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JOURNAL OF COATINGS TECHNOLOGY

"Anticorrosive Function of Primers. Influence on Protection by Subsequent Coatings"

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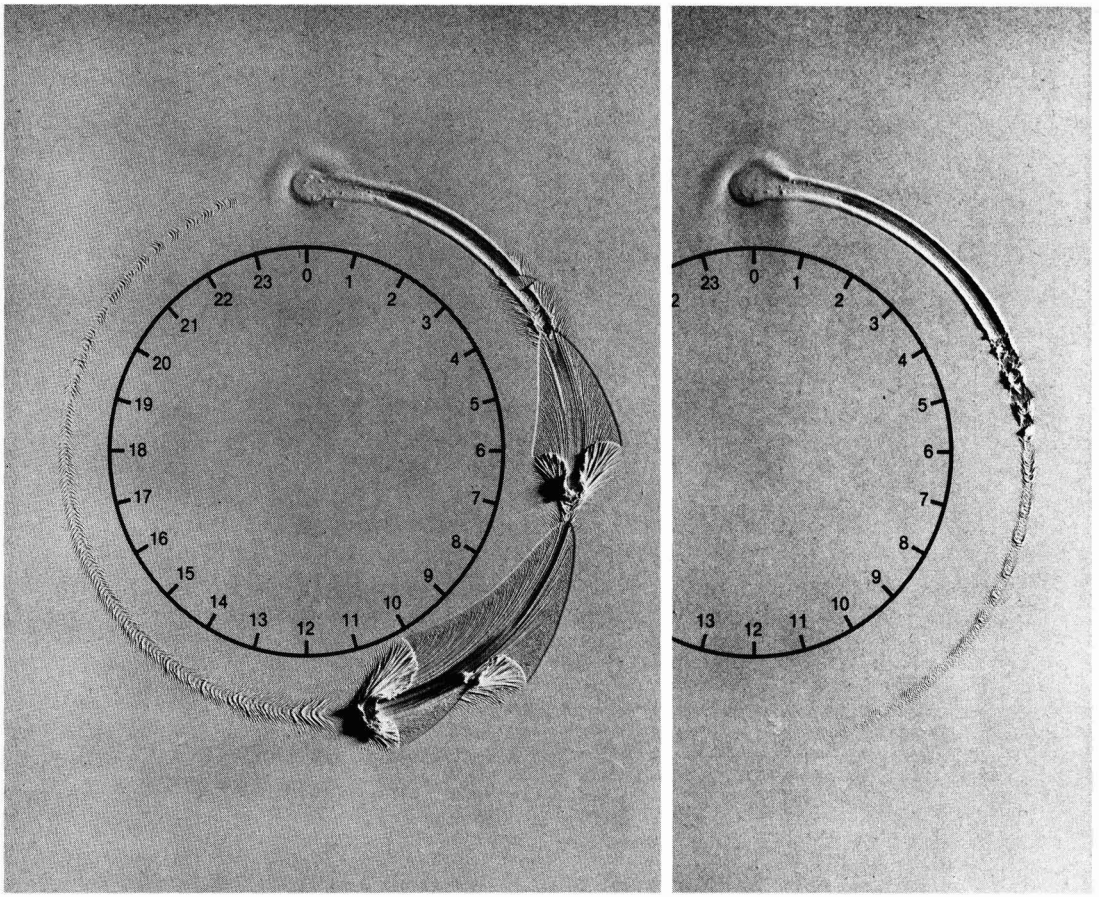

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FEBRUARY 1984

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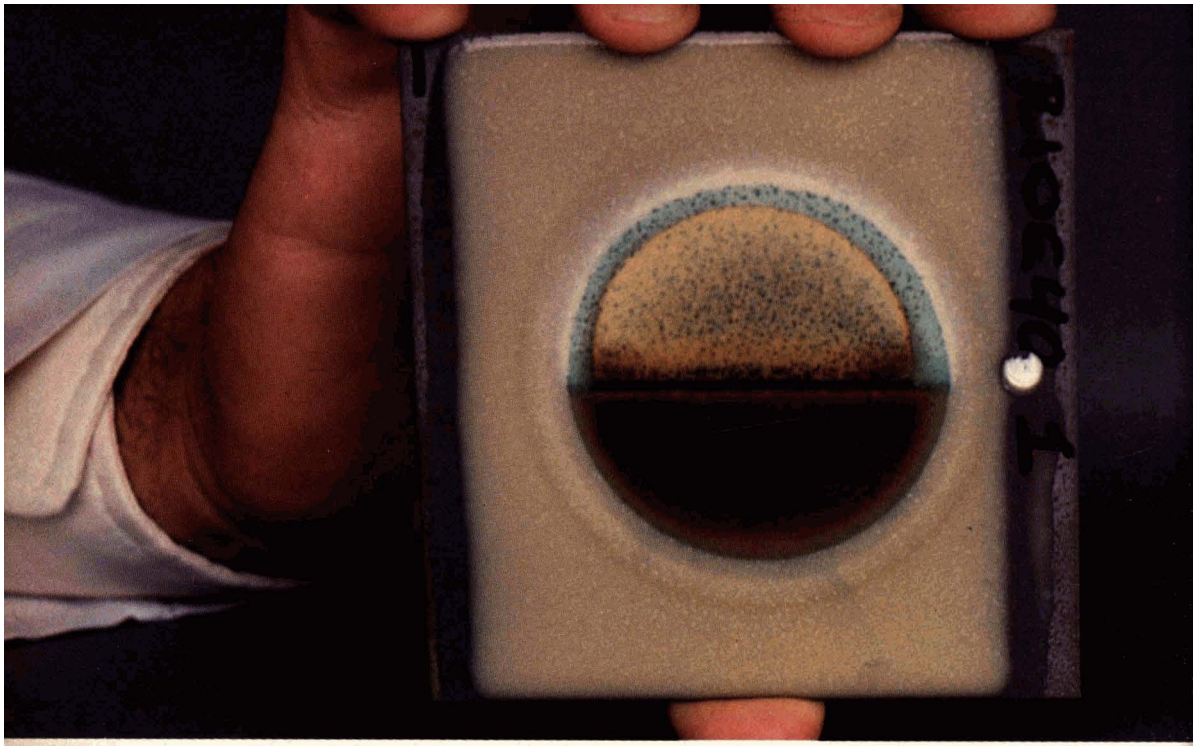

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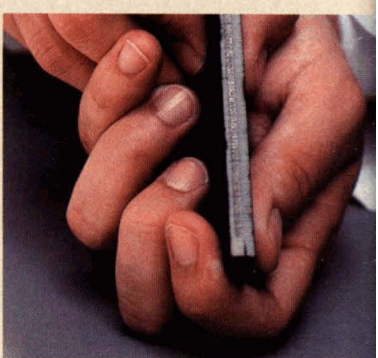

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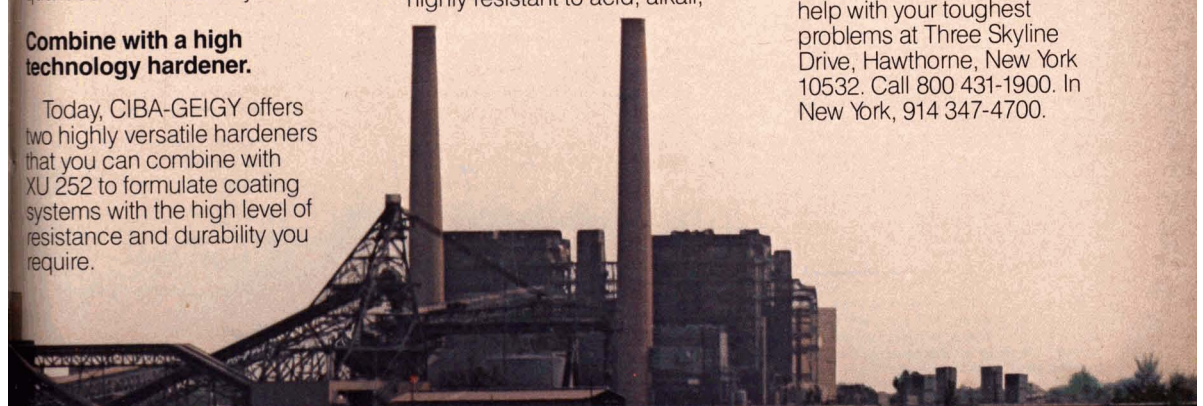

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Coatings Technology—Pride and Accomplishment

The value of coatings technology to our lifestyle is highly underrated. Few outside of our industry realize that coatings technology involves many sciences such as polymer chemistry, organic chemistry, inorganic chemistry, electrochemistry, surface chemistry, physical chemistry, and colloid science. The size of our industry in the western world is $22 billion. We protect and beautify houses, cars, appliances, buildings, and a wide range of industrial products.

On a value-to-performance basis, coatings are probably one of the most cost effective materials in the world. For example, a coating with a film thickness of 3 mils represents only 0.8% of the total value of an average automobile, yet it protects the car from corrosion and provides color and a glamorous appearance. A coating with a film thickness of 1/10 of a human hair protects a food can from corrosion, maintains taste, and beautifies the can at a cost not exceeding 0.4% of the total retail cost of the can and its contents.

Because of this, our industry should demand more recognition and respect. Respect, however, has to be earned. How? It is my belief that quality of performance is the answer. In our industry there are still many people who make quality compromises to gain a sale. They do not serve their customers very well; they do not serve themselves very well; and certainly they do not serve our industry well. The quality standard should be based on the highest level or best possible performance we can attain—nothing lower.

The most direct approach to assure quality is investment in research. Quantum jumps in quality are still needed in our industry. This can be achieved only by continuous commitment to research and with a staff of scientists of excellence comparable to other high-tech industries. This commitment to research must be continuous. *After all, research cannot be turned on and off like a faucet.*

We also must have the capability in research and marketing to anticipate the needs of our customers decades ahead. *A product must be developed before it is needed; by the time it is needed, it is too late.*

Indeed, if the coatings industry in the future can serve its customers with products that represent a quantum jump in quality and performance, the technical recognition of the industry will be a natural result of this endeavor.

Marco Wismer,
Vice-President, R&D
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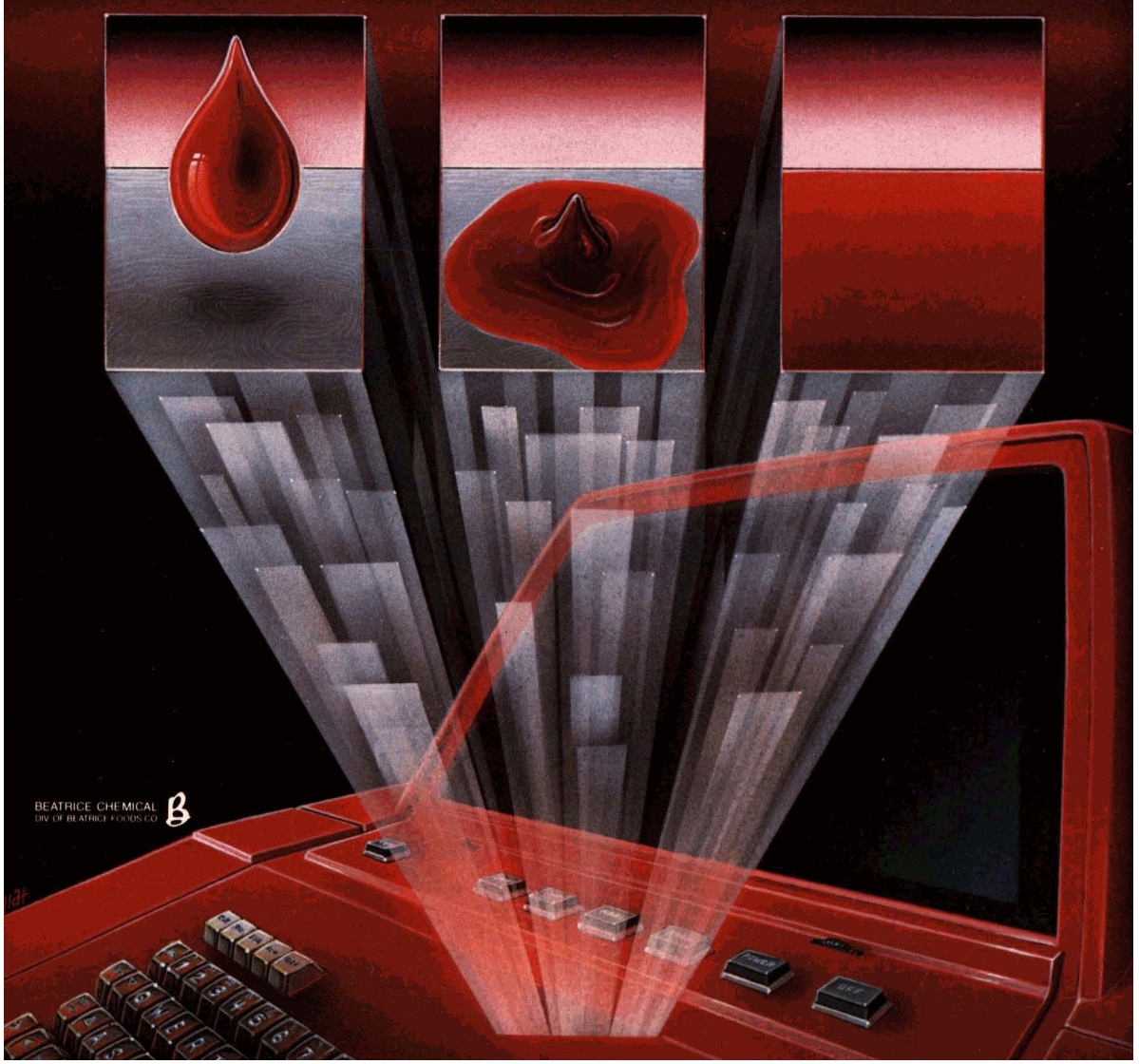


Du Pont Co. to Sell Most of Its Colored Pigments Business To CIBA-GEIGY and Heubach

The Du Pont Co., Wilmington, DE, has announced plans to sell most of its colored pigments business to CIBA-GEIGY Corp. and Heubach Inc., and to withdraw from production and sale of copper phthalocyanine (CPC) blue and green pigments. The colored pigments business serves the automotive finishes, paint, plastics, and ink industries.

CIBA-GEIGY Corp., the U.S. subsidiary of CIBA-GEIGY Ltd., Basel, Switzerland, has signed a letter of intent to purchase Du Pont's line of quinacridone pigments, including the quinacridone production facilities at Newport, DE.

Heubach Inc., a corporation in the Heubach Group of Companies, Langelsheim, West Germany, has signed an agreement to purchase the azo and chromate pigment product lines, along with production operations at Newark, NJ. This purchase includes related trademarks, know-hows, and 37 patents. Heubach Inc. was recently formed to acquire these assets and will be headquartered in Newark.

Heubach plans to offer jobs to about 300 Du Pont employees who will continue to work at the Newark plant. It also expects to hire from Du Pont necessary Marketing and Research and Development personnel who are now directly associated with the pigments business. Stuart C. Soden, currently in pigment marketing for Du Pont, will direct the marketing organization. Peter A. Wriede, Du Pont's manager of color research, will direct research. Production will be headed by Donald Gray and Engineering by Robert F. Mitchell, both of whom are presently working in those respective positions in Du Pont's Newark pigment plant.

Heubach Inc. is headed by Rainer Heubach, President of Dr. Hans Heubach GmbH & Co. KG, of Langelsheim. Heubach has been a producer of inorganic pigments and a participant in the pigments industry for more than 150 years. This acquisition, which complements Heubach's existing product line, further establishes them as a major worldwide supplier of pigments to the paint, plastics, printing ink, paper, and other specialty industries.

Closings of the sales to CIBA-GEIGY and Heubach are expected to occur during the first quarter of 1984. The withdrawal from CPC pigments will be completed by the end of the second quarter of 1984.

These plans do not affect Du Pont's titanium dioxide white pigments business which is based on highly advanced technology. The company is fully committed to maintenance of its position as a leading worldwide supplier of titanium dioxide. Also not affected is Colorquim, S.A. de C.V., the company's subsidiary in Mexico, which produces dyes and colored pigments.

George C. Tunis, director of the colored pigment products division of Du Pont's Chemicals and Pigments Department, said, "We are divesting these businesses because they do not offer a long-term strategic fit with our future plans and directions. Our department's product line is changing, and management and financial resources are being directed to other businesses which are important and growing parts of our product portfolio.

"We feel CIBA-GEIGY and Heubach have the expertise to assure our customers continuity of supply. We believe it is in the best interests of both the affected employees and our customers for us to sell these businesses to companies committed to colored pigments."

In connection with its withdrawal from CPC pigments, Du Pont will provide customers with sufficient inventory of these products to allow a smooth transition to alternate suppliers, according to Mr. Tunis. Prospective purchasers did not express an interest in the CPC product line, which has been in a loss position.

Du Pont anticipates that most employees associated with the businesses to be sold will be offered employment by the acquiring companies.

Du Pont entered the colored pigments business in 1917 with the acquisition of Cawley, Clark and Company, which included the Newark plant. In 1929, Du Pont purchased Krebs Pigment and Chemical Co. of Newport, DE.

A chromium dioxide production facility located at the Newport plant is not included in the sale and will continue to employ about 130 people.

Midland Defines Kalcor Purchase

Some confusion has been caused by several articles which recently appeared in the media reporting the acquisition of a unit of the Midland Division of The Dexter Corp. by Kalcor Coatings Corp.

It should be noted that the Kalcor purchase involved only a portion of the Cleveland, OH business plus the Cleveland plant and equipment, not the entire Midland Division, whose headquarters are in Waukegan, IL.

PPG to Purchase Control Of Italian Coatings Producer

PPG Industries has announced that it has entered into an agreement to purchase control of Industrie Vernici Italiane, S.p.A., (IVI), a subsidiary of Fiat, S.p.A., and a major Italian coatings manufacturer.

IVI is a producer of automotive and industrial coatings, with 1982 sales of $110 million. The company has four plants in Italy—in the Milan area, Quattordio, and Caivano—and employs approximately 1,400 persons.

A PPG spokesman said the company had agreed to purchase 65% of the stock of IVI.

PPG is a worldwide producer of coatings, chemicals, glass and fiber glass. In addition to its North American operations, the company has European coatings operations in France, Spain, and Italy. PPG also owns glass manufacturing facilities in Italy.

OSHA Hazard Rule Allows Use of HMIS

The Hazard Communication Final Standard issued recently by the Occupational Safety and Health Administration will allow the use of the Hazardous Materials Identification System, developed by the National Paint and Coatings Association.

Other key provisions of the standard, as it affects the paint and coatings industry, are:

—preemption of conflicting state and local standards;

—placement of responsibility for hazard determination with chemical manufacturers and importers;

—a requirement that employers provide a written program for compliance, covering labeling, use of Material Safety Data Sheets, and employee education and training programs, and

—provision for safeguarding trade secrets, consistent with the goal of employee health protection.

The standard has been challenged in a suit filed on November 22 by the United Steelworkers of America. The challenge is based on several of the standard's provisions, including its preemption of conflicting state and local laws.

According to Executive Director Larry Thomas, NPCA may intervene in the suit in favor of the preemptive OSHA rule. "We have repeatedly endorsed the concept of a preemptive Federal standard," he said. "We believe the OSHA rule is a very good rule, one that provides safeguards for workers without imposing undue hardship on manufacturers." Without a preemptive Federal standard, manufacturers that operate regionally or nationally could be required to comply with numerous conflicting standards imposed by other jurisdictions, he said.

NPCA Group Aids Inhalant-Abuse Prevention Program

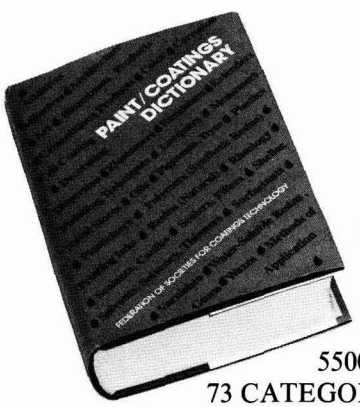
The Spray Paint Manufacturers Committee, of the National Paint and Coatings Association, has made a $25,000 grant to the Center for Educational Development in San Antonio, TX to help fund a pilot program for preventing abuse of inhalants, including paint.

U.S. Secretary of Education Terrel H. Bell recently announced a matching DOE grant of $25,000 for the inhalant abuse education effort.

The pilot program will train five teams of educators from school districts where inhalant abuse problems exist, in techniques of prevention through education, peer-influence, etc. All teams will be drawn from the Southwest; two of the five are from Texas, where paint-sniffing has been identified as a serious problem and has been given high media visibility.

Concerning the NPCA grant, James Kazen, director of the Center, said, "We are extremely grateful to the spray paint industry. The issue of paint-sniffing has become highly politicized, particularly in the state of Texas. NPCA's generosity will make it possible for us to demonstrate that prevention is the best approach to the tragedy of inhalant abuse, and what it does to young people. Paint is not the problem—*abuse* is the problem. Our objective is to change the attitudes and behavior that can lead to abuse."

The pilot program will be carried out during the 1983–84 school year, and will be evaluated at the end of that time.



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Hockmeyer to Open New Manufacturing Operation

Construction of a second manufacturing facility has been started for Hockmeyer Equipment Corp., Harrison, NJ. Ground has been broken on the new plant to be located in Elizabeth City, NC. Completion is scheduled for late March or early April. Manufacturing is planned to commence in May.

The new facility will be 37,500 square feet and is situated on a 7.13 acre site to allow substantial room for the future expansion of this new, modern facility. Its completion will mark the first time in the company's 40-year history that it has conducted manufacturing in two locations. Hockmeyer expects to employ about 50 people at the new plant.

Hockmeyer's headquarters and current manufacturing facilities are at 610 Worthington Ave., in Harrison, NJ. They produce a broad line of mixing equipment for the paint, ink, adhesives, and chemical processing industries. The new plant will manufacture the entire line, while manufacturing and service will continue in Harrison at current levels.

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- Added new technical service personnel and laboratories
- Supplemented its direct sales force with a highly responsive LTL distributor network

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Abstracts of Papers in This Issue

ANTICORROSIVE FUNCTION OF PRIMERS. INFLUENCE ON PROTECTION BY SUBSEQUENT COATINGS—H. Haagen

Journal of Coatings Technology, 56, No. 709, 21 (Feb. 1984)

In a coating system, not only the binders and pigments used determine its properties, interactions between solvents and coating layers are also of importance. And, not only the layers in direct contact influence each other, the substitution or modification of a coating layer may show effects in layers beneath or above it.

Papers to Be Featured in the March Issue

Multifunctional Monomers in Water-Reducible Alkyds—E.J. Kuzma and E. Levine, of Celanese Chemical Co., Inc.

Quick Weathering Test for Screening Silicone Sealants—K.K. Karpati, of the National Research Council of Canada.

Study of the Curing Mechanisms of Thermosetting Resins by Dynamic Viscoelastic Measurement. Part II—T. Izumo and S. Yamamoto, of Nippon Paint Co., Ltd.

Techniques to Measure Melamine/Polyol Reactions in a Film—M.G. Lazzara, of E.I. Du Pont de Nemours & Co., Inc.

Toxicology, the Law, and the Coatings Chemist, H.E. Myer, of Mobay Chemical Corp.

ZINC CONSUMPTION IN ZINC-RICH PRIMERS CO-PIGMENTED WITH DI-IRON PHOSPHIDE—N.C. Fawcett, C.E. Stearns, and B.G. Bufkin

Journal of Coatings Technology, 56, No. 709, 31 (Feb. 1984)

The amount of elemental zinc consumed during salt fog exposure of steel test panels protected with epoxy-ester zinc primers is reported. Partial replacement of zinc by di-iron phosphide was found to affect the fraction of initial zinc remaining after exposure.

Primers pigmented with a 75/25 weight ratio of di-iron phosphide to zinc gave optimum efficiency of zinc use under the conditions of the test, while primers pigmented with a 50/50 weight ratio of di-iron phosphate to zinc gave optimum overall performance. Primers pigmented with zinc alone failed because of severe blistering. Partial replacement of zinc with di-iron phosphide eliminated blistering.

A mechanism for the functioning of di-iron phosphide is proposed.

NUMERICAL COLOR CONTROL FOR EXTERIOR AUTOMOTIVE COATINGS—S.A. Schultz, M.K. Chao, and B.P. Hake

Journal of Coatings Technology, 56, No. 709, 35 (Feb. 1984)

A numerical color control program has been established using the latest colorimetry equipment. Part of this program includes color tolerances which have been designed based on visual judgments and instrumental measurements. These tolerances can be used to minimize the subjectivity from the color matching process and provide a tool to improve the quality of automotive coatings. Studies that have been conducted indicate that the color tolerances developed in the laboratory are also feasible in production facilities as an ongoing quality control technique.

Abstracts of Papers in This Issue (Continued)

SEDIMENTATION OF SUSPENSIONS—Montreal Society for Coatings Technology

Journal of Coatings Technology, 56, No. 709, 41 (Feb. 1984)

The settling phenomenon often found in pigmented surface coatings is an area which is not fully understood; hence, it is very hard to predict. Simple models are well known, but when the same theory is applied to actual paints, it fails and the chemist has to resort to lengthy methods to assess settling.

In order to gain a better insight of pigment settling, a method described by P. E. Pierce to obtain the yield value was studied. The method uses a Brookfield viscometer, a special measuring technique, computer processing of the data and fitting the data into the Casson Equation.

STUDY OF CURING MECHANISMS OF A THERMOSETTING RESIN BY DYNAMIC VISCOELASTIC MEASUREMENT. PART I: AN EMPIRICAL EQUATION ON THE CURING PROCESS—T. Izumo and S. Yamamoto

Journal of Coatings Technology, 56, No. 709, 45 (Feb. 1984)

The cure mechanisms of an acrylic-melamine resin were studied by means of DSA (Dynamic Spring Analysis). Equation (a) of the degree of cure (X) was derived experimentally, and appears to adequately represent the cure behavior from the beginning to the end.

$$1n\ X^{1-m} + \exp(c1nX + d) = 1n((1 - m)kt) \qquad (a)$$

where, $X = (Er' - Er'o)/(Er'\infty - Er'o)$.

$Er'o$, Er' and $Er'\infty$-modulus of relative elasticity at $t = 0$, t and ∞, respectively.

c, d, and m = constants
k = the cure rate constant
t = cure time

Equation (a) was obtained by inserting the modification term, $(c1nX + d)$, in equation (b) which was limited to the initial cure behavior.

$$X^{1-m} = (1 - m)\ kt \qquad (b)$$

The modification term, $\exp(c1nX + d)$, was derived from the ratio, $t_{exp.}/t_{calc.}$, where $t_{exp.}$ and $t_{calc.}$ are the time experimentally determined and the time calculated from equation (b) at a given degree of cure (X), respectively.

The modification term, $\exp(c1nX + d)$, was considered to be due to the decrease of the segmental mobility caused by network formation. This leads to equation (c) which indicates that X is a function of the formation of network structure, i.e., the cure rate constant (k) depends on a degree of cure.

$$X^{1-m}/(1 - m) = k(X)t \qquad (c)$$

where, $k(X) = k \cdot \exp(-d \cdot X^c)$
$k = ko \cdot \exp(\Delta Ea/RT)$
ΔEa = apparent activation energy
ko, d, and c = constants
R = gas constant
T = absolute temperature

Equation (c) indicates that the cure rate constant (k) is a function of a degree of cure (X) which becomes smaller as the formation of the network proceeds, i.e., as a degree of cure (X) increases.

HOW PRODUCTIVE IS YOUR PAINT PLANT?—R. Kennedy

Journal of Coatings Technology, 56, No. 709, 57 (Feb. 1984)

There is an urgent need in the paint industry to establish a common method for measuring productivity. This article describes a simple mathematical model which has been formulated to more accurately determine the production output of a paint plant. The equation employs three important variables: product processing difficulty; batch size; and container size. The resultant formula is called the "Outputivity Index," with 100 as the optimum performance. This index more accurately determines productivity than the existing industry standard of gallons per manhour.

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Registration fee is $135 for FSCT members; $150 for non-members. After May 1, registration fee is $160 for everyone. The fee includes complete set of papers presented, continental breakfast, luncheon, coffee breaks, and bus transportation to the airport at conclusion of the Seminar.

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Chicago, Golden Gate, and Piedmont Societies Win MMA Awards for Notable Achievements

Winners in the 1983 MMA Awards competition for notable achievements by Constituent Societies of the Federation were Chicago, Golden Gate, and Piedmont. The winning Societies were cited and presented with their Awards at the recent Federation Annual Meeting in Montreal.

Established in 1975 by Materials Marketing Associates, a national marketing group of manufacturers' representatives, the Awards recognize notable achievements by Constituent Societies (excluding those Society papers presented at the Federation Annual Meeting).

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

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

Marketing Material Associate Awards were presented by Committee Chairman Al Heitkamp (left) and Howard McCullough (right) of McCullough and Benton, (left to right): Fred Foote, for Chicago Society; Gordon Rook, for Golden Gate Society; and Bob Matejka, for Piedmont Society

Educational Excellence Of SYMCO Programs

The Chicago Society was cited for the excellence of its SYMCO programs, an annual two-day event featuring technical presentations on a variety of coatings topics, dealing with both trade sales and industrial products. Aimed at technically updating coatings personnel, the SYMCO programs have also generated sufficient funds for the Society to underwrite three scholarships for students interested in pursuing coatings/chemistry curricula.

Industry Contribution Through WCCS Symposium/Show

Golden Gate was recognized for sponsoring the 1983 Western Coatings Societies' Symposium and Show, held Feb. 23–25 in San Francisco.

Approximately 2,000 persons registered for the event, which provided an opportunity for industry personnel in the western U. S. to learn of new technologies, raw materials, and applications through presentations at the technical sessions and the display booths of suppliers companies.

A total of 25 papers were featured, along with exhibits of 80 supplier firms.

Income from the event helps support the Society's scholarship fund.

Educational Contributions Through Sponsorship Of Coatings Course

The Piedmont Society won an Award for sponsoring and helping fund a credited academic polymer course at the University of North Carolina—Greensboro.

The introductory course covered polymer synthesis using both step-growth and chain growth polymerizations and structural property relationships of polymers employed in the coatings industry. Three-hour classes were held one evening each week for 14 weeks.

Society funding helped make the course available to UNC-G students and Society members at a reduced fee.

Principles Governing Awards

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

Not eligible are Society papers offered for presentation at the Federation Annual Meeting. Although the Awards are to be presented at the Annual Meeting, it is not mandatory that they be presented to any or all categories each year.

The President of any Society wishing to enter the competition must send a letter of intent, no later than March 31, to the MMA Awards Committee Chairman (Victor M. Willis, The Sherwin-Williams Co., 10909 S. Cottage Grove Ave., Chicago, IL 60628).

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

The members of Materials Marketing Associates who sponsored the 1983 MMA Awards were the following: Apco Industries Co., Ltd., Toronto, Ont.; George C. Brandt, Inc., Elmhurst, IL and Kansas City, KS; Lukens Chemical Co., Inc., Westboro, MA; Matteson-Ridolfi, Inc., Riverview, MI; McCullough & Benton, Inc., Atlanta, GA; McNally & Webber Co., Cleveland, OH; Mehaffey and Daigle, Inc., New Orleans, LA; Wm. B. Tabler Co., Inc., Louisville, KY; Van Horn, Metz & Co., Inc., Conshohocken, PA; Walsh & Associates, Inc., St. Louis, MO; C. Withington Co., Inc., Pelham Manor, NY; American Society of Association Executives, Washington, D.C.; and Majemac Enterprises, Inc., Clearwater, FL.

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Cook Paint & Varnish Co.
P.O. Box 389
Kansas City, MO 64141

Executive Vice-President
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185 Kokubunjishi
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E.C. (Ted) Saultry
46 Tamarisk Ave.
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Proposed Amendments To Federation By-Laws

The following amendments will be presented for first reading at the Federation Board of Directors Meeting, May 18, 1984.

ARTICLE III—ORGANIZATION
C.—Duties of President

WHEREAS an important annual duty of the President is to nominate the Trustees of the Paint Research Institute for election by its Members, who are the Federation Board of Directors, and

WHEREAS this duty is not currently included in the Federation By-Laws, be it

RESOLVED that By-Laws Article III, Section C, Paragraph (1) be amended by adding a new sub-section e., as follows:

"e. Nominate annually the Trustees of the Paint Research Institute for election by its Members (Federation Board of Directors)."

Comment: The By-Laws Committee recommends adoption.

* * * * * * *

ARTICLE V—COMMITTEES
A.—Nominating Committee

WHEREAS the Federation Executive Committee has recommended that the Executive Vice-President be a member of the Nominating Committee, be it

RESOLVED that By-Laws Article V, Section A, Paragraph (1) be amended as follows:

"(1) The President shall appoint a Nominating Committee consisting of the immediate Past-President or the most recent available Past-President as Chairman; one other Past-President; three members of the Board of Directors who are not officers, at least two of whom shall be Society Representatives; and the Executive Vice-President. The committee appointments, except the Chairman and the Executive Vice-President, shall be subject to confirmation by the Executive Committee."

Comment: Members of the By-Laws Committee believe that this proposal is illegal in that the Executive Vice-President is not, himself, a member of the Federation and therefore cannot serve as a voting member of a committee. See Article I, of the By-Laws, wherein membership in the Federation is defined.

As an alternative, in order to accomplish the basic purpose of the above proposal, they recommend the following amendment, adding a new Section C to Article V, which would also provide legal status to current practice of staff participation in committee work:

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."

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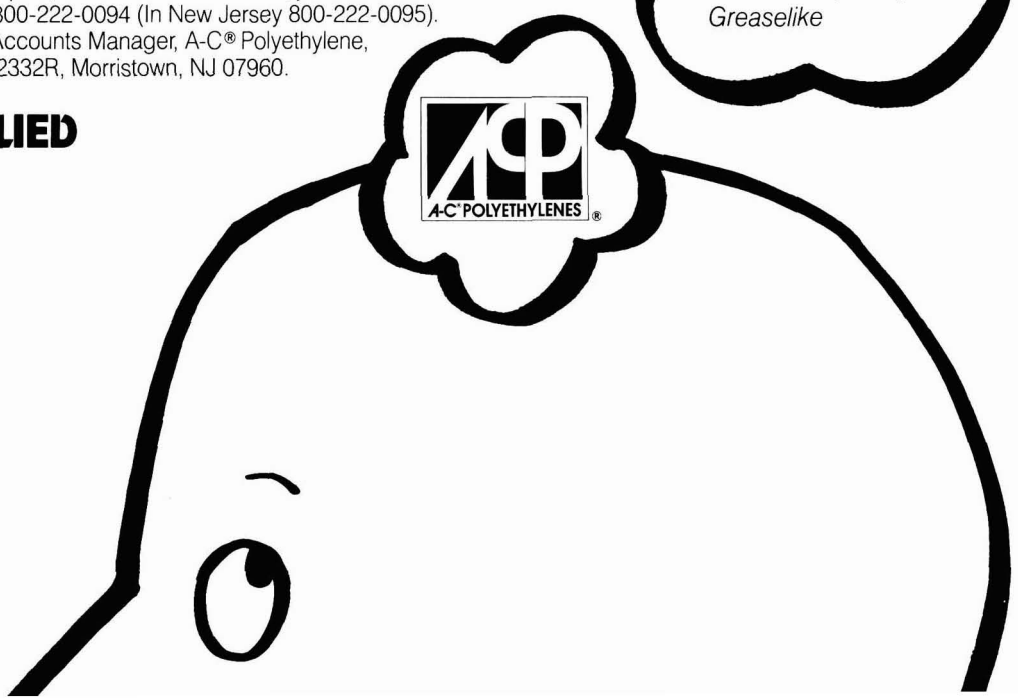

Anticorrosive Function of Primers

Influence on Protection by Subsequent Coatings

Helmut Haagen
Forschungsinstitutes fur Pigmente und Lacke*

In a coating system, not only the binders and pigments used determine its properties, interactions between solvents and coating layers are also of importance. And, not only the layers in direct contact influence each other, the substitution or modification of a coating layer may show effects in layers beneath or above it.

INTRODUCTION

According to an old painters' rule, when drying oils, oleoresinous varnishes and, increasingly, alkyds were used as binders, the single layers of a coating system were based preferably on the same type of varnish. The advantage was that the different layers were compatible to each other as far as varnish and solvents were concerned, and no unexpected detrimental interactions could occur.

Nowadays this rule cannot be adhered to due to the manifold requirements a coating system must meet, and with the large range of binders available, it is no longer generally valid. It is possible now to adjust a coating system to nearly any service condition by selecting the most suitable binder for each single coating layer of the system.

With the large range of binders, solvents, and additives available, the danger of undesired interactions has increased considerably in a one coating layer, and particularly between several layers of a multi-layer system. Therefore, it is not possible to theoretically predict the effect of such possible interactions on the performance of such coatings, or coating systems, under service conditions. Therefore, it is necessary to test the performance of a one-coat system and, if multi-layer systems are concerned, the compatibility of each layer in the system.

Examinations of the anticorrosive properties of some car repair coating systems,[1] showed that depending on the undercoating and/or top coat used, the same primer in a system can give quite different results with respect to blistering, underrusting, and adhesion under extended moisture conditions. The same effect occurred when the primer and/or undercoating were exchanged under the same top coat. Some car repair coating systems were examined and the reactions influencing the change of properties were investigated.

COATING SYSTEMS EXAMINED AND CODES OF THE PAINTS USED

Two-Coat Systems

They consisted of a two component resin modified polyvinylbutyral filled wash primer with phosphoric acid hardener, followed by an alkyd type top coat or an acrylate-isocyanate cured top coat.

Three-Coat Systems

For these systems, the modified wash primer was followed by a nitro combination filler and finished either with the alkyd type top coat as above or with the acrylate-isocyanate cured top coat.

Reprinted with permission from *Farbe und Lack*, 88, 534-540 (1982).
*Wiederholdstr 10-1, 7000, Stuttgart 1, West Germany.

Table 1—Compilation of Solvents Occuring Together in the Individual Coatings

Number	Solvent
1	Dipentene
2	Mineral spirits
3	Higher aromatic
4	n-Butanol
5	Iso-Butanol
6	n-Butyl acetate
7	Iso-Butyl acetate
8	Isopropanol
9	Toluene
10	Xylene
11	Phosphoric acid
12	Water
13	Ethyl acetate
14	Ethylene glycol monoethyl ether acetate[a]
15	Methyl ethyl ketone

(a) Cellosolve acetate.

Coding of the Paints Used

In the remaining text, the paints are coded as follows:

WPO/HO: 2-component wash primer mixed with the original hardener (HO). Schedule changes of the single paint components are indicated by replacing the zero by a figure. WP1/HO, e.g., means that the schedule of the wash primer base was changed, whereas the hardener still was the original one.

The other paints were coded analogously, i.e.,

NCO: Nitro combination filler (intermediate coating)
KHO: Alkyd based top coat
ACO: Isocyanate cured acrylic top coat.

The sixteen solvents used are listed in *Table* 1. The phosphoric acid, which normally is not considered a solvent, is included because it may cause blistering of the coating under moist conditions just as solvents. Besides in the wash primer, phosphoric acid was contained, to a small amount, in the nitro combination filler. Under practical conditions, these are sometimes applied to bare steel, however, this was not done in the tests.

TEST SPECIMENS AND TEST CONDITIONS

Test panels cut of the same type of steel as used for car bodies were cleaned with solvent three times and then coated. After curing, the test panels were submitted to condensation tests similar to the ISO-draft 6270-1980. The test varied with the panels lying, painted side down, on 7 cm diameter holes cut into a polystyrene plate covering a water bath heated to 40°C. The plates were cooled on their back sides by the temperature of the surrounding room, which was 20°C to 23°C. Thereby, a very even, constant, and reproducible condensation was produced on the painted surface at a surface temperature of approximately 35°C. Beakers filled with distilled water were inserted in the holes of the polystyrene plate and the test panels were laid on the beakers. The condensate dropped off the panels and was collected individually for analysis.

WATER VAPOR PERMEABILITY OF THE TWO- AND THREE-COAT SYSTEMS AND SWELLING BEHAVIOR OF THE TOP COATS

It was not possible to obtain free films, either of the single coats of wash primer and nitro-combination filler or of the wash primer overcoated with nitro-combination filler. They broke on handling. Therefore, only the completed systems could be measured.

Results from the two top coats were available from earlier examinations. The isocyanate cured acrylic top coat was about 10-20% less permeable by water vapor than the alkyd based top coat.

In order to obtain free films of the complete systems, they were applied to Teflon® foils with overcoating intervals of 24 hours (at 23°C and 50% relative humidity) between the single coats.

The dry film thickness corresponded with the manufacturers' instructions: WPO/HO—20 μm; NCO—50 μm; and, KHO and ACO—50 μm.

The completed systems (in the two-coat systems, the NCO-filler was excluded) were cured an additional three days under normal climatic conditions prior to testing.

Measurements were performed using Payne cups at 23°C at a humidity gradient 100% to 50%, the partly water filled Payne cups being stored in a room at 50% relative humidity. Loss of humidity was measured at an interval of 24 hours initially and extended intervals later.

Figure 1 shows the results for the two-coat systems. A comparison of the two-coat systems with values for the top coats obtained by earlier measurements, shows that the system with the isocyanate cured acrylic top coat at about 200 hours testing time, and gave values 10-20% below the system with the KHO top coat.

With the three-coat system (*Figure* 2) the differences in the region of 200 hours testing time were only minute. Since the value of the NCO-filler could not be determined, it is not known whether this is due to its permeability behavior or its influence on the top coat.

Comparison of the two systems (*Figures* 1 and 2) shows that independent of the number of coats, the initial values of the systems with KHO top coats were clearly below the values of the systems with ACO top coats. If such measurements were performed for only 2-3 days, one would draw the wrong conclusion that the systems with KHO top coats are less permeable than the systems with ACO top coats.

The KHO system in the first two days clearly showed increasing values and then, after having passed a maximum, decreasing values, until eventually equilibrium was reached. In the initial stages of water vapor transition, obvious competitive reaction took place. The water molecules first had to find access into the film, e.g., according to the mechanisms described by Kumins and

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Roteman[2] and by Lowrey and Broome.[3] This initiated swelling of a coating or system by water. In the film, the water molecules then hit solvent molecules still present. The type and solubility of the solvents in water, or their mixibility with water, determine for a film matrix on the rate of further swelling, e.g., on further water uptake, water retention or water release, or release of water and solvents or their mixtures, and of release of other possibly volatile substances present.

No maximum was passed with isocyanate cured acrylate top coat system. From the beginning, this system showed decreasing values for water vapor permeability. The acrylate system obviously reached earlier water saturation and, therefore, allowed water vapor penetration sooner.

Examinations of the water uptake of the two different top coats showed quite clearly differences in the behavior of the two top coat types as well. Independent of the expected influence of film thickness and curing conditions, weight and length increase of the KHO type was, depending on exposure time, five to 100 times larger than with the ACO type. The differences between the two top coat types were quite distinct in the first hours and increased further (up to over 25 days) with increasing exposure time. *Figure* 3 shows the water uptake of the two top coat types observed over 25 days exposure. Measurements of the film expansion due to water uptake were neither performed on single coats nor on the complete systems applied onto steel, since it was to be expected that the obtained values were superimposed by water absorption and corrosion in the interphase steel/paint coating, or by water absorption in the interphase between coating layers.

Regarding KOH-type systems, conclusions can be drawn on their corrosion protection behavior or tendency of blistering from the speed of increase and decrease of water vapor permeability, or the relationship of both properties, but would have to be examined in detail. Films on substrates may react in a different way compared with free films.

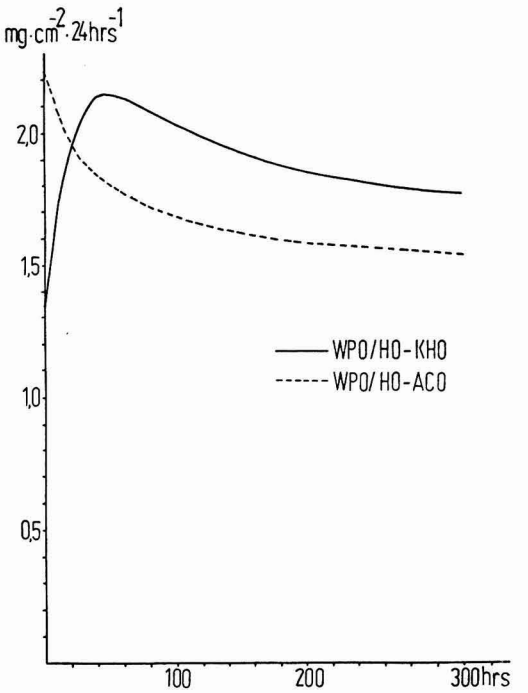

Figure 1—Water vapor permeability of the two-coat alkyd and acrylate system

INVESTIGATION OF ADHESION

Pull off tests were used to determine whether there is a correlation between the area where blisters are formed and the area of adhesion failures on exposed and unexposed specimens. It could be expected that insufficient adhesion on the substrate or decreased intercoat adhesion could predetermine the areas where blisters are formed. The adhesion could be impaired by absorption of substances of the films, or water on condensation tests, in the various interphases.

For the unexposed specimens, the dollies were fixed with an epoxy-resin glue and for the specimens exposed to condensation, a cyanacrylate glue was used; the latter allowed pull off tests after 10 minutes curing time.

Prior to the pull off tests or exposure to condensation the specimens were cured for eight days under normal climatic conditions (23°C and 50% RH). For multi-layer coating systems, the overcoating intervals were 24 hours under above conditions.

For the unexposed systems, the obtained adhesion values were within the usual scale of approximately 10N/mm. Differentiation between the systems was not possible.

For the specimens exposed to the condensation test, depending on exposure time, decreasing values right down to flaking were noticed.

The examinations showed that one must differentiate between tests performed at an early stage of the condensation test and tests performed on specimens exposed for a longer time. On the specimens tested at an early stage, the area of failure was not always identical with the area where blisters formed. In cases where intentionally "weak areas" had been produced, e.g., by applying the wash primer without addition of hardener or applying the NCO-filler directly onto the steel substrate, the area of adhesion failure was identical with the area of blistering after the condensation test.

After prolonged condensation tests, adhesion failure usually occurred on the substrate although blisters had been formed not only between substrate and primer but also between top coat and NCO-filler.

Altogether, the consequences of the examinations are that the pull-off test is unsuitable to detect a reliable way if, and, where a coating system will develop blisters and/or areas of decreased adhesion under condensation conditions.

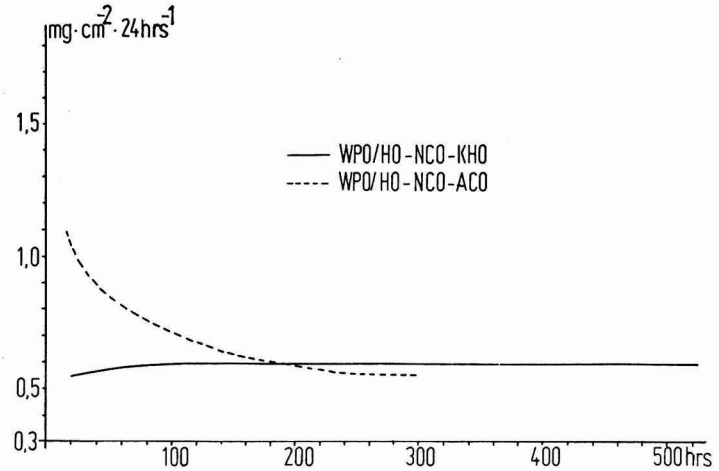

Figure 2—Water vapor permeability of the three-coat alkyd and acrylate system

BLISTERING AND UNDERRUSTING OF ONE-, TWO- AND THREE-COAT SYSTEMS

Preparation and exposure of the specimens were done as previously described.

One-Coat Systems

KHO Top Coat: With the top coat applied directly to bare metal, in all cases initially blisters were formed, and then underrusting occurred. Time until, and degree of blistering were dependent on the drying conditions prior to testing. Decreasing drying time, or increasing film thickness with a fixed drying time, helped formation of blister, or vice versa.

Films of 50 μm dry film thickness, cured for two weeks under normal climatic conditions, produced blisters after three to four days of condensation test. This means that at a time when the conditions as described concerning water permeability, solvent release or, respectively, water uptake of the films were not yet in balance. This, too, points to the retained solvents as the main initiators of blistering.

An interesting phenomenon in this connection occurs in the condensation test if the pigments are omitted off the original schedule and the KH1 clear varnish thus produced is applied once onto bare steel and once as a top coat in the three-coat system with WPO-primer followed by NCO-filler. The KH1 clear varnish applied directly to bare steel showed heavy whitening (*Figure* 4, left) by water inclusion in the form of very small droplets (*Figure* 5), and after 24 hours exhibited blistering and initial corrosion underneath the blisters. Such inclusion of water (whitening) can be caused by water-soluble retained solvents. In the three-coat system, whitening (*Figure* 4, right) either did not occur, or occurred to a much smaller degree. From this it follows that the receptance of solvents contained in the top coat by the two underlying coats (WPO and NCO) was quite different to the one of bare steel. On the steel surface, the solvents are retained more than on the compared intermediate coatings, the latter absorbing a part of the solvents of the top coat. Thereby, under the same drying conditions, the top coat loses more solvent than if applied on steel. This example shows that the reactions, which are complex enough with a one-coat system, can be much more complicated with multi-layer systems.

ACO Top Coat: The ACO top coat proved to be more resistant on steel than the KHO top coat. Here, blistering occurred only after several weeks of condensation test, with corrosion coming even later. This advantageous behavior is likely to be due to lower water uptake (water uptake, *Figure* 3) and much better wet film adhesion of the ACO top coat.[4] On the pull off test, after condensation test, adhesion and cohesion failure occurred with the ACO top coat, whereas the KHO top coat showed adhesion failure only.

WPO/HO Wash Primer: Even after several months of condensation test, the wash primer did not exhibit any visible damage. The collected condensate dropping off the panels contained chromate. This favorable result may be surprising at first glance. It should be considered, however, that such highly pigmented primers, as wash primers usually are, cannot exhibit osmotic blistering due to their high permeability. Consequently, not only solvents but also inorganic water-soluble salts like chromates can be dissolved out of the film. Blistering due to underrusting with this type of primer occurs only when the deposit of chromates has been exhausted and, as a result, corrosion starts. This, however, did not happen during the testing time.

The result, however, can be quite different when this type of primer is sealed with impermeable following coats and then submitted to condensation tests.

NCO-Filler: Compared with wash primer, the NCO filler showed different reaction. Applied directly to steel, blistering and corrosion occurred mostly after two to

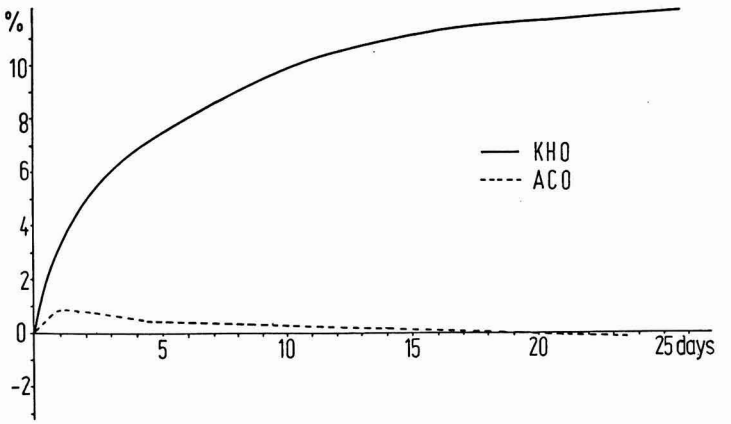

Figure 3—Water uptake of the free alkyd and acrylate films

three days, depending on curing conditions and dry film thickness.

Two-Coat Systems

Unless different figures are stated, the WPO/HO wash primer and the particular top coat had a dry film thickness of about 20 μm for wash primer and 50 μm for the top coat.

Curing time of the wash primer prior to overcoating had no influence on the time when blistering occurred or on the size of the blisters. Investigated were overcoating intervals between 10 minutes and eight days under normal drying conditions.

KHO Top Coat: With this top coat, blisters were formed usually between the substrate and primer within one week. After prolonged condensation test, blisters between primer and top coat were formed as well (*Figure* 6). Beneath the blisters, between substrate and primer, corrosion occurred later.

ACO Top Coat: Only after more than two weeks' condensation test, the acrylate system exhibited a few small blisters between primer and top coat.

If wash primer was applied without the HO hardener, blistering occurred after two to three days always between substrate and wash primer, no matter whether it was overcoated with the KHO or ACO top coat. At the same time, adhesion failure occurred on the substrate as well. Only when the specimens had been cured for several months under normal climatic conditions prior to testing, they showed the reaction as if correctly cured wash primer (with HO hardener addition) had been used. Then blisters between primer and top coat were formed. This phenomenon is of interest showing that the parameters influencing blistering as well as adhesion and, possibly, other properties such as permeability and swelling, are not fixed from the beginning but may change in the course of time. This means that a certain coating system may give quite different results depending, for instance, on exterior conditions like temperature, curing time prior to testing, time of exposure to condensation, etc.

The improvement of the system with wash primer without HO hardener addition, which eventually matched the correctly hardened system with extended curing time, is due to the gradual evaporation of the solvents particularly out of the interphase substrate/primer.

Three-Coat Systems

With the three-coat systems, the influence of overcoating intervals and curing conditions were examined as well.

WPO/HO Wash Primer: As mentioned for the two-coat systems, curing time of the correctly hardened wash primer prior to overcoating with ACO-filler and the particular top coats had no influence either on blistering or corrosion during condensation tests (*Figure* 7, top row).

Here again, however, influencing the completed system was whether the wash primer had been cured correctly or whether it had been applied without hardener addition.

In the case of correct hardening, blisters between NCO-filler and top coats were formed. Where the wash primer was applied without hardener addition, blisters were formed only between substrate and primer (*Figure* 8). This is easily understood since the wash primer without hardener does not achieve the same adhesion as the correctly hardened wash primer. Consequently, with the incorrectly cured wash primer, water can penetrate in the interphase substrate/wash primer. It is not understood why, either initially or simultaneously, blisters are formed between top coat and NCO-filler, as is the case with the WPO/HO wash primer.

Only after several weeks of condensation test in both cases (with and without hardener addition), did blisters of the particular alternative type form, i.e., blisters between top coat and filler with the WPO/- wash primer and blisters between substrate and wash primer with the WPO/HO wash primer.

For multi-layer systems, according to the above, there seem to exist preferential aims for water inclusion.

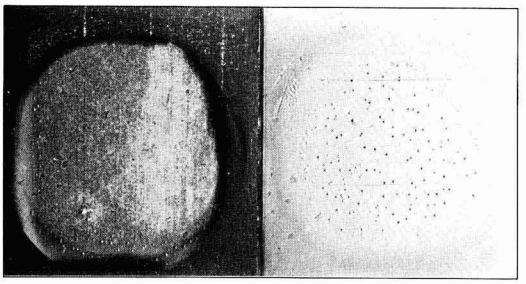

Figure 4—(Left): Whitening of the unpigmented KH1 top coat applied to steel after eight days' exposure. (Right): The same KH1 top coat applied as a third coat to WPO/HO as first coat and NCO as second coat. No whitening after eight days exposure. NCO was applied to WPO/HO after drying 24 hours and KH1 to NCO after drying one hour

Whether the preferential aim lies in the upper region of the system or in the region closer to the substrate, obviously the water is transported to it until saturation is achieved. Only then the less preferred areas are served. It may, as in this case, therefore happen—although the water comes from the top—that at first the bottom layers are saturated and only then the top layers.

NCO-Filler: Curing time of the NCO-filler on WPO/HO wash primer prior to overcoating with the top coats was of distinct influence on number and size of blisters formed. The longer and the more intensively (elevated temperatures) the NCO-filler was dried prior to overcoating, the smaller were the blisters formed and the larger was their number on condensation test (*Figure* 7, bottom row).

The same influence was shown by decreasing film thickness of the NCO-filler.

On investigating the behavior of the NCO-filler, the following strange observation was made. Since the NCO-filler was used up, another sample was ordered from the manufacturer. The new batch, from which the sample was taken, had been manufactured to the same schedule as the previous sample. Compared with the previous sample, the new one behaved oppositely as far as overcoating intervals and film thickness were concerned. With increasing curing time and decreasing film thickness, now the number of blisters decreased whereas the size of the blisters increased.

The analysis did not, either by IR-spectroscopy or by gas chromatography, reveal any difference between the two samples.

This shows that minute differences, which cannot be revealed by the sensitive analytical methods used, can be of influence on the phenomenon of blister formation.

With both samples, however, in the first instance blisters between NCO-filler and top coats were formed. Only after prolonged condensation tests of several weeks were blisters between substrate and primer were formed, too. Blisters between WPO/HO primer and ACO-filler were never noticed.

On adhesion test, failure occurred preferably between the layers where blistering had occurred. Where blisters between NCO-filler and top coats had been formed, the fracture occurred in the top layer of the filler, and where blisters on the substrate had been formed, the adhesion failure occurred on the substrate.

KHO Top Coat and ACO Top Coat: Dependent on the top coats, the three-coat systems behaved similar to the two-coat systems. Therefore, it can be stated that the top coat determined the behavior of the total system. With the three-coat system as well, the specimens with the KHO top coat differed from the specimens with the ACO top coat by a strong tendency to blister. With increasing ageing time of the top coat (and consequently of the total system), the necessary time to form the first blisters increased as well.

CONTENTS OF THE BLISTERS AND THE COLLECTED CONDENSATES

Infrared Spectroscopic Examinations

Contents of the blisters were transferred to potassium bromide pills and only heavy boiling solvents could be determined. In the liquids of the blisters, therefore, only traces of organic substances, for instance glycolester, were found.

Parallel to the liquids of the blisters, the condensates collected in the beakers, as described earlier, and were examined. Here, the concentration of organic matter was distinctly larger than in the liquids of the blisters. In addition to the substances found in the blisters, there were found phthalic acid, esters and ketones. The phthalic acid was derived from the alkyd resin of the KHO top coat.

Inorganic compounds were also present. Due to the small amounts available, it was not possible to identify them distinctly. The inorganic substances, most likely, were water-soluble extracts from the pigments contained in the single coating layers.

Gas Chromatographic Examinations

With this method a number of solvents were found in the liquids of the blisters as well as in the condensates. Since in paint manufacture only technical products are used as raw materials, it was not possible to identify all constituents reliably. However, some characteristic solvents could be identified.

Exact quantitative measurements of alterations produced in the composition of the liquids of the blisters, or in the condensates, by varying drying times or film thicknesses were not possible due to the usually very small concentrations contained in the liquids and because of the difficulties in sampling and preparation.

The blisters formed on the condensation test were very small, particularly in the early stages, so that no liquid could be sampled from the individual blister. Therefore, as many blisters as possible were opened at the same time by scraping over the blisters with a razor blade. Immediately after the tops of the blisters had been scraped off the liquid contained therein was blotted into filter paper and this was sealed in test tubes. By this method, the volume of liquid and its concentration in the filter paper could not be determined. Only from larger blisters could defined amounts of blister liquid be collected by means

of calibrated micro probes. It has to be realized, however, that larger blisters require prolonged condensation tests and, therefore, contain smaller concentration of solvents in their liquid.

Nevertheless, the chromatograms obtained showed partly that a large number of solvents were present in the liquids. In the examined three-coat layer system a total of 16 solvents (*Table* 1) were used. These being technical products, they were not pure but consisted of several components. It is, therefore, understandable that by using gas chromatography via retention times, no exact analysis was possible. With such a large variety of constituents, the possibility of overlapping is so great that the peaks could not be related to the different solvents.

TOP COAT BLISTERS IN THE KHO SYSTEM: Taking the three-layer KHO system as an example, the influence of drying conditions prior to testing, of exposure time, and of the drying conditions of the NCO filler over WPO/HO wash primer on the composition of the blister contents was examined.

As expected, the highest concentration and, consequently, the greatest possibility to analyze the single solvents in the blister liquids were found after short drying times of the specimens and short exposure times to condensation test. The top coat blisters which were found after 48 hours condensation test of the three-layer KHO system had the following overcoating intervals and curing times:

1st coat (WPO/HO)—24 hours
2nd coat (NCO)—24 hours
3rd coat (KHO)—8 days

and contained about 0.2 to 0.5% solvents. This solvent mixture was of the following approximate composition:

50% ethyl acetate
20% ethanol
20% butanol
5% toluene
5% butyl acetate.

If the NCO filler over WPO/HO wash primer was allowed to dry for 24 hours at 80°C prior to overcoating with the KHO top coat, only butanol and toluene could be traced in the liquid of the top coat blisters after 48 hours condensation test.

On prolonged condensation with all specimens, the number and concentration of solvents which could be traced analytically decreased considerably.

It was proved that up to 15 different components

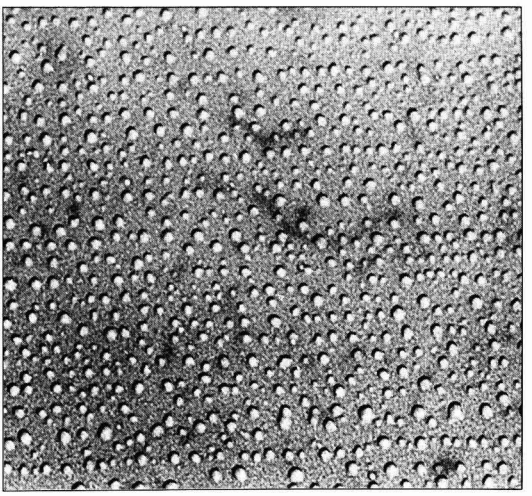

Figure 5—Blister-like water inclusion in a clear varnish after condensation test. (magnification 100X)

were contained in the top coat blisters. However, only the five solvents listed above could be identified clearly and their quantity estimated.

In the corresponding condensates, a number of solvents were present as well; however, no light boiling solvents were present. But, as in the group of medium and high boiling solvents, some could not be traced any longer.

This is not really surprising, since on the one hand, the solvents were dissolved in a much larger volume of water and, on the other hand, the beakers the condensates were collected in were not sealed tightly by the specimens covering the beakers. In addition, the specimens had to be removed from the beakers periodically for examination, thus allowing a number of solvents originally present, to evaporate from the 40°C warm condensate. Since the KHO top coat itself contained only white spirit and aromatic solvents, the five solvents traced could only have emerged from the layers underneath the top coat.

Ethanol was only present in the WPO/HO wash primer. Ethyl acetate and butyl acetate were contained only in the NCO filler. Butanol and toluene could emerge from both layers. This follows from knowledge of the schedules. Furthermore, the small amount of aromatic solvents is striking, although they were contained in the WPO/HO wash primer as well as in the NCO filler.

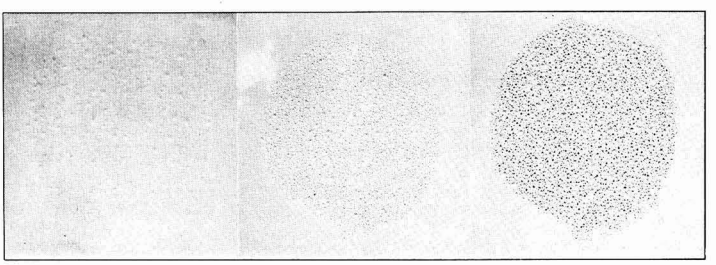

Figure 6—Application of KHO top coat after 24 hours to WPO/HO wash primer, after eight days drying time and exposure to condensation test. Development of blisters is dependent on exposure time. (Left): At 48 hours into test, blisters form. (Middle and right): At 14 days and eight weeks, respectively, the top coat shows blisters increasing with exposure time

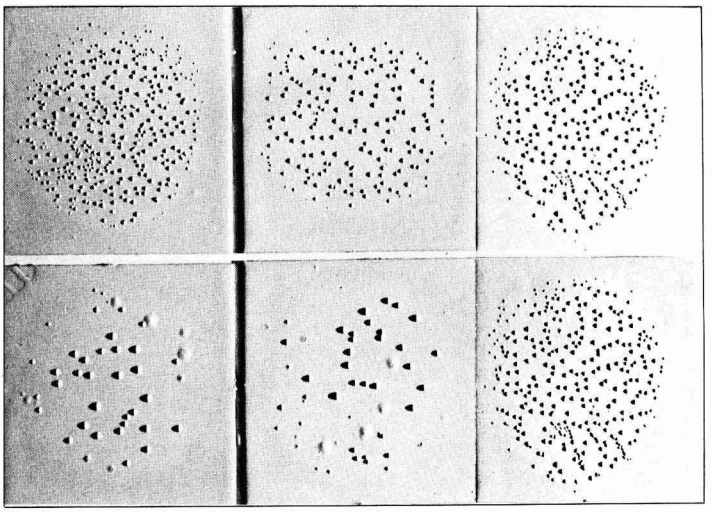

Figure 7—Top row: Application of NCO-filler after one hour (left), four hours (middle), and 24 hours (right) on WPO/HO wash primer. KHO top coat applied after 24 hours in each case. After drying for eight days, panels underwent condensation test exposure for 10 days. Time intervals had no influence on the degree of blistering. Bottom row: Application of NCO-filler after 24 hours drying time on WPO/HO wash primer. KHO top coat was applied after one hour (left), four hours (middle), and 24 hours (right). After drying eight days, 10 days of condensation testing was done. Blistering increased with increasing overcoating intervals

Obviously retained were solvents, especially polar solvents, with bad or nonsolving properties to the top coat. On condensation test, these solvents were extracted by water from the deeper layers, causing blisters beneath the top coat which was tight against them.

By forced drying of the NCO-filler over the WPO/HO wash primer, as previously mentioned, only the solvents contained in the NCO-filler were expelled, whereas traces of butanol and toluene originally present in both layers were still present in the blisters.

SUMMARY

Examining the question of which coating properties and which reactions under moist conditions influence in a variable manner the behavior of anticorrosive systems as far as blistering and underrusting are concerned, the following results were obtained:

In a coating system with the same primer and filler (here WPO/HO wash primer and NCO filler), with the same dry film thickness of the different coats and with the same drying conditions prior to application of the top coat, the type of top coat applied definitely can decide when, to which degree and in which coating layers, blistering and, as a consequence, corrosion occurs. This was clearly proved by example of a top coat based on alkyd resin and a different one based on an isocyanate cured acrylate resin.

Since both top coats differed only slightly with respect to water permeability (the acrylate type was less permeable by about 10 to 20%) and oxygen permeability, as previous measurements showed, the differences in their permeabilities could not be the only reason for the different behavior of the coating systems after application of these top coats.

Examination of the top coat films showed that the KHO top coat at a high relative humidity (as produced on determining the water vapor permeability at a graduation from 100% to 50% RH) at first hoarded the moisture until saturation was reached. Coincidently, the water permeability was increasing. Only after two days did a slight decrease of the water permeability occur, until eventually, equilibrium was reached. As far as water uptake of the top coat is concerned, in the initial phase, as well, a steep increase occurred which, though decreasing to 12% after 25 days, did not cease entirely.

From these examinations it follows that coatings of this type, after exposure, immediately hold a relatively large reservoir of water which is likely to help detachment from the substrate and which certainly is of detrimental influence when in the interphase substrate/coating solvents are included, or contaminations are present, or inhomogeneities exist.

Actually, it takes two to three days until blistering occurs on condensation test with such untempered or shortly dried films. The time to blister can be delayed accordingly by prolonged drying or by tempering. In this way the solvents are expelled more completely and crosslinking is encouraged (both effects cannot be separated from each

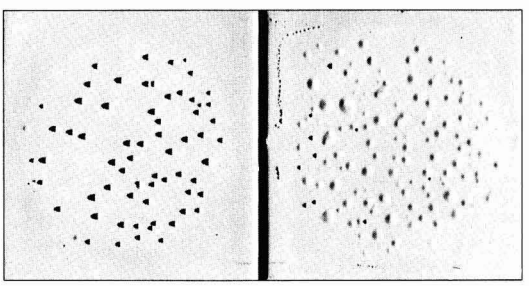

Figure 8—Application of NCO-filler after drying 48 hours on WPO-primer hardened with HO hardner (left) and without HO-hardner (right). The KHO top coat was applied in both cases 24 hours later, with eight days drying followed by 10 days of condensation exposure testing. The interphase where blisters formed depends on the wash primer

other, even vacuum does not remove the solvents quickly enough).

The ACO top coat immediately showed different behavior. With this type, the water vapor permeability decreased immediately and dropped below the value of the KHO top coat. The swelling behavior may be even more important. Although it increased in the first 24 hours, it remained below 1% and decreased eventually (probably parallel to the loss of solvents) down to zero. Such films do not function as a reservoir of water which may be expected to be advantageous to their protective properties, and in fact, the ACO top coat was definitely less sensitive to blistering and showed better wet film adhesion to steel than the KHO top coat.

However, the top coats and the layers underneath, such as fillers, primers, etc., can be of equal influence on the protective effect of the complete coating system. Modification of the primer, e.g., omitting the phosphoric acid hardener of the wash primer, or changes in an intermediate layer, can influence location and degree of blistering and the corrosion protective properties.

Examinations on the three-layer KHO system showed that in multi-layer systems certain areas of layers are the preferred sites for water inclusion and, consequently, blistering. Once these areas are 'saturated' the next less sensitive areas are attacked.

On account of the examinations, it can be assumed that the type of solvents originally present in the different paint layers is of decisive influence on the reactions examined. Depending on the type of solvent and type of binder, they can be included in different layers and in different quantities. Film thickness, or differences in film thickness, and drying conditions can be of considerable influence as well.

Analysis of the liquid contained in the top coat blisters of the three-coat KHO system, which initially developed blisters very quickly but showed substrate blistering only after long exposure to condensation test, proved that not the solvents of the top coat but the solvents retained in layers beneath (WPO/HO wash primer and NCO filler) which, under the influence of moisture, accumulated beneath the top coat, caused blistering in this area. It was interesting that the polar alcohols and esters were concentrated preferentially, whereas the aliphatic and aromatic solvents contained in the WPO/HO wash primer and NCO filler could not be traced in the liquid of the blisters.

The investigation showed that the solvents primarily determine the anticorrosive protection and/or function; to a lesser extent, the binders used in the formulation of anticorrosive systems and the permeability by water vapor and oxygen for the single systems are also involved. Condensation tests proved to be suitable in detecting the interactions caused by solvents.

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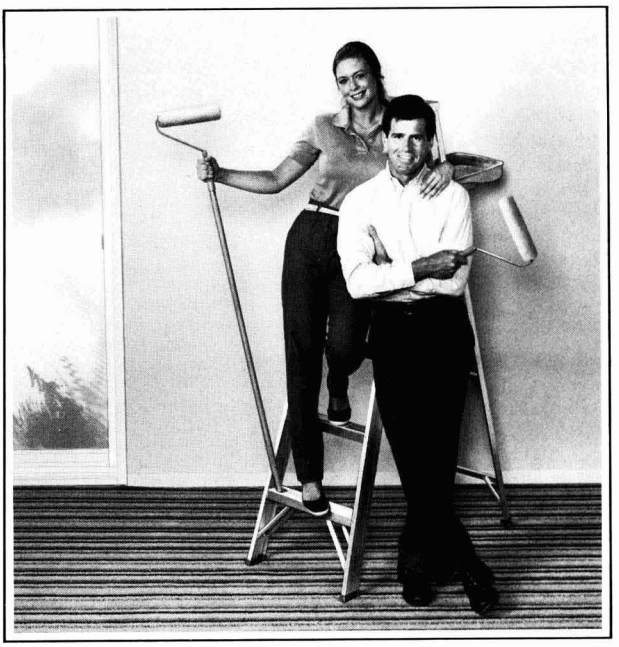
Reported in Error

On page 31 of the January JCT (In Memoriam), we erroneously reported the passing of Calvin H. Marcus, Jr., of the Louisville Society. We are happy to report, correctly, that he is alive and well; it was his father who died last year.

CHEAPER & BETTER



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ANNOUNCING A NEW LOW COST THICKENER FOR INTERIOR FLAT PAINTS THAT ARE EASIER TO APPLY.

Zinc Consumption in Zinc-Rich Primers Co-Pigmented with Di-Iron Phosphide

Newton C. Fawcett,* Craig E. Stearns,* and B. George Bufkin†‡
University of Southern Mississippi

The amount of elemental zinc consumed during salt fog exposure of steel test panels protected with epoxy-ester zinc primers is reported. Partial replacement of zinc by di-iron phosphide was found to affect the fraction of initial zinc remaining after exposure.

Primers pigmented with a 75/25 weight ratio of di-iron phosphide to zinc gave optimum efficiency of zinc use under the conditions of the test, while primers pigmented with a 50/50 weight ratio of di-iron phosphide to zinc gave optimum overall performance. Primers pigmented with zinc alone failed because of severe blistering. Partial replacement of zinc with di-iron phosphide eliminated blistering.

A mechanism for the functioning of di-iron phosphide is proposed.

INTRODUCTION

Metal primers pigmented with zinc dust in excess of their critical pigment volume concentration are known as zinc-rich primers. Because of the relatively high cost of zinc, various lower-cost co-pigments have sometimes been included in primer formulations. These co-pigments are known as extenders. In recent years the refractory and conductive compound known as di-iron phosphide, Fe_2P, has seen increasing use as a co-pigment with zinc.**

We have found that an epoxy-ester-bound, zinc-rich primer can be mechanically removed from steel test panels after the primed panels have been exposed to salt fog for a number of hours and that the coating is removed without damage to the substrate. This has allowed the consumption of zinc in the coating and the extent of substrate rusting to be separately analyzed.

In this paper we report the measurement of elemental zinc consumption in a zinc-rich, epoxy-ester-bound primer and in corresponding primers co-pigmented with varying ratios of zinc and di-iron phosphide. The results of these measurements are compared to the extent of rusting noted on the steel substrates.

EXPERIMENTAL

Primer Formulation: The test primers were all pigment variants of the following formulation:

Component	*Supplier*	*Grams*
RCI 38-407	Reichhold	79
MPA-60	NL Industries	37
Aerosil R972	Degussa	8.4
CaO	Mallinkrodt	4.2
Fe_2P + Zn	Occidental; Federated Metals	697 to 598
Co and Mn driers		2
ketoxime anti-skin agents		0.8

The resin used, Reichhold 38-407, is a tall oil modified epoxy ester that is 50% solids by weight.

The amount of total pigment was calculated to give a constant 30% underbinding. These calculations were based on oil demands of Fe_2P and Zn and were confirmed by oil demand values obtained on various mixed Fe_2P-Zn pigments. Oil demands of pure Fe_2P and Zn pigments were 8.59 and 7.80 grams per gram of oil, respectively.

TEST PANEL PREPARATION: Standard, solvent washed, cold-rolled steel test panels were sprayed on both sides with xylene thinned primer to give a nominal 2 mil coating thickness as determined using an Elcometer. The

*Department of Chemistry, Hattiesburg, MS 39406.
†Department of Polymer Science, Hattiesburg, MS 39406.
‡Dr. Bufkin is currently associated with The Sherwin-Williams Co., P.O. Box 6709, Cleveland, OH 44101.

**Di-iron phosphide is sold by the Occidental Chemical Corp. under the trademark Ferrophos.[1]

Table 1—Zinc Content Before and After 200 Hours Salt Fog Exposure

Zn°/Fe_2P	gZn[a] to start	gZn at end	Amount Consumed
100:0	0.744	0.192	.582
		0.175	.599
75:25	0.555	0.236	.319
		0.220	.335
50:50	0.368	0.127	.241
		0.135	.233
25:75	0.177	0.0185	.158
		0.0155	.162

(a) Calculated

panels were cured for four days at room temperature. Fe_2P augmented primers are harder than straight zinc primers. Typical pencil hardness is 4B for a 60/40 Zn/Fe_2P composition and 6B for 100% Zn. All coatings were 100% adherent by crosshatch adhesion testing.

CALCULATION OF THE AMOUNT OF ZINC INITIALLY PRESENT: The test panels were weighed before and after application of the primer. This was done for each primer tested and the weight difference divided by two gave the weight of primer on one surface. The mean weight of primer per surface for all panels weighed was 2.09 g ± .10 g. The weight of zinc per surface was then computed by taking into account the percentage of the zinc pigment which was elemental zinc (82%) and the nonvolatile composition of the primer. As a check on the calculated zinc content, the cured coating was scraped from several panels before exposure to salt fog. The scrapings were analyzed for zinc by hydrogen evolution and, in each case the zinc found agreed with the calculated zinc content within 5%.

ZINC ANALYSIS: The amount of metallic zinc remaining in each test panel's front surface coating after salt fog exposure was determined by: (1) scraping the softened coating from the panels while still warm and moist; (2) drying and weighing the removed coating; and (3) analyzing for metallic zinc by the hydrogen evolution method. All analyses were done in duplicate.

SALT FOG TESTING: This was carried out according to ASTM method B 117-73 (1979) with the exception that the temperature was elevated to 50°C to encourage early failure and accentuate differences between test panels.

ESTIMATION SURFACE RUST: After removal of the primer coating from the test panels, the degree of front surface rusting was estimated using ASTM rust grade standards according to ASTM method D610-68 (1981).

RESULTS AND DISCUSSION

The reported results pertain specifically to a nominal 2 mil epoxy-ester-bound primer pigmented at 30% under-binding with various Fe_2P/Zn ratios and exposed to accelerated salt fog testing at 50°C.

Table 1 gives the absolute amount of zinc consumed after 200 hours as a function of the initial zinc content and Zn/Fe_2P pigment ratio. The values shown are in grams per front panel surface. These data are re-expressed graphically in *Figure* 1, where the percent of free zinc remaining after salt fog exposure is plotted against the weight percent of zinc in the pigment. It is seen that the fraction of original zinc remaining after 200 hours passes through a maximum near 25% Fe_2P content.

Figure 2 shows how the extent of rusting on test panels, evaluated after primer removal, varied with pigment composition. The point at 40/60 Fe_2P to Zn was available from a previous experiment under identical conditions, however, datum on the amount of zinc remaining at the end of the test was not acquired for this composition. Minimum rusting was observed for the primer pigmented with a 50/50 weight ratio of Fe_2P to Zn.

Severe rusting begins within the first 24 hours of exposure when the only pigment is Fe_2P. Certainly, Fe_2P has no corrosion inhibiting properties by itself.

It was noted that primers pigmented with zinc alone showed extensive blistering under the rather severe conditions of the test. It is probable that this blistering was a precursor to the extensive rusting on panels protected by zinc alone. Blistering was notably absent from panels protected with primers pigmented with Fe_2P exceeding 25%.

Optimum corrosion protection was obtained near a 50/50 weight ratio of zinc to Fe_2P. With only 25% zinc and 75% Fe_2P, protection was still substantial although not as great as that obtained with the 50/50 primer.

Note that failure of the primers to protect the substrate cannot be attributed to exhaustion of zinc because, as *Table* 1 shows, there was a significant amount of elemental zinc remaining in each of the primers at the end of the test.

The maxima of *Figures* 1 and 2 are evidence for the presence of at least two corrosion determining factors that act in opposition to result in a synergistic relationship between zinc and Fe_2P. Zinc appears to be consumed more efficiently when in the presence of the co-pigment Fe_2P, with the result that improved corrosion protection is obtained with lower initial zinc content while a greater fraction of the free zinc initially present remains unoxidized after a given period of time.

Simpson and Simko[2] have published a cathodic polarization curve for Fe_2P and attributed the cathodic reaction to reduction of oxygen, presumably to hydroxide. In unpublished experiments in our own laboratory, we observed an increase in pH when a Fe_2P electrode was potentiostated for 11 hours at a potential of 0.85 V versus a saturated calomel reference electrode in an aerated, aqueous, 5% sodium chloride solution. The applied potential was similar to the corrosion potential we observed in the model system:

$$\text{steel, } Fe_2P, \text{ Zn}|O_2, \text{ NaCl}_{(aq)}||\text{SCE}$$

The above results suggest tht Fe_2P may function by serving as a co-cathodic site with steel. Because Fe_2P is finely divided, its surface area will be appreciably greater than that of the steel substrate. Expansion of the cathodic

surface could bring it into approximate balance with the anodic area of zinc. This could result in decreased cathodic current density, especially during the initial exposure to salt fog, at which stage the cathodic protection mechanism of zinc is thought to predominate.[3]

It is probable that most blistering takes place during the initial, active phase of corrosion protection through zinc anodization. Blistering is generally believed to be initiated by current density hot spots on the steel. High, local concentrations of hydroxide at these points apparently cause film detachment and subsequent blistering from spontaneous diffusion of water and counter ions into the region of detachment. Assuming this mechanism to hold in the present case, then lowering of cathodic current density through incorporation of Fe_2P and the consequent cathodic surface expansion would be expected to decrease blistering. And, indeed, the presence of Fe_2P did result in a marked decrease in blistering to the point of virtual elimination at pigment compositions above 25% Fe_2P. On the other hand, expansion of cathodic surface area would probably be relatively unimportant during the latter stages of corrosive involvement, because then protection is maintained mostly through precipitated basic zinc compounds on the steel substrate and throughout the underbound, and therefore porous, primer structure.[3]

The foregoing arguments may explain the performance maximum observed near a 50/50 pigment ratio. That is, failure at the high end of zinc content probably resulted from blistering traceable to insufficient cathodic surface in the presence of vigorous zinc anodization during initial exposure to a very aggressive atmosphere. But, failure at the low end of zinc content may have resulted from insufficient production of passivating basic zinc compounds.

Assuming Fe_2P to be an active site for hydroxide generation, the maximum in zinc efficiency shown in *Figure* 1 may be attributed in part to near optimum precipitation of basic zinc compounds uniformly distributed throughout the primer film. Formation in the primer film of compounds such as hydrous zinc oxide can be expected to slow down zinc dissolution and enoble the zinc potential, thus conserving zinc while still protecting the steel substrate by deposition of basic zinc compounds on its surface. This is consistent with the potential-pH diagram of zinc which shows that in dilute alkaline solution, zinc forms oxide or hydroxides and can be passivated.[4]

In the case of all-zinc primers, zinc particles would not all be equidistant from an hydroxide generating surface, and less uniform precipitation of basic zinc compounds would result along with increased zinc consumption.

On the other hand, when Fe_2P is present in large excess over zinc, precipitation of zinc compounds may be insufficient to form an effective corrosion barrier, and ultimately, as the zinc content becomes very low, the initial cathodic protection will be ineffective.

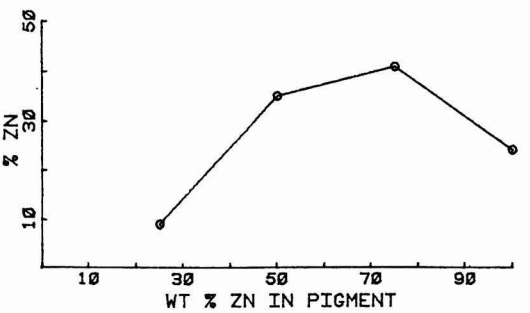

Figure 1—Zinc efficiency expressed as the percent of zinc remaining after 200 hours salt fog at 50° C versus pigment composition

SUMMARY AND CONCLUSIONS

In summary, a synergistic relationship between zinc and Fe_2P was demonstrated when these two substances were present together as co-pigments in a typical underbound, epoxy-ester metal primer.

As a corollary to this relationship, it was found that the ratio of Fe_2P to zinc had a marked effect on corrosion performance. Conjectures were made regarding the mode of action for Fe_2P, and in particular, it was proposed that Fe_2P serves as a co-cathodic site with the steel substrate.

The need for a systematic investigation of the electrocatalytic properties of Fe_2P is evident. Although it would be unwise to extrapolate the results reported here to other binder systems and corrosive environments, one should not be surprised to find similar relationships holding in related systems.

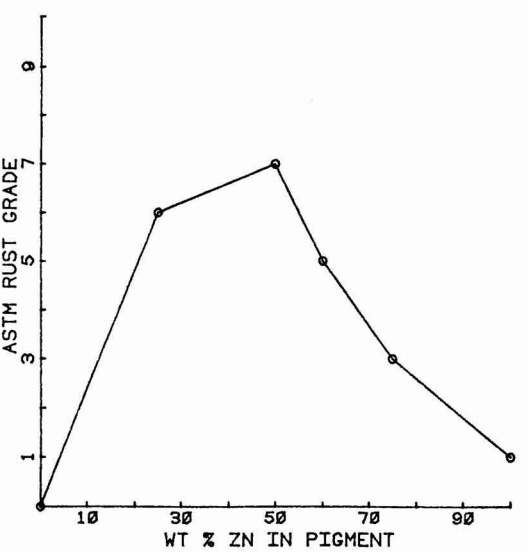

Figure 2—Degree of rust on steel substrate after 200 hours salt fog at 50° C versus pigment composition

ACKNOWLEDGMENT

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Numerical Color Control For Exterior Automotive Coatings

Susan A. Schultz, Marcus K. Chao, and Brian P. Hake
General Motors Corporation*

A numerical color control program has been established using the latest colorimetry equipment. Part of this program includes color tolerances which have been designed based on visual judgments and instrumental measurements. These tolerances can be used to minimize the subjectivity from the color matching process and provide a tool to improve the quality of automotive coatings. Studies that have been conducted indicate that the color tolerances developed in the laboratory are also feasible in production facilities as an ongoing quality control technique.

INTRODUCTION

Competition in the automotive industry has made it necessary to continuously improve the appearance of automobiles. With the present emphasis on fuel economy and pollutants, new higher solids paint systems, electrostatic application, and various lighter weight substrates have become an integral part of the industry. Because of various government regulations, different substrates, sometimes each being painted with a different paint system and/or a different method of application, are mounted adjacent to each other on the automobile body. As a result, color matching problems can and do occur.

Currently, color approval systems for both interior and exterior parts are based entirely on visual judgments, which are highly subjective. Several studies have shown that visual color judgments vary not only from individual to individual, but may also vary within one individual from time to time. Alman and Pfeiffer[1] show that even when the so-called "color experts" (i.e., people involved in the field of color and color matching for 20 years or more) are shown two identical color matched panels, one can experience a 27% false rejection rate.

The color mismatch problem related to this subjectivity is magnified in our industry due to the large numbers of automotive plants and suppliers who manufacture colored parts. Because of this subjectivity and the critical nature of color matches, there arose a need for a color tolerance program. Here, we describe a method of establishing numerical tolerances for exterior automotive color coatings. It should also be noted that this method is also applicable to hard trim items such as grained plastic parts and soft trim items such as body seat cloth.[2]

EXPERIMENTAL

Sample Preparation

Phosphated steel panels (4″ × 12″) were used as the substrate in the laboratory evaluations. The paint system applied was the following:

Electrodeposition Primer	—15 μm (0.6 mils)
Lacquer Sealer	—6.3 μm (0.25 mils)
27% Solids Dispersion Color Coat	—63 μm (2.5 mils)

To insure hiding, colorcoat was applied to both gray/oxide and black/white hiding charts. The painted panels were baked in electric ovens at standard temperatures (30 min at 163° C) which minimized the tendency towards topcoat yellowing. Care was exercised during the

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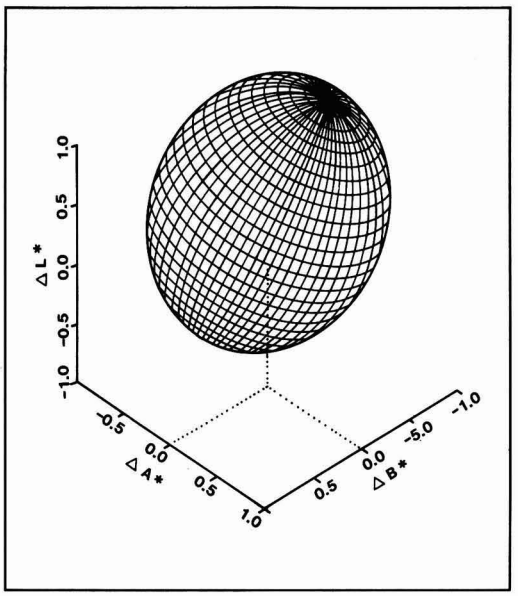

Figure 1—Three dimensional ellipsoidal shaped tolerance for white paint

preparation of the panels to avoid dirt and other contaminations. In addition, after panels were baked, they were carefully packaged in envelopes to avoid scratches and other types of damage.

A number of weighed control and off-color samples were prepared from a 100 liter (25 gal) master batch of control paint. Each off-color paint sample was prepared by adding weighed amounts of various tinting pastes to four liter (one gal) samples of the control paint. The tinting pastes were selected so that each sample would deviate from the control in one direction or vector of color space. It was our intention to produce as many samples as possible to cover all directions of color space. Initially, each colored tint was added to the four liter batch in large enough amounts to insure that, when sprayed out, the color difference between the control and samples would be significant.

Each off-color gallon was then diluted with control paint in several different ratios. The purpose of this was to obtain an array of samples with varying degrees of mismatch. According to our experience, this method of paint preparation enables one to accurately reproduce any sample whenever necessary from the master batch of control paint. The topcoat control paint was applied to the panels to obtain maximum flow and appearance under controlled spray conditions. Off-color samples were then sprayed under the same conditions as the control.

EQUIPMENT AND METHOD

Laboratory Studies

The instrument used in this study was the Hunter D259A tristimulus filter colorimeter. Its geometry consists of two 45° incident beams and 0° viewing. As indicated by the design of filter colorimeters, all values were calculated using the 1931 CIE2° standard observer under Illuminant C (daylight).[3] All instrumental color measurements are expressed in CIE LAB units (ΔL^*, Δa^*, Δb^*) and were made comparing the off-color panels to the control panel. An average of three readings were taken on each panel.

Visual judgments were conducted under daylight lamps in a Macbeth light booth. A panel of judges was asked to rate the off-color to the control panel on the basis of limits of acceptability as opposed to perceptibility of a difference.[3] The judges consisted of two color experts from our Engineering Activity and eight to 13 color experts (Paint Superintendents, Foremen, etc.) from our production facilities. From these instrumental readings and visual judgments, a three dimensional tolerance was obtained using Discriminant Statistical Analysis.[4,5]

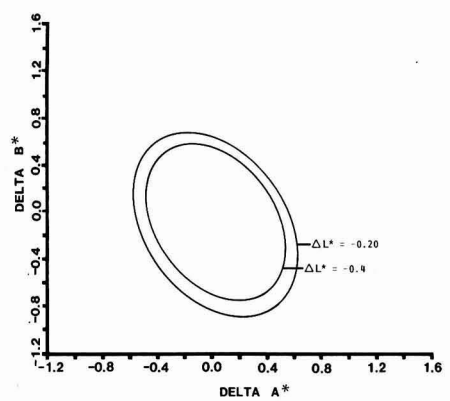

Figure 2—Two dimensional planes of the white tolerance where $\Delta L^* = -0.20$ and $\Delta L^* = -0.40$

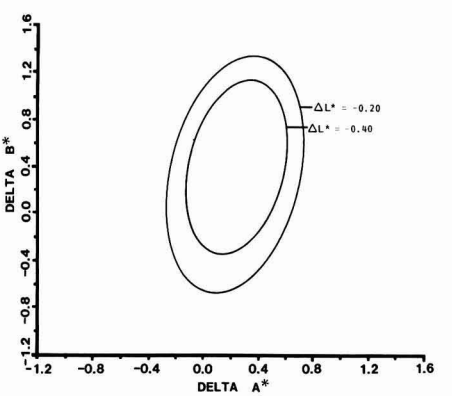

Figure 3—Two dimensional planes of the yellow tolerance where $\Delta L^* = -0.20$ and $\Delta L^* = -0.40$

Production Studies

In the production example cited, 34 red and white cars were studied. The car bodies were painted at one location, while the flexible fascia were supplied in color by sources. Instrumental readings were taken in the assembly plant on three sections of each fascia (center and two ends) and three sections of each car body (leading edge of door, door, and rear fender). Each section was measured in triplicate with the Hunter D259A colorimeter and compared to a Corporate certified color standard. The D259A colorimeter used for the production studies was a model specially equipped with an eight-meter cable, along with handles and a push button on the optical head. This enabled the optical head to become portable and readings to be made right on the assembly line.

RESULTS AND DISCUSSION

Laboratory Tolerance Development

The first tolerance was established using both instrumental readings and visual judgments on 54 white off-color painted panels. After Discriminant Statistical Analysis, a three dimensional ellipsoidal shaped tolerance was obtained and plotted using SAS[6] (a statistical analysis computer system) as shown in *Figure* 1. The standard is at $(\Delta L^*, \Delta a^*, \Delta b^*) = (0, 0, 0)$. Panels with readings that fall inside the tolerance are visually acceptable, while those that fall outside are visually unacceptable.

After the tolerance was established we found that visual judgments agreed with the instrumental data points 98% of the time. In fact, the one misclassified panel (i.e., disagreement between visual judgment and the tolerance) that accounts for the 2% disagreement was near the outside edge of the tolerance envelope ($\Delta L^* -0.27, \Delta a^* = 53, \Delta b^* = -0.44$) as depicted in the slices of the tolerance

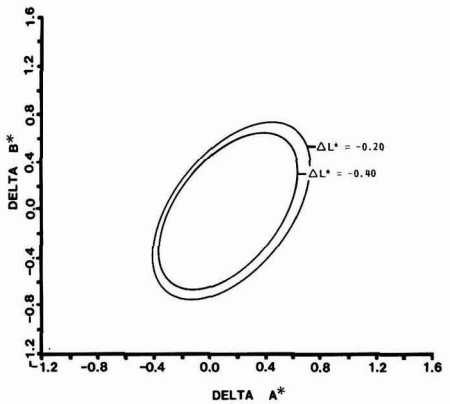

Figure 4—Two dimensional planes of the gray tolerance where $\Delta L^* = -0.20$ and $\Delta L^* = -0.40$

in *Figure* 2. It should also be noted that the visual judgments for the one misclassified panel were almost evenly split by the judges (8 agreements vs 7 disagreements).

Based on the excellent results obtained on white paint, the same off-color experiments were extended to three more solid colors: yellow, gray and red. Ellipsoidal shaped tolerances were established for each color. Each one varied in orientation and size as depicted in the sections of the tolerances as shown in *Figures* 2–6. The percent of misclassified panels was 6.6% for yellow, 4.5% for gray, and 2.2% for red.

These figures can be described by the following equation: $A (\Delta L^*)^2 + B (\Delta a^*)^2 + C (\Delta b^*)^2 + D (\Delta L^*)(\Delta a^*) + E (\Delta L^*)(\Delta b^*) + F (\Delta a^*)(\Delta b^*) + G (\Delta L^*) + H (\Delta a^*) + I (\Delta b^*) + J \leq 0$ where A, B, C, etc., are the

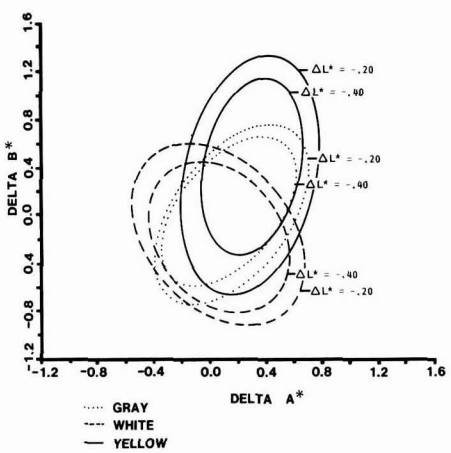

Figure 5—Planes of the white, yellow, and gray tolerances superimposed on each other

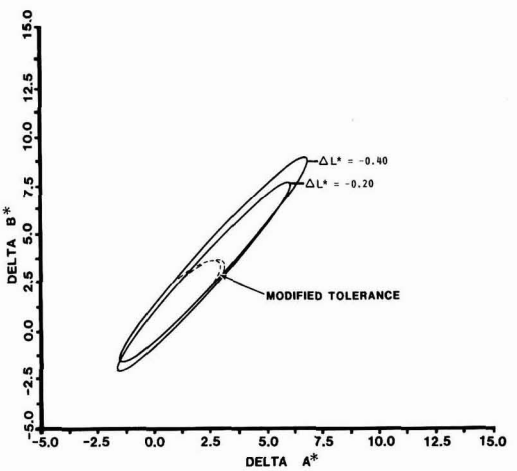

Figure 6—Two dimensional planes of the red tolerance where $\Delta L^* = -0.20$ and $\Delta L^* = -0.40$. Dotted lines depict the modified tolerance

Table 1—Coefficients in Decision Rule

Coefficient	White Paint	Gray Paint	Yellow Paint	Red Paint
A	9.60	6.79	10.20	33.37
B	29.15	41.49	23.18	15.70
C	19.49	23.96	5.31	9.75
D	−5.06	−6.37	−2.10	−37.92
E	−9.88	4.38	3.93	33.92
F	15.94	−29.88	−6.87	−23.99
G	−8.71	−4.17	−6.07	1.08
H	1.36	−10.94	−9.86	−2.16
I	4.70	5.21	−.87	−1.37
J	−10.76	−10.11	−4.99	−8.28

Table 2—Coefficients for Red Paint

Coefficient	Red Paint	Modified Red Paint
A	33.37	7.22
B	15.70	3.22
C	9.75	1.86
D	−37.92	−8.65
E	33.92	6.3
F	−23.99	−4.4
G	1.08	1.12
H	−2.16	−0.70
I	−1.37	0.001
J	−8.28	−1.75

SUSAN A. SCHULTZ received a B.S. Degree in Chemistry from Wayne State University in Detroit, MI in 1971. She is a Senior Experimental Engineer in the Material Development and Testing Laboratory of the Fisher Body Div., General Motors Corp. Her experience in coatings include research and development and quality control for the Polymers Department of the Research Laboratories of General Motors. She is also a member of the Detroit Color Council.

MARCUS K. CHAO is Engineering Group Manager of the Plastic Group in the Material Development and Testing Laboratory, Fisher Body Div., General Motors Corp. He has earned the B.S. Degree in Chemistry from Chung-Yuen College in Taiwan. He is a recipient of a Ph.D. Degree in Analytical Chemistry from the University of Kansas and a M.B.A. Degree from Wayne State University.

He is currently a member of the Inter-Society Color Council and The Society Of Plastics Engineers.

BRIAN P. HAKE received his B.S. Degree in Optics from the University of Rochester in 1981. He is an Associate Engineer in the Material Development and Testing Laboratory at Fisher Body Div., General Motors Corp. Mr. Hake is responsible for developing color tolerances on plastic and soft trim materials. He is a member of the Detroit Color Council.

quadratic equation coefficients unique to each color (See *Table 1*). These coefficients are obtained by substituting the sample means and sample covariance matrices into equations described by Vance.[5] In all cases, the panels are misclassified either because of split decisions by the judges or because the data points lie extremely close to the outside edge of the tolerance.

APPLICATIONS OF LABORATORY TOLERANCE DEVELOPMENT

The potential applications of numerical color tolerancing in our plants are incoming colored parts, material inspection, and on-line production processing control. In our applications, we used the tolerances developed in the laboratory using flat panels to correlate with production parts which are curved and flexible. One example of a production application that demonstrates that the laboratory developed tolerances are feasible for actual parts is described in the following paragraph.

The color matches of both red and white car bodies and flexible fascia were analyzed using the laboratory tolerance. Colorimeter measurements demonstrated that both the red and white fascias were outside the color tolerance 90% of the time, while the car bodies were inside the tolerance 100% of the time. Moreover, the visual judgments made by both supplier representatives and plant personnel agreed with the tolerance 100% of the time. In other words, when the tolerance rejected a part, the judges rejected the part; when the tolerance accepted a part, the judges accepted the part. Other data collections include the measurement of front end sheet metal and doors (metal vs metal), fenders and rear fascias (metal vs plastic), and fenders to fender extensions (metal vs plastic). In these studies, each part was compared to our Corporate standard color panels as well as to the adjacent parts on the automobile. This data shows that plant correlation with the tolerance is 85% or better.

Based upon the data collected on production cars, the red tolerance has been modified as shown by a change in the coefficients in *Table* 2 and on *Figure* 6. Work is now in progress to determine if the boundaries of the remaining tolerances require modification.

Metallic Paints

Metallic paints present difficulties because of aluminum flake orientations and their interaction with light. To date, no satisfactory tolerances have been reported. However, a preliminary tolerance for a light blue metallic paint was established based on 30 off-color samples. It was possible to obtain an ellipsoidal-shaped tolerance using the Discriminant Statistical Analysis technique for face measurements (color of metallic paint when viewed normal to the surface). However, instrumentation is not available at this time to accurately measure both the face and the flop of metallic paints (color of metallic paint when viewed at a grazing angle). Fisher Body Div. is working with both instrument and paint suppliers to develop a program for metallic paint.

SUMMARY

In conclusion, these experiments have shown that color tolerances can and have been established for solid color automotive topcoats based on visual judgments and instrumental readings. Studies conducted in production facilities verify the fact that these solid color tolerances are applicable at production facilities. These techniques are being developed for metallic paints.

ACKNOWLEDGMENTS

The authors would like to thank Dr. L. Vance, of General Motors Research Laboratories, for performing the Statistical Analysis. Discussions with Don Hays and Larry Luce, of Fisher Body Div., were also very helpful.

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Sedimentation of Suspensions

L. Cutrone, R. Cabral, A. Charron, F.H. Hilton,
H.S. Philipp, and J. Flack
Montreal Society for Coatings Technology Technical Committee

The settling phenomenon often found in pigmented surface coatings is an area which is not fully understood; hence, it is very hard to predict. Simple models are well known, but when the same theory is applied to actual paints, it fails and the chemist has to resort to lengthy methods to assess settling.

In order to gain a better insight of pigment settling, a method described by P. E. Pierce to obtain the yield value was studied. The method uses a Brookfield viscometer, a special measuring technique, computer processing of the data and fitting the data into the Casson Equation.

INTRODUCTION

Since paint settling involves many complex factors not readily measurable, it is normal to assess it by an empirical type of rating.[1-5]

The rate of settling depends on four factors: (1) the rheological properties of the suspending medium; (2) the particle characteristics; (3) the solids concentration; and (4) the interparticle forces.[6] There are other factors, such as chemical reactions, but these play a lesser role in settling. One tries to control the above four factors and their interplay in order to reduce the settling rate and obtain a stable suspension.

Presented by Luigi Cutrone at the 61st Annual Meeting of the Federation of Societies for Coatings Technology in Montreal, October 12, 1983.

Settling consists of two stages, whether the particles are inert or reactive. The first stage of settling occurs when particles (inert) and flocs (reactive) move slowly downward because of gravity. The particles or flocs move downward until they are in close contact where compressive strength is formed. The settling process passes into the second stage, called compression or subsidence.[7] At this point the effect of gravity on settling is reduced because it has to act against the developing compressive strength.

For inert particles, their density, shape, and size are important in settling, but increasing particle concentration has a more important role in reducing the rate of settling. The settling of inert particles results in a hard packed sediment which cannot be easily redispersed. For a flocculent system, the rate of settling is faster than for a deflocculated system because of the larger effective particle size. However, loose contact between the flocs is formed and settling will be soft, voluminous, and easily redispersed.[8] There are four methods to control the rate and the type of settling: (1) Viscosity control; (2) Controlled flocculation;[6] (3) Electrical or steric stabilization; and (4) Colloidal structure.[9]

DETERMINATION AND PREDICTION OF SETTLING

To assess settling, there are several methods which can be classified under two categories: qualitative and quantitative. Under qualitative measurements there are: visual observations, photometric means, and the spatula method.[10] Under quantitative measurements there are: X-ray scanning[4] and the pigment settling gauge devised by Temple Patton.[11]

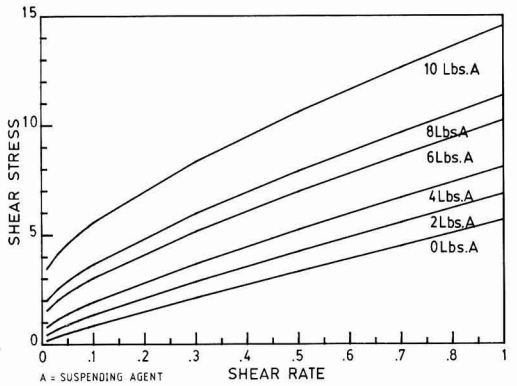

Figure 1—Behavior of a typical suspending agent

Table 1—Behavior of a Typical Suspending Agent In a Semi-gloss Alkyd Paint

Suspending Agent lbs/100 gal.	Casson Yield Value dynes/cm^2	Settling: 15 days oven aging	Settling: 6 months room temp.
0	0.04	0	0
2	0.19	8	6
4	0.44	8	8
6	0.70	8	10
8	1.41	8	10
10	2.66	8	10

For predicting settling there are only two methods and both of these are not very precise. The first method involves centrifuging,[1] which is used to increase the rate of settling. The danger is that the structure which reduces settling will be broken under the applied force and poor results obtained. The second method is oven aging (ASTM D-1309)[12] and involves heating and cooling over a period of two weeks. The method is claimed to be equivalent to six months of room temperature aging. Sometimes, wrong results are obtained because of reactions which occur during the heating period.

In the past, attempts were made to relate viscosity at very low shear rates to the rate of settling. This was not successful, probably because the very weak colloidal structure necessary for pigment suspension was destroyed.[13]

Since most paints are shear-thinning (pseudoplastic) one can measure the degree of shear-thinning, instead of measuring viscosity at very low shear rates. (This is sometimes erroneously called yield stress. Yield stress is defined as the amount of shear stress that must be overcome by an applied force to induce flow. To maintain flow, the applied force must remain. A coating with a yield stress will not settle.) There are several methods to determine the degree of shear-thinning, but the simplest one is described by P. E. Pierce which makes use of the Casson plot.[14] The Casson plot may be obtained from treating the Brookfield data either using a computer or a programmable calculator.

Casson's original equation[15] (equation (1)) was rearranged by Asbeck[16] to give a more representative expression (equation (2)).

$$\tau^{1/2} = K_0 + K_1 \gamma^{1/2} \quad (1)$$

τ = shear stress
γ = shear rate
K_0 & K_1 = constants depending on the solid and liquid phases of the suspension

$$\eta^{1/2} = \eta_\infty^{1/2} + \tau^{0\,1/2} / \dot{\gamma}^{1/2} \quad (2)$$

η = viscosity
η_∞ = infinite shear viscosity
τ^0 = Casson Yield Value
$\dot{\gamma}$ = shear rate

If the square root of the viscosity is plotted against the inverse of the square root of the shear rate, a straight line is obtained. A Newtonian fluid gives a straight line whose slope is zero; a shear-thinning fluid (pseudoplastic) gives a sloped line. The intercept is the viscosity at infinite shear rate and the slope is the degree of shear-thinning which will be referred to as the "Casson Yield Value." Both of these values are related to the performance of the coatings. In the present study, the relationship between the Casson Yield Value and settling will be shown. As the Casson Yield Value increases, the viscosity at very low shear rates also increases. Because of the higher viscosity at low shear rate, the degree of settling is reduced.

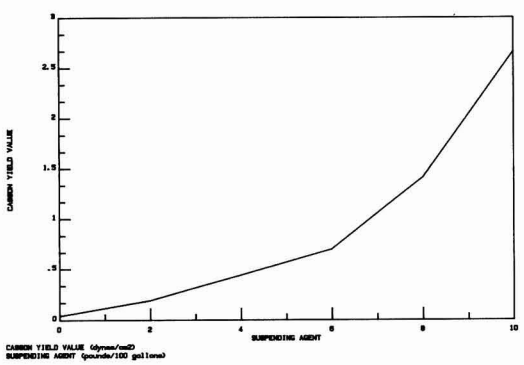

Figure 2—Behavior of a typical suspending agent in a semi-gloss alkyd

EXPERIMENTAL RESULTS

Rheology and Settling

To confirm this theory, two paint samples, which were known to settle at different rates, were examined. Sample A, whose rate of settling was faster than Sample B, had a Casson Yield Value of 1.62 dynes/cm^2, whereas sample B had a Casson Yield Value of 2.98 dynes/cm^2. Addition of

0.5% by weight of a suspending agent to sample A, increased the Casson Yield Value to 10.88 dynes/cm^2 and reduced the settling rate.

Having shown that the Casson Yield Value plays an important role in the settling of particles, a suspending agent was examined for its effect on the Casson Yield Value. A series of semi-gloss alkyd paints was prepared with increasing amounts of suspending agent and evaluated using the Casson equation to obtain the Casson Yield Value. *Figure* 1 shows the rheological behavior as the amount of suspending agent is increased. The paint goes from Newtonian behavior to a shear-thinning behavior. The Casson Yield Value goes from 0.04 dynes/cm^2 to 2.66 dynes/cm^2. The same samples were oven and room temperature aged and checked for settling using ASTM D-869.[10] As the suspending agent is increased (*Table* 1), an ASTM settling of 10 (D-869) is achieved at the optimum level of suspending agent. A further addition, above 6 lb/100 gal, does not improve the settling and can cause the paint to gel. This is shown in *Figure* 2 where the Casson Yield Value is plotted against the amount of suspending agent. Initially, the Casson Yield Value increases slowly with suspending agent level, but beyond the optimum point, where an ASTM settling of 10 is achieved (see *Table* 1), the Casson Yield Value increases drastically. Based on these results one could evaluate any suspending agent and determine its optimum level.

Settling in a Semi-Gloss Alkyd Paint

Several retain samples of commercial paints, which were at least 12 months old, were tested. The Casson Yield Value and the ASTM settling were determined. The ASTM rating was obtained on the undisturbed sample and later the samples were shaken and allowed to restructure before the Casson Yield Value was obtained (see Appendix). The results are shown in *Figure* 3. All samples had a Casson Yield Value. Samples with higher values had better anti-settling properties.

Phase Separation in a Semi-Gloss Latex Paint

In latex paints one deals with a flocculant system, therefore, hard-packed settling is seldom seen. Instead of measuring settling, the amount of the clear supernatant liquid was measured relative to the total amount of paint. These were rated as low, medium, or high. Referring to *Table* 2, low Casson Yield Value gave larger amounts of the clear layer. Samples with a high Casson Yield Value have good suspension properties and less phase separation.

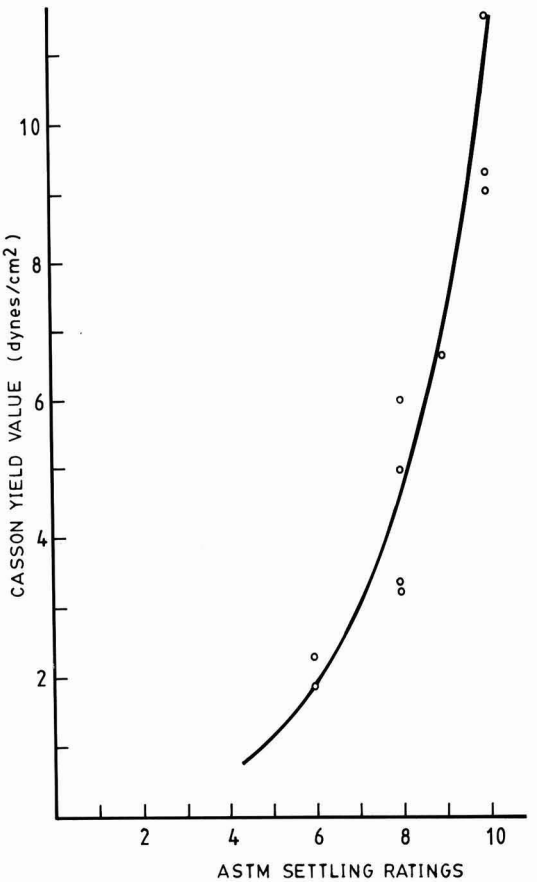

Figure 3—Yield value vs ASTM settling ratings in a semi-gloss alkyd

Table 2—Influence of the Casson Yield Value On Settling for a Semi-gloss Latex Paint

Casson Yield Value dynes/cm^2	Amount of Supernatant Liquid
0.22	High
0.31	High
0.50	High
3.60	Medium
5.40	Medium
8.80	Low
10.10	Low
26.09	None
34.54	None

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CONCLUSIONS

Settling of suspensions is a very complex phenomenon which is not fully understood. However, the Casson Yield Value gives us some insight into the settling behavior of suspensions. The method enables paint chemists to evaluate different suspending agents and determine their efficiency.

The Casson Yield Value is also a useful quality control tool to predict settling.

ACKNOWLEDGMENT

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APPENDIX

The viscosity was measured with the Brookfield RVT model according to the following procedure.

The temperature of the test sample was brought to 25 ± 0.1° C. The sample was not disturbed for a period of 60 minutes. A spindle was selected to give scale readings in the range of 10 to 90 units. The spindle was slightly lowered to one side of the center of the can until it was immersed to the proper depth indicated by the mark on the spindle shaft. The container was slowly moved in a horizontal plane until the spindle was located approximately in the center of the container. The viscometer was started at the lowest speed. After several revolutions, the clutch was depressed to hold the pointer and the scale units were recorded. The last three steps were repeated for the next highest speed and continued until the scale reading exceeded the value of 90.

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Study of Curing Mechanisms Of a Thermosetting Resin By Dynamic Viscoelastic Measurement

Part I: An Empirical Equation on the Curing Process

Takaharu Izumo and Satoshi Yamamoto
Nippon Paint Company Limited*

The cure mechanisms of an acrylic-melamine resin were studied by means of DSA (Dynamic Spring Analysis). Equation (a) of the degree of cure (X) was derived experimentally, and appears to adequately represent the cure behavior from the beginning to the end.

$$1n\ X^{1-m} + \exp\ (c1nX + d) = 1n((1 - m)kt) \quad (a)$$

where, $X = (Er' - Er'o)/(Er'_{\infty} - Er'o)$.

$Er'o$, Er' and Er'_{∞} = modulus of relative elasticity at $t = 0$, t and ∞, respectively.

c, d, and m = constants
k = the cure rate constant
t = cure time

Equation (a) was obtained by inserting the modification term, $(c1nX + d)$, in equation (b) which was limited to the initial cure behavior.

$$X^{1-m} = (1 - m)\ kt \quad (b)$$

The modification term, $\exp(c1nX + d)$, was derived from the ratio, $t_{exp.}/t_{calc.}$, where $t_{exp.}$ and $t_{calc.}$ are the time experimentally determined and the time calculated from equation (b) at a given degree of cure (X), respectively.

The modification term, exp(c1nX d), was considered to be due to the decrease of the segmental mobility caused by network formation. This leads to equation (c) which indicates that X is a function of the formation of network structure, i.e., the cure rate constant (k) depends on a degree of cure.

$$X^{1-m}/(1 - m) = k(X)t \quad (c)$$

where, $k(X) = k \cdot \exp\ (-d \cdot X^c)$
$k = ko \cdot \exp\ (\Delta Ea/RT)$
ΔEa = apparent activation energy
ko, d, and c = constants
R = gas constant
T = absolute temperature

Equation (c) indicates that the cure rate constant (k) is a function of a degree of cure (X) which becomes smaller as the formation of the network proceeds, i.e., as a degree of cure (X) increases.

INTRODUCTION

Measurements of dynamic viscoelasticity have been extensively used for the study of curing mechanisms.[1-5] We previously studied the crosslinking mechanisms of acrylic-melamine resin by the determination of crosslinking density from the stress-strain relation of swollen resin with solvent, and calculated the apparent activation energy for crosslinking from the relation between curing time and crosslinking density at various temperature. From the results that the activation energy of crosslinking increased because of the increase of segmental rigidity of acrylic resin, it was assumed that the crosslinking velocity was controlled by the micro-Brownian movement of the segments.[6] According to this concept, it was considered that the segmental mobility was controlled by, not only the viscosity of the reaction system at the early stage, but also by the formation of the crosslink structure.

*19 17, Ikeda-Nakamachi, Neyagawa City, Osaka 572, Japan.

Table 1—Analytical Results of Acrylic Copolymer

OH Value	Acid Value	Calc. Tg[a]	Molecular Weight[b] $\overline{Mn}$	$\overline{Mw}$	$\overline{Mw}/\overline{Mn}$
68.3	12.6	34.1°C	7200	14800	2.05

(a) Calculated from the following equation:

$$1/Tg = \sum_i w_i/Tg_i$$

Tg: glass transition temperature of copolymer
Tg_i: Tg of homopolymer, i.
(b) Obtained from polystyrene calibration curve of GPC.

Table 2—Analytical Results of Melamine

Number of Groups and Bridges Per Mole of Melamine				Molecular Weight[a]		
–NH	$-CH_2OH$	$-CH_2OR$	$-NCH_2N-$	$\overline{Mn}$	$\overline{Mw}$	$\overline{Mw}/\overline{Mn}$
0.97	1.32	2.70	1.01	1077	2118	1.97

(a) Obtained from epoxy resin calibration curve of GPC.

In this paper, we measure the dynamic viscoelasticity of acrylic-melamine resin at various curing stages by the DSA (Dynamic Spring Analysis) method,[7] and we derived an empirical equation which was applicable to the curing process from the beginning to the end.

EXPERIMENTAL

Materials

An acrylic copolymer (acid value, 12.6; OH value, 68.3) and a conventional butylated melamine-formaldehyde resin (Mw, about 2,100) were mixed at a solid ratio 7:3, and the mixture was used as a sample resin. Analytical results of each resin are listed at *Table* 1 and *Table* 2, respectively.

Measurement of Relative Dynamic Viscoelasticity

The helical springs used in DSA were made of copper (wire diameter, 0.35 mm; spring inner diameter, 2.0 mm). A solution of resin sample, about 0.01 g; was applied to the surface of spring so that a thin and continuous film was formed between the turns of the spring. After that procedure, the composite sample was dried under vacuum before measurement.

The Rheovibron DDV-II was employed in DSA experiments. This sample was analyzed at 120°C and at frequency of 11 Hz.

Table 3—Results of DSA Measurement For Curing Process at 120°C

Time (min.)	Er'	Er' – 1	$X = \frac{Er' - 1}{Er_\infty - 1}$
1.5	1.0	0.0	0.0
2.1	1.012	0.011	3.67×10^{-4}
2.75	1.011	0.011	$3.36 \times$ "
3.33	1.022	0.022	$6.73 \times$ "
4.0	1.034	0.034	1.04×10^{-3}
4.84	1.055	0.055	$1.68 \times$ "
5.5	1.076	0.076	$2.32 \times$ "
6.17	1.112	0.112	$3.42 \times$ "
7.0	1.145	0.145	$4.43 \times$ "
8.25	1.236	0.236	$7.21 \times$ "
8.90	1.270	0.270	$8.25 \times$ "
10.0	1.342	0.342	1.05×10^{-2}
10.83	1.436	0.436	$1.33 \times$ "
12.0	1.578	0.578	$1.77 \times$ "
13.0	1.771	0.771	$2.36 \times$ "
14.0	1.913	0.913	$2.79 \times$ "
14.83	2.078	1.078	$3.30 \times$ "
16.17	2.353	1.353	$4.14 \times$ "
17.75	2.633	1.633	$4.99 \times$ "
18.33	2.763	1.763	$5.39 \times$ "
19.1	2.963	1.963	$6.00 \times$ "
20.67	3.258	2.258	$6.90 \times$ "
40.0	8.932	7.932	2.42×10^{-1}
62.0	14.79	13.79	$4.22 \times$ "
96.0	20.04	19.04	$5.82 \times$ "
135.0	22.90	21.90	$6.70 \times$ "
186.0	25.76	24.76	$7.57 \times$ "
261.0	27.86	26.86	$8.21 \times$ "
2581.0	33.71	32.71	1.0

RESULTS AND DISCUSSION

DSA Results

The experimental results obtained in the way described above are shown in *Figure* 1. If we denote the relative rigidity and degree of cure as Er' and X, respectively, we get equation (1).

$$X = (Er' - Ero')/(Er_\infty - Ero') \quad (1)$$

where Ero', Er', and Er_∞ are relative elasticity at t = 0, t = t, and t = ∞, respectively.

The numerical values shown in *Table* 3 were calculated from the data in *Figure* 1 according to equation (1). The relationship between t and X is shown in *Figure* 2. As is evident from *Figure* 2, in the region below X equal to 0.1 (Region I), we get a linear relationship between log t and log X. In the region above X equal to 0.1 (Region II), the relationship is deviated from a straight line at longer times.

CURING BEHAVIOR IN THE EARLIER STAGE (REGION I): Assuming that X increased according to the n-th order rate equation in the curing processes, equation (2) is applicable.

$$dX/dt = k'(1 - X)^n \quad (2)$$

integrating, we obtain equation (3).

$$(1 - X)^{1-n} = k'(n - 1)t \quad (3)$$

where k' is rate constant and n is the reaction order.

Numerous experimental results from the study of acrylic-melamine resin curing rates have been reported in

the literature, and it was accepted that the curing reaction of acrylic-melamine resin followed second-order rate kinetics.[5] Accordingly, we made the assumption that n = 2 in equation (3), and $1/(1-X)-1$ was plotted as a function of time t in *Figure* 3 which was obtained using X and t values in *Table* 3. In *Figure* 3, X increased by second-order rate reaction kinetics in the region beyond t = 40 minutes. Although we attempted the application of various reaction order rate equations in the curing process, no acceptable rate equation could be obtained. From the results discussed previously for region (I), equation (4) was acceptable in this sample mixture. We made the assumption described below for the curing process after gel formation.

$$\ln X = a \cdot \ln t + b \qquad (4)$$

a,b : constant

(Assumptions)—

(1) In the curing process after gel formation, the chemical reaction between acrylic copolymer and melamine-formaldehyde resins contributes to the degree of cure only when the crosslink density increases.

(2) In the earlier stages of the curing process after gel formation, the velocity of network formation is proportional to the network density (the degree of cure X). The probability of network formation induced from chemical reaction increases in proportion to the degree of cure X, i.e., when larger molecular weights are formed (ref. *Figure* 4).

According to these assumptions, equation (5) is acceptable.

$$dX/dt = kX^m \qquad (5)$$

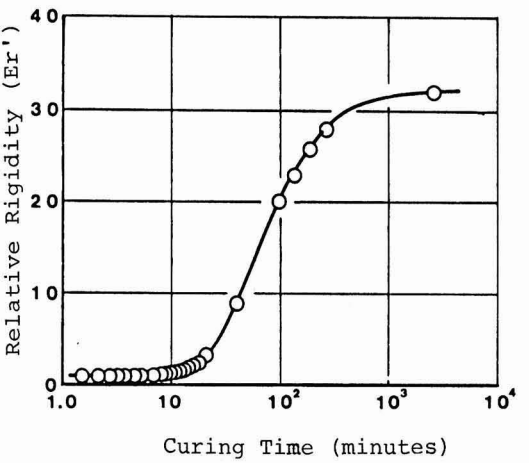


Figure 1—Change of relative rigidity during cure process at 120°C

where k is a constant of increasing velocity of X and m is a constant. Integrating equation (5), we obtain equation (6).

$$X^{1-m} = k(1-m)t \qquad (6)$$

i.e.,

$$\ln X = (\ln t)/(1-m) + \ln(k(1-m))/(1-m) \qquad (6')$$

Equation (6) states that lnX is linearly proportional to ln t, i.e., equation (6) is the same expression as equation

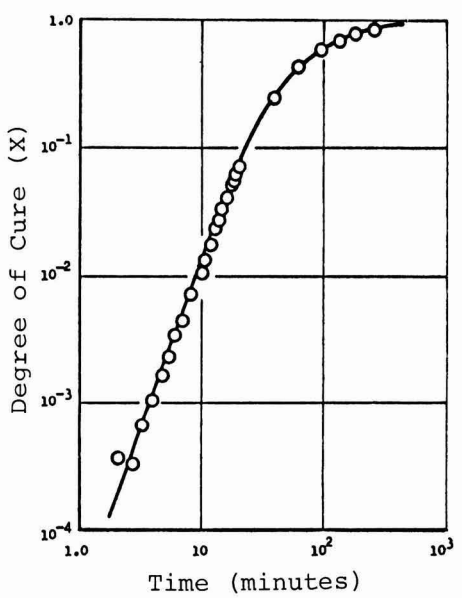


Figure 2—X ~ t plots at 120°C

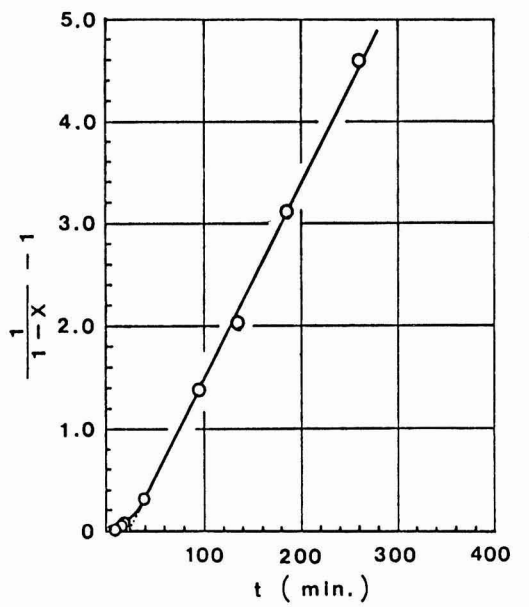


Figure 3—Plots of 1/(1 − X) − 1 vs curing time at 120°C

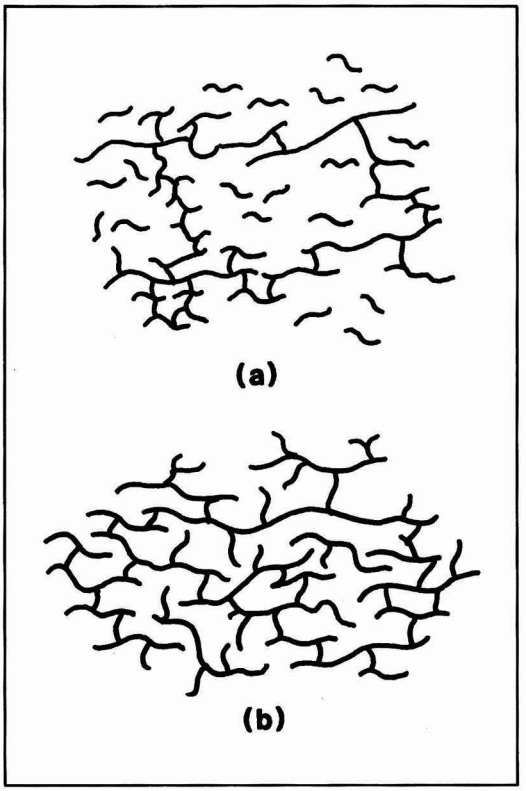


Figure 4—Crosslink structure of thermosetting resins. (a) earlier states; (b) later states

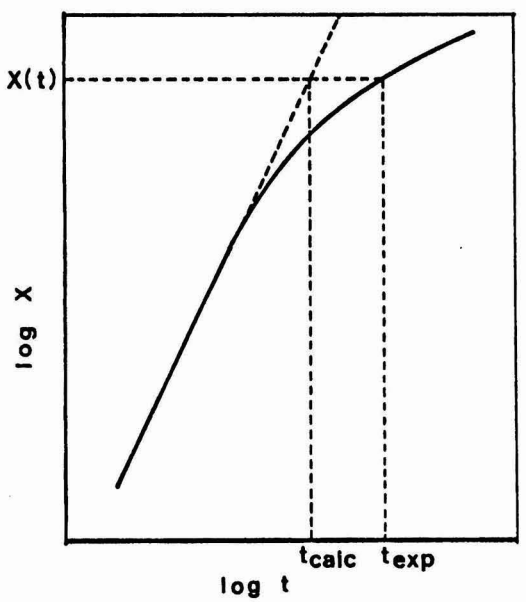


Figure 5—Model curve for rate analyses of the curing processes

Table 4—Relation Between X, $t_{exp.}$, $t_{calc.}$, and $t_{exp.}/t_{calc.}$

X	$t_{exp.}$[a] (min.)	$t_{calc.}$[b] (min.)	$t_{exp.}/t_{calc.}$
0.242	40	32.66	1.225
0.422	62	40.49	1.531
0.582	96	45.88	2.092
0.670	135	48.42	2.787
0.757	186	50.75	3.666
0.821	261	52.40	4.983

(a) t exp: time obtained from experiment
(b) t calc: time calculated from equation

$$t\ calc. = X^{1-m}/(1-m)k$$

(4). Comparing with equation (4) and equation (6), equation (7) is induced.

$$a = 1/(1 - m)$$
$$b = \ln(k(1 - m))/(1 - m) \quad (7)$$

From the log X and log t plots in *Figure* 2, we obtain equation (8), representing the linear part in *Figure* 2 from t = 3.3 min to 20 min using statistical methods.

$$\ln X = 2.588 \ln t - 10.422 \quad (8)$$

Comparing equation (7) and equation (8), we get the value m = 0.6136 and k = 0.0458.

CURING BEHAVIOR IN THE LATER STAGE (REGION II): In *Figure* 2, it was observed that X increased linearly according to equation (4) in the region where X was smaller than 0.1 and that X deviated from the line obtained from equation (4) at $X > 0.1$. The deviation from equation (4) was attributed to the decrease of segmental mobility included in the main chains caused by the growth of network structure with the result that caused the decrease of the probability of collisions between functional groups. From this point of view, we tried to analyze the mechanisms of the curing process.

In *Figure* 5, where the generalized curve line of *Figure* 2 was drawn, the deviation from the straight line expressed by equation (6), i.e., equation (8), was considered. tcalc. which was required to get to the degree of cure X(t) was calculated from equation (8). texp. was obtained through experimental results. tcalc. is the time necessary to get X(t) on the assumption that the rate of network formation is not influenced by disturbing the segmental mobility of the main chains containing functional groups. Therefore, the time necessary to get to X(t) shifted from tcalc. to texp. by a decrease in segmental mobility caused by growth of the network structure. The values of X, tcalc., texp., and texp./tcalc. are tabulated in *Table* 4. According to the concept previously mentioned, there may be some relationship between X and texp./tcalc. Next, we tried to get some empirical equation for the relation between X and texp./tcalc. As a result, we obtained the empirical equation (9) which expresses the relationship between X and texp./tcalc. shown in *Figure* 6.

$$\ln(\ln(texp./tcalc.)) = c \ln X + d \quad (9)$$

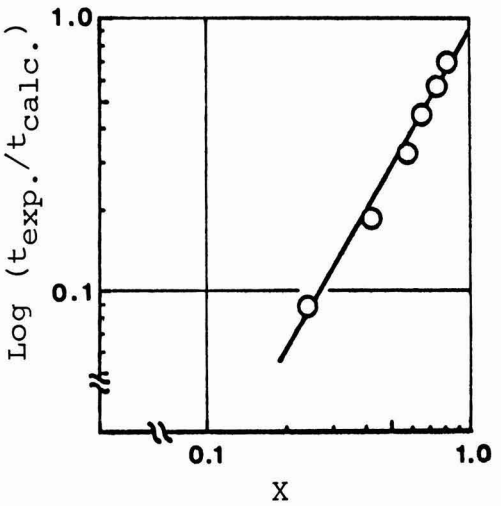


Figure 6—Log-log ($t_{exp.}/t_{calc.}$) ~ log X plots

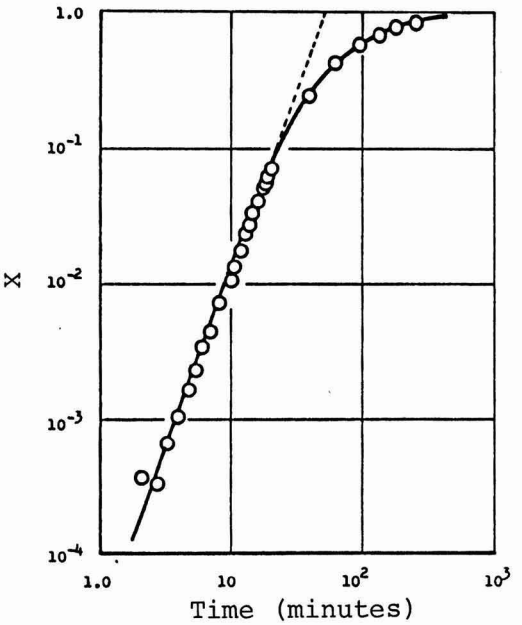


Figure 7—X ~ t plots. (_____), calculated from the following equation: $\ln t = 0.3864 \ln X + 2.051 X^{1.703} + 4.034$; (O), values obtained from the experiment

where both c and d are constant. In this sample, c was .703 and d was 0.7181.

Explanation of Curing Process

Equation (10) was derived from equations (6) and (9).

$$\begin{aligned} c\ln X + d &= \ln(\ln(texp./tcalc.)) \\ &= \ln(\ln(texp./X^{1-m}/(1-m)k)) \\ &= \ln(\ln((1-m)k\cdot texp.) - \ln X^{1-m}) \end{aligned} \quad (10)$$

Then, we obtained the following equation:

$$(1-m)\ln X + \exp(c\ln X + d) = \ln((1-m)k texp.) \quad (11)$$

Equation (11) was derived from equation (6′) adding the modification term, $\exp(c\ln X + d)$. And $(c\ln X + d)$ was a term defined in equation (9). Then equation (12) was obtained by simplifying equation (11).

$$(1-m)\ln X + \ln(texp./tcalc.) = \ln((1-m)kt) \quad (12)$$

i.e.

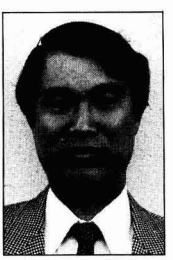
$$X^{1-m} = k\cdot(tcalc./texp.)\cdot(1-m)t \quad (12')$$

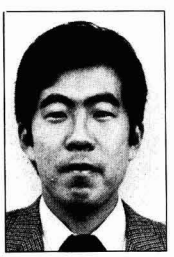
Comparing equation (12) with equation (6), the rate constant k in the equation (6) was a function of degree of cure X which becomes smaller as the formation of network proceeds, i.e., as X increases. From the definition of tcalc. and texp., the curing rate constant at a degree of cure X(t) changed from k to kx (tcalc./texp.). This correction term gives the decrease of probability of collision between functional groups contained with main chain segments due to a decrease of segmental mobility. Based on the law of Hagen-Poiseulle, equation (13) is meaningful in the relationship between viscosity (η) of system and the time necessary to move a distance in the systems of different viscosities.

$$t_1/t_2 = \eta_1/\eta_2 \quad (13)$$

In a polymerization system, Bueche gives equation (14) at

TAKAHARU IZUMO is a staff chemist in the Industrial Coatings Div. of Nippon Paint Co. Ltd. in Neyagawa, Japan. He received his Masters Degree in Chemistry from Kobe University in 1969 and joined the company the same year. His research background covers a variety of disciplines. He has worked on dynamic viscoelastic properties, internal stress and strain of coated films, and curing mechanisms of thermosetting resins.





SATOSHI YAMAMOTO is a co-researcher at Nippon Paint Co. Ltd., Neyagawa, Japan. He received the Bachelor Degree in Chemistry from Kyoto University in 1975 and joined Nippon Paint in 1976. His major interests are mechanical properties of paint films and rheological properties of polymer liquids.

isothermal conditions and at the same degree of polymerization.[8]

$$D \times \eta = \text{constant} \tag{14}$$

where, D is diffusion coefficient and η is viscosity. So, equation (15) is derived approximately.

$$\begin{aligned} \text{tcalc.}/\text{texp.} &= \eta\text{calc.}/\eta\text{exp.} \\ &= \text{Dexp.}/\text{Dcalc.} \end{aligned} \tag{15}$$

Then (tcalc./texp.) in equation (15) is a term showing that the segmental mobility in the main chain, i.e., the faculty of diffusion of segment or hardner, decreased from Dcalc. to Dexp. From equation (9), equation (16) was derived as follows:

$$\begin{aligned} \ln(\ln(\text{texp.}/\text{tcalc.})) &= c \ln X + d \\ \ln(\text{texp.}/\text{tcalc.}) &= d' \cdot X^c \end{aligned}$$

i.e.

$$\text{texp.}/\text{tcalc.} = \exp(d' \cdot X^c) \tag{16}$$

where d′ is exp(d).

From the definition of a rate constant in Arrhenius type, equation (17) can be obtained.

$$k = ko \cdot \exp(-\Delta Ea/RT) \tag{17}$$

where ΔEa is the apparent activation energy for the reaction and T is absolute temperature. Considering equations (12′), (16), and (17), we can obtain equation (18) containing k values defined as a function with degree of cure X.

$$X^{1-m}/(1-m) = k(X)t \tag{18}$$

where

$$k(X) = ko\exp(-d' \cdot X^c) \exp(-\Delta Ea/RT) \tag{19}$$

Comparison of the Calculated Results With the Experimental Results

The efficiency of equation (18) was examined by comparing the curve line obtained from equation (18) with empirical values. Equation (18) could be rewritten as equation (18′), that is, equation (19).

$$X^{1-m}/(1-m) = k \exp(-d' \cdot X^c)t \tag{18′}$$

$$\ln t = (1-m)\ln X + d' \cdot X^c - \ln((1-m)k) \tag{19}$$

In this system, m = 0.6136, k = 0.0458, c = 1.703, d = 0.7181, and d′ = exp(d) = 2.051, respectively. Then equation (19) becomes equation (19′).

$$\ln t = 0.3864 \ln X + 2.051X^{1.703} + 4.034 \tag{19′}$$

Figure 7 shows the curve line obtained from equation (19′) and points obtained from empirical results. As is evident from *Figure* 7, calculated values agree well with the empirical values.

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How Productive Is Your Paint Plant?

A Measure of Productivity for the Paint Industry

Robert Kennedy
Inmont Canada, Inc.*

There is an urgent need in the paint industry to establish a common method for measuring productivity. This article describes a simple mathematical model which has been formulated to more accurately determine the production output of a paint plant. The equation employs three important variables: product processing difficulty; batch size; and container size. The resultant formula is called the "Outputivity Index," with 100 as the optimum performance. This index more accurately determines productivity than the existing industry standard of gallons per manhour.

Introduction

Productivity improvements come only as a direct result of managerial actions. In fact, improving productivity is the specific job of management.

It is imperative, therefore, that every manager refocus attention on the primary role as the "raiser" of productivity. In recognition of this, there is a great need to establish, for the paint industry, a common method of how to measure productivity.

There is absolutely no question that the primary resource of the paint industry is "Raw Materials" as they account for approximately 55% of the sales dollar in Canada.

It is, therefore, most important to continually focus on methods to decrease material cost as this has the highest single impact on overall productivity improvement.

The "measure" of productivity in this article will deal specifically with the output of those employees employed in the production process. It will allow a productive comparison to be made between one paint manufacturing facility and another, irrespective of the country of location.

What Is 'Productivity'

The word "productivity" is part of everyone's vocabulary, and most people have an idea of what it means. However, few know how to measure it and most companies do not even try.

Productivity can be defined in many ways. A general definition is: "The effective use of all the resources of a business, and productivity ratios as a measure of the effectiveness of using all the resources applied to the business."

Another definition related to value is: "A measure of the spread achieved between the cost of resources employed and

Table 1—Factorization Tables

Variable	1	2	3	4	5	6	7	8	9
Product Process Difficulty	Single Solvent	Blend of Solvents	Clear Solutions Coarse Disperation (40 + Mu) Metallics-Untinted	Dispersions (20 + Mu)	Fine Dispersions-Untinted	Fine Dispersions-Tinted	Fine Dispersions-Tinted-High Quality		Multi-Colored Finish
Batch Size—									
Liters		36,300	18,100	4,500	2,270		900		
Imperial Gallons		8,000	4,000	1,000	500		200		
U.S. Gallons		9,590	4,782	1,190	600		238		
Container Size—									
Liters	Tank-Wagon	Totes	204.57	22.73	4.546		1.1365	0.568	
Imperial Gallons			45	5	1		1/4	1/8	
U.S. Gallons			55	5	1		1/4	1/8	

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*10 Craig St., P.O. Box 100, Brantford, Ont., N3T 5M3 Canada.

Table 2—Production Output

Plant Location: **Month:**

Production Code	Sales Code	Batch Number	Batch Size	Actual Fill	Total Filled	P.P.D.	B.S.	C.S.	R.K.f	Production Output

the economic value of the goods produced by those resources; a measure of how effectively it minimizes relative value-added."

The classic economic formula for measuring total productivity under any business conditions is:

$$Pn = \frac{\Sigma(CnOn)}{\Sigma(CnIn)} \times \frac{\Sigma(Colo)}{\Sigma(CoOo)} \times 100$$

Where: Pn = Total productivity of the unit in period n
Σ = Summation sign
Co = Costs or prices in base period
Cn = Costs or prices in period n
Io = Quantity of resources used in base period
In = Quantity of resources used in period n
Oo = Output in base period
On = Output in period n

This formula has many complexities when relating it to the paint industry.

The most common method of measuring productivity in the paint industry has been to divide the volume output (gallons or liters) by the number of labor hours employed. This simple method only serves as a guide; it does not consider many important variables, such as product composition.

Another more accurate method is to establish by time and methods study the standard machine, equipment, and labor time to produce every product within the product mix. Standard times are determined for each of the processes employed. This method is quite tedious and requires at least one full time methods person. Although accurate costs can be developed, this method cannot be used to compare the efficiency of one plant versus another.

Some "Productivity Ratios" commonly used by the industry are:

$$\text{Material Productivity} = \frac{\text{Customer Sales}}{\text{Material Cost}}$$

$$\text{Total Manpower Productivity} = \frac{\text{Customer Sales}}{\text{Total Salaries, Wages \& Benefits Paid}}$$

$$\text{Manufacturing M.P.} = \frac{\text{Customer Sales}}{\text{Manufacturing Labor Paid}}$$

$$\text{Technical M.P.} = \frac{\text{Customer Sales}}{\text{Technical Labor Paid}}$$

$$\text{Marketing M.P.} = \frac{\text{Customer Sales}}{\text{Sales/Marketing Labor Paid}}$$

$$\text{Administration M.P.} = \frac{\text{Customer Sales}}{\text{Administration Labor Paid}}$$

$$\text{Energy Productivity} = \frac{\text{Customer Sales}}{\text{Total Energy Cost}}$$

$$\text{Turnover of Production Inventory} = \frac{\text{Total Cost of Shipments}}{\text{Gross Inventory}}$$

$$\text{Turnover of Receivables} = \frac{\text{Customer Sales}}{\text{Net Receivables}}$$

In attempting to formulate a simple mathematical model to more accurately show and measure production efficiency, a common unit has to be determined.

A Common Model

The current volume unit whether it be gallons or liters is not an equal unit for obvious reasons, and certainly a weight unit as used in some countries is not equal either. To determine what this unit should be, the most important variables in the manufacture of paint were used to factorize and evolve a common denominator.

Three variables were employed:

(1) Product Composition and its Production Process.
(2) Size of Batch (or Lot) Produced.
(3) Type and Size of Container Filled.

The factor evolved from these three variables is known as the R.K. factor.

The R.K.f has been designed to produce a factor of 1.0 for a white enamel paint produced in a batch size of 4,500 liters, dispersed to particle size of 12.5 microns (7 Hegman scale) and filled in 4.5 liter cans.

The ideal production time for the control was determined under perfect conditions and is used as the efficiency standard. The standard production rate was calculated as follows:

Batch
size: 4,500 liters
Product: White Enamel, Finely Dispersed (10 M_u) Untinted
Container
size: 4.546 liters, packaged two per carton

R.K. factor:

$$\frac{(\text{P.P.D.})\ 5 \times (\text{B.S.})\ 4 \times (\text{C.S.})\ 5}{100} = 1.0$$

Ideal production time in labor minutes:

Pre-Batch and mix—	215	Minutes
Dispersion (sand mill)—	160	"
Let-down—	35	"
Sample—	10	"
Fill set-up—	120	"
Fill & package—	480	"
Clean-up—	120	"
	1,140 Min	= 19 Hr

Production output = Volume × R.K.f
= 4,500 × 1 = 4,500 Units

Optimum output per labor hour $= \frac{4{,}500}{19} = 236.84$

Efficiency constant $= \frac{k \times 100}{236.84}$

Therefore, k = 2.3684

An R.K.f of less than 1.0 simply means that the product produced and filled required less labor hours than the control standard White Enamel. The converse of this would be for an R.K.f of greater than 1.0.

The three variables are described as:
(1) P.P.D—Product process difficulty
(2) B.S.—Batch size
(3) C.S.—Container size

A factor of 1 to 9 has been assigned to each category within the three variables. An ascending value of the variable denotes a greater degree of production difficulty and produces a higher R.K. factor. The actual value of the factors was determined by experimentation, this produced the factorization table shown as *Table* 1.

The production output is the actual units produced in liters corrected by the R.K. factor.

Table 3—Outputivity

Plant Location: _____ Month: _____

Production Output =
Direct Labor Man Hours =
k factor = 2.3684

Outputivity for month of _____ $= \frac{\text{Production Output}}{\text{Direct Labor Hours} \times k}$

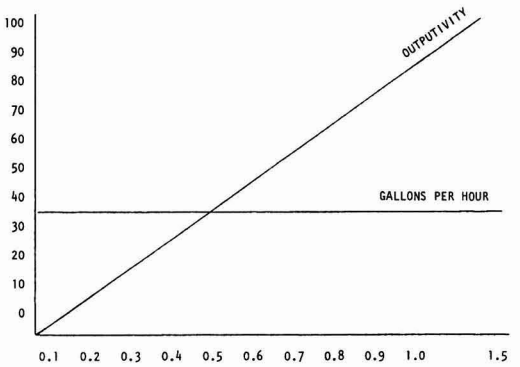
$= \frac{\quad}{\times\ 2.3684}$

$=$ _____

Outputivity by Month

January		July	
February		August	
March		September	
April		October	
May		November	
June		December	

Table 4—Gallons/Hour Versus Outputivity



Direct Labor Hours	R.K. f	Gallons Produced	Liters Produced	Gallons Per Hour	Production Output	Outputivity
4091	0.1	140,000	636,440	34.22	63,644	6.57
4091	0.2	140,000	636,440	34.22	127,288	13.14
4091	0.3	140,000	636,440	34.22	190,932	19.71
4091	0.4	140,000	636,440	34.22	254,576	26.27
4091	0.5	140,000	636,440	34.22	318,220	32.84
4091	0.6	140,000	636,440	34.22	381,864	39.41
4091	0.7	140,000	636,440	34.22	445,508	45.98
4091	0.8	140,000	636,440	34.22	509,152	52.55
4091	0.9	140,000	636,440	34.22	572,796	59.12
4091	1.0	140,000	636,440	34.22	636,440	65.69
4091	1.5	140,000	636,440	34.22	954,660	98.53

Table 5—Productivity Scale

Outputivity	Effective Liters Per Hour	Effective Imp. Gallons/Hour	Effective U.S. Gallons/Hour
100	236.8	52.1	62.6
95	224.9	49.5	59.4
90	213.1	46.9	56.3
85	201.3	44.3	53.2
80	189.4	41.7	50.1
75	177.6	39.1	47.0
70	165.7	36.5	43.8
65	153.9	33.9	40.7
60	142.1	31.3	37.6
55	130.2	28.6	34.3
50	118.4	26.0	31.2
45	106.5	23.4	28.1
40	94.7	20.8	25.0
35	82.9	18.2	21.9
30	71.0	15.6	18.7
25	59.2	13.0	15.6
20	47.4	10.4	12.5
15	35.5	7.8	9.4
10	23.7	5.2	6.2
5	11.8	2.6	3.1

To calculate the "Outputivity" the efficiency constant k is used to produce an optimum value of 100. k is equal to 2.3684 and is derived as shown previously.

$$\text{R.K.f} = \frac{\text{P.P.D.} \times \text{B.S.} \times \text{C.S.}}{100}$$

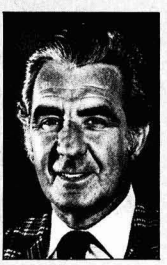
$$\text{Production Output} = \text{Actual Volume} \times \text{R.K.f}$$

$$\text{Outputivity} = \frac{\text{Production Output}}{\text{Direct Labor Man Hours} \times \text{k}}$$

Where:

P.P.D. = Product Process Difficulty
B.S. = Batch Size
C.S. = Container Size (Filled)
Volume = Liters
k = Efficiency Constant = 2.3684

ROBERT KENNEDY is Operation Manager of the Automotive Chemical Coatings Div. and Vice-President and Director of the Presstite Div., both of Inmont Canada, Brantford, Ont. He was graduated from the University of Strathclyde in Glascow, Scotland, and immigrated to Canada in 1957. He is Chairman of the Occupational Health and Safety Committee of the Canadian Paint & Coatings Association and is a Past-President of the Ontario Paint Association. He is also a member of the Toronto Society.



The resultant measure of productivity by this method for the paint industry will be referred to as the *"Outputivity"*.

The monthly "Production Output" is calculated on the form shown in *Table* 2.

The Outputivity for a given month can be recorded as shown in *Table* 3.

As the "Outputivity" is an index with 100 as the optimum performance, it is now possible to compare one paint plant's productivity versus another. As can be seen from the factorization table, the emphasis of this measure is for an "industrial" type manufacturer rather than a "trade sales" producer.

A comparison of gallons per hour versus Outputivity level at various R.K. factors (*Table* 4) shows that at constant gallons per man hour the Outputivity level can vary greatly depending on the variables of product type, batch, and container sizes. The higher the R.K.f at constant labor hours and volume produces a higher productivity level.

The Outputivity level as compared to the effective volume per man hour produced is shown in *Table* 5.

The effective volume relates to the standard production unit which was a White Enamel produced at a batch size of 4,500 liters and filled in 4.5 liter cans.

After determining your Outputivity Index over a period of at least six months, compare your rating to the following efficiency table and find out—

"How Productive Your Paint Plant Is"

Outputivity	Efficiency
100	Utopia
50+	Excellent
40	Very Good
30	Good
25	Fair
20	Poor

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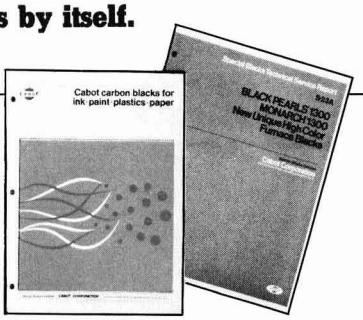

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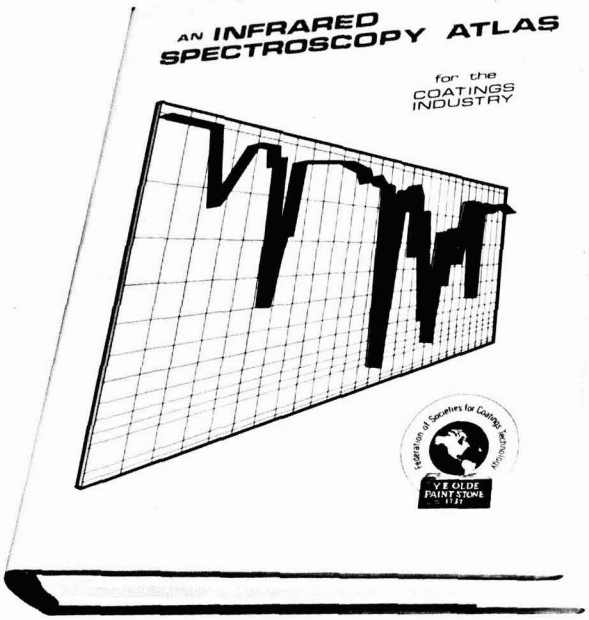

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Society Meetings

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"Awards Night"

Howard Sholl, a Past President of both the Federation and the Society, served as Master of Ceremonies.

Honored guests included Federation Executive Vice-President Frank Borrelle and NPCA Executive Director Larry Thomas.

This year's scholarship recipients were introduced. They are: Deborah Allison, daughter of Gordon Allison, who is majoring in Biology at the University of Maryland; and John Takming Hom, son of Frank K.T. Hom, who is majoring in Chemical Engineering at Johns Hopkins.

Merit Citations were presented to: Tom Mitchell, of Nuodex, Inc.; Richard DiMarcantonio, of Bruning Paint Co.; Carl Minchew, of Benjamin Moore; Don Engdahl, of Union Carbide Corp.; and Joe Giusto, of Lenmar, Inc.

Calvin C. Tatman, of SCM Pigments, presented Gordon Allison, of McCormick Paint Works, with the Herman Shuger Memorial Award.

Mr. Allison presented Mr. Sholl with a plaque for his continued service and leadership to the industry.

FRANK H. GERHARDT, *Secretary*

1983-84 Officers of the Birmingham Club. (Front row, left to right): Secretary—Don Clement; Immediate Past-President—Ray B. Tennant; President—Harry J. Griffiths; Treasurer—Stan V. Brettell; and Roy Arnold. (Back row): Roy Ingleston; David Heath; Ron Jukes; John Hitchin; Brian Addenbrooke; and Gerry Gough. Not shown are Vice-President—Roland Staples and Society Representative—David Lovegrove

BALTIMORE (Virginia Section) ..... NOV.

"Polymeric Thickeners For Latex Paints"

Dr. Robert Washburne, of Rohm and Haas Co., presented "IMPROVED POLYMERIC THICKENERS FOR LATEX PAINTS."

The properties of new second generation polymeric thickeners were described as providing functional thickening of latex paints by a combination of an associative mechanism in addition to the usual alkali swelling mechanism, which provides excellent cost efficiency. Comparisons of handling properties, thickening efficiency, effects on high and low shear rheology, and resistance to microbial growth were made between the subject polymeric thickeners and standard HEC thickeners in flat latex paints. The need for proper neutralization of the acidic polymeric thickener, with emphasis on the necessity of early addition of a base to reduce pigment flocculation possibilities was emphasized. The newer polymeric thickener was described by Dr. Washburne as not imparting as desirable properties to semi-gloss latex paints as older polymeric rheology modifiers.

MICHAEL J. BECKER, *Secretary*

HOUSTON ..... NOV.

"Evaporation During Sprayout Of a Typical Water-Reducible Paint"

Society Representative Willy C.P. Busch reported on the Annual Meeting in Montreal.

Technical Committee Chairman Loren Odell pointed out that the committee's work on a paper is progressing. He also mentioned that he continues to be an active part of ASTM and is currently involved with coatings in D-1, D-33, and G-3.

Mark Dante, Educational Committee Chairman, reported that scholarships will be available for the coming academic year. He urged all members to encourage their children to apply for these scholarships.

Dr. Albert Rocklin, of Shell Development Co., discussed "EVAPORATION DURING SPRAYOUT OF A TYPICAL WATER-REDUCIBLE PAINT AT VARIOUS HUMIDITIES."

Dr. Rocklin pointed out that the viscosity curve of a diluted water-reducible system is not a straight-line function and that in order to predict the paint solvent balance, it was necessary to know the degree of evaporation. He also mentioned that humidity can upset the calculations.

Dr. Rocklin then related how the experimental phase of his work included the collection of paint spray and analysis of that spray for solvent balance and degree of evaporation. Again, he stated that the solvent balance and degree of evaporation were dependent on the relative humidity and temperature of the system.

At fixed pressures and relative humidity, evaporation loss is dependent on the delivery rate which also affects the solvent balance, said Dr. Rocklin. In addition, when the degree of evaporation is known, the solvent balance can be calculated and the degree of evaporation can be predicted under normal spraygun operations.

In conclusion, Dr. Rocklin said that the domino effect would affect all data accumulated. This domino effect would include: (1) erratic spraygun operation; (2) degree of evaporation; (3) solvent balance; (4) rheology; (5) film quality; and (6) dollars.

Dr. Rocklin stated that the most effective counter-measures were to choose tolerant cosolvents.

Q. How did you thicken the solvents for some of your analytical data?

A. We used 1% methocel for thickening.

ARTHUR R. MCDERMOTT, *Secretary*

1983-84 Officers of the Houston Society. (Seated, left to right): Treasurer—Rudolf Burl; President—Donald Montgomery; and Vice-President—Richard Batchelor. (Standing): Secretary—Arthur McDermott; and Society Representative—Willy C.P. Busch

KANSAS CITY ..... NOV.

"Committee Report"

President Gene Wayenberg announced that the Society had tied for third prize for the A.F. Voss/American Paint & Coatings Journal Award. One hundred dollars was awarded to the Technical Society for its presentation, "Performance Comparison of Exterior Flat Finishes on Hardboard Siding." Also, Roger Haines, of Farmland Industries, Inc., was awarded first prize of $100 in the Program Committee Awards competition.

President Wayenberg announced the Society's intent to nominate J.C. Leslie for Federation Honorary Membership.

Technical Committee Chairman Roger Haines reported that he had presented the Technical Paper and Slide slow to the Technical Committee of the American Hardboard Association.

DENNIS MATHES, *Secretary*

LOS ANGELES ..... OCT.

"Use of Diatomite in Coatings"

A moment of silence was observed for Fred Mooney and Mrs. Clarence Nelson who recently died.

Michael Gildon, of Guardsman Chemicals, Inc., was presented with a $50 check for winning second prize in the Ernest T. Trigg Awards competition. Mr. Gildon, Society Secretary, was honored for his reports of Society meetings and discussions following the presentation of papers at those meetings.

Also, Dodwell DeSilva, of Lawson Chemical Products Co., was presented with the A.F. Voss/American Paint & Coatings Journal Award. As Chairman of the Technical Committee, Mr. DeSilva accepted the first prize (tie) of $150 for the committee's presentation, "Water-Based Aerosols."

"USE OF DIATOMITE IN COATINGS" was presented by Thomas E. Remmers, of Manville Corp.

Mr. Remmers described diatomite or diatomaceous earth as the skeletal remains of single celled aquatic plants. These plants extract silica from the water which is retained in their skeleton when they die.

Commercially, deposits are found in abundance in California and Nevada—these deposits are generally 15 million years old. This product is obtained by a surface mining operation. The diatoms are then sent for milling and development of three basic classifications: natural, calcined, and flux calcined.

The coatings industry uses the natural and flux calcined products primarily; the calcined product has an objectionable pinkish color. As this product is milled, it is not reduced in particle size by crushing but by the attrition from high velocities of air that are constantly moving the material in the mill through the various stages of separation, classification, and bagging, explained Mr. Remmers.

Since diatomite is primarily used for flattening and reducing gloss and sheen uniformly, it becomes necessary to classify it according to its physical and chemical properties and its particle size distribution, said Mr. Remmers. As diatomite particles fall under four microns, they do not contribute to flattening and the oil absorption lowers and becomes less efficient. Therefore, care in incorporating diatomite is important, for instance, dispersion equipment is preferred to milling (sand or pebble mill) equipment for effective incorporation.

Mr. Remmers discussed diatomite in comparison to micronized talc. He said that its usage is universally acceptable in trade sales and industrial applications (i.e. PVA emulsions, alkyd flat enamels, semi-glosses, coil coatings, clears and traffic paints). Its contribution characteristics relate to settling, abrasion resistance, and burnish resistance, along with its primary function as a flattening agent.

Q. Have there been any studies of the affects upon other film properties, specifically hardness and adhesion?

A. Specifically, I do not know of anyone in the industry who has done any real work in film properties. In regards to adhesion to the substrate, ¼ to 1/3 lb. addition is correct in most cases. I do not recall any notation not to use this product in regards to adhesion. Hardness should not be affected one way or the other by diatomaceous clay. But remember, hardness is a function of all the pigments and binder that are used to form your film.

HENRY J. KIRSCH, *Secretary*

LOS ANGELES ..... NOV.

"Organo Clays For High Performance Coatings"

Honored guest attending the meeting was Kathy Penprase, of the City of Commerce Library.

Mrs. Penprase noted that the Library offers some excellent literature and outstanding services to the Los Angeles Society. Through financial assistance of the Society and their technical advisement, the Library has amassed an outstanding collection of books, journals, indices (specific to paint technology and to

general scientific needs), and technical encyclopedias. Mrs. Penprase stated that librarians would assist in locating information over the phone and mail photocopies of specific articles. A published bibliography is presented yearly and will be issued to members, she said.

Educational Committee Chairman, James Hall, presented the Savings Bond Award to Scott Shier, who graduated as top student from the Paint Technology course.

Other announcements made by President Haanstra included:

Mr. & Mrs. Edwin Burling made a donation to the Scholarship Fund in memory of Bill Gerhardt.

An architectural task force meeting will be held in November in Ontario to discuss Rule 1113. Environmental hearings, relevant to the California Drum Reconditioners Task Force, will be held in Sacramento in December. Also, in November, at the El Monte office of SCAMQD, there will be a public hearing regarding a progress report on the Regulatory Reform Task Force.

A question was raised as to whether or not the LASCT was going to evaluate or have any special plans to implement any Society sponsored functions during the 1984 Summer Olympics. It was noted that several local companies will have various functions for customers and principals during the Summer games.

"NEW SUPER DISPERSIBLE ORGANO CLAYS FOR HIGH PERFORMANCE COATINGS" was presented by Alfred J. Whitton, of NL Industries, Inc.

According to Mr. Whitton, the advances in rheological additives are keeping pace with the coatings industry through the development of super dispersible organo clays. This new generation of product technology incorporates ease of dispersion, gelling, wetting, and increased manufacturing process.

Previous to this time, high performance systems such as: epoxies, vinyls, acrylics, alkyd melamines, inorganic zinc rich, polysulfides, adhesives, patch compounds, polyesters, ethyl silicales, and urethanes, predominantely utilized pre-gelled organo clays in solvents to obtain consistent viscosity, sag control, and pigment suspension. With the new technology offered today, simple dry addition of these super dispersible organo clays, at any point in the manufacturing process, will result in excellent coatings quality and consistency stated Mr. Whitton.

Mr. Whitton graphically depicted what has been learned about the chemistry and physics of the new generation of organo clays as compared to the previous conventional organo clay additives. Various levels of usage and dispersion techniques and characteristics in high performance coatings were explained. He further compared ease of incorporation, rheological properties, application and film properties with the present industry benchmarks—conventional organo clays and pyrogenic silica.

Q. Is the super organo clay as effective with anti-settling as well as anti-sagging?

A. The super dispersible is just as efficient and depends on what you are replacing. If you are using a conventional organo clay, it will match the conventional organo clay. If you are substituting a castrol derived organic additive, the organo clay provides a different rheological behavior. It will have a tendency to be less thixotrophic than organics and provide less yield value for anti-settling, sag resistance, flow, and leveling. When you replace a conventional organo clay, the super dispersible will match the anti-sag and settling properties.

Q. How do the anti-sag properties work in high solids air dry at 2-3 mils?

A. Our work in high solids has been limited; however, customer evaluations generally indicate positive results on thermo sag resistance with the super

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dispersible organo clay. I do not believe that you will get the anti-settling or anti-sag properties at 2–3 mils because organo clays are not as suited to high build properties as other rheological additives; however, customers indicate excellence in thermo sag resistance on stoving or baking enamels.

Q. Have you evaluated color (yellowness) on aging for these new additives?

A. We have looked at the color development and found that it matches the conventional organo clays, regardless of the type of organo clay used. If you use high levels, about 10 lbs. per 100 gallons, some slight yellowing will occur in the can and in drawdowns. The super dispersible will be no worse than the conventional. Therefore, if you are experiencing a yellowing problem due to high levels of organo clay incorporation, the super dispersible will give you no worse results.

Q. How about moisture content? Can SD-2 be used in two component urethanes without bubbling problems?

A. The super dispersibles have been evaluated in zinc rich systems and do not exhibit any hydrogen generation. We do not have any evaluation directly in two component urethanes, but generally the stability performance noted in zinc rich systems may carry over to urethanes.

Q. How well do the organo clays hold up to acid rain?

A. That you will have to find out for yourself. We have not done any work in that area, so I really cannot answer the question. If you are using the conventional type and they are performing, super dispersibles will do the same.

Q. Which product is best in an aliphatic and alcohol solvent blend such as used in exempt alkyds?

A. If the system contains 80% aliphatic and 20% of the highly polar type solvent, you will use the Super Dispersible #1 product; if the majority of the solvent was alcohol, you would use Super Dispersible #2. Our studies suggest usage of the Super Dispersible #1 product in aliphatics up to 80%, as long as a highly polar solvent is no more than 20%. The reverse is also true for the Super Dispersible #2, if 80% of the solvent is highly polar or moderately polar and only 20% is aliphatic, then it is correct to use the Super Dispersible #2 product.

Q. Is there a preferred identity for the R groups on the quanternary ammonium compound to produce these organo clays?

A. Yes, there is a very specific type and number and that is what took us eight years. It is very difficult to determine which R groups would accomplish specific properties. For instance, certain groups spread the platelets too far apart to readily break apart and, hence we would not achieve the efficiency required. Other groups would not spread the platelets far enough apart, therefore requiring a polar activator.

Q. Could you characterize the effect on gloss of these organo clays?

A. Since the super dispersible products require less shear to activate, you can generally get away with slightly less than with conventional organo clays. Since you are not introducing an activator and you will use less product, you will generally achieve 3–5° better gloss. Even though you do not expect a significant gloss improvement, we have noted greater gloss improvement with Super Dispersible #2, than has been noted with Super Dispersible #1.

Q. Will these products work in water systems?

A. No they will not. The products I discussed this evening are specifically designed to work in solvent systems.

HENRY J. KIRSCH, *Secretary*

LOUISVILLE..... NOV.

"Prevention of Spoilage In Latex Paints"

M. Joyce Specht, of the Spring Symposium Committee, commended committee members for preparing the symposium, "The Environment: Where We Are and Where We're Going," which will be held on April 18, at the Marriott Inn, Clarksville, IN.

Bill Woods, of Nuodex, Inc., spoke on the "PREVENTION OF SPOILAGE IN LATEX PAINTS."

Mr. Woods reviewed the factors involved in latex paints spoilage and the necessary plant practices which minimize contamination and avoid spoilage. Sources of microbial contamination and methods for the prevention of spoilage of latex paint were discussed.

M. JOYCE SPECHT, *Secretary*

NEW YORK..... OCT.

"Safety in the Paint Plant"

Gil Cain, Consultant, presented a talk entitled, "SAFETY IN THE PAINT PLANT."

The principles of solvent concentration and flash fires were discussed. Mr. Cane explained static electricity and pointed out different examples of possible causes of fire.

According to Mr. Cain, the best possible preventive action one can take is to spend at least one hour a week to review the plant and to look for possible potential problems.

RAYMOND P. GANGI, *Secretary*

NEW YORK..... NOV.

"Application of Water-Borne Industrial Finishes"

Richard Benton, of Spencer-Kellogg Div., Textron, Inc., discussed "APPLICATION OF WATER-BORNE INDUSTRIAL FINISHES."

A review of the benefits of water-borne systems was given by Mr. Benton. He discussed dip, flowcoat, air spray, airless spray, and electrostatic spray parameters.

Mr. Benton explained specific resin types and formulating techniques.

RAYMOND P. GANGI, *Secretary*

PHILADELPHIA..... NOV.

"Changing Technologies For Industrial Coatings"

R.H. Hong, of Spencer-Kellogg Div., Textron, Inc., discussed "CHANGING TECHNOLOGIES FOR INDUSTRIAL COATINGS."

Mr. Hong discussed the results of a survey conducted by Spencer Kellogg. Their purpose was to try and determine which new products will be beneficial to meet industry's needs for the future. Over 2000 questionnaires were sent nationwide to manufacturers of industrial coatings. Response was excellent. Questions asked concerned compliance coatings status; which technology will be used in future coatings; which polymer will be preferred for water-borne and high solids; coatings for plastics.

Mr. Hong explained limitations and potential problem areas for water-borne and high solids coatings as well as for problems facing the industry.

High solids resins were discussed as well as recent developments in resin technology to produce lower VOC high solids industrial coatings. Among the resins were polyester, epoxy, urethane, alkyds (bake & air dry).

Q. What is a compliance coating?

A. The VOC limits for various types of coatings. The VOC limit is set by EPA.

Q. What was the date of the survey?

A. April to May 1982.

WILLIAM GEORGOV, *Secretary*

PIEDMONT..... NOV.

"Emulsion Polymerization Technology"

Dr. Ben Kine, of Rohm & Haas Co., spoke on "EMULSION POLYMERIZATION TECHNOLOGY."

Dr. Kine stated that emulsion polymerization (polymeric dispersions), a widely growing system in industry, is composed of (1) a discontinuous phase (polymers), (2) a continuous phase (water),

and (3) a surface activated phase (soap). The soap keeps the discontinuous phase dispersed by adsorption.

The process of emulsion polymerization begins with the addition of a soap to water. Soaps have the property of micelle formation due to their hydrophobic tail and hydrophilic head, explained Dr. Kine. The addition of soap to water reduces the surface tension of water until an equilibrium is established at the air/water interface with the excess soap forming micelles. The hydrophobic tails orient towards each other forming a cylindrical structure. When monomer is added to the soap/water mixture, the soap micelles swell with monomer units because of the hydrophobic nature of monomers. Excess monomer forms droplets that are stabilized by the soap. Then the catalyst is added. The catalyst breaks into two radical fragments that break the double bond of monomer units. The radical fragment attached to the monomer fragment attacks another monomer unit and a chain is formed. This reaction continues until chain termination. These reactions are on/off reactions that vary in length from .1" to .001" with 1" to 10" between each reaction, said Dr. Kine.

The parameters necessary to produce a successful polymeric dispersion, micelle formation, particle growth, and droplet formation, can be determined by elaborate mathematical formulae and verified by observational experimentation. By varying the types of monomers used and technological applications, polymeric dispersions can have linear chains, branched chains, or cross-linked configurations, said Dr. Kine. The specific areas of use determine the type and particle size of polymeric emulsions.

Unlike the direct relationship of viscosity and molecular weight of solution polymers, the viscosity of emulsion polymers is determined by the particle size and solids content, Dr. Kine said.

Q. How many monomer molecules can fit in a single micelle.

A. The number of molecules will vary between 40 to 100 molecules.

MICHAEL S. DAVIS, *Secretary*

PITTSBURGH ..... NOV.

"New Methods in Coating Rheology"

Dr. Richard R. Eley, of Glidden Coatings and Resins Div., SCM Corp., spoke on "NEW METHODS IN COATING RHEOLOGY."

Rheology essentially is the science of flow, and since all coatings must flow during one or more phases of manufacture, application, film formation, and cure or dry, the study of this characteristic takes on great importance, said Dr. Eley. Still, the study of flow is not a simple matter. Consider pouring honey and molasses out of two separate funnels. Their flow rates are extremely different. However, their stirring characteristics are also vastly different, and not necessarily related to their flow characteristics, Dr. Eley explained.

The coatings industry has historically viewed rheology more as a quality control tool, than as an instrument of research, and consequently, single point viscosity measurements using simple viscometers, have been the rule. This is satisfactory if the test fluid is Newtonian in nature, however, most coatings are non-Newtonian, and may have to perform over a range of shear rates, encompassing as much as nine orders of magnitude, said Dr. Eley. Therefore, one needs multipoint measurements in order to know how a coating is going to perform under given flow conditions.

Several important rheology parameters were discussed. They were shear viscosity, which is the laminar sliding of particles; dynamic viscosity/elasticity, which is shear in an oscillatory fashion; normal stress; elongational stress; and surface dilational modulus, which is the interface between liquid and air. Furthermore, since analytical expressions for stress deformation relationships do not yet exist for complex systems such as coatings, it is necessary that a system be studied under experimental conditions, approximating those of actual use as

closely as possible. For example, one should not try to predict the performance of a system applied by airless spray (very high shear process) from an orifice cup visocity measurement (low shear rate experiment). With any given coating formula, you may experience a vastly varied flow characteristic within the application and cure cycle, stressed Dr. Eley. Comparing reverse roll coating with direct roll coating is a simple example of this.

In order to understand varying rheology conditions, one must first apply values to what is taking place within the flow process, said Dr. Eley. To measure shear stress, the force resisting shear value is divided by the area under shear. To measure the shear rate, the relative velocity of shearing planes is divided by the distance between the planes. To determine viscosity, Dynes per second is divided by centimeters squared (poise).

In most coatings firms, and in some development labs, single point viscosity measurements are used, such as the Stomer Gauge, the Gardner-Holdt Bubble Tube, orifice cups, and the falling ball measurement. Even on a strictly research basis, some single point measurement instruments are used, such as the Brookfield Synchro-Lectric and the Wells-Brookfield Coreplate. However, as previously mentioned, single point measurements can be misleading because you are never aware of just where you are in measurement taking. This is why it is important to measure and understand rheology at many different points, explained Dr. Eley.

At Glidden, between four and six very highly specialized instruments are used, and they allow for in-depth analysis. One such instrument is the Ferranti-Shirley, which will measure a flow curve, thereby providing a rheology profile, plus the measurement of the viscosity of cone shear, and also the step shear rate for materials with a thixotropic recovery rate, such as gel-coats. Dr. Eley explained that this machine also utilizes a microprocessor tie in, which provides detailed documentation, and also plots viscosity versus shear rates. A second useful instrument is a nameter oscillatory sphere viscometer. With this unit, a probe is placed into a fluid for constant reading, whereby the viscosity drag on the probe is measured. This instrument has proven to be very useful for measuring resin viscosity through a cook cycle, said Dr. Eley.

Another instrument is the high shear capillary rheometer, which measures viscosity versus shear rate, plus the critical Reynolds number, which is a measurement of turbulent flow. This provides a wider range of measurement than the Ferranti-Shirley.

Still another specialized instrument is the automated dynamic rheometer, which separates viscosity and elasticity measurements. This will measure the true recovery rate of materials, or their viscoelastic properties. This relates well to leveling in water systems as an example.

Dr. Eley mentioned additional measurements to consider in the science of flow, such as the extentional viscosity measurements, which relate to stress versus strain rates. These measurements can be very helpful in determining roller spatter and how to best reduce it. Another to be measured is the surface dilational modulus, which essentially is dynamic surface tension, and can be measured by deforming the surface under control conditions.

JOSEPH L. MASCIA, *Secretary*

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ROCKY MOUNTAIN ..... NOV.

"Organo Clays"

Fred Whitton, of NL Chemicals, spoke on "ORGANO CLAYS."

CARWIN BEARDALL, *Secretary*

ROCKY MOUNTAIN .....DEC.

"Surface Coating Regulations"

Society President Donald Shillingburg presented a special Past President's Award to Donald Bagge, 1982–83 President.

Jean Massa spoke on "SURFACE COATING REGULATIONS."

CARWIN BEARDALL, *Secretary*

SOUTHERN SOCIETY (Miami Section)..... NOV.

"Installation of Officers"

Kay Lutchko, of Acrylux Paint Manufacturing Co., was installed as 1983–84 President of the Miami Section of the Southern Society. She is the first woman to become president of a Southern Society section. Other officers installed were: Vice-President—William Lee; Secretary—Gwen McKirahan; and Treasurer—Earl Toner.

Charles Carr, of Rohm and Haas Co., spoke on market forecasts for coatings and described new resin technology.

GWEN MCKIRAHAN, *Secretary*

WESTERN NEW YORK... NOV.

"Formulating Parameters For Gloss Latex Paints"

Twenty-five year pins were presented to Dick Hong, John Kowalski (retired), Robert Price, and Mark Markoff, all of Spencer-Kellogg Div., Textron, Inc.

"FORMULATING PARAMETERS FOR GLOSS LATEX PAINTS" was presented by Charles Boyce, of Naiasan (National Starch & Chemical).

The parameters discussed by Mr. Boyce were: polymer, pigments, dispersants, surfactants, glycol levels, thickener levels, other additives. Mr. Boyce explained how each one of these parameters could affect properties such as gloss, hiding, durability, stability, color retention, wet edge, lap time, flow, etc. He also emphasized how molecular weights of the polymer can be a key property—dictating reactivity, hardness, strength, and degree of cure.

Next, Mr. Boyce discussed how the glass transition temperatures of the emulsion are important, from the standpoint of paint application, where the emulsion must be above Tg, while being applied to the surface, or adhesion will be lost.

Lastly, thickeners, coalescent aids, and glycols were discussed in terms of their ability to stay in the films and give deleterious effects. Mr. Boyce stressed that one must balance their value and concentration versus long term effects.

CHARLES TABBI, *Secretary*

Future Society Meetings

Baltimore

(Mar. 15)—SOCIAL COMMITTEE NIGHT.

(Apr. 19)—TECHNICAL STEERING COMMITTEE PROGRAM.

(May 17)—ANNUAL BUSINESS MEETING AND ELECTION OF OFFICERS.

(June)—JOINT OUTING WITH BPCA.

Birmingham

(Mar. 1)—"POWDER COATINGS MANUFACTURING METHODS PRESENT AND FUTURE"—E.W. Byerley, Byerley Machinery Sales.

(Apr. 5)—"SATURATED POLYESTER DEVELOPMENTS FOR THE INDUSTRIAL PAINT INDUSTRY"—B. Langdon, Dynomit U.K. Ltd.

(May 3)—"Trends in Automotive Finishes"—R. Hurn, Ford Motor Co. Ltd.

C-D-I-C

(Apr. 9)—"COATINGS DEFECTS—CAUSES AND ANALYSIS"—Dr. Clifford Schoff, PPG Industries, Inc.

Chicago

(Mar. 5)—"OVERVIEW AND CONCEPTUAL DESIGN OF A MODERN PAINT DEPARTMENT"—Thomas Daly, Ace Paint Div. "ILLINOIS ENVIRONMENTAL REGULATIONS AS THEY AFFECT COATINGS"—Karl Franson, Illinois E.P.A.

(Apr. 2)—"COLLOIDAL SILICA—A UNIQUE PIGMENT"—R. Thornton, Nalco Chemical Co. "ROLE OF ADDITIVES IN THE '80'S"—E. Antonucci, Drew Chemical Co.

(Apr. 27)—AWARDS NIGHT.

Cleveland

(Mar. 20)—Manufacturing Committee to sponsor Plant Tour.

(Apr. 16)—"WATER-BORNE MAINTENANCE COATINGS"—Speaker from Spencer-Kellogg Div., Textron, Inc.

(May 21)—Annual Meeting/Spouses' Night. "PAINT EXAMINATION TECHNIQUES UTILIZED IN THE FBI LABORATORY"—James E. Corby, Federal Bureau of Investigation.

Detroit

(May 15)—Joint Meeting with DPCA.

Golden Gate

(Mar. 14)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 18)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 16)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

Houston

(Mar. 14)—"POWDER HANDLING WITH THE AIR PALLET SEMI-BULK CONTAINER SYSTEM"—Charles S. Alack, Semi-Bulk Systems, Inc.

(Apr. 12-14)—Southwestern Paint Convention.

(May 9)—"CONTROL FOR THE MODERN PAINT PLANT"—James T. DeGroff, Applied Color Systems, Inc.

Kansas City

(Mar. 8)—Ladies' Night.

(Apr. 12)—"DISPOSAL OF HAZARDOUS COMBUSTIBLE WASTE"—Melvin C. Eifert and Joseph J. Durczynski, Systech Corp.

(June 8-9)—Joint Meeting of the Kansas City and St. Louis Societies.

Los Angeles

(Mar. 14)—PAST PRESIDENTS' NIGHT. "INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 11)—MANUFACTURING SEMINAR/BOSSES' NIGHT. "DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 9)—AWARDS NIGHT. "THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

(June 13)—ANNUAL MEETING/ELECTION OF OFFICERS. TECHNICAL COMMITTEE PROGRAM.

Montreal

(Mar. 7)—Technical Committee's Presentation, "COLOR ACCEPTANCE"—Steve Velente.

(Apr. 4)—"A PRACTICAL APPROACH TO UNDERSTANDING EMULSIONS"—P.J. McDonald, Reichhold Chemicals, Inc.

(May 2)—MANUFACTURING COMMITTEE'S PRESENTATION.

New York

(Mar. 13)—FEDERATION OFFICERS' VISIT.

(Apr. 10)—Subject to be announced.

(May 8)—PAVAC NIGHT.

Pacific Northwest

(Mar. 15)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 19)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 17)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

Philadelphia

(Mar. 8)—Michael Frantz, Daniel Products Co.—Topic to be announced.

(Apr. 6)—AWARDS NIGHT.

(May 10)—Speaker from Cargill, Inc.

Piedmont

(Mar. 21)—"PAINT EXAMINATION TECHNIQUES UTILIZED IN THE FBI LABORATORY"—James E. Corby, Federal Bureau of Investigation.

(Apr. 18)—"CURRENT USE AND TRENDS—ACCELERATED WEATHERING TESTS IN THE UNITED STATES"—R. Metsinger, Atlas Electric Devices Co.

(May 16)—"INERTING FOR SAFETY IN COATINGS PLANTS"—Kevin Donahue, Neutronics, Inc.

(June 20)—"COMPOSITE VS. SINGLE DISPERSANT IN COLORANTS AND COATINGS"—Elio Cohen, Daniel Products Co.

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Eudowood Gardens, Towson, MD; FRANK GERHARDT, Bruning Paint Co., 601 S. Haven St., Baltimore, MD 21224. Virginia Section—Fourth Wednesday, Ramada Inn-East, Williamsburg, VA).

BIRMINGHAM (First Thursday—Westbourne Suite, Botanical Gardens, Birmingham). D. H. CLEMENT, Holden Surface Ctgs. Ltd., Bordesley Green Rd., Birmingham B9 4TQ England.

CHICAGO (First Monday—meeting sites in various suburban locations). MARTIN F. BALOW, United Coatings, Inc., 3050 N. Rockwell Ave., Chicago, IL 60618.

C-D-I-C (Second Monday—Sept., Jan., Apr., June in Columbus; Oct., Dec., Mar., May in Cincinnati; Nov., Feb., in Dayton). BILL M. HOLLIFIELD, Perry & Derrick Co., Inc., P.O. Box 12049, Cincinnati, OH 45212.

CLEVELAND (Third Tuesday—meeting sites vary). SCOTT E. RICKERT, Case Western Reserve University, Cleveland, OH 44106.

DALLAS (Thursday following second Wednesday—Steak & Ale Restaurant). VAN G. FALCONE, Kuppers Co., 801 E. Lee St., Irving, TX 75060.

DETROIT (Fourth Tuesday—meeting sites vary). AL MOY, Glasurit America, Inc., P.O. Box 38009—Fenkell Station, Detroit, MI 48238.

GOLDEN GATE (Monday before third Wednesday—Alternate between Sabella's Restaurant on Fisherman's Wharf and Francesco's, Oakland, CA). SANDRA LUND, The O'Brien Corp., 450 E. Grand Ave., S. San Francisco, CA 94080.

HOUSTON (Second Wednesday—Sonny Look's, Houston, TX) ARTHUR MCDERMOTT, Nalco Chemical Co. P.O. Box 87, Sugarland, TX 77478.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). H. DENNIS MATHES, Olympic Stain Co., 1141 N.W. 50th, Seattle, WA 98107.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). HENRY J. KIRSCH, Trans Western Chemicals, 7240 Crider Ave., Pico Rivera, CA 90660.

LOUISVILLE (Third Wednesday—Breckinridge Inn, Louisville, KY). JOYCE SPECHT, Porter Paint Co., 400 S. 13th St., Louisville, KY 40203.

MEXICO (Fourth Thursday—meeting sites vary). GEORGE CARRINGTON, Nuodex Mexicana, S.A., Av. de las Granjas 536, 02020 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wong's Restaurant). JEAN BRUNET, Van Waters & Rogers Ltd., 2700 Jean Baptist Deschamps, Lachine, Que., Can., H8T 1E1.

NEW ENGLAND (Third Thursday—Hillcrest Function Facilities, Waltham). MAUREEN M. LEIN, Raffi & Swanson, Inc., 100 Eames St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). RAYMOND P. GANGI, Woolsey Marine, 183 Lorraine St., Brooklyn, NY 11231.

NORTHWESTERN (Tuesday after first Monday—Jay Cafe, Minneapolis, MN). ALFRED F. YOKUBONIS, Celanese Specialty Resins, 5008 W. 99th St., Bloomington, MN 55437.

PACIFIC NORTHWEST (Portland Section—Tuesday following second Wednesday; Seattle Section—the day after Portland; British Columbia Section—the day after Seattle). GERALD MCKNIGHT, Rodda Paint Co., 6932 S.W. Macadam Ave., Portland, OR 97219.

PHILADELPHIA (Second Thursday—Dugan's Restaurant). ROBERT L. TOZER, Delkote, Div. of Lilly Ind. Coatings, Inc., 76 S. Virginia Ave., Penns Grove, NJ 08069.

PIEDMONT (Third Wednesday—Howard Johnson's, Brentwood exit of I-85, High Point, NC.) MICHAEL DAVIS, Paint Products Co., Inc., P.O. Box 648, Walkertown, NC 27051.

PITTSBURGH (First Monday—Skibo Hall, Carnegie Mellon Univ.). JOSEPH MASCIA, Campbell Chemical Co., P.O. Box 11182, Pittsburgh, PA 15237.

ROCKY MOUNTAIN (Monday following first Wednesday—Bernard's, Arvada, CO). CARWIN BEARDALL, Howells, Inc., 4285 S. State St., Salt Lake City, UT 84107.

ST. LOUIS (Third Tuesday—Salad Bowl Restaurant). CHARLES L. GRUBBS, Rockford Coatings Corp., 1825 Ave. H, St. Louis, MO 63125.

SOUTHERN (Gulf Coast Section—Various Dates; Central Florida Section—Third Thursday after first Monday; Atlanta Section—Third Thursday; Memphis Section—Second Tuesday; Miami Section—Tuesday prior to Central Florida Section). S.G. SANFILIPPO. Reichhold Chemicals, Inc., Technical Services Lab., P.O. Box 1610, Tuscaloosa, LA 35401.

TORONTO (Second Monday—Cambridge Motor Hotel). GORDON MAJOR, Mactac Canada Ltd., 100 Kennedy Rd., S., Brampton, Ont., Can., L6W 3E8.

WESTERN NEW YORK (Third Tuesday—The Red Mill, Clarence, NY). CHARLES C. TABBI, Spencer-Kellogg Div., Textron, Inc., P.O. Box 210, Buffalo, NY 14225.

Pittsburgh

(Mar. 5)—"TRENDS IN FUTURE COATINGS"—Dr. Marco Wismer, PPG Industries, Inc.

(Apr. 2)—"EFFECT OF SURFACE TENSION AND VISCOSITY ON SURFACE DEFECTS IN COATINGS"—Cliff Schoff, PPG Industries, Inc.

(May 7)—"INS AND OUTS OF TiO_2"—Richard Ensminger, NL Industries.

Rocky Mountain

(Mar. 7)—"INDUSTRIAL FINISHES—WATER OR HIGH SOLIDS, OR BOTH"—R.N. Benton, Spencer Kellogg Div. of Textron, Inc.

(Apr. 11)—"DISPERSION OF TiO_2"—V.R. Pedersen, Tioxide Canada, Inc.

(May 9)—"THE PROPER SOFTWARE FOR YOU"—L.S. Feldman, Sinclair Paint Co.

Toronto

(Mar. 12)—"HIGH SOLIDS AND WATER EXTENDIBLE COATINGS RESINS"—Rich Johnson, Cargill, Inc.

St. Louis

(Mar. 20)—FEDERATION VISIT.
(Apr. 17)—TEACHERS' NIGHT.
(May 15)—MANUFACTURING NIGHT.

TO OUR READERS:

The JOURNAL OF COATINGS TECHNOLOGY welcomes any responsible views pertaining to the Coatings Industry, Federation activities, and the editorial content of the JCT. Letters should be brief and signed with the writer's address and company affiliation. Effort will be made to publish JCT author's responses to correspondence in the same issue.

Correspondence should be addressed to: Letters to the Editor, JOURNAL OF COATINGS TECHNOLOGY, 1315 Walnut St., Philadelphia, PA 19107.

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Meetings/Education

Louisville Society to Sponsor Joint Seminar on Environment

The Louisville Society and the Louisville Paint & Coatings Association will jointly sponsor a seminar on "The Environment: Where We Are, And Where We're Going," at the Marriott Inn, Clarksville, IN, on April 18.

The following are scheduled for presentation:

"The Right-to-Know Law and What It Means"—Michael Salyers, OSHA Standards for Kentucky.

"Lesson from Seymour and Envirochem: Status of Superfund"—Thomas Graves, NPCA.

"The Manufacturer's Duty to Warn Employees, Customers and the Community"—Patrick Hurd, NPCA.

"Regional Approach to Hazardous Waste Management"—Richard Ellis, Tennessee Valley Authority.

"Why Sewer Restrictions?"—Thomas Herman, Louisville/Jefferson County MSD.

"What Is a Material Safety Data Sheet?"—Harold Flegenheimer, Celanese Specialty Resins.

"The Meaning of Toxicology"—Laszlo Makk, M.D., St. Anthony Hospital.

"New Development in RCRA Regulations"—Lloyd Cress, Attorney, Greenebaum, Doll and McDonald.

"Coping with Technology"—Joseph Hagerty, University of Louisville.

The seminar fee of $20 includes lunch.

A joint meeting of the Society and PCA will be held the evening of April 18 at the Breckinridge Inn in Louisville, and will feature a presentation on, "Can Government Be Effectively Run as a Business?"

For further information, or to register, please contact Ms. M. Joyce Specht, Seminar Chairman, Porter Paint Co., 400 S. 13th St., Louisville, KY 40201.

Theme Announced for Southwestern Paint Convention

"Productivity and Opportunities in the 80's" is the theme of the 41st Southwestern Paint Convention of the Dallas and Houston Societies for Coatings Technology, April 12-14, at the Shamrock Hilton Hotel in Houston, TX.

General Chairman of the event is John B. Pennington, of Cron Chemical Corp. Other members of the Houston Society working with him are: Vice-Chairman—Mike Winters, of Ribelin Distributors; Program Chairman—Dick Batchelor, of Valspar Corp.; Registration Chairman—Rudi Buri, of Champion Coatings; Entertainment Chairman—Lorianne M. Reeves, of Nalco Chemical Co.; Suppliers Reception Chairman—Jim Hearld, of Buckman Labs,; and Hospitality Chairman—Charles Lundquist, of Cron Chemical Corp.

Several papers, keyed to the theme, will be presented at the Friday and Saturday morning sessions.

For further information, contact John Pennington, Cron Chemical Corp., P.O. Box 14042, Houston, TX 77021.

New England Society Announces 'Coatings Tech Expo'

The New England Society will sponsor "Coatings Tech Expo '84," its third biennial, regional exposition, May 16-17, at the Sheraton Inn and Conference Center, Boxborough, MA.

The two-day event will feature technical and business sessions and exhibits, and will conclude with the Annual Dinner, featuring as guest speakers, Boston television personalities, Liz Walker and Bob Lobel.

With over one-half of the exhibit space already sold, the following companies have contracted for space: Applied Color Systems; Burgess Pigment Co.; Data Logix; Federation of Societies for Coatings Technology; Fish Chemical & Equipment Inc.; I-PAK; Jaygo, Inc.; Lincoln Fairfield; Liquid Controls Corp.; D. H. Litter; Lovezzola-Ward Co.; Lukens Chemical Co.; Macbeth; George Mann & Co.; National Paint and Coatings Association; New England Resins & Pigments Corp.; NL Industries; Peltz Rowley Chemical Co.; Poly/Sperse Corp.; Polyvinyl Chemical Industries; Rohm and Haas; Techtronics; The Truesdale Co.; Union Chemical; University of Lowell; and Washburn-Linder Co.

Scheduled concurrently, the technical and business sessions will feature Robert Carson, Chief Economist of Eastman Chemical, and Larry Thomas, Executive Director of NPCA. Technical subjects, such as formulating with propylene-based glycol ethers and new dispersion techniques, as well as other pertinent topics, will be addressed.

Chairman for the exposition is Bruce Ocko, of The Truesdale Co., and the Seminar Chairman is John Fitzwater, of Polyvinyl Chemical Industries.

For information on the programming, or to exhibit, contact Dame Associates, Inc., 51 Church St., Boston, MA 02116.

IAT to Sponsor 'Nuclear Coating Work' Course

The Institute of Applied Technology (IAT) will sponsor "Nuclear Quality Assured Coating Work" course on February 26-March 1, at the Holiday Inn Airport, Pittsburg, PA.

The course will cover the federal regulations, ASTM standards, and ANSI standards that govern the design, selection, handling, application, and inspection of nuclear grade coating systems for nuclear power plants. It will provide quality assurance and inspection personnel and painters with the information necessary to meet the increasingly technical and specialized demands of nuclear coating work.

Designed for QA/QC personnel, inspectors, painting supervisors, design engineers, corrosion and coatings specialists, and specification writers, the four-day course will utilize classroom lectures, small group work, discussions, and practice with inspection tools.

Fee for the course is $695.

For information or to register, contact IAT, P.O. Box 32331, Washington, DC 20007, 202-342-2241.

Presentations Scheduled for ELECTROCOAT/84, April 24-25

The program for ELECTROCOAT/84, a comprehensive technical conference on the electrodeposition of paint, has been announced. The two-day conference, which is sponsored by *Products Finishing Magazine,* will be held April 24-25 at the Drawbridge Inn, Greater Cincinnati, Ohio Airport area.

The conference is divided into four sessions, with two being held daily. Topics and speakers for the sessions include:

Session One—"The World Of Electrocoating"

"Is Electrocoating for You?"—Dr. Thomas J. Miranda, Whirlpool Corp.

"Electrocoating in Europe"—Jeff Knott, Electropaint Ltd.

"Electrocoating in Japan"—Akito Inoue, Poly Techs.

"Electrocoating Now and in the Future"—Howard Ellerhorst, Chemical Marketing Services.

Session Two—"Systems Engineering And Operations"

"Design Parameters for Electrocoating"—Ted Duda, Eisenmann Corp.

"Equipment Design—Concepts and Consequences"—Edwin Schachterle, Industrial Finish Engineering Inc.

"The Electrocoat Operator—Finding, Training, Keeping"—Jack Winters, Jackson Manufacturing.

"Maintenance and Operation of an Electrocoating Line"—Ron Brownlee, Borg-Warner Central Environmental Systems Inc.

"Living Day to Day with Your Electrocoat System"—Dale Overton, Firestone Steel Products Co.

"Process Solution Control: Physical and Chemical"—S.E. Beal, Oakite Products Inc.

Session Three—"What's New in Materials and Equipment?"

"High Film Build Cathodic Electrodeposition for the Automotive Industry"—Fred Loop, PPG Industries, Inc.

"One-Coat Electrocoats"—Linda Fay, Sherwin-Williams Co.

"Improved Product Rinsing Efficiency with Multitubular Ultrafiltration"—Jim Allshouse, Abcor, Inc.

"Closing the Loop with Reverse Osmosis"—William S. Springer, Ford Motor Co.

"Electrocoating Wastewater Treatment"—Roland Ziegler, Durr Industries.

Session Four—"Specialized Electrocoat Applications"

"Electrocoating: Investment for the Future"—Richard Wallin, Kurt Manufacturing.

"Job Shop Electrocoating—Its Value to Worldwide Industry"—Donald Leith, L&J of New England.

"Electrocoat? Powder? or Both?"—Lyle Gilbert, MetoKote Corp.

"Clear Electrocoating of Aluminum Wheels"—Pierre Hawner, Reynolds Metals Co.

"Bulk Electrocoating"—Dr. George Brewer, Consultant.

Question and answer panels will follow each session.

For registration information and complete program information, write ELECTROCOAT/84, Products Finishing Magazine, 6600 Clough Pike, Cincinnati, OH 45244.

CALL FOR PAPERS

NACE CORROSION/85 Symposium on "Electrochemical Techniques for Corrosion"

A three-day symposium on "Electrochemical Techniques for Corrosion" will be held on March 25-27, 1985 during CORROSION/85, the National Association of Corrosion Engineers' Annual Conference in Boston, MA. The purpose of the symposium is to review the state-of-the-art and provide a forum for discussion of new and innovative uses of electrochemical techniques.

The symposium is being sponsored by NACE Unit Committee T-3L on Electrochemical and Electrical Techniques for Corrosion Measurement and Control and will include papers on all aspects of fundamental and applied techniques as well as a debate and open discussion on the Applicability of Electrochemical Techniques to Corrosion Studies. Publication of the proceedings of the symposium and discussion is planned.

Prospective authors should contact the Symposium Chairman, Robert Baboian, Texas Instruments Inc., Mail Station: 10-13, Attleboro, MA 02703.

Binks Training Division Offers Spray Painting Seminars

The Training Division of Binks Manufacturing Co. will offer four five-day Spray Painting Seminars on various dates at several Binks' locations. The schedule includes: March 5-9 in Pine Brook, NJ; May 7-11 in Franklin Park, IL; October 8-12 in Atlanta, GA; and December 3-7 in Franklin Park.

The curriculum of these seminars takes into consideration the growing need to improve transfer efficiency, compliance with recent laws concerning toxic air pollution, coping with increasing cost of coatings and solvents, the demand for improved production rates, and developments in paints and coatings which call for revolutionary changes in the spray application techniques.

Seminars will be of value and interest to both the experienced operator and the novice. They are designed to help participants properly select, operate, and maintain current spray finishing equipment, including recently developed automatic and robotic systems.

For additional information, contact Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131.

Corrosion Short Course Sponsored at Lehigh in May

The 13th annual corrosion short course entitled, "Corrosion and Its Control by Protective Coatings," will be sponsored by Lehigh University, Bethlehem, PA, May 21-25.

Corrosion principles and the mechanisms of corrosion beneath paints, metallic coatings, and inorganic coatings will be discussed.

Further information may be obtained from Prof. Henry Leidheiser, Jr., Sinclair Laboratory #7, Lehigh University, Bethlehem, PA 18015.

RIT to Sponsor Summer Programs in Color Technology

The Munsell Color Science Laboratory will present three nationally known courses on color technology this summer at the Rochester Institute of Technology (RIT). The courses—"Principles of Color Technology," "Color Technology for Management," and "Advances in Color Technology"—were part of an annual program that was presented for 19 years by Dr. Fred W. Billmeyer, Jr., Professor of Analytical Chemistry at Rensselaer Polytechnic Institute (RPI). He will be retiring from RPI in 1984 but will continue to be associated with this program as an adjunct RIT faculty member. The program will be directed by RIT's Richard S. Hunter Professor, Dr. Franc Grum. Several guest speakers will be on the program.

Color Technology for Management will be offered June 6–7. It covers the principles of color technology as they influence management decisions. The program explores the physical and perceptual aspects of color, color measurement, color differences and tolerances, and color matching. Typical problems in the production and sale of colored products will be confronted, and managerial solutions based on the principles of color technology will be presented. The course will show how to improve productivity by applying the principles of color technology to reduce waste and make better use of manpower and equipment. The course is designed solely for executive and management personnel responsible for the production and sale of colored products; those directly involved in color matching and color control are encouraged to enroll in either or both of the other two courses. Tuition for the course is $550.

Principles of Color Technology will be offered twice, June 11–15 and June 18–22. The course provides information on color description, color-order systems, measurement principles, color-difference calculations and tolerances, computer color matching, and colorant properties. Laboratory periods provide hands-on experience in measurement, computation, and problem-solving using the latest commercial equipment. The course is of value to individuals from a variety of disciplines and organizational levels who are interested in color science, and especially to industrial personnel involved in color matching and color control. Attendance is limited to the number which can be accommodated in the laboratory sessions. Tuition is $650.

Advances in Color Technology will be offered June 25–29. It provides current, advanced-level information on developments in and techniques of color science and technology. Topics include instruments, calibration and measurement errors; terminology and standards; color spaces and color differences; color appearance; and turbid-medium theory and color matching. Selected advanced laboratory workshops are included. The course is designed for those with two or more years of direct experience in instrumental color measurement. Industrial personnel involved in color matching and color control at an advanced level are cordially invited. Tuition is $650.

For more information on these programs, contact Brenda Reimherr, RIT One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623.

CALL FOR PAPERS

"International Symposium on The Analysis and Identification of Polymers" Quantico, VA July 31—August 2

The "International Symposium on the Analysis and Identification of Polymers" will be sponsored by the FBI Laboratory at its Forensic Science Research and Training Center, in Quantico, VA, on July 31 through August 2.

The meeting is designed to educate forensic scientists from the United States and other countries in methods of analysis to better characterize and compare plastics and coatings as encountered in criminal matters such as hit and run, bank robbery, and other crimes wherein plastics/coatings could be left at the crime scene.

With respect to coatings, sessions will address such topics as: coatings for automobile components, manufacturing processes and formulations, trends in automobile paint, dating of automobile paints through trends in formulation, primers, and primer trends.

Papers are being sought from technical personnel in the coatings industry who are interested in presenting these papers to an audience composed primarily of forensic scientists from federal, state, and local law enforcement laboratories.

Persons interested in paper presentation or participation are encouraged to contact: K.W. Nimmich, Symposium Coordinator, Forensic Science Research and Training Center, Bldg. 12, Rm. 212, FBI Academy, Quantico, VA 22135.

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'Automotive Color' Is Theme of ISCC 53rd Annual Meeting

The 53rd Annual Meeting of the Inter-Society Color Council will be held at the Michigan Inn, Southfield, MI, on April 8–10. The meeting, which is co-sponsored by the Detroit Society for Coatings Technology and the Detroit Colour Council, will have as its theme, "Automotive Color."

Sunday and Monday, April 8 and 9, will feature meetings of ISCC Project Committees and tutorial workshops, including one on the perception and measurement of gloss. Monday's Luncheon will include the presentation of the 1983 ISCC Godlove Award, the installation of new officers and directors, and a short business meeting. A banquet will be held Monday evening at the Henry Ford Museum at Greenfield Village, Dearborn, followed by a private tour of the museum.

On Tuesday morning, April 10, there will be a symposium on the "Dynamics of Automotive Color." Keynote speaker will be Trevor Creed, Executive Designer, Interior Design, Ford Motor Co. His address is entitled, "Automotive Interiors—Time for a New Approach." Other speakers in the symposium will be:

David Warn, General Motors—"Computer-Aided Graphics in Styling"

June Roche, Milliken Fabrics—"New Concepts in Automotive Fabrics"

David Bash, Ampacet—"Coloring of Plastics and Fibers for Automotive Applications"

Milton Hardt, Sherwin-Williams Co.—"The Refinish Market"

After lunch, the meeting will close with a mini-symposium on "Instrumental Control of Automotive Color." Speakers and topics include:

William V. Longley, Ford Motor Co.—"Limitations of Color Measurement for Automotive Parts"

Lawrence Domas, General Motors Corp.—"Color Quality Control on the Assembly Line"

William A. Ballon, DuPont Co.—"Instrumental Control of Metallic Finishes"

A question and discussion session will follow.

For further information, contact the Conference Manager, Dr. Allan B.J. Rodrigues, E.I. DuPont de Nemours & Co., 945 Stephenson Hwy., P.O. Box 2802, Troy, MI 48007.

Lehigh University to Offer Summer Short Courses

The 15th annual short course, "Advances in Emulsion Polymerization and Latex Technology," and the fifth annual, "Physics and Chemistry of Printing Inks," will be sponsored this summer by Lehigh University.

"Emulsion Polymerization" will be held on the Lehigh University campus in Bethlehem, PA, June 4–8; "Printing Inks" will be held in Davos, Switzerland, August 13–17.

Designed for engineers, chemists, and other scientists and managers who are actively involved in emulsion work, "Advances in Emulsion Polymerization and Latex Technology," is an in-depth study of the synthesis and properties of high polymer latexes. Subject matter includes a balance of theory and applications as well as a balance between chemical and physical problems. Lectures, given by leading academic and industrial personnel, begin with introductory materials and reviews, and progress through recent research results.

"Physics and Chemistry of Printing Inks," is designed for engineers, chemists, and other scientists and managers. The course comprises: a description of the different printing processes used in the United States; a review of the fundamentals of compatibility and wettability including the use of the solubility parameter concept and the mechanism of lithographic printing; printability; dispersion of pigments; rheology of printing inks; composition of printing inks; color theory and its application to printing inks; computer color-matching; colorants used in printing inks; evaluation of print quality and problems encountered in printing; and a description of the available literature. Included in the session are lectures and laboratory demonstrations presented by the faculty and staff of the National Printing Ink Research Institute.

Fee for each course is $575 for the entire week and $175 per day for any part.

For further information, contact Dr. Mohamed S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015.

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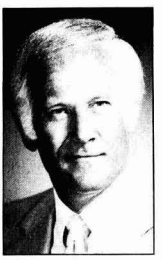
People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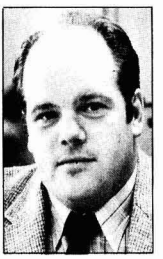

P. Gabriele

J. Goodman

J.H. Willner

C.B. Ruzicka has been named General Manager at Chemcentral/San Antonio. Mr. Ruzicka joined Chemcentral in 1971 as a Sales Representative in Dallas, TX, and in 1976 he was promoted to General Manager for Chemcentral/Toronto. In September 1980, he was promoted to President and General Manager of Chemcentral/Buffalo. Mr. Ruzicka is a member of the Western New York Society.

Replacing Mr. Ruzicka as President and General Manager of Chemcentral/Buffalo is **Ron C. Wells.**

Chemcentral/Detroit has announced the appointment of **Thomas G. Reiter** as Sales Manager. Mr. Reiter joined Chemcentral/Fort Wayne in 1975 as a Sales Trainee. In 1980, he was promoted to his most recent position as Resident Salesman for Chemcentral/Cincinnati in Columbus, OH. Mr. Reiter is a member of the C-D-I-C Society.

Peter Gabriele has been appointed Technical Representative for the Coatings, Radiation Curing and Photography Group of Ciba-Geigy Corp., Ardsley, NY. Mr. Gabriele joined the firm in 1980 and most recently served as Senior Chemist in the Additives Trade Sales Product Development Group.

Edwin R. Gaskell has joined the Midland Div., Dexter Corp. as Manager, Resin Department at the Hayward, CA facility. Mr. Gaskell has 30 years of experience in the field of resin research and development and is the author of a U.S. patent for Surfactant for Mineral Benefaction and Pigment Grinding Aids. He is a member of the Golden Gate Society.

Also joining the firm is **Gerry Steele** as Senior Research Chemist in the General Industrial Laboratory at the Waukegan, IL facility.

Named to the position of Research Associate are **John Gibb, Dr. K.G. Srinivasan,** and **Robert Henderson.** All are based at the firm's Waukegan facility. Mr. Henderson is a Pittsburgh Society member.

O'Brien Corp., S. San Francisco, CA, has promoted **Nola Ashworth** to the position of Buyer, Western Region. Ms. Ashworth joined O'Brien in 1966 and previously served as Group Leader, Raw Material Control. She is a member of the Golden Gate Society.

Georgia Kaolin Co., Inc., Union, NJ, has announced the appointment of **James Goodman** to the position of Senior Sales Representative, Southeastern region.

Trinity Coatings Co., Div. of Gulf & Western Industries, Fort Worth, TX, has appointed **John H. Bress** to the newly created position of Technical Advisor. Mr. Bress has over 30 years of experience in surface coatings and related fields. Prior to joining Trinity, he was associated with BASF Wyandotte Corp. as a Market Development Specialist. Mr. Bress is a member of the Dallas Society.

Thompson-Hayward Chemical Co. has appointed **Dennis Miller** as Sales Representative in the St. Louis and central Illinois areas. Working out of the St. Louis distribution center, Mr. Miller will specialize in sales to the paint and coatings industry. He is a member of the St. Louis Society.

The appointment of **Richard A. Smith** as Regional Sales Manager has been announced by Burgess Pigment Co., Sandersville, GA.

John H. Edholm was named Director of Manufacturing of Pierce & Stevens Chemical Corp., Buffalo, NY. He most recently served as Manager, Technical Administration.

Manville, Filtration & Minerals, Denver, CO, has appointed **David C. Perry** to Merchandising Manager. Mr. Perry assumes responsibility for merchandising and marketing the firm's diatomite functional fillers and perlite. Prior to his promotion, Mr. Perry served as Merchandising Manager with responsibility for fiberglass filtration products.

D/L Laboratories, New York, NY, has announced the appointment of **Jerry H. Willner** to the position of Chief Chemist—Senior Scientist. Mr. Willner, a graduate of Brooklyn College, has been associated with D/L for 20 years and has 27 years experience in the industry. He is a member of the New York Society and is active on its Technical Committee, having served as Vice-Chairman in 1980-81.

Also announced by D/L was the appointment of **Thomas J. Sliva** to Assistant Technical Director. Mr. Silva joined D/L in 1973 and most recently served as Chemist and Group Leader. He is a member of the New York Society and serves on its Technical Committee.

Rudy Richter has resigned from Reichhold Chemicals, Inc., Elizabeth, NJ, after 14 years of service, in order to establish Wyoming Paint and Chemical Co. in Casper, WY. Mr. Richter served in Reichhold's International Div. and in its Resins & Binders Div. Prior to joining Reichhold he served as Technical Director in the Architectural and Industrial Coatings Div. of Montana, Venezuela, South America. Mr. Richter is a member of the New York Society.

Michael L. Siegall has been promoted to President of Daniel G. Hereley Co., Chicago, IL. Formerly Vice-President of Sales, Mr. Siegall has been with the company for 20 years. The company also announced that **Lawrence W. Paul** has been named Vice-President, and **Paul L. Messerschmitt,** former President, will stay on as Chairman of the Board.

Robert R. Wolfe has been named Operations Manager for Ashland Chemical Company's Industrial Chemicals & Solvents Div.

Reliance Universal Inc., Louisville, KY, has announced the promotion of **Herbert A. Champlin** to the position of Vice-President and General Manager of the Specialty Coatings Div. Mr. Champlin will retain his former responsibilities as Vice-President of Marketing and Commercial Development.

United Technologies' Inmont Corp., Clifton, NJ, has appointed **J. Larry Jameson** to Senior Vice-President, North American Automotive Finishes. Mr. Jameson most recently served as an Inmont Vice-President and General Mangager of North American OEM Finishes.

James E. Depew was appointd to the newly created position of Director-Purchasing for Glidden Coatings & Resins, Div. SCM Corp., Cleveland, OH. Mr. Depew joined Glidden as Purchasing Manager—Solvents in 1972, and five years later assumed additional responsibilities as Manager.

Also announced by Glidden was the appointment of **William F. Ritter** as Manager—Physical Distribution. Mr. Ritter formerly served as Manager—Corporation Transportation and Distribution.

Union Carbide Corp., Danbury, CT, has announced the appointment of **Ronald S. Wishart** as Vice-President, Federal Government Relations. Mr. Wisehart previously served as Director of Energy and Transportation Policy. He replaces **James C. Rowland,** who retired after 37 years with the firm.

Harold Mark has been promoted to Vice-President and Business Manager of the Specialty Catalyst, Stearates and Waxes Business Group of the Organics Div. of Witco Chemical Corp. Mr. Mark, who will relocate from Chicago to Witco's headquarters in New York City, most recently was Product Manager of the Specialty Catalysts Products Group.

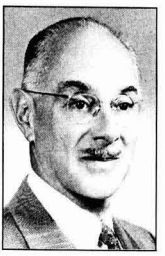
The appointment of **Dale H. Morehouse** to the position of Vice-President, Sales and Marketing, has been announced by Morehouse Industries, Inc., Fullerton, CA.

S.C. Johnson & Son, Racine, WI, has announced the appointment of **Charles G. Gallman** to Commercial Development Manager of the Polymers, Specialty Chemicals Group. Prior to his promotion, Mr. Gallman served the Group as District Manager.

Obituary

Leo Roon, Nuodex Founder And PRI Supporter, Dies at 91

Leo Roon, a well-known figure in the coatings community, died December 7 at the Scripps Clinic and Research Center in La Jolla, CA. He was 91.



Leo Roon

Mr. Roon, Founder and President of both Nuodex Products Co., Inc. and Roxalin Flexible Finishes, Inc., was a principal supporter of the Paint Research Institute of the Federation. He established the Leo Roon Foundation Fund, which supports not only the research grants of PRI but also furnishes cash prizes for the Roon Awards, presented for outstanding papers given at the Annual Meeting.

Born in New York City, Mr. Roon graduated as a pharmaceutical chemist from Columbia University, where he later studied engineering. He taught chemistry at Columbia and at New York University, where he received a Masters Degree.

In 1916, he began work at E.R. Squibb & Sons, in Brooklyn, as a research chemist, and, later, as Chief of the Chemical Div. In 1920 he turned to consulting work, and, in 1924, founded Roxalin Flexible Finishes, in Elizabeth, NJ. The unusual and innovative coatings products developed there, and at Nuodex Products which he founded in 1932, won defense awards from the government during World War II.

Mr. Roon's interests went far beyond the coatings industry to include a variety of disciplines and subjects. The Roon Foundation served many interests, including the Scripps Clinic, where the Roon Center for Research of Cardiovascular Diseases was named in his honor. He served as Director of the Elizabeth (NJ) General Hospital and President and Director of the Eastern Long Island (NY) Hospital. He was also President and a Trustee of Columbia University's College of Pharmacy.

Mr. Roon provided grants to the University of California at San Diego Medical School and established a five-year scholarship program at the University of San Diego. He also provided grants to the San Diego Museum of Art, the San Diego Opera, and the Los Angeles Philharmonic Orchestra.

In addition to the Leo Roon Fellowship, created in his honor by the Paint Research Institute at the California Institute of Technology, the Harvard Medical School created a visiting professorship in urology in honor of his support.

Mr. Roon received an Honorary Doctorate Degree from the University of San Diego in 1978.

He was a Trustee of PRI in 1960-1961, and of the Ernest T. Trigg Foundation in 1951-1953.

He received the George Baugh Heckel Award from the Federation in 1965, and was honored by PRI for his generous support in 1976.

His industry activities included being Director of Nuodex Products of Canada (1937-1954); Director of Roxalin of Canada Ltd. (1946-1965); Chairman of Board and Director of Hysol Corp. (1955-1967); Director of Hysol (Canada) Ltd. (1955-1967); President of the Naphthenate Preservatives Institute (1953-1954); and President of the New York Paint, Varnish & Lacquer Association (1941-1942). He was elected an Honorary Member of NYPVLA in 1957.

Dr. Calvin A. Knauss, 84, retired Vice-President of Reichhold Chemicals, Inc., died December 1.

Dr. Knauss, a Federation Honorary Member, was President of the Philadelphia Paint and Varnish Production Men's Club (now the Philadelphia Society for Coatings Technology) in the early 1930's. At that time, Dr. Knauss also served the Society as Technical Committee Chairman.

Dr. Knauss was a graduate of Muhlenberg College, Allentown, PA, and received a Master's Degree from Lehigh University, Bethlehem, PA, where he worked on linseed oil research with Dr. J.S. "Shorty" Long. Following his work at Lehigh, he was associated with Dr. Henry A. Gardner at the Institute for Paint and Varnish Research.

In the late 1920's, Dr. Knauss served as Director of Research and Development with John Lucas & Co., Inc., Philadelphia, PA. In 1934, he became Vice-President and Sales-Service Director of Nuodex Products, Inc.

Literature

High Solids Alkyd

A high solids oil-free alkyd resin for use by coating manufacturers in formulating clear finishes and one-coat enamels for a variety of industrial applications is covered in a newly published bulletin. Described is how Beckosol[R] synthetic resin solution 13-601 provides hardness, flexibility, overbake resistance, and exterior durability. Specifications, typical reduction curves, and a bar graph illustrating the effect of solvents on viscosity and stability of Beckosol 13-601-based vehicles are included. The bulletin is available from Reichhold Chemicals, Inc., 525 N. Broadway, White Plains, NY 10603.

Emulsions

The special properties and advantages of polymer emulsions used for paints and coatings applications are detailed in a newly published product list. The list describes four types of emulsions which are important additions to exterior, interior and primer sealer paints, industrial coatings, wood fillers, caulks, and mastics. In addition to describing the uses, special advantages, and typical performance properties of the emulsions, the product list also includes information about viscosity, solid percentage, average particle size, film clarity, and glass transition temperature. For a copy of "Emulsions for Paints and Coatings," write Air Products and Chemicals, Inc., Polymer Chemicals Dept., P.O. Box 538, Allentown, PA 18105.

Phenolic Resins

A 32-page booklet describing durable coatings based on UCAR phenolic resins has been recently issued. The 20 phenolic resins listed in a table of physical properties include five for baking coatings, eight for oleoresinous varnishes (and alkyd modification), three for epoxy crosslinking, and four for specialty coatings. An applications table matches these coatings with their use in can linings, metal primers, maintenance and marine paints, pipe coatings, insulating varnishes, wood finishes, printing inks, and paper coatings. Copies of the booklet, "Durable Coatings Based on UCAR Phenolic Resins," designated F-48308, can be obtained from, Union Carbide Corp., Specialty Chemicals Div., Dept. K3442, Danbury, CT 06817.

Polyurethanes Study

"Polyurethanes, II," a multi-client, techno-economic marketing study, has recently been completed and is available. The data is contained within 617 pages and 415 tables, and includes an index with 3,700 entries. The study provides a comprehensive analysis of forms, markets, raw materials, technological trends, marketing shifts, prices, major suppliers, leading end users, and volumes for 1982 with projections for 1987. Special topics include: fire retardant chemicals, reinforced RIM, and aliphatic isocyanates for non-yellowing coatings. The subscription fee is $7,500. A free brochure, with Table of Contents, is available from Skeist Laboratories, Inc., 112 Naylon Ave., Livingston, NJ 07039.

New Formulation For CMC Gels

A new method of gelating solutions of CMC (sodium carboxymethyl-cellulose) using aluminum foromoacetate (AFA) is described in a recent technical information bulletin. Discussed is the use of AFA, which opens new and efficient techniques for formulating CMC gels. The literature explains how AFA and other formulations using aluminum and chromium salts can provide gels of varying textures, extreme stability, and other desirable properties sought by gell formulators. For a copy of Bulletin VC-405D, write Hercules Incorporated, Hercules Plaza, Wilmington, DE 19894.

Metal Cans

A full range of metal cans covering three styles and a variety of sizes to meet all the needs of paint customers, as well as those in allied fields, is the subject of new literature. Contact Continental Can Company, U.S.A., The Continental Group, Inc., 51 Harbor Plaza, Box 10004, Stamford, CT 06904 for information.

pH Meters

Information is available on a new line of five easy-to-operate pH meters with a unique "delta" shape and unified display which allow easy use and quick reading from the laboratory benchtop. Write Corning Science Products, Dept. PR-NM, P.O. Box 1150, Elmira, NY 14902 for literature.

Thickener

An associative thickener/rheology modifier for latex paints has been introduced in new literature. Properties, advantages, and application uses of this nonionic, water-soluble synthetic polymer are listed. Further information is available from Union Carbide Corp., Specialty Chemicals Div., Dept. K3444, Danbury, CT 06817.

Plastic Paint Can

Literature is available featuring a one-gallon plastic paint can for water-base paints which offers the traditional benefits of a metal can plus the advantages of a next generation package. Design features, cost advantages, filling practices, and engineering services are included. For information, write Continental Can Company, U.S.A., The Continental Group, Inc., 51 Harbor Plaza, Box 10004, Stamford, CT 06904.

Dispersions

Literature is available featuring a new line of colorants for use in solvent thinned high performance coatings based on alkyd, acrylic, urethane, epoxy, polyester, vinyl, and cellulosic vehicle systems. Discussed is the composition of these dispersions, which are stable, free-flowing pigment concentrates in a special, broadly compatible thermoplastic acrylic resin. Also included is information on the wide range of organic and inorganic pigments which are available for unlimited color matching possibilities. For information, contact Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

Plastics Properties

A 40-page "Plastics Properties Guide," which is a comprehensive guide to an entire line of resins, is now available. The guide lists property values for resins in SI, as well as English units. Also included are the physical, thermal, electrical, and mechanical properties of each resin, enabling quick reference across the entire product line. Technical assistance phone numbers and additional literature information is also included. Copies of the guide are available from General Electric Co., Plastics Group, One Plastics Ave., Pittsfield, MA 01201.

Solvent

A new slow-evaporating, colorless, water-immiscible solvent that is useful as a retarder solvent and coalescing aid in coating systems is featured in recently published literature. Application uses, benefits, and typical properties of the solvent are listed. For information, write Eastman Chemical Products, Inc., Chemicals Div., Building 280, Kingsport, TN 37662.

Coated Coil

A new four-color publication which explains the coil coating process is now available. Designed for those unfamiliar with precoated metal, the six-page booklet, "Let Us Be Your Paint Line," emphasizes the benefits available to metal fabricators and answers questions which potential customers frequently ask. A copy of the literature is available from the National Coil Coaters Association, 1900 Arch St., Philadelphia, PA 19103.

NCCA Literature List

A comprehensive updated Literature List of materials for both customers and members is available from the National Coil Coaters Association. The newly-revised brochure provides a complete description of the manuals, articles, case studies, and seminar proceedings explaining the coil coating process, together with pricing and odering information. The Literature List is available from the NCCA, 1900 Arch St., Philadelphia, PA 19103.

Paint Drying Process

A patented technology that enables polymer coatings, from automotive paints to furniture and refrigerator finishes, to be dried more quickly at room temperature than is usual in thermal drying ovens is featured in new literature. Formulations, applications, and useful advantages of the process are detailed. For information, contact The Office of the Australian Trade Commissioner, 636 Fifth Ave., New York, NY 10111.

Reactive Diluents

Two caprolactone-based multifunctional intermediates, developed specifically as reactive diluents for high-solids baking coatings used for automotive, appliance, and general metal finishing, are introduced in new literature. Property data and application uses are detailed. Further information can be obtained from Union Carbide Corp., Specialty Polymers and Composites Div., Dept. M1553, Danbury, CT 06817.

Microscopes

Information is available on several high-performance, general laboratory microscopes. Discussed are how the systems are tailored to specific routine applications. For literature, contact Carl Zeiss, Inc., Scientific Instruments Div., One Zeiss Dr., Thornwood, NY 10594.

Spectrocolorimeters

An eight-page, full color brochure is available describing the LabScan line of spectrocolorimeters. "PerfectColor" provides comparative information on LabScan™, LabScan II, and Compuscan™. Beginning with a brief description of each system, the literature follows with a detailed presentation on each system's capabilities, including standard and optional features. A color, cross reference grid simplifies system comparisons. For a copy of the brochure, contact HunterLab, Hunter Associates Laboratory, Inc., 11495 Sunset Hills Rd., Reston, VA 22090.

Classification System Of Colored Pigments

The Dry Color Manufacturers' Association (DCMA) has published the second edition of its "Classification and Chemical Description of the Mixed Metal Oxide Inorganic Colored Pigments." The literature presents a system of classification and nomenclature for the family of mixed metal oxide pigments manufactured, imported, or processed in the U.S. This update of the first edition broadens the number of pigments included, and is the only publication which defines, identifies, characterizes, classifies, and names the entire group of complex inorganic color products known as "porcelain enamel oxides," "ceramic stains," "ceramic color," etc. The system includes Chemical Abstract Service (CAS) Registry Numbers from the Toxic Substances Control Act Chemical Substances Inventory, Colour Index Generic Names, and Colour Index Constitution Numbers. It also classifies and indexes pigments according to their colors, use categories, crystal class, and metal content. The book is available for $2.00 from DCMA, 206 N. Washington St., Suite 202 Alexandria, VA 22314.

Filter Vessels

Bag type pressure filter vessels that remove from 1 to 850 micron contaminants from liquids flowing at up to 4,500 gpm are the subject of recently published literature. This bag and basket line are dual-purpose filters or strainers. For additional information, write American Felt & Filter Co., New Windsor, NY.

Radiation Curing

Electron beam, ultraviolet, infrared, microwave, high frequency radiation sources, and the resin systems suitable for use with these sources are surveyed in a new report from the Polymer Science and Standards Div. of the National Bureau of Standards. Prepared for the U.S. Bureau of Engraving, the report includes discussion of: advantages and disadvantages of radiation cured inks; typical ink components and formulations; requirements for specialized machinery; and parameters unique to radiation curing methods on the printing process. Nonprinting, but related industrial operations utilizing radiation for treating thin films and coatings are also included. Costs, examples, and market statistics are given for commercial procedures. Also included are 16 tables, 38 figures, and an extensive list of sources and suggested references. Copies are available for $14.50 from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

Storage Tanks

Cone bottom, type 304 stainless steel ribbed tanks that have 14 gauge shells and cone tops and 12 gauge cone bottoms, which can withstand maximum loads without rupture or spills, are featured in new literature. Features, models, and options of the tanks are highlighted. Contact Certified Equipment & Manufacturing Co., P.O. Box 298, Springfield, IL 62705.

Surface Area Analyzer

Literature is available introducing a high-speed, single-point surface area analyzer which uses a flowing gas adsorption system to perform rapid B.E.T. measurements on particulate matter. Features and useful advantages of the analyzer are detailed. For further information, write Micromeritics Instrument Corp., 5680 Goshen Springs Rd., Norcross, GA 30093.

Alumina Technical Ceramics

The story of alumina technical ceramics from bauxite ore through finished product is the subject of an eight-page brochure. The illustrated, four-color brochure includes information on current and potential applications for alumina technical ceramics. Design guidelines, specifications, manufacturing methods, and properties of the various grades of alumina technical ceramics are also covered. For a copy of the literature, contact Diamonite Products, Dewey & Almy Chemical Div., W.R. Grace & Co., 453 W. McConkey St., Shreve, OH 44676.

Water-Soluble Polymers

"Water-Soluble Polymers, III," a multi-client techno-economic study has been recently completed and is now available. This 343-page study examines in depth the markets, raw materials, technological trends, marketing shifts, competing systems, prices, suppliers, end users, and volumes for 1982 with projections for 1987. The review gives a comprehensive assessment of the structure of this business and the status of its leading factors. Subscription fee is $6,500. A brochure, with Table of Contents, is available from Skeist Laboratories, Inc., 112 Naylon Ave., Livingston, NJ 07039.

Liquid Polymers

Literature describing a line of reactive liquid polymers (RLP) for solution epoxy coatings is available. Data include a description of benefits these copolymers can provide. Improvements in coating properties such as impact strength, metal adhesion, and low-temperature flexibility are illustrated. Application uses such as in water-borne, high-solids, and powder coatings are also discussed. To obtain a copy of the literature, contact BFGoodrich Chemical Group, Public Relations Dept., 6100 Oak Tree Blvd., Cleveland, OH 44131.

Coil Coating System

Information is available introducing a revolutionary coil coating system with extremely high versatility for the metal building panel industry. Discussed is a three-coat metalescent finishing system that produces a metallic-like appearance without using a metal pigment. Specification sheets and technical information may be obtained from Robert Moorman, Market Manager, Glidden Chemical Coatings, 925 Euclis Ave., Cleveland, OH 44115.

Weather-Ometer

A brochure has been published describing a new xenon arc weather-ometer for testing the lightfastness and weather resistant properties of all types of materials and products. Discussed is how the instrument reproduces and accelerates the environmental process through its close simulation of the natural light, heat, and moisture components. Bulletin No. 1430 is available from Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

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(Coatings)

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Coming Events

FEDERATION MEETINGS

(May 15-18)—Federation "Spring Week." Manufacturing Seminar on 15th and 16th; Society Officers on 17th; and Board of Directors on 18th. Galt House, Louisville, KY. (FSCT, 1315 Walnut St., Philadelphia, PA 19107).

(Oct. 24-26)—62nd Annual Meeting and 49th Paint Industries' Show. Conrad Hilton Hotel, Chicago, IL. (FSCT, 1315 Walnut St., Suite 832, Philadelphia, PA 19107).

1985

(May 14-17)—Federation "Spring Week." Seminar on 14th and 15th; Society Officers on 16th; and Board of Directors on 17th. Hilton Hotel, 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).

SPECIAL SOCIETY MEETINGS

(Mar. 7-9)—Southern Society for Coatings Technology. Fiftieth Anniversary Meeting. Surfside Hotel, Clearwater, FL. (James E. Geiger, Sun Coatings, Inc., 12295 75th St., N., Largo, FL 33543).

(Apr. 10)—Annual FOCUS Symposium on "Dynamics of Automotive Color." Sponsored by Detroit Society, Detroit Color Council, and Inter-Society Color Council. Michigan Inn, Southfield, MI. (Dr. R.A. Rodriques, E.I. Du Pont de Nemours & Co., Inc., 945 Stephenson Hwy., P.O. Box 2802, Troy, MI 48007).

(Apr. 12-14)—Southwestern Paint Convention of Dallas and Houston Societies. Shamrock Hilton Hotel, Houston, TX. (John Pennington, Cron Chemical Corp., P.O. Box 14042, Houston, TX 77021).

(Apr. 17-18)—Chicago Society for Coatings Technology's 14th Annual Chicago Area Coatings Symposium, Symco '84, "Dawn of a New Beginning." Knickers Restaurant, Des Plaines, IL. (Chairman Bob Becker, D.R. Fitzgerald Co., 4001 W. Devon, Suite 510, Chicago, IL 60646).

(Apr. 18)—"The Environment: Where We Are, And Where We're Going," Seminar sponsored by the Louisville Society for Coatings Technology and the LPCA. Marriott Inn, Clarksville, IN. (Joyce Specht, Porter Paint Co., Coatings Div., 400 S. 13th St., Louisville, KY 40203).

(May 3-5)—Pacific Northwest Society for Coatings Technology Symposium, Holiday Inn Crowne Plaza, Seattle, WA. (Robert Hogg, Preservative Paint Co., 5410 Airport Way S., Seattle, WA 98108).

(May 15-16)—Cleveland Society for Coatings Technology 27th Annual Technical Conference, "Advances in Coatings Technology." (Richard Eley, Glidden Coatings & Resins Div. SCM Corp., 16651 Sprague Rd., Strongsville, OH 44136).

(May 16-17)-"Coatings Tech Expo '84." 3rd Biennial Convention & Exposition sponsored by New England Society for Coatings Technology. Sheraton Inn & Conference Center, Boxborough, MA. (Dame Associates, Inc., 51 Church St., Boston, MA 02116).

(June 8-9)—Joint Meeting of St. Louis and Kansas City Societies for Coatings Technology. Kansas City, MO.

(June 18)—Golden Gate Society for Coatings Technology's Manufacturing Committee Symposium on "Safety and Robotics." Sabella's, San Francisco, CA. (Louie Sanguinetti, Jasco Chemical Co., P.O. Drawer J. Mountain View, CA 94042).

1985

(Feb. 26-Mar. 1)—Western Coatings Societies Symposium and Show. Disneyland Hotel, Anaheim, CA.

(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.

OTHER ORGANIZATIONS

(Mar. 5-9)—Spray Painting Seminar. Binks Manufacturing Co., Pine Brook, NJ. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(Mar. 25)—Painting and Decorating Contractors of America Convention and Show. New York Hilton, New York, NY. (Mr. E. Glen Craven, PDCA, 7223 Lee Hwy., Falls Church, VA 22046).

(Apr. 2-3)—24th Annual Symposium of the Washington Paint Technical Group. Marriott Twin Bridges Motel, Washington, DC. (WPTG, P.O. Box 12025, Washington, DC 20005).

(Apr. 2-5)—CORROSION 84, NACE Materials Performance and Corrosion Show. Rivergate Exposition Center, New Orleans, LA. (National Association of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218).

(Apr. 4-11)—"Surface Treatment Exhibition" at the 1984 Hannover Fair, Hannover, West Germany. (Hannover Fairs Information Center, P.O. Box 338, Rt. 22 E., Whitehouse, NJ 08888).

(Apr. 8-10)—Inter-Society Color Council Annual Meeting. Michigan Inn, Southfield, MI. (Fred W. Billmeyer, Dept. of Chemistry, Rensselaer Polytechnic Institute, Troy, NY 12181).

(Apr. 12-13)—"Electrochemical Test Methods of the Protecting Properties of Metals Coatings" Meeting. Genoa University, Genoa, Italy, (Prof. P.L. Bonora, Istituto di Chemica, Fac. Ingegneria—Fiera del Mare Pad. DI 16129 Genoa, Italy).

(Apr. 12-15)—"FARBE 84". Munich Trade Fair Centre, Munich, West Germany. (Kallman Associates, Five Maple Court, Ridgewood, NJ 07450).

(Apr. 24-25)—Electrocoat/84 Conference, sponsored by *Products Finishing* Magazine. Drawbridge Inn, Cincinnati, OH. (Anne Porter, Products Finishing, 6600 Clough Pike, Cincinnati, OH 45244).

(Apr. 25-26)—Protective Coatings Div. of Chemical Institute of Canada Symposium on "Curing in Coatings." 25th in Montreal; 26th in Toronto. (Dr. K.G. Rutherford, University of Windsor, Windsor, Ont. N9B 3P4).

(Apr. 29-May 2)—"Opportunities in the Automotive Market" meeting sponsored by the National Coil Coaters Association. Rancho Las Palmas, Rancho Mirage, CA. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Apr. 29-May 3)—75th Annual Meeting of the American Oil Chemists' Society, Fairmont Hotel, Dallas, TX. (AOCS, 508 S. Sixth St., Champaign, IL 61820).

(May 1-3)—Oil & Colour Chemists' Association's 35th Annual Exhibition. London, England. (R.H. Hamblin, OCCA, Priory House, 967 Harrow Rd., Wembley, Middlesex, HAO 2SF).

(May 1-4)—Painting and Decorating Contractors of America. 100th Anniversary Meeting. New York, NY.

(May 7-11)—Short Course on "Dispersion of Pigments and Resins in Fluid Media." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 7-11)—Spray Painting Seminar. Binks Manufacturing Co., Franklin Park, IL. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(May 16-18)—"Appearance Science Workshop." HunterLab, Reston, VA. (Ms. V. Baca, HunterLab, 11495 Sunset Hills Rd., Reston, VA 22090).

(May 20-23)—ASTM Annual Meeting. Queen Elizabeth Hotel, Montreal, Que., Canada. (ASTM, 1916 Race St., Philadelphia, PA. 19103)

(May 21-25)—Short Course on "Adhesion Principles and Practice for Coatings and Polymer Scientists." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(May 21-25)—Short Course on "Corrosion and Its Control by Protective Coatings." Lehigh University, Bethlehem, PA. (Prof. Henry Leidheiser, Jr., Sinclair Laboratory #7, Lehigh University, Bethlehem, PA 18015).

(May 22-24)—Chemical Coaters Association. "Surface Coating '84." Bloomington, MN. (Matt Huertz, Chemical Coaters Assn., Box 241, Wheaton, IL 60187).

(May 23)—ASTM Symposium on "Review and Evaluation of Appearance: Methods and Techniques" sponsored by Committee E-12. Queen Elizabeth Hotel, Montreal, Canada. (Symposium Chairman, J.J. Rennilson, Retro-Tech, P.O. Box 3103, La Mesa, CA 92041).

(June 4-8)—Short Course on "Advances in Emulsion Polymerization and Latex Technology." Lehigh University, Bethlehem, PA. (Dr. M.S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

(June 4-8)—Short Course on "Thermal and Rheological Characterization of Coatings and Polymers." Kent State University, Kent, OH. (Dr. Carl J. Knauss, Chemistry Dept., Kent State Univ., Kent, OH 44242).

(June 6-7)—"Color Technology for Management" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 10-13)—"58th Colloid and Surface Science Symposium." Carnegie-Mellon University, Pittsburgh, PA. (G.D. Parfitt, Chemical Engineering Dept., Carnegie-Mellon University, Pittsburgh, PA 15213).

(June 11-15)—"Principles of Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 17-20)—Dry Color Manufacturers' Association's Annual Meeting. The Greenbrier, White Sulphur Springs, WV. (P.J. Lehr, DCMA, Suite 202, 206 N. Washington St., Alexandria, VA 22314).

(June 18-22)—"Principles of Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(June 25-29)—"Advances in Color Technology" course. Rochester Institute of Technology, Rochester, NY. (Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, One Lomb Memorial Dr., P.O. Box 9887, Rochester, NY 14623).

(July 9-13)—10th International Conference on "Organic Coatings Science & Technology." Athens, Greece. (Prof. Angelos V. Patsis, Director, Materials Research Lab., CSB 209, State University of New York, New Paltz, NY 12561).

(July 31-Aug. 2)—"International Symposium on the Analysis and Identification of Polymers." Forensic Science Research and Training Center, Quantico, VA. (K.W. Nimmich, Symposium Coordinator, Forensic Science Research and Training Center, Bldg. 12, Rm. 212, FBI Academy, Quantico, VA 22135).

(Aug. 13-17)—Short Course on "Physics and Chemistry of Printing Inks." Davos, Switzerland. (Dr. M.S. El-Aasser, Dept. of Chemical Engineering, Sinclair Lab #7, Lehigh University, Bethlehem, PA 18015).

(Sept.)—"Maintenance Painting of Industrial Plants" Symposium sponsored by the Steel Structures Painting Council. Pittsburgh, PA. (SSPC, 4400 Fifth Ave., Pittsburgh, PA 15213).

(Sept. 13-15)—Oil and Colour Chemists Association Australia. 26th Convention. Mandurah, Western Australia. (Grant McManus, P.O. Box 490, Cloverdale, Western Australia 6015).

(Sept. 22-25)—Canadian Paint and Coatings Association. Annual Convention. Westin Hotel, Winnipeg, Man., Canada. (CPCA, 515 St. Catherine St. W., Montreal, Que. H3B 1B4, Canada).

(Sept. 23-26)—American Oil Chemists' Society Short Course on Fatty Acids. Kings Island, OH. (AOCS, 508 S. Sixth St., Champaign, IL 61820).

(Sept. 23-28)—XVIIth Congress of FATIPEC (Federation of Associations of Technicians in the Paint, Varnish, Lacquer and Printing Ink Industries of Continental Europe). Lugano, Switzerland. (C. Bourgery, Secretary General, FATIPEC, Maison de la Chimie, 28 Rue St.-Dominque, 75 Paris (7), France).

(Oct. 8-12)—Spray Painting Seminar. Binks Manufacturing Co., Atlanta, GA. (Binks Manufacturing Co., Training Div., 9201 W. Belmont Ave., Franklin Park, IL 60131).

(Oct. 22-24)—National Paint & Coatings Association 97th Annual Meeting. Palmer House, Chicago, IL. (Karen Bradley, NPCA, 1500 Rhode Island Ave., N.W., Washington, DC 20005).

(Oct. 23-26)—Fall Technical Meeting of the National Coil Coaters Association. Hyatt Regency O'Hare Hotel, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Nov. 16-17)—37th National Decorating Products Show. McCormick Place, Chicago, IL. (NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132).

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'Humbug' from Hillman

This column of Humbug is being compiled in December 1983—a time for retrospection, listing of the 10 best or worst of anything, and listing of the "I told you so's" of 1983. In just a few short weeks it will be the time for predictions, vows of reform, diets, 1984 budget proposals, and worst of all—the corporate business plans and projections. The world hurtles on with changes that are exciting, appalling, and mystifying. Yet over the years that I can recall, December and January have always given me the feeling of sameness regardless of where we have been, how we celebrated, and with whom. It has been the time for the intellectual gymnastics of looking back while looking forward.

Some time ago, the *Construction Digest* summed it up for me with, "If you had your life to live over again—you'd need more money!"

• • •

Always alert, Howard Jerome, a voracious reader, (I am tempted to say "of all sorts of garbage") found the following in the October 1983 issue of *World Wastes*. (I'm sure it does, Howard).

From time to time certain catch phrases take hold and, as time goes on, they are used in a way different from the original meaning. There was a time when "tough" meant resolute, unyielding, aggressive. Today, tough may mean "good" or even "great" as in "wasn't that a tough movie."

To alleviate this problem of what catch phrases really mean, a new dictionary has been put together. It suggests these meanings:

Competitive Pricing—Everybody dance. Or, how to go broke at the same time as the guy down the street.
Private Label—Your product sold for less.
Man-made Material—That which does not come from an artificially inseminated cow.
State of the Art—This is as good as it gets.
Econometrics—Rube Goldberg at work
Megatrend—How to state the obvious 400 ways.
Management—Spend a little, make a bundle.
Good Management—Spend less and make a big bundle.
Secretary—Girl who types.
Administrative Assistant—Girl who can spell and type.
Executive Assistant—Man looking for your job.
Corporate Spying—What the competition does.
Intelligence Gathering—What you do.
Liberal—Man with your money.
Conservative—Man with his own money.
Independent—Man with no money.
Fiscal Responsibility—Spending just enough.
Just Enough—See definition of liberal, conservative, and independent.
Workday—Time between breakfast, lunch, dinner, coffee breaks and bowling.

Tom Miranda, our Technical Editor, writes:

The enclosed is from an Evansville newspaper and reflects a number of contributions of Ahlfisms. Bob Ahlf is a real charming guy and has volumes of these sayings, i.e., "If it makes you nervous—don't watch."

—And many more like:

• I never did find out how we could have leftovers the first day we were married.
• Life seems strange, but then I have nothing to compare it with.
• Teamwork is good. You have somebody else to blame.
• This place has grown by fits and starts. Right now we're having one of our fits.
• Being older is knowing all the answers and nobody asks.
• Coles Law—Thinly sliced cabbage.
• You will not find your hammer until one hour after you buy a new one. Two days later, hammers will go on sale.
• After you have repaired a flaw, you find it was supposed to be that way.
• Genius is more objectionable than incompetence.
• Historical Marker: On this spot on July 14, 1974, I heard an encouraging word.
• Don't vote, it only encourages them.
• My blind date had a face that would chase a freight train down a dirt road.
• Being old is calling in sick—and you're sick.
• Why do people always give the "V for Victory" sign with only one finger?
• I keep on my toes—I wear double strength, high tension suspenders.
• This is the last day of your life—so far.

If you want to know the secret to Frank Borrelle's charm—if not his honesty, this is what he confided to me—

Short Course in Human Relations

The six most important words:
I admit that I was wrong.
The five most important words:
You did a great job.
The four most important words:
What do you think?
The three most important words:
Could you please . . .
The two most important words:
Thank you.
The most important word:
We.
The least important word:
I.

—Zoo Idea Pack, Sept-Oct. 1983
Friends of the Natl Zoo
from Association Trends

—Herb Hillman

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Celite provides high flatting efficiency because of the structure of its particles. Their irregular shapes disrupt specular reflection, resulting in uniformly reduced gloss and sheen, even over non-uniform surfaces. Celite provides luster control to any desired level.

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Filler	Lbs/ Gallon*	Cost/ Gallon Index**	Hegman	60° Gloss	85° Sheen
Celite 499	1.0	100	4	12	24
Celite White Mist®	1.0	190	5	15	32
Hydrogel	0.9	400	5½	16	30
Precipitated Silica	0.9	290	5½	20	34
Calcium Carbonate	3.0	70	6	18	55
Talc, Micronized	2.5	160	6	20	52
Amorphous Silica	2.75	130	6	28	48
Delaminated Clay	2.75	120	5½	26	58
Calcined Clay	2.5	150	5½	19	50

*Addition is to high gloss white alkyd enamel mixed 5 minutes in disc disperser. Initial enamel reading: 89° gloss, 94° sheen.

**Index uses Celite 499 as base = 100. Ratios based on 10,000 lb. shipments FOB NY, December, 1982.

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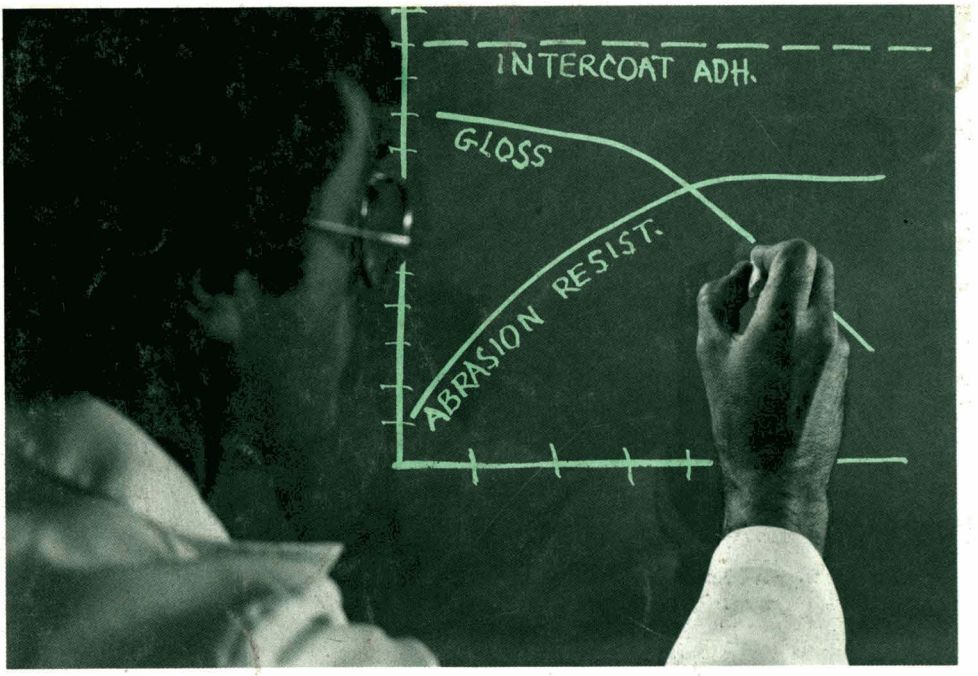

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