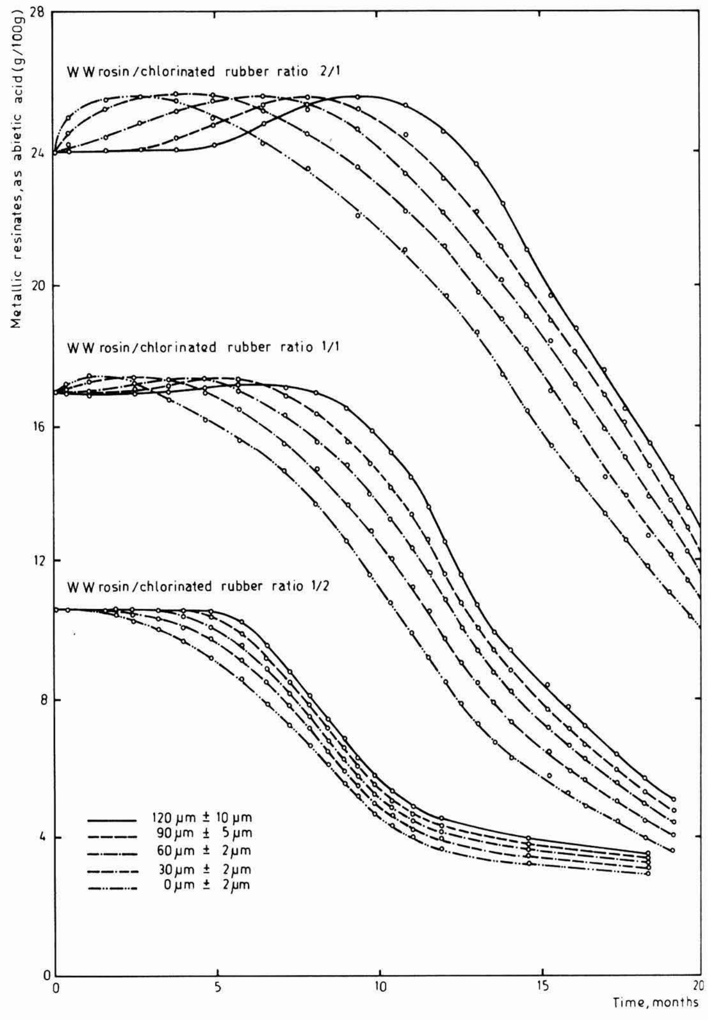


Figure 4—Content of metallic resinates in the binder film during its immersion in sea water (20 months)

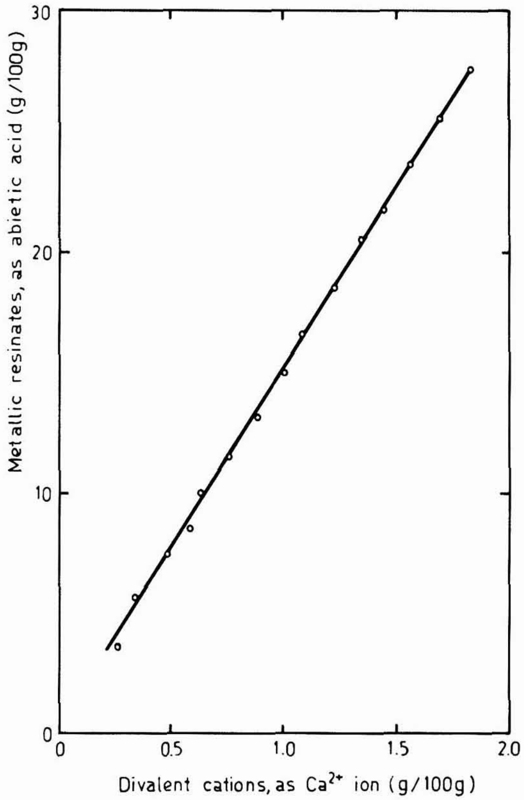


Figure 5—Insoluble metallic resinates and divalent cations in the binder film

centration was observed followed by a sudden decrease. That maximum concentration was also reached after different immersion periods (*Figure* 4) for each selected depth in the film.

Different results were obtained for the binder corresponding to the smallest content of WW rosin (1/2 ratio); in this case there was no increase in the metallic resinates content (thus, no maximum was observed) for any of the film depths considered.

The concentration of metallic resinates was directly proportional to divalent cations content (expressed as Ca^{2+}) for all the binders and different depths in the film and immersion times studied (*Figure* 5). This confirms that the resinic acids of WW rosin were neutralized during pigment dispersion and mainly during immersion, forming resinates with the divalent cations, which remain in the film during long immersion periods. After those periods, free resinic acids were practically absent in the film and binder dissolution was a consequence of the solubilization of the alkaline resinates formed. This fact was confirmed by the decrease of metallic resinates content (*Figure* 5) after the mentioned initial increase.

As a consequence of the dissolution process described, the content of insoluble materials in the film (chlorinated rubber, chlorinated paraffin, and non-saponifiable products of the WW rosin) increased during immersion and led to a significant reduction in the binder dissolution rate (*Figure* 6).

Some of the data generated in the laboratory tests, necessary for the calculation binder dissolution rate, are given in *Table* 1.

Figure 6 shows a high initial dissolution rate for the three experimental binders considered; a steady state was reached with values around 12.4, 10.8, and 9.9 $\mu g.cm^{-2} \cdot day-^{1}$ for the binders with WW rosin/chlorinated rubber ratios 2/1, 1/1, and 1/2, respectively. The duration of the steady state period was highest for the first mentioned ratio and decreased for the other two.

After 20 months immersion, the 2/1 ratio binder showed a high value for the dissolution rate (6.3 $\mu g \cdot cm^{-2} \cdot day^{-1}$ as comparing with those corresponding to the other two (3.0 $\mu g \cdot cm^{-2} \cdot day^{-1}$, for the 1/1/ ratio, and practically negligible for the 1/2 ratio). In the latter case the binder would not be adequate for the formulation of soluble-matrix type antifouling paints.

CONCLUSIONS

(1) In the original binders (before pigment dispersion), the experimental results showed that the amount of free resinic acids was consistent with the rosin content.

(2) In the binders extracted from just manufactured paints, obtained values indicated a lesser amount of free resinic acids. This is due to the neutralization reactions carried out during pigment dispersion. An important metallic resinates content was also determined.

(3) During immersion in artificial sea water, experimental binders extracted from paints showed a greater diminution of free resinic acids content and after long immersion periods the residual amount was practically negligible.

(4) In above mentioned binders and concerning metal-

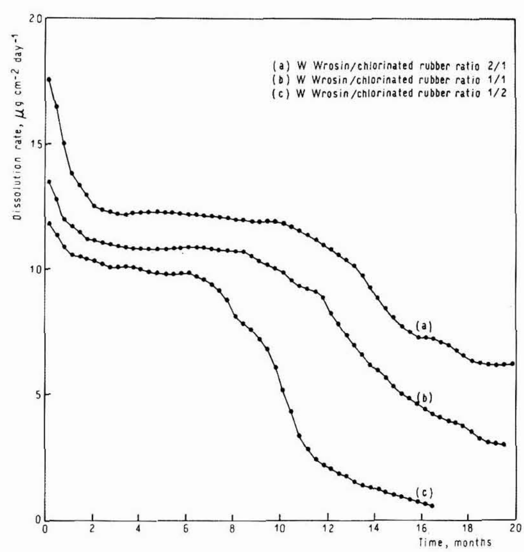


Figure 6—Dissolution rate of the binders during immersion in water

Table 1 — Loss of Weight and Dissolution Rate of Binders

		Immersion Time[a] (days)	Loss of Weight[b] (mg)	Dissolution Rate[c] ($\mu g.cm^{-2}.day^{-1}$)
Binder 2/1 Ratio	Initial dissol. rate	0-10	77.9	17.3
		30-40	61.6	13.7
	Constant dissol. rate	60-70	55.8	12.4
		90-100	54.9	12.2
		270-280	55.8	12.4
		300-310	55.4	12.3
	Final dissol. rate	330-340	50.0	11.1
		360-370	48.2	10.7
		570-580	28.8	6.4
		600-610	28.4	6.3
Binder 1/1 Ratio	Initial dissol. rate	10-10	58.5	13.0
		30-40	52.2	11.6
		60-70	49.5	11.0
	Constant dissol. rate	90-100	48.7	10.8
		120-130	48.2	10.7
		240-250	48.6	10.8
		270-280	48.1	10.7
	Final dissol. rate	300-310	44.6	9.9
		330-340	40.5	9.0
		570-580	13.9	3.1
		600-610	13.6	3.0
Binder 1/2 Ratio	Initial dissol. rate	0-10	51.7	11.5
		30-40	47.2	10.5
		90-100	45.8	10.2
		120-130	45.4	10.1
	Constant dissol. rate	150-160	44.6	9.9
		180-190	44.4	9.9
	Final dissol. rate	210-220	41.3	9.2
		240-250	34.6	7.7
		360-370	8.1	1.8
		390-400	5.4	1.2

(a) Every experimental period was 10 days; this table shows only some of the values determined (see *Figure* 6).
(b) Dissolution area was 450 cm^2.
(c) Dissolution rate is given by the loss of weight per unit area and per unit time.

lic resinates content, an initial increase, followed by a sudden fall and finally a gradual decrease were observed.

(5) Binder dissolution rate was influenced by rosin/chlorinated rubber ratio.

ACKNOWLEDGMENT

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BALTIMORE .... NOV.

Joint Meeting with Baltimore Association

The following members received Federation 25-Year Pins: Richard Chodnicki, of Kerr-McGee Chemical Co; Bill Tate, of Tate Chemical Sales Co; and Don Marsh, of Spencer Kellogg Prod.-NL Chemicals.

Merit Citations were bestowed to Mr. Chodnicki; Joe Giusto, of Lenmar, Inc; Bob Hopkins, of SCM Corp; Helen Keegan, of Valspar Corp; Bob Massarelli; Bill Stenger, of DuPont Co; and Vickie Vojik.

Society Scholarship awards in the amount of $1,000 were presented to Pam Kester and Lisa Rohleder.

Mike Beatty, of C.M. Athey Paint Co., the 1984 recipient of the Herman Shuger Memorial Award, introduced this year's recipient, Mitch Dudnikov, of Genstar Stone Products Co.

ED COUNTRYMAN, *Secretary*

BIRMINGHAM............. NOV.

"Vehicle Refinishing"

Club President, Ron Jukes, of Croda Paints Ltd., announced the award of second place bestowed to Brian Addenbrooke, of Croda Paints Ltd., by the Federation for the form and manner of his presentation of the Club Technical Committee's work, "The Correlation of Results from 'Color Matching Aptitude Test' Scores," at the 1985 Paint Show.

Alan Stacey, of Glasurit/Valentine, provided the technical talk for the evening. Mr. Stacey discussed, "VEHICLE REFINISHING: PAST, PRESENT, and FUTURE."

He began by exploring the method of vehicle refinishing used in the past citing the use of brush finishes based on oleo resin, congo copal, china woodoil, etc., pigmented by naturally occurring pigments and thinned with turps. This method was used until the 1930's, he stated.

Vehicle finish changes began with the introduction of Henry Ford's mass-produced automobiles. Nitrocellulose modified for flexibility by castor oil or camphor were introduced, explained Mr. Stacey. They showed poor UV stability and were susceptible to yellowing but were ideal for black finishes which suited Mr. Ford. At that time the pigment used was soot.

The introduction of alkyds into the manufacture of auto finishes occurred in the 1930's and 40's. Nitrocellulose as the base for finishes became more widely used and alkyds were used to modify.

The 1950's saw the introduction of acrylic finishes, Mr. Stacey recalled. Both thermoplastic and thermosetting acrylic finishes were used. A wider range of colors and metallic finishes also sprang into use. The introduction of acrylics stimulated the development of improved nitrocellulose lacquers.

Moving in to the present, Mr. Stacey explained that in the 1960's the car buyers' market developed. The regular new colors along with the introduction of foreign colors make the range now near 10,000 colors, he stated. The mixing scheme with matching at the point of application to give individual matching to vehicles was introduced in the 1970's.

In closing Mr. Stacey commented on what the future holds for automotive refinishing. He stated that: refinishes may be waterbased to replace solvent shortages; powder coatings may be used for original finishes; plastics would probably be used to a greater extent in vehicle manufacturing; and a non-isocyanated 2-pack system would be developed.

DAVID M. HEATH, *Secretary*

CHICAGO................ SEPT.

"Solvent Formulations" And "Ceramic Coatings for Spacecraft"

Bill Wellman, of Exxon Corp., provided the first presentation of the evening. He addressed the topic of "SOLVENTS POINT THE WAY TO HIGH QUALITY COMPLYING ACRYLIC COATINGS."

Mr. Wellman discussed the current role of the solvent. In recent years, he stated, the solvent has become a key factor in the formulation and performance of high solids coatings. They enable compliance with VOC regulations and enhance coatings appearance and durability.

His presentation closed with a look at a number of commercial solvents. They were examined for their ability to: control and lower molecular weight of the resin; lower polydispersity; increase solids level of the formulation; increase resistivity and transfer efficiency in electrostatic spraying; and improve gloss and impact resistance of the final film.

The post-dinner talk was delivered by Yoshiro Harada, of ITT Research Institute. Dr. Harada spoke on "CERAMIC COATINGS FOR SPACECRAFT."

A variety of ceramic thermal control coatings developed for the Apollo, Gemini, and Skylab missions were outlined by the speaker. He explained that the coatings are an integral part of the spacecraft engineering design and insure survivability of electronic gear, cryogenic detectors, and people.

Relating to the coating system used, Dr. Harada told the audience that, in general, organic solar reflector systems have shown desirable characteristics including: low solar absorbance; high emittance; good optical and physical stability in a high UV-vacuum environment; low outgassing; and moderate electrical conductivity which minimizes problems due to charge buildup.

RAY CZICZO, *Secretary*

CLEVELAND............. OCT.

"Solvents in High Quality Complying Acrylic Coatings"

Bill Wellman, of Exxon Chemical Co., presented "AN UPDATE ON THE ROLE OF THE SOLVENT IN HIGH QUALITY COMPLYING ACRYLIC COATINGS."

Dr. Wellman explained that solvents are the key to positive properties in high solids compliance coatings. He then discussed how the role of today's solvents is somewhat different from their historical role: solvents today must contribute low viscosity, improved application properties, decrease the molecular weight of the polymer, have low toxicity, and provide good durability. In concluding his presentation, Dr. Wellman demonstrated how esters can provide a combination of the high solvency and high resistivity needed.

RICHARD R. ELEY, *Secretary*

CLEVELAND.............. NOV.

"Adhesive Failure of Coatings: Prediction and Control"

Professor Sam Moet, of Case Western Reserve University, spoke on "ADHESION FAILURE OF COATINGS: PREDICTION AND CONTROL."

The comprehensive presentation began with a description of some fundamental fracture mechanics. He discussed the failure of the classical approach to properly describe breaking strengths of simple materials (the "Griffith dilemma"), explaining that microscopic flaws in materials have the ability to act as stress concentrators enabling extremely high stresses to be generated from low stresses near the flaw.

Next, Dr. Moet described two fundamental types of crack-generation failure modes: crazing and shear-banding. Comparing the two, he stated that in crazing cracks are generated perpendicular to the elongation direction, representing brittle failure whereas in shear-banding crisscross cracks appear at 45° angles to the direction of the strain, representing ductile failure. He noted that polymers are the exception to fracture mechanics. When they crack, the formation of the new surface is a complex process. Fibrils tend to pull out of the separating surfaces as a function of the polymer molecular weight. Thus, the amount of surface and the energy to form it are hard to predict.

The various peel tests were then examined by Dr. Moet. He recommended a blister test in which a film is forced away from its substrate underneath by an injection of pressurized fluid through a small drilled hole.

Lastly, debonding due to Mode II fracture was covered by Dr. Moet. He stated that this failure mode is caused by relative sliding motion of coating and substrate due to differential thermal expansion and contraction of the two.

RICHARD R. ELEY, *Secretary*

HOUSTON .... OCT.

"Silica Gels"

Nolan Phillips, of J.M. Huber Corp., discussed "SILICA GELS."

Mr. Nolan began by introducing three basic types of synthetic silica: fumed, gelled, and precipitated. He then explained the synthesis reaction for each type and the resulting physical structure, properties, and characteristics.

An outline of the various commercial applications of synthetic silica was given. Included on his list were plastics, toothpaste, scouring powder, and polishing compounds. Mr. Nolan stated that synthetic silicas impart durability, viscosity, rheology, and abrasiveness to these products. In paint, synthetic silicas are used primarily as a prime pigment extender and as a flatting agent.

In conclusion, Mr. Nolan stated that synthetic silicas pose a minimal threat to employee health. They have not been shown to cause "silicosis" like quartz, diatomaceous earth, and other natural occurring silicas because they are not crystalline in structure. These particles do not puncture lung lining because they do not have the sharp points of crystals, he stressed.

JAMES W. JUDLIN, *Secretary*

KANSAS CITY............ OCT.

"Driers in Coatings"

An Educational Committee report was given by James O'Brien, of DuPont Co. He told of the Society's intention to support the Science Fair and award those entries which merit and relate to the coatings industry.

Society Representative, Norman Hon, of Cook Paint and Varnish Co., summarized some of the highlights of the Annual Meeting and made available a more detailed report for members requesting it.

Paul Baker, of Nuodex, Inc., delivered a presentation on "DRIERS IN COATINGS."

STEVEN D. JOHNSON, *Secretary*

LOS ANGELES............ OCT.

"Can Computer Color Matching Work for Paint Dealers"

Out-going Society President, Earl Smith, of Spencer Kellogg Prod.-NL Chemicals, was presented the Past-President's pin and plaque by Incoming President Mike Gildon, of Guardsman Chemicals.

Society Representative Jan P. Van Zelm, of Byk Chemie, announced the awards won by the Society at the Federation's Annual Meeting. He recognized James Hall, of Sinclair Paint Co., for winning the Speakers Award for his presentation of the Society's work, "Implementation of Laboratory Paint Formula Calculations on an Apple II Microcomputer." He then presented Ray DiMaio, of Koppers Co., with a check in the amount of $100 for winning the Trigg Award in recognition of his excellent minutes last year.

Don Curl, Past-President of the South Coast Paint and Coatings Association, gave an environmental update. Mr. Curl explained that the 380/250 VOC four-year extension was approved by the South Coast Air Quality Management District and is about to be approved or more likely disapproved by the EPA. The EPA decision, when made, will be published in the *Federal Register*. If it is disapproved, the EPA must hold hearings 30 to 60 days after the decision is published, explained Mr. Curl. The NPCA is talking to EPA in Washington, D.C. but a lot of political muscle will have to be utilized to counteract EPA's position, he stressed.

Mr. Curl then explained that Henry George has been hired by the S.C.A.Q.M.D. as their consultant. Mr. George is recommending that the rule regarding opaque stains be rescinded until 1987. According to Mr. Curl, the South Coast Staff will be following Mr. George's recommendation. The EPA will probably turn it down however.

"CAN COMPUTER COLOR MATCHING WORK FOR PAINT DEALERS?" was the theme of a presentation given by Jim DeGroff, of Color Tech Associates.

Mr. DeGroff told of the advantages and disadvantages of employing computer color matching. He stated that they can be extremely useful in the hands of knowledgeable operators who understand the output and how colorants work in paint formulations.

MELINDA K. RUTLEDGE, *Secretary*

LOS ANGELES............ NOV.

"In-House Solvent Recovery"

Society President Mike Gildon, of Guardsman Chemicals introduced Albert Milo, of the City of Commerce Library. Mr. Milo spoke of the Society bibliographies compiled by the Library of its books related to coatings.

Lloyd Haanstra, of Sinclair Paint Co., gave an environmental report. He stated that the EPA is at opposition on Rules 1107 and 1113. Regarding 1107, he explained that the South Coast Air Quality Management District approved a two-year demon-

FSCT Membership Anniversaries

25-YEAR MEMBERS

Baltimore

Richard C. Chodnicki, Kerr-McGee Chemical Co.
Donald Marsh, Spencer Kellogg Prod./NL Chemicals
William M. Tate, Tate Chemical Sales Co.

Birmingham

Brian J. Addenbrooke, Croda Paints Limited
S.T. Harris, Consultant
D.H. Tonkinson, Llewellyn Ryland Ltd.

stration program on the rule and the EPA does not recognize the program. The EPA has sent letters out to various industrial paint companies and has imposed fines on them. The EPA does not recognize the 380/250 VOC four-year extension of Rule 1113 either. EPA wants the paint industry to be at 250 VOC on a non-flat coatings.

Kathy Sampsel, of Disti Incorporated, spoke on the "ADVANTAGES OF IN-HOUSE RECOVERY."

Q. *What is the temperature of sludge discharge? What is the current cost of disposal of semi-solid sludge?*
A. The temperature of the sludge being discharged depends on when the unit is cleaned. Cleanup is easier when the sludge is warm, but not too hot. It cost about $185 a barrel two months ago, for semi-dry sludge disposal.

Q. *Do you use a solid substrate to solidify the residue or is it generally solid on its own?*
A. It depends, you can make it solid on its own. You can get it down to a solid state very easily. This is not the case with liquid resin but in most cases paint sludge can be dried to the point that it is like dirt.

MELINDA K. RUTLEDGE, *Secretary*

LOUISVILLE .... NOV.

"Quality Report Card Approach"

Technical Committee Chairperson, Louis Holzknecht, of Devoe Marine Coatings, reported that the literature research on mildew resistant paint was still being conducted. He announced that volunteers are needed to help with ASTM D3234 Test Method. He also reported that a new pocket computer program is available on video cassette.

A presentation entitled, "QUALITY REPORT CARD APPROACH IN AREAS INVOLVING MANAGEMENT," was given by Frank B. Bredimus, of DuPont Co.

LARRY PITCHFORD, *Secretary*

NEW ENGLAND .... OCT.

"Formulating Water-Borne Coatings for Plastics"

Kurt Bimmler, of Polyvinyl Chemicals, Inc., discussed "FORMULATING WATER-BORNE COATINGS FOR PLASTICS—THE PROBLEMS AND THE SOLUTIONS."

Environmental reasons for designing water-borne coatings for plastics were explained by Mr. Bimmler. He also described the performance requirements necessary to meet the applications demands.

Next, Mr. Bimmler mentioned several areas that are critical in developing water-borne formulations. The first area is in the pigment dispersion itself. Water-borne formulations require different formats for preparation of pigment dispersion. The pH of these systems is critical in preventing flocculation, he stressed.

The choice of dispersants was another critical area explored. He emphasized that dispersants are one of the most important ingredients in water-borne coatings. He also mentioned that in most water-borne systems, anionic dispersants are preferred because they are more efficient. To select the most appropriate dispersant depends on such factors as water resistance, gloss, gloss development, and stability of the formulation.

In closing, he stated that there are many ingredients in the development of water-borne coatings for plastics that play a role in determining the success of the coating.

GAIL POLLANO, *Secretary*

NEW ENGLAND .... NOV.

"Boston Stone"

An "Open Forum" concerning regulatory issues, specifically the hazards communications deadline of November 25 was held. Chairman of the Environmental Committee Bruce Ocko, of Truesdale Co., provided a short explanation of the regulation.

It was announced that the Sheraton Lexington has been selected as the site for the Expo Symposium to be held in May of 1986. The symposium, entitled "Launching the New Revolution—Compliance for the 21st Century," will emphasize new regulations, HMIS, hazardous waste, and right-to-know laws.

Sara Chase, of Society for the Preservation of New England Antiquities, delivered a lecture on "A TALK ON THE BOSTON STONE AND OTHER CURIOUS ASPECTS OF HOUSE PAINT MANUFACTURE AND APPLICATION IN COLONIAL AMERICA."

The presentation began with a discussion on the Boston Stone. Ms. Chase indicated that the stone was actually used in paint manufacturing back in the 1690's. The date on the Stone reads 1737, and according to Ms. Chase, this date indicates the year in which the stone was placed on the corner of the house, to "defense" the exposed portion. The inscription on the Stone was done to act as a landmark for business in the area, she added.

Ms. Chase addressed the subject of determining paint color on Colonial wall and ceilings. A lump of paint, usually found near the bottom edge of a hinge is located in the home. Next, a scalpel is used to carve out a crater of unfaded paint, from within the lump. Polish is then applied to see the layers of paint.

The speaker discussed the various periods of houses built in the U.S. and the type and color of paint applied to them. She closed her presentation stating that, painting is as important as fire insurance and buildings unprotected by paint and will decay.

GAIL POLLANO, *Secretary*

NORTHWESTERN .... OCT.

"High-Solids Thermoset Coatings"

Society President Al Yokubonis, of Celanese Specialty Resins, announced that the Society will award $50 to the person who submits the topic chosen by the Committee for their second Committee project.

Society Representative Richard Fricker, of Valspar Corporation, reported on the Annual Meeting held in St. Louis. He told of the motion made by the L.A. and Golden Gate Societies' to add a technical person to the FSCT staff to act as a liaison to testify at hearings on VOC and other regulations that may come up. The motion was tabled to allow the Executive Committee to consider it at their next meeting, he added.

The technical talk was delivered by Hal Yousuf, of S.C. Johnson and Son, Inc. Mr. Yousuf spoke on "HIGH SOLIDS THERMOSET COATINGS."

Introducing his topic, Mr. Yousuf explained the key elements in the selection of ingredients for formulating high solids thermoset coatings. He also discussed the impact of the selection of resins, pigments, solvents, additives, and crosslinking agents on the total paint formulation and what to look for in making raw material selections.

JOAN B. LAMBERG, *Secretary*

NORTHWESTERN .... NOV.

"The Role of Azeotropy" And "Dynamic Uniaxial Extensional Viscosities"

Ed Ferlauto, of Valspar Corp., gave a report of the Technical Committee. He reviewed highlights of the Federation's Technical Committee Chairman's Meeting held in Madison, WI, on October 29 and 30.

The first speaker of the evening was Albert L. Rocklin, of Shell Chemical Co. Dr. Rocklin discussed "THE ROLE OF AZEOTROPY IN SPEEDING UP WATER/SOLVENT EVAPORATION IN HUMID AIR."

Dr. Rocklin spoke of the fast evaporation rate of water/solvent azeotropes stating that they evaporate faster than water, but do so without change in composition only in dry air. In humid air they lose cosolvent composition because the water evaporation is retarded.

He went on to define *pseudo azeotropes*. They are blends which evaporate into humid air without change in composition and have a higher cosolvent concentration than the azeotropes. Their composition depends on relative humidity and is close to the composition of the fastest evaporating blend at that humidity.

In conclusion, Dr. Rocklin compared the azeotroping efficiencies of cosolvents with computed evaporation rate studies of binary and ternary water/solvent blends over a wide range of humidities.

R. Hilary Fernando, a student majoring in Polymer and Coatings at North Dakota State University, presented "THE CONTRIBUTION OF DYNAMIC UNIAXIAL EXTENSIONAL VISCOSITIES TO TRADE SALE ROLL AND INDUSTRIAL ROLL AND SPRAY APPLICATION PERFORMANCE."

Ms. Fernando's technical presentation focused on a study in which the dynamic uniaxial extensional viscosity (DUEV) of water-borne latex coatings thickened with a cellulose ether was measured for the first time and related with the coating's spatter characteristics. She explained that the DUEV's of industrial coil coating formulations, varying in their ribbing and misting characteristics, were also measured and related in the study. Attempts were made to measure the DUEV's of interior can coatings applied by spray, but were unsuccessful without the addition of high molecular weight poly(oxyethylene). Modification in small amounts resulted in an inverse relationship between the coating's tendency to mist and its DUEV. Ms. Fernando then gave a more detailed explanation of the relationship existing between the coatings tendency to mist and its DUEV.

In spray coating applications, the relationship is straightforward. In coil coatings the phenomena is more complex, she said. Ribbing occurs when the viscous forces overcome the influence of surface tension in minimizing the fluid's free surface area. The radius and peripheral velocity of the rolls and nip spacing between the rolls all contribute to the onset of ribbing. In individual polymer blend studies which permitted separation of shear and extensional components, the importance of DUEV's in facilitating an earlier onset of ribbing at a given nip spacing and roll velocity were illustrated. In total, she concluded, the study delineates the primary importance of DUEV and nip spacing in determining the number of ribs at a given set of roll conditions, and shows the importance of DUEV at high roll velocities in web growth and misting.

JOAN B. LAMBERG, *Secretary*

NORTHWESTERN......... DEC.

"Understanding Emulsions" And "Return of Comet Halley"

Technical Committee Chairman, Ed Ferlauto, of Valspar Corp., reported on the Committee meeting held on November 8. Out of six topics, three were selected and literature searches are being conducted, he stated. He added that it looks promising for the Society to present a paper at the 1986 Federation Annual Meeting.

Mark Uglem, of Creative Paint Mfg., announced that plans are underway for the symposium, "Color, Its Effects and Interactions." Mr. Uglem, the symposium Chairman, announced that it would be held on March 4, 1986 at the Marriott Hotel, in Bloomington, MN.

Society Representative, Richard Fricker, of Valspar Corp., told of a chemical coaters seminar he had attended in Detroit. The seminar, he explained, was conducted by a spokesman from Ford Motor Co., a firm recently fined by the EPA because the coating furnished to it by a supplier did not comply with VOC regulations.

The first speaker of the evening was Bill Betts, of Reichhold Chemicals. Mr. Betts gave a talk on "UNDERSTANDING EMULSIONS."

He began by stating that the terms latex and emulsion are used interchangeably. They are not the same, he stressed, and cited definitions of each found in the Chemical Dictionary. He added that most polymers used in trade-sale paints are a latex, even though they are made by emulsion polymerization.

Next, Mr. Betts discussed the types of polymerization and the role of surfactants, initiators, catalysts, protective colloids and pH control in emulsion polymerization. He also enumerated on four variables important to control the polymerization process. They include agitation, polymerization temperature, monomer addition and finishing temperature, and holding time.

His presentation concluded with an examination of two latices. The large particle size latex showed superior paint properties of flow, leveling, and freeze-thaw resistance. Therefore, he concluded that the balance of molecular weight and particle size of the latex appears important to develop desired properties in latex-based paints.

Ron Nerdahl, of University of Minnesota, gave the second talk of the evening. He presented a timely talk on the "RETURN OF COMET HALLEY."

Mr. Nerdahl compared the current return of the comet to its most previous sweep past the earth in 1910. He also covered some of Halley's physical features and characteristics.

JOAN B. LAMBERG, *Secretary*

PACIFIC NORTHWEST..... OCT.

"Concepts of Colors and Color Matching"

An Educational Committee report was given by George Schaffer, of Uniplast Products Ltd. Mr. Schaffer reminded members of the Advanced Latex Course commencing in early November. He then told of a reference book library to be established at B.C.I.T. under the Society. For the purchase of the books, $600 has been set aside. A listing of all the books will be available soon, he added. He also told of a metal cabinet being purchased to store the instrumentation used in teaching the Paint Technology course. It will be kept at B.C.I.T.

Jim DeGroff, of Colortec Associates, discussed the "CONCEPTS OF COLORS AND MATCHING" and the trend in the U.S. toward in-store computer color matching technology.

JOHN BERGHUIS, *Secretary*

PACIFIC NORTHWEST..... NOV.

"Acrylics"

Valerie Braund, Chairperson of the Safety and Manufacturing Committee, proposed that the committee begin investigating the possibility of filming a video on safety in the workplace. Stephen Nozewski, of International Paint, and John Wong, of Reliance Universal, have volunteered to assist in contacting various paint manufacturers and raw material suppliers for source material for the film, she added.

Deryk R. Pawsey, of Rohm and Haas Canada Inc., provided a presentation on "ACRYLICS."

Many aspects of acrylics, including their manufacture and varied end uses were addressed by Mr. Pawsey.

JOHN BERGHUIS, *Secretary*

PHILADELPHIA .... OCT.

"Antimicrobials for Use in Coatings"

Society Representative Carl Fuller, of Reichard-Coulston, Inc., attended the October Board of Directors meeting in St. Louis and reported that the By-Laws had been changed to lower dues from $20 to $10 for Society Honorary members.

William Woods, of Nuodex, Inc., provided a slide presentation on "ANTIMICROBIALS FOR USE IN COATINGS AND PLASTICS."

The use of additives for the prevention of microbial deterioration of liquids (water-based) and films (paint, polymeric) was discussed by Mr. Woods. He also spoke on the two main types of additives: bactericides (preservatives) and fungicides (mildewcides).

Next, Mr. Woods discussed spoilage sources during manufacturing. They include: air dust, process water, raw materials, and residue left on equipment. He noted that several effects of spoilage will indicate bacteria infestation, such as gas, odor, viscosity loss, and pH drift.

To prevent spoilage, Mr. Woods recommended limiting contamination during manufacturing and using anti-microbial additives to control contaminants. He offered the following methods of disinfection: use steam or chemical disinfectants, such as formaldehyde, sodium hypochlorite, quaternary ammonia salts, and preservatives.

Preservatives were then explored by Mr. Woods. He stated that the ideal preservative will be non-yellowing, effective at low cost, have a low order of toxicity, be easily handled, and should be stable. Incorporating a preservative in finished products will control contaminants and increase shelf life, he added. Characteristics of two types of preservatives, mercurial and non-mercurial, were then examined. Mercurials offer a broad range of activity, but are designated a hazardous material, require special packaging and disposal, and can only be used in latex paints. The characteristics of non-mercurials depends upon the chemical type used, he explained. Presently there are approximately 10 compounds on the market. Mr. Woods stressed that all preservative must have approval from one or all of the following agencies: EPA, USDA, and/or FDA.

Lastly, sources of fungi were discussed by Mr. Woods. Fungi (mold/mildew) are found in the soil and in airborne spores. The optimal condition for fungal growth is 85°F and 95% humidity. He added that both mercurials and non-mercurials are available as fungicides.

THOMAS L. PETA, *Secretary*

PHILADELPHIA .... NOV.

"Inerting of Coatings Plants"

Bill Fabiny, of Sermatech International Inc., asked members to become involved in the various technical committees. The Technical Committee Chairman then announced that the technical seminar will be held on May 12, 1986. Chaired by Christine B. Johnson, of Pennwalt Corp., the seminar theme is "Impact of Environmental Regulations on the Coatings Industry."

The technical speaker for the evening was Gary S. Halpern. He discussed "INERTING IN COATINGS PLANTS: ECONOMICS AND SAFETY."

Mr. Halpern opened his talk with a slide presentation. He gave a detailed explanation on how to eliminate the risk of fire in coatings plants stressing that the risk of fire in the coatings industry is virtually inherent due to the solvents, liquids, and powders used in generating products.

Methods employed by the industry to create a "safe" environment were then explored by Mr. Halpern. His methods included: maintaining solvent temperatures below auto-ignition point; grounding-bonding, and humidification to suppress and eliminate static electricity; and timed volume inerting and pressurization. No combination of the above methods provides absolute safety, he noted. The Neutronics Automatic Inerting Control System can assure absolute safety by controlling the oxygen levels below the flammability point.

Mr. Halpern gave a listing of the ingredients necessary for combustion. The requirements are fuel, oxygen, and ignition. Successful elimination of one of these elements removes the possibility of fire or explosion. A detailed explanation of sources of ignition were then given by the speaker.

In closing, Mr. Halpern stated that controlling oxygen is by far the most controllable area of the combustion triangle in process vessels.

THOMAS L. PETA, *Secretary*

PIEDMONT .... OCT.

"Industrial Lacquers"

Past-President Phil Wong, of Reliance Universal, Inc., was presented with an honorarium for his last four years of assistance to the Society. An honorarium gavel was then handed to Incoming President Mike Davis, of Salodin Paint Products, Inc., by Tom Mitchell, of Nuodex, Inc.

Phil Reitano, of Inolex Chemical Co., spoke on "INDUSTRIAL LACQUERS BASED ON SATURATED POLYESTERS AND CO-POLYESTERS."

Aided by a slide show, Mr. Reitano covered various differences between polyesters and co-polyesters. His presentation included an explanation of the general chemistry of polymers, highlighting the amphorous and thermoplastic differences. He listed the advantages of amphorous co-polyesters and how they differ from the standard form of co-polyesters.

CHARLES T. HOWARD, *Secretary*

PIEDMONT .... NOV.

"Acid Catalyst Trouble Shooting"

An Educational Committee report was given by Bob Matejka, of Reliance Universal. He reminded the membership of the symposium scheduled and explained that the topics would be in conjunction with process control and quality circles.

Candidates are being sought for the Dave Bouldin Outstanding Award. So far, two names have been taken, E.O. Cummings and Dot Forward.

Robert Baker, of King Industries, Inc., spoke on "ACID CATALYST TROUBLE-SHOOTING IN HIGH SOLIDS AND WATER-BORNE COATINGS."

Using a slide presentation, Mr. Baker discussed the usage of acid catalyst with reactions between various coatings. Current regulatory affects on coatings require reduced emissions; therefore solids have been increased on lower molecular weight resins, he explained. In order to accelerate the reactions of these resins, a catalyst is required.

Mr. Baker concluded by indicating trouble-shooting when using various acid catalysts. He included an explanation of performance at various levels and types of catalysts and described various properties of the finished coatings which can be controlled by making the correct choice of the acid catalyst.

CHARLES T. HOWARD, *Secretary*

PITTSBURGH .... NOV.

"Solvents Paint the Way in High Solids Acrylics"

William E. Wellman, of Exxon Chemical Co., provided a technical presentation on "SOLVENTS PAINT THE WAY IN HIGH SOLIDS ACRYLICS."

The talk began with a discussion of how solvents differ from all other components in a coating system. All other components have a final function, he stated, while a solvent is only there temporarily. In the struggle for EPA compliance, solvents can be more of an ally than an enemy, he stressed.

Dr. Wellman included a discussion of four areas of a particular coatings system observed in a study of materials polymerized with methyl-amyl-ketone and let down with various solvents. They included reducing solvent, the polymerization solvent, the interaction of the initiator with the solvent, and, finally, the electrostatic spray.

Through proper selection of the solvent, you can make the solvent work for you. It can help in terms of controlling or decreasing the molecular weight, it can decrease the molecular weight poly-dispersity, it can increase solids, resistivity, and transfer efficiency, and it can improve the final film properties, he concluded.

MARK D. TROUTMAN, *Secretary*

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's Eudowood, Towson, MD). ED COUNTRYMAN, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224. 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—meeting sites vary). RAYMOND CZICZO, Reliance Universal, Inc., 1915 Industrial Ave., Zion, IL 60099.

CDIC (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; and Nov., Feb. in Dayton). SAMUEL KRATZER, D&L Paint Co., 215 Brownsville Ave., Liberty, IN 47343.

CLEVELAND (Third Tuesday—meeting sites vary). RICHARD ELEY, Glidden Coatings & Resins, Div. of SCM Corp., D.P. Joyce Research Center, P.O. Box 8827, Strongsville, OH 44136.

DALLAS (Thursday following second Wednesday—Executive Inn, near Lovefield Airport). FREDERICK T. BEARD, Glidden Coating & Resins, Div. of SCM Corp., 1900 North Josey Ln., Carrolton, TX 75006.

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

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabella's Restaurant on Fisherman's Wharf and Francesco's in Oakland, CA). KARL SAUER, Pfizer, Inc., MPM Div., 776 Rosemont Rd., Oakland, CA 94610.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX). JAMES A. HARRELL, Buckman Laboratories, 5127 Wightman Ct., Houston, TX 77069.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). STEVEN JOHNSON, Cook Paint & Varnish Co., P.O. Box 389, Kansas City, MO 64141.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). MELINDA RUTLEDGE, Allo Chemical Co., P.O. Box 443, Ontario, CA 91761.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). LARRY F. PITCHFORD, Reynolds Metals Co., P.O. Box 3530, Plant III, Louisville, KY 40232.

MEXICO (Fourth Thursday—meeting sites vary).

MONTREAL (First Wednesday—Bill Wong's Restaurant). W WILDE, Hoechst Canada, Inc., 4045 Cote Vertu, Montreal, Que., Canada H4R 1R6.

NEW ENGLAND (Third Thursday—LeChateau Restaurant, Waltham, MA). GAIL POLLANO, Polyvinyl Chemical Industries, Inc., 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). JOHN W. BURLAGE, Pacific Anchor Chemical, 14 Ridgedale Ave., Cedar Knolls, NJ 07927.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). JOAN B. LAMBERG, Horton-Earl Co., 750 S. Plaza Dr., St. Paul, MN 55120.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). YVON POITRAS, General Paint Co., 950 Raymur Ave., Vancouver, B.C., V6A 3L5, Canada.

PHILADELPHIA (Second Thursday—Dugan's Restaurant, Philadelphia, PA). THOMAS L. PETA, J.C. Osborne Chemicals, Inc., P.O. Box 1310, Merchantville, NJ 08109.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood Exit of I-85, High Point, NC). CHARLES HOWARD, DeSoto, Inc., P.O. Box 22105, Greensboro, NC 27420.

PITTSBURGH (First Monday—Montemurro's, Sharpsburg, PA). MARK TROUTMAN, Bradley Paint Co., 608 W. Crawford St., Connellsville, PA 15425.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). MARCY S. BAUGH, Hutson Industries, 60 Tejon St., Denver, CO 80223.

ST. LOUIS (Third Tuesday—Engineers Club). JAMES N. MCDERBY, F.R. Hall & Co., 6300 Bartmer Ind. Dr., St. Louis, MO 63130.

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). C. LEWIS DAVIS, Ambrosia International, 802 Black Duck Dr., Port Orange, FL 32019.

TORONTO (Second Monday—Cambridge Motor Hotel). HANS WITTMAN, BASF Canada Ltd., 10 Constellation Ct., Rexdale, Ont., Canada M9W 1K1.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). JEAN L. LUCK, Pratt & Lambert Inc., Powder Coatings Div., P.O. Box 22, Buffalo, NY 14240.

PITTSBURGH .... DEC.

"Coatings Dispersions"

Education Committee Chairman, Don Boyd, of PPG Industries, Inc., reported that his group is having a great deal of success in setting up presentations with both small local colleges and area high schools. Mr. Boyd also mentioned that discussions between his committee and some local colleges in regards to Society support of some type of senior thesis or project are also underway.

Kenneth Madonia, of PPG Industries, Inc., provided a presentation on "THE DEVELOPMENT OF PROPER COATINGS DISPERSIONS."

MARK D. TROUTMAN, *Secretary*

ST. LOUIS .... NOV.

"Exterior Latex Paint Study"

Honored guests in attendance included Joe Bauer, Past-President of the Federation, and Frank Borrelle, Federation Executive Vice-President.

Mr. Borrelle thanked the membership who helped make the St. Louis Show the second largest show in history. He and Mr. Bauer presented gifts to the many committee members who contributed during the show.

On behalf of the Materials Marketing Association, Tim Walsh, of Walsh & Associates, Inc., presented the Society with a check in the amount of $350 for winning the 1985 MMA Class C Award at the Paint Show.

Dan Dixon, Engelhard Corp., discussed a five year evaluation of various extender pigment blends in a presentation entitled, "EXTERIOR LATEX PAINT STUDY."

First, Mr. Dixon explained that typical five-year exposure studies generate a tremendous amount of data. Most of this data is discarded and only the very best panels and data are retained. He then showed how he had set up a test series involving seven grades of clay and six other extenders in a white tint and deep tone latex paint at 45% PVC. He described the way in which the panels were arranged on the fence and told of the seven criterion he measured each year. A program was developed to allow easy manipulation and evaluation of the data, he added.

He closed by suggesting that the next step would be to run a ladder study at various PVC's using duplicate panels and cleaning the panels before performing the testing each year.

JAMES N. MCDERBY, *Secretary*

Elections

BALTIMORE

Active

Krouse, James—Lenmar, Inc., Baltimore, MD.
Lally, Thomas A.—Environmental Inks, Baltimore.
Lisby, Alva C.—Valspar Corporation, Baltimore.
Pund, C. Herbert III—A.B. Kohl Sales Co., Baltimore.
Sheikh, Muhammad Saied—C.M. Athey Paint Co., Baltimore.

Associate

MacKinnon, Kenneth—BASF Wyandotte Corp., Parsippany, NJ.

C-D-I-C

Active

Betts, Paul—Surface Research Corp., Blacklick, OH.
Clingerman, Michael C.—Ashland Chemical Co., Columbus, OH.
Comer, Jeffrey L.—Beecham Home Improvements, Tipp City, OH.
Stewart, Debra—Paint America Co., Dayton, OH.
Swanson, Howard B.—Columbia Paint Corp., Huntington, WV.
Tuckerman, Thomas D.—Yenkin Majestic Paint Co., Columbus.
Urnezis, Matthew—DeSoto, Inc., Columbus.
Walters, Mark—D&L Paint Co., Liberty, IN.

Associate

Flowers, Richard A.—Raybo Chemical Co., Huntington, WV.
Fortney, Timothy L.—Dar-Tech, Inc., Louisville, KY.
Hill, Dennis I.—S.C. Johnson, Cincinnati, OH.
Likens, Carney—Commercial Filters, Lebanon, IN.
Neu, Robert—Spencer Kellogg Prod./NL Chemicals, Cincinnati.

CHICAGO

Active

Berka, Roman—DeSoto, Inc., Des Plaines, IL.
Braun, Kevin G.—O'Brien Corp., South Bend, IN.
Brennan, John W.—Valspar Corporation, Kankakee, IL.
Bussell, Leonard J.—DeSoto, Inc., Des Plaines.
Coad, Eric C.—DeSoto, Inc., Des Plaines.
Cygan, Ludwik S.—DeSoto, Inc., Des Plaines.
Daly, Thomas M.—Midland Div. Dexter Corp., Waukegan, IL.
Deitch, Jeffrey H.—DeSoto, Inc., Des Plaines.
DiMaano, Hilda R.—DeSoto, Inc., Des Plaines.
Engel, David A.—DeSoto, Inc., Des Plaines.
Engelking, Marcia R.—Valspar Corporation, Kankakee.
Estes, Valerie A.—DeSoto, Inc., Des Plaines.
Gibb, John M.—Midland Div. Dexter Corp., Waukegan.
Grotefend, Alan C.—Meyercord Co., Carol Stream, IL.
Hansen, Marc A.—Benjamin Moore & Co., Melrose Park, IL.
Heiden, William D.—Ace Hardware, Paint Div., Matteson, IL.
Hoppenworth, Robert C.—Midland Div. Dexter Corp., Waukegan, IL.
Laffoon, Michael D.—Technical Coatings Co., Melrose Park.
Lamb, Brian R.—Technical Coatings Co., Melrose Park.
Lockhart, Gary—Ashland Chemical Co., Willow Springs, IL.
Maple, James L.—U.S. Steel Supply, Chicago, IL.
Nelson, Kathleen—Ace Hardware, Paint Div., Matteson.
Poganski, William J.—Rockford Chemical Coatings Inc., Rockford, IL.
Polivka, Mark A.—Dreeblan Paint Supply Co., Chicago.
Rubinstein, Clifford—Technical Coatings Co., Melrose Park.
Salvador, Roman B.—Dreeblan Paint Supply Co., Chicago.
Sjoholm Allan J.—O'Brien Corp., South Bend.
Smith, Stephen M.—Rust-Oleum Corp., Evanston, IL.
Suga, R.S.—DeSoto, Inc., Des Plaines.
Swanson, John T.—DeSoto, Inc., Des Plaines.
Ullrich, Frederick J.—Benjamin Moore & Co., Melrose Park.
Wille, Steven L.—DeSoto, Inc., Des Plaines.
Wyman, Patricia—Chase Products Co., Maywood, IL.
Zahn, Walter G.—Premier Coatings Inc., Elk Grove Village, IL.

Associate

Cwik, James E.—Kemira Inc., St. Charles, IL.
Decker, Rodman R.—Ciba-Geigy, Oak Brook, IL.
Gaede, Lori Hilson—T.H. Hilson Co., Wheaton, IL.

HOUSTON

Associate

Baird, Gerald B.—Arco Chemical Co., Houston, TX.

NEW YORK

Active

Boutier, Robert H.—Kay-Fries, Inc., Stony Point, NY.
Busch, Richard W.—Thibaut & Walker Co., Inc., Newark, NJ.
Choo, Joon S.—Shamrock Chemical Corp., Newark.
Farese, Frances—New York Bronze Powder Co., Elizabeth, NJ.
Gersoff, Alan A.—Debevoise Co., Brooklyn, NY.
Greene, Tarra R.—Shamrock Chemical Corp., Newark.
Hulyalkar, Ram K.—Thibaut & Walker Co., Inc., Newark.
Mikhail, Sami S.—Stanwood Devries, Saddle Brook, NJ.
Waelde, Lawrence R.—Insl-X Products, Yonkers, NY.
Zaki, Mokhtar T.—Everseal Mfg. Co., Inc., Irvington, NJ.

Associate

Becker, Daniel B. Jr.—D.B. Becker Co., Inc., Glen Head, NY.
Chung, Philip D.—Thibaut & Walker Co., Inc., Newark, NJ.
Deitzer, Harry J.—Pfizer, Inc., Easton, PA.
Esslinger, Hanspeter—Hercules Incorporated, New Boston, NH.
Fahey, Michael T.—Kay-Fries, Inc., Rockleigh, NJ.
Lavelle, Michael S.—Engelhard Corp., Edison, NJ.
Meyer, Charles A.—Toyo Ink America, Inc., Englewood, NJ.
Newfield, Alan—Seaboard Chemical Corp., Paterson, NJ.
Papson, Edward T.—Ashland Chemical Co., Newark.
Riker, Ralph A.—Union Chemicals Div., Clark, NJ.
Robin, Alexander—Shamrock Chemical Corp., Newark.
Terzian, Aram E.—E.M. Industries, Hawthorne, NY.
Tirpak, George—Ashland/Drew Ind. Div., Boonton, NJ.

Retired

Garvey, Joseph P.—Milford, CT.
Hundert, Murray B.—Livingston, NJ.
Steinmetz, Peter D.—Staten Island, NY.

NORTHWESTERN

Active

Clifton, Hal J.—ArcoGraph, Montrose, MN.
Dowell, Richard J.—Valspar Corporation, Minneapolis, MN.
Emami, Mehrdad—Cargill, Inc., Minneapolis, MN.
Govern, Steve—Loes Enterprises, Inc., St. Paul, MN.
Johnson, Shirlee E.—Valspar Corporation, Minneapolis.
Mittelsteadt, John W.—Valspar Corporation, Minneapolis.
Mooney, Raymond M.—Valspar Corporation, Minneapolis.

Associate

DEKKER, SANDRA M.—Spencer Kellogg Prod./ NL Chemicals, Minneapolis, MN.
FAXVOG, THOMAS A.—Sun Chemical Corp., Apple Valley, MN.
HOUCK, WILLIAM C.—Ashland Chemical Co., Shakopee, MN.
MCGRATH, KATHY—Johnson Wax, Chicago, IL.
MILLS, BRIAN—Monsanto Co., Appleton, WI.
WERTH, JOSEPH—Consolidated Container Corp., Minneapolis.

PACIFIC NORTHWEST

Active

BOWYER, SHIRLEY—Preservative Paint Co., Seattle, WA.
BREIHOF, DANIEL—McCloskey Corp., Portland, OR.
LIND, ED—Preservative Paint Co., Seattle.
ORABY, WADIDA—Willamette Valley Co., Eugene, OR.
PHILLIPS, SCOTT R.—Reliance Universal, Inc., Salem, OR.
SVENSSON, HAKAN P.—Gaco-Western, Inc., Seattle.
YOUNG, BRUCE M.—Willamette Valley Co., Eugene.

Associate

HOWARD, BOB—Harrisons & Crosfield Inc., Portland, OR.
NEFF, JANE—Polyvinyl Chemical Industries, Inc., Hayward, CA.
SPENCER, BOB—MacKenzie & Feimann Ltd., Vancouver, B.C.

PIEDMONT

Active

GUINEY, LEE—Valspar Corporation, High Point, NC.
PROVOST, DALE JOHN—Manville Corp., Denver, NC.
THOMAS, CHARLES K.—Reliance Universal, Inc., High Point.

Associate

KOWALSKI, EDWARD B.—SCM Pigments Corp., Hedgesville, WV.
MCDANIEL, GARY D.—Che Mar Co, Inc., Greensville, SC.

PITTSBURGH

Active

FUNK, JOHN C.—Ball Chemical Co., Glenshaw, PA.

Associate

WINTER, LORI A.—Durr Marketing Assoc., Inc., Pittsburgh, PA.

ROCKY MOUNTAIN

Active

BROWN, J. VINCENT—Kwal Paints, Inc., Denver, CO.
MISCHELL, BOB—Kwal Paints, Inc., Denver.
MULLEN, J. DICK—G-3 Industries, Aurora, CO.
SHAPIRO, GARY RICHARD—Irathane Systems, Colorado Springs, CO.
WALL, JAMES—Komac Paints, Inc., Denver.

Associate

HELD, MERLE D.—Cyprus Industrial Minerals Co., Englewood, CO.

WESTERN NEW YORK

Active

DOUGHERTY, WILLIAM R.—Spencer Kellogg Prod./NL Chemicals, Buffalo, NY.
GOLINSKI, MICHAEL P.—Pratt & Lambert, Inc., Buffalo.
VOLLES, DAVID—Inglis Co., Inc., Manlius, NY.

Future Society Meetings

Birmingham

(Mar. 6)—"Improvement of Solvents and Water-Based Coatings by the Use of UV Stabilizers"—R. Wolf and E. Hess, Sandoz Chemicals.

(Apr. 3)—"Insurance in the Paint Industry"—A.L. Beechey, Thomas Selfe (Midlands) Ltd.

(May 1)—"Sitting on the Fence—Most of the Time"—D. Eddowes, PPCJ.

(May 22)—Symposium—"Management and Investment Required to Achieve Coatings Laboratory Efficiency—Miracle."

(June 5)—General Meeting.

Chicago

(Mar. 3)—"Appearance Analysis"—Richard Harold, Hunter Associates Laboratories. "Distillation Technology: Past, Present, and Future"—Earl Pifer, Finish Engineering Co.

(Apr. 7)—"Tools and Rules of Adhesion Science"—Doug Rahrig, S.C. Johnson and Son, Inc.

(May 9)—Awards Night Banquet.

Cleveland

(Mar. 18)—"Computer Control for the Modern Paint Plant"—James De Groff, Applied Color Systems, Inc.

(Apr. 15)—Awards Night, Annual Meeting. "Organic and Inorganic Coatings Used in the Microelectronics Industry"—C.C. Liu, Case Western Reserve University.

(May 20)—"Aftermarket Automotive Coatings: History and Technology"—Milton I. Hardt, Sherwin-Williams Co.

Dallas

(Mar. 13)—"Grinding Media Selection"—Roy Nelson, EMCO.

Detroit

(Apr. 8)—"Annual Focus Seminar: Troubleshooting II."

(May 14)—Joint Meeting with DPCA.

Kansas City

(Apr. 10)—"Distillation Technologies: Past, Present, and Future"—Earl E. Pifer, Finish Engineering Co.

(May 8)—"Polyurethane Coatings—Enjoying Their Advantages While Understanding and Controlling Health Risks"—Paul Ziegler, Mobay Chemical Corp.

(June)—Joint Meeting with St. Louis Society.

Louisville

(Mar. 19)—"Solvents Point the Way to High Quality Complying Acrylic Coatings"—Robert E. Moran, Exxon Corp.

(Apr. 16)—"Legal Liability"—Ronald R. Van Stockum, Jr.

New England

(Mar. 20)—Federation Night.

(Apr. 8 or 22)—Annual Western Mass. Meeting.

(May 15-16)—Symposium—"Launching the New Revolution—Compliance for the 21st Century."

New York

(Mar. 11)—"Five Keys to Loss Prevention in the Paint and Coatings Operation"—Jeffrey Flemington, Hercules Inc.

(Apr. 8)—"Future New Coatings"—William E. Wellman, Exxon Chemical.

(May 9)—"Composite vs Single Disterants"—Michael C. Frantz, Daniel Products Co.

Pacific Northwest

(Mar. 19)—"Protective Polyurethane Coatings"—Terry Potter, Mobay Chemical Corp.

(Apr. 16)—"Closing the Gap with High Solids"—Robert M. Price, Spencer Kellogg/NL Industries, Inc.

(May 21)—"Titanium Dioxide—Why So Many Grades?"—Richard I. Ensminger, NL Industries, Inc.

Philadelphia

(Mar. 13)—Educational Night.

(Apr. 11)—Awards Night.

(May 8)—"Advantages of Predispersed Polyethylene Waxes"—Mike Frantz, of Daniel Products, Inc.

Piedmont

(Mar. 19)—"Solvents Point the Way to High Quality Complying Acrylic Coatings"—Jay Reynolds, Exxon Corp.

(Apr. 16)—"Surface Modifiers in Coatings"—Speaker from Cavedon Chemical Co.

(May 21)—"Advances in Waterborne Epoxy Technology for Coatings"—Clifford Dukes, Celanese Specialty Resins.

Rocky Mountain

(Mar. 10)—"Protective Polyurethane Coatings"—Terry Potter, Mobay Chemical Corp.

(Apr. 7)—"Closing the Gap with High Solids"—Robert M. Price, Spencer Kellogg/NL Chemicals.

(May 12)—"Titanium Dioxide–Why So Many Grades?"—Richard I. Ensminger, NL Industries, Inc.

Southern
Central Florida Section

(Mar. 20)—"Non-Mercurial Mildewcides and Can Preservatives."

(May 22)—"The Competitive Trade Sales Market Place"—Dick Fuchs, The Enterprise Cos.

St. Louis

(Mar. 18)—Technical Speaker from Applied Color Systems.

(Apr. 15)—Education Night.

(May 20)—Manufacturing Seminar.

Western New York

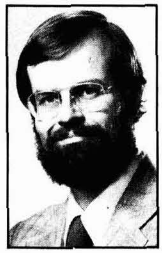
(Mar.)—Joint Meeting Hosted by BPCA.

(Apr. 15)—Manufacturing Night. "Advantages and Disadvantages of Dispersion Equipment"—Earl Baumhart, Coatings Engineering & Systems.

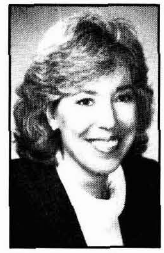
(May 20)—Federation Night. "Recent Advances in Radiation Coatings Technology"—Richard Kemmerer, Celanese Chemical Co.

People

L.M. Friedman



R.E. Smith



M.R. Capozzi

R. Brady

The chemical coatings division of Sherwin-Williams Company has named **Lori M. Friedman** to the position of Business Development Specialist for the marketing group of the division. A member of the Chicago Society, she previously served as the firm's Director of Information Services.

In addition, the coatings division of Sherwin-Williams has promoted **Linda Fay** to Market/Product Manager for electrodeposition coatings. Ms. Fay began her career with the company in 1969 as group supervisor of the electrodeposition laboratory.

PPG Industries, Inc., Allison Park, PA, has announced the promotion of **Ronald E. Smith** to Senior Research Chemist. Dr. Smith is a member of the Pittsburgh Society.

Fayez Hanna, of Thibaut & Walker, has been promoted to Quality Control Manager. Mr. Hanna has been with the Newark, NJ-based firm since 1979.

Thibaut & Walker has appointed **Rick Busch** to Technical Director Alkyd Resins. Mr. Busch succeeds **Tony Petrillo** who has retired after 20 years with the firm.

In addition, **Ram Hulyalkar** has been named Technical Director of Latex at Thibaut & Walker. Previously, he served with Spencer Kellogg and Dart & Kraft in research and development posts.

Coatings Research Group, Inc., Cleveland, OH, has elected **William Warlick**, President of Warlick Paint Co., to the office of President. Mr. Warlick succeeds **George Gable**, President of Perfection Paint & Color Co. Other officers elected by CRGI include: Vice-President—**Sam Guerrera**, of Valspar Corporation; and Secretary-Treasurer—**Joseph S. Junkin**, of California Products Corp.

Lloyd R. Garrison has been appointed Senior Chemical Salesman for the Organic Chemicals division of W.R. Grace & Co., Lexington, MA. A member of the Los Angeles Society, Mr. Garrison will represent the firm in the western region of the U.S. and Canada.

The Board of Directors of Cleveland-based Ferro Corp. has elected **Werner F. Bush** to the position of Vice-President International. Mr. Bush most recently held the post of Vice-President International and Area Manager for Latin America, Canada, Australia, and South Africa.

Joining the Coatings Division of Ferro is **Thomas E. Deller**. Mr. Deller will serve as Operations Manager for fiberglass reinforced plastics coatings overseeing the firm's five domestic coatings manufacturing operations.

In addition, Ferro has named **Marie R. Capozzi** to Technical Sales Representative for the firm's color division. She will promote inorganic pigments in the northeastern portion of the U.S.

Akzo Coatings America, Inc., Troy, MI, has promoted **Rosemary Brady** to Group Leader Zinc Products and Analytical Laboratories. Ms. Brady joined the firm in 1979 and formerly served as supervisor in the same department. As a member of the Detroit Society, Ms. Brady chairs the Membership Committee.

David Busker has retired from Kenrich Petrochemicals, Bayonne, NJ. Most recently he served as the company's National Sales Manager of coatings and plastics. A member of the New York Society, he will continue as a sales consultant to Kenrich on special marketing matters.

"Mitch" Dudnikov Receives Herman Shuger Award; Others Also Honored at Baltimore Joint Meeting

Mitchell Dudnikov, of Genstar Stone Products Co., received the Baltimore Coatings Industry's annual Herman Shuger Memorial Award on November 21, 1985, at a joint dinner of the local Society and Association. Mr. Dudnikov has served the Baltimore Society in every capacity for many years, including the Presidency in 1982. A graduate of Rutgers University, he began his coatings industry career with Roxalin Finishes. Since 1971, he has been associated with Genstar where he is presently Technical Manager of the Calcium Carbonate Lab. He was the 30th member to receive the coveted award.

Merit Awards were also presented at the dinner. The recipients were: **Richard Chodnicki**, of Kerr-McGee Chemical Corp.; **Joe Giusto**, of Lenmar, Inc.; **Robert Hopkins**, of SCM Pigments; **Helen Keegan**, of Valspar Corp.; **Robert Massarelli**, of Bruning Paint Co.; **William Stenger**, of the DuPont Co.; and **Vickie Vojik**, Executive Secretary of the Baltimore Paint and Coatings Association.

Twenty-five year Society pins were awarded to: Mr. Chodnicki; **Don Marsh**, of Spencer Kellogg Prods.; and **William Tate**, of Tate Chemical Sales Co.

Coatings Industry Scholarships ($1,000 each) were presented to **Lisa Rohleder** and **Pam Kester**.

Southern Clay Products, Inc., an E.C.C. America company, headquartered in Gonzales, TX, has promoted **Charles "Chuck" Diefenderfer** to Technical Sales Specialist. Previously, he served as the firm's midwestern Sales Representative. Assuming the midwestern sales post is **Mark W. Gillespie**, a member of the CDIC Society. Formerly with Dearborn Chemicals and NL Industries, Mr. Gillespie will promote organoclays to the paint and coatings, inks, and grease markets.

M.J. Barrett has advanced to Product Manager for automotive powder coatings at Glidden Coatings & Resins, Division of SCM Corp., Cleveland, OH. Mr. Barrett joined Glidden in 1980 as a powder coatings specialist.

The industrial coatings group at Glidden has appointed **James G. Bowman** to Customer Service Manager for powder coatings. In addition, **Herb E. Straub** has been named Technical Service Manager for powder coatings.

John M. Montgomery, President of Verlan Limited, the captive insurance company of the paint and coatings industry, retired at the end of 1985. He continues with Verlan in an advisory capacity.

Lawrence G. Noble, Vice-President, was elected to the office of President, effective January 1, 1986.

Mr. Montgomery, C.E.O. of Verlan for the last three years, was elected to that position after retiring as Vice-President and General Counsel of the National Paint and Coatings Association where he helped organize Verlan Limited 16 years ago.

Prior to joining the staff of NPCA in 1966 as Director of Government and Industry Relations, Mr. Montgomery served 26 years in the Navy. During his military career, in addition to obtaining a Law Degree from the George Washington University Law School in 1949, he commanded two ships and held positions of responsibility in the Office of Navy Comptroller, Office of the Chief of Naval Operations, and Executive Office of the Secretary of the Navy.

Mr. Noble received his BS degree in Finance and Law from Drexel Institute of Technology in 1967. He joined Verlan Limited in 1972 as Director of Client Services responsible for the administration of the marketing and underwriting functions of the company.

CLASSIFIED ADVERTISING

R & D FINISHER/APPLICATION DEVELOPMENT

We are a large manufacturer of specification leathers for the automotive and furniture upholstery industries; and a division of a fortune 500 company.

The responsibilities of this job include formulating new specification leather finishes and developing improved application techniques in order to maintain Garden State Tanning as a leader in its field.

This position does not include styling, color matching or production responsibilities.

We prefer that the applicant have at least a bachelors degree and ten years' experience in coating formulation and application.

Salary commensurate with experience and ability.

All inquiries will be kept confidential.

Reply to:

Bruce D. Miller
Director of Manufacturing
Garden State Tanning
Fleetwood, Pennsylvania 19522

Eastern Michigan Univ. Initiates Coatings Continuing Professional Development Program

An extensive schedule of coatings short courses and seminars is being held in various sites in the U.S. in 1986 by the Continuing Professional Development Program of Eastern Michigan University, Ypsilanti, MI.

The program is part of the university's effort to become a comprehensive source for educational services to the coatings industry. The schedule contains fifteen separate programs featuring as speakers selected industry experts who will supplement the university's full-time staff.

The 1986 schedule includes the following courses and seminars:

"Introduction to Coatings Technology (for new technical personnel)"—Ann Arbor, MI, July 22-25.

"Formulation of Industrial Coatings"—Ann Arbor, Oct. 1-3.

"Formulation of Architectural Coatings"—Ann Arbor, Apr. 28-30.

"Introduction to Automotive Finishes"—Ann Arbor, Sept. 3-5.

"Assuring Quality in Industrial & Architectural Finishes"—Ann Arbor, Apr. 1-4.

"Statistical Process Control for Improved Coatings Production"—Oakland, CA, May 12-15; Houston, TX, May 19-22; Chicago, IL, June 24-27; Ann Arbor, July 8-11.

"Just-in-Time Manufacturing Management Techniques for Coatings Suppliers"—Ann Arbor, June 19-20; Chicago, June 23-24.

"Production Painting: The Processes & the Problems"—Oakland, May 14-15; Ann Arbor, June 16-17.

"Industrial Spray Painting"—Ann Arbor, Apr. 8.

"Spray Paint Defects"—Ann Arbor, Apr. 9; Oakland, May 16; Ann Arbor, June 18.

"Surface Preparation for Painting & Bonding"—Ann Arbor, Apr. 7.

"Bringing Creativity Out of the Closet: Techniques for Technical Managers"—Oakland, May 12-14.

"Introduction to Paint Job Estimating"—Atlanta, GA, Feb. 24-25.

"Update on Coatings for Painting Contractors"—Atlanta, Feb. 26-28.

(1987) "Second Bi-Annual Symposium on New Chemistry for Coatings"—Ann Arbor, October 19-21, 1987.

Additional short courses are under consideration for the last quarter of 1986 in the areas of urethanes, water-borne, high solids, computer technology for coatings, and laboratory management techniques for smaller companies.

For more information on any of these courses, contact Alan Green, Project Director for the Technology Services Center, Eastern Michigan Univ., 150 Sill Hall, Ypsilanti, MI 48197, or call 313-487-2259.

Video Tape on "Laboratory Test Procedures" Added to Federation Training Series

Addition of a video tape program on "Laboratory Test Procedures" to its training series has been announced by the Federation of Societies for Coatings Technology.

The program, which runs approximately 60 minutes, describes and demonstrates the correct procedures for conducting 15 quality control tests on liquid resin solutions or coatings. A list of instruments and equipment necessary for conducting each test is included, along with instructions for operating the test equipment and determining correct results.

The following test methods are covered: Brookfield Viscometer; Viscosity—Gardner/Holdt Bubble Method; Determination of Reduced Viscosity; Cure Point (Stroke Cure); Acid Value or Acid Number; Color: Transparent—Gardner Method; Determination of Viscosity—Ford Cup Method; Weight-Per-Gallon—Gardner Cup Method; Determination of Dry-Finger Method; Flash Point—Setaflash Method; pH Determination; "Quick" Non-Volatile by Weight Test; Grit, Solvent Resins; Zapon Tack Tester; and Krebs Stormer Viscometer.

A training manual (which includes supplementary information on each of the tests) accompanies the tape.

Price for the video tape program (VHS format) is $50 prepaid; postage and handling charges added for orders requiring billing.

Orders and inquiries should be directed to Federation of Societies for Coatings Technology, 1315 Walnut St., Suite 832, Philadelphia, PA 19107.

CALL FOR PAPERS

High Performance Coatings And Linings for Hostile Environments Symposium

March 9-13, 1987
San Francisco, CA

As part of the annual conference of the National Association of Corrosion Engineers a symposium will be held which will be limited to organic-based coatings and linings where hostile environments are defined as inorganic acids, bases, and/or organic solvents at high temperatures, pressures, or both for extended immersion, gas or fumes service and exposure time length must be a minimum of one year.

Abstracts are being solicited and should consist of 300 to 500 words on proposed papers. Interested persons should forward abstracts to Marcel Gaschke, CIBA-GEIGY Corp., Three Skyline Dr., Hawthorne, NY 10532, by April 15, 1986.

ISCC to Hold 1986 Annual Meeting In Toronto, June 15-18

The 1986 annual meeting of the Inter-Society Color Council will be held at the Ryerson Polytechnic Institute, Toronto, Ont., Canada, from June 15-18.

Held as a joint meeting with the Canadian Society for Color, the event will include a full-day symposium on "Color Reproduction: State of the Art." The symposium will present the latest scientific techniques used in the color reproduction of an original, which may be an existing object, or a creative idea conceived from the artist's mind.

Presentations discussing this topic will include:

"Color in Ceramics"—Robin Hopper.

"Color in High Definition Television"—Representative from the Canadian Broadcasting Corp.

"Color Reproduction in the Automotive Industry"—Helen Delp, of DuPont.

"Color Xerography and Non-Impact Printing Technology"—Robert Buckley, of Xerox.

"New Developments in Color Reproduction of Negative/Positive Photographic Systems"—Paula J. Alessi, of Eastman Kodak.

"Transfer of Color from Video Display to a Hardcopy Medium"—Richard Ingalls, of Target Color Technology.

In addition to the project subcommittee meetings, three workshops will be conducted. They are:

"Update on OSA Uniform Color Scales," chaired by Nick Hale, of Hale Color Consultants.

"Using CIELAB for Development of a Universal Color Card"—Ralph Stanziola, Color Consultant.

"Generation of Electronic Images"—Joy Turner Luke, of Studio 231.

For more information, please contact Dr. Peter Kaiser, Dept. of Psychology, York University, 4700 Keele St., N. York, Ontario M3J 1P3; or, Paula J. Alessi, Eastman Kodak Co., 1669 Lake Ave., Rochester, NY 14650.

Additives Symposium to be Held In Montreal and Toronto

The Protective Coatings Division of the Chemical Institute of Canada will hold a Professional Development Symposium on Additives in Montreal and Toronto on April 23 and 24, respectively.

The current list of topics includes:

"Waxes as Additives to Improve the Properties of Surface Coatings"—O. Iverson, Hoechst, Canada.

"Preventol Microbiocides for Coatings"—Dr. Schmitt, Bayer AG Leverkusen, West Germany.

"Wetting and Dispersing Agents"—R. Vash, Byk-Chemie, U.S.A.

"Anti-Microbials used in Coatings and Plastics"—Dr. W.B. Woods, Nuodex, Inc., U.S.A.

"Organotins—Extraordinary PVC Stabilizers"—R. Dworkin, Akzo-Chemie, U.S.A.

"U.V. Absorbers"—speaker from CIBA-Geigy.

Meeting sites will be: Le Biftheque in Montreal, and The Old Mill in Toronto. Advance registration fee for CIC members is $50; non-members, $55. Registration at the symposium is $60 for all participants.

For further information, contact (in Montreal) Bert Papenburg, Canada Colours and Chemicals Ltd., 9999 Trans-Canada Hwy., Ville St. Laurent, Que. H4S 1V1, Phone 514-333-7820; or (in Toronto) Collin Bryant, Ashland Chemicals, 2620 Royal Windsor Dr., Mississauga, Ont. L5J 4E7, Phone 416-823-1800.

Lehigh to Hold Latex Technology Short Course

The 17th annual one-week short course, "Advances in Emulsion Polymerization and Latex Technology," will be held at Lehigh University during the week of June 2-6, 1986. Designed for engineers, chemists, other scientists, and managers involved in emulsion work, as well as those who wish to develop expertise in the area, the course provides an in-depth study of the synthesis and properties of high polymer latexes. Lectures, given by leading academic and industrial workers, begin with introductory material and reviews, and progress through recent research results.

The fee is $600 for the entire week or $175 per day per any part. Further information can be obtained from Dr. Mohamed S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015.

CALL FOR PAPERS

TWELFTH INTERNATIONAL CONFERENCE
ORGANIC COATINGS SCIENCE AND TECHNOLOGY

July 7-11, 1986
Athens, Greece

A conference bringing together scientists, engineers, and educators in an international forum to discuss recent research and development work covering all aspects of organic coatings will be conducted. Approximately 15 leading researchers from various countries will be invited to present lectures on topics of interest selected by the Scientific Committee.

Those interested in presenting contributed papers should submit abstracts (limited to one page) on subjects related to the science and technology of organic coatings, no later than March 1, 1986, to Professor Angelos V. Patsis, Director, Materials Research Laboratory, CBS, State University of New York, New Paltz, NY 12561. The Scientific Committee will review the papers and assign 15-30 minutes for the presentation, depending on the time available and the number of papers submitted.

CALL FOR PAPERS

AESFS SUR/FIN '87

July 13-16, 1987
McCormick Place
Chicago, IL

The American Electroplaters and Surface Finishers Society (AESFS) is sponsoring an international conference and exhibition of Electrocoating and Surface Finishing, along with participation from the International Union for Surface Finishing (IUSF), the National Association of Metal Finishers (NAMF), and the Metal Finishing Suppliers Association (MFSA). The program will consist of presentations by authors from the worldwide surface finishing community.

Those interested in presenting contributed papers should forward a title, 75-word abstract, and draft paper for review no later than March 14, 1986, to Mr. Fred Clay, Bendix Corp., Dept. 816 5A-1, Box 1159, Kansas City, MO 64141. Abstracts must be accompanied by a statement specifying that the paper has not been presented and is not pending publication elsewhere. All surface finishing topics of interest are welcome.

ELECTROCOAT/86 Scheduled for March 11-13

Products Finishing Magazine is sponsoring a conference, ELECTROCOAT/86, on March 11-13, 1986, at the Drawbridge Inn, Cincinnati, OH. More than 20 experts in the electrocoating field will address the latest developments and current state-of-the-art technology for this method of applying paint finish on metal.

Beginning on Tuesday, March 11, Dr. Edward Jozwiak, of PPG Industries, Inc., will conduct "Electrocoating Basics," a session designed to provide background information to help those with little or no experience in electrocoatings. Four other general conference sessions will also be held. They include: Session I—Equipment and Systems; Session II—Materials and Methods; Session III—Improved Process Control; and Session IV—Application Experience.

For complete registration and program information, contact Anne Yaindl, *Products Finishing* Magazine, 6600 Clough Pike, Cincinnati, OH 45244-4090.

Philadelphia Society To Hold Seminar May 12

"The Impact of Environmental Regulations and 'The Right to Know' on the Coatings' Industry," is the theme of the Philadelphia Society's seminar to be held on May 12, 1986, at the Airport Hilton, in Philadelphia, PA.

Speakers from both government and industry will cover topics including MSDS, labelling and right to know, punitive measures for non-compliance, and employee education. For further information, contact Program Chairman, Chris Johnson, Pennwalt Corp., Philadelphia, PA 19102.

Milton Roy To Hold Color Technology Seminars

The DIANO® color products group of Milton Roy Co., headquartered in Rochester, NY, is offering a series of two-day educational seminars on "Color Technology and its Application to Industrial Problems," in several U.S. and Canadian cities in 1986.

Color industry experts Wes Coppock and Robert Weaver will conduct the seminars designed for technical personnel involved with instrumental color control. Further information is available from the Milton Roy Co., 30 Commerce Way, Woburn, MA 01801.

Binks Offers Spray Painting Seminars

Binks Manufacturing Co., Franklin Park, IL, has scheduled eight five-day spray paintings seminars in 1986. They will be conducted at the firm's facilities located in: Franklin Park, IL; Pine Brook, NJ; Livonia, MI; and Norcross, GA.

For complete details, including costs, accommodations, and application forms, contact the Training Div., Binks Manufacturing Co., 9201 W. Belmont Ave., Franklin Park, IL 60131.

Literature

Housing Unit

Information which describes a new single filter housing unit has been introduced in literature. These stainless steel housings are built to accept one inch single open end metallic cartridges and are intended for general industrial filtration in both normal and backwash applications. For details, contact Filterite, 2033 Greenspring Dr., Timonium, MD 21093.

Power Coatings Chart

A new 29-color powder coatings color chart is now available. Included are 17 polyester/polyurethane and 12 epoxy powder coatings standard colors, as well as product cure schedules, gloss and pencil hardness data, and a powder coatings coverage chart. Copies are available from Edward J. Bickrest, Manager, Marketing Services, Coatings Div., Ferro Corp., 4150 E. 56th St., Cleveland, OH 44105.

Anticorrosive Pigments

The newest product in a line of nontoxic, high-performance anticorrosive pigments has been introduced in literature. Designed for solvent systems where performance and economy are of primary concern, this pigment promotes adhesion to steel substrates to minimize underfilm corrosion. For additional information, write NL Chemicals/NL Industries, Inc., P.O. Box 700, Hightstown, NJ 08520.

On-Line Information

Details of a Business Information On-Line seminar have been published. Reported to demonstrate what to search, how to search, and with what to search, the one-day seminar is designed for marketing and management personnel. Contact Mr. Dip Dasgupta, Paint Research Association, Waldegrave Road, Teddington, Middlesex, TW11 8LD, England, for copies.

Packaging Program

To assist packaging manufacturers with the wide array of new substrates, information regarding a new packaging program has been released. Leaflets are available from Croda Inks Corporation, 7777 N. Merrimac Ave., Niles, IL 60648-3940.

Paint and Coatings Brochure

A four-color brochure highlights the capabilities of a firm's diversified products group. To order copies, write: E.P. Richards, Products Specialist, Lubrizol Corp., 29400 Lakeland Blvd., Wickliffe, OH 44092.

Fatty Amides

A wide range of applications cited for fatty amides are included in a new 24-page booklet. Amides offered in a variety of forms to impart lubricity, chemical and thermal stability, and different melting ranges in formulated products are covered in the publication. To obtain copies, contact Humko Chemical Div., Witco Corp., P.O. Box 125, Memphis, TN 38101-0125.

Coatings Gauge

The performance features of a new magnetic coatings thickness gauge are outlined in a product bulletin. The new gauge measures all non-magnetic coatings over ferrous substrates. Complete specifications are available from KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275.

Formulator's Guide

Comprehensive literature lists typical properties of 40 different kinds of key raw materials. Included in the brochure are acrylic latex vehicles, opaque polymers, rheology modifiers and thickeners, dispersants, wetting agents, fungicides, and preservatives. Request copies from Rohm and Haas Co., Independence Mall West, Philadelphia, PA 19105.

Drier

The cost effectiveness and performance specifications of a new drier offering full range combinations of air drying and microwave drying have been released in a pamphlet. For more information, contact Microdry Corp., 3111 Fostoria Way, San Ramon, CA 94583.

Shipping Container

The features of a new aluminum model portable shipping container are outlined in a brochure. Write: Clawson Tank Co., 4701 White Lake Rd., Clarkston, MI 48016, for full details on the lightweight, corrosion resistant container.

Titrator

Details of a new titrator for industrial, research, and university application are now available. To learn more about the volumetric titrator and its full range of safety features, contact Jerry F. Gerdes, Freeman Gerdes & Co., Inc., 41 Washington Ave., Pleasantville, NY 19570.

Colorant Dispenser

Application and performance data of a new colorant dispenser designed for retail paint dealers are discussed in literature. For full information, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08540.

Spray System

Features and benefits of an electrostatic spray system are discussed in a product bulletin. The full-color bulletin also lists economic advantages. Copies can be obtained from Nordson Corp., Finishing Equipment Div., 555 Jackson St., P.O. Box 151, Amherst, OH 44001.

Radiometer

A new high energy UV integrating radiometer used in measuring and determining the proper UV level for curing inks, coatings, and adhesives is featured in literature. For further information, contact Electronic Instrumentation & Technology, Inc., 108 Carpenter Dr., Sterling, VA 22170.

Floor Safety System

The cost efficient benefits of a floor safety system along with non-slip safety treatments are explained in a leaflet. For complete details, write: Wagoner's Floor Safety Systems, P.O. Box 2784, Reno, NV 89505.

Color Dispersions

A new brochure describes 20 color dispersions, each available in four different, 100% solids, polymeric vehicles. The colorants are detailed according to colorant grinding compatability with 15 solvents and 15 resins, as well as colorant characteristics. The brochure is available from PDI, A Business Unit of ICI Americas, 54 Kellogg Ct., P.O. Box 412, Edison, NJ 08818.

Microwave Processing

The advantages of microwave heat processing are discussed in a two-color brochure. The publication explains how microwaves heat and outlines how industrial microwave systems differ from home microwave ovens. For copies, contact Microdry, 3111 Fostoria Way, San Ramon, CA 94583.

Compliance Software

Literature covering the application of a new software package geared for the chemical industry has been released. Time saving benefits of the system and a list of compatible hardware are included in the brochure. Write: Mitimite Software Div., Clough Management Services, P.O. Box 625, Rouse's Point, NY 12979-0625, for additional details.

Paper Coatings Survey

An eight-page pamphlet details a survey covering pigments, binders, and additives used for paper coatings. The comprehensive technical guide gives data and commercial information on 718 different commercial products offered to companies which manufacture paper. For copies, contact William H. Hoge, H&H Consulting Group, Box 10, R.D. 2, Flemington, NJ 08822.

Spectrocolorimeter

Technical data sheets highlight the performance capabilities of a new spectrocolorimeter. Featuring improved instrument reliability, the new model measures color and appearance properties in a wide range of industrial applications. Further information can be obtained from HunterLab., 11495 Sunset Hills Rd., Reston, VA 22090.

Media Mill

A two-page data sheet outlines a convertible lab bench size small media mill. The mill is reported to produce ultrafine particles from feedstock up to 120 microns in any type of solvent or aqueous system. The data sheets can be obtained from Netzsch, Inc., Grinding Dept., 119 Pickering Way, Exton, PA 19341-1393.

Filling Machines

Two new filling machines have been introduced in literature. Designed to fill two part epoxies, the models are intended to partially fill containers to leave room for the second part of the epoxy. Performance data is offered by Beltron Corp., P.O. Box 893, Red Bank, NJ 07701.

Sensor Support

A new product catalog for on-line sensor support computers used in the measurement of density, level, weight, moisture, and mass flow is now available. For copies, contact The Ohmart Corp., 4241 Allendorf Dr., Cincinnati, OH 45209.

Hazards Software

Software designed to maintain and track chemical information is the subject of a recently published brochure. The self-contained system can be used to generate reports to comply with government standards. For complete details, contact Mark Furst, Battelle Memorial Institute, Software Products Center, 505 King Ave., Columbus, OH 43201-2693.

Graphics

A computer package designed for a precision particle analyzer is discussed in literature. The system allows data acquisition and handling, plotting and storage, and is capable of presenting tabular or plotted data in one of eight different formats. Technical details are offered from Marco Scientific, 1055 Sunnyvale-Saratoga Rd., #8, Sunnyvale, CA 94087.

Esters

A wide variety of esters used as active solvents in coatings formulations are described in a recently published 12-page booklet. The booklet, offering selection tips and formulating guidelines, designated F-48589, can be requested from Union Carbide Corp., Solvents and Coatings Materials Div., Dept. K3442, 39 Old Ridgebury Rd., Danbury, CT 06817-0001.

Acrylic Copolymer

A high-solids acrylic copolymer designed for very fast air dry finishes is covered in a product bulletin. Supplied at 75% nonvolatile in xylene the copolymer features fast hardness development and fast recovery after immersion in gasoline. Further information can be obtained from Reichhold Chemicals, Inc., 525 N. Broadway, White Plains, NY 10603.

Mineral Reinforcements

A new booklet provides information on chemically modified minerals. The booklet provides information on upgrading composite performance as well as cost-containing tips. Copies of the free brochure, "Chemically Modified Minerals," write to NYCO, Mountain View Dr., Willsboro, NY 12996.

Thixotropic Alkyd

Data sheets are available on a new type of thixotropic alkyd compatible with most medium and long oil alkyds. Based on new technology, the thixotropy given to paint by this type of alkyd is very sensitive to the polarity of the solvent used, to pigmentation, and to the nature of other resins present. For complete details, write: Cray Valley Products, Inc., 140 E. Union Ave., E. Rutherford, NJ 07073.

Defoamers

A new generation of defoamers and antifoaming agents for the coatings industry have been introduced in literature. The oil-free liquid defoamers show excellent compatability and performance in aqueous coatings and lower the risk of side effects such as craters and lower gloss levels. Samples and brochures are available from Servo BV Deldon, P.O. Box 1, 7490 AA Delden, the Netherlands.

Recovery System

The major components of a dryer/solvent recovery system are discussed in a product bulletin. An explanation of how the components can reduce environmental contamination due to solvent discharge in the atmosphere is also included. For additional information, contact Netzsch, Inc., Grinding Dept., 119 Pickering Way, Exton, PA 19341-1393.

New Products

Recently published is a 32-page catalog reviewing the latest products developed for use in the manufacture of coatings. For copies of the publication, contact Rohm and Haas Co., Independence Mall West, Philadelphia, PA 19105.

Latexes

Two carboxylated styrene butadiene latexes designed as bases for non-skid coatings are featured in literature. One offers low tack, good water resistance, and good heat aging properties, and the other offers a high degree of tack and good machinability. For further information, contact Reichhold Chemicals, Inc., Emulsion Polymers Div., P.O. Box Drawer K, Dover, DE 19903.

Wollastonite

A data sheet describes the research being conducted on a chemically modified wollastonite as a functional pigment extender in urethane barrier coatings and in mid- and finish-coat vinyls. To receive copies of the findings, contact NYCO, Mountain View Dr., Willsboro, NY 12996.

Thickening Agent

Performance characteristics of a high molecular weight organic additive which combines with clay to form a thickening agent for oil-based paints is the subject of a brochure. Copies are offered from Hodag Chemical Corp., 7247 N. Central Park Ave., Skokie, IL 60076.

Product Catalog

The technology, product line, and capabilities of a firm are the subject of a full-color, six-page catalog. For copies, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08540.

Planetary Mixers

A brochure outlines the performance characteristics of a line of planetary kneader mixers designed for stirring, mixing, and kneading medium to high viscosity liquids and pastes. Copies of the brochure can be requested from Draiswerke, Inc., 3 Pearl Ct., Allendale, NJ 07401.

Attritor

The advantages of using a new heavy-duty laboratory attritor are outlined in a product bulletin. Design features including the explosion-proof electric motor, variable speed drive, and large capacity tank are discussed in the bulletin. For copies, contact Union Process, Inc., 1925 Akron-Peninsula Rd., Akron, OH 44313.

Book Review

REACTIVE OLIGOMERS

Edited by
Frank W. Harris
and Harry J. Spinelli

Published by
American Chemical Society
Washington, D.C.

Reviewed by
Joseph A. Vasta
E.I. du Pont de Nemours & Co., Inc.
Wilmington, DE

The book, "Reactive Oligomer," is another excellent offering of the ACS Symposium Series (No. 282). It contains a varied assortment of high quality papers by industrial, government, and academic scientists working actively with reactive oligomers; sometimes referred to as telechelic oligomers.

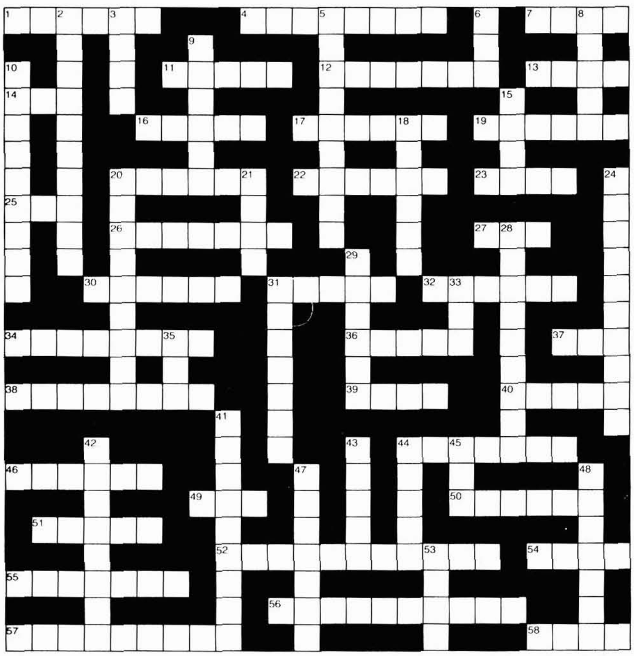
Quoting the book advertising jacket: "Researchers involved in the preparation of composite resins, electronic coatings, high solids coatings resins, block copolymers, and various thermoset resins such as epoxies and urethanes will find the material in this volume helpful and informative." The reviewer agrees wholeheartedly with this statement.

Each of the papers are well illustrated and contain ample reference literature. The book can be used as a primary resource for finding pertinent literature in this specific area of science technology.

The editors, Drs. Frank W. Harris and Harry J. Spinelli, have done a splendid editing job. This reviewer recommends this book and suggests it as a worthwhile addition to interested scientists' bookshelves.

CroSSLinkS

by Earl Hill



Solution to be published in March issue.

No. 10

ACROSS

1. Pour off
4. Narrow stripe; king's cord
7. ____ stone; porous flint
11. Cold flow; deformation
12. Red
13. To touch lightly
14. Mineral ____
16. Relative of 9 down
17. Vegetable oil, Jatropha ____
19. Domed brush, e.g.
20. Lanolin precursor
22. Wood joint covering
23. Measurement unit (MVT)
25. Owed to Uncle Sam
26. Intaglio printing process
27. Oil nearly synonomous with Baker
30. ____ per gallon
31. Processing step (natural resins)
32. Iron oxide rouge
34. Preserves wood
36. C.C.H. ____ ity C.
37. German ASTM counterpart
38. Spreading rate
39. Used to make 53 down
40. A happening
44. Small colloidal particle, e.g.
46. Ozone cracking (Elect.)
49. Overflow material
50. To congeal
51. Heat unit
52. Tristimulus ____
54. U.S. equivalent of 37 across
55. Type of surface preparation
56. Skin affliction
57. ____ -indene resins
58. Absolute force unit

DOWN

2. C_6H_{11} aliphatic radical (Chem.)
3. Coil coaters group
5. Art form, e.g.
6. A colorant
8. Structure
9. Three units (Chem.)
10. Gelatin printing process
15. Result of exterior exposure
18. Alcohol plus aldehyde (Chem.)
20. Lanolin source; natural grease
21. Be positive
24. To come apart
28. Organic dyestuff, insect based
29. Nut shell oil derivative
31. Lb/gal
33. Popular car color
35. Another type of 45 down
41. A drying process
42. Natural abrasive
43. Famous solvent value or number
44. Optical wavelike pattern
45. Flashpoint, e.g.
47. Cinnabar (Syn.)
48. Starch adhesive
53. Woodwork; molding, e.g.

OIL & COLOUR CHEMISTS' ASSOCIATION

SURFEX 86

Exhibition of the latest developments in raw materials and equipment used in the manufacture of paints, printing inks, colour, adhesives and allied products to be held at

Harrogate Exhibition Centre,
Yorkshire, England.

Wednesday 14 May 1986	09.30–17.30 hrs
Thursday 15 May 1986	09.30–17.30 hrs

Admission Free

The "Official Guide" will be printed in the April 1986 issue of the Association's Journal (JOCCA) and will be freely available at the entrance to the Exhibition.

Oil & Colour Chemists' Association,
Priory House, 967 Harrow Road,
Wembley, Middlesex, HAO 2SF, England.
Tel: 01-908-1086 Telex: 922670 OCCA G

Coming Events

FEDERATION MEETINGS

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

1986

(May 13-16)—Federation "Spring Week." Seminar on "Special Purpose Coatings" on 13th and 14th; Society Officers on 15th; and Board of Directors on 16th. Sheraton Station Square, Pittsburgh, PA.

(June 3-6)—Symposium on Automotive Color Control (SACC). Sponsored jointly by FSCT, Detroit Society, Detroit Colour Council, and Manufacturers Council on Color and Appearance. Michigan Inn, Southfield, MI.

(Nov. 5-7)—64th Annual Meeting and 51st Paint Industries' Show. World Congress Center, Atlanta, GA.

1987

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

SPECIAL SOCIETY MEETINGS

1986

(Mar. 4)—Northwestern Society. Symposium on "Color, Its Effects and Interactions." Marriott Hotel, Bloomington, MN (M.W. Uglem, Creative Paint Mfg. Co., 4450 Lyndale Ave. N, Minneapolis, MN 55412).

(Mar. 25-26)—Chicago Society. Manufacturing Committee Seminar. "Back to Basics and on to the Future." Nordic Hills Resort, Itasca, IL. (Audrey LeNoble, Carl Lechner, Inc., 700 Deerfield Rd., Deerfield, IL 60015).

(Apr. 2-4)—Southern Society. Annual Meeting. DeSoto Hilton Hotel, Savannah, GA. (Ronald R. Brown, Union Chemicals Div., P.O. Box 26845, Charlotte, NC 28213).

(Apr. 9-11)—Southwestern Paint Convention of Dallas and Houston Societies. Wyndham Hotel, near Houston Intercontinental Airport, Houston, TX. (Mike Winters, Ribelin Distributors, Inc., 7766 Blankenship, Houston, TX 77055).

(Apr. 29-May 1)—"Advances in Coatings Technology" Conference sponsored by the Cleveland Society for Coatings Technology. NASA, Lewis Research Center, Cleveland, OH. (Dr. Rosemary Loza, Standard Oil Co. (Ohio), 4440 Warrensville Center Rd., Cleveland, OH 44128).

(May 1-3)—Pacific Northwest Society. Annual Symposium. Marriott Hotel, Portland, OR. (Gerald A. McKnight, Rodda Paint Co., 6932 S.W. Macadam Ave., Portland, OR 97219).

(May 12)—Philadelphia Society. Seminar on "Impact of Environmental Regulations on the Coatings Industry." Airport Hilton Hotel, Philadelphia. (C.B. Johnson, Pennwalt Corp., Three Parkway, Philadelphia, PA 19102).

(May 15-16)—New England Society. Symposium: "Launching the New Revolution—Compliance for the 21st Century." (Maureen Lein, Davidson Rubber Co., Industrial Park Dr., Dover, NH 03820).

(May 22)—Birmingham Club. Symposium: "Miracle '86." Strathallan Hotel, Birmingham, England. (David Heath, Holden Surface Coatings Ltd., Bordesley Green Rd., Bordesley Green, Birmingham B9 4TQ, England).

1987

(Feb. 23-25)—Western Coatings Societies' Symposium and Show, Monterey Convention Center, Monterey, CA. (Barry Adler, Royell, Inc., 1150 Hamilton Ct., Menlo Park, CA 94025).

OTHER ORGANIZATIONS

1986

(Feb. 24-27)—Steel Structures Painting Council Annual Meeting and Symposium. Peachtree Plaza Hotel, Atlanta, GA. (Harold W. Hower, SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Mar. 4-6)—"Coatings Inspection of Chemical Plants." Seminar sponsored by KTA-Tator, Inc., Pittsburgh, PA. (Bill Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Mar. 4-7)—Painting and Decorating Contractors of America. 102nd National Convention. Honolulu, HI. (PDCA, 7223 Lee Hwy., Fall Church, VA 22046).

(Mar. 10-14)—"The Basic Composition of Coatings" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Chemistry Dept., University of Missouri-Rolla, Rolla, MO 65401).

(Mar. 11-13)—Electrocoat/86. Sponsored by *Products Finishing* Magazine. Drawbridge Inn, Ft. Mitchell, KY. (Ann Yaindl, Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(Mar. 11-13)—"Finishing Automotive Plastics" Seminar sponsored by the Association for Finishing Processes of SME. Plymouth Hilton Hotel, Plymouth, MI. (Diana M. Korona, AFP/SEM, One SME Drive, P.O. Box 930, Dearborn, MI 48121).

(Mar. 17-21)—Annual Meeting of Chemical Coaters Association. Georgia International Convention and Trade Center, Atlanta, GA. (CCA, P.O. Box 241, Wheaton, IL 60189).

(Mar. 17-21)—CORROSION/86. Materials Performance and Corrosion Show of the National Association of Corrosion Engineers. Albert Thomas Convention Center, Houston, TX. (Nace, P.O. Box 218340, Houston, TX 77218).

(Mar. 18-19)—"Spray Application for Furniture" Seminar sponsored by the Association for Finishing Processes of SME. Radisson Hotel, High Point, NC. (Diana M. Korona, AFP/SEM, One SME Drive, P.O. Box 930, Dearborn, MI 48121).

(Mar. 19-21)—Joint Annual Meeting of Zinc Institute Inc. and Lead Industries Association, Inc., Lincoln Hotel Post Oak, Houston, TX. (Annual Meeting, LIA/ZI, 292 Madison Ave., New York, NY 10017).

(Mar. 26-28)—"Bridges and Highway Structures Coating Inspection." Seminar sponsored by KTA-Tator, Inc., Pittsburgh, PA. (Bill Corbett, KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Apr. 7-11)—"Paint Formulation" Introductory Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(Apr. 9-16)—"Surface Treatment '86" sponsored by the World Center for Industrial Technology. Hannover Fairgrounds, Hannover, West Germany. (Hannover Fairs USA Inc., P.O. Box 7066, 103 Carnegie Center, Princeton, NJ 08540).

(Apr. 12-13)—Workshop on "Size-Exclusion Chromatography." Sponsored by ACS Div. of Polymeric Materials: Science and Engineering. New York, NY. (Theodore Provder, Glidden Coatings & Resins, Div. of SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 14-15)—"Advances in Size-Exclusion Chromatography" Symposium. Sponsored by ACS Div. of Polymeric Materials: Science and Technology. New York, NY. (Theodore Provder, Glidden Coatings & Resins, Div. of SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(Apr. 14-15)—ASTM Symposium on "Testing of Metallic and Inorganic Coatings," Chicago, IL. (Teri Carroll, ASTM Standards Development Div., 1916 Race St., Philadelphia, PA 19103).

(Apr. 15-18)—ASTM Committee B-8 on Metallic and Inorganic Coatings. McCormick Center Hotel, Chicago, IL. (Teri Carroll, ASTM, 1916 Race St., Philadelphia, PA 19103).

(Apr. 22-24)—PaintCon '86 sponsored by *Industrial Finishing* Magazine. O'Hare Expo Center, Chicago, IL. (Professional Exposition Management Co., 2400 E. Devon Ave., Des Plaines, IL 60018).

(Apr. 23-24)—"Professional Development Symposium—Additives," Sponsored by the Protective Coatings Div., Chemical Institute of Canada. (Apr. 23—Le Biftheque, Montreal, Que.; Apr. 24—The Old Mill, Toronto, Ont.). (Mr. G. Parsons, DeSoto Coatings, Ltd., 895 Rangeview Rd., Mississauga, Ont. L5E 3E7).

(Apr. 28-May 2)—"Applied Rheology for Industrial Chemists" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 5-9)—"Physical Testing of Paints and Coatings" Short

Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(May 12-16)—"Adhesion Principles and Practices for Coatings and Polymer Scientists" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(May 13-15)—11th Annual Powder & Bulk Solids Conference/Exhibition. O'Hare Exposition Center, Rosemont, IL. (Patricia Dickinson, Show Manager, c/o Cahners Exposition Group, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5060, Des Plaines, IL 60017).

(May 14-15)—Surfex '86. Oil and Colour Chemists' Association. Harrogate Exhibition Centre, Yorkshire, England. (Robert H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, England HAO 2SF).

(May 19-22)—"Basic Microcomputer Programs for Coatings" Short Course sponsored by the University of Missouri-Rolla, Rolla, MO. (Prof. James O. Stoffer, Dept. of Chemistry, University of Missouri-Rolla, Rolla, MO 65401).

(May 21-23)—"Advances in the Stabilization and Controlled Degradation of Polymers" Eighth International Conference. Luzern, Switzerland. (Dr. A.V. Patsis, Institute in Materials Science, State University of New York, New Paltz, NY 12561).

(June 2-6)—"Dispersion of Pigments and Resins in Fluid Media" Short Course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Kent State University, Chemistry Dept., Kent, OH 44242).

(June 2-6)—"Advances in Emulsion Polymerization and Latex Technology" Short Course sponsored by Lehigh University, Bethlehem, PA. (Dr. Mohamed S. El Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University Bethlehem, PA 18015).

(June 10-16)—CHINAPLAS 86. International Exhibition Centre, Beijing, China. (Kallman Associates, 5 Maple Court, Ridgewood, NJ 07450).

(June 15-18)—60th Colloid and Surface Symposium. Georgia Institute of Technology, Atlanta, GA. (Symposium Chairman, M.J. Matteson, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332).

(June 15-18)—1986 Annual Meeting of Inter-Society Color Council. Ryerson Polytechnical Institute, Toronto, Ont. (Dr. Peter Kaiser, Dept. of Psychology, York University, 4700 Keele St., N. York, Ont. M3J 1P3).

(June 17-19)—"Industrial Painting Processes" clinic sponsored by AFP/SME. Toronto, Ont., Canada. (Diane Korona, SME Special Programs Div., SME Dr., P.O. Box 930, Dearborn, MI 48121).

(July 3-6)—Oil and Colour Chemists' Association Australia. 28th Annual Convention. The Estate, McLaren Vale, South Australia. (OCCAA, 6 Wilson Ave., Felixstow, South Australia 5090, Australia).

(July 7-11)—"Organic Coatings Science and Technology" Twelfth International Conference. Athens, Greece. (Dr. A.V. Patsis, Institute in Materials Science, State University of New York, New Paltz, NY 12561).

(Sept. 7-12)—Symposium on High Solids Coatings. Sponsored by the ACS Div. of Polymeric Materials: Science and Engineering. Anaheim, CA. (George R. Pilcher, Hanna Chemical Coatings Corp., P.O. Box 147, Columbus, OH 43216).

(Sept. 8-13)—190th National Meeting. American Chemical Society. Chicago, IL. (ACS, A.T. Winstead, 1155 16th St. N.W., Washington, D.C. 20036).

(Sept. 9-11)—RadCure '86—Association for Finishing Processes of the Society of Manufacturing Engineers Conference and Exposition. Baltimore Convention Center, Baltimore, MD. (AFP/SME Public Relations, Society of Manufacturing Engineers, One SME Dr., Dearborn, MI 48121).

(Sept. 15-17)—13th International Naval Stores Meeting. Waldorf-Astoria, New York, NY. (Douglas E. Campbell, Executive Director, Pulp Chemicals Assn., 60 E. 42nd St., New York, NY).

(Sept. 21-23)—Canadian Paint and Coatings Association. 74th Annual Convention. Hilton Hotel, Quebec City, Que., Canada. (CPCA, 515 St. Catherine St. W, Montreal, Que., Canada H3B 1B4).

(Sept. 21-26)—XVIIIth Congress of FATIPEC. (Federation of Associations of Technicians in the Paint, Varnish, and Printing Ink Industries of Continental Europe). Venice, Italy. (C. Bourgery, Secretary General of FATIPEC, 76 Blvd. Pereire, 75017 Paris, France-or-Amleto Poluzzi, AITIVA, Piazzale R. Morandi 2,20121 Milano, Italy).

(Sept. 22-25)—"Your Chosen Finish." FINSTRAT Conference and Exposition sponsored by the Association for Finishing Processes of the Society of Manufacturing Engineers. Long Beach, CA. (Gerri Andrews, SME, Public Relations Dept., One SME Dr., P.O. Box 930, Dearborn, MI 48121).

(Sept. 23-25)—"Industrial Painting Processes" clinic sponsored by AFP/SME. Indianapolis, IN. (Diane Korona, SME Special Programs Div., SEM Dr., P.O. Box 930, Dearborn, MI 48121).

(Nov. 3-5)—Paint Research Association. Sixth International Conference, Sheraton Hotel, Brussels, Belgium. (D. Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

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(Mar. 17-19)—Powder Coatings '87. G-MEX Exhibition Center, Manchester, England. (Mervyn W.K. Little, Specialist Exhibitions Ltd., Grantleigh House, 14-32 High St., Croydon, CRO 1YA Surrey, England).

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'Humbug' from Hillman

Those of you who have been paying attention may recall that, recently, I complained that these columns, composed in pursuit of intellectual excellence, are written months before their appearance in the back of this book. Imagine, please, the difficulty for me to find stimulation to write, gayly, of the winter holidays in early autumn. Peace on earth and joy to the world in October?? Nonsense and Humbug!!!!

Well, here it is, mid December and I am surrounded by bright holiday lights. Holiday music fills the air. Presents are being bought and we're about to celebrate a joyous New Year. I am swept up with the enthusiasm of the holiday spirit. I am even thinking kindly about people I'd rather not know and am temporarily shelving the "bahs" as in humbug. I feel the urge to wish all our readers a merry holiday and a joyous and successful New Year but problems of production decree otherwise.

I will not, however, be denied. So — A merry what's left of February and a peaceful and healthful rest of the year to you all!!!!

Irwin Young proposes that the Paint Dictionary should include, — "A paint raw material is that substance which, when injected into a rat, will become a scientific report."

Maureen Lein, who can always be relied upon to save this column when our contributions diminish, came up with these column savers.

- A tree surgeon became so successful that he opened several branch offices.
- You know it's a bad day when your twin forgets your birthday.
- A gossip is one who gives you the benefit of the dirt.
- An after dinner mint is what you need when the waiter brings you the check.
- Can these really be the good old days that will be reminisced about in 2025??

All from the National Safety Council

Aside to Tony Wright of Bury-Lancashire, England — "Alas, you've been censored but I laughed."

Old friend and new New England neighbor, Sid Lauren found the following in a September C&En News. I'm sure there are those who have read it. If so, skip to next month.

Light Bulbs Attract Attention of Superfund

Circulating through the headquarters offices of the Environmental Protection Agency in Washington, D.C., is a document headed, "How many Superfund people does it take to change a light bulb?" The answer is 14, one each to handle the following tasks:

- Install a barrier around the darkened site to prevent danger to the public while a permanent solution is investigated.
- Plan and implement a community relations program to explain to the affected persons the problem, the steps being taken to resolve the problem, and to invite their input into the resolution process.
- Prepare a site safety plan to ensure the safety of all entering the darkened site.
- Prepare a quality assurance project plan to be sure that all lumens measurements are properly taken and analyzed.
- Investigate why the previous light bulb failed.
- Establish lighting objectives for the site.
- Evaluate alternatives including different types of bulbs, the possibility of permanent containment of the darkened site, and, of course, taking no action.
- Select an alternative, documented in a record of decision.
- Design the installation of the light bulb.
- Competitively procure the selected light bulb.
- Install the light bulb.
- Monitor the effectiveness of the installed light bulb and perform any required maintenance.
- Write the final technical report on the project.
- Document the deletion of the site from the Maintenance Priority List.

—Herb Hillman
Humbug's Nest
P.O. Box 135
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