JCTAX 57 (720) 1-96 (1985)

January 1985

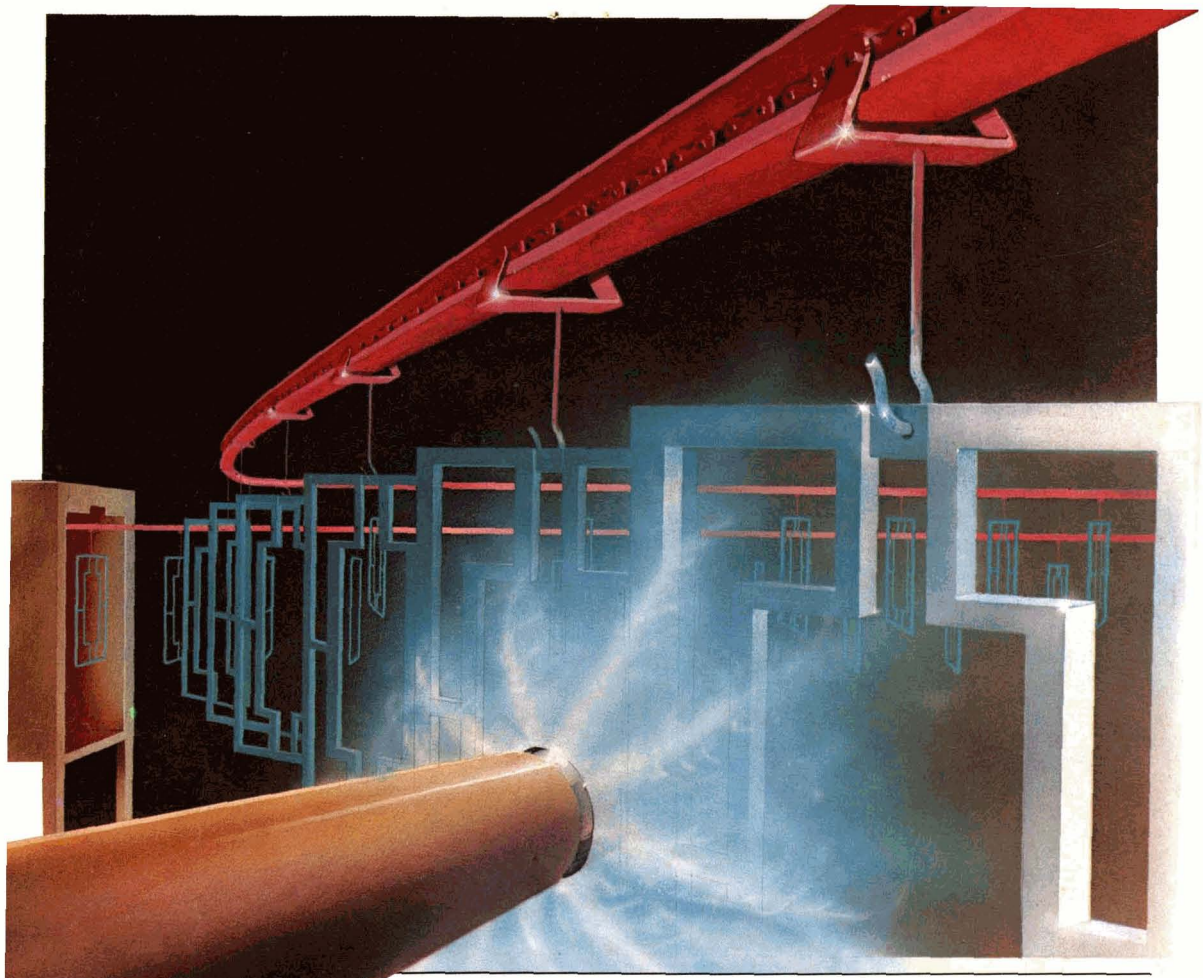
JOURNAL OF COATINGS TECHNOLOGY

1985 50 Fiftieth Anniversary of the Paint Industries' Show

and Sixty-Third Annual Meeting

CERVANTES CONVENTION CENTER
ST. LOUIS, MISSOURI OCTOBER 7-9

Objective Predictors of Paint Appeal



Use our powder line to broaden your own.

Look to Dow for the broadest line of epoxy powder coating resins and curing agents in the industry. We can provide all the epoxy products you need to enter and service the rapidly expanding market for decorative and functional powder coatings.

DOW* epoxy powder coating resins offer batch-to-batch consistency for easy processing. They're manufactured to narrow epoxide equivalent weight and melt viscosity ranges for predictable reactivity and handling properties. And, they meet stringent insolubles and gel contamination guidelines. Naturally, powder coatings made with DOW epoxy resins offer the high performance and long-term economy that have made powder coating technology increasingly popular among end-users.

Explore the broad options our epoxy powder coatings resin line offers. Write: The Dow Chemical Company, Coatings and Resins Dept., Inquiry Services, 1703 S. Saginaw Road, Midland, Michigan 48640. Or call the Coatings Extension toll free: 1-800-258-CHEM.

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A Dow Report

Coatings Compliance

Control evaporation rates with solvent blending for excellent paint performance.

In most coatings, the fast evaporation rates of exempt chlorinated solvents mean significantly lower energy requirements and increased production speeds. But left uncontrolled, rapid solvent evaporation can mean paint performance problems:

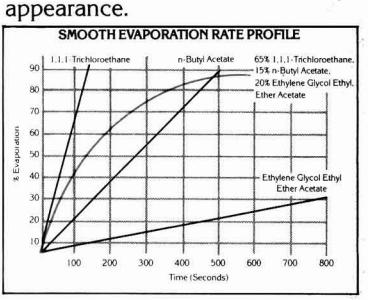
- orange peel
- solvent popping
- resin kickout

In certain applications, it may be necessary to modify the solvent evaporation rate by solvent blending. Accurate blending will result in paint performance equivalent to that of conventional solvents, and still deliver all the inherent benefits of fast evaporation.

Dow has identified certain families of solvents that, when added to paint formulations, either accelerate or retard the evaporation rates of CHLOROTHENE* SM 1,1,1-trichloroethane and AEROTHENE* MM methylene chloride coating solvents. Blending of fast and slow evaporating solvents will, of course, give an evaporation rate somewhere in between that of the components. The effect of retarding the evaporation rate of a chlorinated solvent by blending in a slower-evaporating solvent can be maximized by choosing a proton-accepting solvent. On the other hand, a hydrogen-bonding solvent should be blended when acceleration is desired.

RETARDANTS (proton-accepting)	ENHANCERS (hydrogen-bonding)
ethers ketones esters glycol ether acetates	alcohols glycols glycol ethers

As shown in the graph below, with proper solvent blending, smooth evaporation rate profiles can be achieved, which yield films with excellent flow-out properties and final appearance.



For more information, write or call us at **1-800/248-9160**. Request our technical paper, "Controlling the Evaporation Rate of Chlorinated Solvents." In addition, consult our Coatings Laboratory for recommendations on resin and formulation compatibility, as well as evaporation profiles.

CHLOROTHENE*SM
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Specialty Solvents For Coatings

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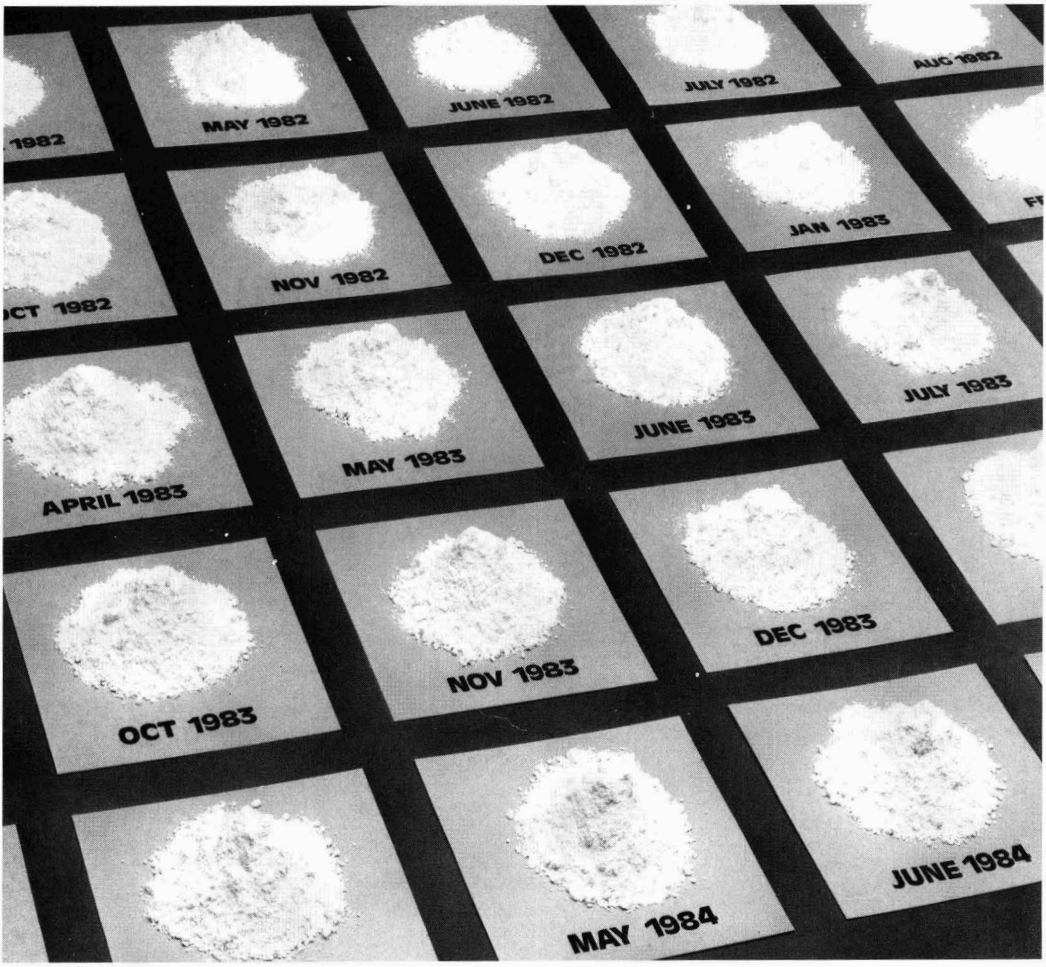
With NYTAL®, the big difference is no difference.



NYTAL talc's consistent uniformity starts with selective mining from our extensive deposits. Batch after batch, the uniformity is also enhanced by careful processing under the strictest of quality controls. And our patented bottom-loading procedure, at our 1500-ton silos, further insures it.

When a few rail cars or trucks have taken on NYTAL from one of these silos, we blow additional talc in through the bottom. New material is thoroughly mixed with the old. As a result, there is no variation because each batch is virtually endless.

In fact, NYTAL is so predictably uniform, that several paint manufacturers have omitted checking during production. That can cut costs and save time.

For data sheets and samples, write or phone R.T. Vanderbilt Company, Inc., Paint Department, 30 Winfield Street, Norwalk, CT 06855. (203) 853-1400.

R.T. Vanderbilt Company, Inc.
INDUSTRIAL MINERALS AND CHEMICALS

JANUARY 1985

JOURNAL OF COATINGS TECHNOLOGY

VOLUME 57 NUMBER 720

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

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New Rhoplex® EC-2218 challenged traditional roof mastics to resist moisture. And they ran.

Traditional roof mastic after 5 minutes dry-time.

Who can blame them? No other roof mastic shrugs off dew and light rain like those based on Rhoplex EC-2218 emulsion. These unique coatings set faster in high or low humidity, so they don't get watered down. And don't run like the others do. Yet Rhoplex EC-2218 retains the durability, low-temperature flexibility, dirt resistance, ultraviolet and water ponding resistance that made roof mastics based on Rhoplex EC technology advantageous in the first place. And that gives you a lot more confidence in your formulations.

This test simulates roof conditions after a fresh coat of roof mastic is applied and allowed to dry for 5 minutes. Both panels were sprayed with a heavy mist at 30-second intervals. The results were immediately obvious. New Rhoplex EC-2218 emulsion set up faster, resisted moisture better and didn't run.

Now a contractor can put more sq. ft. of roof mastic on in a day without worrying about dew or humidity. Or running out of time. The quick-setting new formula also means fewer call-backs and more satisfied customers.

Find out about the industry's best moisture-resistant acrylic roof mastic, before the others run out on you again. Call your nearest Rohm and Haas representative. Or write: Rohm and Haas Company, Marketing Services Department, Independence Mall West, Philadelphia, PA 19105.

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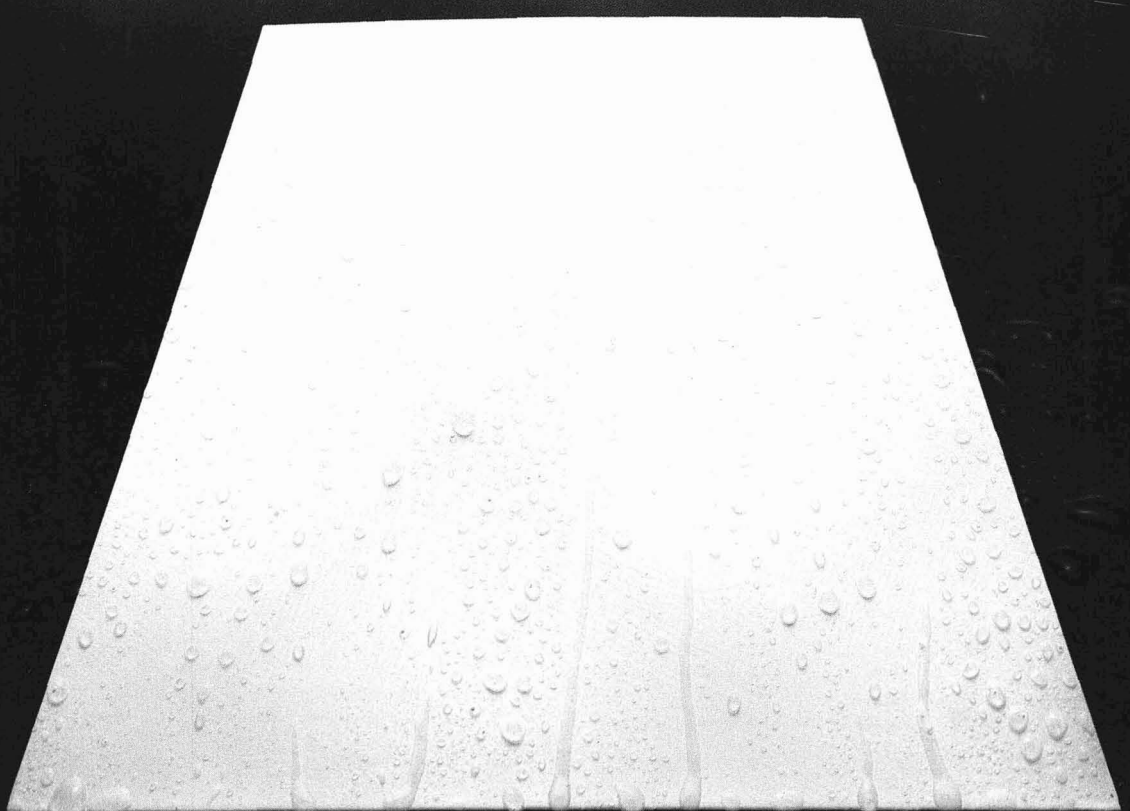

Rhoplex® EC-2218 after 5 minutes dry-time.

jct JOURNAL OF COATINGS TECHNOLOGY

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1 Year	$27.00	$ 50.00	$ 37.00
2 Years	$51.00	$ 97.00	$ 71.00
3 Years	$73.00	$142.00	$103.00

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

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

A Guide for Authors is published in each January issue.

The JOURNAL OF COATINGS TECHNOLOGY is available on microfilm from University Microfilms, a Xerox Co., Ann Arbor, Mich. 48106.

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

Comment

Trends to the Future

Last year the coatings industry dragged itself out of the mire of recession and onto the road of recovery. This year we will find out if those pleasant year-end figures are an aberration or a justifiable trend leading to good times ahead.

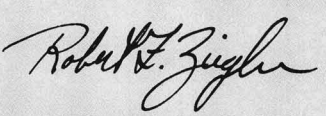
The year of 1984 proved also to be a good one for the Federation—in fact, one of its best ever.

The Federation's first Spring Week was held in Louisville in May. Incorporating the FSCT Seminar, "Producing Paint Efficiently, Safely, and Economically," the Society Officers meeting, and the Board of Directors meeting all in one week all at one site, Spring Week was a resounding success!

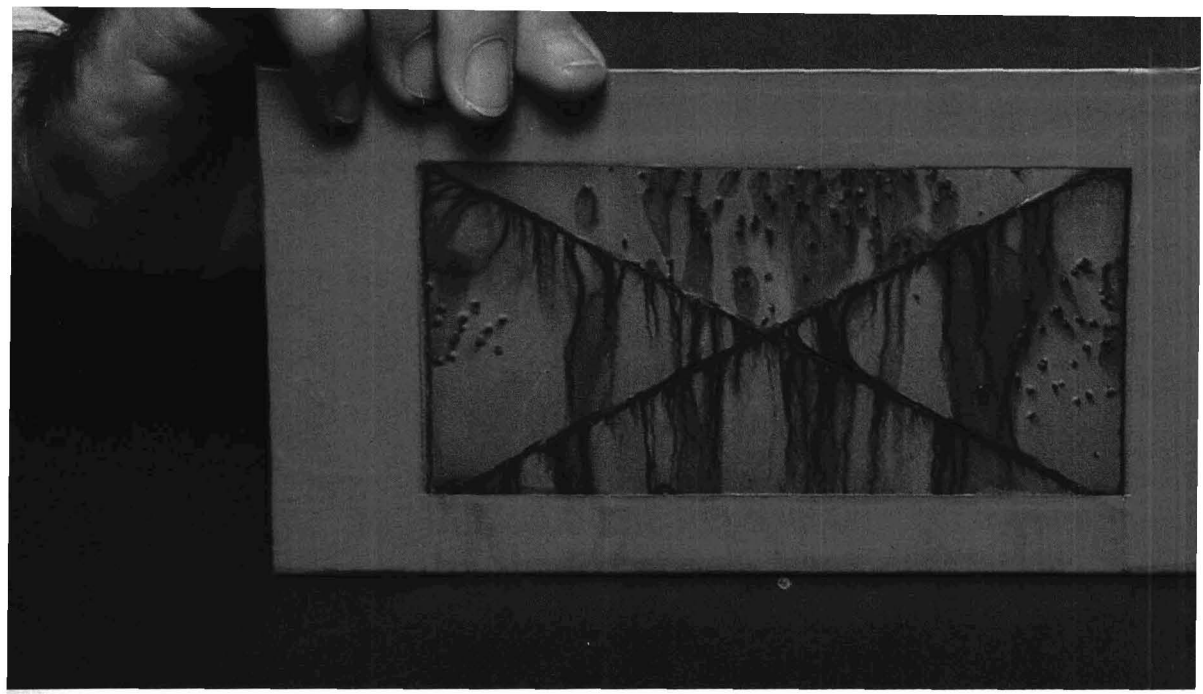
The FSCT-sponsored Paint and Coatings Proficiency Testing Program got underway and, as can be seen from FSCT Technical Advisor Roy Brown's update (see December 1984 JCT), the initial test set results were worthwhile. Welcomed by both ASTM and the National Bureau of Standards, the collaborative testing program is currently being used by over 60 companies, with more joining every week.

The recent Annual Meeting and Paint Industries' Show in Chicago saw records set in attendance (7,000 plus), exhibitors (196), and booths (45,400 sq. ft.), making it an unqualified success!

We look forward to continuing this trend of success in 1985. The Federation's second Spring Week will be held in Baltimore, May 14–17, starting off with the seminar on "Recent Developments in Home Painting." The collaborative proficiency testing program will, by all indications, continue to grow, providing a valuable yardstick for all testing laboratories in the industry. And, on October 7–9, St. Louis will be host city for the 50th Anniversary Paint Show. Already over 150 companies have signed up to exhibit at what will be the largest exhibition of coatings raw materials and manufacturing equipment and services in the world. The "BIG 50" will be big indeed! Plan to attend!



Robert F. Ziegler,
Editor



CIBA-GEIGY epoxy hardeners and the VOC solution

With new 100% solids Hardener XU 283, you can formulate an EPA-acceptable coating with improved performance.

Nobody has to tell you about EPA-mandated restrictions on the volatile organic content (VOC) of industrial coatings. Or about the fact that these restrictions are being adopted state by state.

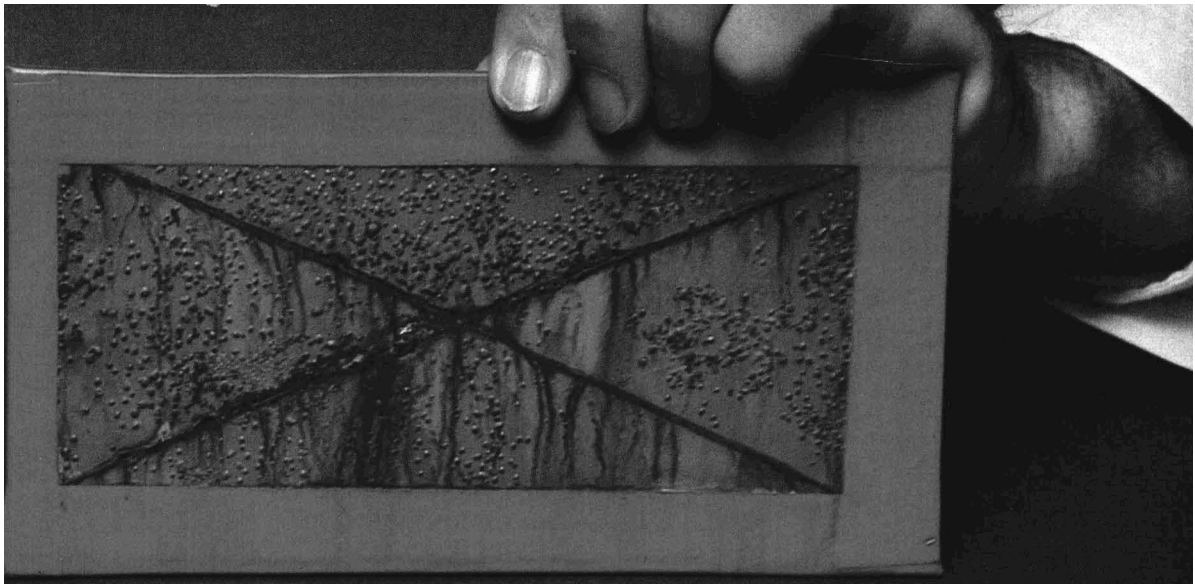
Ever since VOC became a concern, formulators have been looking to their suppliers to develop high solids substitutes for existing standard epoxy resin/poly (amidoamine) hardener formulations—substitutes that could provide the high performance characteristics necessary in coatings for bridges, containers and tanks, pipes, ships, and railroad cars.

That's why we challenged our chemists to work on a solution. And why that solution is available today as a 100% solids, modified poly (amidoamine) hardener known as XU 283.

More than just a replacement.

A look at its properties should be sufficient to convince you that XU 283 is more than just a replacement for conventional poly (amidoamine) hardeners to achieve high solids coatings.

Because its viscosity ranges between 3000-4500 cP. at



In this side-by-side test, two cold rolled steel panels were coated—one with pigmented Araldite® 6010 epoxy resin and Hardener XU 283, the other with conventional pigmented resin and hardener. Both were then scribed. After 1,000 hours in a salt fog cabinet, the XU 283 formulation had dramatically demonstrated improved corrosion resistance over control.

25°C, XU 283 requires significantly less solvent than standard poly (amidoamine) hardeners to reach a workable stage. Because XU 283 is compatible with solvent-free liquid epoxy resins such as our Araldite® 6010 epoxy resin, no induction period is necessary and, consequently, coatings can be applied immediately after mixing. In addition, XU 283 also resists blushing and exudation.

But what about end results? In the final analysis, how does XU 283 compare to conventional products? The fact is, crosslinked with Araldite 6010 resin, XU 283 actually improves the performance and application of coatings formulations. Compared to formulations using unacceptably high solvent levels, XU 283 produces harder film; exhibits better chemical (see chart), corrosion and abrasion resistance; and can provide excellent mechanical properties, especially adhesion. Add all this to the high solids content of XU 283 and its elimination of sweat-in time, and you can understand why initial response from formulators has been overwhelmingly enthusiastic.

Chemical resistance

Immersion tests
12-16 mils; Cured 7-10 days @ R.T.

Formulation	1	2
	Parts by weight	
Araldite® 6010	100	—
XU 283	70	—
"1" Type Epoxy Resin	—	100
Conventional Polyamide	—	54
	Weeks to failure (1 Year Test)	
Tap water	>52	8
Deionized water	>52	8
Sea water	>52	>52
50% NaOH	>52	>52
10% NH_4OH	>52	1
10% H_2SO_4	>52	2
10% HCL	>52	1
Unleaded gas	>52	>52
Diesel fuel	>52	>52
Skydrol® 500B*	>52	8
Heptane	>52	>52
Xylene	>52	16
MEK	12	1
Isopropanol	>52	26
50% Ethanol/H_2O	>52	8

Note >52=Unaffected after 1 year.
Substrate: Sandblasted hot rolled steel
*Registered trademark of Monsanto Industrial Chemicals Co.

Technology and service.

Facing up to EPA-mandated restrictions on VOC is an important challenge to the coatings industry. But it's a challenge we're prepared to help you resolve. Call the CIBA-GEIGY Resins Department—your source for high technology specialty resins and hardeners, and responsive service—at (800) 431-1900. Ask for Rob Crespi. In New York call (914) 347-4700. Or write, Resins Department, CIBA-GEIGY Corporation, Three Skyline Drive, Hawthorne, New York 10532.

CIBA–GEIGY

Abstracts of Papers in This Issue

OBJECTIVE PREDICTORS OF PAINT APPEAL—G.W. Cermak and M.H. Verma

Journal of Coatings Technology, 57, No. 720, 39 (Jan. 1985)

Four groups of non-experts judged the subjective appeal of 40 paint samples which varied in color, gloss, and distinctness of image (DOI). Statistical analysis showed that the subjective judgments were best predicted by color and gloss, while DOI was not an important predictor. These results were observed for both fluorescent lighting and sunlight, for both single and paired presentation of samples, and for two different demographic groups of judges. Large individual differences among judges were observed in color preference.

IDENTIFICATION OF ORGANIC PIGMENTS IN PAINTS—R. Kumar, F.W. Billmeyer, Jr., and M. Saltzman

Journal of Coatings Technology, 57, No. 720, 49 (Jan. 1985)

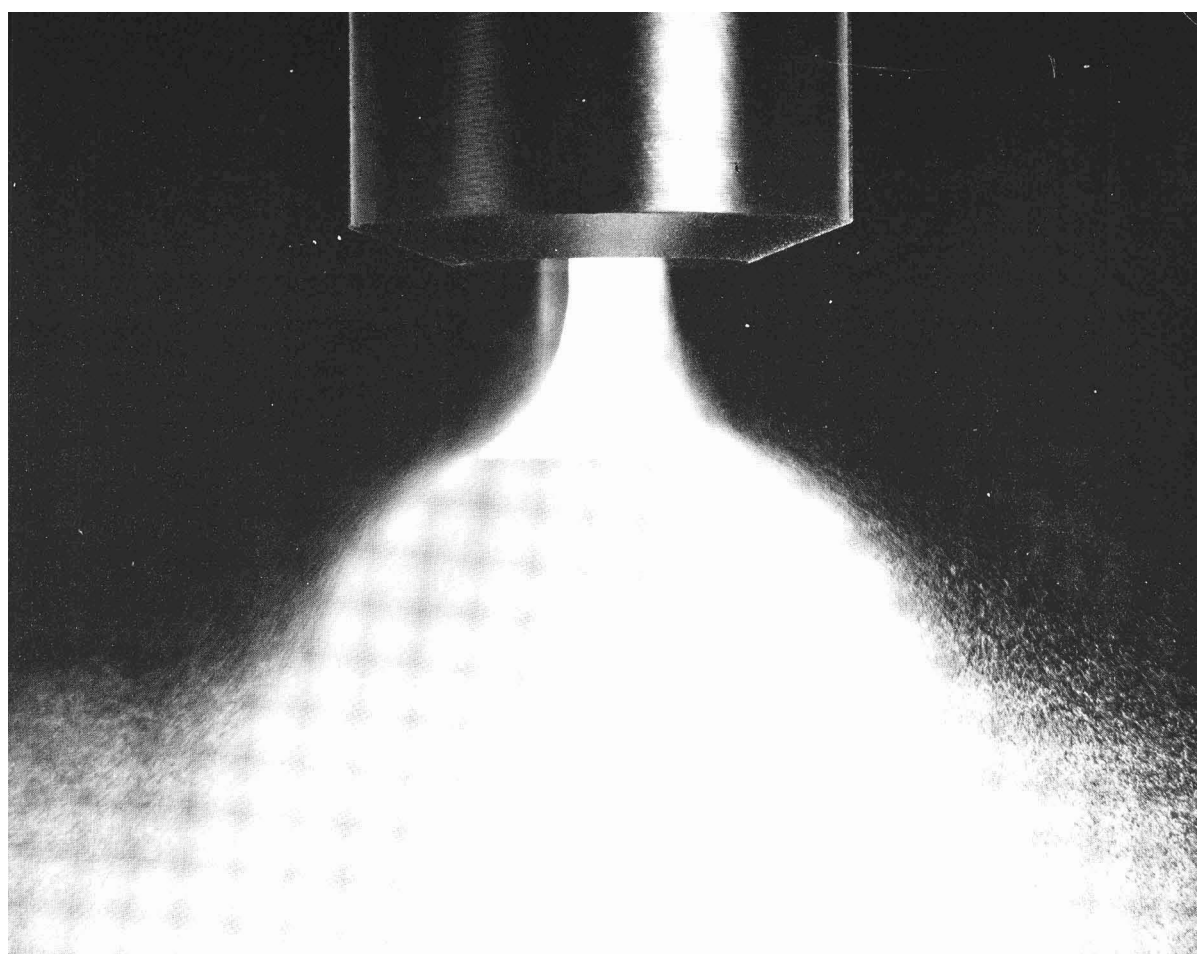
Organic pigments in paints can be identified easily by solution spectrophotometry. In this quick, simple, and inexpensive technique a small amount of pigment is extracted from a paint sample (wet or dry) in a few selected solvents. The resulting solution is measured on a visible-range spectrophotometer. The spectrophotometric curve is obtained on a log absorbance vs wavelength scale, in which case the concentration of the pigment in solution does not affect the curve shape. The identification is made by comparison of the shape of the spectrophotometric curve to those in a library of reference curves.

The solution spectrophotometry technique requires only a very small sample, which can usually be obtained by extracting the pigments from less than a square centimeter of a dry paint film or a few grams of the paint sample into a suitable solvent. The presence of any resinous material itself, if it dissolves along with the pigment, rarely interferes with the identification. In most cases, mixtures of pigments do not need to be separated and purified for identification.

KINETICS OF THE ALCOHOLYSIS OF ORTHOSILICATES—D.J. Oostendorp and J.O. Stoffer

Journal of Coatings Technology, 57, No. 720, 55 (Jan. 1985)

Partially hydrolyzed orthosilicates, primarily tetraethoxysilane (TEOS), are used as binders in zinc-rich coatings. One possible source of TEOS is tetramethoxysilane (TMOS) which is prepared from elemental silicon and methanol. The TEOS is prepared when TMOS is reacted with ethanol in the presence of an acid catalyst. Research involving kinetic and mechanistic information of this acid-catalyzed alcoholysis is somewhat limited. In this study we have investigated the rate of the reaction using several different catalysts. We have determined the order of the reaction and its activation energy, from which we have proposed a mechanism. This knowledge will be helpful in the preparation of zinc-rich coatings.



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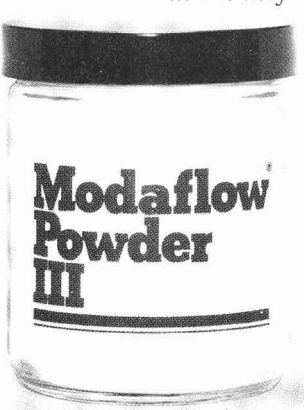
Presenting Modaflow® Powder III resin modifier ...the improved acrylic flow aid by Monsanto that costs less than Modaflow Powder II, yet offers *more* active ingredient.

Modaflow Powder III has 5% more active ingredient than Modaflow Powder II: 65% as compared to the previous 60%. So you can use 8% less material than Modaflow Powder II in your formulations.

In addition, Modaflow Powder III is based on a more efficient processing technique. As a result, we're able to produce and sell Modaflow Powder III for less per pound than its predecessor. And that adds up to savings for you.



Best of all, Modaflow Powder III is backed by one of the world's largest chemical companies—Monsanto—recognized by the coatings industry as the acrylic flow aid leader for over 25 years.

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Abstracts of Papers in This Issue (Continued)

ACYLUREA REACTIVE OLIGOMERS FOR HIGH-SOLIDS COATINGS—G.K. Noren, S.C. Lin, and E. Eldridge

Journal of Coatings Technology, 57, No. 720, 61 (Jan. 1985)

Acylurea reactive oligomers were conveniently synthesized by the reaction of low molecular weight carbodiimides with polyunsaturated carboxylic acids. The effect of oligomer structural variables such as molecular weight, functionality, and carboxylic acid type on the cure rate and various coating properties was investigated. These materials were examined for application in the rapidly emerging compliance oriented technologies of high-solids and UV-cured coatings. A model high-solids coating formulation based on one oligomer gave five to eight minutes tack free time, HB pencil hardness after one week, and 1/16" creepage from the scribe after 250 hours salt spray. Model UV cure formulations had lower viscosities and slower cure rates than a commercial urethane acrylate.

THE CHALLENGE OF AUTOMOTIVE COLOR—A PERSONAL EPILOGUE—S. Panush

Journal of Coatings Technology, 57, No. 720, 67 (Jan. 1985)

The capacity to experience color is truly an awe-inspiring gift. Color has a powerful impact on perception, illusion, and decision making. Emotionally and psychologically, color influence is both subtle and decisive. Visual information comprises 80% of all information received—40% consists of information about color. Since color is exclusively color sensation, it is a potent means of aesthetic expression. Understanding color adds a dimension to life and is thereby critical as an automotive marketing tool. While there have been dramatic automotive coatings breakthroughs in the last five years, automotive color concepts have not kept pace. As the frontier of lifestyle progresses beyond the "Gucci, Porsche, and Rolex" contemporaries, the challenge to automotive color is an imperative for bold innovation.

Papers to Be Featured in the February Issue

1984 Mattiello Lecture—"Reading the Signals of Society: Technology Push or Market Pull"—T.J. Miranda, Whirlpool Corp.

1984 Roon Award Winner—"Dependent Scattering Theory: A New Approach to Predicting Scattering in Paints"—S. Fitzwater and J.W. Hook III, Rohm and Haas Co.

1984 Annual Meeting Keynote Address—"Meeting the Challenge of Managing Change"—R.E. Pajor, Valspar Corp.

"A Convenient Preparation of Acrylic-Urethane Nonaqueous Dispersions"—A.N. Theodore and M.S. Chattha, Ford Motor Co.

"Stabilization of Aqueous Oxide Pigment Dispersions"—W.H. Morrison, E.I. Du Pont de Nemours & Co., Inc.

"Volume Concentrations of (Magnetic) Pigments"—H.F. Huisman, PD Magnetics B.V.

"Branched Polyether/Ester Oligomers for Water-Reducible Coatings"—T. Misev, F.N. Jones, and S. Gopalakrishnan, North Dakota State University.

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When form follows finish, crosslink your coil coatings with Resimene® resins from Monsanto.

With coil coatings, the finish is just the beginning. To stand up to the demands of post-forming you need a tough crosslinker like Resimene.® Its bonding properties work to prevent the coating surface from crazing and cracking no matter how the metal gets treated during forming.

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You can also count on Monsanto for the new products you need, like new Crosslinker EP-3560 for coil coat applied primers. And to get our products to you even faster, we're adding a new plant in Cincinnati.

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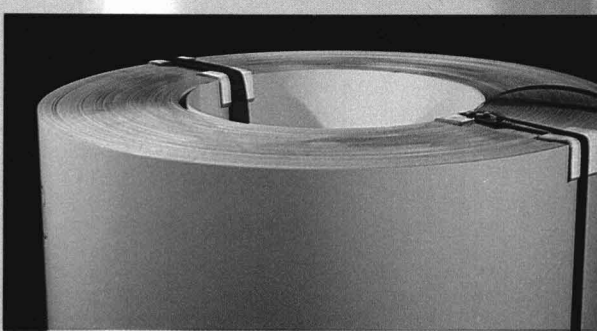
Resimene.®
For finishes that stay finished.



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Roon Awards Competition Offers $4,000 in Prizes For Winning Technical Papers Presented in 1985

The Roon Foundation Awards, established in 1957, will be continued at the Federation's 1985 Annual Meeting in St. Louis, Missouri, where the best technical papers offered for presentation will be eligible for up to $4000 in cash prizes, as established by the late Leo Roon, and administered by the Paint Research Institute.

Serving as Chairman of the Federation's 1985 Roon Awards Committee is Phillip W. Harbaugh, of Reliance Universal, Inc., P.O. Box 37510, Louisville, KY 40232.

The 1985 Annual Meeting of the Federation will be held at the Cervantes Convention Center in St. Louis, on October 7–9 and the deadline for notifying the Chairman of expected participation in the competition is March!

Principles Governing the Roon Awards

These awards, established in 1957 by the late Mr. Leo Roon, a Director of the Roon Foundation, and sponsored since 1977 by the Paint Research Institute, are for the best technical papers (other than those by a Constituent Society of the Federation) submitted for presentation at a Federation Annual Meeting.

Papers to be considered for the competition will be those by individuals associated with the organic coatings industry, including raw material suppliers and educational institutions.

The principles governing the awards are as follows:

(1) The papers will be of such caliber that they will reflect a step forward in real scientific contribution to the coatings industries. The papers shall describe original work which has not been previously published or presented.

(2) Papers must be directly related to the protective coatings industry.

(3) None of the work shall originate from, be guided by or be any part of a Coatings Technology Society. These awards shall in no way detract from the cooperative efforts of Societies' Technical Committees and their convention papers.

(4) An Awards Committee, appointed by the President of the Federation, will judge the entries.

(5) The Committee is not obligated to award prizes if in its opinion none of the submitted papers are of a caliber to be worthy of such recognition.

(6) The submitted papers may be presented at the Annual Meeting with the consent of the President of the Federation and the Chairman of the Program Committee. Although it is the intent of the Roon Awards that winning papers will be presented at the Annual Meeting, papers accepted for presentation and papers awarded prizes are separate and distinct. An invitation from the Program Committee to present his/her paper should not be construed by any author as an indication that the Roon Committee has awarded the paper a prize.

(7) Winning papers will be published in the JOURNAL OF COATINGS TECHNOLOGY, which has prior rights to publication of all submitted papers.

(8) The papers shall be concise and informative discussions of up to approximately 6,000 words. Papers greatly exceeding this length should be divided into more than one paper. Multiple entries in the competition from a single author are acceptable. It is requested that manuscripts be prepared in accordance with JOURNAL OF COATINGS TECHNOLOGY style, as outlined in the Guide for Authors. Copies are available from the Federation office in Philadelphia upon request.

(9) A 150 to 200 word abstract shall accompany the paper.

(10) Papers will be rated with emphasis on: (a) Originality (40%); (b) Scientific Importance (20%); (c) Practical Value (20%); and (d) Quality of Composition (20%).

(11) The Awards will be open to anyone involved in study or engaged in work related to the protective coatings industries, including paint, varnish and lacquer manufacturers, raw material suppliers, research laboratories and universities. (The Committee, however, will not accept papers which involve raw material sales promotion or are self-serving in regard to exploiting a proprietary product.)

(12) The Committee may award any number of prizes, the total of which is not to exceed $4,000.

(13) All papers must be accompanied by company or educational institutional clearance for publication.

(14) Those planning to submit a paper in 1985 must advise the Chairman (Mr. Phillip W. Harbaugh, Reliance Universal, Inc., P. O. Box 37510, Louisville, KY 40232) by March 1. He must have 10 publication manuscripts by May 1.

(15) The 1985 Awards and accompanying engraved plaques will be presented during the Annual Meeting in St. Louis

Winners of the 1984 Roon Awards Competition

FIRST PRIZE ($2000)—"Dependent Scattering Theory: A New Approach to Predicting Scattering in Paints," by Susan Fitzwater and John W. Hook, III, of Rohm and Haas Co., Research Laboratories, Springhouse, PA.

SECOND PRIZE (tie—$1,000 each)—"Dispersion of (Magnetic) Pigments Powders in Organic Liquids," by H.F. Huisman, PD Magnetics B.V., Oosterhout, The Netherlands; and "An Analysis and Prediction of Roller Spatter from Latex Paints," by Debora Flanagan Massouda, Dept. of Chemical Engineering, University of Delaware, Newark, DE.

"CREATIVE COLORSHIP FOR OVER A CENTURY"

COLORSHIP is DISTRIBUTION

The Yankee Clippership was the mainstay of America's world trade network in the 19th century. Clipperships best fulfilled the essentials of successful distribution – delivering the right material to the right place, at the right time, in the right condition.

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Pfizer has the most extensive iron oxide manufacturing and distribution system in America. It delivers:

- *Right Material:*
  141 pigment products – Dry and Slurry
- *Right Place:*
  Three major producing plants in California, Illinois, and Pennsylvania
- *Right Time:*
  – Direct sales force in major cities
  – LTL distributors in 27 market areas

You expect the Industry Leader to give you cost-saving distribution – Pfizer: *"Creative Colorship For Over A Century."*

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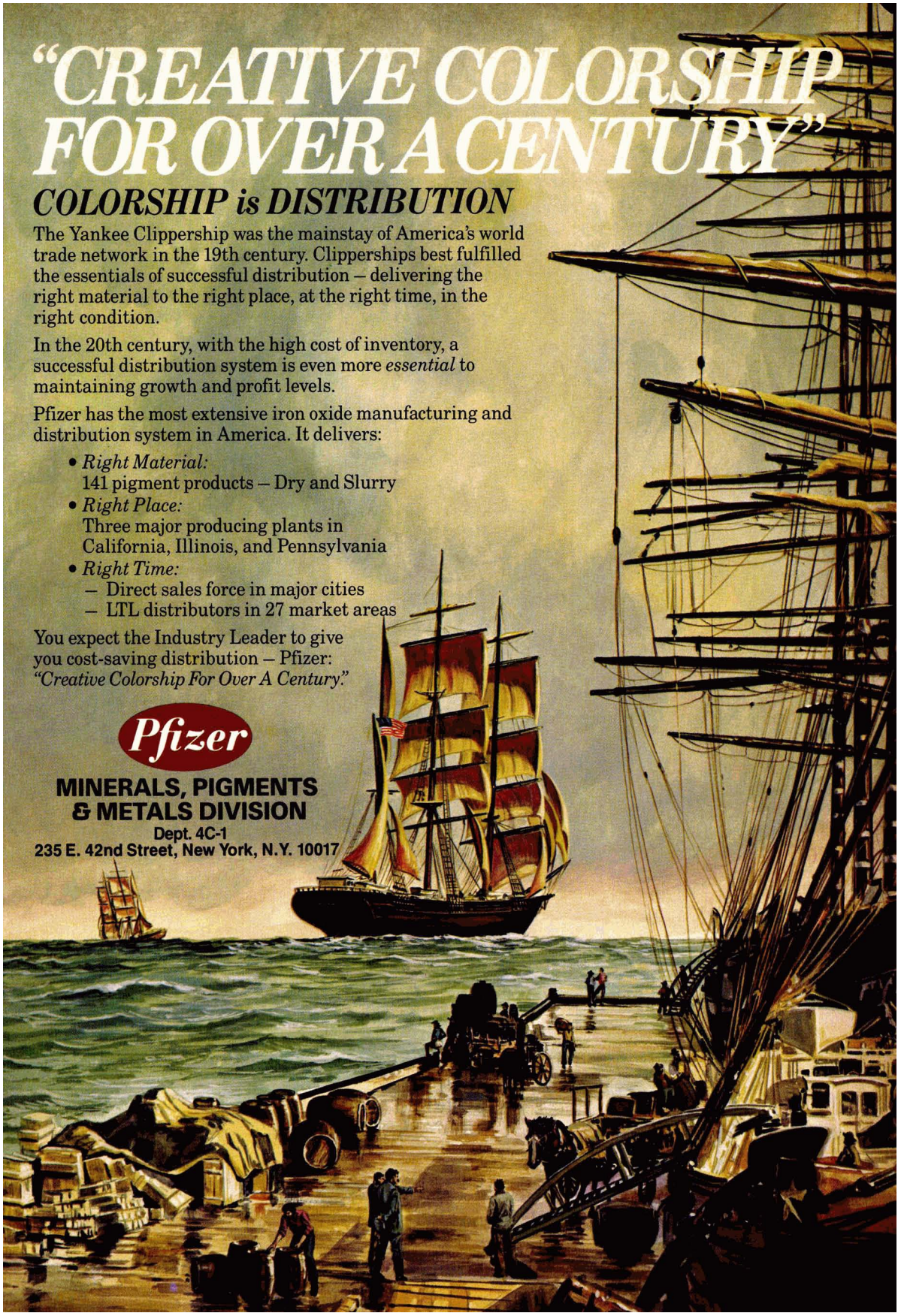

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POLYVINYL CHEMICAL INDUSTRIES

Fall 1984
Board of Directors Meeting

Thirty-three members and 27 guests attended the Fall Meeting of the Board of Directors of the Federation of Societies for Coatings Technology on October 23, 1984, in Chicago, IL.

The following were in attendance:

Officers

President ..... Terryl F. Johnson
President-Elect ..... Joseph A. Bauer
Treasurer ..... William Mirick

Society Representatives

Baltimore ..... James A. McCormick
Birmingham ..... Harry Griffiths
Chicago ..... John T. Vandeberg
C-D-I-C ..... Lloyd Reindl
Cleveland ..... Fred G. Schwab
Dallas ..... Carlos Dorris
Detroit ..... Harry B. Majcher
Golden Gate ..... Barry Adler
Houston ..... Willy C.P. Busch
Kansas City ..... Normon Hon
Los Angeles ..... Dermont G. Cromwell
Louisville ..... James Hoeck
Mexico ..... Antonio Pina
Montreal ..... Horace Philipp
New England ..... Daniel Toombs
New York ..... Saul Spindel
Northwestern ..... Richard L. Fricker
Pacific Northwest ..... Deryk R. Pawsey
Philadelphia ..... Carl W. Fuller
Piedmont ..... Gary Marshall
Pittsburgh ..... Edward Vandevort
Rocky Mountain ..... James E. Peterson
Southern ..... Berger Justen
Toronto ..... Kurt F. Weitz
Western New York ..... Thomas Hill

Other Members

Rudolph C. Albrecht ..... Chicago
A. Clarke Boyce ..... Toronto
Neil S. Estrada ..... Golden Gate
Ted Favata ..... Golden Gate
Al Heitkamp ..... Northwestern

Guests

E.C. (Ted) Saultry, President of the Oil and Colour Chemists' Association Australia.

Uriel Gonzalez, President of the Mexico Paint and Ink Manufacturers Association.

Dr. Kenjiro Meguro, Vice-President of Japan Society of Colour Material.

Dr. Toyohiko Yoshida, a Director of Japan Society of Colour Material.

The following Past-Presidents of the Federation: S. Leonard Davidson, William H. Ellis, Howard Jerome, Elder C. Larson, J.C. Leslie, Michael W. Malaga, John J. Oates, Eugene H. Ott, A. Gordon Rook, and Carroll M. Scholle. (Board members A. Clarke Boyce, Neil S. Estrada, and James A. McCormick are also Past-Presidents.)

Dr. Thomas J. Miranda, President of the Paint Research Institute, and PRI Trustees Darlene Brezinski, Mary G. Brodie, Loren W. Hill, Joseph V. Koleske, and Colin Penny.

Incoming Board member J. Richard Kiefer, Jr.

FSCT Technical Advisor Royal A. Brown.

Other guests included: Robert Thomas, Alternate Society Representative from Cleveland Society; Abel Banov, Co-Publisher/Editor *American Paint & Coatings Journal;* Lloyd Haanstra, President of Los Angeles Society and incoming Chairman of A.F. Voss/*American Paint & Coatings Journal* Awards Committee; Joseph A. Vasta, Mattiello Lecture and Roon Awards Committee Chairman and incoming Chairman of Annual Meeting Program Committee; and Jan Van Zelm, Past-President of Los Angeles Society and incoming Society Representative.

Staff

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

Mr. Borrelle called the roll of members and reported all present except the Representative from the St. Louis Society, who was ill.

A moment of silence was observed in honor of the memories of Federation Past-President Martin E. Schleicher and former Executive Director of the Paint Research Institute Dr. James S. (Shorty) Long.

The report of the Spring 1984 Board of Directors meeting was approved as published in the August 1984 JOURNAL OF COATINGS TECHNOLOGY.

Dr. K. Meguro and Dr. T. Yoshida, of Japan Society of Colour Material attended. Also shown are Helen Skowronska, Chairman of Technical Information Systems Committee, and J.C. Leslie, Past-President

Report of Officers And Staff

PRESIDENT JOHNSON

October marks the end of my reign as President of the Federation. It has been a wonderful year, full of pleasures and pleasant associations.

Thanks to the excellent job done by our Past-Presidents, this year has been easy.

Two major items presented themselves. The first was the prospect of relocating the Federation Office. Our Ad Hoc committee presented a firm recommendation to consider the purchase of a condo type office with the provision that our lawyer and real estate consultant were in agreement. To our dismay and frustration, nothing has been formalized.

The second was the noble decision of the PRI Trustees to recommend its disbandment. This subject will be discussed at the current Board meeting.

I wish to thank all of you who have served so faithfully throughout the year, and to the Federation staff for their complete cooperation and assistance.

TERRYL F. JOHNSON,
President

PRESIDENT-ELECT BAUER

Federation travel has been minimal since the spring meeting. I attended the summer Executive and Host Committee Meetings in Chicago, visited the Piedmont Society with Tom Kocis, and, along with my wife, attended the Canadian Paint and Coatings Association Annual Meeting in Winnipeg.

My selection of committee chairmen is complete. Some members are repeats and others are new. All are highly qualified people and I want to thank them for serving. I will enjoy working with them during the coming year.

The Federation is made up of a lot of good people. Working with the other Officers, Board Members, Committee Chairmen, Society Officers, and especially the Staff, has been a real pleasure. They make an officer's job really easy.

Dorothy and I look forward to the coming year with great expectations, especially the "Big 50" Paint Show in St. Louis. Please join us.

JOSEPH A. BAUER,
President-Elect

TREASURER MIRICK

A review of the financial report shows that the Federation is operating within the 1984 budget and financially it looks like another banner year.

Since the Board meeting in Louisville, I have represented the Federation as Treasurer at the Executive and Host Committee Meetings in Chicago and as a Trustee of PRI.

As my year as Federation Treasurer draws to a close, I thank the Board, the Executive Committee, and the staff for making the task of Treasurer an enjoyable experience.

WILLIAM MIRICK,
Treasurer

EXECUTIVE VICE-PRESIDENT BORRELLE

Federation activities keep moving forward at a steady pace. The developments involving the Paint Research Institute, the first "Spring Week," and the Federation office have contributed to an interesting and lively 1984, which will be topped off with a great Annual Meeting Program and another record-breaking Paint Show.

THE BUDGET

At the eight-month mark, all income and expense accounts are in line with the budget, except for those few accounts mentioned in the First Half report. It will be another good year.

PUBLICATIONS

JCT: Advertising page sales are currently 8% over last year. The supply of manuscripts (from authors around the globe) continues to be good. A new feature, "CrossLinks," by Earl Hill, made its debut in August.

Thanks are extended to the Publications Committee (Dr. Thomas J. Miranda, Chairman) and the Editorial Review Board for their good services during the year.

The distribution of the JCT is currently 9,398 (U.S.—6,832; Canada—831; and other countries—1,735). The totals for October 1982 and 1983, respectively, were 9,307 and 9,243.

Year Book: Reminders have been sent to the Society Treasurers re the 1985 edition, which is targeted to be released in early March.

Series Units: Progress toward the new Series on Coatings Technology is being steadily made under the direction and leadership of the Co-Editors, Dr. Thomas J. Miranda and Dr. Darlene Brezinski. Twenty-seven of the 40 titles have been assigned to authors; 12 units are in outline form; and two in draft.

Other Publications: The Infrared Book, Pictorial Standards Manual, and Dictionary continue to sell well. It is our understanding that the Southern Society intends to submit the final draft of "Latex Exterior Paints" to the Federation for consideration.

OTHER SERVICES

Color-Matching Aptitude Test Set: One hundred and forty-two sets from the second production of 400 have been sold.

Audio-Visual: Kansas City's "*Operation of a* Vertical Sand Mill" has been added to our A/V catalog.

Federation Membership

The names of 6,700 members were published in the 1984 *Year Book*. Twenty-three of the Societies have since submitted 288 members (189 Active, 94 Associate, and five other).

Annual Meeting and Paint Show

We will return to Chicago (after six years) with another record-breaking Paint Show:

	1982	1983	1984
Paid Exhibitors.....	169	171	186
Comp. Exhibitors.....	3	5	10
	172	176	196
Net Paid Sq. Ft.....	36,498	39,610	44,300
Comp. Sq. Ft.....	420	500	1,100
	36,918	40,110	45,400

In 1978, the Paint Show occupied two exhibit areas in the Conrad Hilton Hotel. This year, it was necessary to use five.

Dr. Darlene Brezinski and her Program Committee have done a super job in preparing an outstanding selection of papers and seminars. There will be a couple of new twists this year: (1) Two major speakers at the opening session: Pat Buchanan, political columnist, and Bob Pajor, President of the Valspar Corp.; and (2) Since there will be no Friday afternoon program session, all of the Federation Awards will be presented at the Friday Luncheon.

Our thanks are extended to Rick Hille and the members of the Chicago Society's Host Committee for their good help in assisting the Federation staff with convention arrangements. We met with them in August.

The exhibit brochure for the "Big 50" Paint Show in St. Louis next year has been completed. More than 500 booths are on the floor plan.

Spring Week

The Federation's first "Spring Week" (Louisville, May 15-18) was a great success. One hundred and thirty-six attended the Seminar—"Producing Paint Efficiently, Safely, and Economically"—arranged by Technical Advisor Roy Brown. That was followed with good attendance at the Society Officers meeting on Thursday and the Board meeting on Friday. The Louisville Society and local paint manufacturers and supplier firms were hosts and I again thank them for their great hospitality.

Next year's "Spring Week" is set for May 14-17 in Baltimore. Roy is lining up architects, home builders, painting contractors, paint manufacturers, paint dealers, etc., for a most interesting two days on "Recent Developments in House Painting."

SCAI III

The third Symposium on Color and Appearance Instrumentation (sponsored by the Federation, ISCC, and MCCA) will be held April 17-19, 1985, in Pittsburgh. ISCC handles the program, MCCA the exhibits, and FSCT the meeting arrangements.

Officer/Staff Visits

In May, the Johnsons and Borrelles represented the Federation at the 100th anniversary of the Painting and Decorating Contractors of America and the Pacific Northwest Society Symposium. In June, we attended the joint St. Louis/Kansas City meeting in KC. Also on our schedule is a visit to the Birmingham Club and the FATIPEC Congress in late September.

Federation Office

The future status regarding the location of the Federation office seemed quite clear in May. All signs then were favorable toward the purchase of office condominium space.

Since then, that same proposition has become questionable because—simply stated—that building is not selling. The Federation does not want to find itself in the vulnerable position of being an occupant/owner of a huge "white elephant."

The owner, aware of our concern about ownership, has made two other proposals for the 8,000 sf space: a lease/purchase and a straight lease with option to purchase. The former is unacceptable; the latter is being held aside, pending a proposal from the building in which the Federation office is now located.

On August 1, additional space became available adjacent to our current offices. A plan for a total of 7,000 sf (an increase of 3,000 sf) has been prepared and we are waiting for the owner's proposal, which will include extensive renovations and improvements. (The lease expires in October 1985).

Miscellany

Computerization: Staff has spent considerable time with a consulting organization re the computerization of these Federation operations: accounting, JCT advertising and circulation fulfillment, membership records, Paint Show exhibits, manuscript tracking, and word processing. We should have some starting recommendations for the Executive Committee in January.

Proficiency Testing Program: This program—designed to upgrade the ability of companies to perform quality control tests and to obtain reproducible test results from one laboratory to another—is sponsored by the Federation and administered by Collaborative Testing Services, Inc., in cooperation with Roy Brown. More than 60 companies have signed up so far and more are expected.

President Terryl F. Johnson presented Rosemary Falvey, Director of Meetings and Conventions, with a Certificate of Appreciation for her 25 years of service

Federation Exhibit: We will exhibit at the Western Coatings Societies Symposium and Show in Anaheim, February 26-March 1. The exhibit space has been donated by the DuPont Co.

Mexico Society: We were pleased we have a visit by two Mexico Society members (Secretary George Carrington and Technical Chairman Jesus Ortega) in August.

Puerto Rico: I have been advised that about a dozen employees of the paint manufacturing and supplier industries in Puerto Rico are interested in forming a Federation Society. I have had correspondence with one individual who is coming to the Annual Meeting.

STAFF

Members of the staff are: Audrey Boozer, Rosemary Falvey, Kathryn Ferko, Victoria Graves, Linda Hanratty, Tom Kocis, Lorraine Ledford, Dorothy Robinson, Mary Sorbello, Patricia Viola, Kathy Wikiera, and Bob Ziegler. Victoria came aboard in August as an Editorial Assistant.

In mid-September, Pat was promoted to Managing Editor of the JCT. At about the same time, Rosemary marked her 25th anniversary with the Federation staff. We congratulate them both.

I thank them all for their good work, cooperation, and contributions to the continuing progress of the Federation.

OUTGOING ADMINISTRATION

For the staff, I extend sincere thanks to President Terryl Johnson, the other Officers, Executive and Board members, and Committee Chairmen for their dedicated service and fine spirit of cooperation throughout the year. It was a pleasure for us to have served them.

FRANK J. BORRELLE,
Executive Vice-President

FSCT Technical Advisor, Royal A. Brown

DIRECTOR OF FIELD SERVICES KOCIS

COMMITTEE LIAISON

Program—Staff support has been provided for development of the 1984 Annual Meeting programming. Close contact has been maintained with members of the Program Committee and speakers, and arrangements have been accommodated for all on-site needs in Chicago.

A full complement of presentations has been scheduled, keyed to the theme, "Appearance and Protection—Essential to Our Lifestyle." By all indications it is an excellent program dealing with a wide variety of coatings topics.

Programming arrangements are meanwhile underway for the 1985 Annual Meeting. Committee will hold organizational meeting in conjunction with '84 AM to discuss a theme and topics for session presentations at next year's event. Follow-up discussions will be held at subsequent full-day meeting, to solidify planning and assign responsibilities.

Technical Advisory—Five Societies will discuss project work in papers to be presented at Annual Meeting.

Certificate of Merit has been produced, and will be made available to Societies, for presentation to Technical Committee members whose project is described in a paper presented at an Annual Meeting (not restricted to award-winning presentations).

Compilation of reports on Society Technical Committee work was published in September JCT.

Manufacturing—Arrangements have been completed for Steering Committee members and Society Manufacturing Committee Chairmen to tour the Ace Hardware Corp.'s new paint plant in Matteson, IL on October 23, in conjunction with the Annual Meeting.

Committee-sponsored session at AM will feature a panel of speakers discussing various aspects of filtration technology.

Kansas City Society's slide-tape production of "Operation of a Vertical Sandmill," has been added to the Federation library of A/V programs, and will be available for viewing at the Federation booth in the Paint Show.

Corrosion—Committee will have new Chairman for the coming year. Arrangements have been made for organizational meeting, to be held during convention, to plan activities for 1984-85.

Educational—Script is being developed for narrative of slide-tape program "telling the coatings story," which will be aimed at high school students as part of effort designed to foster greater understanding and appreciation of coatings' contributions to our lifestyle, improve the industry's image, and spur interest in career opportunities.

Steering Committee will meet during AM with educators from schools supported by FSCT scholarship funds, to exchange ideas and suggestions relative to assisting mutual efforts to serve the industry.

Scholarship reports from participating schools are being prepared for Educational Subcommittee review and subsequent recommendations re funding for the 1985-86 academic year.

Compilation of reports on Society educational activities was published in September JCT.

SYMPOSIUM ON COLOR AND APPEARANCE INSTRUMENTATION

Federation is again co-sponsoring (with Inter-Society Color Council and the Manufacturers Council on Color and Appearance) a Symposium on Color and Appearance Instrumentation (SCAI), to be held in Pittsburgh, April 17-18, 1985. The two-day event, previously held in 1978 (Cleveland) and 1981 (Louisville), will feature paper presentations, workshops, and "hands-on" displays of color instrumentation equipment. SCAI

III discussions will focus on instrumentation, sample preparation and presentation, and statistical control for the coatings industry, with special emphasis on coil coatings and automotive applications.

Preliminary arrangements have been completed, and papers and authors are being selected for the program. FSCT staff is again responsible for planning, promotion, and on-site needs for the event.

Miscellaneous

Annual update of "Talks Available to Constituent Societies" was completed and distributed—record number of 84 presentations offered for the 1984–85 meeting season . . . Staff support being provided for publicity, programming, and on-site arrangements for '85 Spring Seminar on "Recent Developments in Home Painting." . . . Assisting Advisory Board in development of booklets for new Series on Coatings Technology . . . Staff support also provided for activities of Environmental Control, Memorial, and Roon, AP&CJ, and MMA Awards Committees.

Thomas A. Kocis,
Director of Field Services

Attending the Board meeting were (Front row, left to right): S.L. Davidson, Past-President; G. Rook, Past-President; L. Haanstra, President of L.A. Society; and W. Ellis, Past-President. (Second row): U. Gonzalez, President of Mexico Paint and Ink Manufacturers Assoc.; and J. Van Zelm, L.A. Society Representative

TECHNICAL ADVISOR BROWN

1985 FSCT Seminar

The third national Federation Seminar will be held May 14–15, 1985 in Baltimore, MD. As in Louisville this year, next year's seminar will be a part of Federation Spring Week. We have chosen the title, "Recent Developments in Home Painting," and we expect to discuss the many changes in home building techniques, choice of building materials, types of coatings to be used and the proper way to paint all surfaces. Speakers involved will be architects, home builders, painting contractors and paint dealers, as well as personnel from paint manufacturing companies. The National Association of Home Builders and the American Institute of Architects are pleased that we are having the seminar and have agreed to help us publicize it and to help us secure speakers from their organizations.

The seminar subject chosen is an area of broader interest than before, and involves industries and professions other than our own. This is appropriate, however, since the use of paint products is of very great interest and importance to many industries. The subject areas available for discussion in this seminar are numerous—perhaps too great to cover in one seminar. We may decide to choose a limited number of subjects for this seminar and save others to be discussed in future seminars. A short questionnaire which was sent to the Board on August 7, brought many responses with numerous suggestions. Thank you for this help.

Federation Proficiency Testing Program

The testing program being conducted in cooperation with Collaborative Testing Services, Inc., of McLean, VA is well on its way. More than 60 laboratories are enrolled in the first year's 12-test program.

The first two paint samples were mailed to cooperators, test results were received and tabulated by CTS, and a report has been mailed to all who participated. The second set of paint samples were sent in September. CTS will welcome suggestions for improving the report sent after each set of samples is evaluated. Test results on the first two paint samples were generally pretty good. These, of course, were fairly simple tests (Stormer Viscosity and Fineness of GrindASTM methods D-562 and D-1210). The next tests are more difficult as they include Water Content D-4017, and Volatile Organic Content D-3960.

The National Bureau of Standards advises that participation in the Federation program qualifies as meeting one of the requirements for laboratories wishing to become accredited under the National Voluntary Laboratory Accreditation Program operated by NBS. More about the test results obtained in the Federation program will be published in future editions of the JCT. It is believed that this program will prove to be very valuable to the paint and coatings industry. Brochures describing the program and respective enrollment fees are available from Federation headquarters.

Society Cooperative Mildew Work

The practical mildew research in which eight Society Technical Committees are engaged has reached the stage of exterior exposure comparison of the experimental paints involved. The eight Societies cooperating in this work are:

President Johnson (right) awarded Past-President J.C. Leslie with a certificate recognizing his Federation Honorary Membership

Chicago, Golden Gate, Kansas City, Los Angeles, Louisville, New England, New York, and Southern. According to their reports paint panels are exposed at 11 locations throughout United States. Some panels were exposed as early as the summer of 1983, while others have been out a much shorter time.

A request was sent to the eight societies for a report on the exposure panels on August 27. So far reports have been received from only two Societies—Chicago and Louisville. It is too early to draw definite conclusions regarding mildew growth. Some difficulty was reported by both Societies, however, in that the experimental paints were showing poor adhesion. More details will be provided later.

ROYAL A. BROWN,
Technical Advisor

Amendments To By-Laws

ADOPTED

The following amendment to the By-Laws passed the first reading at the Federation Board of Directors Meeting, May 18, 1984, and was adopted at the October 23, 1984 meeting.

ARTICLE V—COMMITTEES
C.—Staff Participation

"The Executive Vice-President or his staff representative shall give advice and counsel while participating in the work of the Nominating Committee, all Standing Committees, and all other committees unless specifically disallowed by action of the Executive Committee. The staff participant shall not vote in any matter to be decided by any committee."

Review of Actions Of Executive Committee

The actions of the Executive Committee, at its meeting of August 24, 1984, are listed below. All were approved by the Board of Directors.

That the name of the Paint Research Institute be changed to "Coatings Industry Education Fund," instead of "Roon Fund."

That the Ad Hoc Committee on Education be continued.

That the four annual Statements of Policy regarding: Technical Editor of the JCT; First Quarter 1985 Budget; Reimbursement of transportation expenses; and Payment of travel expenses be approved.

That increases in publications advertising, JCT non-member subscription, and Paint Show exhibit rates be approved.

Society Business

Pacific Northwest—Mr. Pawsey noted again that the Federation's Spring Week (middle of May) is too close to the PNW Symposium, usually held during the first week in May. He asked the Federation to consider a change.

New England—Mr. Toombs reported that the Preservation of the Boston Stone Fund is now at $5,364. Also that the Society will produce an A/V on Career Opportunities.

Society Displays at the 1985 Annual Meeting and Paint Show—Space (probably poster boards) will be provided for Societies . . . as was done at the 50th Annual Meeting in Altantic City, 1982. Staff will issue guidelines to the Societies.

Nominations And Elections

The following slate of candidates for Federation Office (1984-85) was presented by the Nominating Committee (Chairman A. Clarke Boyce) at the Spring 1984 meeting.

President-Elect: William Mirick, of CDIC Society (Battelle Memorial Institute). One-year term. He is currently Treasurer.

Treasurer: Carlos Dorris, of Dallas Society (Jones-Blair Co.). One-year term.

Executive Committee: Saul Spindel, of New York Society (D/L Laboratories, Inc.). Three-year term.

Board of Directors (Members-at-Large): James Geiger, of Southern Society (Sun Coatings); Richard Keifer, of Philadelphia Society (McCloskey Varnish Co.). Two-year term for each.

Board of Directors (Past-President Member): Michael Malaga, of Cleveland Society (Consultant). Two-year term.

At the spring meeting, Mr. McCormick, of the Baltimore Society, placed John Emmerling, of the Baltimore Society (Lenmar, Inc.), in nomination as a Member-at-Large on the Board. There were, therefore, three candidates for the two available positions.

VOTING

With the exception of the Board of Directors, the slate presented by the Nominating Committee was elected by unanimous vote.

A secret ballot was taken for the Board of Directors and Messrs. Geiger and Keifer were declared the winners.

Ad Hoc Committee On Research and Education

This committee was formed by President Terryl Johnson after the Spring Board Meeting when it appeared that the name, "Paint Research Institute," would be changed to the Roon Fund. In view of the possible disappearance of the PRI, Mr. Johnson instructed the committee to determine the research and educational areas in which the Federation should be engaged.

Committee members were: Howard Jerome, a Past-President, as Chairman; Neil S. Estrada, a Past-President and Chairman of the Investment Committee; Saul Spindel, Chairman of the Technical Advisory Committee; and Percy E. Pierce and Loren Hill, Trustees of PRI. They met on June 19, 1984. Following is the report of Chairman Jerome.

Discussion centered around the question, "What should the Federation be doing now that PRI is no longer functioning?"

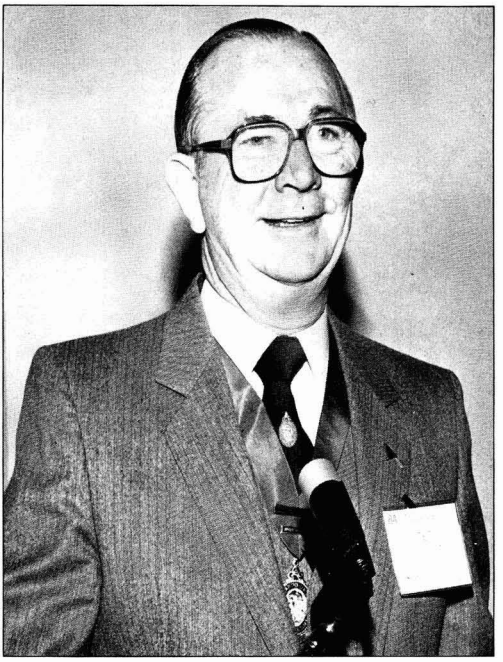
Conclusions reached by this committee present a challenge to the Federation and can be stated as follows:

(1) The name, "Paint Research Institute," be changed. We suggest the name be changed to "Coatings Industry Research Fund" (CIRF). This name is not the only possible one but it is pertinent and was agreed upon by the Ad Hoc Committee. In any event, we feel that the name "Roon Fund" should not be used. The committee feels that the name "Roon Fund" is too limiting and could possibly "turn off" financial donors, whether they be individuals, organizations, or corporations. These types of donors would be more likely to contribute to a fund involving the Federation. In addition, the name "Roon Fund" would not be descriptive of the intent of the new organization. It should be noted that the Executive Committee recommended, and the Board of Directors accepted the proposal, that the name PRI be changed to "Roon Fund." However, this was for the too limited objective of just maintaining the "Roon Fund." The action of the PRI Trustees in recommending that PRI be dissolved left a large gap in Federation activities only partially covered by their suggestion to establish a Professional Development Committee.

(2) The present Trustee arrangement should be terminated and an Advisory Committee should be appointed by the future trustees of the CIRF (the Executive Committee of the Federation). As we envision it, this advisory group of four to five members would have the prime function of determining the future Federation activity in the area of research and education. This group should emit a high level of confidence and credibility and should be responsible for their actions to the trustees. As an ultimate objective the advisory group would be headed by a suitable technical person or staff. This step should be taken as activities demand and funds permit.

(3) The Federation should expend whatever funds are available to educate and provide relevant useful information to the membership. This statement essentially summarizes the feelings of the Ad Hoc Committee. We suggest the following as possible areas of activity:

(a) Provide symposia and tutorials covering technical, manufacturing, and management subjects. Consideration should be given to presenting the same program at several locations across the country to allow more opportunity for members to attend. The inclusion of motivational materials should be an objective. It is our feeling that symposia should be held preferably at a university or a research facility to improve both atmosphere and credibility.
(b) Establish a grant program to universities supporting coatings courses. This would make available money for special equipment which many times is not available or is not available in sufficient quantity.
(c) Should funds become available, criteria should be established to award scholarships to children of Federation members.
(d) Develop a library of audio-visual educational aids. Make these available to Federation members and Societies. The services of qualified professionals should be obtained to develop subject material. Material for professional and motivational development should not be overlooked.
(e) Computer programs on paint-related topics should be developed, possibly by grants at suitable academic sites.
(f) Establish a named Chair (Federation Chair) at Rolla in the field of coatings or polymers. Cost for this has already been determined at $10,000 per year for ten years. The University of Missouri at Rolla welcomes this approach and looks forward to positive action by the Federation. At least one other Society has indicated they would like to participate in such an undertaking.



E.C. (Ted) Saultry, President of the Oil and Colour Chemists' Association, Australia

The above suggestions were discussed in some detail by this committee. We do not consider this the final word but we do feel it gives insight into areas of Federation involvement. The Executive Committee would be well advised to promote discussion regarding the future direction of CIRF with leading members of our industry. Additional input will be valuable. The organizational aspects of the new CIRF, including a name other than "Roon Fund," should be established. Adoption and pursuit of areas of activity will require future consideration and time.

HOWARD JEROME,
Chairman

Paint Research Institute

At its meeting of January 4-5, 1984, the Board of Trustees of the Paint Research Institute recommended to the Federation that PRI be dissolved. They also recommended the establishment of a Professional Development Committee within the Federation.

The Federation Executive Committee met on January 27 and, upon advice from legal counsel, recommended to the Federation Board that PRI not be dissolved, but kept alive for purposes of maintaining the Roon funds and further, that the PRI name be changed to "Roon Fund."

This was approved by the Federation Board in May.

In August, the Executive Committee, following the recommendation of the Ad Hoc Committee on Research and Education, decided to change the name, "Roon Fund," to "Coatings Industry Education Fund."

Since only the Paint Research Institute Trustees can change the name of the organization, a special meeting of the Trustees

was called by President Thomas J. Miranda on October 2. His report of that meeting follows.

A meeting of the Paint Research Institute Trustees was held in Cleveland, OH, on October 2, 1984, to discuss the action of the FSCT Ad Hoc Committee and the proposed action regarding PRI.

Members present were: Dr. Thomas J. Miranda—President; Dr. Darlene Brezinski—Vice-President; William Mirick—Treasurer, Mary Brodie, F. Louis Floyd, Dr. Joseph Koleske, Dr. Percy E. Pierce, and Colin Penny. Absent were Dr. Howard Bender, Secretary, and Dr. Loren Hill.

The Trustees will not approve the agreement to rename the PRI, as proposed by the FSCT Executive Committee and Board of Directors because:

(1) It redelegated control to the FSCT Executive Committee and not the PRI Trustees.

(2) It ignored the recommendations of the PRI Trustees to form a Coatings Professional Development Board.

(3) The FSCT Ad Hoc Committee recommendations did not reflect the aims of the PRI Trustees and duplicated the activities of the FSCT Educational Committee.

(4) It did not provide for the professional needs of the membership, as recommended by the PRI Trustees.

The following recommendations were passed by the Trustees:

(1) PRI should continue as an entity but be renamed "Coatings Professional Development Board."

(2) Retain the current PRI Trustees as constituted, but eliminate the post of Executive Director.

(3) The mission of the "Coatings Professional Development Board" will be to: be dedicated to the professional development of the technical arm of the Coatings Industry and support of the sources of professional education that serve the industry. This may be accomplished through the support and sponsorship of:

- Seminars
- Workshops
- Short Courses
- Speaker Programs for Local Societies
- Coatings Programs at appropriate institutions
- Society research and professional development activities

Uriel Gonzalez, President of the Mexico Paint and Ink Manufacturers Association

(4) Administrative expenses of the CPDB will be tightly controlled to achieve objectives at costs consistent with the funds available.

SPECIFIC OBJECTIVES

(1) Fund a Speakers Group for Societies in which CPDB would pay expenses for quality speakers while Society assumes honorarium costs.

(2) Seek input from Societies formally and informally; establish regular visits by Trustees to the Societies.

(3) Support Society technical activity with matching funds.

(4) Organize and present workshops/seminars on topics of current interest.

(5) Develop short courses.

FUNDING

Funding would be from the FSCT in the current amount now allocated to PRI and from Society and Industry contributions. Part of the income would be set aside to build an annuity resource to provide for future income.

This activity would permit the Trustees of CPDB to reestablish credibility and demonstrate its value to the membership.

The PRI Trustees felt that they were bypassed with the appointment of an Ad Hoc Committee and felt that the FSCT Executive Committee should have permitted the PRI Trustees to respond to their recommendations of January 27, 1984.

It is also recommended that the FSCT Educational Committee be dissolved and its functions assumed by the "Coatings Professional Development Board."

THOMAS J. MIRANDA,
President

New Business

PAINT RESEARCH INSTITUTE TRUSTEES 1984-1985

Incoming Federation President Joseph A. Bauer indicated that—at the PRI Stockholders meeting to follow—he would nominate the incoming members of the Federation Executive Committee as the Trustees of PRI for the coming year. (This followed the recommendation of the 1983-84 Executive Committee). [*Mr. Bauer did present these nominees and they were elected.*]

AD HOC COMMITTEE ON PRI

Mr. Bauer stated he would appoint an Ad Hoc Committee, to include the 1983-84 Trustees of PRI, to: (1) recommend a change in the name of PRI and (2) evaluate the recommendations of the PRI Trustees in President Miranda's report and those of the FSCT Ad Hoc Committee in Chairman Jerome's report—and—set up guidelines as to how they may be implemented. [*Mr. Bauer later appointed F. Louis Floyd, PRI Trustee for the past two years, as Chairman.*]

AD HOC COMMITTEE ON "CHAIRS"

Mr. Bauer was instructed by the Board to form an Ad Hoc Committee to study the possibilities and ramifications of Federation sponsorship of "Chairs" at various universities (as

mentioned in Mr. Jerome's report). [*Mr. Bauer later appointed Loren Hill, formerly of NDSU and a PRI Trustee for the past two years, as Chairman.*]

FEDERATION HONORARY MEMBERSHIP FOR LOWELL F. WOOD

Lowell F. Wood, Society Representative from the Northwestern Society from 1964–1982, was proposed by the Society for Federation Honorary Membership. As specified in Standing Rules II, the Secretaries of each Society and the Board of Directors were advised of the nomination.

The Board elected Mr. Wood a Federation Honorary Member.

Federation Office

The Board had been advised that the purchase of office condominium space in Philadelphia (as had been proposed and approved at the May 18 meeting) was no longer under consideration by the Ad Hoc Committee on the Federation Office because that property was not selling. To purchase 8,000 sf would be an unsound risk which the Federation should not undertake.

Additional space had since become available adjacent to the present offices at 1315 Walnut St. Building management submitted a proposal for an expanded Federation office (4,175 sf to 7,145 sf), including major alterations and improvements, totalling $100,000. As part of the five-year renewal lease arrangement, the Federation would be required to assume a one-time share of $20,000 for those renovations. The sf rental rate offered was $11.00 for the first year and then 75¢ additional each year, ending up in the fifth year at $14.00.

The condomimium property had also submitted lease proposals, the sf rate being $16.50 flat for five years.

In view of the need to enlarge the Federation office as soon as possible and considering the low rate offered by 1315 Walnut St., it was Executive Vice-President Borrelle's recommendation that the offices remain where they are.

With the urgency of the situation in mind, the Board approved Mr. Borrelle's recommendation and he was instructed to obtain the lease agreement for review by the Federation's attorney. The lease is to include a provision permitting sub-lease.

Several Board members stated that it is still in the best interests of the Federation to own an office building sometime in the future. Incoming President Bauer was directed to form an Ad Hoc Committee to study the feasibility of purchasing or erecting a building to house the Federation office. No restriction was placed on location. [*Mr. Bauer later appointed Mr. Mirick as Chairman.*]

Committee Reports

EDUCATIONAL

The annual Educators' Luncheon was held in conjunction with the 1983 Annual Meeting. The meeting was presided over by J. A. Hoeck, Chairman.

This meeting serves as a meeting place for the exchange of ideas to promote and improve our educational commitment to the coatings industry.

At this meeting, we had the opportunity to meet Dr. Robson Storey, a recent addition to the staff of the University of Southern Mississippi. We also had the pleasure of meeting Dr. Peter Rodak, of Toronto, who gave an impressive report on the activities of the George Brown College of Applied Arts and Technology.

The Federation Board of Directors approved a total of $20,000 for the Scholarship Fund for the 1984–85 academic year:

University of Southern Mississippi—$6,000
North Dakota State University—$6,000
University of Missouri-Rolla—$3,000
University of Detroit—$2,000
Kent State University—$2,000
Eastern Michigan University—$1,000

The annual educational meeting was held on April 6, in Cleveland and was presided over by the Vice-Chairman, Ted Favata.

Business of the meeting included:

(a) Review of Federation and Society Scholarship programs.

(b) Society reports; Reports on the annual activities in each Constituent Society.

(c) Report on promoting coatings career opportunities.

JAMES A. HOECK,
Chairman

ENVIRONMENTAL CONTROL

Attended were the meetings of the NPCA Hazardous Waste Water Quality Task Force in November 1983 and March and May 1984, and the Air Quality Task Force in December 1983 and March and September 1984.

Articles on the Uniform Manifest for Transportation of Hazardous Wastes and an OSHA Update were published in the JOURNAL OF COATINGS TECHNOLOGY.

A proposed committee meeting and plant trip to a Hazardous Waste Facility outside of Chicago were cancelled because of lack of interest.

A bulletin on reporting of VOC's by suppliers of paints and coatings is being distributed at the Paint Show and an article on the new form will appear in an early issue of the JCT.

Also attended was a seminar given by the EPA on TSCA 8 (c). Video tapes of the new regulations were made available to the membership of the Federation.

SIDNEY J. RUBIN,
Chairman

PUBLICATIONS

Most of the activities of the Committee involve implementing the work of the joint meeting of the Editorial Review Board and the Publications Committee held in April.

The following are highlighted:

- Review procedures. Review of manuscripts have improved. In most cases, reviewers are returning manuscripts within the time set by the Editor.
- Technical paper supply. We now have an adequate supply of manuscripts and anticipate a good return from the Annual Meeting and from the Roon Award papers. In addition, we are soliciting papers from outside meetings, i. e., American Chemical Society and other sources. We are also reprinting articles from other journals.
- JCT features. "Humbug from Hillman" continues to be popular and we urge readers to provide input to this successful column. Earl Hill's crossword puzzle (CrossLinks) feature has been published. A computer page

CDIC Society Representative Lloyd Reindl chats with Terryl Johnson and Louisville Society Representative James Hoeck

is also under consideration and will be followed up by Dr. Darlene Brezinski.

- Book reviews. They are continuing.
- Federation booklets. As of September 21, 1984, 18 booklets are being written. The editors have four manuscripts in hand at this writing which was the plan set out in January 1984.
- Roon Award papers have been reviewed in accordance with the agreement between the Publications Committee and Joseph Vasta, Chairman.
- The Chairman expresses his sincere thanks to the members of both committees for their dedicated efforts on behalf of the Federation.

THOMAS J. MIRANDA,
Chairman

ROON AWARDS

Our committee received 23 papers from members and non-members of the FSCT. The quality of the papers was excellent. It was a difficult chore to select the finalists. After reviewing all the submitted papers, the committee selected ten for the final round of judging.

Three outstanding papers were selected as winners:

FIRST PRIZE: "Dependent Scattering Theory: A New Approach to Predicting Scattering in Paints" by Susan Fitzwater and John W. Hook, III, of Rohm and Haas Co.

SECOND PRIZE (Tie): "An Analysis and Prediction of Roll-Spatter from Latex Paints" by Debora Flanagan Massouda, of Department of Chemical Engineering University of Delaware; and "Dispersion of (Magnetic) Pigment Powders in Organic Liquids" by H. F. Huisman, of PD Magnetics.

It is interesting to note that Mrs. Massouda, formerly with Hercules and now doing doctoral studies at the University of Delaware, continued her interest in finishes research and submitted a paper on her own.

The other seven papers (among the ten) will also be included in the Annual Meeting Program.

JOSEPH A. VASTA,
Chairman

TECHNICAL ADVISORY

The Technical Advisory Committee has traditionally held one annual meeting at which all Chairpersons of Society Technical Committees are invited to attend to discuss the status of their programs. This meeting also provides them an opportunity to interface with peers and to discuss successful (and unsuccessful) ideas for Technical Committee activities.

The 1984 meeting was held in March and was reported upon at the May Board meeting.

It is anticipated that a meeting of the Technical Advisory Committee will be held this fall to formulate plans for the 1985 meeting to which Society Chairpersons will be invited.

SAUL SPINDEL,
Chairman

TECHNICAL INFORMATION SYSTEMS

The Technical Information Systems Committee (TISCO) has received suggestions that the following projects, all of interest to small coating companies, be considered for committee action:

(1) a bibliography of current books in coatings and related fields;

(2) a list of commercially available computer programs for use in the coatings industry;

(3) a list of information sources and services which cover published information pertinent to the coatings industry;

(4) a cumulative index to the JOURNAL OF COATINGS TECHNOLOGY.

Committee members will be polled for their comments, priorities, and additional suggestions for projects.

As is customary, TISCO is compiling the 1984 Annual Subject Index to the JCT.

The compilation of the update to the "Technical Computer Applications in the Coatings Industry: A Bibliography 1968-1979," mentioned in the last TISCO report to the Board of Directors, continues.

HELEN SKOWRONSKA,
Chairman

DELEGATE TO SSPC

Approximately 300 attended either the SSPC annual meeting, the symposium or both, held September 17-20, 1984. Of these, about 15% are members of the Federation.

At the meeting, it was announced that SSPC now has about 1,000 members and 160 supporting organizations.

The following awards were made:

John D. Keane (Retired Executive Director of SSPC)—SSPC Award of Merit and the Mellon Institute Certificate of Commendation. In addition, the SSPC Award of Merit will now be called the John D. Keane Award of Merit.

"Duke" Mallory (Retired from Wheelabrator-Frye)—John D. Keane Award of Merit.

John Peart (Avondale Shipyards)—SSPC Certificate of Appreciation.

The following technical groups met during September 17-18:

Surface Preparation—Power Tool Cleaning—
Draft #3 of a proposed specification was reviewed and then submitted to the main Surface Preparation Committee for consideration. It exceeds the standards of SSPC-SP3 in that it describes surface cleaning equivalent to that achieved by abrasive blasting.

Surface Preparation—Wet Blast Cleaning—
Draft #3 of a "Guide to Water Blasting With and Without Abrasives" was reviewed and will be submitted to SSPC for approval. Draft #1 of "Air/Water/Abrasive Blast Cleaning" was also reviewed and will be circulated for comment.

Surface Preparation—Blast Cleaning—
The balloting of revised specifications for SSPC-SP5, SP6, SP7 and SP10 was reviewed and the negatives resolved. The final documents will be presented to SSPC for final approval. It is anticipated that they will be published by the end of the year.

Surface Preparation—Blast Cleaning Abrasives—

Abrasive specifications by the US Navy and the Society of Naval Architects and Marine Engineers (SNAME) were reviewed. It was decided to broaden the scope of the proposed SSPC specification to include sand, slag, mineral abrasives, organic abrasives, manufactured abrasives and metallic abrasives. The physical and chemical characteristics specified will include fines, moisture content, soluble salt content, hardness, free silica, specific gravity and dust generation.

Surface Preparation—Visual Standards—

The results of a survey were reviewed and demonstrated the need for revised and expanded visual standards. A task group was formed to prepare an outline of work to be done. SSPC will determine costs for conducting a pilot project.

Zinc Coatings—Metallic Zinc Coatings—

The scope of this new committee will be: To determine the elements of good practice in the use of and topcoating of metallic zinc coatings, and to prepare a guide describing good practice for users of metallic zinc coatings. Three task groups were formed:

(1) Metallizing;

(2) Hot Dip Galvanizing;

(3) Electrodeposited, Electrogalvanized, and Mechanically Deposited Metallic Coatings.

Zinc Coatings—Zinc-Rich Topcoating—

Draft #3 of the "Guide to Topcoating Zinc Rich Primers" was reviewed and revised. The revised version will be circulated for comment.

Metallizing—

The scope of this new committee will be: To develop recommended practices, procedures and guides for thermal spraying for the corrosion protection of steel. A draft specification, prepared by a Zinc Institute task group, will be circulated for comment.

Chlorinated Rubber—

Four sub-guides of SSPC Painting System Guide 15.00 were reviewed and approved after some minor revisions. These will be forwarded to SSPC for final approval. It is anticipated that they will be included in the next edition of SSPC Manual, Volume 2 "Systems and Specifications".

Coal Tar Epoxy—

SSPC—Paint 16, "Coal Tar Epoxy—Polyamide Black (or Dark Red) Paint" was reviewed and approved after some minor revisions. An ad hoc task group was formed to revise two military specifications MIL-C-18480B and MIL-C-15203D to conform to SSPC specification format. All will then be submitted for approval.

Latex Coatings—

A survey on the extent of use of SSPC—Paint 23, Paint 24 and Painting System Guide 18.01 was reviewed. It appears that little use is made of these specifications. Furthermore, advances have been made in their technology. Therefore, the specifications will be revised to bring them up to date. The preparation of a latex metal painting handbook will also be considered.

Water Miscible Coatings—

Draft #2 of the specification "Water Miscible Primer for Steel Surfaces" was reviewed and revised. Draft #3 will be circulated for consideration and comment.

Water-Borne Epoxies—

Drafts of two paint specifications and one painting system specification were reviewed and some minor revisions made. Unresolved questions on minimum requirements for salt fog and humidity exposure tests were directed to SSPC for laboratory investigation.

Thickness Measurement—

Draft #1 of a specification on "Method of Measurement of Dry Film Thickness by Destructive Means" was reviewed and revised. Draft #2 will be distributed for consideration before the next meeting.

Inspection—

Draft #6 of the outline for the comprehensive Inspection Manual were reviewed and revised. Additional authors and reviewers were recruited from those attending. Letters will be sent to authors soliciting draft chapters.

Maintenance Repainting—

The Guide for Maintenance Repainting was reviewed with reports from eight task groups:

(1) Establishing a Maintenance Painting Objective;

(2) Conducting a Survey for Maintenance Repainting;

(3) Economic Considerations in Selecting Systems for Repainting;

(4) Identifying Existing Paints on a Structure;

(5) Compatability of New Paint Over Existing Paint;

(6) Repair and Repainting Techniques;

(7) Painting Contracts for Maintenance Repainting;

(8) Requirements for Record Keeping.

Protective Coating Work Economics—

The scope for this new committee will be: To develop information, refine methodologies and develop recommended procedures for determining costs for coating work so that the costs of various systems can be understood on a comparative basis.

Three task groups will investigate:

(1) Surface Preparation—Applications Costs;

(2) Coating Material Costs;

(3) Maintenance Coating Work Costs.

Regulations—

The committee discussed regulations with respect to volatile organic compounds (VOC), abrasive dust, lead compounds, chromates, cuprous oxide, zinc compounds and the right-to-know laws. Compilations of these regulations will be made by surveying the membership and other organizations.

FHwA Bridge Painting Research—

A review was presented on FHwA research projects for improving field reliability, coatings for non-blast cleaned steel and corrosion of and painting weathering steel.

Advances in Coatings Technology for Steel—

This is the new name (ACTS) to replace PACE III. This program, an extension of PACE I and II, is primarily concerned with the evaluation of coatings formulated for environmentally acceptable surface preparation, pigmentation and VOC. It also provides an opportunity for both user and supplier to obtain unbiased evaluations of their proprietary products in comparison with well known controls whose performance has been monitored over the past 30 years.

The Symposium on Maintenance Painting of Industrial Plants was held on September 19 and 20. It consisted of four sessions:

(1) Five speakers discussed various aspects of "The Systems Approach to Painting Steel Structures."

(2) Four speakers covered typical "Paint Materials for Industrial Maintenance."

(3) Four speakers reviewed various "Contractor/Consultant-Aided Painting Programs."

(4) Three speakers discussed some "Technical Innovations in Plant Maintenance."

SIDNEY B. LEVINSON,
Chairman

Society Reports

Baltimore

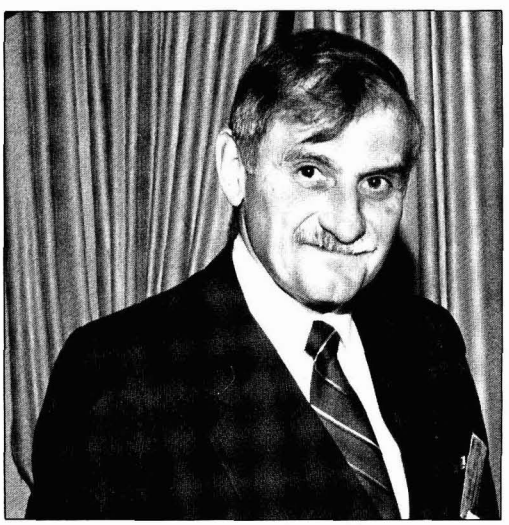
Membership stands at 236 . . . Technical Steering and Manufacturing Committees each sponsored Society meeting programs . . . Society sponsored seven-week paint additive course at Essex Community College . . . Two $1,000 scholarships awarded to children of members . . . Gordon Allison, Society Past-President, awarded Herman Shugar Award . . . Technical Steering Committee working on three projects: Instrumental Chalk Adhesion; Introduction of Computers to the Laboratory; and Dispersion—Make It More Objective . . . Society's Virginia Section held four meetings.

Birmingham

Average attendance at monthly meetings was 83—a new record . . . Technical Committee completed work on Color Aptitude Test Set study and is preparing paper . . . History Subcommittee nearing completion of study on paint industry in Birmingham area . . . Club continues to sell FSCT publication in UK . . . Issued Membership Certificates and Distinguished Service Certificates . . . Quarterly Club Newsletter to be issued starting in fall 1984.

Chicago

Membership is steady at 860, with 145 persons attending monthly . . . Education Committee working with Chicago PCA in sponsoring basic coatings course at Kendall College . . . Successful "SYMCO" held April 17-18, with theme, "Dawn of a New Beginning" . . . Paint-related seminars sponsored at Purdue University . . . Sponsored award at Chicago Science Fair . . . Scholarships provided for North Dakota State University, University of Missouri—Rolla, and Eastern Michigan University . . . Technical Committee completed project on "Renewable Resources for Coatings" and presented paper at 1984 Annual Meeting. Committee continuing mildew-inhibiting paint testing program and oven vs shelf stability testing . . . Manufacturing Committee held successful first seminar—"Manufacturing and Waste Management"—attendance was 105.



Board Member-at-Large Rudolph C. Albrecht, of the Chicago Society

C-D-I-C

Technical Committee reactivated. Initiated two projects on Can Lining and Pigment Corrosion Inhibitors . . . Society honored Lew Larson for his 50 years in paint industry.

Cleveland

Record 36 members inducted at October meeting . . . Initiated student rates at seminars and monthly meetings . . . Contributed reference books to local university libraries . . . Held joint meeting with Cleveland PCA. Sponsored joint symposium with PCA on Innovative Manufacturing Concepts . . . Held successful 27th annual symposium.

Dallas

Contributed to scholarship fund at University of Southern Mississippi . . . Technical Committee completed work on project, "Factors Affecting Application and Marketability of Water-Borne Industrial Enamels"; presented paper at 1984 Annual Meeting.

Detroit

Society gained 40 new members . . . Held first joint Focus symposium with Color Council and ISCC, "Dynamics of Automotive Color"; attended by 500 . . . Charles Linahan, Technical Director of Mercury Paint, elected Member of the Year . . . Contributed $2,000 to Dr. K.C. Frisch, of University of Detroit, for ongoing research on the preparation of urethane acrylic interpenetrating polymer network . . . Education Committee continuing sponsorship of coatings courses at University of Detroit: Coatings Laboratory, Surface Coating Technology, Fundamentals of Automotive Paint Systems, Polymer Technology, and Principals of Color Technology . . . Society offering $1,000 scholarships to U of D.

Golden Gate

Manufacturing Committee sponsored conference on "Safety and Robotics"—65 attendees . . . Technical Committee presented paper on "Water-Borne Corrosion-Inhibitive Primers" at 1984 Annual Meeting . . . Two $1,000 scholarships awarded.

Houston

Hosted Southwest Paint Convention, with 237 attendees . . . Technical Committee now active and presented paper on "Paint Spray" at 1984 Annual Meeting.

Kansas City

Manufacturing Committee completed FSCT A/V presentation, "Operation of a Vertical Sandmill" . . . Technical Committee participating in mildew-inhibitive paint exposure testing . . . Society contributed to New England Society's Boston Stone project . . . Awarded prizes at local Science Fair.

Los Angeles

Membership increased to 613 . . . Awarded $7,000 in scholarships and donated $1,000 to University of Missouri—Rolla . . . Manufacturing Committee held successful seminar with 100 attending . . . Paint course, sponsored by Education Committee, held at Cal State. Committee created summer job placement bureau . . . Technical Committee active with six projects: Block resistance of gloss latex enamels and water-reducible coatings; Spontaneous combustion of surface coatings; Rheology of gloss latex enamels; Acrylic modification of water-reducible alkyds; Computer program for paint calculations; and Mildew resistant latex project. Society review

committee formed to screen Technical Committee papers . . . Contributed several new books to Coatings Section at City of Commerce Library . . . Awarded 50-year pin to Bernard Friedland, of Seaside Paint; eleven 25-year pins presented. Elected Albert Aronow and Clyde Smith Honorary Members . . . Plans continuing to host Western Coatings Societies Symposium in Anaheim, Feb 26-Mar. 1, 1985 . . . Text Book Committee in process of writing text of modern paint technology for use in courses.

Louisville

Hosted FSCT Spring Meetings . . . Manufacturing Committee being reorganized . . . Education Committee continues to sponsor courses at University of Louisville: "Surface Coatings Technology I—Resins" and "II—Formulation of Chemical Coatings" . . . Held successful environmental symposium, with 113 attending.

Mexico

Decrease in membership and financial problems severely limited Society activity . . . Sponsored one-week course in Coatings Technology, presented by John Gordon.

Montreal

Hosted 1983 Annual Meeting, first FSCT convention held outside U.S. . . . Distributed questionnaire to members to update Long Range Planning Committee data . . . Prepared duties roster for members of Executive Committee.

New England

Held joint meeting with New England PCA . . . Highlight of year was Third Biennial Expo—73 exhibit booths and 800 attendees . . . Educational Committee developing A/V presentation on career opportunities in coatings industry . . . Boston Stone project continuing, with progress being made on historic review and display and protection studies. Over $5,300 raised to support project . . . Technical Committee participating in mildewcide exposure project . . . Formed new Long Range Planning Committee.

New York

Elected Herbert Hillman and Herman Singer, both Society Past-Presidents, to Honorary Membership . . . Society continues to administer three industry scholarships . . . In conjunction with New York PCA, Education Committee sponsors Basics of Coatings course. Laboratory Course for Paint Technicians is also offered . . . Technical Committee active in two areas: Utilization of Computers in the Coatings Industry and Biocidal Polymers in Paints.

Northwestern

Nominated Lowell Wood, Past-Society Representative, for FSCT Honorary Membership . . . Sponsored Education Night for students from North Dakota State University . . . Contributed to New England Society's Boston Stone project.

Pacific Northwest

Membership continuing to increase presently at 233 members . . . Held successful spring symposium, with 241 attending . . . Sponsored John Gordon presentation of two-day course in Advance Formulations in Latex Coatings . . . Published Society Handbook.

Piedmont

Society celebrated its 25th anniversary . . . Averaged 50% of membership attending monthly meetings . . . Continuing to sponsor academic program at University of North Carolina at Greensboro . . . Working to activate Technical Committee program.

Pittsburgh

Looking forward to acting as host Society for both the Symposium on Color and Appearance Instrumentation, to be held April 17-18, 1985, and the Federation 1986 Spring Meetings . . . Held joint meeting with National Association of Corrosion Engineers . . . Technical Committee compiling literature survey on computer hardware/software applicable to the coatings industry . . . Educational Committee's coatings technology basics presentations generating high school student interest . . . Contributing awards at local Science Fair.

Rocky Mountain

Gaining in both membership and monthly meeting attendance . . . Educational Committee established formal educational fund . . . Technical Committee active in project work for presentation at 1985 Annual Meeting.

Toronto

Manufacturing Committee holding monthly dinner meetings . . . Toronto/Montreal Joint Technical Symposium outstanding success with 165 registrants . . . Membership remained constant at 400 . . . Society incorporated in May 1984 . . . William Dunn elected to Honorary Membership.

Western New York

Admitted 12 new members . . . Held joint meeting with Buffalo PCA.

The next meeting of the Board of Directors will be on May 17, Omni International in Baltimore, MD.

In Memoriam

We report with deep regret the passing of the following members during the last year.

Baltimore

JULES A. FELEDY—Drew Chemical Corp.

Chicago

MARTIN J. MONAHAN—Retired (Acorn Chemical Co.)
DAVID E. BENOIT—Kerr-McGee Chemical Corp.

C-D-I-C

ROBERT F. SCHWARTZ—Hanna Chemical Coatings Corp.

Cleveland

WILLIAM A. HARSHAW—Harshaw Chemical Co.

Detroit

CHARLES R. HARVEY—Boehle Chemicals, Inc.

Kansas City

STANLEY M. COX—Retired (Cook Paint & Varnish Co.)
CLARENCE MAYFIELD—Retired (Davis Paint Co.)
RICHARD VAN DEUTEKOM—Retired (Sherwin-Williams Co. and Tnemec Co.) and Society Honorary Member

Los Angeles

WILLIAM A. GERHARDT—Retired (Reichhold Chemicals)
FRANK H. MARTIN—Retired (PPG Industries)

Louisville

W. JERRY MORRIS—Celanese Specialty Resins Co.; Society Treasurer

New England

JAN EARLY—Eastman Chemical Products' Chemical Division
WALTER F. KUSTER—Retired (Carpenter-Morton Co.); Federation Past-Pres. (1942-43) and Society Past-Pres.

New York

MARVIN KRESS—Red Devil Paints & Chemicals
W. ARTHUR WEISMANN—Reichhold Chemicals, Inc.
JOSEPH LORE—Verflex Co.
M. A. ZECCHIN—Global Coatings

Northwestern

STANLEY VIEHL—Retired (Glidden)

Pacific Northwest

GEORGE H. GOUGH, JR.—Retired (McCloskey Varnish Co.); Society Past-Pres.
ANDREW W. DEBRINO—Drew Paints, Inc.
JACK MEYERS—Myers Drum Co.
ROBERT NORRIS—(Company affiliation not known)

Philadelphia

DR. CALVIN A. KNAUSS—Retired (Reichhold Chemicals, Inc.); Federation Honorary Member and Society Past-Pres.

St. Louis

WILLIAM J. MOORE—Retired (U. S. Vehicle & Chemical Co.)
WILLIAM WECKBACH—Brod-Dugan Co.

Southern

JOHN C. CALDWELL—Caldwell Chemical Coatings, Inc.
DR. J. SCOTT LONG—Retired (Professor at University of Southern Mississippi and Executive Director of Paint Research Institute); Federation and Society Honorary Member.
HOWARD S. MCCULLOUGH, SR.—McCullough & Benton, Inc.

Toronto

RON HOUSE—Agquip Ltd.

Western New York

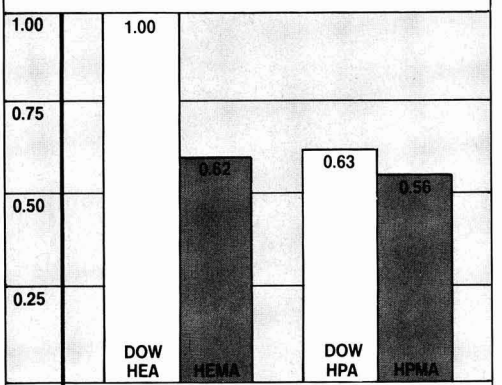
GLENN L. KNOTT—Retired (Mooney Chemicals, Inc.)
MARTIN E. SCHLEICHER—Retired (Bisonite Co., Inc.); Federation Past.-Pres. (1968-69) and Society Honorary Member and Past.-Pres.

ELDER C. LARSON,
Chairman, Memorial Committee

DOW HEA and HPA . . .

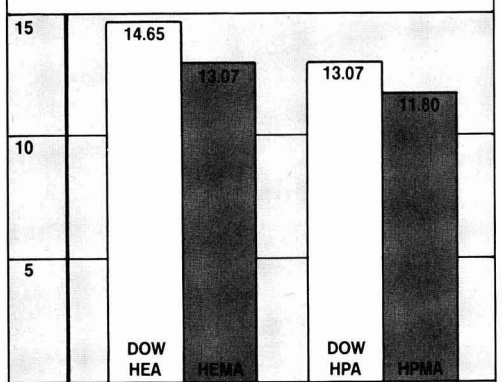
Pound for pound, more crosslinking sites than methacrylates.

Relative Reaction Rates of Copolymers Incorporating Hydroxyalkyl Acrylates vs. Hydroxyalkyl Methacrylates.†



†Measurement using example copolymer of styrene/butyl acrylate and 0.05 mole of hydroxy monomer per 100 g. polymer. Reaction rate with hexamethoxymethyl melamine at 100°C.

Comparative Hydroxyl Content – Hydroxyalkyl Acrylates vs. Hydroxyalkyl Methacrylates.



HEA: DOW hydroxyethyl acrylate
HEMA: hydroxyethyl methacrylate
HPA: DOW hydroxypropyl acrylate
HPMA: hydroxypropyl methacrylate

DOW hydroxyethyl acrylate (HEA) and hydroxypropyl acrylate (HPA) functional vinyl monomers offer substantially higher OH reactivity than hydroxyalkyl methacrylates. Plus, their lower molecular weights translate into a 12% reduction in functional monomer requirements and lower material costs.

Exceptional versatility for resin polymerization.

DOW HEA and HPA copolymerize with a wide variety of other vinyl monomers in both aqueous and non-aqueous systems. The resulting pendant hydroxyl functionality can be used in crosslinking reactions with melamine resins, polyisocyanates, polyanhydrides and epoxy resins.

Faster crosslinking and lower temperature requirements save time and money.

When HEA and HPA hydroxyl functionality is added to polymers and copolymers, higher reactivity in crosslinking reactions is the result. This permits faster curing cycles and accelerated line speeds for increased productivity.

With DOW HEA and HPA, polymers can be converted into radiation curable resins when vinyl unsaturation is introduced through reactions with backbone functional groups. And high reactivity at lower temperatures makes HEA and HPA useful in coatings for plastics and other temperature-sensitive substrates.

Favorable end-use properties.

DOW HEA and HPA hydroxyl functionality can also contribute:

- Outstanding mechanical and endurance properties in coatings enamels.
- Solubility in water and polar solvents.
- Stabilization of aqueous polymer dispersions.
- Improved adhesion to metals, wood, textiles, paper and other substrates.

Put DOW HEA and HPA to work for you.

Dow pioneered the commercial development of hydroxyalkyl acrylates. As the HEA/HPA leaders, we have in-depth product knowledge and experience to assist you with polymer development. Find out how DOW HEA and HPA can outperform methacrylates in your resin systems, pound for pound.

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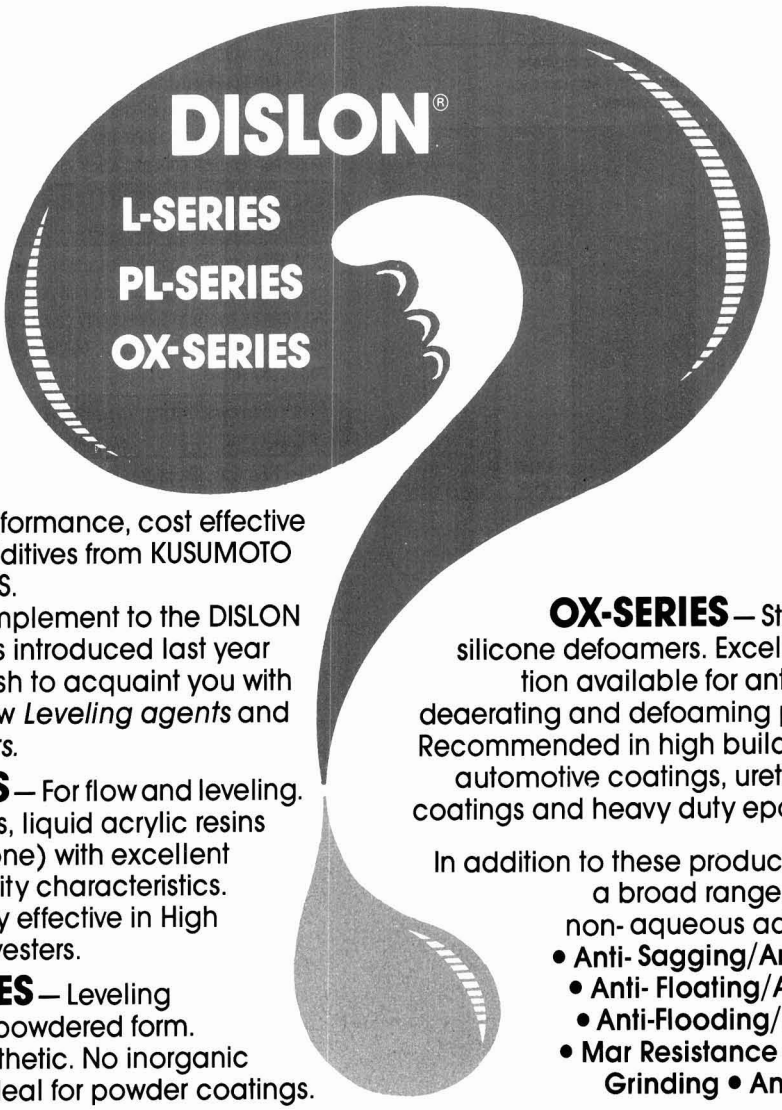

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JOURNAL OF COATINGS TECHNOLOGY

GUIDE FOR AUTHORS

GENERAL

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

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

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

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Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1985 Roon Awards Committee, Phillip W. Harbaugh, Reliance Universal, Inc., P.O. Box 37510, Louisville, KY 40232. (For complete details, see "Roon Awards" section of the JOURNAL for January 1985.)

MANUSCRIPT PREPARATION

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

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

Title

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

Authors' Biographies and Photographs

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

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

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

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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Graphs should be on good quality white or non-photographic blue-lined 8½ × 11 inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a *copy* of the original graph. Graph captions and legends should also be typed on a separate sheet for typesetting.

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

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

Nomenclature

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

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

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

Equations

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

Summary

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

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

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

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

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

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

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CITY AND STATE

Battelle Cites Growth of U.S. R&D, but Is Not Panacea for Unemployment

While the United States leads in creating new technology, it lags some nations in applying technological developments.

This is one of several observations on research and development presented by Dr. Joseph W. Ray, Associate Director of Battelle Memorial Institute's Columbus Division, while speaking at a gathering of 200 industrial and governmental leaders attending a technology briefing at Battelle.

Dr. Ray also noted that:

- Continued growth of industrial spending for research and development in the U.S. "signals a clear commitment to technology"
- University-industry collaboration in research is increasing, but care should be taken to assure continuation of quality instruction, the emergence of new technologies through basic research, and the flow of scientific and engineering graduates for industry
- High-technology industries are important, but their biggest impact on the economy will come from their application in more mature and basic industries
- Manufacturing in the U.S. is recovering and technology should be applied to help it remain competitive.

Commenting on the position of the United States in R&D, Dr. Ray said America is the acknowledged leader in developing new technology, but he cautioned: "The application and use of technology is where our international trading partners have scooped us—and often by using the very technology we've created."

However, he cited several hopeful actions under way to regain U.S. leadership in applying technology. First, he said, the continued growth of industrial R&D spending in the U.S. signals a clear commitment to technology. "For the past six or seven years," Dr. Ray said, "R&D spending by U.S. industry has averaged over 5 percent annual real growth—growth over and above inflation."

There also is an awareness, he said, that U.S. industry views technology as a key to international competitiveness, as do other countries. For example:

- Japan and Western Europe are increasing their R&D investments and by some measures are already outpacing U.S. investment levels
- Newly developed countries already have relied on technology to gain significant economic growth
- Many developing countries are attempting to tie their future to the high-technology bandwagon.

On another front, Dr. Ray noted, there has been "enormously increasing pressure for university-industry collaboration in research."

At the federal level, he said, the National Science Foundation has sparked and is continuing to encourage a number of university-industry centers, and many states have initiated similar programs.

While these efforts to increase technology application are to be applauded, Dr. Ray suggests two caveats: (1) attention must be given to industry involvement in teaching, such as through providing laboratory equipment, to continue the flow of scientific and engineering talent needed by industry; (2) universities must continue, through basic research, to supply needed new technology. "We need," he said, "a balance of technology creation and technology application."

Observing that several states have initiated programs to promote industry-university cooperation, Dr. Ray cited Ohio's Thomas Alva Edison Partnership Program, which serves as a bridge between basic research and applications. "In large measure," he said, "it looks to universities as the creators of technology and to industry and independent laboratories as the appliers and exploiters of these opportunities." The Ohio program, unlike those in many states, focuses each technology application center on a specific technical area related to the strengths of its home city and nearby universities.

Many state university-industry programs, Dr. Ray noted, are prompted by a desire to "climb on the high-technology bandwagon." However, he said, while high tech is important to our economic future, "there is the danger of getting so wrapped up in the 'magic of high tech' that we lose sight of its real impact on our economy."

He observed the tendency to pursue high-tech industry as the solution to unemployment. But, he pointed out, during the 1970s high technology accounted for less than three percent of the 20 million new jobs in the U.S., and despite expected rapid growth, high-tech jobs are expected to account for less than six percent of all new jobs created during the next 10 years.

"An important point often overlooked in all the high-tech rhetoric," he said, "is that the biggest impact of high-tech industry will come from the application of its products in our more mature and our basic industries."

Dr. Ray rejected the recent doomsday predictions of the death of the U.S. manufacturing industry. While there are individual problem areas, he said, U.S. manufacturing is enjoying a recovery overall.

"But we can't be complacent," he warned. "We should use this reprieve to address our underlying problems and to avoid another obituary which might be far more accurate."

Technology, he concluded, is not the total answer to all of these problems. However, the right technology, used well, can be a significant factor in solving many of them.

Johnson Wax to Construct Emulsion Polymer Plant

Johnson Wax, Racine, WI, will purchase a 20-acre site in Seaford, DE, for construction of a fully automated emulsion polymer manufacturing facility. Richard M. Carpenter, Executive Vice-President of Worldwide Innochem, said that this site was selected because many current key polymer customers are located on the East Coast.

NL Industries Acquires American Cyanamid TiO_2 Business

NL Industries, Inc., New York, NY, has purchased the titanium dioxide pigment business of American Cyanamid. Located in Savannah, GA, the acquired facilities include both sulfate and chloride process titanium dioxide pigment plants, having a total capacity of about 100,000 tons per year, as well as a sulfuric acid unit and an environmentally secure waste acid neutralization plant.

Chicago School's Renovation Draws Attention from White House

James K. Coyne, Special Assistant to the President for Private Sector Initiatives, recently honored a paint-industry coalition for a renovation project sponsored at Chicago's Providence-St. Mel High School. Located in Chicago's poverty-stricken West Side, the school has received national attention for its academic successes. Unfortunately, the school's physical environment is not at the same level as its curriculum.

According to school principal, Paul Adams, the building is in constant need of repair. President Ronald Reagan visited the school twice and has made numerous appeals for financial support.

The National Paint and Coatings Association joined forces with NPCA member Dow Chemical Co., of Midland, MI, and the Chicago Paint and Coatings Association (CPCA) to refurbish the school. Also supporting the project is the Chicago Decorating Products Association.

The group, which represents the largest coalition of industry yet to respond to the President's call for private sector initiative, has already restored the school's library. Made possible by a $25,000 grant from Dow Chemical, the work included knocking out one wall, nearly doubling the size of the room, replastering crumbling walls, and painting. A Chicago non-profit foundation has given $60,000 to be distributed over two years to purchase new books for the renovated library.

In addition, Dow is assisting the school through their "Visible Scientist" program in which a research scientist is helping the school update its chemistry curriculum.

The library's refurbishment is only the first step in the school's renewal. Commented Mel Vincent, of CPCA, "The paint industry has made an on-going commitment to refurbish the entire school, but we can't do that until the major structural problems remaining have been taken care of. We're launching a major effort to enlist more private sector support to get the job done, and we are challenging other businesses to match our commitment."

This project is being undertaken as part of NPCA's "Picture It Painted" campaign, a four-year-old program aimed at beautifying the nation with paint. Similar projects are underway in cities throughout the U.S. Other projects sponsored in Chicago by area paint manufacturers include the donation of paint to the DuSable Museum of Black History, and to Habilitative Systems, a facility for the handicapped.

Sun Chemical and Sandoz to Cooperate in Pigment Production/Distribution

Sun Chemical Corp., New York, NY, has entered into a cooperative agreement with Sandoz of Basle, Switzerland, one of the world's leading manufacturers of dye stuffs, organic pigments, and specialty chemicals. The agreement affords Sun Chemical, a leading U.S. producer of organic pigments for printing inks, textiles, plastics, paints and cosmetics, a direct pigments manufacturing presence in Europe. Sandoz will be provided with access to Sun's pigments distribution network in the U.S.

Under terms of the agreement, Sun Chemical will produce organic pigments and "flushed colors" at a facility on the site of the Sandoz manufacturing complex in Huningue, France. Flushed colors—organic pigments that have been pre-dispersed in an oil vehicle—are widely used in the manufacture of printing inks for publications and packaging. Sun will distribute the pigments chiefly in Western Europe.

In addition, Sun Chemical will serve as the exclusive U.S. distributor of a line of high performance pigment toners manufactured in Europe by Sandoz. These pigments are used extensively by the automotive, plastics, and paint industries.

To facilitate its entry into European pigment production, Sun Chemical will form a new subsidiary, Sun Chemical (France), to be operated under the direction of Peter Ludwig.

Engelhard Plans to Purchase Freeport Kaolin Co.

Engelhard Corp. has announced that it has agreed in principle to acquire Freeport Kaolin Co., a subsidiary of Freeport-McMoRan, Inc., for $100 million in cash. Freeport Kaolin Company is a Gordon, GA-based producer of performance minerals primarily for the paint, paper, and plastics industries.

The proposed acquisition, according to Orlin R. Smith, Engelhard's President and Chief Executive Officer, is "subject to various conditions including negotiation of a definitive agreement to be approved by the Boards of Engelhard Corporation and Freeport-McMoRan, Inc."

Smith said the purchase of Freeport Kaolin would represent "an excellent fit to several of Engelhard's strategically important and growing specialty chemical businesses." He noted that the acquisition would provide Engelhard with "additional manufacturing capacity and mineral reserves needed for its pigments and extenders business and its specialty mineral-based fluid cracking catalysts and Asphalt Residual Treatment (ART^{sm}) process."

PPG Industries to Purchase German Paint Company

PPG Industries, Pittsburgh, PA, has entered into an agreement to purchase a majority interest in Lackwerke Wuelfing Gmbh & Co., a subsidiary of Wilhelm Becker, a major European coatings manufacturer based in Stockholm.

Lackwerke Wuelfing Gmbh is a producer of automotive and industrial coatings. The company has one plant in Wuppertal, West Germany, and employs about 250 persons. PPG has coatings operations in North America, France, Spain, Italy, and Taiwan.

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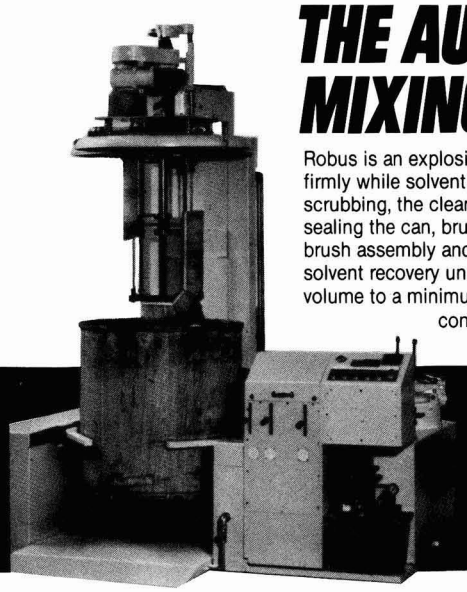

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Objective Predictors Of Paint Appeal

Gregory W. Cermak
General Motors Research Laboratories*

and

Monica H. Verma
General Motors Corporation†

Four groups of non-experts judged the subjective appeal of 40 paint samples which varied in color, gloss, and distinctness of image (DOI). Statistical analysis showed that the subjective judgments were best predicted by color and gloss, while DOI was not an important predictor. These results were observed for both fluorescent lighting and sunlight, for both single and paired presentation of samples, and for two different demographic groups of judges. Large individual differences among judges were observed in color preference.

INTRODUCTION

In studying the appearance factors that influence the subjective appeal of paint finishes, one is faced with the twin problems (a) that there are potentially many factors of importance, and (b) these factors may be interrelated in complex ways. The result of these problems is that if a finish is judged appealing it could be appealing for many reasons. Further, these reasons probably are not equally important. Designers of paint finishes may find it useful to know which of the appearance factors are most important, and yet the complex relationships among the appearance factors may make it difficult to isolate the importance of factors separately.

To isolate the effects of appearance factors, one must create an artificial situation in which the factors of interest are controlled and forced to be separate. For example, consider the case of gloss and distinctness of image (DOI). Although conceptually separate, both are similar measures of reflective properties of surfaces. Any single painted sample exhibits both properties and in a collection of samples, gloss and DOI typically co-vary, i.e., samples high in DOI usually are found to also have high gloss levels. If a sample was rated as highly appealing subjectively, one would not know whether DOI or gloss, or both, was responsible. However, suppose one had a collection of samples for which all the glosses were the same but DOI differed. Then one could ask whether greater subjective appeal was associated with greater DOI. If one also had a collection of samples in which DOI was constant but gloss varied, then one could (a) also determine the impact of gloss on subjective appeal and (b) compare the magnitude of the gloss impact to the magnitude of the DOI impact.

If one could create collections of paint samples so that in the first collection all appearance factors but one were held constant, in the second collection all appearance factors, including the prior variable factor, were held constant but a second factor were allowed to vary, and so on for as many collections as there are factors, then one would have isolated all appearance factors. However, to achieve this in a complete factorial experimental design would require a number of samples that increases exponentially in the number of appearance factors. Furthermore, actually achieving certain combinations of factors might be infeasible due to their inherent correlation. Thus, one might begin a program to isolate effects of appearance factors on subjective appeal with more modest goals.

Presented at the 62nd Annual Meeting of the Federation of Societies for Coatings Technology in Chicago, IL, October 24, 1984.

*Societal Analysis Dept., Warren, MI 48090.
†Paint Materials Group, Chevrolet • Pontiac • GM of Canada, Warren, MI 48090.

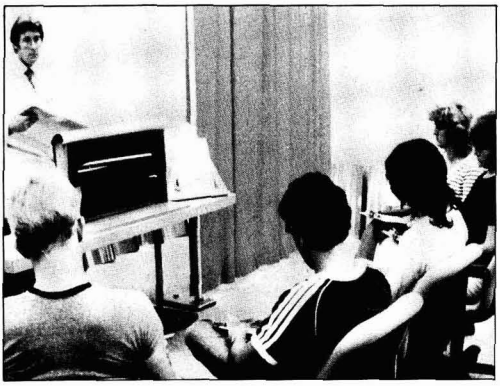


Figure 1—Five judges rate a single sample under fluorescent lighting

GOALS OF THE EXPERIMENTAL DESIGN

The main goal of the present experiments was to isolate the influences of DOI and gloss on the subjective appeal of paint samples. Color and the metallic content of topcoats could conceivably affect the relative importance of DOI and gloss, so both color and metallic vs nonmetallic were also chosen as experimental variables. Other aspects of surface quality, such as roughness and prevalence of defects, were to be left undifferentiated within the color and metallic vs nonmetallic variables. For example, "color travel," apparent "depth of color," and color brightness enhancement by metallic flakes are all sub-factors within the metallic vs nonmetallic and color variables. Thus, within any color and metallic/nonmetallic combination, gloss and DOI were to be isolated and controlled. But, between any two color and metallic/nonmetallic combinations other appearance factors also could vary.

A further goal of the design was to vary methodological details to determine their effects on the relative importance of DOI and gloss. Does illumination by sunlight vs fluorescent lighting affect the relative importance of gloss and DOI for subjective appeal? In judging paint samples, does paired presentation of samples improve gloss and DOI discrimination and change their relative importance compared to the rating of single samples? Importance of appearance factors can be inferred from the statistical relationship between objective measurements (DOI and gloss) and subjective judgments. Do people *say* the same appearance factors are important? Do different consumer types emphasize gloss and DOI differentially? These methodological variables were included in the design goals. Three experiments are discussed:

- Single presentation of samples, fluorescent lighting.
- Single presentation, sunlight.
- Paired presentation, fluorescent.

Paint Samples

Paint samples were prepared using curved aluminum panels measuring 0.7m by 0.4m with a sharp feature line across the main axis. These panels were used because the color travel of metallic colors and other color effects on the automotive body can be simulated on these panels. Four metallic colors, dark brown, green-gray, blue, and gray, and two nonmetallic colors, red and beige, were selected for this study. In addition, a silver color with varying sizes of silver flake was used.

Six panels of each color except silver were made. The aluminum panels were primed with primer surfacer and topcoated with automotive finishes. Three levels of DOI, low, medium, and high, were produced at a low gloss of about 60 (20 degree gloss), and another set was made at a higher gloss of about 80. The DOI and gloss levels were varied by controlling the processing parameters such as air pressure, fluid flow, gun distance, and flash time. The silver panels were made using different flake sizes of aluminum. Only one panel was made with each size flake, and the DOI and gloss obtained were recorded. The average flake sizes used for these panels were 20 μ for a fine flake, 30 μ for a medium flake, and 40 μ for a coarse flake. The fourth panel was also made using a fine flake to produce a bright European-style silver with the help of a rheology control agent. All metallic colors were made using a basecoat/clearcoat automotive finish, and the two non-metallic colors were prepared with a high solids enamel finish.

Measurement of Appearance Variables

The DOI values above 50 were measured with an experimental electro-optic, digital DOI meter being developed at General Motors Corp. A Landolt ring measuring device was used for DOI values below 50. Gloss measurements were taken using a 20 degree geometry meter. Dirt that appears in the finishes was also quantified so that it could be factored into the analysis and its effect on the ratings could be separated from that of the positive appearance attributes of DOI, gloss, and color. The dirt was visually rated by experienced personnel on a three-point scale.

METHOD—SINGLE PRESENTATION, FLUORESCENT LIGHTING

Viewing Conditions

The samples were illuminated by cool white fluorescent ceiling lamps in rectangular fixtures (with sharply defined edges). The illumination level was measured at 80 foot-candles (fc). By way of comparison, measurements were also made in seven dealership showrooms at night when the only source of illumination was lamps. The range of illumination levels observed was 40-150 fc. Thus, the laboratory lighting conditions were very similar to showrooms at night. During the day, however, dealer showrooms have higher illumination levels, and the illumination levels are more variable. Measurements made in 15 showrooms during early afternoon had a range of values from 50-380 fc. The laboratory illumination level was equal to or greater than that of six of the 15 showrooms in the afternoon.

For presentation, a single sample was mounted in a stand with a curtain blocking the view of the panel. The curtain was raised for viewing, then lowered while another panel was being mounted. The stand was painted

a neutral gray. It rested on a table, so that the sample was at eye level for a seated person. Chairs were placed in an arc 2.0 m from the sample. From each chair, reflections of the lamps could be seen in the samples. Since the lamps had sharp edges, any distortion of their images could be clearly seen. The view of the sample was slightly different from each chair. Therefore, any statistical effects attributed to individual judges are actually due to both judges and viewing position. *Figure* 1 shows the presentation of a sample.

Judges

Two groups of judges participated in the experiment. One group consisted of 24 non-GM people who were available during working hours, mainly housewives and students. Fifteen were female, nine were male. The age distribution was bimodal, 13 being 18–25 and seven being 46–55. Ten of the judges had finished some college, four had completed at least four years of college, and the remaining ten had completed high school. Of the ten people who reported a family income, the range was $20,000 to $40,000. The group represents the families of the buyers of mid-priced cars.

The second group of judges consisted of 20 General Motors employees who had previously indicated on a survey that they owned a personal luxury car or were considering buying one. Half the group was female, half male. The modal age was 36–45. Of the 19 who answered the question about education, six had completed at least four years of college, four had some college, and nine had completed high school. In summary, the two groups were quite different. The groups differed in age and income, in occupation, and in types of cars they actually drive. Perhaps more importantly, one group consisted of people in the automobile industry. It may not be an exaggeration to say that if the two groups agree on anything, then what they agree on must be a fairly general phenomenon.

Instructions

The judges were given two sets of instructions—pre-presentation and post-presentation instructions. The pre-presentation instructions requested them to rate the appeal of samples on a nine-point numerical scale. A descriptor was associated with each number ranging from "extremely poor appeal" through "satisfactory appeal" to "sensational appeal." The judges were asked to rate the finish as if it were the finish on a new car they were buying. They were also told there were no right or wrong answers.

The post-presentation instructions introduced three short questionnaires. The first listed nine appearance factors described in lay terms; judges were instructed to indicate those factors to which they paid special attention. The factors included color, metallic content, gloss, orange peel, DOI, depth of color, defects, uneven spray, and dirt content. The second questionnaire listed six attributes of metallic paints, and asked the judges to indicate which of these they noticed. Again, the attributes were described in lay terms. The third questionnaire asked about the judge's age, gender, education, family income, and present automobile.

Procedure

Seven panels were presented as a warm-up, one from each of the colors. Then, the 40 panels were presented in random order. The panels were handled so that the judges could not see their painted side until the curtain of the presentation stand was lifted. About five seconds elapsed with the curtain down while the panels were changed. Each panel was on display for approximately 40 seconds. If any judge was slow in responding, the panel was left on display until everyone had responded. A week later, the same judges rated the same samples again, but they were presented in a different random order.

RESULTS—SINGLE PRESENTATION, FLUORESCENT LIGHTING

Figure 2 shows results of the DOI and gloss measurements. Clearly, the task of completely isolating these two variables was not accomplished. DOI and gloss correlate 0.65 in this set of paint samples, whereas the experimental design called for a correlation of 0.0. However, the correlation is far enough from perfect to permit isolation of the effects of DOI and gloss by statistical means. Intuitively, this isolation of variables can be seen in the figure, since for most values of DOI a range of glosses exists, and for most values of gloss a range of values of DOI exists. The expanded range of DOI's and glosses, relative to the target design values, makes the results of the experiment general across the entire range of possible DOI and gloss.

Overview of the Rating Data

Figure 3 shows the distributions of ratings for the two groups of judges. The distributions are very similar, indicating only a small group effect. The difference between them is in the greater relative frequency of ratings 1, 2, and 3 for the GM group. Since the ratings are not all the same, one can gain an overview of the rating data by allocating the variability of the ratings to different sources. One might suppose that any single rating would depend on the paint sample being rated, on the person

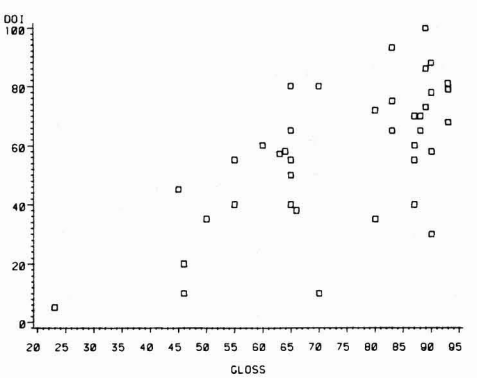


Figure 2—DOI is plotted against gloss for the 40 samples. The correlation is 0.65

doing the rating, and perhaps on the group to which the person belongs. If any given rating were independent of the paint sample being rated, clearly this experiment could say nothing about the subjective appeal of different paints.

To allocate sources of rating variability, an analysis of variance was performed on the ratings as the dependent variable, with paint samples, judges, groups, and a sample/judge interaction as the independent variables. Each of the independent variables was a statistically significant ($p < 0.0001$) source of rating variability. Adjusting for expected mean squares,[1] the size of effects of the independent variables were ordered: (1) sample/judge interaction, (2) sample, (3) judge, and (4) group. The sample/judge interaction can be interpreted as "taste." Each judge has a mean rating over all samples, and each sample has a mean rating over all judges. But, the rating a particular judge assigns to a particular sample also depends on that combination of judge and sample and cannot be predicted knowing only the judge's mean and the sample's mean. The group effect was minor.

Regression Analysis

In the remaining analyses, ratings for the paint samples were averaged across the judges to eliminate the large effects due to judges and concentrate on effects due to appearance factors. Two aspects of the data made the analysis nonroutine. First, the appearance factors contain both variables that are nearly continuous (DOI, gloss) and variables that are categorical (color, dirt level). Second, the nearly continuous variables are correlated. Two analysis programs from the Statistical Analysis System (SAS) package were used to handle the combination of categorical and nearly continuous variables. The programs are called "Bestreg"[2] and "GLM"[3] (for general linear model). They treat the problem of correlated variables in different ways.

The analysis proceeded in three phases. The first phase used the simplest model, namely that mean ratings are a simple linear combination of effects due to color, dirt level, DOI, gloss, and judges' group (GM or non-GM). Effects calculated using GLM are measured by the statistical significance of each variable when it is the last one added to the model. For correlated variables, this

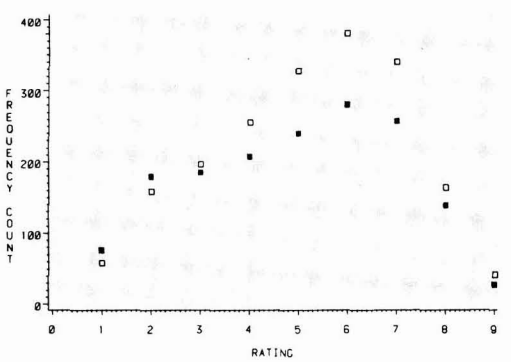


Figure 3—Frequency of ratings for the non-GM judges (open squares) and for the GM judges (filled squares)

Table 1—Results of General Linear Model Analysis of Ratings As a Function of Objective Predictors for Two Lighting Conditions And Two Demographic Groups

Lighting/Group	Variable	F	Probability
Fluorescent/	Color	11.99	0.0001
Both groups	Dirt	0.56	0.5761
	DOI	0.45	0.5058
	Gloss	106.93	0.0001
	Group	6.18	0.0154
Fluorescent/	Color	7.43	0.0002
Non-GM	Dirt	0.39	0.6841
	DOI	0.61	0.4421
	Gloss	62.55	0.0001
Fluorescent/ GM	Color	7.24	0.0001
	Dirt	1.90	0.1681
	DOI	0.01	0.9585
	Gloss	49.86	0.0001
Sunlight/ Non-GM	Color	8.78	0.0001
	Dirt	0.05	0.9535
	DOI	0.51	0.4794
	Gloss	7.61	0.0100

procedure measures the predictive power of a variable beyond the fact of its association with another predictor. *Table* 1 shows the results of this analysis for both groups of judges and for each group separately. The statistic reported is the F-ratio of variance in the ratings accounted for by a variable divided by residual error variance. For both groups, separately and together, gloss and color were important predictors of ratings while DOI and dirt level were not. The model accounted for 86% of the variance in the mean ratings, which indicates that whatever appearance factors were not measured or otherwise controlled could not add much to the prediction of the ratings. The same results held when only samples with DOI of at least 50 and gloss of at least 60 were considered.

The second phase of the analysis was to determine whether any "interaction" effects should be considered, as well as to check on the results of the first analysis. As in the case of the analysis of variance, an "interaction" of two independent variables refers to their joint effect on the ratings which is either greater or smaller than the combination of their separate effects. The Bestreg program was used to examine the importance of interaction effects at a disaggregate level. By "disaggregate" it is meant that each of the categorical variables can be decomposed into several variables, one for each category (minus one, to account for a baseline). The variables group, dirt, color, gloss, DOI, and all their two-way interactions were examined by successively increasing the number of variables added to the regression. At each step a complete search over all variables was conducted, and the combination yielding the greatest variance accounted for was reported. Note that this is not a normal stepwise regression since a variable included in step n need not be included in step $n+1$. After 15 variables had been added, 94% of the variance in the ratings had been accounted for, and further addition of variables was not indicated. Gloss was included in the best combination of variables for all 15 combinations. DOI never appeared as a single

variable, and group appeared only once. Most of the colors appeared as single variables. Group-color and gloss-color interactions also appeared.

The third phase of the analysis used these results to find a good model of the data using the categorical variables in the aggregate. The best model of the rating data using aggregate variables, found with the GLM program, included gloss, color, a gloss-color interaction, and a group-color interaction. The model accounted for 92% of the variance in the ratings. The group-color interaction means that the chief effect of the two groups of judges was on color preference. Both groups agreed that color (and gloss) were important. The gloss-color interaction means that ratings were more dependent on gloss level for some colors than for others. Further analysis showed that the ratings were more affected by gloss level for the metallics than for the nonmetallics. This result also held when only samples with gloss of at least 60 were considered. Recall in *Figure* 1 that light fixtures above and behind the judges are reflected in the paint samples. The greater importance of 20 degree gloss for the metallics may be an artifact of the way basecoat/clearcoat surfaces reflect light at larger angles of incidence compared to the enamel nonmetallics.

The regression results contain two main messages. First, color and gloss are important predictors of appeal ratings, while DOI is not. Second, two quite different groups of judges produced data with this same message. It may be premature to conclude that gloss is more important than color for two reasons: (a) While the range of glosses was large, the range of colors may not have been. If the set of colors had included several truly unattractive samples, one might have observed a larger change in ratings from color to color; (b) When estimating the statistical importance of color, the proper procedure[1] requires that the overall effect of color be normalized by the greater number of parameters estimated for color (6) as opposed to gloss (1). This puts a categorical variable at a disadvantage, statistically. It may also be premature to conclude that gloss is more important for metallics than for nonmetallics for two reasons: (a) The sets of metallics and nonmetallics used were small; (b) The results may have been affected by the geometry of the lighting and viewing conditions.

Table 2—Frequency of Response to the Questions "Are there any particular aspects of the paint samples that you paid a lot of attention to?" (top) and "Which attributes of metallic paints did you notice?" (bottom)[a]

	Non-GM	GM
Color	23	16
Metallic	13	11
Shine	23	17
Bumpiness	8	5
Depth of color	13	11
Clearness of images in paint	16	12
Defects (scratches, chips, etc)	5	8
Uneven paint	5	7
Dirt in paint	1	2
Sparkly, metal-rich, flashy	19	17
Makes color change from dark to light on panel	9	14
Makes color change color on panel	8	8
Highlights the edge in the panel	9	10
Makes color look brighter, shinier	23	19
Small, fine flakes vs large flakes	6	8

(a) The non-GM group contained 24 judges; the GM group 20.

Table 3—Mean Ratings and Standard Errors of the Means For Metallics and Nonmetallics and Four Silver Types, For Fluorescent Lighting and Sunlight

	Fluorescent		Sunlight	
Sample Type	Mean	Std. Error	Mean	Std. Error
Metallic	5.07	0.04	5.85	0.13
Nonmetallic	5.12	0.05	5.15	0.11
Coarse Silver	6.78	0.19	6.29	0.55
European Silver	6.44	0.18	5.62	0.38
Medium Silver	6.17	0.19	6.00	0.38
Fine Silver	5.93	0.21	6.48	0.38

Questionnaire Results

Results from the paint questionnaire are given in *Table* 2, and indicate that both groups of judges were fairly accurate in their self-assessment of what influenced their ratings. Color and "shine" (the lay descriptor of gloss) were chosen most often as attracting attention. "Clearness of images" was also chosen fairly often, which probably reflects the fact that gloss and DOI are correlated in people's perception just as they are in reality. The judges from the automotive industry tended to be more sensitive to the subtle aspects of metallic paints than the non-industry judges.

Mean Ratings for Silvers And Metallics vs Nonmetallics

Table 3 shows mean ratings, and standard errors of the means, for the four silver samples with different flake sizes and for the metallic and nonmetallic samples. For the judgments under fluorescent lighting, the coarser flake samples were preferred, except for the European-style silver. No difference in ratings was observed between the metallics and nonmetallics. This pattern of results suggests that, except for easily-seen coarse flake metallics, fluorescent lighting does not emphasize the subtle aspects of metallic finishes for people who are not paint professionals.

METHOD—SINGLE PRESENTATION, ILLUMINATION BY SUNLIGHT

Viewing Conditions

The paint samples were viewed outdoors in a courtyard bounded on the sides by three-story buildings and on the ends by one-story buildings. All experimental sessions were conducted at times when the samples would not be in the shadows of the surrounding walls. Two sessions were in the morning, two in the afternoon, in late summer when the sun is at a fairly high altitude above the horizon. Illumination was measured at the judges' positions facing the samples with a quality photometer. Three of the four

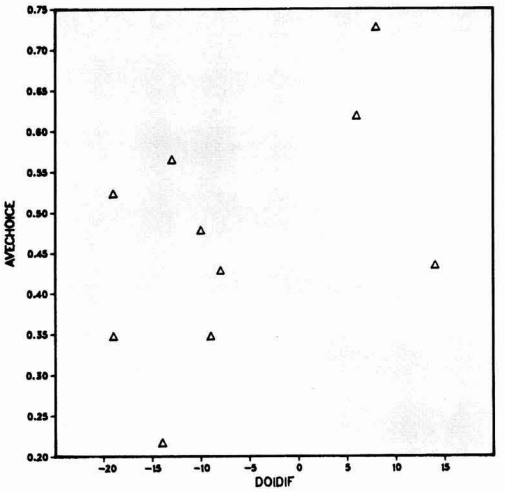


Figure 4—Proportion of left samples chosen (Avechoice) as a function of the difference in DOI between the left and right samples in a pair (DOIDIF)

sessions were sunny or mostly sunny, while the weather during the fourth session changed from completely overcast to partly sunny during the session.

Judges

A group of 21 judges was chosen to be representative of the public at large (within the industrial Midwest). Judges were recruited by an opinion research firm by phone using a quasi-random sampling technique. Potential judges were screened to be between the ages of 18 and 65, and to be licensed drivers. To obtain roughly equal numbers of males (11) and females (10), weekend experimental sessions were offered. Demographic data confirmed that this group closely approximates the general public.

Instructions and Procedure

The paint sample display was set up for each session so that the judges could see the fully illuminated samples. The roof of one of the side buildings could be seen outlined against the sky from the judges' positions as a reflection in the panels. This edge, and the vertical and horizontal details of the building's side, provided a target image for evaluating DOI. Groups of five or six judges sat on benches approximately 2 m from the samples; the view was slightly different for each judge. The instructions from the previous experiment were read to the judges, and the samples were presented singly, as before.

RESULTS—SINGLE PRESENTATION, ILLUMINATION BY SUNLIGHT

Illumination Measurements

Illumination measurements varied from 95–760 fc. Naturally, these measurements varied with time of day (200–300 fc in the morning, 300–760 fc in the afternoon), and with cloud cover. Readings of 280 fc and 760 fc were obtained only minutes apart. Of course, diffuseness of illumination varied with level of illumination. Evidently variability is one of the characteristics of natural lighting. Too few data were taken to permit separate analyses for each level of illumination.

Regression Analyses

The GLM program was used to examine models involving both main effects and interactions. Again, sizes of effects were determined using the F-ratio for a variable when all other variables had already entered the model. Results are given in *Table* 1. Again, color and gloss are significant predictors of ratings and DOI is not. DOI was not a significant predictor of ratings for any regression model in which gloss also appeared. DOI was significant when gloss was not entered in a model due to the correlation between DOI and gloss. Models with gloss consistently yielded greater R^2 fit statistics than the comparable models with DOI (the R^2 for the model with color and gloss was 0.80 and was 0.73 for color and DOI). Note that a metallic/nonmetallic variable cannot be used in the same model as a color variable, for this set of samples, because the two variables were not separated (i.e., a given color did not appear in both metallic and nonmetallic forms). However, when the metallic/nonmetallic variable was substituted for color, it had a larger effect per degree of freedom than did color. Thus, the subjective importance of metallic content increases for strong direct lighting. As before, the dirt level of the samples was not a significant predictor of the ratings.

Mean Ratings

Mean ratings for metallics and nonmetallics, and for the four silver samples, are given in *Table* 3. As already indicated by the regression analysis, metallics were rated higher than nonmetallics in sunlight. Also, the pattern of ratings for the silvers changed. In sunlight, there was no relationship between flake size and mean rating. One point should be noted: The variability of ratings was much larger for the coarse flake in sunlight. Twelve of the

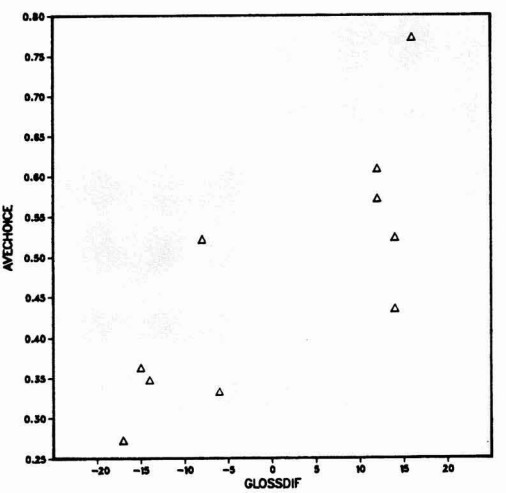


Figure 5—Proportion of left samples chosen (Avechoice) as a function of the difference in gloss between the left and right samples in a pair (GLOSSDIF)

21 judges rated the coarse flake higher than the other silvers, but some of the judges rated it very low. This led to an unexceptional mean rating and a large variance in the ratings. (The standard errors for the outdoor ratings are about twice as large as for the indoor ratings because the number of outdoor ratings was about one-fourth the number of indoor ratings.)

Differences Among Judges

The analysis of variance for the first experiment showed that individual differences exist among judges in how they rate the samples. To examine these differences in more detail, a separate regression was performed for each judge using the variables gloss and color. For the indoor experiment, gloss was the more important predictor of ratings for 40 of the 44 judges. In contrast, for the outdoor ratings, color was more important for seven judges and gloss was more important for eight (six showed no statistical difference). Thus, the effect of color on ratings was more pronounced in sunlight. But, individual differences in color preference tend to mask this effect when ratings are averaged across judges. These individual differences were especially large for the outdoor experiment. Some judges had diametrically opposed preference orders for the various colors.

METHOD—PAIRED PRESENTATION, FLUORESCENT LIGHTING

Design

To present the 40 panels two at a time would result in 780 possible pairs. To obtain a more manageable set of pairs, a computer-aided search yielded 82 pairs with the proper combinations of color, gloss, and DOI. These 82 pairs were in six categories: (1) pairs of the same color where sample A had higher gloss and sample B had higher DOI (a difference of more than five gloss or DOI units); (2) pairs of the same color and equal gloss (less than five units difference) but different DOI; (3) pairs of the same color and equal DOI but different gloss; (4) pairs of equal DOI and gloss but different colors; (5) pairs equal in DOI but different in both gloss and color; and (6) pairs equal in gloss, but different in both DOI and color. For present purposes, the first three categories are most important. They allow a comparison of the effects of DOI and gloss, and show the ability of judges to choose between samples that differ only in DOI or gloss.

Viewing Conditions

A pair of holders for the paint samples replaced the single holder shown in *Figure* 1. The lighting and seating were the same as in the first indoor experiment. A reflection of a lighting fixture could be seen in each sample of a pair from each judge's viewing position.

Judges

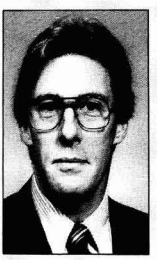
Twenty-three non-GM employees were recruited from local neighborhoods as judges. They were chosen to approximate the non-GM group from the rating experiment. This group does not approximate the population of new car buyers; it consisted mainly of housewives and students. Their ages ranged from 18 to 54; the median was 37. Six were male; 17 were female. Over half had attended at least some college. Median reported family income was $35,000.

Instructions

One advantage of paired comparison experiments is freedom from ambiguities due to the wording of instructions. Subjects are told simply to choose the sample they prefer, for whatever reason. Subjects select their own judgment criteria, and their judgments reveal those criteria. In contrast, when rating scales are used the experimenter must be concerned about (a) the words that describe the scale as a whole (e.g., is paint "appeal" a better descriptor than paint "attractiveness" or paint "quality?") and (b) the words that describe intervals on the scale (e.g., is the interval from "poor appeal" to "fair appeal," nominally one unit, the same as the interval between "satisfactory appeal" and "good appeal," also nominally one unit?). Do these words obscure the judges' natural criteria? Do the judges understand the words in the sense intended by the experimenter? In the present instructions, judges were told to simply indicate the sample in each pair they preferred. They were told to "think of each sample as a potential paint job on a new car that you would drive."

Procedure

Three to five judges participated in an experimental session. The experimenter read the instructions and answered any questions. The 82 pairs were presented in a pre-determined randomized sequence that was the same for each session. For each presentation, the two samples



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were loaded into their respective holders, the curtains were raised, and the samples remained visible until all judges had responded. A session lasted approximately 50 minutes, of which ten minutes were devoted to instructions and questions. Therefore, each presentation cycle lasted about 30 seconds. For each pair, a judge indicated on a printed answer sheet whether she/he preferred the left or right paint sample. The samples had no identifying labels visible to the judges and were hidden behind large free-standing curtains when not in the holders. Thus, the judges had no obvious way to use information about the previous presentation of a particular sample to influence their judgment of it on a current presentation.

RESULTS—PAIRED PRESENTATION, FLUORESCENT LIGHTING

Gloss and DOI Discrimination

The measure of subjective judgment is the proportion of judges who chose a particular sample in a pair. For the ten pairs differing only in gloss, 221 choices were recorded. Of these, 134 (61%) were consistent with the hypothesis that people prefer paint with more gloss. This proportion is significantly greater than chance (50%), given the large number of choices, but is far from impressive. Similarly, for the ten pairs differing only in DOI, 223 choices were recorded. Of these, 131 (59%) were consistent with the hypothesis that people prefer paint with greater DOI, which is again significantly greater than chance but not impressive.

If one considers an individual pair with 23 recorded choices, more than 70% of the choices must be the same to conclude that the choices were non-random. *Figures* 4 and 5 show the proportion of times the left sample was chosen as a function of the difference in DOI (or gloss, respectively) between the left and right samples. In both figures, only two of ten pairs fall outside the range of random responding. As can be seen, gloss and DOI differences on the order of 15 units are required for statistically non-random choice. Recall that the judges were not instructed specifically to attend to DOI or gloss but were told simply to choose the sample they prefer. However, when samples differed only in DOI or gloss, the judges did not spontaneously discover and use these differences in making their choices most of the time. A re-analysis of the data from the single-presentation indoor experiment was consistent with these results. For seven of the same ten pairs differing only in gloss, the ratings of the two samples did not differ significantly at the 0.05 level. And, for all of the ten pairs differing only in DOI, the ratings of the two samples did not differ significantly.

These results show two things: (1) Paired presentation of paint samples did not markedly improve the ability of non-expert judges to use gloss or DOI to form their opinions; and (2) Data for small numbers of paint samples are not powerful. Only when data for many samples and many judges are aggregated does one see clear relationships between objectively-measured appearance factors and subjective judgments.

Gloss vs DOI

For the 12 pairs differing in both DOI and gloss, in opposite directions, 267 choices were recorded. On the basis of random responding, or of equal weighting of DOI and gloss, one would expect 133.5 ± 16.3 choices to be consistent with either hypothesis (a) that DOI is more important than gloss, or (b) that gloss is more important than DOI. In fact, 150 choices (56%) were consistent with the hypothesis that gloss is more important than DOI. This number is too high to support the hypothesis that DOI is more important.

Comparing choices for those samples that differ in DOI and gloss in opposite directions has the advantage of simplicity but the disadvantage of weak data. One can aggregate the results over all 82 pairs and use regression to analyze the relationship between choice probability and gloss and DOI differences. In this analysis, color and dirt level were included as control variables. The results showed a highly significant effect for gloss ($F = 23.8$) and a nonsignificant effect for DOI ($F = 0.2$). Color again was significant ($F = 19.6$). These results are consistent with those of both single-presentation experiments.

SUMMARY

Isolating the separate effects of topcoat appearance factors on the subjective appeal of paint is an important but difficult task. The experiments reported here are a step in that direction. Recognizing that all conclusions are based on the particular set of 40 paint samples used, the results support the following conclusions.

- Gloss and DOI, though correlated, have statistically-separable effects on judged appeal. Gloss is a better predictor of appeal than is DOI.
- Color is an important determinant of appeal.
- The importance of gloss and color, and the lack of importance of DOI, holds for two quite different illumination conditions and for two different subjective judgment tasks.
- Metallic paints are more preferred in sunlight than in fluorescent light. Larger metallic flakes are preferred under weaker and less direct illumination.
- Two quite different groups of judges produced very similar results. The largest effects on subjective appeal are attributable to differences between individual judges, not to differences between groups. Individuals and groups agree that gloss and color are important. They disagree on which colors are more appealing.
- Non-expert judges are not very accurate in relating gloss or DOI differences between paint samples to differences in subjective judgments. This inaccuracy was observed for both single and paired presentation

of samples. Many samples and judges are required to show statistically strong results.

ACKNOWLEDGMENTS

Paint samples were prepared by DuPont, Glasurit, Inmont, and PPG Industries. W. C. Palmer assisted in the data analysis. W. Naschak assisted in measuring gloss and DOI. J. A. Dana evaluated the quality of the paint samples. The study benefited from the advice of L. S. Angell, H. S. Bender, G. D. Cheever, V. M. Guarrasi, D. J. Hart, L. L. Luce, L. T. Medler, and E. A. Praschan.

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Errata

In the article, "Effect of Organic Solvents on Internal Stress in Latex Coatings," by D.Y. Perera and D. Vanden Eynde (Nov. 1984, pp 69–75), Figure 8 was not printed in its entirety. It should appear in the following form:

Corrected
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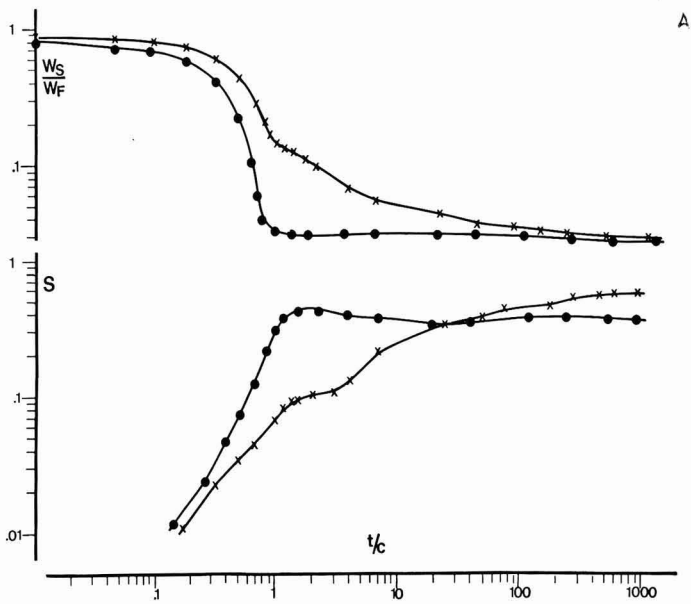
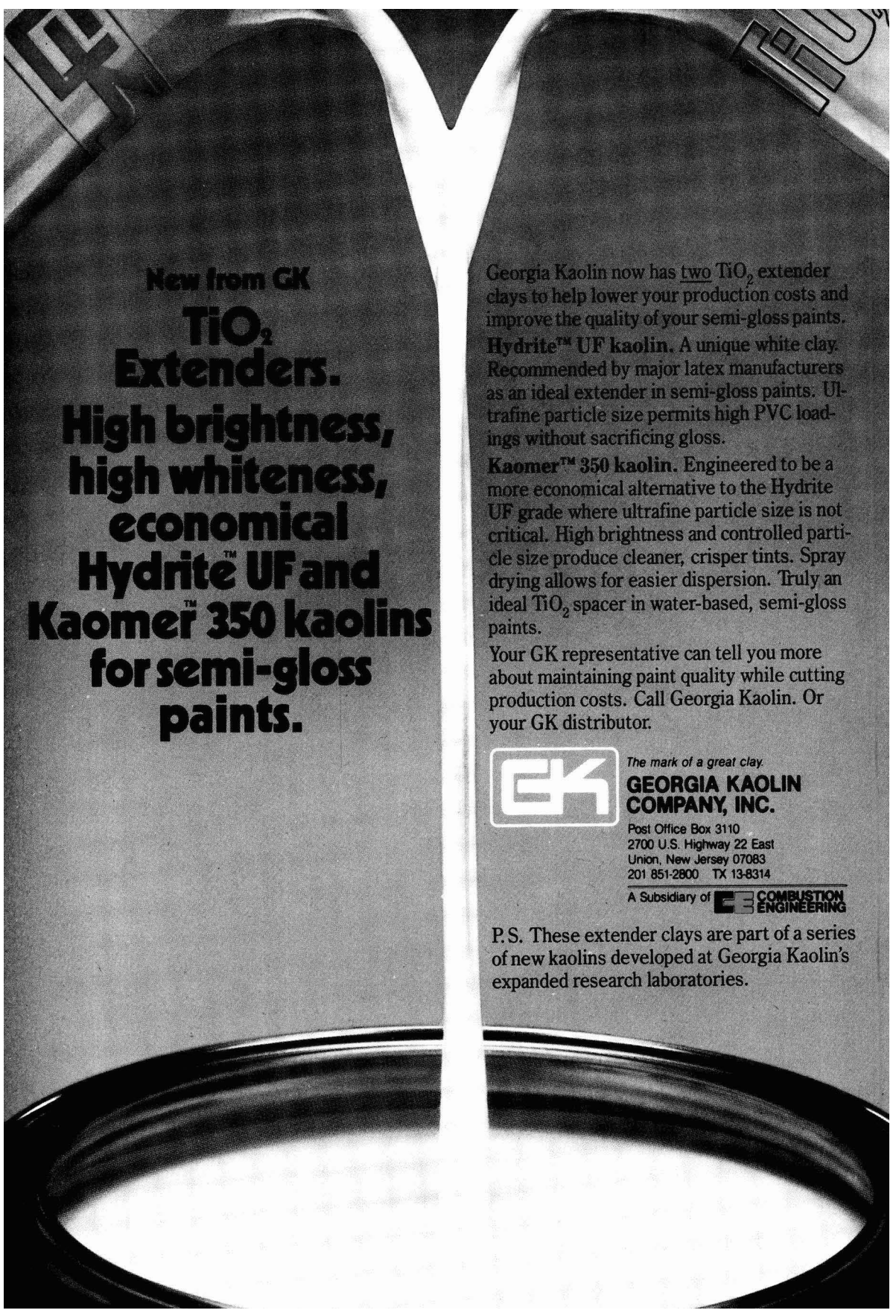


Figure 8—Effect of propylene glycol. Evaporation kinetics (W_s/W_F vs t/c) and internal stress (S, MPa vs t/c) for Paint 6 (•) and Paint 9 (X)



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Identification of Organic Pigments In Paints

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Consultant Color Technology**

Organic pigments in paints can be identified easily by solution spectrophotometry. In this quick, simple, and inexpensive technique a small amount of pigment is extracted from a paint sample (wet or dry) in a few selected solvents. The resulting solution is measured on a visible-range spectrophotometer. The spectrophotometric curve is obtained on a log absorbance vs wavelength scale, in which case the concentration of the pigment in solution does not affect the curve shape. The identification is made by comparison of the shape of the spectrophotometric curve to those in a library of reference curves.

The solution spectrophotometry technique requires only a very small sample, which can usually be obtained by extracting the pigments from less than a square centimeter of a dry paint film or a few grams of the paint sample into a suitable solvent. The presence of any resinous material itself, if it dissolves along with the pigment, rarely interferes with the identification. In most cases, mixtures of pigments do not need to be separated and purified for identification.

INTRODUCTION

It is well known that the best color match is an invariant, non-metameric match that is seen as a match by all observers under all light sources. The best way to make such a match is to use the same pigments as those in the sample to be matched. A paint manufacturer who does custom color matching uses pigments from among a wide variety of organic pigments available in industry and is therefore faced with the problem of selecting the proper pigments to arrive at a non-metameric match. A simple, inexpensive means of identifying the pigments in a sample to be matched would greatly alleviate this problem. Knowledge of the identity of the pigments in the standard to be matched also helps the user of computer color matching in terms of savings in computation time and the assurance of obtaining a non-metameric match. In addition, proper identification can also help to resolve many pigment-related problems between the pigment supplier and buyer, such as contamination, poor performance, etc.

Since the number of inorganic pigments used in paints is relatively small compared to the wide variety of organic pigments used, and inorganic pigments can be analyzed by well-established methods such as atomic absorption spectrophotometry, x-ray diffraction, etc., we shall discuss the analysis of organic pigments only. This paper describes how the organic pigments in paint samples can be identified by solution spectrophotometry without much expense to the laboratory already established. The extraction, separation, and identification of more than one pigment in a sample using a stepwise scheme is also discussed. The reader is referred to references (1–4) for further details and documentation of the identification technique.

SOLUTION SPECTROPHOTOMETRY

Solution spectrophotometry is based on the fact that, in a paint sample, some portion of an organic pigment dissolves to a sufficient degree in appropriate solvents to give a colored solution which has a characteristic spectrum. The spectrum is measured and compared with

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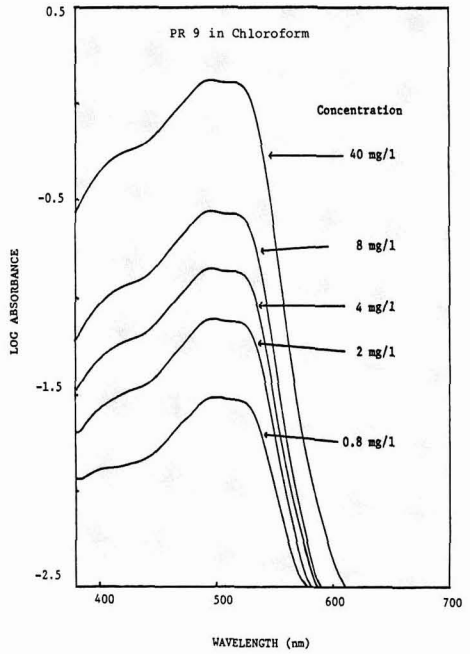

Figure 1a—Constant shape of log-absorbance vs wavelength curves of a pigment solution as the concentration is varied

a set of standard spectra to establish the identity of the pigment. Solution spectrophotometry was used first in 1889 by Bamberger and Bordt,[5] for identification of various dyes from their solutions in water. However, it was not until 1899 that it was used for analysis of the organic pigments available at that time. Soon after, Formanek[6] published a three-volume treatise on the method. Much later, Abbott and Stearns[7] applied this technique to the analysis of (mostly red) organic pigments. Saltzman and Keay[8] further improved this technique by using modern instrumentation and extended its use to many more organic pigments. This paper describes the identification of all types of organic pigments, many of which have been used in paints in the last 10–15 years.

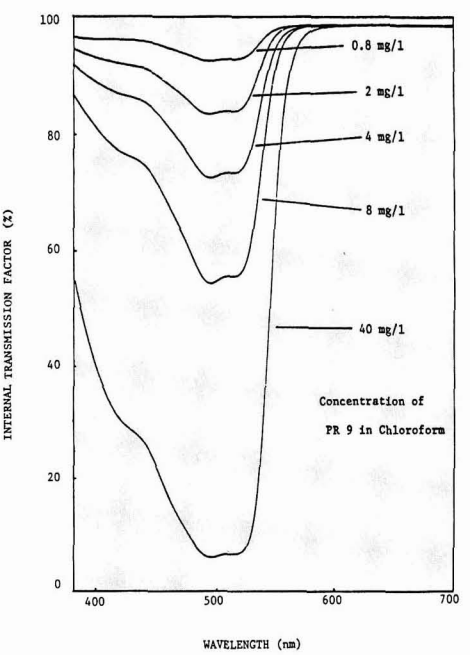

Figure 1b—Effect of concentration of pigment solution on curve shape of spectral internal transmission factor vs wavelength

Important Features Of Solution Spectrophotometry

Two important features which make pigment identification by solution spectrophotometry very useful are: (1) independence of the curve shape upon the pigment solution concentration, and (2) solvent effects on the curve shape. The former makes the curve comparison reliable and the latter allows confirmation of the identification by means of multiple curve comparisons.

In solution spectrophotometry, a spectrophotometric curve is usually obtained by placing the pigment solution in the sample beam and the pure solvent in the reference beam of a double-beam spectrophotometer and scanning through the spectrum. Single-beam instruments can be used by appropriate modification of the technique. Extension of the wavelength range beyond the visible (380–700 nm) into the near infrared (up to 900 nm) is required only to identify the phthalocyanine blue and green pigments. The spectrum is preferably plotted as log absorbance vs wavelength. Log-absorbance vs wavelength curve shapes are independent of the concentration of pigment solution whereas the regular transmittance and absorbance vs wavelength curve shapes are not. Assuming that the pigment solutions follow Beer's Law,[9]

$$A(\lambda) = -\log_{10} T_i(\lambda) = a_c(\lambda)\, c\, \ell$$

or

$$\log_{10} A(\lambda) = \log_{10} a_c(\lambda) + \log_{10} c + \log_{10} \ell$$

where A = absorbance, T_i = internal transmittance, a_c = molar absorptivity, c = molar concentration of pigment solution, ℓ = solution thickness.

In the above equation, the concentration c and solution thickness ℓ are not functions of wavelength whereas the other quantities are. If the spectrophotometric data for a particular pigment solution are plotted as log absorbance vs wavelength, the curve obtained has a shape independent of sample thickness and concentration of the solution[10] and determined solely by the log absorptivity, $[\log_{10} a_c(\lambda)]$, which is a function of wavelength. This is illustrated in *Figure* 1a where log absorbance for five concentrations of PR 9 [Color Index (C.I.) Pigment Red 9, a naphthol pigment]* is plotted against the wavelength; all the curves are of identical shape. On the other hand, for the same four solutions the transmittance and absorbance curves (*Figures* 1b and 1c) do not have the same shapes. Provided that there are no concentration-

*For an explanation of Color Index designations, see reference (11).

dependent anomalies, log-absorbance curve shapes are constant over at least a 10-fold absorbance range.

Another important feature of solution spectrophotometry is that the same pigment dissolved in different solvents may give different curve shapes. This probably has to do with polar and hydrogen-bonding interactions between the pigment and solvent molecules, among other reasons. The different curve shapes not only allow the confirmation of the identity of the pigment, but also help in distinguishing between pigments by means of multiple curve comparison. For example, as shown in *Figure* 2, PR 57 (a metal-salt azo pigment) gives three different spectra for solutions in methanol, dimethyl formamide

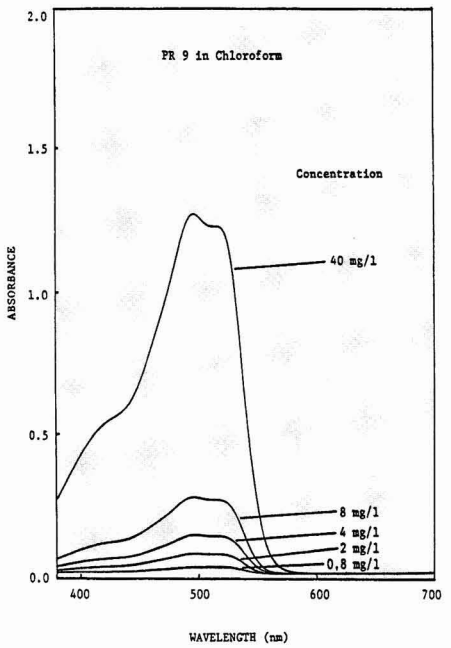

Figure 1c—Effect of concentration of pigment solution on curve shape of absorbance vs wavelength

(DMF), and concentrated (conc.) sulfuric acid. Another example is shown in *Figure* 3, where PR 81 and PR 172 (dye derivative pigments) have identical spectra in DMF but different spectra in conc. sulfuric acid.

SOLUBILITY OF ORGANIC PIGMENTS

All the organic pigments are soluble in one or more of the four solvents chloroform, methanol, DMF, and conc. sulfuric acid. Most of the monoazo, thioindigo, basic dye derivatives, disazo, dioxazine, and some vat pigments are soluble in chloroform. The only azo pigments insoluble in chloroform are benzimidazolone, metal-salt lakes, disazo-condensation, and some metal-complex pigments. Of the chloroform-insoluble azo pigments, methanol dissolves only metal-salt azo pigments. DMF, being a powerful solvent, dissolves all the pigments which are soluble in chloroform and methanol, plus the benzimidazolone, quinacridone, isoindolinone, perylene, some anthra-

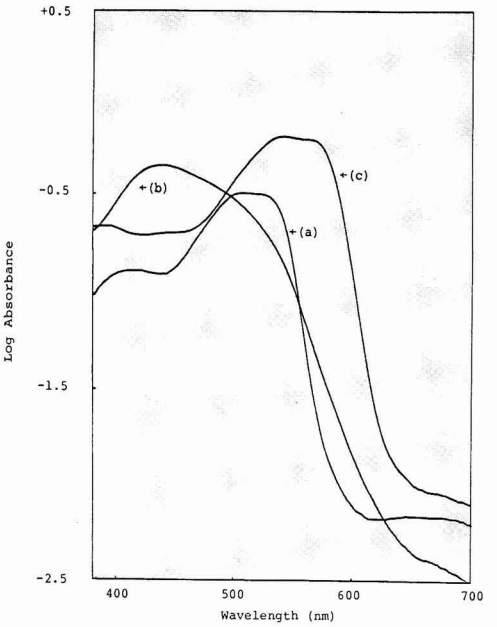

Figure 2—Log-absorbance spectra of solutions of PR 57 in methanol (a), DMF (b), and conc. sulfuric acid (c)

quinone, and metal-complex pigments. Conc. sulfuric acid dissolves all the available organic pigments.

If the paint sample (dry or wet) to be analyzed contains organic pigments soluble in any one of the four solvents mentioned above, they can easily be brought into solution by treating a few milligrams of sample with 4–5 mL of the

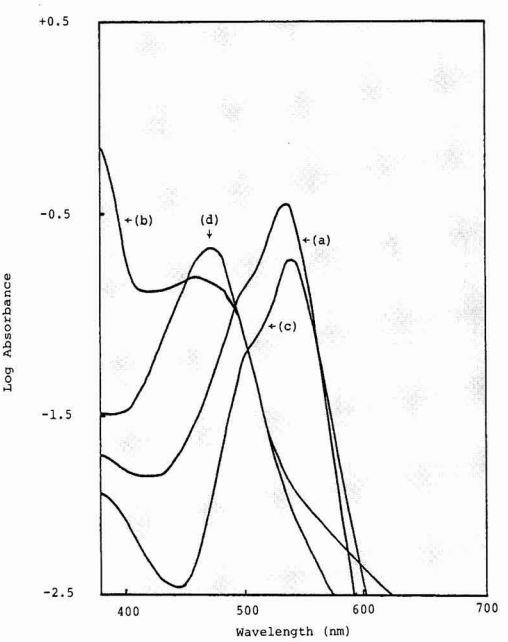

Figure 3—Log-absorbance spectra of solutions of PR 81 in DMF (a) and conc. sulfuric acid (b), and PR 172 in DMF (c), and conc. sulfuric acid (d)

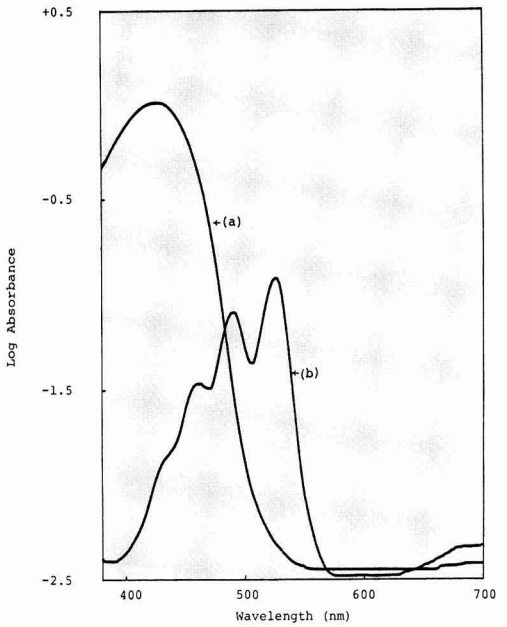

Figure 4—Log-absorbance spectra of solutions in chloroform of PY 12 (a) and PR 149 (b)

solvent. Sometimes it is advantageous to warm the sample and the solvent to 50–60° C to speed the release of the pigment. From a baked enamel film colored with PR 48 (a BON red), the pigment can be easily extracted in methanol. From another paint sample containing PY 12 (a diarylide yellow) the pigment can be extracted in chloroform.

If a paint sample contains two or more pigments, and the pigments have different solubilities in chloroform, methanol, DMF, and conc. sulfuric acid, each pigment can be brought in solution separately without any possible interference from the others. For example, from a sample containing PY 83 (a diarylide yellow) and PV 19 (a quinacridone pigment), the former can be brought in solution in chloroform but the latter dissolves only in DMF. Similarly from a sample containing PY 12 and PR 48, the first pigment is soluble in chloroform and the second is soluble in methanol. In this way, it is possible to extract pigments from all types of paint samples.

SPECTROPHOTOMETRIC MEASUREMENT OF PIGMENT SOLUTIONS

After the pigment is brought into solution in a particular solvent, the next step towards its identification is the measurement of the solution on a spectrophotometer. Any visible range (380–700 nm) full (not abridged) spectrophotometer that can measure solutions in glass cells can in principle be used for measurement of the pigment solutions. The spectrophotometer should have the capability to produce log-absorbance curves. Many color-measuring and analytical spectrophotometers can do this, and others can be equipped with auxiliary recorders, or recorders interfaced to the instrument through a microprocessor, to convert the data into the log-absorbance form.

SPECTROPHOTOMETRIC CURVE COMPARISON

The spectrophotometric (log-absorbance) curve obtained as mentioned above is compared with the curves in a reference file obtained under identical conditions to establish the identity of the pigment in the solution. When there is one pigment in solution, this comparison usually identifies the pigment. For example, as shown in *Figure* 4, a chloroform solution of the pigment in a sample gave a single-maximum curve which corresponds to PY 12, and the solution in chloroform of the pigment from another sample gave a two-maximum curve identified as that of PR 149 (a perylene pigment). However, there are some cases in which organic pigments that belong to the same chemical class, for example two Hansa Yellow pigments, PY 1 and PY 3, have similar color and solubilities and thus give almost identical curves in one solvent (chloroform in the case shown in *Figure* 5). This may confuse the identification, and in such cases it becomes essential that another solvent (from the four: chloroform, methanol, DMF, and conc. sulfuric acid) be used to dissolve a portion of the sample. The curve for the solution in this solvent is then compared to those in the reference file. In the case of PY 1 and PY 3, solutions obtained in DMF give curves, as shown in *Figure* 6, different enough to confirm the presence of either PY 1 or PY 3.

A large number of samples from a wide variety of paints were analyzed for their pigmentation using the four solvents. The systematic use of these four solvents is very helpful in terms of saving time in the identification of pigments in paints and is referred to as the "four-solvent

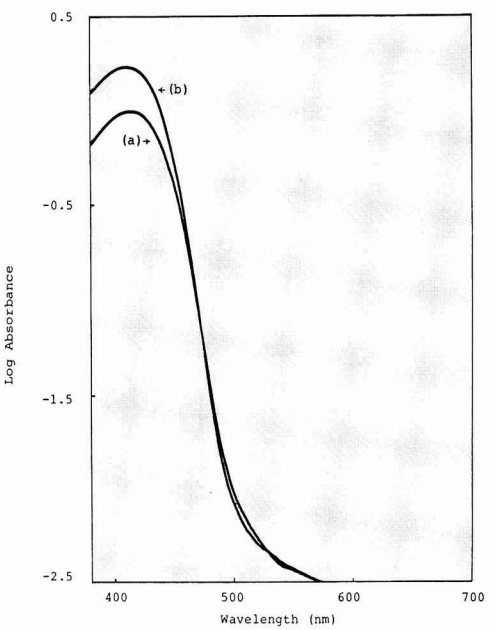

Figure 5—Log-absorbance spectra of solutions in chloroform of PY 1 (a) and PY 3 (b)

scheme" (*Table* 1). As an example of the use of the four-solvent scheme, a sample containing PY 83 and PV 19 was analyzed using this scheme, in which PY 83 was extracted in chloroform and PV 19 in DMF and the solution spectra were compared for identification. PY 83 was also dissolved in DMF and PV 19 in conc. sulfuric acid to obtain respective spectra for confirmation.

In the case of samples containing more than one organic pigment soluble in the same solvent, the solution curve can often identify the presence of two pigments. For example, the chloroform solution of the pigments extracted from a dry paint film containing PY 83 and PR 149 gave a spectrum indicating the presence of these two colorants (*Figure* 7). However, when the pigments present in a sample are chemically similar and are soluble in the same solvents (chloroform, methanol, or DMF) and their spectra are almost identical, it may be necessary to separate them before final identification. In such cases, the use of additional solvents,[1,3-4] such as cyclohexane, carbon tetrachloride, ethanol, and toluene are recommended. In extremely rare cases (in industrial practice), it may be necessary to use thin-layer chromatography[12,13] for the separation of individual pigments before their exact identification.

In almost all cases, the presence of resinous or other colorless material in the sample, whether or not it goes into solution with the pigment, does not interfere with the identification by solution spectrophotometry. However, in the case of the phthalocyanine pigments, which dissolve only in conc. sulfuric acid, the resin may react with the solvent to give colored products and thus may mislead the analyses. In such cases, obtaining the spectrum in the near infrared (up to 900 nm) spectral range is very helpful for identification.[8] Sometimes, however, phthalocyanine blue pigments disperse in solvents like DMF and xylene and can be identified by the curve obtained for the dispersion. For example, spectra for phthalocyanine blue pigments PB 15 and PB 16 in DMF dispersion indicate distinct differences allowing their positive identification (*Figure* 8).

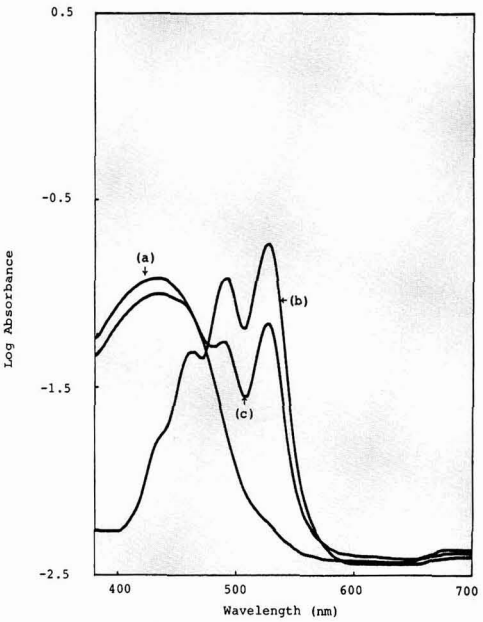

Figure 7—Log-absorbance spectra of solutions in DMF of PY 83 (a), PR 149 (b), and a sample containing PY 83 and PR 149 (c)

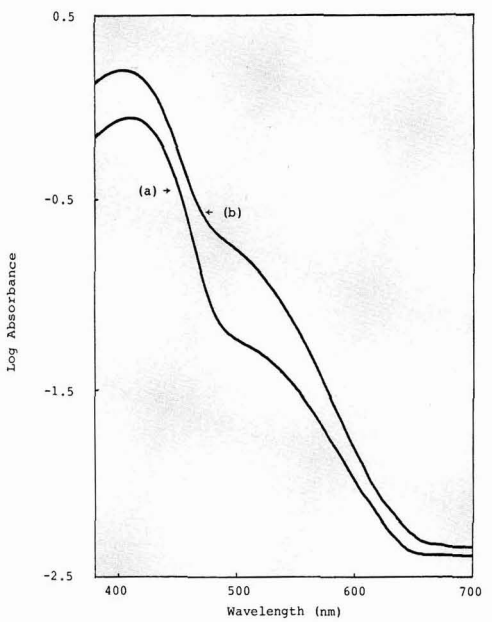

Figure 6—Log-absorbance spectra of solutions in DMF of PY 1 (a) and PY 3 (b)

Table 1—Four-Solvent Scheme for the Separation of Organic Pigments by Solubility

Sample		
Chloroform		
Colored solution[a]	Residue	Colorless solution[b]
Methanol		
Colored solution[a]	Residue	Colorless solution[b]
Dimethylformamide		
Colored solution[a]	Residue	Colorless solution[b]
Conc. Sulfuric Acid		
Colored solution[a]	Residue[c]	Colorless solution[b]

(a) Obtain spectrum
(b) Discard
(c) If colored, an inorganic pigment may be present

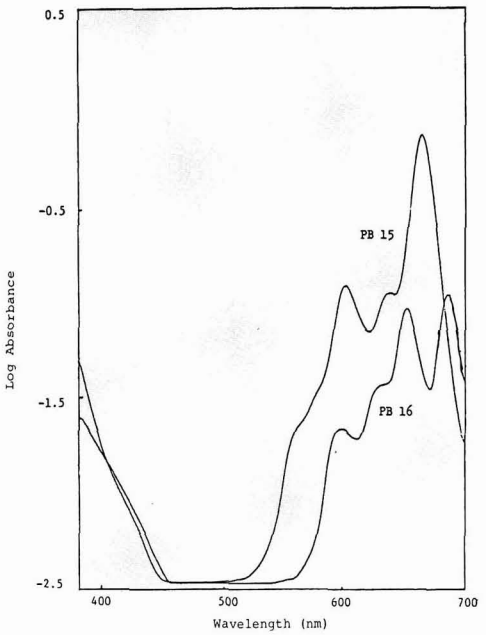

Figure 8—Log-absorbance spectra of phthalocyanine blue pigments PB 15 and PB 16 dispersed in DMF

Some organic pigments give solutions that are fluorescent. Such solutions give log absorbance vs wavelength curves of different shapes depending on the mode of illumination, polychromatic or monochromatic, in the spectrophotometer. We have determined that these differences rarely if ever affect the identification, which is based largely on the wavelengths of absorption maxima, that are affected least by the fluorescence phenomena.

Because only a small amount of pigment is required for identification, less than 50 micrograms in favorable cases, the solution spectrophotometry method is applicable to virtually any type of paint, varnish, lacquer, or other coating that contains organic pigments. We have yet to find any paint, or for that matter any plastic, even the most heavily crosslinked, from which it was not possible to extract enough pigment for identification using the procedures described briefly here and in more detail in references (1–4).

We make no claim, however, that the method is quantitative. In general no effort is made to extract pigments quantitatively, since it is not necessary. The objective of this method is identification, a qualitative step.

REFERENCE CURVE LIBRARY

We think that the reason why the solution spectrophotometry method has not been more widely used has been the lack of a library of reference curves for the identification step. Each prospective user has up to now had to develop his own library of the curves of all the pigments he might expect to find. These are required in several of the solvents mentioned earlier, since the curve shape for a given pigment may change from solvent to solvent, and this provides a very valuable aid to the analyst. If a pigment gives curves matching those of the reference material in two or more solvents, identification is virtually certain.

We have assembled a reference library of log-absorbance curves of solutions of about 175 organic pigments in more than one solvent, totalling about 400 curves. They are scaled to duplicate the dimensions produced on several widely used color-measuring instruments. We have also developed a numerical curve shape index (again based on the extension of earlier work[14]) that can be assigned to the curve of an unknown pigment by the user. The reference curves are indexed in the same way, and the selection of reference curves by index greatly simplifies the curve-shape match step. Copies of these curves, plus documentation, are available.[15]

For those who prefer to build their own reference library, knowledge of the paint system is helpful, because it limits the selection of pigments that are useful. The analytical schemes can often be simplified and the size of the reference library reduced in such a limited case.

ACKNOWLEDGMENT

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(15) For information regarding the purchase of an Organic Pigment Identification Package, consisting of the curves described in the text and two theses (references 1 and 2), contact Dr. Fred W. Billmeyer, Jr., 2121 Union St., Schenectady, NY 12309.

Kinetics of the Alcoholysis Of Orthosilicates

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Partially hydrolyzed orthosilicates, primarily tetraethoxysilane (TEOS), are used as binders in zinc-rich coatings. One possible source of TEOS is tetramethoxysilane (TMOS) which is prepared from elemental silicon and methanol. The TEOS is prepared when TMOS is reacted with ethanol in the presence of an acid catalyst. Research involving kinetic and mechanistic information of this acid-catalyzed alcoholysis is somewhat limited. In this study we have investigated the rate of the reaction using several different catalysts. We have determined the order of the reaction and its activation energy, from which we have proposed a mechanism. This knowledge will be helpful in the preparation of zinc-rich coatings.

INTRODUCTION

Partially hydroylzed alkoxysilanes, primarily tetraethoxysilane (also known as ethyl silicate or TEOS), are used as binders in zinc-rich coatings.[1] Recently a process has been developed in which elemental silicon and methanol are brought together to form tetramethoxysilane (TMOS).[2] To use this process to prepare zinc-rich coatings, it is necessary to convert the TMOS to TEOS. This is accomplished by the following reaction:

$$Si(OMe)_4 + 4\ EtOH \xrightarrow{H^+} Si(OEt)_4 + 4\ MeOH$$

The reaction is catalyzed by both acids and bases. Because of the importance of this reaction, we were interested in determining which catalyst worked best.[3] This led to the present study in which we hoped to learn more about the mechanism of the alcoholysis. This knowledge should be helpful in the preparation of zinc-rich coatings.

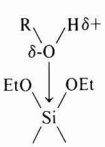
The alcoholysis of alkoxysilanes is a very widely studied reaction. Although an excellent review of the literature in this area up to 1978 can be found in "The Siloxane Bond" by Voronkov, Mileshkevich and Yuzhelevskii,[4] research involving kinetic and mechanistic information of the acid-catalyzed alcoholysis is somewhat limited. The earliest reference pertaining to a mechanism appeared in 1948 when Malatesta proposed the following mechanism:[5]

$$(RO)_4Si + H^+ + R'OH \rightleftarrows \left[(RO)_3SiO\begin{matrix}R\\H\end{matrix}\right]^+ + R'OH \rightleftarrows$$

$$\rightleftarrows \left[(RO)_3Si^+ + \begin{matrix}ROH\\R'OH\end{matrix}\right] \rightleftarrows (RO)_3Si(OR') + H^+ + ROH$$

There was no experimental evidence given for this mechanism. It was proposed as a mechanism typical of an acid-catalyzed reaction.

In 1949, Ridge and Todd proposed a somewhat different mechanism. They reacted TEOS with various alcohols and compared their relative rates. The rates were measured by noting the time it took to distill ethanol away from the mixture. They found that the alcoholysis proceeded most easily with alcohols which tend to ionize. Since they felt that the addition of the alcohol happens in the same manner as in the alcoholysis of silicon tetrachloride, they concluded that the Si-O bond is broken, yielding the following intermediate[6]:



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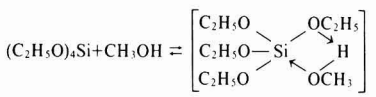
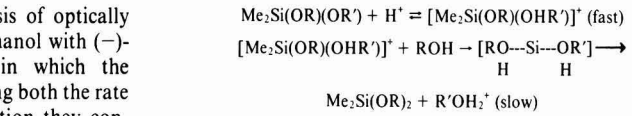
Eaborn, et al. studied the methanolysis of optically active silanes in 1963. They reacted methanol with (−)-methoxymethyl-o-naphthylphenylsilane in which the methoxy group was tritiated. By measuring both the rate of detritiation and the rate of racemization they concluded that the reaction was first order in silane. Since methanol was used as the solvent, it was impossible to tell its order. An involved six-step mechanism was proposed consisting of several proton transfers and an Sn2 type attack.[7]

In 1970, Petukov, Luzin, and Shabanova suggested a different sort of mechanism. They studied the methanolysis of TEOS, reporting the product as dimethoxydiethoxysilane. Using NMR to analyze the reaction, they proposed a four-centered transition state[8]:



$$+(C_2H_5O)_3SiOCH_3+C_2H_5OH$$

In two papers published in 1972, Boe investigated the Hammett relationships of the alcoholysis of alkoxysilanes containing para substituted phenyl groups in both acidic and basic media. He reported rho values and the order of the reaction. He found that the rho values with an acid were small and negative (approximately −0.50). This indicated to him that the transition state had a slight positive charge on the silicon. Once again an excess of alcohol was used so it could only be reported as pseudo first order in the silane. His data did indicate that the reaction is also first order in the catalyst. From his data, Boe proposed the following two-step mechanism[9,10]:



Several papers have been written which deal with the base catalyzed alcoholysis.[7,11-15] Most of these have used the methoxide ion as the catalyst. The most interesting were papers by Sommer[15] and Schowen.[12,13] Sommer found that the mechanism was influenced by the polarity of the solvent used. By using optically active compounds he found that the reactions run in nonpolar solvents retained their stereospecificity, while those carried out in polar solvents were inverted. Schowen studied the sigma rho relationship of the methanolysis of a substituted phenoxy group. He found that the reaction involved general base catalysis.

EXPERIMENTAL

Materials

The TMOS used was technical grade product. It was distilled using a silver-jacketed distilling column with a reflux ratio of 10:1 in order to remove any higher alkoxysilanes and alcohols present. Commercial grade absolute ethanol was used. Practical grade mesitylene which gave only one peak by GC was used. All acids were reagent grade.

Rate Measurements

The progress of the reaction was followed using a Varian 3700 gas chromatograph (GC) containing a 50

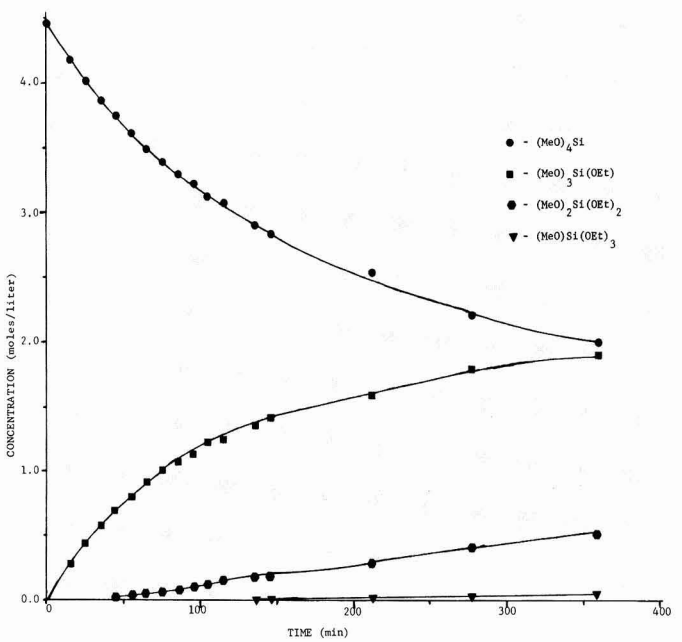


Figure 1—Ethanolysis of tetramethoxysilane. Legend: ○—$(MeO)_4Si$; □—$(MeO_3Si(OEt)$; ◇—$(MeO)_2Si(OEt)_2$; ▽—$(MeO)Si(OEt)_3$

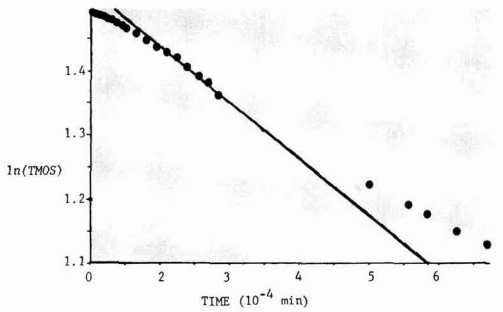


Figure 2—0.1M Benzoic acid @ 25° C. Change in concentration of TMOS with time

meter glass capillary column with an SE-30 coating. Because of its boiling point and apparent inertness in this reaction, mesitylene was used as the internal standard. Response factors for each of the alkoxysilanes relative to mesitylene were determined.

The reaction was carried out in a polypropylene vial. After the catalyst was weighed into the vial (to 0.001gm), approximately 0.85gm of the internal standard was added. Ten grams of TMOS were added through a repipet and weighed. Initially a rubber septum was used to seal the vial, but it was determined that it was interfering with the reaction. The vial was then sealed with a polypropylene cap. It was mixed using a Vortex-Genie and placed in a constant temperature water bath for 20 minutes. After temperature equilibrium was reached, the vial was removed and unsealed. After ethanol was repipeted in, the vial was resealed, weighed, and returned to the water bath.

As the reaction proceeded, samples were removed using a syringe and were injected into the GC. Samples were taken every 10 minutes initially, with increasing time intervals as the reaction proceeded. The intervals chosen depended upon the observed rate of the reaction.

By input of the proper calibration data, the GC's integrator reported the data in the form of grams of each component in the total mixture. A computer program has been written which converts these data into concentrations and can plot it in either logarithmic or exponential form.

RESULTS AND DISCUSSION

The research conducted has been a kinetic study. We hoped to answer several questions about the ethanolysis of TMOS in particular, and the alcoholysis of alkoxysilanes in general. First, we wanted to measure the rates using several different catalysts to see if lability of the acidic proton was a good indication of catalytic activity. The development of a better understanding of the rate law and the mechanism which controls it was also desired. Finally we wanted to use the rates found at different temperatures to find an activation energy.

The rates for several different acids were followed. These were chiefly carboxylic acids because mineral acids, with the exception of phosphoric, and stronger organic acids produced reactions which were too fast to follow with the methods used. A sulfuric acid catalyzed reaction at 0° C comes to equilibrium within one minute. Typically, as a reaction proceeds trimethoxy-monoethoxysilane (TMMES) appears first, followed by dimethoxy-diethoxysilane (DMDES), and then monomethoxy-triethoxysilane (MMTES). No tetraethoxysilane was found because a limiting amount of ethanol was used. There were two reasons for limiting the ethanol. First, since we were studying the first exchange, we needed to suppress the competing reactions. Second, we wanted to discover the role of ethanol in the rate law. A typical reaction profile showing the disappearance of TMOS and the appearance of the various products is found in *Figure* 1.

Plots of the natural log of the TMOS concentration versus the time yielded relatively straight lines (see *Figure* 2). There are two phenomena which can be seen in this plot. First, there is a tail deviating from the line at long reaction times. This is due to the growing importance of the reverse reaction. Second, there is a slight induction period before the reaction sets in. This period generally constitutes approximately 3% of the reaction. It is believed that it is caused by an equilibrium between the catalyst and the ethanol which must take place before the reaction begins. Taking these two phenomena into consideration, a more sophisticated analysis of the data was done with the help of Dr. G.L. Bertrand.[16]

If we make the assumption that the actual catalytic species is some sort of complex formed between the alcohol and the catalyst, equilibrium constants can be written which describe the concentration of the complex:

$$\text{Catalyst} + \text{Ethanol} \rightleftharpoons \text{Complex (CE)} \qquad K = \frac{C_{CE}}{C_E C_C}$$

$$\text{Catalyst} + \text{Methanol} \rightleftharpoons \text{Complex (CM)} \qquad K = \frac{C_{CM}}{C_M C_C}$$

We assume that these equilibrium constants are about equal. If the total amount of catalyst is C_C° and the initial ethanol concentration is C_E°, then:

$$C_C^\circ = C_C + C_{CE} + C_{CM} \quad \text{and} \quad C_E^\circ = C_E + C_{CE} + C_M + C_{CM}$$

Combining and rearranging these equations with the equilibrium equations yields concentration expressions for the catalytic complexes:

$$C_{CE} = \frac{K\, C_E\, C_C^\circ}{1 + K\, C_E^\circ} \qquad C_{CM} = \frac{K\, C_M\, C_C^\circ}{1 + K\, C_E^\circ}$$

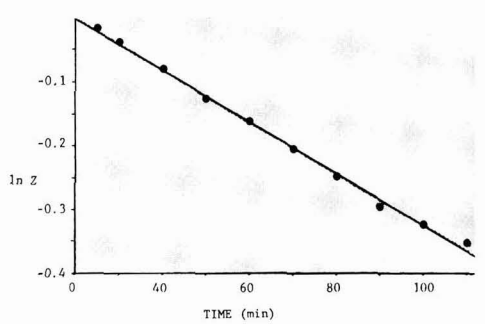


Figure 3—0.01M Trichloroacetic acid @ 50° C. Dependence of ℓn Z on time

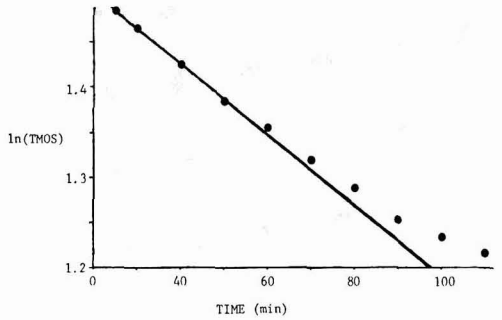


Figure 4—0.01M Trichloroacetic acid @ 50°C. Change in concentration of TMOS with time

If the rate determining step involves attack of the silane by the catalytic complex, then the reaction and the rate expression can be written as follows:

$$TMOS + CE \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} TMMES + CM$$

$$\frac{d(TMOS)}{dt} = -k_1 (TMOS)(CE) + k_{-1} (TMMES)(CM)$$

Statistically $k_1 = 4\ k_{-1}$, assuming that the methanol complex attacks with the same rate as the ethanol complex. Substituting for k_1 and the alcohol complex concentrations into the rate expression yields:

$$\frac{d(TMOS)}{dt} = -k_1 \left[\frac{(TMOS)\ K\ C_E^\circ\ C_C^\circ}{1 + K\ C_E^\circ} - \frac{(TMMES)\ K\ C_M\ C_C^\circ}{4\ (1 + K\ C_E^\circ)}\right]$$

$$\frac{d(TMOS)}{dt} = -\frac{k_1\ K\ C_C^\circ C_E^\circ}{1 + K\ C_E^\circ}(TMOS)\left[1 - \frac{C_M}{C_E^\circ}\left(1 + \frac{(TMMES)}{4\ (TMOS)}\right)\right]$$

$$-\frac{d\ ln(TMOS)}{dt} = \frac{k_1\ K\ C_C^\circ C_E^\circ}{1 + K\ C_E^\circ}\left[1 - \left(\frac{C_E^\circ - C_F}{C_E^\circ}\right)\left(1 + \frac{(TMMES)}{4\ (TMOS)}\right)\right]$$

$\Downarrow$ k′ $\qquad$ $\Downarrow$ Z

We now have an expression that is first order in TMOS which includes a complex constant (k′) and a correction term (Z). Z corrects for the appearance of TMMES and methanol. Because Z is a function of the TMOS concentration, the rate expression is very difficult to integrate. It is possible to determine Z as a function of time using an empirical fit. *Figure* 3 demonstrates that a plot of ln Z versus time yields a straight line. This gives the following equation for Z:

$$\ln Z = a + bt \quad \text{or} \quad Z = e^a\, e^{bt}$$

This equation can be substituted into the rate expression, which can now be integrated:

$$-d\ ln(TMOS) = k' Z\ dt$$

$$ln(TMOS) = ln(TMOS)_i - k' \int_{t_i}^{t} Z\ dt$$

Where t_i is the initial time used, $ln(TMOS)_i$ is the logarithm at t_i and

$$\int_{t_i}^{t} Z\ dt = \frac{e^a}{b} = \frac{e^a}{b} e^{bt} + \frac{e^a}{b} e^{bt_i}$$

The slope of the plot of ln(TMOS) versus $\int_{t_i}^{t} Z\ dt$ equals k′. *Figures* 4 and 5 demonstrate how this treatment corrects for the reactions involving TMMES as the reaction proceeds. *Figure* 4 is a simple ln(TMOS) vs time plot. *Figure* 5 shows how plotting ln(TMOS) vs $\int_{t_i}^{t} Z\ dt$ for the same data straightens out the line. The rate data comparing various catalyst are found in *Table* 1. The reported k values are determined by dividing k′ by the catalyst concentration. It is clearly seen that the rates increase with increasing lability of the proton on the catalyst.

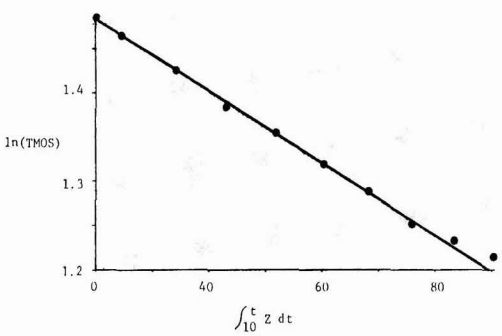


Figure 5—0.01M Trichloroacetic acid @ 50°C. Change in concentration of TMOS with $\int_{10}^{t} Z\ dt$

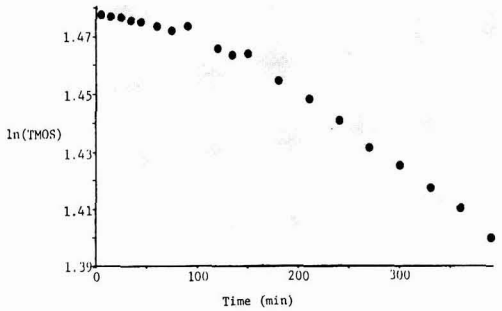


Figure 6—0.16M Acetic acid @ 50°C. Acid added to the TMOS

Ethanol Dependence

As stated earlier, it was thought that the induction period was caused by a pre-equilibrium between the ethanol and the catalyst. The hypothesis was tested by varying the order of reactant addition. Normally, the silane, internal standard, and catalyst are placed in a vial and allowed to come to equilibrium. The reaction is then started upon the addition of the ethanol. This time, the ethanol, internal standard, and catalyst were placed together and the silane was added later to start the reaction. *Figures* 6 and 7 show the results of this procedure. *Figure* 6 is the log plot of a normally run reaction. *Figure* 7 is a plot on the same reaction mixture at the same temperature, but with the catalyst added to the ethanol. It can be seen that the induction period almost totally disappears. We feel that the slight curvature still

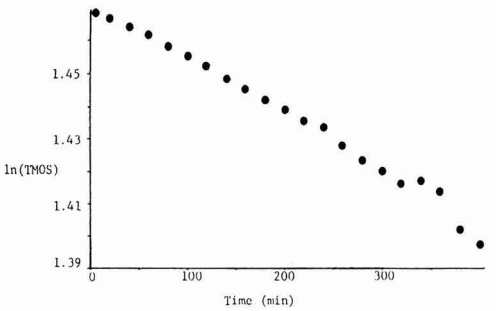


Figure 7—0.16M Acetic acid @ 50° C. Acid added to the ethanol

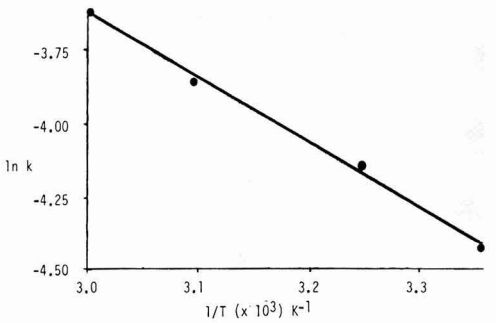


Figure 8—0.05M Dichloroacetic acid. Arrhenius plot

seen is due to a shifting of the equilibrium caused by the addition of the silane. In conducting reactions, care must be taken to insure that the reaction has proceeded far enough past the induction period to find the true slope.

Since Boe had suggested that the Sn2 attack of the ethanol was the slow step, we had expected to find the reaction first order in ethanol. This was not the case. The reactions in *Table* 2 show the change in k as the ethanol concentrations are varied. If the reaction were first order in ethanol, we would expect the k values to be directly proportional to the initial ethanol concentration. If the reaction were zero order in ethanol, we would expect the k values to be independent of the initial ethanol concentration. It can be seen that as the ethanol concentration is varied, the k values fall somewhere in between these two extremes. A look at the expression for k explains this.

$$k = \frac{k_1 K C_E^\circ}{1 + K C_E^\circ}$$

If KC_E° is small compared to one, the reaction would be first order in ethanol. If KC_E° is large compared to one, the reaction would be zero order in ethanol. If a KC_E° was of the same magnitude, one would give an ambiguous order that was not proportional to the concentration. For the ethanol concentrations that we are using, we are apparently in this ambiguous range.

Catalyst Dependence

We were able to confirm Boe's contention that the reaction is first order in the acid. *Table* 3 gives k′ and k values when the catalyst concentration was varied. According to our expression, k should be independent of the catalyst concentration if the reaction is first order in acid. The values for k are all within the confidence limits of ±0.003. These limits were determined by making six identical runs with 0.092M dichloroacetic acid.

Activation Energy

We have determined the activation energy using the Arrhenius equation by plotting ln k vs 1/T for the acids which were measured at three or more temperatures. Values for all three of the chlorinated acetic acids were calculated. *Figure* 8 is a plot of the dichloroacetic acid data and *Table* 4 lists the calculated activation energies.

Table 1—Rate Data with Various Catalysts

Catalyst (Acid)	Temp (°C)	[Catalyst]	k′	k
Acetic	25	0.100M	0.50E-5	0.050E-3
Chloroacetic	25	0.100	3.07	0.307
Dichloroacetic	25	0.058	69.0	11.9
Trichloroacetic	25	0.011	213	194
Benzoic	25	0.104	0.84	0.081
Phosphoric	25	0.084	596	71.0
Sulfuric	25	0.100	a	—
p-Toluenesulfonic	25	0.053	a	—
Acetic	50	0.102	3.77	0.370
Chloroacetic	50	0.099	22.2	2.24
Dichloroacetic	50	0.054	112	20.7
Trichloroacetic	50	0.011	411	374
Benzoic	50	0.101	4.52	0.448
Phosphoric	50	0.084	1430	170
Chloroacetic	60	0.099	26.3	2.66
Dichloroacetic	60	0.056	148	26.4
Trichloroacetic	60	0.010	431	431

(a) These reactions were too fast to follow.

Table 2—Ethanol Dependence

Catalyst (Acid)	Temp (°C)	[EtOH]	[Catalyst]	k′	k
Dichloroacetic	50	1.29M	0.089M	4.75E-4	5.34E-3
Dichloroacetic	50	2.43	0.088	5.55	6.31
Dichloroacetic	50	3.12	0.090	6.31	7.01
Dichloroacetic	50	3.44	0.089	7.71	8.66
Dichloroacetic	50	3.76	0.087	7.79	8.95

Table 3—Catalyst Dependence

Catalyst (Acid)	Temp (°C)	[Catalyst]	k′	k
Dichloroacetic	50	0.010	1.74E-4	1.74E-2
Dichloroacetic	50	0.032	5.68	1.71
Dichloroacetic	50	0.054	11.2	2.07
Dichloroacetic	50	0.074	16.1	2.18
Dichloroacetic	50	0.092	19.1	2.09

Table 4—Activation Energy

Catalyst (Acid)	Activation Energy kcal/mole
Chloroacetic	11.8
Dichloroacetic	4.39
Trichloroacetic	4.03

There are two possible explanations for the apparently changing activation energies. It is possible that we are actually seeing a general acid catalysis in which the anion is playing a role in the mechanism. This explanation follows the idea of a catalyst complex being involved in the rate determining step. Another explanation could involve the actual proton concentration. If the dissociation constant of the acid is shifted by the change in temperature, then the proton concentration would not be directly proportional to the acetic acid concentrations as our calculations assumed.

With the information found in the literature, coupled with the results of our work, we would like to propose a mechanism. First, there is an equilibrium between the catalyst and the ethanol, forming a complex. The complex is then involved in an Sn2 replacement of the methoxy group on the silane.

$$\mathrm{EtOH + Catalyst \rightleftharpoons Complex\ (CE)}$$

$$\mathrm{Si(OMe)_4 + CE \rightleftharpoons \left[CE-\overset{|}{\underset{/\ \backslash}{Si}}-OMe\right]}$$

$$\mathrm{\rightleftharpoons EtOSi(OMe)_3 + Complex\ (ME)}$$

SUMMARY

The kinetics of the ethanolysis of tetramethoxysilane has been studied. This reaction is of interest because of its role in the preparation of zinc-rich coatings. The acid-catalyzed reaction was studied using several different catalysts under various conditions.

The data indicated that a shift in mechanistic control was occurring during the reaction. Initially the reaction rate was controlled by the formation of an ethanol catalyst complex. Once the complex came to equilibrium with its reactants, the reaction between the complex and the tetramethoxysilane assumed control of the rate.

The reaction was found to be first order for the acid catalyst. The order of the ethanol turned out to be of the form [EtOH]/(1 + K[EtOH]). Activation energies were determined for reactions with the chloroacetic acids as catalysts. The variation in these supports the idea of an ethanol-acid complex. A mechanism involved first the formation of an ethanol-acid complex, followed by an Sn2 replacement of a methoxy group by the complex.

ACKNOWLEDGMENTS

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Acylurea Reactive Oligomers For High-Solids Coatings

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Acylurea reactive oligomers were conveniently synthesized by the reaction of low molecular weight carbodiimides with polyunsaturated carboxylic acids. The effect of oligomer structural variables such as molecular weight, functionality, and carboxylic acid type on the cure rate and various coating properties was investigated. These materials were examined for application in the rapidly emerging compliance oriented technologies of high-solids and UV-cured coatings. A model high-solids coating formulation based on one oligomer gave five to eight minutes tack free time, HB pencil hardness after one week, and 1/16" creepage from the scribe after 250 hours salt spray. Model UV cure formulations had lower viscosities and slower cure rates than a commercial urethane acrylate.

INTRODUCTION

Higher and high-solids coatings represent one of the emerging technologies designed to solve the formulation problems encountered due to the rising costs of petroleum-based solvents and the environmental requirements for clean air. Oligomers are used in these coatings because of their low viscosity, which is primarily a consequence of their low molecular weight (i.e., 1500–3000). Most oligomer research has been confined to reducing the molecular weight of conventional coating polymers (acrylics, epoxies, alkyds, and urethanes) with the resultant properties of the coating corresponding to those observed with the high molecular weight analogs. Therefore, it may be necessary to develop new oligomers to obtain the required properties for some specialty application areas. In addition, many specialty industrial coating applications require room temperature curing through either air drying or UV radiation. The design of novel oligomers with the desired combination of low molecular weight and high reactivity presents a unique challenge in polymer engineering.

The goal of this research was to investigate a novel polymer backbone, polyacylurea, as a new oligomer for air dry and UV-cured coating systems. Starting with commercially available raw materials and the known chemistry of isocyanates, a versatile oligomeric backbone (polycarbodiimide) was produced which was readily modified by a known organic reaction to introduce air dry and UV-curable moietics.

RESULTS AND DISCUSSION

Oligomer Synthesis

Acylurea reactive oligomers (*Figure* 1) were prepared by a two-stage, one pot reaction starting with an aromatic diisocyanate. In the first stage, carbodiimides were prepared by polycondensation of the diisocyanate in the presence of a phospholene-1-oxide catalyst.[1] The reaction (*Scheme* 1) is first order in both isocyanate and catalyst,

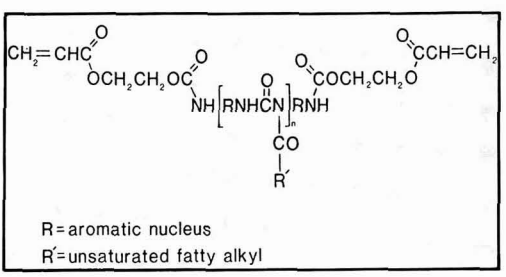

Figure 1—Acylurea reactive oligomers

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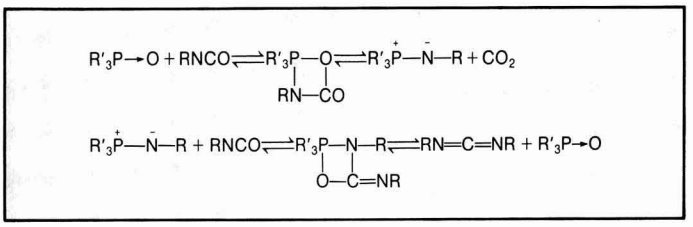


Scheme 1

and yields high molecular weight polymers in short periods of time at ambient temperature.[2-5] The reaction is reversible with a low energy of activation which leads to instability on storage. Stability problems can generally be overcome by judicious choice of reaction solvents, molecular weight control, and by separation of the carbodiimide linkages by long polymeric segments.[5] Toluene diisocyanate (TDI) was used as the diisocyanate for synthesis of the polycarbodiimides in this study. Although many monofunctional alcohols could be used to modify molecular weight, hydroxyethyl acrylate was chosen since its incorporation into the oligomer would provide additional reactive double bonds for crosslinking through air drying or UV radiation. The required amount of hydroxyethyl acrylate needed to obtain the desired number average degree of polymerization ($\overline{X}_n$) was calculated using the Carothers' Equation. Where p is the extent of reaction

$$\overline{X}_n = \frac{1 + r}{1 + r - 2rp}$$

where:

$$r = \frac{N_a}{N_a + 2N_{a'}}$$

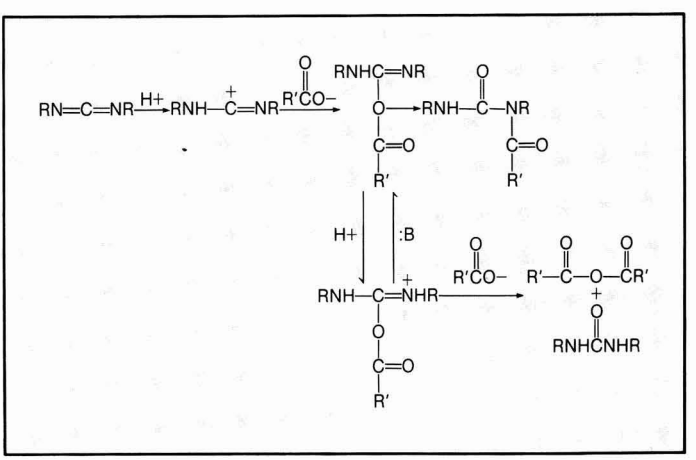
and is taken as equal to one, N_a is the number of molecules of difunctional monomer (TDI), and $N_{a'}$ is the number of molecules of the monofunctional molecular weight controlling agent (TDI + HEA adduct). This degree of polymerization will also be the degree of polymerization for the final acylurea oligomer. The products from the first step were modified almost immediately after preparation to avoid stability problems.

The second step in the synthesis of acylurea oligomers was the base catalyzed reaction of the carbodiimide moiety with a carboxylic acid.[1] The two possible pathways for this reaction are shown in *Scheme* 2. Path B leads to the better known dehydration reaction producing the acid anhydride while Path A leads to the desired acylurea. Path A has been shown to be highly efficient and yields a linear poly(N-carbamoylamide) when a biscarbodiimide is reacted with a dicarboxylic acid.[6] Base catalysis facilitates acylurea formation over the undesired side-reaction of anhydride formation and was used to insure complete acylurea formation.[6]

Unsaturated fatty acids (linseed fatty acid, oleic acid, and Sylfat V-18, a commercial vegetable fatty acid) were used to obtain reactive acylurea oligomers of varying reactivity. The major structural variables that were studied were: reactivity for curing, degree of polymerization ($\overline{X}_n$), and amount of separation between the carbodiimide (acylurea) groups. A typical synthetic reaction for the synthesis of reactive acylurea oligomers is shown in *Scheme* 3.

The structures of the experimental acylurea oligomers are shown in *Table* 1. In oligomers 1-7 the diisocyanate used was TDI while a 2:1 adduct of TDI and either dipropylene glycol or tripropylene glycol was used for oligomers 8 and 9, respectively. This increased molecular weight resulted in higher viscosities and lower solids (70%). In spite of the low degree of polymerization

Scheme 2

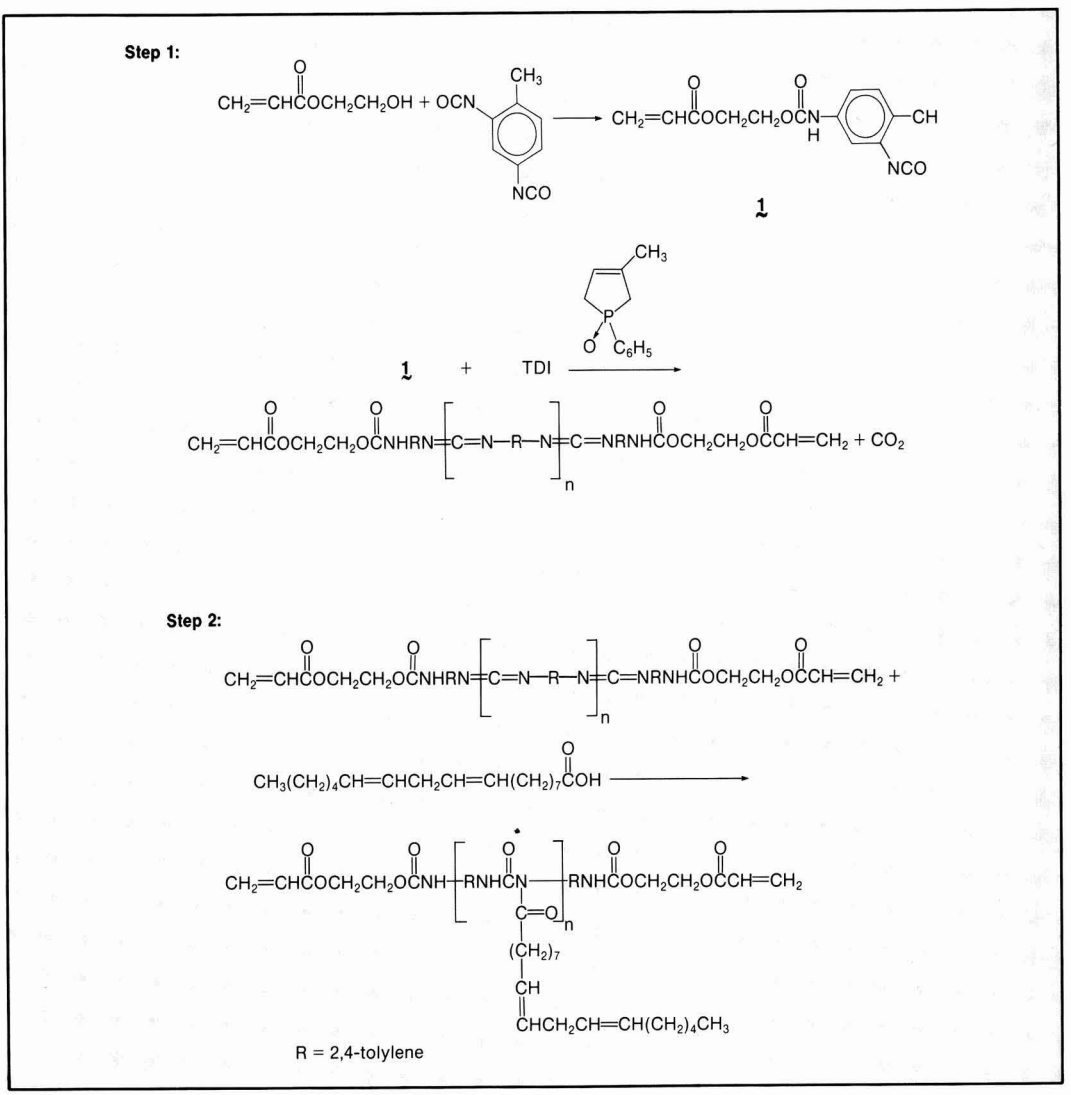


(1.5–3.0) the viscosities of these oligomers were quite high, ranging from 28,000 cps to 60,000 cps at 80% non-volatile material.

Evaluation of Acylurea Oligomers In High-Solids Coatings

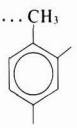
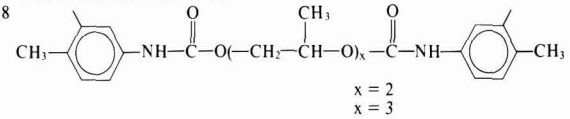
Preliminary evaluations of the curing properties of acylurea oligomers were carried out using both steel and aluminum substrates. Initially, clear films were prepared using cobalt naphthenate drier (drier system A). The results of these studies are shown in *Table* 2. As would be expected the rate of cure was reduced as the drying activity of the fatty acid decreased according to the series linseed> vegetable> oleic (oligomers 1, 6, 7). The introduction of a polypropylene oxide (x=3) spacer group (oligomer 9) into the backbone also reduced the cure rate (<100 MEK double rubs after seven days). An increase in the degree of polymerization resulted in a cure rate which seemed to increase to a plateau at $\overline{X}_n = 2$ (oligomers 1–3). This result was not pursued due to the high viscosity (> 40,000 cps, *Table* 1) of oligomers with $\overline{X}_n > 2$ which probably would not allow the formulation of coatings with weight percent solids in excess of 70%. Thus, the oligomers with $\overline{X}_n > = 1.5$ were chosen for further evaluation and an attempt to increase the cure rate with different drier systems was made using oligomer 1.

The results of a screening study of several different drier combinations are shown in *Table* 3. The best drier system contained cobalt, manganese, and calcium in a ratio of 1:3:4 (designated drier system B in *Table* 2) and gave a set-to-touch time of nine minutes and a through



Scheme 3

Table 1—Experimental Acylurea Oligomers as Shown in *Figure 1*

Oligomer Number	*From Figure 1* R	*From Figure 1* R′	Theoretical $\bar{X}_n$	% NVM	Brookfield Viscosity[a] (cps)
1		From linseed fatty acid	1.5	80	28,130
2	"	"	2.0	80	46,320
3	"	"	2.5	80	41,840
4	"	"	3.0	80	—
5	"	"	3.5	80	—
6	"	From Sylfat V-18	1.5	80	45,000
7	"	From oleic acid	1.5	80	60,530
8	 x = 2 x = 3	From linseed fatty acid	1.5	70	34,620
9	Same as Sample 8 with x = 3		1.5	70	35,540

(a) Number 6 spindle, 10 RPM

Table 2—Curing Studies of Acylurea Oligomers

Oligomer Number	% NVM	Substrate	Set to touch time (min.) Drier System A[a]	Set to touch time (min.) Drier System B[b]	MEK Double Rubs Drier System A 2 days	Drier System A 4 days	Drier System A 7 days	Drier System B 7 days
1	70	steel	22	12	—	—	>100	>200
		aluminum	16	9	—	—	>100	>200
2	70	steel	10	—	38	52	>100	—
		aluminum	8	—	41	50	>100	—
3	70	steel	15	—	41	55	>100	—
		aluminum	10	—	40	51	>100	—
6	70	steel	10	10	—	—	59	>200
		aluminum	9	6	—	—	53	>200
7	70	steel	13	19	—	—	5	8
		aluminum	14	20	—	—	4	60
9	70	steel	19	—	18	28	58	—
		aluminum	14	—	22	30	56	—

(1) Drier System A = 6% cobalt naphthenate at 14 g/100 g resin.
(2) Drier System B = 6% cobalt naphthenate 1 g/100 g resin, 9% manganese naphthenate 2 g/100 g resin, 6% calcium naphthenate 4 g/100 g resin.

Table 3—Evaluation of Drier Systems for Acylurea Oligomer Number 1
Amount of Drier (g/100g Oligomer)

6% Cobalt Naphthenate	Lead Naphthenate	9% Manganese Naphthenate	6% Calcium Naphthenate	Metal Ratio	Set-to-Touch (min)	Through Dry (day)
4	3	—	—		16	7
5	—	2	—	1.67:1	12	7
3	3	—	1		14	3
2	1	4	—		18	7
4	—	1	2	4:3:2	16	5
2	—	2	3	2:3:3	12	3
1	—	2	4	1:3:4	9	1

Table 4—Model White Enamel Formulation

	Formulation (lbs/100 gal)		
Part 1	I	II	III
Commercial alkyd resin	141	—	—
Acylurea sample number 1	—	141	141
Titanox 2090	341	341	341
Butyl acetate	43	43	43
Part 2			
Commercial alkyd resin	390	—	—
Acylurea oligomer number 1	—	390	390
Butyl acetate	170	170	170
Silicone surfactant (L-5310-50) (Union Carbide)	4	4	4
18% cobalt naphthenate (Manchester)	1.5	1.5	—
15% potassium hex-chem 977 (acetate) (Mooney Chemical Inc.)	0.6	0.6	—
6% cobalt naphthenate	—	—	0.5
9% manganese naphthenate	—	—	0.95
6% calcium naphthenate	—	—	1.9
Exkin	1.7	1.7	1.7
	1092.8	1092.8	1094.05
Properties			
Weight percent solids	70.5	70.5	70.4
Solvent VOC level (lbs/gal)	3.2	3.2	3.2
Volume percent solids	55.6	55.6	55.6
Viscosity (#4 Ford Cup)			
Initial (sec)	62	73	80
3 Weeks (sec)	76	81	87

dry time of one day. When drier system B was utilized with other $\overline{X}_n = 1.5$ oligomers (oligomers 6 and 7, *Table* 2), an increase in the number of MEK double rubs after seven days from ~55 to >200 was observed when R′ (*Figure* 1) was a vegetable fatty acid residue. However, little effect on the total cure was noticed when the non-drying, oleic acid containing oligomer was tested. The drier system B cured clear films from oligomers 1 and 6 gave pencil hardness values of <4B and crosshatch adhesion values of 0–20%.

A model high-solids air dry enamel formulation was prepared using either oligomer 1 or a commercial short oil alkyd for comparison. The formulations and the properties of the resultant enamels are shown in *Table* 4. Formulations I and II contain the drier system recommended for the commercial alkyd while Formulation II used drier system B. Note that low VOC's (3.2 lb/gal) and viscosity values (73–80 seconds, #4 Ford Cup) are obtained for the acylurea system and that very little viscosity increase was observed after three weeks. The coating properties of the model white enamels are summarized in *Table* 5. Both of the acylurea enamels were completely cured (>200 MEK double rubs) after seven days while the conventional alkyd was not (27–41 MEK double rubs). The acylurea based enamels had higher gloss by ~6 units and also gave harder coatings (HB and F compared to B). Although the salt spray results were about equal, the acylurea systems showed much better resistance to detergent, acid, and base. This may be due to the inherent hydrolytic stability of the acylurea moiety compared to the ester functionality. The differences observed in the staining tests may be a result of the low degree of cure of the conventional alkyd. Adhesion of the acylurea based enamels was a problem (0% crosshatch) but could be overcome by the addition of ~4% γ-methacryloxypropyltrimethoxy silane to give 95–100% adhesion in fully cured coatings.

Evaluation of Acylurea Oligomers In UV-Cured Coatings

A proprietary UV-curable coating formulation was used to evaluate the utility of acylurea oligomers. This typical formulation contained the oligomer, trimethylolpropane triacrylate, tetraethylene glycol diacrylate, methyldiethanol amine, benzophenone, and a surfactant. The oligomer portion of the formulation constituted

Table 5—Coating Properties of Model White Enamels

				Properties after 7 Days Cure					Tests Run on 7 Day Cured Panels					
Formulation	Substrate	Tack Free Time	Thru Dry Time	60° Gloss	MEK D.R.	Reverse Impact Resist. (in/lb)	Pencil Hard.	X-Hatch Adhesion	Salt Spray 245 Hrs	Det. Resis. 24 Hrs	Acid Res. 24 Hrs	Base Res. 24 Hrs	Spot Test 24 Hrs	Mustard Resis. 24 Hrs
A	Al	5 Min	24 Hrs	90.3	41	<2	B	100%	No creepage	Fail	Pass	Fail	Fail	Fail
	Steel	6 Min	24 Hrs	88.7	27	<2	B	0%	~1/16″	Fail	Pass	Fail	Fail	Fail
B	Al	5 Min	24 Hrs	96.2	>200	<2	HB	0%	Through film corrosion	Pass	Pass	Pass	Pass	Pass
	Steel	8 Min	24 Hrs	92.5	>200	<2	F	0%	1/16″	Fail	Pass	Pass	Pass	Pass
C	Al	7 Min	24 Hrs	96.0	>200	<2	2B	0%	No creepage	Pass	Pass	Pass	Pass	Pass
	Steel	7 Min	24 Hrs	93.8	>200	<2	F	0%	1/16″	Pass	Pass	Pass	Pass	Pass

(a) Percent remaining
(b) 24 hr 5% acetic acid
(c) 24 hr 5% sodium hydroxide

Table 6—UV-Cure Studies on Acylurea Oligomers

Oligomer	Formulation Viscosity (25°C)	MEK Double Rubs after 1 Pass at 100 fpm
Urethane acrylate	162 cps	80
1	130 cps	70
7	150 cps	60

about seven percent. Oligomers 1 and 7 were evaluated and the results are shown in *Table* 6. Basically, slightly lower viscosities and slower cures were obtained with acylurea oligomers. These results precluded further research in this area. However, it is conceivable that UV-curable coatings that would have acceptable cure speeds could be formulated with other acylurea oligomers.

CONCLUSIONS

Acylurea oligomers prepared from carbodiimides obtained from aromatic diisocyanates have been shown to be a feasible resin system for high-solids coatings. Air dry enamels produced from the acylureas showed better cure and improved gloss and resistance properties compared to a commercially available short oil alkyd. Adhesion problems which were encountered in preliminary testing could be overcome by incorporating a reactive silane coupling agent into the formulation. UV-curable systems containing acylurea oligomers cured slower than conventional urethane acrylates.

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OPEN FORUM

The Challenge of Automotive Color . . . . . A Personal Epilogue

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The capacity to experience color is truly an awe-inspiring gift. Color has a powerful impact on perception, illusion, and decision making. Emotionally and psychologically, color influence is both subtle and decisive. Visual information comprises 80% of all information received—40% consists of information about color. Since color is exclusively color sensation, it is a potent means of aesthetic expression. Understanding color adds a dimension to life and is thereby critical as an automotive marketing tool. While there have been dramatic automotive coatings breakthroughs in the last five years, automotive color concepts have not kept pace. As the frontier of lifestyle progresses beyond the "Gucci, Porsche, and Rolex" contemporaries, the challenge to automotive color is an imperative for bold innovation.

". . . a terrible beauty is born and an awesome energy made manifest"

The earth where we live is a colorful planet. The colors therein inspire a sense of wonder and humility always in the presence of mystery. Hidden insights which the world holds in store for us touch the mundane and sublime.

Color is life, for a world without color appears to us as dead. Light, the first phenomenon in the world, reveals to us the spirit of the world through colors, which are the children of light. When an individual dies, he blanches. His face and body lose color as the light of his life is extinguished; the corpse is devoid of chromatic emanations. Color is Life.

To experience color is to see. An unlikely abstract process of sight conveys a sense that a terrible beauty is born and an awesome energy made manifest. Engulfed in a constant bombardment of wavelengths as small as atoms and as large as mountains, the human eyes respond only to those electromagnetic vibrations with a wavelength between 0.00007 and 0.00004 centimeters. Red light in one second accomplishes 400 billion successive vibrations. If we could perceive one vibration each 1/500 of a second, it would take 25,000 years to experience this red light. Therefore, we perceive color as a sensation. It all begins when light enters the pupil, for the eyes act as a camera. In back of the pupil is a lens which focuses the light on a membrane in back of the eye called the retina. Optic nerves convey from the retina to the brain these light sensations. The fibers of the optic nerve spread out to form the retina. Of the 137 million nerve fibers, 130 million are rods, seven million are cones. The rods interpret light (and dark) but not color. The cones give rise to the sensation of color.

The rods and cones contain molecules of pigment which absorb the light which enters the eye. When light strikes a molecule of this pigment, rhodopsin (100,000 per rod), the pigment bleaches as the molecule splits into the component parts, triggering the release of a chemical transmitter—and an electrical message is conveyed to the brain for interpretation. On the basis of laborious calculations and long chains of inferences and assumptions, the brain concludes the presence of color sensations.

Our ability to live and preserve life on the planet is constrained by infinitesimal parameters of the mind-boggling largesse active in space. The precise orbit/distance of the earth from the sun, the angle of the earth on its axis, the atmospheric pressure and temperature on earth, and the temperature of our bodies are but a few examples. No wonder that the capacity to experience color is such an awe-inspiring gift. The tiniest range of electromagnetic vibrations is our total allotment for the realm of color; the twenty million shades a human being is able to differentiate.

". . . an artist can never achieve . . . the brilliance of a real rainbow"

Light, the mother of color, must impinge on something that either absorbs, transmits, or reflects. Colors produced by a light source, such as the sun or a fluorescent or incandescent bulb, are an additive mixture of primary colors, and any color can be achieved through this additive mixture. Any spectral primaries when mixed yield white. In automotive applications, as in any other paint field, we produce colors by intermixing individual pigments. True, we add the pigment, but in effect we are subtracting a certain amount of specific color from each one and, in doing so, we reduce the effective

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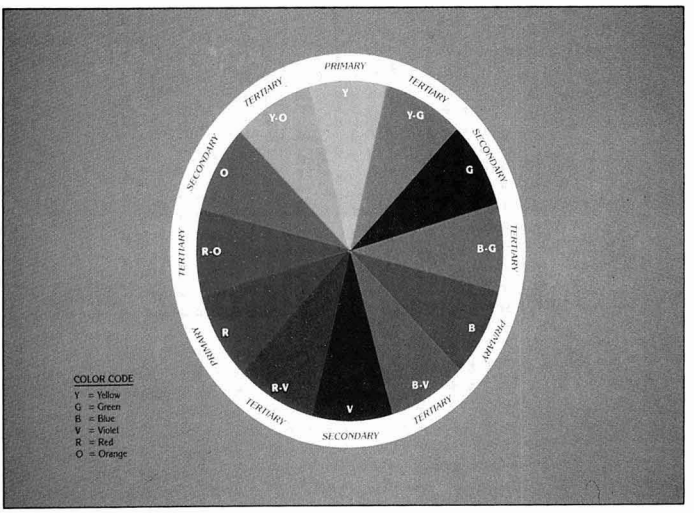


color intensity. That is why an artist can never achieve with his palette the brilliance of a real rainbow.

Color can be interpreted through three distinct properties—hue, chroma, and value. The color circle representing all visible colors determines the hue. One such picturization can contain 12 basic hues at full intensity and maximum spectral value yielding a closed color circle. A primary color is defined as one that cannot be produced by any mixture. The three primary colors are red, blue, and yellow. These are highly aggressive. The three secondary colors—green, orange, and violet—are ones that are more readily produced by a mixture, and are less aggressive. The six tertiary colors—red/orange, yellow/orange, yellow/green, blue/green, blue/violet, and red/violet—are definitely produced by a mixture and are benign. These 12 color tones (three primary, three secondary, six tertiary) should be seen as precisely as a musician hears the 12 tones of his harmonic scale so that proper harmony is achieved.

Any two of the above colors opposite in the circle are complementary; if mixed together in balanced proportions they will yield gray—red/green, blue/orange, yellow/violet. Yellow, which is the brightest, is also the lightest. Violet, the darkest, is the deepest. Of all the complementary combinations in nature, those of blue/orange or blue/yellow-orange appear to be the most common. When complementary colors are placed side by side, they incite each other to maximum vividness, but when mixed, they annihilate each other to gray-black. Any color is always seen in relation to its surroundings. Complementary colors placed next to gray areas give an opalescent and shimmering quality to these areas. Undiluted primaries and secondaries have the impact to portray a celestial coronation, or to reverse to a mundane still-life.

The second color property, chroma, is the intensity, purity, or saturation of any given hue. Absolute fullness of chroma for any given hue can occur at only one value (white/black scale). Strong light diminishes the chroma of colors upon which it falls, because bright light decreases the degree of saturation of strong opaque colors. Chroma can be reduced without a hue shift (1) By adding neutral gray or black; (2) By mixing some of its complementary hue; or (3) By mixing it with the two colors which adjoin it in the spectrum.

The first approach (1) yields colorless gloom and is depressing. The second approach (2) yields a degree of vitality. The third approach (3) yields more luminosity and vibrancy. The hue of any color can be reproduced by a mixture of the colors adjacent to it in the spectrum circle; however, the chroma is lowered, e.g., orange and violet yield a dull red. The closer the mixed colors are in the color circle, the greater the chroma of the resultant hue.

The third and final color property is value, that degree of grayness which spans black and white. The highest of all values, white, achieves a full reflection of light. Black, the lowest of all values, completely absorbs all light. Gray is that mixture of white and black from light to dark. The middle value acts as an anchor for tone relations and is therefore extremely important. This medium gray generates a state of complete equilibrium in the eye. Salesrooms where the color of goods are to be appreciated should always be done in neutral grays. The intensity of the light source profoundly affects the value; for example, red-orange and yellow look darker in reduced light whereas blue and green look lighter.

Color conveys emotional messages and exerts a profound effect on behavior. The myriad of direct and mental associations, objective and subjective impressions, neuroses and psychoses, health and illness, human endeavors, aesthetics and the like have found a haven in the psychology of color. An examination of some major hues (including white, black, and gray) reveal both positive and negative connotations. In automotive applications, negative must be carefully balanced out with only the positive predominating.

"White . . . *the mother of all color*"

Positive—Light, triumph, good/day, luck, birth, purity, bride, virginity, clinical, innocence, joy, cleanliness, youthful.

Negative—White-haired boy, white flag, pallor, blankness, ghostliness.

White light is a most vital thing in nature, being the mother of all color. Its total reflection yields cool tones such as snow and frost. Since black and white are absolute and supreme (as in a pontifical "black and white" dictum) great skill is needed in their use. In automotive applications, pure white has been avoided due to its clinical look. Besides, it is difficult to achieve since the best titanium dioxide pigments have to be treated (silica and/or aluminum oxide encapsulation) for maximum outdoor durability and thereby decrease their hiding levels. With base coat/clear coat technology, the base coat has to totally hide at 1.2–1.3 mils thickness, so hiding is achieved at the sacrifice of white purity. The amazing 12 percent popularity achieved by off-white in 1974 has remained constant.

White reaches out and overflows the boundary. Its spacial expansiveness negates confinement. However, it is sterile unless backed by chromatic surroundings. To soften its stark character other than by tinting, a new traditional approach needs exploration. One such device could be the use of micaceous pigment, but only if the highest gloss and physical properties could be maintained. Natural pearl and titanium coated mica suffer from humidity blistering and weakness of exterior exposure. The challenge exists.

"Yellow . . . *analogous to the life-giving sun*"

Positive—Happiest of colors, radiates warmth, inspiration, sunny disposition, understanding, knowledge, divine love, light, cheerful, advances, high spirit.

Negative—Cowardice, yellowing with age, jaundice, sickness, meanness, treason, deceit (yellow streak).

Yellow is always light. If it ceases to be light, it ceases to seem yellow. It is analogous to the life-giving sun above. As the lightest of hues, it advances the most, as dark colors recede. It is the only hue that is the brightest when fully saturated, whereas other colors darken. It is the color of spring, of rebirth. In ancient China it was venerated as an Imperial color. Strong yellow can be provocative, arousing, and even erotic. Yellow on red-violet connotes extremely hard power. Yellow on medium blue is radiant, but alien and repellent. Yellow on red is loudly joyful. Yellow on black is vigorous, short, uncompromising, and abstract. Some shades of yellow can induce nausea and are therefore avoided in aircraft; others have been used in classrooms to improve students' work.

With automobiles, saturated yellows were made possible by the evolution of chrome yellow chemistry to acceptable levels of opacity and exposure and when blended with proper organic yellow, such as anthrapyrimidine or flavanthrone, to reasonable levels of other needed properties. These were desirable for sporty car and truck colors. However, the governmental non-lead, non-chrome restrictions nullified these advantages which are lacking in organic pigments. The popularity of light yellows has remained at less than one percent over the past ten years. The true vibrancy of joyful yellows is a need that cannot be fulfilled to meet the next popularity cycle in the late eighties, when metallized (aluminum flake) yellow strongly shifts to a lime, chartreuse, or green.

Gold, however, can be simulated in both solid colors and metallics and undergoes cycles of popularity; nine percent in 1974 to three percent in 1983, with a renewal surge for the future. Gold relates to earthly wealth and tangible glory suggesting the highest sublimation of matter by the power of light—radiant and marvelous. Black on gold expands the power of wealth, whereas gold on black draws in the horizons of infinity. One reason why gold is highly artistic is the very wide range of hues which it reflects. Golden surfaces strongly suggest not only yellow but also green and orange, the true colors which adjoin yellow in the spectrum. In the hollows of a configured gold object, the light is reflected back and forth between the sides and the depression before it emerges yielding a multiplication of hues. So, also, gold cars should have a sculptured design for maximal impact. Currently, there are no true automotive gold pigments so that research areas such as micaceous types and dyes (too soluble and non-durable) need pursuit.

"Orange . . . approaches with affection"

Positive—Warmth, cheerful, stimulating, expansive, rich, extroverted, high visibility, sexual connotation, hope of fruitfulness.

Negative—None except if muddied (desaturated), then is irritating, spineless, cheap, tawdry.

While playing second fiddle to red, orange is unequivocally a warm color. The red glow of incandescencing bodies is usually orange. It approaches with affection and is non-threatening. Automotive orange finishes have always been popular in sporty cars and trucks as long as the highly developed molybdate orange pigment was usable. Governmental restrictions on lead and chrome and organic pigments highly limit proper orange color achievement. In 1974, an orange nonmetallic had a ten percent popularity in compact cars, while in 1983 there were no oranges. Opacity, cleanliness of color, and durability are the big obstacles to be overcome. Occasionally, a metallized orange grabs a sliver of the market as when quinacridone orange became available. Currently, there is no transparent organic orange with sufficient brightness and durability to lend itself for metallic color.

A darkened orange leads into the brown family. Brown is the first and last word in natural colors. Coffee, chocolate, comfort, and security reside in brown. Dark brown can be sensuous, warm, and reassuring to some, and to others it is utterly drab and depressing. Reddish browns, russets, and ochres are the earth colors radiating warmth and cheer. If strong, they are autumnal colors. The light tones, the warm beiges, umbers, and sandstones could be lifeless and boring to some, but to the shy, retiring, and sophisticated, these warm neutrals may be sober, soothing, and safe. From 1974 to 1983, dark brown metallic doubled from four to eight percent while beige halved from ten to five percent. An interesting aberration in 1983 was the ascendency of a light red-brown metallic which hit the dizzying height of nearly 20 percent popularity in full and intermediate size cars. This "mauving" of America phenomenon could reflect the ambivalence of an America emerging from a crushing recession with its associated polarization on all fronts, e.g., sex, abortion, rich/poor, city/suburbs, race, etc. The light red-brown metallic is non-definitive, neither masculine nor feminine, totally non-threatening. The color's absence of hilarity, joviality, and exuberance conveys the statement "I will not take a strong position" as an invidious marketing tool. The reverse requires rich, vivid browns, necessitating research in pigment rheology if future positive statements are to be made.

"Red . . . the sensation of heat"

Positive—Aggressive, advancing, warlike, red-plush, red carpet, grandeur, aristocracy, greatest respect, joy, happiness, blood, heart, flesh, emotion, love, courage, lust, valor, fervor, energy, fire, murder, rage, heat.

Negative—Cruelty, wrath, sin, paint the town red, sees red, draw a red herring across the path, communist/red, red letter days, red lamp/brothel.

Red has the longest wavelength and lowest energy of all visible light. Being the nearest to infrared, it actually produces the sensation of heat, so that what one ceases to see, one feels—at times with violent emotions. Red/orange flows with passionate physical love; blue/red connotes a spiritual love. Red on green/blue blazes fire. Red on yellow/green is impudent, rash, loud, and common. Red/orange on black is demonic and sinister. Red pronounces and announces. This year for the first time since 1979, TV advertising of cars has been predominantly in orange-red. This effort to generate a love affair with the consumer is permissible in a rising economy where a greater degree of passion can be tolerated—note the Nissan 300ZX, the Corvette, and Fiero.

The red range in automobile finishes is generally produced by blending violet with orange in solid colors and quinacridones and perylenes in metallics. A true red is not achievable due to opacity,

"Color can be interpreted through three distinct properties: hue, chroma, and value."

chroma, and durability limitations. The use of aluminum flake immediately grays off a red in metallics. Reds are always popular in the six to ten percent range, but always need the proper pigment tools to reach a cleanliness worthy of the color.

Red's alter ego is pink, for no one has a bad word for pink. It is gentle and acquiescent. Strong pinks with a hint of blue are sensuous and voluptuous; however, pale bluish pinks are pretty and feminine. Life is wonderful for everything is rosy and, if not, it could be if seen through rose-colored glasses. Except for a slight spurt in the early fifties, pink has been eschewed in automotive finishes. However, a delightful pink to platinum color, achieved by interference potential, reflecting the eyelids of dawn, would be highly rewarding both aesthetically and in sales. Considerable mica interference pigments with associated polymer development is needed to bring such a concept to fruition.

The other end of the red story is covered by maroon and magenta. While maroon is highly elegant and dignified as pioneered by early Mercedes, magenta can be zany, sensational, bright, exciting, intense, or maddening. That is why magenta has never caught on in cars, although a temporary fling was tried with the "penta-magenta" color.

"Blue . . . *immortality via infinity*"

Positive—Infinity, eternity, royalty, peacemaker, cool, soothing, orderly, blue ribbon, blue chip, blue blood, calm, aloof, silence, passive, frigid, truth, wisdom, immortality, constancy, loyalty, true blue, blue moon.

Negative—Despondency (St. Louis Blues), Blue Monday, melancholy, gloom, fearfulness, furtiveness.

Abundant in sky and sea but rare underground, blue permeates our lives, offering continuity *sans* passion, with the least emotional response. Blue has its greatest glory in darkness. It is an intangible nothing. We sense immortality via infinity. Blue on black gleams in bright pure strength. Blue on lilac appears withdrawn, inane, and impatient. Blue on yellow is very drab, devoid of radiance. Blue on red/orange becomes luminous, melancholic, and lonely. Blue is the color of silence—contemplative, mysterious, and passive. Pale blue creates space, emptiness, and vapidity—also its refreshing coolness can be frigid. Blue light is cold. Snow and ice have a bluish cast. Blue is a favorite color in children's clothing as blue denim, and of nearly a billion Chinese. The ritual blue "Tekhelet" commanded by Moses as a convenant reminder was originally derived from Hyacinthine purple. The rare exceptions of underground sources of blue are turquoise, azurite, and lapis lazuli (yielding ultramarine). Blue walls have a calming effect in hospitals where there are emotionally disturbed people; but the same color in a cafe caused employees to complain of the cold. All were satisfied when the walls were repainted orange. In recessionary years, two-tone painted cars are used to secure sales. The most popular two tones relate to blues of the same hue but altered values. They have a calming effect on jagged nerves.

"Color conveys emotional messages and exerts a strong effect on behavior."

In 1974, blues and greens had a 22 percent popularity, about equally divided. In 1983, green practically died out with blue sustaining the total popularity of 22 percent. Nearly all colors undergo cycles of popularity but blue traditionally remains constant. Among its numerous attributes is constancy—blue will always be with us. The automotive needs for blue are probably better covered than any other color. Phthalocyanine blue is the workhorse, with phthalocyanine green ready to carry it to the green side and indanthrene blue, quinacridone violet, and carbazole dioxazine carrying it to the reddish side. Discrete combinations of iron blue fortified with phthalocyanine and/or indanthrene blues provide the deep urbane shades. One area is illusive, demanding solution—that of an opalescent light blue, shimmering and glowing, reflecting yet absorbing, soft and pearly pleasing to the eye yet radiating excitement.

"Purple . . . *eschewed by the auto industry*"

Positive—Regal prerogative, sensual, power, depth of feeling, self-esteem, piety, solitude, mysterious, impressive, born to the purple, royal, sovereignty, dignity, imperial.

Negative—Ostentatious, power corrupted, shrinking violet, lavender (and lace), effeminate, homosexual, unconscious, oppressive, menacing, terrifying, dark superstition, chaos, death, mourning, grief, loneliness, desperation, pomposity.

Because purple has ancient significance to power, the negative connotation outweighs the positive, more so than any other color. The ancient Tyrian purple (from the Mollusk 'pupura') required ten thousand snails to prepare one gram of dye. Only the super elite, wealthy, and powerful could afford such an endeavor. The pomposity of the color is all-pervasive. Purple has the shortest wavelength with the highest energy bordering on the ultraviolet which is invisible and highly destructive. As with all power, it is corruptive. With the occasional muted plum, an 'excuse me' color, the auto industry has eschewed purple. Two tries were made to bring purple into the picture, a 'regal Burgundy' in the fifties and more recently a 'plum crazy.' Both were dismal failures. In the cycling of color popularity purple has the longest span, in excess of 19 years. While automotive needs are adequately filled with carbazole dioxazine in deep shades, the need for a more durable pigment in lighter shade does not exist. It is ironic that when reduced to a pale lavender a most delicate shade can be produced.

"Green . . . *the power of nature (and) rebirth*"

Positive—Quieting, refreshing, peaceful, stability, security (green bank note), emotional balance, camouflage, tranquility, contentment, hope, life, growth, rebirth.

Negative—Jealousy (green with envy), decay, ghostliness, disease, terror, guilt, malignance, creepiness.

Green epitomizes the power of nature; it is the dominant color of all growth. Green is hope triumphant in the rebirth in spring following the death knell of winter. All is well with green and the eye is at rest. Green is the negation of the vigorous, dramatic, and cataclysmic events. Mellow greens are restrained, the epitome of tasteful elegance (cool). However, great care must be exercised so as not to impinge on the negative connotations. When luminous green is dulled by gray, a sense of sad decay results. The after-image of green, its complementary color, red (blood), can be annoying. Yellow green makes patients feel ill and so must be avoided in hospitals and kitchens. Pro-

duction at a factory increased ten percent overnight after the men's room had been painted a ghastly electric green, which had the effect of discouraging malingerers.

As previously mentioned, green plus blue has traditionally enjoyed, year in year out, a 22 percent popularity in automotive sales. Sometimes the blue would go up slightly, sometimes the green, but the total remained relatively constant. It was assumed that green, like blue, would always be with us. Beginning with 1980, that assumption, reliable since World War II, collapsed. Green fell out, and is still out of favor, dipping to less than two percent in 1983. Possibly the recession nullified hopes of economic rebirth. Green was immune in previous economic declines; we were more naive then, less skeptical, more sure of the future. The demise of green was so precipitous that for the first time, it joined the cycle of other colors (except blue) with a six year potential. It is doubtful if once back in favor it will maintain its traditional sustaining power.

In the automotive industry, green is well served by phthalocyanine green. If there is a need to shift to the blue side, phthalocyanine blue will do the job, and if to the yellow, anthrapyrimidine and flavanthrone yellows will serve well. A missing area is the true flavored jade green, which can be approached through micaceous interference opalescence with the proper polymer system. A potential but not imperative area for exploration is that of emerald green, the primary hue which is complementary to red. A glowing, urbane, sophisticated color would be the objective.

"Black . . . *intrinsic, strange beauty*"

Positive—Weight, spacial, solidity, infinity.

Negative—Unknown, death, darkness, ominous, malevolence, night, depressing, black list, blackmail, blackball, black market, black sheep, black art/voodooism, unlucky, funereal.

Black is total absorption; it is as close as we can come to absolute darkness. To be enveloped by blackness is to see nothing at all, to be enclosed by dark doors that will remain shut forever—to withdraw inward and turn off all lights. Because of such darkness, light can be experienced by contrasting the binary opposition between day and night, light and darkness, life and death. To break out of the blackness, out of the death wish, reveals the energizing power of panoramic vision, the splendor and vastness of life, the cluster of arresting color images of creation. Black serves this purpose with its own intrinsic and often strange beauty. Black is not a product of nature. Black flowers are bred; black in animals is due to the pigment melanin. True blue black hair, only seen among oriental races, owes its blue sheen to Tyndall scattering. The rare beauty of the multitude of shades of black has deeply ingrained in us the unknown/love relationship. After all, since it is a total absorber, it definitely is a warm color. It offers substance and weight. Workmen shifting black boxes complained that they were too heavy. When they were repainted green, they promptly felt lighter.

Black is the earliest of automotive colors. Over the decades black has continually shifted from the muddy, chalky brown tones to the current deep jet blue black. Jetness in black is that illusion of diving into it without hitting bottom. Black like blue is always with us, cycling not in the popularity mode of other colors, but with economic trends. Usually at four percent popularity, it approached ten percent in trucks in 1983. When times are bad, as with the last recession, car buyers who can afford to spend the money do not wish to be ostentatious while their fellow neighbors are out of work. They want to withdraw and yet have a sophisticated "color." Black admirably serves that purpose for black contracts any given boundary yet is fashionable in any setting.

Air pollution regulations have eliminated channel black from production, so that furnace black, which is not a jet, is now the norm. The jetness of black needs great improvement through pigment, dispersion of that pigment, polymer, and synergistic research. "Insoluble" dyes of the chrome complex variety have great potential but are limited by their excessive conductivity, negating the electrostatic spray application most common in all modern automotive plants. Black offers great potential in emanating the myriad tones of the spectrum since it has absorbed all of them. Picture a super jet black substrate with a celestial play of tiny diamonds glittering above.

"Gray . . . *the most unobtrusive of colors*"

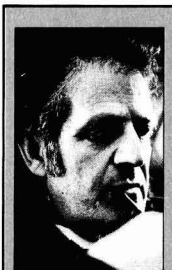
Positive—Intelligence, gray matter, quiet, reserved, little emotion, cool, noncommittal, uninvolved, sophisticated atmosphere, massive, mechanical.

Negative—Loss of distinction, confusion, cloud, shadow.

Pure gray is rare in nature with some exception such as slate, graphite, cats, and doves. Gray in its gunmetal shades is the color of combat, yet can be most soft and ephemeral in texture as in cobwebs and dust. Gray is the most unobtrusive of "colors," gently receding and satisfying to the eye. All colors can be diluted by gray. Actually, there are four ways to dilute colors. The first, mere, dilution by white produces anemic tints, the second with black, the third with gray, and, finally, an equivalent complementary pair is the most pleasing. It has been previously noted that complementary colors next to gray areas give an opalescent and shimmering quality to these areas.

Back in the early days of automotive finishes, nonmetallic gray was the easiest color to make, and on the 1938 Ford it was the most popular color. After World War II, with the advent of chromatic organic pigments, gray fell into disfavor. A dove gray appeared in the early seventies and captured the consumers' imagination for two years. Thereupon, it receded, being replaced by silver metallic and metallic grays. In 1983, that nonmetallic light gray still had a following of a few percent. Solid color grays are stable and most any value can be readily achieved. Metallic grays have had sporadic flings, especially during depressed economies, with dark gray metallics offering the aloof, sophisticated desires.

With the introduction of silver metallic by Mercedes, an aura of sophistication enveloped that color. America was enamoured at that time with chrome, and silver offered a back-off from the gaudy chrome. It yielded the illusion of austerity, brilliance, luxury, and wealth. It caught on rapidly and to date still retains



SOL PANUSH is Manager-Color with United Technologies/Inmont Corporation. His 43-year background in pigment evaluation and dispersion process engineering has led to many innovations in the coatings field. He holds a number of patents on novel color developments and pigment dispersion processes and is a recognized authority in the pigment field. Mr. Panush received a B.S. Degree in Chemical Engineering from Wayne State University.

great popularity; consistently fluctuating between 10 and 15 percent. Ironically, with the acceptance of the base coat/clear coat concept, the primary goal is to move to a chrome appearing silver. Leafing aluminum flake yields a pseudo-chrome look, but the treatment needed to secure leafing destroyed all adhesion of the clear coat. Considerable development work is underway and will continue to reach that chrome look with the ubiquitous non-leafing aluminum flake.

The wave of the future for a most pleasing gray lies with essence of pearl simulation (must be non-toxic; therefore, non-lead or arsenic) so that the diffraction of light by myriad striations in the transparent nacre substitute gives a softly reflective gray touched with delicate colors. To reach the glory of the iridescent wings of the Madagascan moth, urania rhiphoeus would be an aesthetic automotive utopia.

Old Masters Used The Colorants of Nature

As previously mentioned, man can never duplicate the glory of nature which with very few colorants spans the spectrum. For instance, chlorophyll is the green in leaves. When it breaks down in autumn, carotenoids are exposed; the magnificent reds, oranges, and yellows. Anthocyanins yield the blue-red color range of blackberries, red cabbages, and purplish autumn leaves. Hemoglobin reflects red light as in blood. Melanin colors animals black and is exuded by squid and octopus to confuse predators. The algae trichodesmium enythraeum has a pigment phycoerythrin which absorbs nearly all the wavelengths (except red) which keeps the plant alive. The non-absorbed red is reflected strongly enough to color the plant and the waters in which it lives strongly enough to give the Red Sea its name.

The great masters produced magnificent art from a highly inadequate and limited pigment availability. Basically, the pigments did not differ substantially from the colorants already known to antiquity. A few examples would show that the commonest yellow was ochre, aluminum silicates which derived their color from iron oxides. A pigment similar to ochre was umber, also a natural earth. Other yellow pigments were orpiment and the redder realgar, both arsenic sulphides. Naples yellow, an antimoniate of lead manufactured artificially, is now known as "yellow of the Old Masters." Massicot, produced by heating basic lead carbonate (white lead), was also a mineral yellow manufactured artificially.

In the red areas we find cinnabar (mercuric sulphide), sinopia (red ochre), and bole (red clay). Two blues predominated: Mountain blue (basic copper carbonate) also called azurite, and lapis lazuli (azure stone) from which ultramarine is derived. Malachite (basic copper carbonate) was the key green along with verdigris (basic copper acetate) and green earth (a naturally green colored silica containing ferrous oxide). White was dominated by white lead (flake white), a lead carbonate. When contaminated by farmyard manure, some hydrogen sulfide led to the formation of basic lead sulfide yielding a strong gray tinge. Finally, black came from either soot (carbon black) or bone char (bone black). The above mineral colorant being of low chroma were highlighted with pigments from animal and vegetable dyes highly fugitive in direct sunlight, such as saffron yellow, madder lake, kermes carmine, cochineal red, sepia brown, and indigo blue. The available binders for these colorants further constrained the system—balsam, linseed oil (from flax), poppy oil, nut oil, and hempseed oil. Yet the masters produced monumental art, a tribute to a key attribute—genius.

What a contrast is in the tools available today. We live in an age where explosive technology in the automotive coatings industry made available 100 percent synthetic (manmade) components incredibly superior to anything the Old Masters had. Polymeric binders for thermosetting high solids and base coat/clear coat technologies revolve around acrylics, urethanes, polyester, cellulose acetate butyrate, and the like. In colorants, the pigments cover the rainbow with exterior durability and physical properties previously undreamed of. Automotive coatings have to meet the most stringent specifications anywhere, both chemical and physical; outdoor exposure durability when exposed at 5° South in the Miami/Fort Lauderdale (near the ocean) area must show hardly any color change or film breakdown for two years on "single coat" and five years on base coat/clear coat systems.

The Challenge is Offered

Even with the wealth of current quality pigments and those yet to be developed for automotive finishes through the innovative impulse for excellence, automotive color, as such, will not keep pace. As the frontier of lifestyle progresses beyond the "Gucci, Porsche, and Rolex" contemporaries, beyond the synthesized music of Debussy and Bach, the challenge to automotive color is an imperative for bold design.

Consider gradation and movement of color. Gradation of value and chroma give vibrancy to a color. Gradation of related hues is an important element of beauty. Its absence yields aloofness and impersonality. In nature no color exists without gradation. Dissonant colors, linked by gradation to a mutually acceptable color can be made compatible, as do quiet colors which often appear stronger than they are with greater vitality and richness. Movement toward and away from light can be suggested by a gradual change from one color to an adjacent color. Passing toward yellow, or the other warm colors (orange and red), approaches light, and a move toward violet, or the other cool colors (blue and green), is a move toward gloom. Yellow is the hue most suggestive of light. As illumination increases, blue become greenish and red appears orange-red. As illumination decreases, both blue and red become purplish.

How can gradation and movement enter automotive illusion? This is a most difficult task which many would claim unnecessary or even lacking in taste. But it need not be flamboyant and garish, for gentleness, subtlety, and softness can just as well be the fruition of such an endeavor. With the advent of base coat/clear coat or higher multicoat systems of superb durability and physical properties, and sophisticated application procedures such as the turbobell, electrostatic spray robotics, and the like, capable of precise film thickness control, much is possible.

Knowledge, judgment, and intuition must be combined for capable management of color. Imagination must synergize with technology, but not be constrained by indifference. Knowing how colors change under different kinds of lighting, why they fade or darken, and how they can be used to alter mood, line, form, shape, and perspective, understanding the optical effects of certain color combinations and the psychological impact of colored lighting—all are needed if color will do what you want it to do.

Taste and style are subjective at best, and automobiles, like the beauty of women and wine, definitely are in the eyes of the beholder. To take risk, with possible success or failure, can be thrilling and rewarding. To be too conservative is just as dangerous as being too radical. We must accelerate the exploration of the frontiers of automotive color adding a new dimension to car ownership and lifestyle.

On the walls of glorious ancient Cordoba in Spain, there is engraved a kind of proverb: "Give alms to the blind man, for he will never see Cordoba." I would say "Pity the person who cannot see life in gifted color."

The future is now. Let us soar beyond limiting horizons with innovations and excitement in the realm of automotive color.

OPEN FORUM

Some Useful Conversion Charts

H. Earl Hill
Lord Corporation*

Introduction

A prime factor in coatings work is the importance of volume relationships for ingredients. Although raw materials are generally purchased and used on a weight basis, they are sold, when formulated, by volume. Volume is the basis for expressing not only price but coverage and some performance characteristics such as scrub and stain resistance. Three charts have been prepared to allow easy conversion between coatings solids, spreading rate, and dry film thickness; and spreading rates and wet film thickness in English and metric units. These mathematical charts have been designed to simplify conversion calculations and to aid in selecting coatings for product use.

Discussion

With the current interest in the VOC of paints, it is helpful to be able to convert between the amount of applied paint in gallons/100 ft^2, the total solids by volume of the paint TS_v, and the dry film thickness obtained at any combination of TS_v and applied amount of coating.

One U.S. gallon contains 3786 cc. If a coating is applied at 10 cc per one sq ft, then 3786 cc (one gallon) would obviously cover 378.6 sq ft. Therefore:

$$\text{sq ft/gal} = \frac{3786}{\text{cc/sq ft}} \qquad (1)$$

Thickness is volume per unit area, and for one gallon:

$$T(\text{mils}) = \frac{230.98 \text{ sq in.} \times 1000 \text{ mils}}{144 \text{ sq in./sq ft}} \qquad (2)$$

$$\text{and } T = 1604 \text{ mils/sq ft/gal} \qquad (3)$$

Using equation (2), we can write:

$$\frac{TS_v \times 1604}{10^2 \times T \text{ mils}} = \frac{ft^2}{gal} \qquad (4)$$

where T (mils) is the dry film thickness of the applied coating. Rearranging:

$$\frac{10^4 \times T(\text{mils})}{TS_v \times 1604} = \frac{gal}{100\ ft^2} \qquad (5)$$

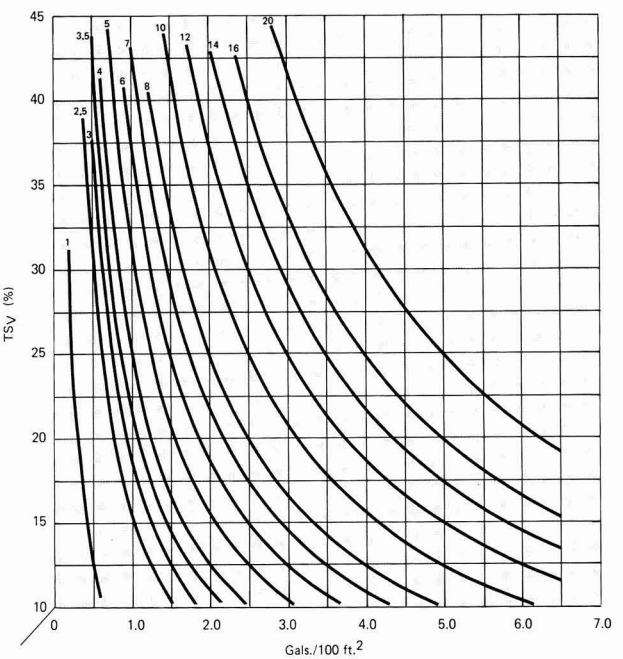


Figure 1—Coating solids by volume at different coverage rates to yield selected values of dry film thickness in mils

*1635 West 12th St., Erie, PA 16514.

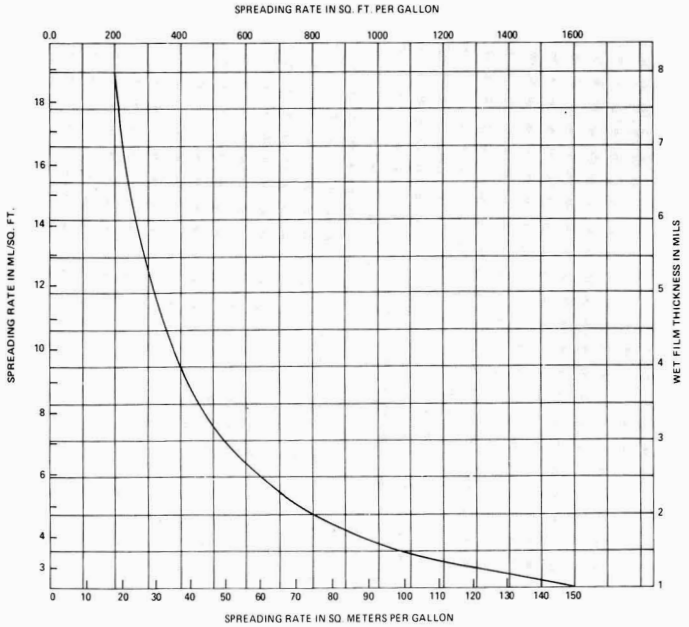


Figure 2—Spreading rate in square meters per gallon

Table 1

mL/sq ft	sq ft/liter
3	333.30
5	200.00
6	166.70
8	125.00
10	100.00
12	83.30
14	71.43
16	62.50
17	58.82
18	55.56

Table 2

sq ft/liter	T (mils)
53.0	8
60.5	7
70.6	6
84.8	5
105.9	4
141.3	3
211.9	2
423.8	1

With equation (4), we can construct *Figure* 1, which shows the relationship between these three properties. *Figure* 1, coating solids by volume at different coverage rates to yield selected values of dry film thickness in mils, may be described as follows: The left hand vertical column is the TS, from 10 to 45 percent. The horizontal bottom line represents the amount of coating applied in gallons per 100 sq ft. For example, a coating with 37.5% total solids by volume applied at 1 gal/100 ft^2 would give a dry film thickness of 6 mils. Other properties such as the wet film thickness and the spreading rate in sq ft per gallon can be easily derived from these graphical values. Of course, actual paint coverage may differ drastically from theoretical values, depending on application methods and other somewhat more miscellaneous factors, such as film shrinkage during oven curing.

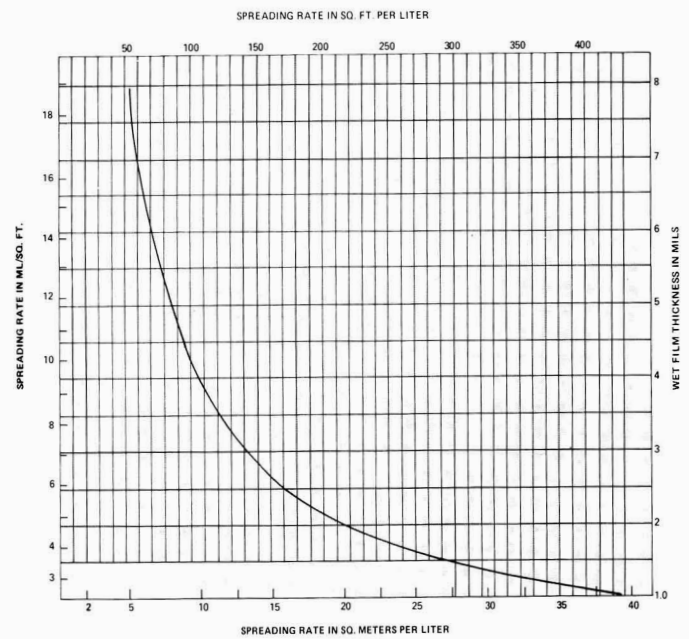


Figure 3—Spreading rate in square meters per liter

Another useful graph is that relating to the relationships between spreading rate as applied to hiding power charts at various amounts per sq ft. These amounts in mL (or cc) per sq ft can be related to coverage in various units such as spreading rate in sq ft or sq meters per gallon and mil wet film thickness. Conversion of these units to metric graphs is as follows: From equation (1)

$$\frac{\text{sq ft/gal}}{3.7853\ \text{liter/gal}} = \text{sq ft/liter} = \frac{\frac{3785.3}{\text{mL/sq ft}}}{3.7853} \quad (6)$$

and

$$\text{sq ft/liter} = \frac{1000}{\text{mL/sq ft}} \quad (7)$$

From equations (2) and (3), then

$$\text{T (mils)} = \frac{1604}{\frac{\text{sq ft/gal}}{3.7853}} = \frac{1604}{\text{sq ft/liter}} \quad (8)$$

Table 3

T (mils)	mL/sq. ft.
1.5	3.54
2.0	4.72
2.5	5.90
3.0	7.07
3.5	8.26
4.0	9.43
4.5	10.60
5.0	11.80
5.5	12.95
6.0	14.15
6.5	15.30
7.0	16.50
7.5	17.65
8.0	18.85

and

$$\text{sq ft/liter} = \frac{1604}{3.7853 \times \text{T (mils)}} \quad (9)$$

Substituting in equation (7)

$$\text{T(mils)} = 0.4238 \times \text{mL/sq ft} \quad (10)$$

using

$$\text{sq ft/liter} \times 0.092903 = \text{m}^2\text{/liter}$$

which is also identical for converting sq ft/gal to m^2/gal, and by appropriate substitution in equation (7), *Table* 1 is obtained.

By appropriate substitution in equation (9), *Table* 2 is obtained.

By appropriate substitution in equation (10), *Table* 3 is obtained.

The graph of these values for gallons is shown in *Figure* 2 and that for liters in *Figure* 3. By use of these graphs, when any one value is known, the remaining three can be read directly from the chart. By appropriate calculations, conversions can be made from dry film thickness to wet film thickness and by use of the graphs or other conversions (e.g., sq ft to sq m) any problem involving film thickness and spreading rate may be solved.

References

(1) Hill, H.E., "Coating Calculations", *Paint & Varnish Production*, June 1964.

Future Society Meetings

Birmingham

(Feb. 7)—"Doing Business in Japan" —G. Clayton, CIBA-GEIGY.

(Mar. 7)—"The Significance of Wavelength of UV Radiation on Durability"—L.A. Simpson, BTP Tioxide.

(Apr. 4)—"A Critical View of the Paint Industry"—M. Levete, Paintmakers Assoc. of Great Britain.

(May 2)—"Two Components Spraying Technology"—P. Green, Binks Bullows Ltd.

(June 12)—Symposium—"Miracle 85—Management and Investment Required to Achieve Coatings Laboratory Efficiency."

Chicago

(Feb. 4)—"Influence of Inactive and Active Pigments on Corrosion Inhibiting Properties of Paint Films" —Dr. Rolf Odenthal, Mobay Chemical Corp. "Federation Update"—Frank J. Borrelle, FSCT Executive Vice-President.

(Mar. 4)—"Air-Dry Water-Borne Primers for Metal Substrates"—Al Heitkamp, Cargill, Inc. "Environmental Update"—Dr. Hugh Smith, Sun Chemical Corp.

(Apr. 1)—"Paint Examination Techniques"—David W. Nichols, Federal Bureau of Investigation. "Seven Stages of an Invention"—Dr. George E.F. Brewer, Retired.

(May 10)—Awards Night Banquet.

Golden Gate

(Mar. 18)—"The Sensible Way to Paint and Profit"—Al McMichael, Universal Color Dispersions.

(Apr. 15)—"Water Systems for Plastics"—Speaker from Polyvinyl Chemical.

(May 20)—"Exterior Latex Paint Study"—Dan Dixon, Freeport Kaolin Company.

Kansas City

(Feb. 14)—"Paint Examination Techniques Utilized in the F.B.I. Laboratory"—James E. Corby, Federal Bureau of Investigation.

(Mar. 14)—Ladies Night.

(Apr. 11)—"Environmental Update"—Dr. Hugh Smith, Sun Chemical Corp.

(May 9)—Federation Night.

Los Angeles

(Mar. 13)—"The Sensible Way to Paint and Profit"—Al McMichael, Universal Color Dispersions.

(Apr. 10)—"Formulating with Water-Borne Acrylic Coatings for Plastics"—John E. Fitzwater, Polyvinyl Chemical.

(May 15)—"Exterior Latex Paint Study"—Dan Dixon, Freeport Kaolin Co.

(June 12)—Annual Meeting, Election of Officers.

New York

(Feb. 14)—"Legislative Update." Joint Meeting with NYPCA.

(Mar. 12)—Subject to Be Announced.

(Apr. 9)—"Toxicity of Glycol Ethers and Acetates"—Nancy Morris, Dow Chemical Corp.

(May 14)—PaVac Award Night.

Pacific Northwest

(Mar. 19-21)—"The Sensible Way to Paint and Profit"—Al McMichael, Universal Color Dispersions.

(Apr. 16-18)—"Water Systems for Plastics"—Speaker from Polyvinyl Chemical.

(May 21-23)—"Exterior Latex Paint Study"—Dan Dixon, Freeport Kaolin Company.

Philadelphia

(Feb. 14)—"Organoclays: A New Look at a Mature Product"—Thomas Powell, United Catalyst.

(Mar. 14)—FSCT Officers Night.

(Apr. 19)—Awards Night.

Piedmont

(Mar. 20)—"Driers and Related Additives"—Sam Bellettiere, Nuodex, Inc.

(Apr. 17)—"Industrial Lacquers Based on HM-Linear Saturated Polyesters"—Philip A. Reitano, Dynamit Nobel of America, Chemical Div.

(May 15)—"Influence of Inactive and Active Pigments on the Corrosion Inhibiting Properties of Paint Films"—Dr. Rolf H. Odenthal, Mobay Chemical Corp.

(June 19)—Nomination of Officers.

Pittsburgh

(Feb. 7)—Joint Meeting with Pittsburgh Section, National Association of Corrosion Engineers—Ken Tator, KTA Associates.

(Mar. 4)—"Composite vs Single Dispersants in Colorants and Coatings"—George Goodwin, Daniel Products. "Past-Presidents' Night."

(Apr. 1)—"Solvents for the Future"—Ron Readshaw, Union Carbide Corp.

Rocky Mountain

(Mar. 11)—"The Sensible Way to Paint and Profit"—Al McMichael, Universal Color Dispersions.

(Apr. 8)—"Water Systems for Plastics"—Speaker from Polyvinyl Chemical.

(May 13)—"Exterior Latex Paint Study"—Dan Dixon, Freeport Kaolin Company.

St. Louis

(Mar. 19)—"Organic Pigments: Past, Present, and Future"—Hugh M. Smith, Sun Chemical Corp.

(Apr. 16)—Education Night.

(May 21)—Manufacturing Night.

Toronto

(Feb. 11)—"Water-Borne Resins for Industrial Applications"—Carol Williams, Spencer-Kellogg. Div. of Textron.

(Mar. 11)—"Polymers and Applications in Building and Road Constructions and Repair"—Ray Crowne, Cappar Ltd. and "Federation Night."

(Apr. 18)—"Painting on Plastics"—J. Van Nocker, PPG Industries, Inc.

Western New York

(Feb. 19)—"Acrylic Emulsions"—Mike Ellis or Ted Deldono, Rohm and Haas Co.

(Mar. 19)—Joint Meeting. Speaker to be announced.

(Apr. 16)—"Melamine Crosslinkers"—Speaker from American Cyanamid.

(May 21)—"Organic Pigments: Past, Present, and Future"—Dr. Hugh Smith, Sun Chemical Corp.

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Society Meetings

BALTIMORE.....SEPT.

"Driers and Related Additives"

The Nuodex Gavel was presented to incoming President Robert Hopkins, of SCM Corp., by Thomas Mitchell, of Nuodex.

Bob Morrison, Chairman of the Technical Steering Committee, requested volunteers for the project on exterior exposure chalking of titanium dioxide. Especially needed are people with instruments that can measure the transition of light.

Sam Bellettiere, of Nuodex, Inc., spoke on "DRIERS AND RELATED ADDITIVES."

Mr. Bellettiere began his discussion with a comparison of the two classes of driers—active and auxiliary. He stated that a drier is a metal soap and that although the same metals are used in different types of driers, acid is the variable. After noting the typical acids used in driers, Mr. Bellettiere discussed the different formulations of and uses for driers.

HARRY POTH, *Secretary*

BALTIMORE..... OCT.

"Corrosion-Resistant Zinc Phosphates"

Past-President Joseph Giusto, of Lenmar, Inc., announced that the Baltimore Society-sponsored Mini-Show will be held at the Baltimore Hilton, Pikesville, MD, on April 17.

CLEVELAND SOCIETY PRESIDENT Robert D. Thomas (right) welcomes guest speaker Mike Oliveri, of Shamrock Chemicals

Robert Zabel, of Heubach, Inc., presented "THE NEW GENERATION OF CORROSION-RESISTANT ZINC PHOSPHATES."

Mr. Zabel stated that his work was done in Germany, where various zinc phosphates are manufactured. He explained that non-toxic zinc phosphate is considered to be a replacement for zinc chromate and strontium chromate which are generally recognized as toxic.

Zinc phosphates will form a reaction with the metal to give a suitable base for painting, he continued. Although zinc aluminum phosphate gives the best surface reaction of the various zinc phosphates, zinc chromate is better than any of the zinc phosphates. Mr. Zabel said that enough free binder must be present and that a certain pigment volume concentration must be maintained to formulate good metal primers. According to Mr. Zabel, the best results are obtained by the following guidelines: (1) Control of the particle size; (2) Maintain a certain amount of free binder; (3) PVC level in the range of 35-40%; and (4) Anti-corrosion pigment of 25-30%.

HARRY POTH, *Secretary*

BIRMINGHAM ..... OCT.

Installation of Officers

The following slate of officers for the year 1984-85 was installed: President—Roland Staples, of Midland Specialty Powders; President-Elect—J.R. Jukes, of Croda Paints Ltd.; Secretary—David M. Heath, of Holden Surface Coatings; Treasurer—S.V. Brettell, of Llewellyn Rylands; and Society Representative—David Lovegrove, of Carrs Paints Ltd.

In recognition of his years of service to the Federation, Harry Griffiths was the recipient of a 25-Year pin. Employed at Postans Ltd., Mr. Griffiths serves as immediate Past-President of the Society.

Distinguished service certificates were presented to Raymond Tennant, Ron Jukes, and David Yates.

Mr. Tennant, of Carrs Paints Ltd., served as Society President in 1982-83. His contributions include six years of service as Chairman of the Technical Committee.

Mr. Jukes was Treasurer of the Society from 1967-71. Employed by Croda Paints Ltd., he served as Society President in 1972.

A member of the Society since 1945, Mr. Yates was Chairman of the Technical Committee in 1950 and from 1954-57. Society President in 1952, Mr. Yates resides in Birmingham.

DAVID M. HEATH, *Secretary*

CLEVELAND .....SEPT.

"Environmental Update"

Robert Thomas, of PPG Industries, Inc., was installed as President for 1984-85. Other officers installed were: President-Elect—Scott Rickert, of Case Western Reserve; Secretary—Madelyn K. Harding, of Sherwin-Williams Co.; Treasurer—George S. Sajner, of Man-Gil Chemicals; and Society-Representative—Fred Schwab, of Coatings Research.

A moment of silence was observed in memory of J.C. Caldwell, who died recently.

James M. Wenker, of Sun Chemical, discussed an "ENVIRONMENTAL UPDATE."

Mr. Wenker gave a comprehensive presentation on current environmental issues and how government, industry, and advocacy groups relate to these. He discussed keeping up with the environmental explosion; the environment and the workplace; the EPA; worker's compensation; and transporting hazardous materials. In addition, his presentation included reference information on the key regulatory agencies concerned and the available literature sources for current information updates.

MADELYN K. HARDING, *Secretary*

CLEVELAND ..... OCT.

"Mechanisms of Mar Resistance"

Mike Oliveri, of Shamrock Chemicals, discussed "MECHANISMS OF MAR RESISTANCE."

Mr. Oliveri enumerated the various types of oils, synthetic and natural waxes, and silicones that have been used as mar-proofing agents. He outlined the forms in which they are available, including liquids, dry powders, pastes, and emulsifiers. He concluded with a discussion of the mechanisms by which these agents function to enhance mar resistance.

MADELYN K. HARDING, *Secretary*

GOLDEN GATE ..... SEPT.

"Synthetic Thickeners for Paint Systems"

A moment of silence was observed in memory of Ed Baker, of D.J. Simpson Co., who died recently.

After incoming President Ken Trautwein, of Sherwin-Williams Co., was presented with the Nuodex Gavel, the following officers were installed: Vice-President—Bob Miller, of F.W. Dunne Co.; Treasurer—Patricia Shaw, of Davlin Coatings, Inc.; Secretary—Karl Sauer, of Pfizer, Inc.; and Society Representative—Barry Adler, of Royell Products, Inc.

Scholarship Committee Chairman Dave Waldron, of Heubach, Inc., presented $1000 scholarships to Paula Ganser and Janet Kinser. Ms. Ganser, daughter of Paul Ganser, of O'Brien Corp., will attend San Jose State. The daughter of Ned Kinser, of Triangle Coatings, Ms. Kinser will attend University of California, Davis.

Charles W. Glancy, of Union Carbide Corp., spoke on "SYNTHETIC THICKENERS FOR PAINT SYSTEMS."

Paint rheology studies showed how the use of associative thickeners improved leveling and film build and reduced roller spatter. Mr. Glancy compared the advantages and disadvantages of both the cellulose and the polyurethane thickeners.

With the use of high speed photos, Mr. Glancy showed how roller spatter developed and how the spatter was reduced with the use of the polyurethane associative thickeners.

Q. As the paint film loses water in drying, does the thickener lose effect?

A. No, there is a balance between the sag resistance and viscosity as it dries.

Q. Does a dried paint film made with the new thickeners show less water resistance than the same paint made using the cellulose thickeners?

A. No, all tests to date show that there is no difference in water resistance of the two dried films.

KARL F. SAUER, *Secretary*

KANSAS CITY ..... OCT.

"Extender Pigments in Latex Paints"

Barney Pallia and Jack Tucker were presented with 25-Year pins in appreciation of their years of service to the Society. Additional 25-year members recognized were John Ormsby, Lawrence Schulte, Warren Manley, Karl King, Hugo Manco, Bill Koehn, Reg Robertson, Ray Frederick, Harry Oliver, Bob Briscoe, Bill Fitzpatrick, Earl Baumhart, Terryl F. Johnson, and J.C. Leslie.

William D. Meadows, of Cyprus Industrial Minerals, spoke on "EXTENDER PIGMENTS IN LATEX PAINTS, CHOICES BASED ON PHYSICAL PROPERTIES."

JERRY HEFLING, *Secretary*

LOS ANGELES ..... OCT.

"Propylene-Based Glycol Ethers and Acetates"

In appreciation for his accomplishments as Society President in 1983-84, the Society presented Lloyd Haanstra with a Past-President pin.

Nancy Morris, of Dow Chemical Co., addressed the topic of "MAKING THE SWITCH TO PROPYLENE-BASED GLYCOL ETHERS AND ACETATES IN INDUSTRIAL COATINGS."

Ms. Morris explained that glycol ethers and glycol ether acetates find extensive use as active solvents in industrial and trade sale coatings. Toxicity studies conducted on several ethylene-based glycol ethers (E-series) have raised concern in the paint and coatings industry regarding the safe handling and use of these products.

Propylene-based glycol ethers and acetates (P-series) have been demonstrated to be attractive replacements for the E-series glycol ethers in industrial coatings. This presentation provided specific formulation data on the use of P-series glycol ethers and acetates as replacements for E-series in conventional and high solids coatings. In addition, a timely update on the latest toxicity study activities and results was included. It was demonstrated that propylene-based glycol ethers and acetates were far less toxic

(70–90% less) than their ethylene-based counterparts.

The conclusion that was drawn from the studies was that if ethylene-based glycol ethers were being used in the workplace, an ongoing employee awareness program should be made a matter of policy. Work practices should include gloves, respirators, and ventilation unless reformulation to propylene-based glycol ethers could be accomplished.

RAY DIMAIO, *Secretary*

LOUISVILLE..... OCT.

"Formulation of Architectural and Maintenance Coatings"

John Ballard, of Kurfees Coatings, Inc., spoke on "APPROACH TO FORMULATION OF ARCHITECTURAL AND MAINTENANCE COATINGS."

Mr. Ballard stated that the most difficult problem in formulating coatings is in dealing with people. He emphasized the interrelationship between sales, laboratory, and factory people. In addition, he spoke on the importance of close adherence to formulae to avoid problems at the point of use and to minimize impact of product liability litigation.

Mr. Ballard continued with a discussion of several examples of coatings formulae and his personal opinion about each raw material in each example.

K.E. HYDE, *Secretary*

MEXICO.....SEPT.

Installation of Officers

The following officers were elected to serve during 1984–85: President—Antonio Pina, of Pinturas International, S.A.; Vice-President—Angel Ruiz, of Isomex, S.A. de C.V.; Secretary—Rosa Ma. Rojas, of Mobil Atlas, S.A. de C.V.; and Treasurer—Cuauhtemoc Pereda, of Pinturas Pittsburgh de Mexico, S.A.

ROSA MA. ROJAS, *Secretary*

NEW YORK.....SEPT.

"Polyethylene and ETFE Waxes"

Morris Coffino, of D.H. Litter Co., presented the Nuodex Gavel to incoming President Michael Iskowitz, of New York Bronze Powders. Other officers installed were: Vice-President—Raymond Gangi, of International Paints; Secretary—Kenneth DePaul, of Whittaker, Clark & Daniels; and Treasurer—John C. Burlage, of Pacific Anchor Chemicals. Saul Spindel of D/L Laboratories will serve as Society Representative.

Michael Oliveri, of Shamrock Chemical Corp., discussed "POLYETHYLENE AND ETFE WAXES."

Mr. Oliveri focused on polyethylene and ETFE waxes that are dispersed in industrial finishes to obtain mar and abrasion resistance. It had been assumed, he stated, that these particles float to the surface to create this property.

According to Mr. Oliveri, key advantages for polyethylene wax additives are resistance to abrasion, mar, scruff, and rub; slip, lubricity; antiblocking, gloss reduction, and texturing. He discussed the key mill characteristics of three different wax additives types.

KENNETH J. DEPAUL, *Secretary*

PHILADELPHIA.....SEPT.

"Iron and Zinc Phosphates"

Installed as officers for 1984–85 were the following: President—William Georgov, of J.M. Huber Corp.; President-Elect—Philip Reitano, of Kay Fries, Inc.; Secretary—Donald F. Denny, of E.W. Kaufmann Co.; Treasurer—Thomas L. Peta, of C.J. Osborn Chemicals Inc.; and Society Representative—Carl Fuller, of Reichard-Coulston Inc.

William J. Wittke, of Oakite Products Co., spoke on "MODERN METAL TREATMENT—IRON AND ZINC PHOSPHATES."

Mr. Wittke reviewed the types of coatings now available, emphasizing the advantages of pre-paint treatment. This treatment can be iron or zinc phosphates.

According to Mr. Wittke, iron phosphate has the advantages of ease of application, it is the cheapest, gives good results, and can be applied to multi-metal surfaces. The disadvantages are that it can be an irregular coating; there may be show-through of base metal; and involve high energy costs.

Mr. Wittke then outlined the advantages of zinc phosphate, including providing the best corrosion resistance, most uniform surface, better color, and less powdering. However, zinc phosphate involves greater cost, has the most stages for application, and has more involved chemistry.

Mr. Wittke reviewed application methods, both spray and immersion, and the problems and advantages of application from one to seven stage systems. He concluded by outlining modifiers for zinc phosphates, including chromate and calcium, and what they contribute to the system.

DONALD F. DENNY, *Secretary*

PIEDMONT.....SEPT.

Installation of Officers

The Nuodex Gavel of Office was presented to incoming President Phil Wong, of Reliance Universal. Also installed were officers for 1984–85: President-Elect—Michael S. Davis, of Sadolin Paint Products; Secretary—Steve Lasine, of McCullough & Benton; Treasurer—Charles Howard, of DeSoto, Inc.; and Society Representative—Gary Marshall, of Sadolin Paint Products.

Honored guests in attendance were Federation President-Elect, Joseph Bauer, and Director of Field Services, Thomas Kocis.

Mr. Bauer reported that the Federation is in good financial condition and is operating within a balanced budget. He commended the Society on their efforts in education, and congratulated them on winning the MMA Award, to be presented at the Annual Meeting in Chicago.

Mr. Kocis used slides to demonstrate the financial income of the FSCT. He also stated that the New England Society is involved in the historical research and preservation of the Boston Stone. The Federation and other Societies have donated funds for this effort. Mr. Kocis informed members about publications available through the FSCT, upcoming seminars and workshops, and Federation committee efforts. He announced that the 1985 Paint Show will be held in St. Louis.

MICHAEL S. DAVIS, *Secretary*

TORONTO .....SEPT.

"Coatings Formulation"

Luigi Cutrone, of Tioxide Canada Inc., spoke on "COATINGS FORMULATION USING THREE COMPONENT CONTOUR PLOTTING."

Mr. Cutrone stated that a coating is a complex mixture of pigments, vehicles, extenders, solvents, and additives. Variation of any one component results in a coating with different properties. He said that if the effect of several components has to be evaluated, the formulator is confronted with a formidable task because of the large number of samples that he has to prepare.

Before setting up a design, it is necessary to know which components influence the desired response, he continued. For a three-component system, ten samples are required. Using the special cubic equation derived from the Taylor series, the results from the ten samples are used to calculate the coefficients in the response surface equation. Mr. Cutrone described a computed program which first calculates all the coefficients and then generates all the

isoresponse curves that are required. He said that the application of response surface contour plots has been found very useful and time saving in developing new and optimizing existing coatings formulations.

PHILIP READ, *Secretary*

TORONTO ..... OCT.

"Coil Coatings"

Roger Taylor, of Baycoat Ltd., Hamilton, Ont. presented "A BEGINNER'S GUIDE TO COIL COATINGS."

Mr. Taylor defined the coil coating line as a continuous coated operation where line accumulators allow coils to be mechanically stitched together without stopping the production line. He reviewed the application equipment and paint systems used in the production of coil coated metal. Mr. Taylor explained that end uses include home and industrial siding, eaves and down-pipes, noise barriers, hot plates, farm implements, etc. Costs are moderated and performance is good, he concluded.

PHILIP READ, *Secretary*

WESTERN NEW YORK . . . SEPT.

"Titanium Dioxide"

A moment of silence was observed in memory of Martin E. Schleicher, Past-President of the Federation, who recently died.

The following officers were installed for the year 1984-85: President—Donald M. Kressin, of Spencer Kellogg, Div. of Textron, Inc.; Vice-President—Charles C. Tabbi, of Spencer Kellogg; Secretary—Michael L. DePietro, of Spencer Kellogg; Treasurer—Jean L. Luck, of Pratt & Lambert; and Society Representative—Thomas E. Hill, of Pratt & Lambert.

Publicity Chairman Mark Markoff presented 25-Year pins to John Yeager, William Birk, William Bown, David Vanderweide, Robert Kline, and Lloyd Nesbitt.

R.I. Ensminger, of NL Chemicals, presented a paper on "TITANIUM DIOXIDE—WHY SO MANY GRADES?"

Mr. Ensminger explained how organic and inorganic treatment of TiO_2 changes its performance and manufacturing characteristics. He pointed out that as the percent of treatment increases, the lower the gloss and the better the chalk resistance. Choosing the correct grade of TiO_2 is a compromise between high gloss grades and chalk resistant grades, with many versions in between, he concluded.

MICHAEL L. DEPIETRO, *Secretary*

WESTERN NEW YORK . . . OCT.

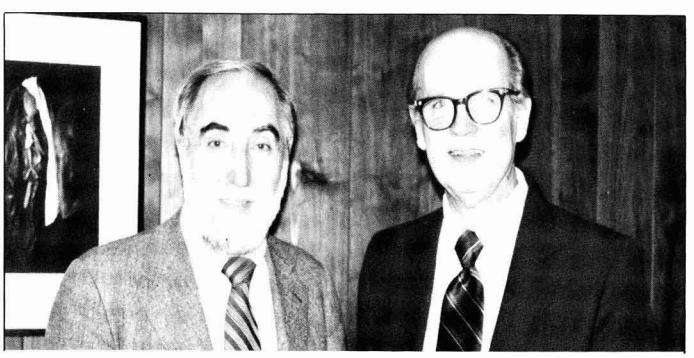
"Defoamers for Aqueous Coatings"

Mark Markoff presented 25-Year pins to Anthony Pappano, of Allerton-Voplex and John D. Bousser, of Pierce & Stevens.

Barbara Gan, of Drew Chemical, spoke on "DEFOAMERS FOR AQUEOUS COATINGS."

After showing a movie about foam in liquids, Ms. Gan stated that foam stability is a function of surface area, surface tension, viscosity, temperature, concentration, and pH of the coating. Foam control by chemical agents was accomplished by adding a defoamer, spreading of the defoamer, thinning of the bubble wall, and rupture of the bubble or foam. The types of defoamers she described for most aqueous coatings are hydrophobic silicas, organics, silicone compounds, waxes, and various combinations.

MICHAEL L. DEPIETRO, *Secretary*



WESTERN NEW YORK SOCIETY MEMBERS Anthony Pappano (left), of Allerton-Voplex and John D. Bousser, of Pierce & Stevens were the recent recipients of FSCT 25-Year pins

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD; HARRY POTH, Ainsworth Paint Co., 3200 E. Biddle St., Baltimore, MD 21213. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA).

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

CHICAGO (First Monday—meeting sites in various suburban locations). RON KLEINLEIN, Sherwin-Williams Co., 10909 S. Cottage Grove Ave., Chicago, IL 60628.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). JOSEPH W. STOUT, Hanna Chemical Coatings, P.O. Box 147, Columbus, OH 43216.

CLEVELAND (Third Tuesday—meeting sites vary). MADELYN HARDING, Sherwin-Williams Co., P.O. Box 6027, Cleveland, OH 44101.

DALLAS (Thursday following second Wednesday—Executive Inn, near Lovefield Airport). ASHWIN V. PARIKH, Union Carbide Corp., 2326 Lonnecker Dr., Garland, TX 75041.

DETROIT (Fourth Tuesday—meeting sites vary). CAROLYN GESSNER, Inmont Corp., 26701 Telegraph, P.O. Box 5009, Southfield, MI 48086.

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

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX) DAVID SATZGER, O'Brien Corp., P.O. Box 14509, Houston, TX 77221.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). JERRY P. HEFLING, Loctite Auto & Consumer, 3255 Harvester Rd., Kansas City, KS 66115.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). RAY DIMAIO, Koppers Co., P.O. Box 22066, Los Angeles, CA 90022.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). KEN HYDE, Reliance Universal, Inc., Louisville, KY 40233.

MEXICO (Fourth Thursday—meeting sites vary). ROSA MA. ROJAS, Mobil Atlas, S.A. de C.V., Poniente 146 No. 700, 02300 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). VIJAY SHARMA, Swing Paints Ltd., 2100 St. Patrick St., Montreal, Que., Canada.

NEW ENGLAND (Third Thursday—Hillcrest Function Facilities, Waltham). KEVIN MULKERN, Samuel Cabot, 229 Marginal St., Chelsea, MA 02150.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). KENNETH DEPAUL, Whittaker, Clark & Daniels, 1000 Coolidge St., S. Plainfield, NJ 07080.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). LARRY BRANDENBURGER, Valspar Corp., 1101 Third St. S., Minneapolis, MN 55415.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). DENNIS HATFIELD, J.F. Shelton, 1067 Industry Dr., Tukwila, WA 98188.

PHILADELPHIA (Second Thursday—Dugan's Restaurant). DONALD F. DENNY, E.W. Kaufmann Co., P.O. Box 529, Southampton, PA 18966.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood exit of I-85, High Point, NC.) STEVE LASINE, McCullough & Benton, P.O. Box 29803, Atlanta, GA 30359.

PITTSBURGH (First Monday—A.J. ISACCO, Puritan Paint & Oil Co., 1 N. Main St., Pittsburgh, PA 15215.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). CRAIG HANSEN, George C. Brandt, Inc., 6500 Stapleton Dr. S., Denver, CO 80216.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). JAMES N. MCDERBY, JR., F.R. Hall & Co., 5007 Fyler, St. Louis, MO 63129.

SOUTHERN (Gulf Coast Section—Third Thursday; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—bi-monthly, Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). RONALD R. BROWN, Union Chemicals Div., P.O. Box 26845, Charlotte, NC 28213.

TORONTO (Second Monday—Cambridge Motor Hotel). PHILIP READ, Sico, Inc., 30 Bethridge Rd., Rexdale, Ont., Canada M9W 1N2.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). MICHAEL DEPIETRO, Spencer-Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 14225.

Elections

CHICAGO

Active

BROMLEY, RAY W.—Whittaker Corp., Batavia, IL.

CAMPBELL, DALE R.—Sherwin-Williams Co., Chicago, IL.

CIEMNY, RONALD E.—Sun Chemical Corp., Northlake, IL.

CRAMSEY, GREGORY A.—Sun Chemical Corp., Northlake.

FANGER, GENE O.—Bell & Howell, Zeeland, MI.

GEARON, RICHARD T.—Rust-Oleum Corp., Evanston, IL.

HARRISON, MYRTLE—Sherwin-Williams Co., Chicago.

KELLOGG, TERRY—Packaging Corporation America, Skokie, IL.

LAT, GERONIMO E.—Paslode Co., Wilmette, IL.

LAWSON, DONALD C. III—Sherwin-Williams Co., Chicago.

SIRESS, CRAIG—Elpaco Chemicals, Elkhart, IN.

WESTERHOFF, TERRY L.—The Enterprises Companies, Chicago.

Associate

BONA, JACK—Cabot Corp., Glen Ellyn, IL.

DEMPSEY, DENNIS—Color Corporation of America, Rockford, IL.

GALLAGHER, WILLIAM F.—Mobay Chemical Corp., Rosemont, IL.

NACK, DENNIS K.—Celanese Specialty Resins, Schiller Park, IL.

MAU, THOMAS—Daniel G. Hereley, Chicago, IL.

Retired

KITUN, ALEXANDER—San Diego, CA.

LOS ANGELES

Active

ALEXANDER, CYRIAC P.—Frazee Industries, San Diego, CA.

BALOW, MARVIN F.—Frazee Industries, San Diego.

BROWN, MELBA R.—Major Paint & Varnish Co., Torrance, CA.

BURDURLU, YUCEL—Ameritone Paint Corp., Long Beach, CA.

CURADO, A.L.—Western Specialty Co., Los Angeles, CA.

DE JONG, HELENE Y.—Major Paint & Varnish Co., Torrance.

EICK, JANICE M.—Major Paint & Varnish Co., Torrance.

FERRER, VERONICA M.—Major Paint & Varnish Co., Torrance.

DE FRETES, INA E.—Major Paint & Varnish Co., Torrance.
FULTON, LARRY—Ameritone Paint Corp., Long Beach.
GILMARTIN, PLATT J.—Tnemec Co., Inc., Compton, CA.
GOLDEN, MILTON M.—M & S Golden, Inc., West Los Angeles, CA.
GUTIERREZ, CRISTITO V.—Major Paint & Varnish Co., Torrance.
HAYASHIDA, CARMEN F.—Major Paint & Varnish Co., Torrance.
HULL, KAREN E.—Major Paint & Varnish Co., Torrance.
KIYUNA, KEITH K.—Cargill Inc., Lynwood, CA.
LINDSEY, STEVEN A.—Major Paint & Varnish Co., Torrance.
LU, ROGER C.—Sierracin/Sylmar, Sylmar, CA.
MCDOUGALL, MICHELLE L.—Major Paint & Varnish Co., Torrance.
OSEN, LAMBERT—John K. Bice Co., Inc., Garden Grove, CA.
PEREZ, GERARDO M.—Major Paint & Varnish Co., Torrance.
RAY, FRANK A.—Reliance Universal, Inc., Cerritos, CA.
SAYTA, ANIL R.—Major Paint & Varnish Co., Torrance.
SCARLATA, DANA L.—Major Paint & Varnish Co., Torrance.
SIY, ENRIQUE C.—Frazee Industries, San Diego.
WITT, JULIAN E.—Whittaker Corp., Colton, CA.

Associate

BENBOW, CHARLES—Waymire Drum Co., Los Angeles, CA.
BRINKMAN, DAN—Pfizer, Inc., Los Angeles.
DAHM, LEONARD—Pfizer, Inc., Los Angeles.
FULLER, NORVELL—Pfizer, Inc., Los Angeles.
LEE, BOB—Pfizer, Inc., Los Angeles.
LINNETT, ROGER—Pfizer, Inc., Los Angeles.
MASSON, JERRY—Masson Construction, Hacienda Heights, CA.
PINKL, THOMAS—Pfizer, Inc., Los Angeles.
PODELL, CRAIG M.—Interstab Chemicals Inc., Sepulveda, CA.
SAMPSEL, KATHLEEN—Morehouse Industries, Inc., Fullerton, CA.
TRUDEAU, LEE—Double R Co., West Covina, CA.
WENZEL, TOM—Pfizer, Inc., Los Angeles.
WIEDENHAEFER, JAMES—Columbian Chemicals Co., Santa Ana, CA.

Federation Membership Anniversaries

25-YEAR MEMBERS

Birmingham
Harry J. Griffiths, Postans Ltd.

Kansas City
Barney Pallia, Retired
Jack Tucker, Valspar Corp.

WOOL, GLENN O.—Harrisons & Crosfield, Tustin, CA.

SOUTHERN

Active

ANAPOLLE, KENT E. DR.—AZS Corp., Atlanta, GA.
BOBZIN, BONNIE R.—AZS Corp., Atlanta.
CAULKINS, GLENN A.—Akzo Coatings America, Norcross, GA.
CHRISTOPHER, KEVIN F.—United Paint Co., Memphis, TN.
ETHERTON, WILLIAM P.—Southern Coatings, Slidell, LA.
FORRESTER, W. KENT—Stabler Paint Mfg. Co., Birmingham, AL.
JANUARY, JAMES R.—ODC, Inc., Norcross.
JONES, LEE—Cea Lee, Inc., Inverness, FL.
MARSCHALL, DANIEL—DPI Quality Paints, Clearwater, FL.
MEILUS, LEO—AZS Corp., Lakeland, FL.
MULVEY, JOSEPH L.—Reichhold Chemicals, Inc., Pensacola, FL.
SENENTZ, JULES A. II—Southern Coatings, Slidell.
SOOD, KRISHAN C.—Coronado Paint Co., Edgewater, FL.
WEST, ROBERT W.—E.A. Thompson Co., Olive Branch, MS.
WINTERS, BILLY K. JR.—Reichhold Chemicals, Pensacola.
ZIEMER, PAUL D.—AZS Corp., Atlanta.

Associate

ACHEY, PAUL D.—AZS Corp., Tampa, FL.
BOGAN, JOHN C.—McKesson Chemicals Co., Memphis, TN.
COYLE, JAMES L.—Mat Chemicals, Inc., Hialeah, FL.
CRABTREE, THOMAS J.—The Manufacturing Co., Orlando, FL.
DURR, DAVID—Azalea Color Co., Pittsburgh, PA.
ELLIS, THOMAS R.—Dow Chemical USA, Atlanta, GA.
GLOVER, JERRY V.—Dow Chemical USA, Memphis.
GUNTER, JOHN W. JR.—Azalea Color Co., Winston Salem, NC.
HISLOP, ROBERT P.—McWhorter, Inc., Carpentersville, IL.
LOPER, ROBERT E.—Byk-Chemie USA, Tuscaloosa, AL.
MCKENNY, MICHAEL J.—Union Chemicals Div., Memphis.
O'BRIEN, JOSEPH J.—ITD Industries, Inc., St. Petersburg, FL.
SCHNEIDER, RANDY J.—Chemcentral, New Orleans, LA.
SCHRAMM, THOMAS—Damron Chemicals, Atlanta.

AFFILIATED

CHIN, KENNY K.L.—International Paint, Hong Kong.

TEXTBOOK OF POLYMER SCIENCE

Written by
Fred W. Billmeyer, Jr.

Published by
John Wiley & Sons, Inc.
New York, NY
578 Pages, $34.95

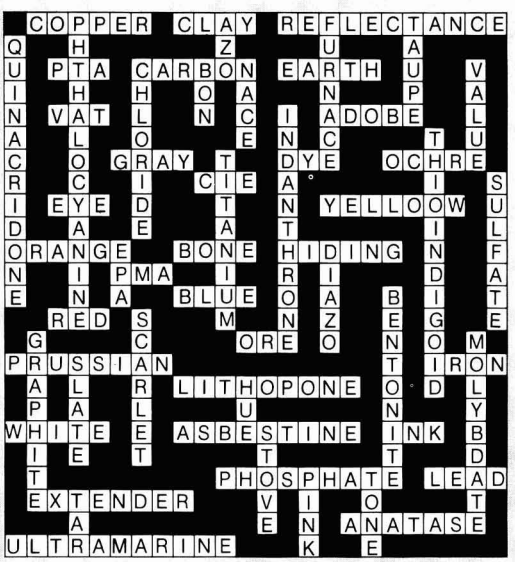
Reviewed by
Dr. Thomas J. Miranda
Whirlpool Corp.
Benton Harbor, MI

In this rewritten version of the popular textbook by Professor Billmeyer, he has made two major changes in direction. First, to increase its value as a textbook, he has rearranged the text to include polymerization in the first part of the book. The second change is to bring the text up to date with new material inserted where appropriate. In this regard some sections are not changed, reflecting the maturity of the subject matter; however, each chapter contains some new material.

The reference material is similar to that used in the previous editions, with the author using general references rather than specific original articles due to the immense explosion of polymer literature. The overall structure of the book will be easily recognized by those familiar with the previous editions.

The six sections of the book include: introduction, polymerization, characterization, structure and properties, properties of commercial polymers, and polymer processing. A useful feature of the new volume is the inclusion of discussion questions and problems which adds pedagogical value to the book. This book should continue to be of good value to students and teachers and for those in industry working in the polymer field.

We are fortunate that Professor Billmeyer made this contribution to the polymer field before his retirement.



Solution to December *"CrossLinks"*

POLYMERIC MATERIALS AND ARTIFICIAL ORGANS

Edited by
Charles G. Gebelein
Youngstown State University
Youngstown, OH

Published by
American Chemical Society
Washington, D.C.
208 pp., $36.95

Reviewed by
Joseph V. Koleske
Union Carbide Corp.
South Charleston, WV

This interesting book, based on an Organic Coatings and Plastics Chemistry Division symposium held in early 1983, contains both generalized and specialized information for those interested in the role synthetic polymers play in the field of artificial organs and prosthetic devices. Each of the 13 chapters has been written by different authors, and the editor and reviewers have the information well organized and presented.

The first two chapters describe the type of devices and polymers that are used in this field. Other early chapters deal with the immune responses—physiological, interfacial, etc.—of the foreign polymeric system to the receiving body. Two polymers, poly(1,4-hexadiene) and polydimethyl-siloxane, that are extensively used in artificial organ manufacturing are discussed in detail. The later chapters describe the historical and recent research on particular artificial devices. The topics include lungs and oxygenators, heart valves, kidneys, cells, and skin.

This book should serve as an interesting volume for anyone who wishes to become aware of the use of artificial devices in the human body. The extent to which such devices are used is surprising to the uninitiated—for example, each year over 400,000 finger joints are replaced with synthetic materials. "Before and after" photographs illustrate the improvement that can be achieved in damaged hands, body contours, etc.

Symposium on Color and Appearance Instrumentation To Be Keyed to Theme of "Color: The End User"

A two-day symposium on instrumentation for measuring color and appearance in the coatings industry, to be held April 17–18, 1985, at the Sheraton Hotel at Station Square, Pittsburgh, PA, will feature paper presentations and "hands-on" workshop sessions at which the latest color measurement equipment will be displayed.

The event is being sponsored jointly by the Federation of Societies for Coatings Technology, the Manufacturers Council on Color and Appearance, and the Inter-Society Color Council.

The symposium will immediately follow the ISCC's Annual Meeting, also being held at the Sheraton, April 14–16. Theme for both events will be "Color: The End User," and a special "bridge" session on April 16 will serve to tie in the back-to-back programming.

The symposium will be divided between general oral presentations and workshop sessions on instrumentation, sample preparation and presentations, and statistical control.

The workshop format is designed to offer a "working meeting" environment, and *registrants are invited to bring samples with them for evaluation.*

Attendance will be limited so that registrants will have maximum opportunity for discussions.

Open time will be available for those wishing to pursue additional inspection of equipment on display and for discussions with representatives from the equipment manufacturers.

General program sessions are under the direction of Jacki Welker, of PPG Industries, Inc., who chairs the Federation's Inter-Society Color Council Committee. Arrangements for the workshops and instrument displays are being handled by Charles Leete, of the Manufacturers Council on Color and Appearance.

Registration fee for the symposium is $145. This includes two lunches, two continental breakfasts, three coffee breaks, and bus transportation to the airport at the conclusion of the symposium.

Complete program information and registration/housing forms are available from Federation of Societies for Coatings Technology, 1315 Walnut Street, Suite 832, Philadelphia, PA 19107 (215/545-1507).

Kent State University Sponsors Coatings Courses

Kent State University has scheduled three short courses designed for polymer and coatings specialists to be held in the spring. Subjects to be presented include dispersion, adhesion, and rheology of coatings and polymers. The programs are sponsored by the Rheology and Coatings Division of the Chemistry Dept.

"Dispersion of Pigments and Resins in Fluid Media" will be held from May 6–10; "Adhesion Principles and Practice for Coatings and Polymer Scientists" from May 20–24; and "Applied Rheology for Industrial Chemists" from June 3–7.

Additional information on these programs can be obtained by contacting Dr. Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242.

ISCC Annual Meeting

The 54th Annual Meeting of the Inter-Society Color Council will be held at the Sheraton Hotel at Station Square, Pittsburgh, PA, from April 14 to 16.

Workshops scheduled include such topics as "A Survey of Color Systems," by Dr. Fred W. Billmeyer, Jr., and "Metamerism, from Strict Definition to Real Samples, Observers, and Illuminants," by Henry Hemmindinger.

Sessions planned for Tuesday afternoon, April 16, are designed to serve as a bridge between the ISCC and the Symposium.

Joy Turner Luke will serve as Program Chairman for the ISCC. Further details may be obtained by contacting the Secretary, Therese R. Commerford, U.S. Army Natick R&D Center, Attn: STRNC-ITC, Natick, MA 01760.

A CALL FOR PAPERS

For
A Conference on New Monomers for
Product Diversification and Specialization
Dearborn Inn, Dearborn, Michigan
May 20-22

Sponsored
By
Eastern Michigan University
College of Technology

As the polymers industry heads through the 1980's and beyond, the need for diversification and specialization is evident. Many of the specialty resins of the 1960's and 1970's are either approaching or are presently at commodity status. To embark on the road to specialization and diversification, new or overlooked specialty monomers are needed. This monomer conference will discuss the chemistry of new monomers and intermediates and their potential role in generating new or unique polymer systems. The audience will be exposed to a variety of specialty monomers with application in diverse areas of polymers.

The conference will be held May 20, 21, & 22 at the historic Dearborn Inn in Dearborn, Michigan, adjacent to the Henry Ford Museum and Greenfield Village complex and 15 minutes from the Detroit Metropolitan Airport.

Interested parties should submit a 50 word abstract by February 15, 1985, and a final paper by March 30, 1985, to:

Dr. John Graham, Program Coordinator
Polymers & Coatings
Eastern Michigan University
College of Technology
Sill Hall
Ypsilanti, MI 48197

Answers to questions or clarification can be obtained by calling Dr. Graham or Dr. Kuwik at (313) 487-1161.

Emulsion Polymerization Course Offered, June 3-7, at Lehigh University

The 16th annual short course, "Advances in Emulsion Polymerization and Latex Technology," will be offered at Lehigh University during the week of June 3-7. This course is designed for engineers, chemists, other scientists, and managers who are actively involved in emulsion work or for those who wish to develop expertise in the area.

The course is an in-depth study of the synthesis and properties of high polymer latexes. Subject matter includes a balance of theory and application, as well as between chemical and physical problems. Lectures, given by leading academic and industrial workers, begin with introductory material and reviews, and progress through recent research results.

Fee for the course is $600 for the entire week, or $175 per day. For further information, contact Dr. Mohamed S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015.

New England Society To Prepare A/V On Careers

The Educational Committee of the New England Society has announced plans to prepare a 20-minute audio/visual presentation on "Careers in the Paint and Coatings Technology." It will be aimed at secondary and college freshman students. Ronald B. Child, of California Products Corp., is in charge of the project.

Los Angeles Society Scholarship Program

The Los Angeles Society for Coatings Technology (LASCT) Scholarship Program will be continued for the 1985-86 academic year. The program was established during 1980-81 to encourage the academic training of students majoring in a technical curriculum (science, engineering, mathematics, etc.) applicable for employment in the coatings industry.

Scholarships will be awarded in the following priority: (1) member of the LASCT; (2) students related to a member of the paint industry and preferably a member of the LASCT; and (3) other students currently enrolled in a coating technology curriculum. Further, **all applicants must reside within the geographic boundaries of the LASCT** as defined in Sec. 25 of the LASCT Constitution and By-Laws.

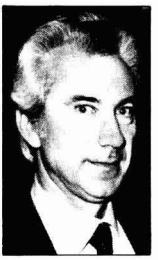
Candidates currently enrolled or planning to enroll in a four year institution should contact the LASCT Scholarship Committee Chairman as soon as possible: Charles Miyada, c/o Reichhold Chemicals, Inc., 107 S. Motor Ave., Azusa, CA 91702, or by calling (818) 334-4974 for an application form.

The scholarship program is also applicable to those enrolled or planning to enroll in a graduate school majoring in Paint Technology.

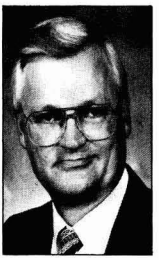
People

During its Annual Meeting in Chicago, the National Paint and Coatings Association presented awards to those who have contributed to the coatings industry. Among the recipients were **Robert Minucciani,** of Glidden Coatings and Resins, Div. of SCM Corp., Baltimore, MD, and **Colin D. Penny,** of Hampton Paint Manufacturing Co., Hampton, VA.

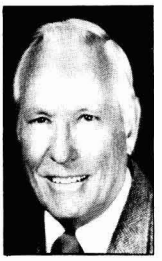
Mr. Minucciani, a member of the Golden Gate Society, was recognized for Achievement in State Government Affairs. Active in the Baltimore Society, Mr. Penny was honored for Achievement in Service to the Industry.



C.D. Penny



J.A. deRidder



J. King

A.J. Kirsch

W. Anthony Major has been elected to Vice-President, Operations at Silberline Manufacturing Co., Inc., Lansford, PA. Mr. Major served as General Manager of plant operations in the United States prior to his advancement.

Siberline Manufacturing has elected **John A. Kalinovich** to Vice-President, Finance. Joining the firm in 1970, Mr. Kalinovich most recently held the position of Assistant Treasurer.

Sun Chemical Corp., Cincinnati, OH, has appointed **John Pitt** to the position of Canadian Sales Representative for the company's Pigments Div. An active association worker, Mr. Pitt has been a committee chairman in the Toronto Society since 1982 and has also represented Canadian Industries Ltd. at the National Coil Coaters Association.

Anne Ernst, a Sun Chemical employee for eight years, has been promoted to the company's newly created position of Technical Service Representative. Ms. Ernst most recently served as a Dry Color Coordinator.

Raymond B. Tennant, J. Ron Jukes, and **David E. Yates,** of the Birmingham Paint, Varnish, and Lacquer Club, were awarded Distinguished Service Certificates at the October meeting. Mr. Tennant, of Carrs Paints Ltd., has been a member for 11 years, was President in 1982-83, and Technical Committee Chairman for six years. Mr. Jukes, of Croda Paints Ltd., has been a member for 30 years, was President in 1971-72, and Treasurer for four years. Mr. Yates was President in 1952 and has been a member for 44 years.

Metal Coatings International, Inc., Chardon, OH, has named **Jon A. deRidder** to Vice-President and Director of Marketing/Sales. Mr. deRidder had been with the Metals Coatings Division of Diamond Shamrock Chemicals Co. since 1973.

McCloskey Varnish Co., Philadelphia, PA, has named **Joseph E. King** to Vice-President/General Manager for the western region of the company. Mr. King is a member of the Los Angeles Society and has been with McCloskey since 1982.

United Catalysts, Inc., Louisville, KY, has appointed **Gary W. Beall** to the position of Technical Director of the company's new rheological division. In this position, Mr. Beall will be in charge of quality control, research and development, and customer technical assistance.

Midland Div., The Dexter Corp., Waukegan, IL, has named **Thomas E. Rauls** to the position of Laboratory Supervisor for its Birmingham, AL facility, and **Frank Meyers** to Laboratory Supervisor for general line and aircraft coatings at its Hayward, CA facility.

In addition, **Jim Wright** has joined the General Industrial Sales Dept. of the Midland Div. as a Coating Specialist for the Southeast. He will work out of the division's Birmingham facility.

At a recent meeting of the Golden Gate Society, $1000 scholarships were presented to **Paula Ganser** (daughter of Paul Ganser, an employee at O'Brien Corp., San Francisco, CA) and **Janet Kinser** (daughter of Ned Kinser, of Triangle Coatings, Berkeley, CA). Ms. Ganser will attend San Jose State, and Ms. Kinser, the University of California at Davis.

Albert J. Kirsch, a member of the New York Society, has retired from American Cyanamid Co., Wayne, NJ. Most recently in Marketing at Cyanamid's world headquarters, Mr. Kirsch's career spanned 38 years. He joined the company to work as a Chemist, and subsequently held positions in Technical Service and in Product Management. Mr. Kirsch plans to work as a Consultant to the coatings industry.

Allied Chemicals, Allied Corp., Morristown, NJ, has named **Fred G. Karasek** to General Manager of Allied Chemicals' polyethylene business. In 1960, Mr. Karasek joined Allied as an Engineer and most recently served as Director of Marketing for polyethylenes.

Juergen Dormann has been elected Chairman of the Board of Directors for American Hoechst Corp., Somerville, NJ. A deputy member of the Hoechst AG Board of Management, Mr. Dormann succeeds **Prof. Rolf Sammet,** who is also Chairman of the Hoechst AG Board of Management.

At a recent meeting of the Buffalo Paint and Coatings Association, **William G. Ringle** was honored for 50 years of service to the paint industry. Bob Ray, Eastern Regional Vice-President of the NPCA, presented Mr. Ringle with his 50-year certificate.

In 1934, Mr. Ringle joined Pratt and Lambert as a Laboratory Assistant. There he remained for his entire career, working his way up to Vice-President and Technical Director. He retired in 1981, but has remained active with the BPCA, where he has served as Secretary for the last four years. Mr. Ringle is active in the Western New York Society, of which he was President in 1962.

Jack E. Crouch has joined Occidental Chemical Corp., Darien, CT, as Vice-President and General Manager—olefins. A 35-year veteran of the chemical industry, Mr. Crouch had served for 22 years with Allied Corp., where he most recently held the position of General Manager—specialty polyethylenes.

SCM Pigments, SCM Corp., Baltimore, MD, has appointed **William S. Eaton** to the position of Director—Marketing. In this capacity, Mr. Eaton will be responsible for the planning and direction of the marketing function. He is a member of the New York Society.

Manuel Sanhueza has joined CasChem, Inc., Bayonne, NJ, as a Senior Research Scientist, directing the activities of the urethane coatings laboratory.

Three promotions have been announced at CasChem: **Melvin Brauer**—Technical Director; **Dr. Y.C. (Jack) Chu**—Group Leader—specialty chemicals and elastomers; and **William J. Downey**—Group Leader—telecommunications and automotive applications. Mr. Brauer is a member of the New York Society.

Douglas W. Huemme has been elected a Vice-President of Whittaker Corp., Los Angeles, CA. Mr. Huemme joined Whittaker's Chemicals Group in 1976. An active participant in association work, Mr. Huemme is a member of the Los Angeles Society, and is a Director of the National Paint and Coatings Association and the National Coil Coaters Association.

Humko Chemical Div. of Witco Chemical Corp., New York, NY, has appointed **Frank Griffin** as Southern Regional Sales Manager and **Erich M. Bodnar** as Eastern Regional Manager.

Morton Thiokol, Inc., Chicago, IL, has announced four appointments in its Chemical Division's Adhesives and Coatings Group: **Neal G. Reddeman**—Senior Vice-President; **Alfred H. Isenberg**—Technical Director; **Timothy J. Bendle**—Business Manager; and **Peter Yates**—International Sales Manager.

Krishan Sood, a 25-year member of the Chicago Society, has become Technical Director of Coronado Paint Co., Edgewater, FL. Mr. Sood brings 30 years of research and development experience to the position.

Spencer Kellogg Div. of Textron, Inc., Buffalo, NY, has appointed **Richard K. Hong** to the position of Market Manager, industrial resins. Mr. Hong, a member of the Western New York Society, most recently served as Product Manager for high-solids resins.

At the Canadian Paint and Coatings Association's 72nd Annual Convention, the following four individuals received the CPCA Industry Statesman Award: **Alun Morris,** recently retired from L.V. Lomas Chemical Co.; **Jack Schimnowski Sr.,** Western Paint; **Phil Shep,** Phillips Paint Products; and **Doug Wood,** recently retired from PPG Canada Inc. Mr. Morris is an active member of the Toronto Society.

Penn Color, Inc., Doylestown, PA, has recently promoted **James P. Garton** to Plant Manager for its Manville, NJ, facility. Mr. Garton joined the firm in 1978 and has served in a series of production and technical positions.

Sylvachem Corp., Panama City, FL, a part of the Organic Chemicals Group of SCM Corp's Chemical Div., has reorganized its management responsibilities. As part of this reorganization, three employees have been promoted: **Michael R. Boyce** to the position of Vice-President/General Manager; **Roland Glotzer** to Director of Marketing and New Business Development; and **Lan L. Maycock** to Director of Sales.

Len Verhagen has been appointed to National Sales Manager for Hockmeyer Equipment Corp., Harrison, NJ. Most recently, Mr. Verhagen has held the position of Product Manager for Jaygo, Inc.

J. Earl Burrell has retired from PPG Industries, Pittsburgh, PA, following a career of over 40 years of service with the company. Prior to his retirement, he was President and Chief Operating Officer, a post he held for eight years. Mr. Burrell will remain a member of the PPG board.

Obituary

S. Leonard Davidson, retired from NL Industries, Inc. and Past-President and Honorary Member of the Federation, died November 10 at the age of 66.

S.L. Davidson

Mr. Davidson, a graduate of the University of California, began his 40-year career in the coatings industry with National Lead Co., San Francisco, in 1943. He served as Chief Chemist from 1944 until 1951, when he was transferred to Perth Amboy, NJ, as Chief, Paint Development.

In 1967, he moved to NL's Hightstown, NJ laboratories as a Senior Chemist and Color Consultant. He was a Regulatory Affairs Specialist with NL Industries at the time of his retirement on March 1, 1983.

He was President of the Golden Gate Society in 1950, and President of the New York Society in 1965. He received the latter's Kienle and PaVaC Awards in 1960 and 1968, respectively.

In 1954, he was Chairman of the New York Society's Technical Subcommittee on "Color Matching in Production" and presented that group's still well-known and in-use "Color Matching Box" at the Federation's Annual Meeting in 1955.

Mr. Davidson initiated the evening color courses sponsored by the New York Society and served as the instructor for several years. He authored several papers on coatings and pigments technology and lectured in this country and abroad on these subjects as well as "Color Control in the Coatings Industry." He received the Federation's Bruning Award in 1969 for his contributions to the science of color in the coatings industry.

President of the Federation in 1970–71, he was elected to Federation Honorary Membership in 1981.

He was a member of ACS, ASTM, and Treasurer of both the Inter-Society Color Council and the Munsell Foundation. A long-time member of the Oil and Colour Chemists' Association, he was elected Vice-President and Member of Council earlier this year.

Mr. Davidson is survived by his wife, Edythe; two sons, Charles and John; a daughter, Susan; and three grandchildren. The Davidson residence is at 42 Kemp Ave., Fair Haven, NJ 07701.

David E. Benoit, Director of Marketing for Kerr-McGee Chemical Corp., West Chicago, IL, died on September 8, 1984, following a brief illness. He was 54 years old. A member of the Chicago Society, Mr. Benoit served the coatings industry for 27 years.

Literature

Silane Coupling Agents

Literature explaining the chemistry of silane coupling agents and how to select the appropriate product for coupling various classes of polymers is now available in an eight-page brochure. The publication also includes a section on various methods for applying a silane coupling agent. Copies of the brochure, "Silanes—Coupling Agents, Polymer and Sealant Additives," are available from Petrarch Systems, Inc., 2731 Bartram Rd., Bristol, PA 19007.

Filter Vessel

A four bag filter vessel designed to accommodate #2 size filter bags has been introduced in literature. The vessel is welded of carbon steel, nickel-plated steel for harsh, corrosive environments, and complies with OSHA standards. For detailed performance specifications and optional equipment on the Model FSP-800, write: FSI, Filter Specialists, Inc., 100 Anchor Rd., Michigan City, IN 46360.

Formula Book

A new formula book has recently been published which features a total updating of all formulation information including cost-of-sales figures. For your copy of the Super V-Line formula book, contact Universal Color Dispersions, 2700 E. 170th St., Lansing, IL 60438.

Zinc Phosphate Pigment

A formulary detailing the proper loading and handling of zinc phosphate has been published. Zinc phosphate is offered to coatings formulators as an environmentally safe, non-toxic anti-corrosive replacement for zinc chromate. For copies on Grade 317 zinc phosphate, contact Michael Coulston, President, Reichard-Coulston, Inc., 1421 Mauch Chunk Rd., Bethlehem, PA 18018.

Liquid Storage Tanks

Information is available on flat bottom tanks which are constructed of heavy steel with welded seams to withstand maximum loads and to prevent ruptures. For complete details, contact Certified Equipment & Mfg. Co., P.O. Box 298, Springfield, IL 62705.

Fume Hood Control

The cost/performance effectiveness of a laboratory fume hood control system is described in a new brochure. The system saves expensive conditioned air and maintains a constant face velocity. For a free brochure, write: TSI Incorporated, P.O. Box 64394, St. Paul, MN 55164.

Health and Safety Studies

The Canadian Paint and Coatings Assoc. has published "Health and Safety Bulletin No. 28," which summarizes three recent investigations into the health effects of chromates. Both an epidemiological study and laboratory tests are included in the investigations. Information on the bulletin may be obtained from CPCA Headquarters located at Suite 825, 515 St. Catherine St. West, Montreal, Quebec, H3B 1B4.

Coating Thickness Gauge

Information has been published on the recently introduced portable microprocessor-based digital coating thickness gauge. The bulletin contains technical data regarding the instrument's range, accuracy, and resolution. For more details, contact Mr. Frank Rueter, Vice-President—Marketing, Zorelco Ltd., P.O. Box 25500, Dept. Y2, Cleveland, OH 44125.

Disperser

Information is now available on a new disperser. The new machine, which features a pinned-disk impeller, is recommended for a wide range of uses including mixing pastes, breaking down agglomerates, dissolving, and dispersing viscous materials. For copies, contact Mr. Gisbert Schall, Vice-President, Draiswerke, Inc., 6 Pearl Court, Allendale, NJ 07401.

Rosin Products

A new 10-page brochure covering the new line of rosin products and specialty resins is now available. The two-color pamphlet provides product descriptions and specifications as well as applications and shipping information. For copies, write to Sylvachem Corp., P.O. Box 690, Jacksonville, FL 32201.

Motorized Filters

A new line of motorized industrial filters has been introduced in a four-page illustrated brochure. Information regarding the installation, operating, and replacement parts of these automatic, continuous cleaning filters is included in the publication. For copies, contact AMF CUNO, General Filter Products Div., Public Relations Dept., 400 Research Parkway, Meriden, CT 06450.

Monomers

A new family of multifunctional monomers designed to reduce the primary irritation index of "parent" acrylates has been introduced in literature. These monomers are recommended for use as a direct replacement for other commercially used monomers in high energy and conventional cure coatings, inks, and adhesives. Technical data on the Chemlink 9020-9025 monomers, and the SR-355 and SR-399 monomers can be obtained from Sartomer Co., West Chester Plaza, West Chester, PA 19382.

Acetate

Information and technical data sheets may now be obtained on a new high performance, low toxicity solvent. The product is specifically designed for those applications requiring a slow evaporating, non-hydroxylic solvent and is claimed to be useful in formulations requiring a tail solvent or as a coalescent in water-borne emulsions systems. For copies write: Marketing Communications Department, ARCO Chemical Co., 1500 Market St., Philadelphia, PA 19101.

Chemical Intermediates

An eight-page brochure provides an easy-to-use index of literature on formulating paint and coating resins based on chemical intermediates. The two-color booklet contains information on how to make resins for solvent-based coatings, water-borne coatings, high solids and solventless coatings, coil and can coatings, and specialties such as inks and paper coatings. For copies of "A Guide to Formulating Paints and Coatings," write: Amoco Chemicals Corp., Mail Code 4002, Dept. ADV-JCT, P.O. Box 8640-A, Chicago, IL 60680.

Why Dow Corning silicone resins and additives are such a big plus.

- **Outstanding heat resistance.**
- **Superior weathering properties.**
- **Better wetting and flow-out.**
- **Increased adhesion.**
- **Improved mar-resistance.**
- **Reduced foaming.**

You can choose from a full line of silicone paint resins and additives that offer proven advantages over organic alternatives. So you'll be able to improve your paint's resistance to temperature and weather. And solve any number of performance and processing problems.

They can be used with a wide variety of coatings, too. Solvent or solventless. Water-borne or powder. Conventional or compliance.

Then there's the Dow Corning commitment to silicone technology that assures you of state-of-the-art-products, and guidance on using them. And our nationwide distributor network gets them to you fast.

To add a big plus to your formulation, write for our free product selection guides. Dow Corning Corporation, Dept. E-4026, P.O. Box 0994, Midland, MI 48640.

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DOW CORNING

Dispersators

A new line of high intensity laboratory mixers with three unique mixing heads: simplex dispersator head, duplex dispersator head, and hi-vis head are described in a technical bulletin. The simplex is recommended for small droplet emulsion preparation and rapid mixture of dissimilar fluids. The duplex pulls ingredients that tend to float into the liquid with a down and up motion, ensuring that the batch is uniform. The hi-vis is recommended for dispersion and deagglomeration of solids in viscous fluids. For more detailed information on the Series 2000 Model 84 and the Series 2001 Model 84, write to Premier Mill Corp., 220 East 23rd St., New York, NY 10010.

Reactive Cure Buyers' Guide

A 256-page buyers guide for technologists using radiation curing processing has recently been published in bound volumes. The guide contains nine sections of buying information which should be of interest to those in many industries, including automotive, building and construction, fasteners, flooring, graphic arts, metallizing, and wood finishing. The guide costs $110.00 domestic and $120.00 overseas. For further information, contact Claire Bluestein, Captan Associates, Inc., P.O. Box 1563, Rutherford, NJ 07070.

Cleanable Filters

A two-page brochure describing a disposable, cleanable filter has been published. Through the use of photos, illustrations, and tables, the literature aids in the selection of the filter as well as providing information on installation, operation, cartridge cleaning and replacement parts. The filters are ideally applicable to the machine tool, metalworking, coatings, diesel and turbine industries in which oil-based fluids are used. Contact AMF CUNO, General Filter Products Div., Public Relations Dept., 400 Research Parkway, Meriden, CT 06450 for more details on DDS Auto-Klean.

Iron Oxide Pigment

Information is now available on an iron oxide pigment which will not cause haziness or milkiness after extended exposure to weather. This pigment is recommended for use in a wide range of applications, including food wrappings and coatings. For complete details on Irox Yellow 207ED, write to Reichard-Coulston, Inc., 1421 Mauch Chunk Rd., Bethlehem, PA 18018.

Binding Clamp

Information is now available on a series of bonding and grounding wires which use a heavy duty hand-clamp. Because of the high spring tension and stainless steel contact points of this clamp, it is recommended for penetrating filmy coatings for a good positive electrical connection. For further details, contact Justrite Manufacturing Co., 2454 Dempster St., Des Plaines, IL 60016.

Coatings Formulary

State-of-the-art coatings formulations are described in a new 148-page volume. Pointers on handling coatings systems, tips on paint formulation for premium performance, and starting-point formulations using UV-cure resins, are among the many topics discussed. For free copies of the formulary entitled, "A Helping Hand," write to Richard Johnson, Specialty Products Service Manager, Cargill, Inc., P.O. Box 5630, MN 55440.

Solvents

A new colorless ketone solvent is featured in literature. In higher solids coatings, this solvent provides lower viscosities than most other oxygenated solvents at equivalent levels. It is recommended for lacquer formulations and other conventional coatings. Complete information on UCAR Methyl n-Amyl Ketone can be obtained from Union Carbide Corp., Solvents and Coatings Materials Div., Dept. K3442, Danbury, CT 06817.

Grinding and Dispersing Equipment

A new 12-page, two-color brochure featuring grinding and dispersing equipment has been published. Included in the literature are illustrations of each model, performance specifications, benefits, and applications. Order copies of "Grinding and Dispersing Equipment," from Netzsch Inc., Grinding Dept., 119 Pickering Way, Exton, PA 19341.

Valve Bagging Line

A complete line of valve bagging equipment has been introduced. The new line is recommended for packing most materials into valve bags at high speed. The equipment makes the completely automated bagging of dry, granular, powdered, flaked or flushy products possible. Contact Howe Richardson Corp., Mangood Corp., Mike Hudak, 680 Van Houten Ave., Clifton, NJ 07015.

Colorant

Information on a new extra-strength phthalocyanine blue colorant has been compiled in a publication. This colorant is offered in powder form and has been approved by the U.S.D.A. for use in plastic materials that come into direct contact with meat or poultry food products prepared under Federal inspection. For performance specifications of this pigment, contact Dr. Peter Lewis, Sun Chemical Corp., Pigments Div., 4526 Chickering Ave., Cincinnati, OH 45232.

Pulverizer

Performance specifications of a new line of high capacity air impact mills has been released in literature. Recommended for pulverizing virtually every kind of plastic powder, pharmaceutical, chemical or natural material, including hard, brittle, abrasive, soft, and agglomerate materials, the mills claim to boost energy savings up to 20% or more. Write: Mr. Bruce Baker, Garlock Inc., Plastomer Products, Friends Lane, Newtown, PA 18940 for more information on the T-60 Air Impact Mills.

Alkyd Resin

A new high solids short oil alkyd for industrial baking enamels has been introduced in literature. The applications of this product include baking enamels for general metal finishes, hardware, tools, and metal furniture. Further information on Synthetic Resin Solution 12-511 can be obtained from Reichhold Chemicals, Inc., Resins and Binders Div., P.O. Box 1433, Pensacola, FL 32596.

Pigments

A new four-page brochure containing technical information on the characteristics of pearl luster pigments and iridescent colors has been published. These pigments may be applied to plastics, coatings, inks, paper, and a variety of packaging materials. For copies, contact The Mearl Corporation, 41 East 42nd St., New York, NY 10017.

Microviscometer

Literature may now be obtained on a new microviscometer. Designed for fluids such as dilute polymer solutions, solvents, and plasma, the new instrument is expected to automatically and repeatedly measure the viscosity of low viscosity fluids. Additional details are available by writing: Darren Bronen, Haake Buchler Instruments, Inc., 244 Saddle River Rd., Saddle Brook, NJ 07662.

Cavity Pumps

A new line of progressive cavity pumps is detailed in an eight-page, two-color brochure. The literature contains illustrations, specifications, performance, and technical data on the pumps. Contact Netzsch Inc., 119 Pickering Way, Exton, PA 19341 for copies.

Custom Coating

A service is now available for the manufacturing of your product on a toll basis. All that is needed are the specifications and chemical description of the product. For more detailed information, contact Paul S. Morris, Director, Contract Custom Coating, Polaroid Custom Coatings, 1265 Main St., Waltham, MA 02254.

Digital Controller

A digital ratio controller has been introduced in literature. The controller is claimed to accurately maintain a pre-set ratio of two-streams, even when one is fluctuating in volume and is recommended for blending two liquid products or two dry products. Further details may be obtained from S.J. Controls, Inc., P.O. Box 91059, Long Beach, CA 90809.

Coming Events

FEDERATION MEETINGS

1985

(Apr. 17-18)—Symposium on Color and Appearance Instrumentation. Jointly sponsored by FSCT, Manufacturers Council on Color and Appearance, and Inter-Society Color Council. Sheraton Station Square, Pittsburgh, PA. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

(May 14-17)—Federation "Spring Week." Seminar on 14th and 15th; Society Officers on 16th; and Board of Directors on 17th. Omni International/Baltimore, MD. (FSCT, 1315 Walnut St., Philadelphia, PA. 19107).

(Oct. 7-9)—63rd Annual Meeting and 50th Paint Industries' Show. Convention Center, St. Louis, MO. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

1986

(May 13-16)—Federation "Spring Week." Seminar on 13th and 14th; Society Officers on 15th; and Board of Directors on 16th. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

(Nov. 5-7)—64th Annual Meeting and 51st Paint Industries' Show. World Congress Center, Atlanta, GA. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

SPECIAL SOCIETY MEETINGS

(Feb. 13-15)—"Water-Borne and Higher-Solids Coatings" Symposium sponsored by the Southern Society for Coatings Technology and the University of Southern Mississippi. New Orleans, LA. (Dr. Gordon L. Nelson, Chairman, Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS 39406-0076).

(Feb. 26-Mar. 1)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA. (11911 S. Woodruff Ave., Downey, CA 90241).

(Mar. 12-13)—Cleveland Society. 27th Annual Technical Conference on "Advances in Coatings Technology." Case Western Reserve University, Cleveland, OH. (Harry A. Scott, Glidden Coatings & Resins, 16651 Sprague Rd., Strongsville, OH 44136).

(Mar. 27-29)—Southern Society. Annual Meeting. Atlanta Hilton Hotel, Atlanta, GA. (Salvatore G. Sanfilippo, Reichhold Chemicals, Inc., P.O. Box 1610, Tuscaloosa, AL 35403).

(Apr. 9)—"Focus" Conference sponsored by Detroit Society. Management Education Center, Troy, MI. (Detroit Society, 765 Dellwood Dr., Ann Arbor, MI 48103).

(Apr. 10-12)—Southwestern Paint Convention of Dallas and Houston Societies. Anatole Hotel, Dallas, TX. (T. LaBaw, Sherwin-Williams Co., 2802 W. Miller Rd., Garland, TX 75041).

(Apr. 17)—Baltimore Society Mini-Show. Baltimore Hilton, Pikesville, MD. (Joseph Giusto, Lenmar, Inc., P.O. Box 4434, Baltimore, MD 21223).

(Apr. 25-27)—Pacific Northwest Society for Coatings Technology Symposium. Empress Hotel, Victoria, B.C. (Ottwin Schmidt, Helzer Canada Ltd., 8531 Cullen Crescent, Richmond, B.C., V6Y 2W9 Canada).

1986

(Mar. 25-27)—Southern Society. Annual Meeting. 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. Houston, TX. (Mike Winters, Ribelin Distributors, Inc., 7766 Blankenship, Houston, TX 77055).

OTHER ORGANIZATIONS

(Jan. 28-30)—"Materials Durability in the 1980's." Atlas School for Natural and Accelerated Weathering. Doral Country Club, Miami, FL. (Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(Feb. 10-13)—"Color: Then and Now." 13th Annual Conference of Inter-Society Color Council. Williamsburg Lodge, Williamsburg, VA. (Mrs. Bonnie K. Swenholt, 5717 Gulick Dr., Honeoye, NY 14471).

(Feb. 11-13)—"Adhesion: Science and Technology" Course. East Brunswick, NJ. (Center for Professional Advancement, Box H, East Brunswick, NJ 08816).

(Mar. 4-6)—"Adhesion: Science and Technology" Course. Chicago, IL. (Center for Professional Advancement, Box H, East Brunswick, NJ 08816).

(Mar. 5-8)—Painting and Decorating Contractors of America. Annual Convention. Red Lion Inn, Portland, OR. (PDCA, 7223 Lee Highway, Falls Church, VA 22046).

(Mar. 25-27)—"Electrochemical Techniques for Corrosion" Symposium to be held during CORROSION/85, sponsored by the National Association of Corrosion Engineers. Boston, MA. (Symposium Chairman, Robert Baboian, Texas Instruments, Inc., Mail Station 10-13, Attleboro, MA 02703).

(Mar. 25-27)—Joint Annual Meeting of Zinc Institute Inc. and Lead Industries Association, Inc. Four Seasons Hotel, Toronto, Ont., Canada. (Ernest L. Pennington, LIA/ZI, 292 Madison Ave., New York, NY 10017).

(Mar. 25-29)—CORROSION/85. Annual Conference for the National Association of Corrosion Engineers, Boston, MA. (Meetings Manager, NACE Headquarters, P.O. Box 218340, Houston, TX 77218).

(Apr. 14-16)—54th Annual Meeting of Inter-Society Color Council. Sheraton Station Hotel, Pittsburgh, PA. (Therese R. Commerford, U.S. Army Natick R&D Center, attn: STRNC-ITC, Natick, MA 01760).

(Apr. 14-17)—"Achievements and Opportunities in the Appliance Market." National Coil Coaters Association's Annual Meeting. Camelback Inn, Scottsdale, AZ. (Tony Carroll, NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Apr. 15-16)—25th Annual Technical Symposium, Washington Paint Technical Group. Twin Bridges Marriott Hotel, Washington, D.C. (Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Apr. 16-18)—PaintCon '85. O'Hare Expo Center, Chicago, IL. (Professional Exposition Management Co., Inc., Ste. 205, 2400 E. Devon Ave., Des Plaines, IL 60018).

(May 6-10)—"Dispersion of Pigments and Resins in Fluid Media" Short Course. Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242).

(May 20-24)—"Adhesion Principles and Practice for Coatings and Polymer Scientists" Short Course. Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242).

(May 28-June 2)—International Surface Finishing and Printed Circuit Board Making Exhibition. Beijing, People's Republic of China. (Sino Trade Promotions, Tak Cheung Building, 22-24 Wing Lok St., Central, Hong Kong).

(June 3-7)—"Advances in Emulsion Polymerization and Latex Technology" Short Course. Lehigh University, Bethlehem, PA. (Dr. Mohamed S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

(June 3-7)—"Applied Rheology for Industrial Chemists" Short Course. Kent State University, Kent, OH. (Carl J. Knauss, Chemistry Dept., Kent State University, Kent, OH 44242).

(June 10-12)—International Conference on Biologically Influenced Corrosion, sponsored by the National Association of Corrosion Engineers, Washington, DC. (Meetings Manager, NACE Headquarters, P.O. Box 218340, Houston, TX 77218).

(June 11-13)—Eastern Plant Engineering & Maintenance Show and Conference. Georgia World Congress Center, Atlanta, GA. (Show Manager, Plant Engineering & Maintenance Shows, 999 Summer St., Stamford, CT 06905).

(June 16-19)—Dry Color Manufacturers' Association. Annual Meeting. The Greenbriar, White Sulphur Springs, WV. (DCMA, 206 N. Washington St., Ste. 202, P.O. Box 931, Alexandria, VA 22313).

(June 26-29)—Oil & Colour Chemists' Association's Biennial Conference. Edinburgh, Scotland. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(July 4-7)—Oil and Colour Chemists Association Australia. 27th Convention. Hunter Valley, NSW, Australia.

(Sept. 2-4)—Federation of Scandinavian Paint and Varnish Technologists. 11th Congress. SAS Hotel Scandinavia, Oslo, Norway. (Paal Ivan, Nodest Industries A/S, Boks 500, N-3001 Drammen, Norway).

(Sept. 17-19)—FINISHING '85. Cobo Hall, Detroit, MI. (AFP/SME, P.O. Box 930, Dearborn, MI 48128).

(Oct. 8-11)—A.F.T.P.V. (French Association of FATIPEC). Biennial meeting. Strasbourg, France. (J. Roire, AFTPV, 5 Rue Etex, 75018 Paris, France).

(Oct. 14-18)—European Conference on Applications of Surface and Interface Analysis. Veldhoven, The Netherlands. (ECASIA Conference Bureau: QLT Convention Services, Keizersgracht 792, 1017 EC Amsterdam, The Netherlands).

(Nov. 4-6)—National Paint and Coatings Association. 98th Annual Meeting. Hilton Hotel, New Orleans, LA. (Karen Bradley, NPCA, 1500 Rhode Island Ave. N.W., Washington, DC 20005).

(Nov. 6-8)—National Coil Coaters Association Fall Technical Meeting. Hyatt Regency Dearborn, Dearborn, MI. (Tony Carroll, NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Nov. 15-17)—38th National Decorating Products Association Show. McCormick Place, Chicago, IL. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

1986

(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).

(Week of September 22 or 29)—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, 6 Blvd. Pereire, 17 Paris, France - or - Amleto Poluzzi, AITIVA, Via Taranto, 20142 Milano, Italy).

Advertisers Index

'Humbug' from Hillman

If you haven't had enough of those Bob Ahlfisms, here are some more to keep you well fed. I haven't had the real pleasure of meeting Bob, either in person or by mail, since his wisdom comes to us by way of Technical Editor Tom Miranda. I'll bet, though, that he doesn't have a television set. Nobody could be that delightfully original and still be sitting in front of the tube. We've got three sets at home.

- It's always darkest before it turns completely black.
- I hope you got everything you wanted, whether you wanted it or not. (Merry Christmas!)
- Have a nice day!—whether you want it or not.
- Jogging is good for the heart—every morning a girl jogs past and it does my heart good.
- Truth is cleaner than fiction.
- You know you never feel like washing dishes in the morning.
- The early bird yawns a lot.
- A penny saved is a waste of time.
- I spent 30 minutes hunting for the instant coffee.
- What really counts is who gets to write the report.

• • •

Robert Kennedy of Inmont Canada was so stimulated by that Aussie story on house painting performance that he dug up the following.

A young man with a wife and small children to support was laid off from his work. He could not find suitable employment anywhere.

In desperation, his wife suggested he visit the highly priced neighborhood and see if he could get odd jobs from well-to-do homeowners.

The next morning, the young man set out. He came upon an elderly gentleman raking leaves on the front lawn of a beautiful large home and told him of his plight.

The elderly gentleman needed some painting done and an agreement was reached on wages. He told the young man to go to the back of the house where he would find a gallon of light green paint, a brush, stir stick, thinner and a wiping rag, and to proceed to paint the porch.

The young man returned to the front of the house a short time later. The elderly gentleman said, "You can't possibly be finished, you have only been painting for 50 minutes!" "Oh yes sir, the job is finished," replied the young man, "I am a fast worker and incidentally sir, that is not a Porche but a Mercedes!"

• • •

I pledge that what Saul Spindel sent me as examples of some more "authentic" accident reports will be the almost last on the subject—for a while. This collection as found by the Dartnell Corp. should at least, as Saul said, "bring a smile to your face," unless, of course, you wrote one of these reports.

Collected Collisions

If you've ever had a car accident and then tried to describe it in as few words as possible for the insurance forms, you'll appreciate the following descriptions as they appeared in the *Toronto Sun:*

"An invisible car came out of nowhere, struck my vehicle, and vanished."

"The pedestrian had no idea which direction to go, so I ran over him."

"I had been shopping for plants and was on my way home. As I reached an intersection, a hedge sprang up, obscuring my vision."

"The other car collided with mine without giving warning of its intentions."

"My car was legally parked as it backed into the other vehicle."

• • •

Earl Hill who works for the Lord------Corporation, that is, contributed this short bit some time ago. I've waited to publish it, though, in the hope that many of my readers have forgotten that they read it in the Sept. C&E News.

Flotsam and Jetsam

Norman Hochella of Sunbury, Mass., says the statement that iguana meat "tastes somewhat like chicken" (C&EN, Aug. 13, page 80) is merely a subformulation of Chamberlain's Law, "Everything tastes more or less like chicken." The law is one of 15 that Hochella supplied. Among them are Jenkinson's Law, "It won't work."
(as published in the C&EN, Sept. 3, page 40)

• • •

What Cards!

We want to share with you some of the more memorable Christmas cards received one year, mostly by Don Kreger, a freelance writer, plus a few received by us.

FROM THE CHAIRMAN OF THE FTC:
"Although I lack documentation, I feel reasonably certain you will have a positive Christmas experience."

FROM JERRY DELLA FEMINA:
"Merry Christmas from those wonderful folks who gave you Easter."

FROM XEROX:
"This card is an exact duplicate of the beautiful original."

FROM "MS." MAGAZINE:
"The right to a Merry Christmas shall not be denied because of sex."

FROM WENDY'S GIFT CERTIFICATE REFUND DEPARTMENT:
"Holiday Greetings to you and yours. What's the beef?"

With Humbug's usual insistence on being prompt, we wish you the best of all years in 1985.

—Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361

NOW, BAKED-ON TOUGHNESS FROM AIR-DRIED COATINGS

Now there's an alcohol-free, toluene-wet nitrocellulose from Hercules. Its compatibility with urethanes allows you to formulate a new generation of tough "Superfinishes" that air-dry fast, then cure by cross-linking at room temperature!

Such coatings combine the fast-dry and ease of application of nitrocellulose lacquers, with the durability, gloss retention, and stain resistance of urethanes.

This makes them ideal for metal finishing, particularly large objects such as aircraft, since a second coat may be applied only a few hours after the first. They also find application in coating wood furniture to achieve toughness approaching that of high-pressure laminates.

For more data on these fast air-dry coatings, including trial formulations, contact Hercules Incorporated, Hercules Plaza, Wilmington, DE 19894, Attn: D. Joyce. (302) 594-6500, Ext. 7060. Or Hercules Chemical Corporation, 20 Red Lion Street, London WC1R 4PB, England. Telex 25803. Attn: H. Vincent.

A new generation of superfinishes.
From Hercules, of course.

HERCULES

NC 83-2

Resume' of a coatings Tribologist

Most simply defined* as "one who specializes in the control of friction and wear." The title could apply to all 80+ employees at our 100,000 sq. ft. plant. More particularly, it relates to:

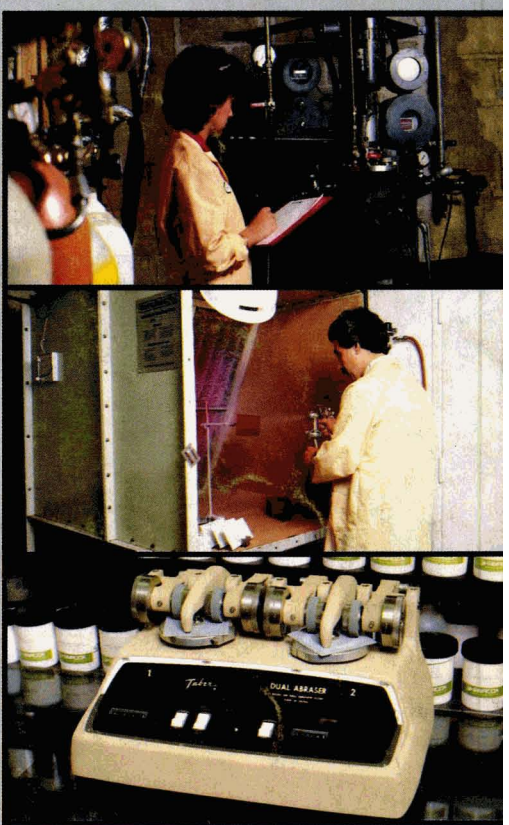
+ the engineers, scientists and technicians specializing in product development and applications testing,
+ the production supervisors responsible for grind consistency and quality control,
+ the trained sales staff doing problem analysis and formulation recommendations in the field.

*from the Greek TRIBEIN - 'to rub or wear'

We take polyethylene and PTFE raw materials and manufacture them into products that provide wear, mar, scuff, abrasion resistance, and other properties.

Why does Shamrock invest so much in sophisticated testing, elaborate manufacturing checks and balances, and exacting quality controls? Simply, to make certain that the small percentage of your formulation represented by our wide variety of stir-in powders, is consistent in performance! And, to make available a staff with the experience and ability to analyze your problems and help you solve them.

We care! And, we deliver...consistently and with quality! For samples and technical data, contact us or your nearby sales office/representative.



TOP: *Reactor produces developmental polyethylene waxes.* MIDDLE: *Samples are prepared by roller, brush, draw-down and spray application techniques.* BOTTOM: *Testing is conducted for slip and friction, rub and mar, and wear and abrasion.**

*Taber Abraser shown distributed by Testing Machines, Inc.

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