April 1997

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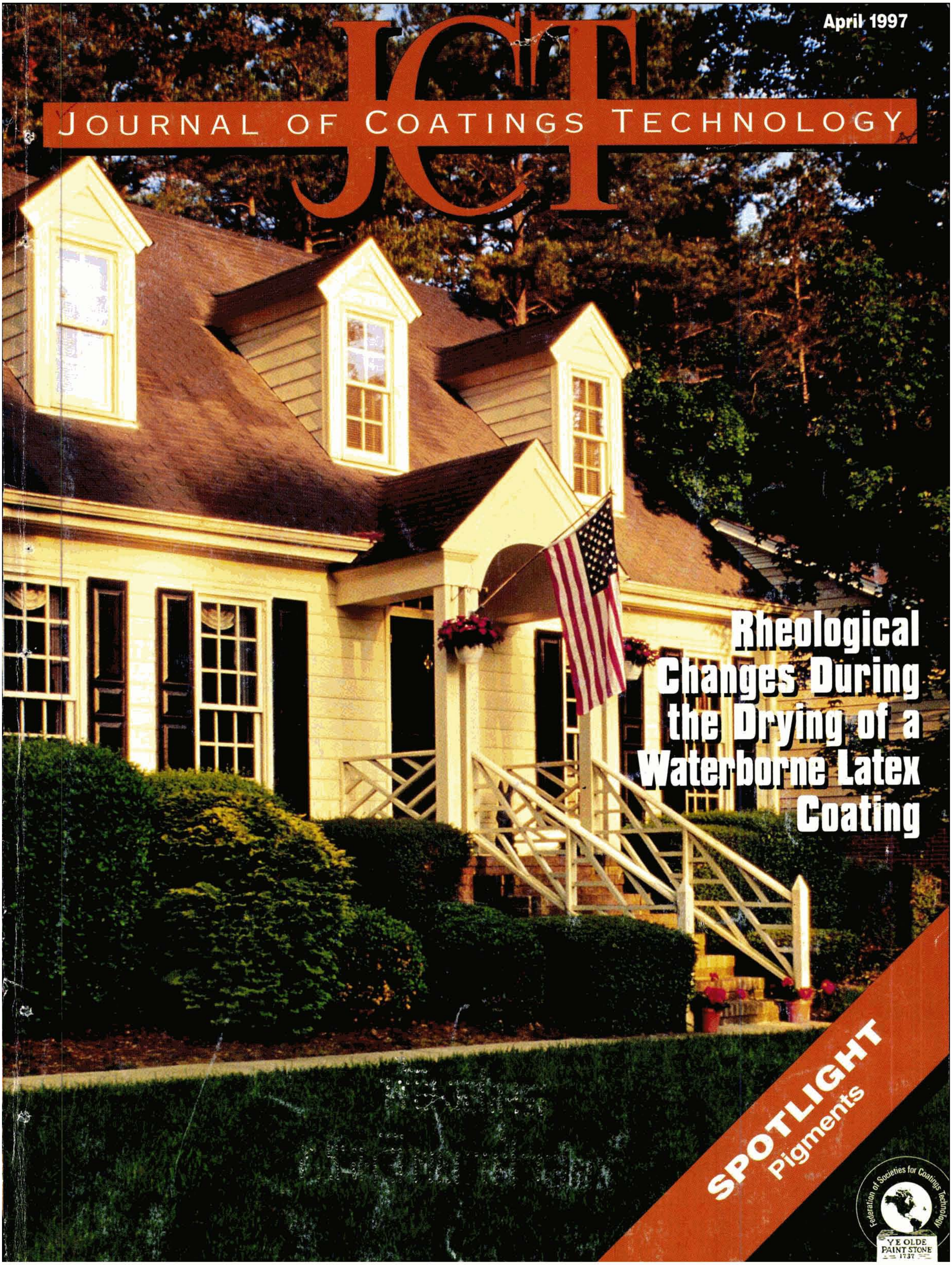

Rheological Changes During the Drying of a Waterborne Latex Coating

SPOTLIGHT
Pigments

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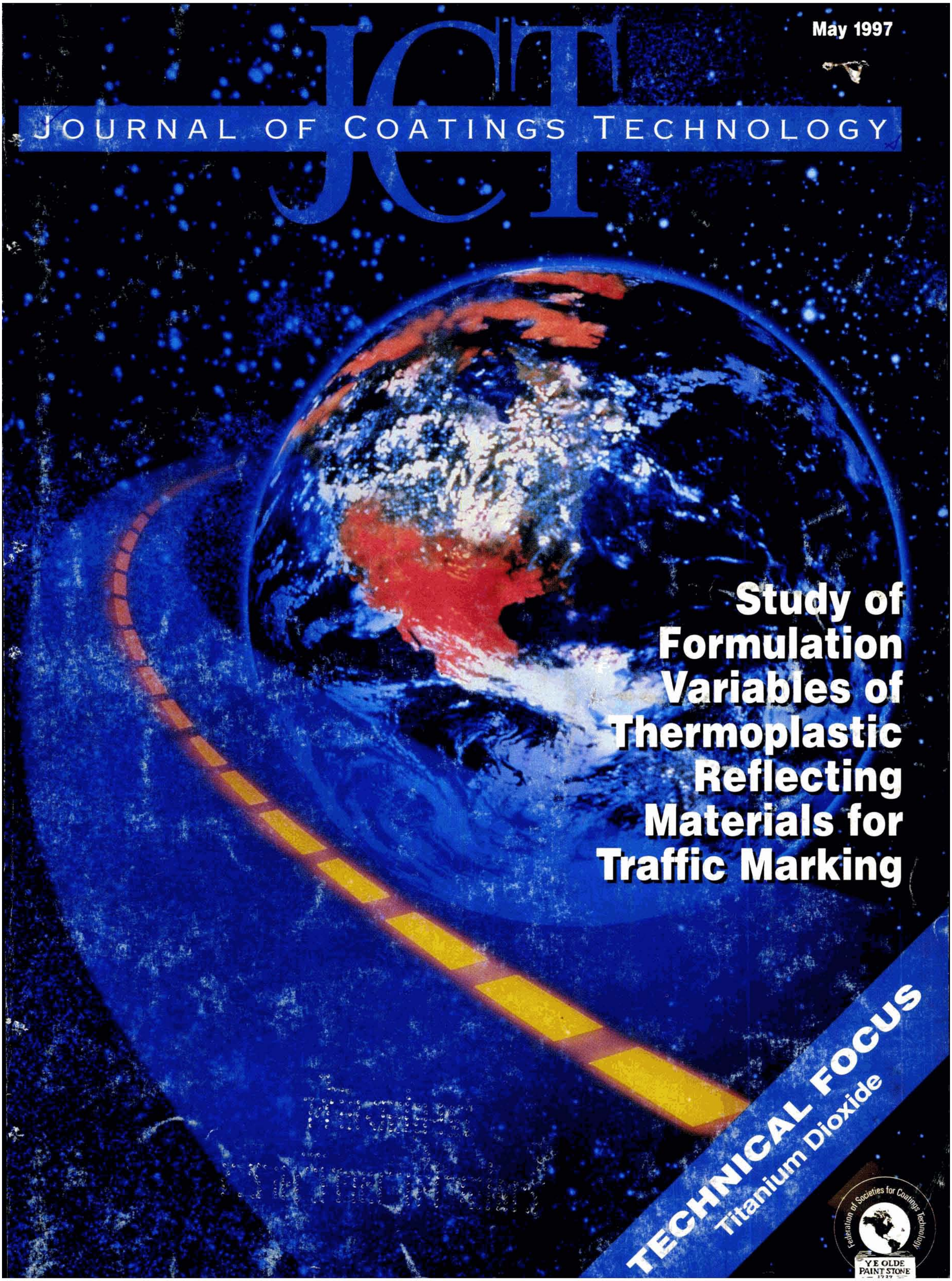

Study of Formulation Variables of Thermoplastic Reflecting Materials for Traffic Marking

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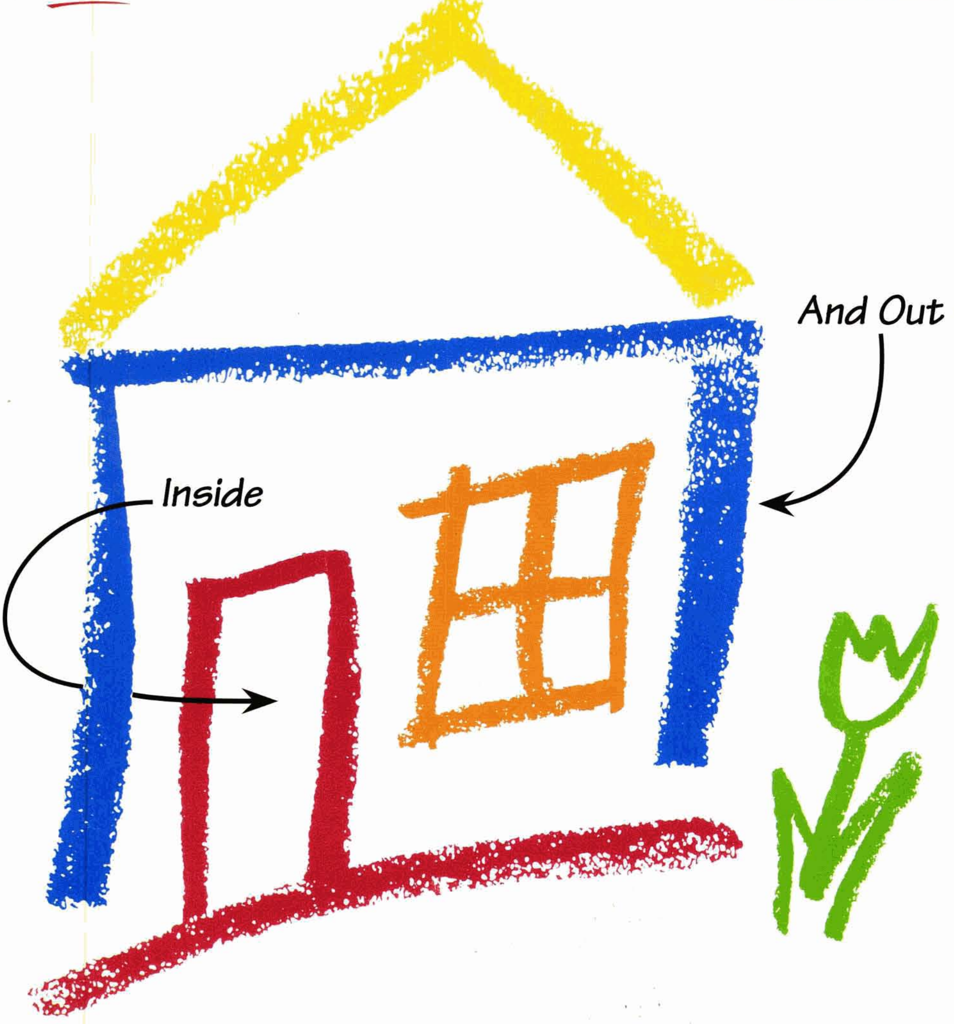

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MAY 1997 VOL. 69, NO. 868

Technical Articles

33 Study of Formulation Variables of Thermoplastic Reflecting Materials for Traffic Marking—A.C. Aznar et al.

The objective of this research is to determine the influence of composition variables (pigment/binder ratio, resin content, plasticizer type and content, fillers employed, and PVC) on the adhesion or wearing resistance of the thermoplastic applied on a concrete surface.

39 Flame-Retardant Brominated Styrene-Based Polymers. X. Dibromostyrene Grafted Latexes—N.A. Favstritsky and J.-L. Wang

This paper shows that dibromostyrene can be easily grafted onto commercial latexes to enhance fire retardance without compromising other useful properties.

45 Determination of Metallic Zinc Content of Inorganic and Organic Zinc-Rich Primers by Differential Scanning Calorimetry—D.G. Weldon and B.M. Carl

The authors demonstrate a rapid and precise method for determining the metallic zinc content of the zinc dust pigment in inorganic and organic zinc rich primers based on differential scanning calorimetry.

51 Selectivity of Isophorone Diisocyanate in the Urethane Reaction Influence of Temperature, Catalysis, and Reaction Partners—R. Lomölder, F. Plogmann, and P. Speier

This work expands our fundamental understanding of the reactivity of a commercially significant isocyanate. It also teaches how to control the NCO and provides a useful bibliography of past studies.

Federation News

Technical Focus

Departments

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THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422-2350, Phone (610) 940-0777; Fax: (610) 940-0292.

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Guide for Authors

GENERAL

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

The Editors invite submission of original research papers, review papers, and papers under the special headings *Open Forum* and *Back to Basics*, and *Letters to the Editor*. All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere. When review papers contain tables or graphs from copyrighted articles, the authors will be required to obtain permission for use from the copyright holders. When the organization with which the authors are affiliated requires clearance of publications, authors are expected to obtain such clearance before submission of the manuscript. Papers presented to associations other than the Federation must be released by written communication before they can be considered for publication in the Journal of Coatings Technology. Authors are obligated to reveal any exceptions to these conditions at the time a manuscript is submitted.

The Journal of Coatings Technology has first right to the publication of papers presented at the Annual Meeting of the Federation and at local regional meetings or symposia of the Constituent Societies.

Papers in which proprietary products or processes are promoted for commercial purposes are specifically nonacceptable for publication.

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...for the Journal

Four complete copies should be sent to the Editor, Journal of Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422. The cover letter should address copyright, clearance, and release issues discussed above and should specify paper category: *Original Research, Reviews, Open Forum*, or *Back to Basics*.

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

...by Constituent Societies For Annual Meeting Presentation

Ten complete copies of the manuscript are required for committee review. The set of copies should be addressed to Mike Bell, Director of Educational Services, FSCT, 492 Norristown Rd., Blue Bell, PA 19422.

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to Mike Bell at the address previously listed.(For complete details, see "Roon Awards" section of the Journal in the January 1997 issue.)

MANUSCRIPT PREPARATION

In general, authors are advised to use the "Handbook for Authors" published by the American Chemical Society as a guide to the preparation of manuscripts (ACS, 1155 Sixteenth St., Washington, D.C. 20036).

Authors are encouraged to consider submissions in several categories and to prepare their manuscripts accordingly. The categories are:

Original Research Papers: The main technical content of the Journal of Coatings Technology will continue to be original research papers. Editors support the trend in scientific writing to a direct, less formal style that permits limited use of personal pronouns to avoid repititious or awkward use of passive voice.

Review Papers: Papers that organize and compare data from numerous sources to provide new insights and unified concepts are solicted. Reviews that show how advances from other fields can beneficially be applied to coatings are also desired. Reviews that consist mainly of computer searches with little attempt to integrate or critically evaluate are not solicited.

Open Forum: Topics for this category may be nontechnical in nature, dealing with any aspect of the coatings industry. The subject may be approached informally. Editors encourage submission of manuscripts that constructively address industry problems and their solutions.

Back to Basics: Papers that provide useful guides to Federation members in carrying out their work are solicited. Topics in this category are technical but focus on the "how to" of coatings technology. Useful calculations for coatings formulation and procedures that make a paint test more reproducible are examples of suitable topics. Process and production topics, i.e., paint manufacture, will also be reviewed in the *Back to Basics* category.

If a submitted paper consists of the text of a presentation made previously to a monthly or special meeting of a Society for Coatings Technology, or to another technical group, the name of the organization and the date of the presentation should be given. If someone other than the author of the paper made the presentation, this information, too, should be noted. Papers originally composed for oral presentation will have to be revised or rewritten by the author to conform to the style described in this guide.

Manuscripts should be typed with double spacing on one side of $8^1/2$ x 11 inch (22 x 28 cm) paper, with at least one-inch (2.5 cm) margins on all four sides. All paragraphs should be indented five spaces, and all pages should be numbered at the top center, or upper right corner.

Title

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

Authors' Biographies and Photographs

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

Abstracts

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

Text

Main headings and sub-headings should be used to improve readability, and to break up typographical monotony. The text should *not* be presented as an alphanumeric outline.

The main headings usually should be INTRODUCTION, EXPERIMENTAL, RESULTS AND DISCUSSION, and SUMMARY or CONCLUSIONS. Sub-headings will be specific to the subject.

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

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

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

Metric System

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

Tables, Graphs, and Drawings

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

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

Graphs should be on good quality white or nonphotographic blue-lined $8^1/2$ x 11 inch paper. Each graph should be drawn on a separate sheet, numbered, and the captions listed on a *copy* of the original graph. Graph captions and legends should also be typed on a separate sheet from original for typesetting.

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

Photographs

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

Color prints and slides are unacceptable.

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

Nomenclature

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

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

Nomenclature of chemical compounds should conform to the style of *Chemical Abstracts* and the IUPAC rules. For oligomeric or polymeric materials, characteristics such as molecular weight, polydispersity, functional group content, etc. should be provided.

Equations

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

Summary

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

Acknowledgment

If used, it should follow the summary.

References

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

(1) Pascal, R.H. and Reig, F.L., "Pigment Colors and Surfactant Selection," *Official* DIGEST, 36, No. 475 (Part 1), 839 (1964).
(2) Davidson, H.R., "Use and Misuse of Computers in Color Control," JOURNAL OF COATINGS TECHNOLOGY, 54, No. 691, 55 (1982).
(3) Stephen, H.G., "Hydrogen Bonding—Key to Dispersion?," *J. Oil & Colour Chemists' Assoc.*, 65, No. 5, 191 (1982).
(4) Patton, T. (Ed.), *Pigment Handbook*, Vol. 1, John Wiley & Sons, Inc., New York, 1973.
(5) Henderson, W.A. Jr. and Singh, B. (to American Cyanamid Co.), U.S. Patent 4,361,518 (Nov. 30, 1982).

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Learning About the Members

Meeting the technical and educational needs of the 7,000 members of the Federation of Societies for Coatings Technology is quite a challenge. In addition to understanding the diverse technical interests of the membership, there are considerations such as the various levels of expertise the members possess in each technical area, their preferred method of delivery of the technical information, along with many other factors to weigh.

Both the Federation staff and the members of many of FSCT's committees assess these needs on an ongoing basis. To assist in this pursuit, the Federation recently received the final results of its 1996 Membership Survey. An article is being prepared for a future issue of JCT which will report many of the findings to the membership, which should be very interesting.

The survey was sent to a random sampling of members in October 1996, and over 25% of the recipients responded to the survey. The survey consisted of 48 questions, ranging from demographic information such as age and gender; to the value of the various FSCT membership benefits; to seeking feedback about the future issues and challenges facing the industry. In many cases, the answers to the questions were as varied as the colors of the spectrum.

To those who participate in the various committees of the Federation, a new tool will be available shortly perform your role more efficiently. To all FSCT members, this information will help us make your Federation membership even more valuable in the future. And most of all, to those took the time to respond to the survey, a hearty thank you!

Michael G. Bell
Director of Educational Services

Technical Abstracts

Spanish translations provided by Mexico Society Member Ing. Marina Estévez, El Nervion, S.A. de C.V.

Study of Formulation Variables of Thermoplastic Reflecting Materials for Traffic Marking—A.C. Aznar, J.J. Caprari, J.F. Meda, and O. Slutzky

JCT, Vol. 69, No. 868, 33 (May 1997)

Nine formulations of thermoplastic materials for traffic marking were prepared using a resin based on maleic anhydride modified with rosin in different proportions (18, 22, and 26%). A liquid coconut long oil alkyd resin (100% solids) was employed as a plasticizer.

Titanium dioxide was used as a hiding pigment while calcium carbonate and micronized talc were used as extenders. Coarse marble powder facilitated the incorporation of glass beads. The operation was made by employing a double Z mixer heated with oil to obtain a mass temperature of 180-190°C. The mixer was equipped with two asynchronous arms rotating at 46 rpm.

Dry and wet abrasion tests were carried out and the results obtained indicated that wearing values are three times greater in the case wet test.

It is demonstrated that plasticization degree controls hardness variation as a function of temperature; therefore, a critical point, which is the beginning of an abrupt reduction of hardness, is determined. Water absorption increases when the plasticizer content increases. A matrix correlation of tests results was used to analyze the obtained numeric values.

Flame-Retardant Brominated Styrene-Based Polymers. X. Dibromostyrene Grafted Latexes—N.A. Favstritsky and J.-L. Wang

JCT, Vol. 69, No. 868, 39 (May 1997)

This paper describes the synthesis, characterization, and some applications of flame-retardant dibromostyrene grafted latexes. These latexes are synthesized by an emulsion polymerization technique. One of the prime factors to be considered in the choice of a commercial latex or a latex blend to be grafted is the glass transition temperature(s) of the polymer(s) in the final latex desired. The graft latexes were characterized in terms of glass transition temperature, solids content, bromine content, grafted dibromostyrene content, and flame retardancy. They are useful for a wide range of applications, including fabric backcoatings, carpetings, paints, sealants, caulks, nonwoven binders, etc.

Polimeros Basados en Bromo-Estireno Como Retarantes a la Flama Latex Modificados Con Dibromo Estireno—N.A. Favstritsky y J.L. Wang

Este articulo describe la sintesis, caracterizacion y algunas aplicaciones de los latex modificados con dibromoestireno como retardantes a la flama.

Uno de los primeros factores que deben ser considerados en la eleccion de un latex comercial o un copolimero de latex para ser modificado, es la temperatura de transicion vitrea de el polimero final deseado. La latex modificados fueron caracterizados en terminos de: su temperatura de transicion vitrea, contenido de solidos, contenido dibromo estireno y retardacia a la flama.

Son utiles para un amplio rango de aplicaciones incluyendo la fabricacion de capas intermedias, carpetas, pinturas, adhesivos, selladores, caucho, elastomeros y mucho mas.

The Determination of Metallic Zinc Content of Inorganic and Organic Zinc-Rich Primers by Differential Scanning Calorimetry—D.G. Weldon and B.M. Carl

JCT, Vol. 69, No. 868, 45 (May 1997)

Although several methods exist for determining the metallic zinc content of the zinc dust pigment in inorganic and organic zinc rich primers, no generally recognized method exists for the analysis of the metallic zinc content in the dried films of such coatings. This paper demonstrates a rapid and precise method, based on differential scanning calorimetry, for making this determination.

Determinacion del Contenido de Zinc Metalico en Primarios Ricos En Zinc (Organicos e Inorgancios) Mediante Exploracion Diferencial Colorimetrica—D.G. Weldon y B.M. Carl

Aunque existen varios metodos para determinar el contenido de zinc metalico en los pigmentos de polvo de zinc de los primarios ricos en zinc organicos e inorgancios, no existe un metodo generalmente reconcido para el analisis del contenido de zinc metalico en las peliculas secas de estos primarios. Este articulo muestra un metodo rapido y preciso, basado en la exploracion diferencial colorimetric para hacer esta determinacion.

The Selectivity of Isophorone Diisocyanate in the Urethane Reaction Influence of Temperature, Catalysis, and Reaction Partners—R. Lomölder, F. Plogmann, P. Speier

JCT, Vol. 69, No. 868, 51 (May 1997)

In a model study of the selectivity of isophorone diisocyanate (IPDI) in the urethane reaction, the influence of the type of catalyst, temperature, and type of OH-group was demonstrated using primary and secondary butanol as reaction partners.

In particular, the choice of catalyst has a dramatic effect on the composition of the final product mixture. The most important conclusions of the model study were confirmed in NCO-prepolymer synthesis.

La Selectividad del Iosforon Diisocianato en la Reaccion de Uretano y la Influencia de la Temperatura, el Catalizador y las Reacciones Secudarias—R. Lomölder, F. Piogmann, y P. Speter

Es un modelo de estudio de la selectividad de los grupos isoforon diisocianato (IPDI) en la reaccion de uretanos, se analiza a influencia de la temperatura, el catalizador y el tipo de grupos hidroxilos (OH), el efecto de estos ultimos fue demostrado usando alcoholes (Butanol), primarios y secundarios para las reacciones secudarias.

En particular la eleccion del catalizador mostro efectos dramaticos sobre la composicion de la mezcla del producto final. La conclusion mas importante del modelo de estudio fue confirmada en la sintesis del prepolimero de NCO.

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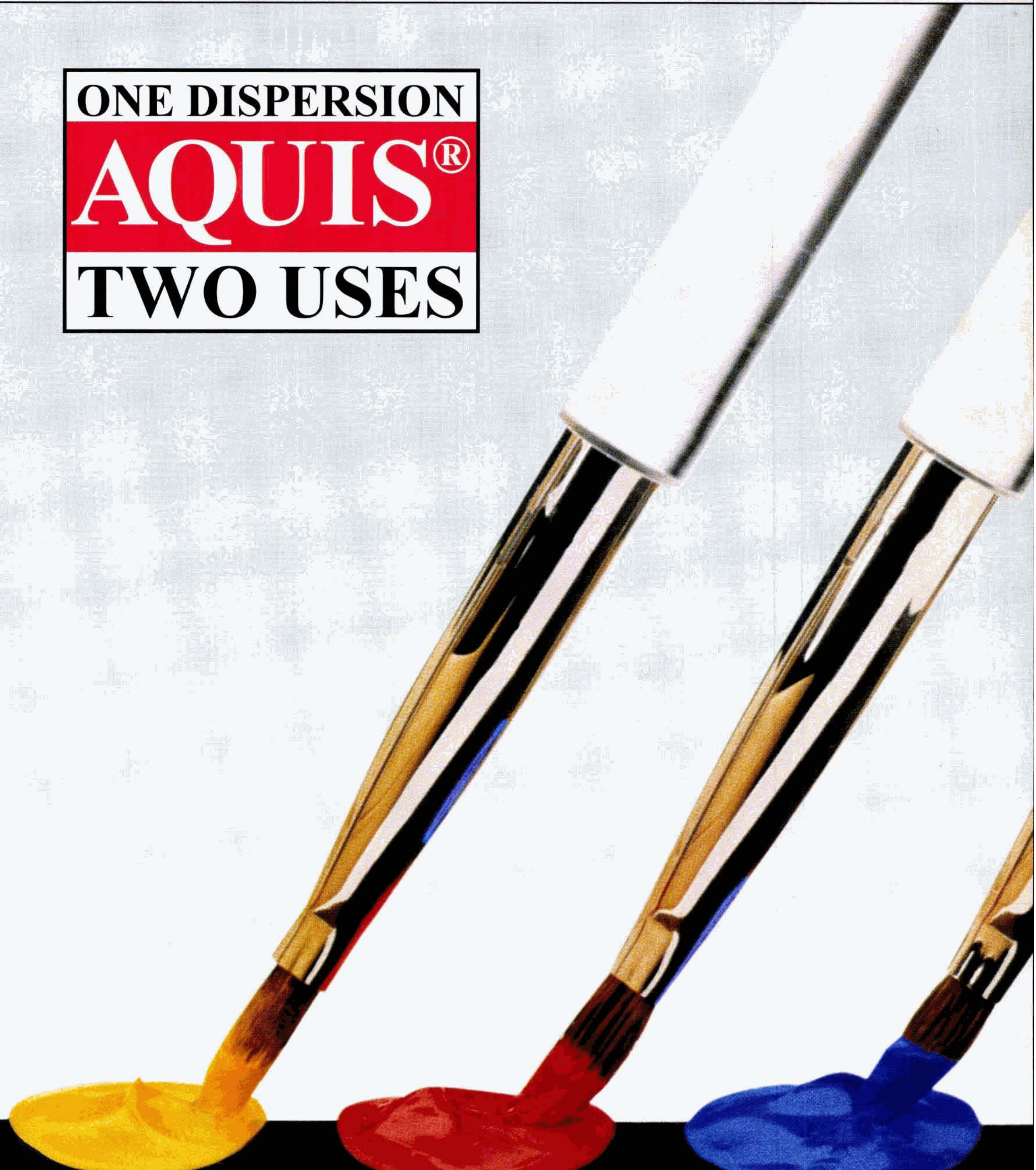

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NEW	PBlk-7	KW3729	Conductive Carbon Black	☐	☐
	PBlk-7	KW3750	Carbon Black	☐	☐
	PG-7	GW3450	Phthalocyanine Green	☐	☐
	PG-7	GW3454	Phthalocyanine Green	☐	☐
NEW	PG-36	GW3436	Brominated Phthalocyanine Green	☐	☐
	PO-5	OW3270	DNA Orange	☐	☐
NEW	PO-16	OW3235	Dianisidine Orange	☐	☐
NEW	PO-43	OW3243	Antharaquinone Orange	☐	☐
	PR-3	RW3125	Toluidine Red	☐	☐
	PR-3	RW3126	Toluidine Red	☐	☐
	PR-3	RW3127	Toluidine Red	☐	☐
NEW	PR-22	RW3191	Naphthol YS	☐	☐
	PR-23	RW3140	Naphthol BS	☐	☐
	PR-48:2	RW3170	Calcium Red 2B	☐	☐
	PR-101	RW3100	Red Iron Oxide Light	☐	☐
	PR-101	RW3105	Red Iron Oxide Medium	☐	☐
NEW	PR-122	RW3114	Quinacridone Magenta	☐	☐
NEW	PR-122	RW3116	Quinacridone Magenta	☐	☐
NEW	PR-166	RW3166	Disazo Scarlet	☐	☐
NEW	PR-170	RW3147	Naphthol Red F5RK	☐	☐
NEW	PR-179	RW3118	Perylene Maroon	☐	☐
NEW	PR-254	RW9111	Diketo Pyrol-Pyrol	☐	☐
NEW	N/A	RW3113	Diketo Pyrol-Pyrol	☐	☐
NEW	PV-19	VW3619	Quinacridone Violet	☐	☐
	PV-23	VW3620	Carbazole Violet	☐	☐
	PW-6	WW3000	Titanium Dioxide	☐	☐
	PY-3	YW928P	Monoarylide	☐	☐
	PY-14	YW3340	Diarylide AAOT	☐	☐
	PY-42	YW3300	Yellow Iron Oxide	☐	☐
	PY-74	YW811P	Monoarylide	☐	☐
	PY-74	YW911P	Monoarylide	☐	☐
	PY-74	YW968P	Monoarylide	☐	☐
	PY-83	YW3310	Diarylide HR	☐	☐
	PY-109	YW3351	Isoindolinone Yellow	☐	☐
NEW	PY-128	YW3328	Disazo Yellow GG	☐	☐
NEW	PY-150	YW3338	Nickel AZO Complex	☐	☐
NEW	N/A	YW3326	Monoarylide Blend	☐	☐

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Company . . . .

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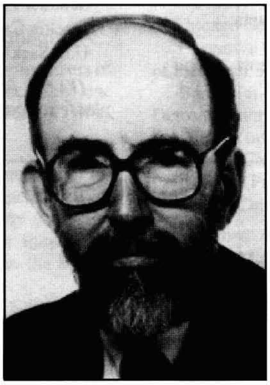
Fax . . . .

Dr. Ray A. Dickie Named Technical Editor of JOURNAL OF COATINGS TECHNOLOGY

The Federation of Societies for Coatings Technology is pleased to announce that Dr. Ray A. Dickie, Corporate Technical Specialist in the Chemical and Physical Sciences Laboratory at Ford Motor Company, Dearborn, MI, has been named Technical Editor of the JOURNAL OF COATINGS TECHNOLOGY. He will also serve as Chair of the JCT Editorial Review Board.

Dr. Dickie was graduated from the University of North Dakota with a B.S. in Chemistry. He earned a Ph.D. Degree in Physical Chemistry at the University of Wisconsin and did post-doctoral research at the University of Glasgow and at Stanford Research Institute. He joined Ford Motor Company in 1968.

Dr. Dickie's research interests center on the chemistry of the polymer-metal interface and related areas of surface coating technology and adhesive bonding. The interfacial chemistry of corrosion-induced adhesion failure has been an area of special interest.



He was awarded the Distinguished Alumni Lectureship in Chemistry at the University of North Dakota in 1989. In 1991, he received the Midgley Award of the Detroit Local Section of the American Chemical Society for "outstanding contributions in the field of chemistry related to the automotive industry." In 1992, he was the recipient of the prestigious Roy Tess Award in Coatings from the American Chemical Society. Dr. Dickie presented the Joseph J. Mattiello Memorial Lecture at the FSCT's 1994 Annual Meeting in Atlanta, GA entitled "Chemical Origins of Paint Performance."

Dr. Dickie has published more than 80 papers, and has been awarded 40 patents.

A member of the Detroit Society for Coatings Technology, Dr. Dickie is also affiliated with the Society of Rheology and American Chemical Society. He served as Chairman of the ACS Division of Polymeric Materials: Science and Engineering in 1987, and was General Secretary of the ACS Macromolecular Secretariat in 1990. He has organized ACS symposia on composites, crosslinking systems, and corrosion protective coatings. In addition to his many years of service on the Editorial Review Board of the JCT, he has served on the editorial advisory and/or review boards of *Progress in Organic Coatings,* and the *Journal of Adhesion Science and Technology.*

Dr. Dickie succeeds Dr. Robert F. Brady, Jr., who served as Technical Editor for the past five years. Dr. Brady is Head of the Coatings Section in the Materials Chemistry Branch in the Chemical Division of the Naval Research Laboratory in Washington D.C.

A recent recipient of the Navy's Meritorious Civilian Service Award, Dr. Brady directs and conducts basic research in polymer chemistry and coatings science, formulates and tests advanced marine and industrial coatings and devices, and validates test methods for coatings. In addition to Technical Committee Chair, he served as head of the Editorial Review Board of the JCT and chaired the FSCT Publications Committee. Dr. Brady was the recipient of the FSCT Roon Foundation Award in 1992, and was named the Washington Paint Technical Group's Man of the Year. He was elected a fellow of the Royal Society of Chemistry in London 1992.

ICE '96 "Audience Survey" Profiles Attendees

Results of the "Audience Survey of the 1996 FSCT International Coatings Expo (ICE) and Technology Conference" have been published. Conducted independently by Exhibit Surveys Inc., Red Bank, NJ, the "Audience Survey" provides a statisticalprofile of the 8772 attendees at ICE '96, held in Chicago, IL, on October 22-25.

According to survey results, almost half (49%) of ICE attendees are involved in research and development, with the majority of those being managers, directors, supervisors, technical directors, chief chemists, group leaders, senior chemists, engineers, or scientists. Nearly 17% represent those in administration (presidents, vice presidents, general managers, plant managers, etc.) and 23% are in sales, marketing or technical service.

In terms of industry representation, 40% represent the coatings manufacturing industry. Distributors and Manufacturer's Reps also factored highly (22%).

The geographical distribution was broad, with 25 states represented by 1% or more of attendees; 18% were international visitors.

In the area of attendee habits, it was determined that 30% visited the Expo for the first time in 1996, while 32% are regular attendees (with participation for three or more consecutive years). Attendees spent an average of 8.4 hours at ICE '96 . This compares to the all-show national average of 7.6. The average number of days spent at the exhibits was 2.0, with the first and second days recording the heaviest traffic.

Of the products and services exhibited, Raw Materials generated the most interest in 1996 (85%), followed by Production/Application Equipment (53%), Laboratory and Testing Equipment (52%) and Services/Other Equipment (37%).

Total Buying Plans, based on the percentage of attendees planning to buy one or more of the products exhibited as a result of what they saw at the Expo, was 58%, an increase of five percent from 1995. In addition, Net Buying Influences—the percentage of attendees who have final say, specify the supplier, or recommend for purchase the types of products exhibited—was 83%.

When questioned which publications were read regularly, 34% of attendees indicated the JOURNAL OF COATINGS TECHNOLOGY and *Paint & Coatings Industry;* 33% read *American Paint & Coatings Journal* and 23% noted *Modern Paint & Coatings.* For "Publications Most Useful in Their Work," the attendees again selected JOURNAL OF COATINGS TECHNOLOGY and *Paint & Coatings Industry* (17%); *American Paint & Coatings Journal* (10%); and *Modern Paint & Coatings* (5%).

For additional information on the "Audience Survey," contact FSCT at 492 Norristown Rd., Blue Bell, PA 19422.

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S.B.P. SPIRITS
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ice
INTERNATIONAL
COATINGS EXPO
NOVEMBER 3-5, 1997
ATLANTA, GA

Federation of Societies for Coatings Technology
1922
1997
75
years

ice '97
F S C T
75th Annual Meeting
International Coatings
Expo and Technology
Conference

FSCT's "ICE '97" Marks Our 75th Anniversary

Encompassing the spectrum of coatings manufacturing, the new format of the FSCT's annual convention will again feature an exhibition of over 300 supplier companies at the **International Coatings Expo, on November 3-5, 1997 at the Georgia World Congress Center, in Atlanta, GA.** Held in conjunction with the **FSCT Annual Meeting and the Technology Conference,** the Expo will present the industry's largest exhibition of suppliers. Come meet these suppliers for a face-to-face discussion of your needs and concerns. Problem-solving opportunities abound at "ICE '97"!

Both you and your company benefit from attendance at this event. Your personal knowledge increases, which in turn improves your value within your organization, while the company stands to benefit from the new ideas and solutions you've learned by attending the conferences. The conferences also provide an opportunity for all coatings personnel to participate in the industry's premier event and learn the latest advances in the coatings industry.

The FSCT's concurrent Technology Conference will provide a forum for learning at all levels of the coatings industry, from the newly hired technician to top level management. Each Course has been designed for specific areas of your organization, including lab personnel, sales and marketing staff, manufacturing, research and development, and quality assurance.

Highlights of the Technology Conference include:

- Two Executive Forums, covering new product development and technology management on Monday, November 3.
- Nine one-day Courses, scheduled over three days; November 3,4, and 5, allowing attendees ample time to visit the International Coatings Exposition.
- Four two-day Courses, scheduled for Monday and Tuesday, November 3 and 4, which again allows attendees time to visit the Exposition on November 5.
- Course attendees will be given *complimentary attendance* to the International Coatings Expo and the technical presentations given at the FSCT's Annual Meeting.
- Set of Course Materials is provided to the attendees of each Course.

An Invitation from the President

Friends:

On behalf of the FSCT, I am happy to invite you to attend this year's Annual Meeting and Coatings Technology Conference—and to celebrate with us our 75th Anniversary—at the Georgia World Congress Center in Atlanta. Building on the overwhelming success of the first "ICE" held last year, the Federation looks forward to presenting an even more formidable array of exhibits at the 1997 International Coatings Expo.

Please review the impressive list of Conference Courses. You will see that the FSCT takes seriously its mission of "providing for the technical education and professional development of its members and the industry." You will find that this educational investment will provide a wealth of knowledge which will benefit both you and your company.

And, while suppliers may visit you from time to time, there is nothing like the face-to-face attention you will receive from visiting the exhibits at the International Coatings Expo. Over 200 companies have reserved space to date and we expect that all 900-plus booths will be filled by the show date. Bring your questions, bring your problems; the answers are here!

As this year's theme says, "75 Years: Tradition, Discovery, Opportunity." From the Opening Session, featuring noted futurist Daniel Burrus, to the closing Mattiello Lecture by F. Louis Floyd, of Duron, Inc., the FSCT will be in celebration of its 75th Anniversary. Come join us as we learn from the past, become stronger in the present, and look forward to the future!

M. Jay Austin
FSCT President, 1996-97

INTERNATIONAL COATINGS EXPO

NOVEMBER 3-5, 1997
ATLANTA, GA

FSCT 75th Anniversary Annual Meeting Program

Celebrating 75 years as the premier technical organization in the coatings industry, the FSCT has planned an event that will truly reflect the theme "75 Years . . . Tradition . . . Discovery . . . Opportunity." ICE '97 will provide a fascinating look back to the organization's origins. Even further, it will offer attendees insights into the coatings industry as it moves into the future—previewing innovative technologies and solutions to current challenges.

Participants of ICE '97 will have the opportunity to attend Annual Meeting technical sessions as part of their registration. Highlights of this year's technical program include:

ICE '97 Opening Session: Keynote Address by Daniel Burrus

Daniel Burrus, respected Science and Technology Forecaster, will provide the Keynote Address at the Opening Session on Monday, November 3.

Recent innovations in science and technology have provided us with a "new" set of tools to work with which will greatly increase our productivity and efficiency in all areas. Knowing what these tools are, and how to apply them creatively is rapidly becoming a matter of business survival and a key to personal gain. In his presentation, Mr. Burrus uses down-to-earth terminology, insight and humor to provide an informative, provocative and fascinating look at the impact of scientific innovations on how we will live and work in the near future.

Roon Award Competition Papers

Representing the best technical work directly related to the protective coatings industry, the Roon Award Papers describe original work of high scientific caliber, not previously presented or published. Awards for the papers are determined on the basis of originality, scientific importance, practical value, and the quality of composition.

International Papers

Reflecting the global audience of ICE '97, papers are presented from international industry experts. These papers often report on technologies which may affect the global marketplace or detail some of the latest technical advances outside of North America.

APJ/Voss Award Competition Papers

These FSCT Constituent Society papers are developed and presented by the Societies' technical committees. Their work deals with the research, development, manufacture or application of the industry's products or raw materials entering into their preparation.

Women in Coatings Roundtable

Entitled, "Coatings 2000: Women Leading into the New Century," this panel discussion will feature female leaders of the coatings industry addressing a timely topic—the role of women in the paint and coatings industry, both now and in the future.

Technical Focus Lecture

One of the most popular features of the Annual Meeting, the Technical Focus Lecture kicks off the technical portion of the Annual Meeting technical program. The Lecturer is chosen by the Chairs of several FSCT Committees, for on-going work in critical technical areas.

Mattiello Memorial Lecture

The 1997 Mattiello Lecturer is F. Louis Floyd, Vice President for Technology of Duron Paints and Wallcoverings, Baltimore, MD. The Mattiello Lecturer is an individual who has made outstanding contributions to science, technology, and engineering, related to the coatings industry. The Lecturer embodies the standards of technical accomplishment, service to the coatings industry and leadership established by Joseph J. Mattiello, who did much to expand the application of science in the decorative and protective coatings field.

Coatings Societies International to Present Medallion Honoring Technical Achievement at FSCT 75th Annual Meeting

Coatings Societies International will sponsor an award honoring outstanding technical achievement in the presentation of papers at the FSCT Annual Meeting in Atlanta, on November 3-5, 1997. This award, first presented at the XXIII FATIPEC Congress in June 1996, is given at selected annual congresses of CSI-member organizations.

In addition to the Federation of Societies for Coatings Technology, member organizations of CSI include: FATIPEC (Federation d'Association des Technicians des Peintures, Vernis, Emaux, et d'Imprimerie de l'Europe Continentale); JSCM (Japan Society of Colour Materials); OCCA (Oil & Colour Chemists' Association); SLF (Skandinaviska Lackteknikers Forbund); SCAA (Surface Coatings Association Australia); and SCANZ (Surface Coatings Association New Zealand).

The award is a polished bronze medallion, inscribed with the CSI logo. Interested parties may contact the CSI General Secretariat at the Federation of Societies for Coatings Technology, 492 Norristown, Rd., Blue Bell, PA 19422-U.S.

Coatings Technology Conference

All Courses held at Georgia World Congress Center

Sunday, November 2

Sunday Evening (Reception and Dinner)

(Included when you register for Executive Forum I & II)

Monday, November 3

Executive Forum I:

Strategically Effective New Product Development: An Enterprise-Wide Approach from Concept through Commercialization

Course Description

A one-day interactive workshop introducing participants to the "Why's" and "How's" of enterprise-wide New Product Development (NPD), fuzzy front end processes, concept generation, portfolio management, supporting systems and tools and fast development. The course is geared toward company executives and decision makers with key responsibilities for improving their organization's NPD output.

Attendees will learn:

- The major problems and challenges with most new product development processes
- Why speed to market is insufficient
- Critical elements of enterprise-wide NPD
- How to develop NPD strategy that delivers results; assess the risks of NPD projects and portfolios; and ways to align fuzzy front end processes with NPD process
- Methods to turn NPD ideas into organizational actions
- How to effectively use the tools and techniques that support the NPD process

Instructors

- Paul O'Connor, Adept Group, Ltd.
- Chris Miller, Innovation Focus

Attendance Limit

30

Executive Forum II:

Advanced Topics in Technology Management

Course Description

Targeted to R&D and business executives who have strategic leadership responsibility in their organizations, this executive level workshop will introduce participants to three management topics focused on maximizing technology to achieve commercial success in the coatings industry.

Attendees will learn:

- What a CEO should expect from the R&D function
- How to assess technology to achieve commercial success in the coatings industry
- The various Competitive Analysis Methods available for Technology Managers

Instructors

- Stephen E. Rudolph, A.D. Little
- John F. Martin, A.D. Little

Attendance Limit

30

Effective Technical and Scientific Writing Workshop

Course Description

For all levels of laboratory and R&D personnel, along with applicators and anyone with responsibility for writing memos, letters, reports, manuals, specifications and proposals on a routine basis. The session includes in-class writing exercises designed for practical application and allows time for individual instructor attention. Participants are invited to submit writing samples in advance for confidential review by the instructor.

Attendees will learn:

- Skills and techniques to improve technical communication
- Improve effectiveness in communicating technology
- Data collection and tabulation (maximize impact of data)
- Making technical issues understandable
- How to translate technical terms to easily understood everyday language
- Writing skills/structure, format
- "Rethink how you write"

Instructor

- Sal Iacone

Attendance Limit

25

Effective Employee Motivation Strategies

Course Description

Designed for all managers, this course will provide attendees with the necessary techniques to keep employees all pulling in the same direction for a common cause. Participants will learn the benefits of different types of motivational strategies and why some techniques work on certain people and not others. Attendees will also learn the value of incorporating these strategies into their management style.

Attendees will learn:

- What really motivates employees
- The various kinds of effective motivational techniques
- The different styles of employees
- Which motivational techniques work for which employees
- Money — Is it the great motivator?

Attendance Limit

30

Monday-Tuesday, November 3-4

(Two-Day Courses)

Introduction to Radiation Curing

Course Description

Radiation curable coatings are fast becoming an efficient method to meet the regulatory challenges facing the industry. This course is designed for formulating chemists, R&D chemists, technical directors and company decision makers in the adhesives, inks, plastics and coatings industries, and will provide details on the basics of radiation cure as a low VOC, low energy cure technology.

Attendees will learn:

- A basic understanding of radiation curing and its potential as a type of coating
- The various types of radiation curing (electron beam, free radical, and cationic)
- The equipment used in the technology
- Formulation methods for radiation curable coatings
- Information on toxicology and issues related to safety and handling

Instructors (Partial List)

- Latoska Price, Akzo Nobel
- Paul Gupta, Flint Ink Corp.
- Ed Jurczak, Sartomer
- Richard Stowe, Fusion
- Roy Modjewski, Akzo Nobel
- Ron Golden, UCB Radcure
- Bill Schaeffer, Sartomer

Attendance Limit

125

Methodology of Evaluating Corrosion Resistance

Course Description

This course is designed to review what corrosion is, its mechanism, methods of prevention, and a discussion of standardizing the process of testing for corrosion resistance. Attendees will learn important details of corrosion, the principles of protection, and then participate in and discuss possible methods of standardizing the evaluation process. It is designed for formulators, R & D chemists, technical service personnel and technical management.

Attendees will learn:

- Gain a better understanding of the corrosion cell and its various constituents
- How to analyze various methods of preventing corrosion
- About the many methods of evaluating corrosion resistance of coatings
- Ways to gain an understanding of the limitations due to the various exposure conditions
- Approach the goal of having a standard process in describing corrosion resistance
- Review an extensive project which attempted to make a correlation of accelerated tests with actual exposure

Attendance Limit

125

Back to Basics: Resins, Pigments, Solvents & Additives

Course Description

For chemists, lab technicians, sales, marketing, and field support personnel new to the industry or with minimal experience. Participants will gain a better understanding of the basic composition of coatings and will be given tips on troubleshooting techniques to effectively formulate coatings.

Attendees will learn:

- In-depth review of the four main components of a coating: resins, pigments, solvents, and additives
- Understanding the role these four main components play in the development of coatings
- The effect various application methods have on coatings performance
- Information on the various types of coatings

Attendance Limit

125

Polymer Chemistry for the Coatings Formulator

Course Description

Provides current information on polymer chemistry for coatings formulators, R&D chemists, and sales and marketing personnel with strong technical backgrounds or interests. Attendees will realize a greater understanding of the essential concepts of polymer science and the underlying principles to determine coating performance. The course helps attendees to develop coatings using specific scientific principles as opposed to trial and error and is also relevant for ink, sealant and adhesive industry personnel.

Attendees will learn:

- Fundamental principles behind chain-growth and step-growth polymerization
- The basic principles of emulsion polymerization and how it differs from solution polymerization
- Crosslinking reactions and how they modify film formation
- The most important classes of polymers used in coatings, their properties and how polymer chemistry can modify these properties
- How polymer structure is related to the rheology and mechanical properties of polymers
- How polymers are characterized with modern analytical techniques

Attendance Limit

125

Tuesday, November 4

(One-Day Courses)

Winning Technical Presentations

Course Description

For laboratory and R&D personnel at all levels, in addition to marketing and sales staff and anyone else responsible for delivering technical presentations. Attendees will learn how to develop effective visuals; proper speaking techniques and data organization; how to handle question and answer sessions; tips on transferring written information to speaking terms; and how to communicate clearly to all audiences. This program offers a combination of lecture, interaction and small group projects.

Attendees will learn:

- How to effectively develop visuals for technical presentations
- Learn proper speaking techniques
- How to organize data
- Tips to transfer written information to speaking terms
- How to handle question and answer sessions
- Presentation style and format
- How to effectively communicate to all audiences

Instructor

Carter Johnson

Attendance Limit

25

Effective Negotiating Skills

Course Description

Every day, in every aspect of our lives, we are faced with negotiations. This program, designed for both technical staff and sales personnel, will provide attendees with proven techniques to enable your organization to benefit, both financially and time wise, from improved negotiations.

Attendees will learn:

- How to produce win-win situations
- How to avoid confrontational negotiations
- Identifying various negotiating styles
- Closing the deal
- Effective communication tools

Attendance Limit

30

Creative Decorating

Course Description

Designed for decorators, applicators, those who develop trade sales paints, forward marketers, painting contractors, store owners, and anyone interested in do-it-yourself projects, this course will provide current information on the latest techniques being used to decorate homes and the workplace. The course will cover techniques such as stenciling, rag painting, sponge and broom painting and many other methods used to provide the current "looks" for home and office decoration.

Attendees will learn:

- Stenciling
- Rag Painting
- Sponge Painting
- Broom Painting
- Pickling (cabinets)
- Antiquing
- Marbling
- Colors
- Textures

Attendance Limit

50

Wednesday, November 5

(One-Day Courses)

Surfactant Chemistry and Application

Course Description

For R&D personnel, technicians, formulating chemists and application chemists, along with technical service personnel in the coatings and inks industries, this course will provide attendees with a better understanding of the various aspects of surfactant chemistry and its effect on the development of coatings and inks. Attendees will also develop an open thinking approach to surfactants and problem solving. This course content will include case studies and live demonstrations. Attendees are encouraged to submit questions in advance.

Attendees will learn:

- Information to gain a better understanding of surfactant types, surfactant chemistry and physical properties
- Fundamentals of surfactants: wetting and dispersing; substrate wetting; surface tension control (flow and leveling); and defoaming
- Practical application tests and problem solving methods—through case studies and panel discussions

Instructors (Partial List)

- Bob Stevens, Dow Corning
- Steve Snow, Air Products
- Ed Orr, BYK Chemie
- Joel Schwartz, Air Products
- Fred Lewchik, BYK Chemie
- Tara Greesing, Ultra Additives

Attendance Limit

75

Industry Leadership with Product Stewardship

Course Description

This course has been developed for senior officers, hygienists, regulatory personnel, and those individuals involved in regulatory enforcement from the DOT, military, refinishing industry as well as the coatings and chemical industries. The program will give attendees a good description of the benefits of developing a Product Stewardship program and the value it has to the company. Initiatives such as Responsible Care™ and Coatings Care™ will be reviewed, and the benefits of these initiatives will be illustrated. This overview will give a basic understanding to attendees on how to install and manage such a program.

Attendees will learn:

- Practical information on Responsible Care™ and Coatings Care™
- Why Product Stewardship programs are being utilized by the industry
- Rules of the concept (TSCA, SNUR)
- Personal protective equipment involved
- Disposal issues
- What training aids/resources are available

Attendance Limit

100

Responsible Care™ is a registered trademark of the Chemical Manufacturers Association.
Coatings Care™ is a registered trademark of the National Paint and Coatings Association.

Spray Applications Workshop

Course Description

Provides both experienced and novice applicators, field service personnel, specifiers and formulators with information on current and upcoming technologies as they apply to the application of coatings and finishes. Considered a "Learning Exchange Seminar," attendees will learn how to properly select, maintain and operate spray finishing equipment and to answer a variety of questions related to spray finishing.

Attendees will learn:

- Various types of spray equipment (adjust, tip, size, fanning technique)
- How to choose equipment wisely
- Problem-solving techniques
- Proper care and maintenance of spray equipment
- Electrostatic application of liquid and powder coatings
- Application of coatings by air atomization, airless and air-assisted airless
- Various operator techniques
- High Volume Low Pressure (HVLP)

Attendance Limit

25

Chemistry and Formulation of Powder Coatings

Course Description

Designed to provide formulators, R&D chemists, technical directors, and company decision makers with information on the basic processes of formulating powder coatings. This course will be beneficial to both newcomers to the powder coatings industry as well as give information to those companies that are considering adding powder coatings as a product line.

Attendees will learn:

- The basic principles of powder coating formulation
- Up-to-date information on the chemistry of powder coatings
- What processes are utilized in the preparation of powder coatings
- Issues related to the application techniques for the coatings formulator

Attendance Limit

100

ICE '97 Tentative Schedule of Events

Sunday, November 2

Registration Services	8:00 a.m. to 5:00 p.m.	Georgia World Congress Center (GWCC)

Monday, November 3

Registration Services	7:00 a.m. to 5:00 p.m.	GWCC
Technology Conference	8:00 a.m. to 5:00 p.m.	GWCC
Opening Session	8:30 a.m. to 10:00 a.m.	GWCC
Expo Hours	10:00 a.m. to 5:00 p.m.	GWCC
Annual Meeting Program	10:00 a.m. to 4:00 p.m.	GWCC
Social Guests Welcome Reception	2:00 p.m. to 4:00 p.m.	GWCC

Tuesday, November 4

Registration Services	7:00 a.m. to 5:00 p.m.	GWCC
Technology Conference	8:00 a.m. to 5:00 p.m.	GWCC
Expo Hours	9:00 a.m. to 5:00 p.m.	GWCC
Social Guests Optional Tours	9:30 a.m. to 3:30 p.m.	departs from GWCC
Annual Meeting Program	10:00 a.m. to 4:00 p.m.	GWCC
International Reception	6:30 p.m. to 7:30 p.m.	Marriott Marquis

Wednesday, November 5

Registration Services	7:30 a.m. to 12:00 p.m.	GWCC
FSCT Anniversary Breakfast	8:00 a.m. to 9:30 a.m.	GWCC
Technology Conference	8:00 a.m. to 5:00 p.m.	GWCC
Expo Hours	9:00 a.m. to 12:00 p.m.	GWCC
Annual Meeting Program	9:00 a.m. to 12:00 p.m.	GWCC

INTERNATIONAL
COATINGS EXPO

NOVEMBER 3-5, 1997
ATLANTA, GA

Guest Accommodations

There are 10 hotels providing convention rates for ICE '97. All have undergone extensive renovations to prepare for the Olympics held in Atlanta in 1996. Properties have been included to match every travel budget.

The Atlanta Convention Bureau's housing department is the official housing coordinator for ICE '97. To obtain a reservation for the convention, you must complete the official housing form and send it to ICE Housing. Only international attendees using a credit card may fax to 404-521-6392. The Bureau will provide an acknowledgment of all reservations. The hotel assigned will then forward a confirmation of the reservation. Please read your confirmation carefully for the hotel's cancellation policy.

The deadline for housing is **October 3**. After October 3, the Housing Bureau will place reservations on a space available basis. A deposit is required on all reservations. The deposit amount is $125 per room reservation with three exceptions: the Ritz Carlton, the Westin, and Omni at CNN, each of which requires a deposit equal to one-nights' stay. If paying by check, make the check payable to the ICE Housing Bureau. Credit card deposits will be processed 30 days prior to arrival. Before October 3, contact the Housing Bureau at 404-521-6630 with changes required. After October 3, contact the hotels directly.

The ICE Housing Bureau strives to place your reservation in the hotel of your choice. If the property desired is not available, the reservation will be placed based on the next choice available. Please be sure to indicate three choices on your form.

Rates

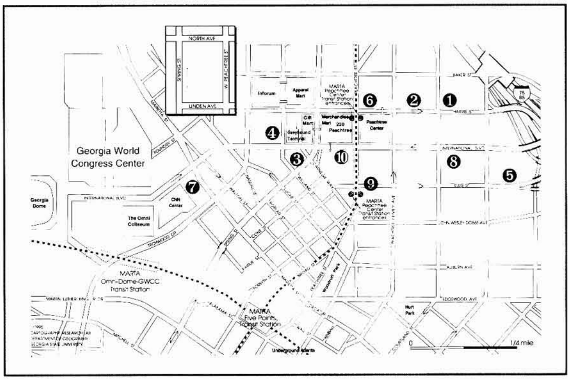
Hotel	Single	Double or Twin	1 BR Suites	2 BR Suites	X indicates Shuttle stop
FSCT Headquarters					
Atlanta Marriott Marquis*	$150	$170	$500 - $1,250	$650 - $1,400	x
Marquis level	194	214			
Atlanta Hilton and Towers	150	170			x
Hyatt Regency Atlanta	155	175	605 - 925	825 - 1,075	x
Concierge level	189	209			
Westin Peachtree Plaza	147	167			x
Concierge Level	177	197			
Radisson	91	101			x
Omni at CNN*	159	179	675 - 825	825 - 1,800	
Courtyard by Marriott	129	139			x
Best Western American	99	114			x
Concierge level	119	134			
Ritz Carlton	165	180			x
Comfort Inn	105	115			x

Key: Single = room with one occupant; Double = room with two occupants, 1 bed; Twin = room with two occupants, 2 beds; 1 bedroom suites = living room parlor and one connecting bedroom; 2 bedroom suites = living room parlor and two connecting bedrooms

*Exhibitors will be limited to a block of 10 rooms at the Marriott Marquis and the Omni at CNN. A one-bedroom suite counts as 2 rooms. A two-bedroom suite counts as 3 rooms.

KEY to HOTEL MAP

1. Atlanta Hilton and Towers
2. Atlanta Marriott Marquis
3. Best Western American Hotel
4. Comfort Inn Downtown
5. Courtyard by Marriott Downtown
6. Hyatt Regency Atlanta
7. Omni at CNN
8. Radisson Hotel Atlanta
9. Ritz Carlton Atlanta
10. Westin Peachtree Plaza Hotel



1997 Housing Application Form

Reservations must be placed with the ICE Housing Bureau to receive preferred rates. Hotels will not accept reservations directly. *Reservations must be received by* ***October 3, 1997.***

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
ice
INTERNATIONAL COATINGS EXPO
AND TECHNOLOGY CONFERENCE

1. To Make Reservations

- ◆ Please print or type all items to ensure accuracy
- ◆ Complete each part below in detail for correct and rapid computer processing
- ◆ Form may be duplicated or supplemental room list must be attached using same format as below

---

MAIL or FAX

Send completed form and payment (in U.S. dollars only) to:

ICE Housing Bureau
233 Peachtree St., N.E.
Suite 2000
Atlanta, GA 30303

International Attendees may fax to 404-521-6392

Prior to October 3, all reservations, changes, and cancellations must be made with ICE Housing Bureau. After this date, these changes must be made with the hotel directly. Cancellation policies vary by hotel, please read confirmations carefully.

2. Hotel Information

Select 3 hotels of your choice to facilitate processing. Requests are given priority in the order received. First choice is assigned IF AVAILABLE. Be sure to list definite arrival and departure dates. Please use brackets to indicate those sharing a room.

1st ______________________ Rate ________ 3rd ______________________ Rate ________

2nd ______________________ Rate ________ No. of rooms requested ________

Names of Occupants	Room Type*	Arrival	Departure
1.	☐ single ☐ dbl/dbl ☐ double		
2.	☐ single ☐ dbl/dbl ☐ double		
3.	☐ single ☐ dbl/dbl ☐ double		
4.	☐ single ☐ dbl/dbl ☐ double		
5.	☐ single ☐ dbl/dbl ☐ double		

* Room Key: single (1 person, 1 bed); double (2 people, 1 bed); double/double (2 people, 2 beds).

Requests for the Marriott Marquis and the Omni @ CNN will be limited to 10 rooms per exhibitor company.

3. Room Deposit

All rooms require a room deposit or credit card guarantee. Deposits are $125 per room for all hotels with the exception of the Omni @CNN, Westin, and Ritz Carlton. They require a one night's stay deposit. Deposits may be made by major credit card or check (U.S. dollars).

☐ Enclosed is my check payable to the ICE Housing Bureau for $ ______

Please bill my: ☐ AMEX ☐ MC ☐ Visa

Credit Card Number ______________________ Expiration Date ____________

Name of Card Holder ______________________ Signature ______________________

4. Send Confirmations to:

Contact Name: ______________________ Telephone: ______________________

Company: ______________________ FAX: ______________________

Address: ____

City/State (Province): ______________________ Zip Code (Mailing Code): ____________

Country (if other than U.S.): ______________________

♿ ______________________ requires special assistance. Please attach a written description of your needs.

ice
INTERNATIONAL
COATINGS EXPO

NOVEMBER 3-5, 1997
ATLANTA, GA

Registration Information

Registration Procedures

By Mail Complete ICE '97 Registration Form and mail with payment to:

ICE Registration
P.O. Box 998
Park Ridge, IL 60068

By Fax 24 hours a day, 7 days a week
U.S. 800-952-9812
International 847-698-9245

By the Internet The FSCT's ICE '97 Registration has gone on-line. To register via the Internet, use the address: "www.coatingstech.org"

If you have any questions on how to complete the registration form, contact the ICE Registration Help Line:

U.S. 800-823-1530
International 847-384-7755

All cancellations and refund requests must be in writing and sent to ICE Registration. Cancellations received after October 26 are non-refundable.

All pre-registered attendees will receive a confirmation statement of their registration selection. Badges and materials will be available for pickup at the ICE Registration Services Area located in the Georgia World Congress Center beginning on Saturday, November 1.

Registration Rates

	EARLY BIRD DISCOUNTS *(Deadline is June 30, 1997)*		ADVANCE PRICING *(After June 30, 1997)*		CANCELLATION FEES	
	Member	Non-Member	Member	Non-Member	Before Oct. 3	After Oct. 3
ICE Expo/Annual Meeting Attendee	$70	$90	$75	$100	$25	$25
Retired Members	–	–	30	–	–	–
Students	–	–	15	15	–	–
Social Guests	–	–	40	40	–	–
Swan House Tour	–	–	60	60	–	–
Atlanta Tour	–	–	60	60	–	–
Conf. Package 1	225	315	250	350	50	100
Conf. Package 2	405	540	450	600	50	100
Conf. Package 3	495	675	550	750	50	100
Executive Forum	495	675	550	750	50	100

Registration Options

ICE Expo/Annual Meeting	Attendee receives 3-days' admittance to the Expo and to the Annual Meeting program
Conference Package 1*	Receives admittance to 1 ONE-DAY course
Conference Package 2*	Receives admittance to 2 ONE-DAY courses <u>or</u> 1 TWO-DAY course
Conference Package 3*	Receives admittance to 3 ONE-DAY courses <u>or</u> 1 TWO-DAY & 1 ONE-DAY course
Executive Forum	Receives admittance to 1 Executive Forum and 3 days admittance to the ICE Expo/ Annual Meeting

**All conference packages include admittance to the Expo and Annual Meeting Program*

Do Not Use This Form After October 3, 1997

ICE '97, PRE-REGISTRATION FORM

November 3-5, Atlanta, GA

Early-bird pricing is in effect until JUNE 30. For regular pre-registration, this form must be postmarked no later than OCTOBER 3, 1997. Form must be filled out completely for processing. A confirmation of your registration will be sent to you. ICE badges must be worn for admission to the ICE exhibits and all Technical Conference programs.

STEP 1. Industry Attendee Badge Information

FIRST NAME (Nickname)

FIRST NAME LAST NAME

COMPANY

MAILING ADDRESS (or P.O. Box)

CITY STATE/PROV.

COUNTRY (other than U.S.) POSTAL CODE

AFFIX MAILING LABEL HERE

TELEPHONE NO. FAX NO.

STEP 2. Registrant Profile

Are you a first-time attendee?
1 ☐ Yes 2 ☐ No

FSCT Society Affiliation____________________________

Information below must be completed for registration to be processed:

Your Company (Check one only)

- 31 ☐ Manufacturers of Paints, Varnishes, Lacquers
- 32 ☐ Manufacturers of Printing Inks
- 33 ☐ Manufacturers of Sealants, Caulks, Adhesives
- 34 ☐ Manufacturers of Powder Coatings
- 35 ☐ Manufacturers of Raw Materials
- 36 ☐ Manufacturers of Equipment and Containers
- 37 ☐ Sales Agents for Raw Materials and Equipment
- 38 ☐ Government Agency
- 39 ☐ Research/Testing/Consulting
- 40 ☐ Educational Institution
- 41 ☐ Paint Consumer
- 42 ☐ Environmental Services
- 43 ☐ Other __________________

Your Position (Check one only)

- 51 ☐ Management/Administration
- 52 ☐ Mfg. & Engineering
- 53 ☐ Quality Control
- 54 ☐ Research & Development
- 55 ☐ Technical Sales Service
- 56 ☐ Sales & Marketing
- 57 ☐ Consultant
- 58 ☐ Educator/Student
- 59 ☐ Other __________________

STEP 3. Social Guest Badge Information

FIRST NAME (Nickname)

FIRST NAME LAST NAME

CITY STATE/PROV.

COUNTRY (other than U.S.) POSTAL CODE

TELEPHONE NO.

Social Guest Registration
(Welcome Social and Expo) $40

Optional Activities *(Select only one—include selection in Step 5):*
Tues. Tour to Swan House $60
Tues. Tour of Atlanta Highlights $60

STEP 4. Conference Registration: Conference registrants must check boxes of session they wish to attend *(Not more than one box per day)*

Monday, Nov. 3	**Tuesday, Nov. 4**	**Wednesday, Nov. 5**
ONE-DAY COURSES ☐ **1** TECHNICAL WRITING ☐ **2** MOTIVATION	**ONE-DAY COURSES** ☐ **3** TECH. PRESENTATIONS ☐ **4** NEGOTIATING ☐ **5** CREATIVE DECORATING	**ONE-DAY COURSES** ☐ **6** SURFACTANT CHEM. ☐ **7** PROD. STEWARDSHIP ☐ **8** SPRAY APPLICATION ☐ **9** POWDER COATING
TWO-DAY COURSES (Nov. 3-4) ☐ **A** RADIATION CURING ☐ **B** CORROSION ☐ **C** BACK TO BASICS ☐ **D** POLYMER CHEM.	(TWO-DAY COURSES WILL BE COMPLETED ON TUESDAY)	***NOTE: Registration is limited for many courses. Provide alternate selections (put an X over appropriate choice/s):*** ***one-day courses:*** ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ***two-day courses:*** Ⓐ Ⓑ Ⓒ Ⓓ ***executive forum:*** (F1) (F2)
EXECUTIVE FORUM (incl. dinner, Sun., Nov. 2) ☐ **F1** NEW PROD. DEV. ☐ **F2** TECH. MGMT.	For Office Use Only B/N ______ R ______ E ______ P ______ C ______	

STEP 5. Calculate Amount

	EARLY BIRD DISCOUNTS *(deadline June 30)*		ADVANCE PRICING *(after June 30)*		
	FSCT member	nonmember	member	nonmember	amount
ICE EXPO/ANNUAL MTG. ONLY	$70	$90	$75	$100	$_____
Retired Members	—	—	$30	—	$_____
Students	—	—	$15	$15	$_____
SOCIAL GUEST Registration	—	—	$40	$40	$_____
Tues. Tour to Swan House (optional)	—	—	$60	$60	$_____
Tues. Tour of Atlanta (optional)	—	—	$60	$60	$_____
CONFERENCE & ICE EXPO:					
Conference Package 1 (1 one-day)	$225	$315	$250	$350	$_____
Conference Package 2 (1 two-day or 2 one-day)	$405	$540	$450	$600	$_____
Conference Package 3 (full conference* or 3 one-day)	$495	$675	$550	$750	$_____
EXECUTIVE FORUM	$495	$675	$550	$750	$_____
			SUBTOTAL		$_____
FSCT Industry Breakfast Tickets (number of tickets______) $30			$30	$______	
			TOTAL		$_____

*Full conference includes one one-day course and one two-day course

STEP 6. Method of Payment

(Make check payable in U.S. Funds to FSCT)

SELECT ONE: ☐ Check enclosed ☐ MasterCard
☐ VISA ☐ American Express

Card number: ______________________________

Exp. date: month _____ year _____

Cardholder's name ______________________________
please print

Signature: ______________________________

Amount Enclosed (from Step 5) .... $________________

REGISTER TODAY!

By Fax: **USA (800) 952-9812**
International (847) 698-9245

By Mail **send to: ICE Registration,**
P.O. Box 998,
Park Ridge, IL 60068 USA

Avoid duplication of registration: if you fax your registration, please do NOT mail it.

ICE '97 Registration Helpline **(between 9:00 am and 5:00 pm CST)**
USA (800) 823-1530
International (847) 384-7755

General Information

Social Guest Program

This year's Social Guest program includes registration to attend a welcome program featuring Decorating Trends for Your Home, on Monday, November 3, as well as admittance to the FSCT Opening Session on Monday, November 3, and three days admittance to the Expo.

Social Guest registration is offered only to the spouse or guest of the industry attendees. To register, complete the Social Guest portion of the official FSCT registration form. Advance Registration fee is $40. On-Site fee in Atlanta is $50.

Optional Tours

Social Guests have the opportunity to register for optional guided tours to be conducted on Tuesday, November 4. Two choices are offered: The Goodlife in Historic Buckhead and A Taste of the Peach. Each will run from 9 a.m. to 3 p.m.

The tours include transportation on deluxe motorcoaches, admission fees to attractions specified, and lunch. To participate Social Guests must complete the Activities portion of the Social Guests Registration Form.

Tour 1: The Good Life in Historic Buckhead features a visit to the Atlanta History Center offering participants a chance to tour the regal Swan House, the Tullie Smith House, and browse through the Atlanta History Museum. Following the morning tours, participants will travel to 103 West for a lunch at the posh Four Star restaurant. After lunch, participants will travel to Phipps Plaza and Lenox Square, two of Buckhead's favorite malls!

Due to limited availability, pre-registration is encouraged.

$60/person

Tour 2: A Taste of the Peach is a city tour highlighting the Olympic Village, the State Capitol, as well as the Historic District on Sweet Auburn Avenue. Participants will visit the Fox Theater as well as the Shops of Bennett Street. Following the morning tours, participants will travel to 103 West for a lunch at the posh Four Star restaurant.

After lunch, participants will travel to Phipps Plaza and Lenox Square, two of Buckhead's favorite malls!

Due to limited availability, pre-registration is encouraged.

$60/person

Shuttle Service

Shuttle service will be provided between the participating hotels and the Georgia World Congress Center.

Hours of Operation

Sunday, Nov. 2 .... 8:00 a.m. to 5:00 p.m.
Monday, Nov. 3 .... 7:00 a.m. to 6:00 p.m.
Tuesday, Nov. 4 .... 7:30 a.m. to 6:00 p.m.
Wednesday, Nov. 5 .... 7:30 a.m. to 3:00 p.m.

Pick-up locations and up-to-date schedule information will be posted at the Georgia World Congress Center and in the lobby of each participating hotel.

Travel Notes

The official carrier is Delta Airlines. To receive the special Delta convention rates*, you may wish to arrange your travel through the FSCT Travel Desk OR through Delta's Meeting Network.

If you book your travel through the **FSCT Travel Desk**, you will receive a chance to win round-trip transportation for two to FSCT's ICE '98 in New Orleans. To earn a chance at the drawing, you must book through the **FSCT Travel Desk at 1-800-448-FSCT and mention the ICE Show.**

Should you or your travel professional desire to make travel arrangements through the **Delta Meeting Network contact them at 1-800-241-6760** and refer to the convention file number **I-3697.**

**Certain restrictions apply.*

Airport and Ground Transportation

Hartsfield International Airport serves the Atlanta-metropolitan area. With 2,000 flights a day, it's one of the world's largest passenger terminals.

Located in Hartsfield International Airport near the baggage claim area is a station for MARTA, Atlanta's rapid transit system. MARTA provides a fast and economical transportation option to the downtown area. Call 404-848-4711 for further details. Other transportation options from the airport are shuttle service and taxis. Atlanta Airport Shuttle provides scheduled service from Hartsfield to the downtown hotels every 15 minutes from 7 a.m. to 11 p.m. One-way runs $8.00 and round-trip is $14.00. The trip takes approximately 30 minutes. Taxi service from Hartsfield operates on a flat fee: $18 for one person, $20 for two people, and $24 for three people.

Weather

Temperatures average 64°F (17.8°C) in Atlanta during early November. In the evenings expect the average to be 46°F (7.8°C).

Attire

Business attire is appropriate for all events.

Visitor details on Atlanta are available on the world wide web at "www.atlanta.com"

ICE '97 Exhibitors

(As of 5/13/97)

A.P. Dataweigh Systems
ABC Dispensing Technologies Inc.
Aceto Corp.
ACT Laboratories
Adhesives Age/Intertec Publishing
Advanced Software Designs
Air Products & Chemicals Inc.
Akzo Nobel Resins
Alar Engineering Corp.
Alnor Oil Co. Inc.
American Chemical Society
Amer. Paint & Coatings Journal
Amoco Chemical Co.
ANGUS Chemical Co.
Anker Labelers USA Inc.
Aqualon, A Div. of Hercules Inc.
ARCO Chemical Co.
Argus Business Media
Arizona Instrument Corp.
Ashland Chemical Co., Drew Industrial Div.
Atlas Electric Devices
Atotech USA Inc
Avestin Inc.
BASF Corp.
BatchMaster Software Corp.
Bayer Corp.
Borden Chemical Inc.
Bowers Process Equipment Inc.
Brookfield Eng. Labs. Inc.
Buckman Laboratories Inc.
Buhler Inc.
Bulkcon Systems USA
Burgess Pigment Co.
BYKChemie USA
BYKGardner Inc.
Cabot Corp., CABOSIL & Special Blacks Div.
Calgon Corp.
Cardolite Corp.
Cellulose Filler Factory Corp.
Chemical & Engineering News
Chemical Marketing Reporter
Chemical Week
Chemicals Incorporated
Chemir/Polytech Labs. Inc.
Ciba Specialty Chemicals, Additives Pigments & Polymers Divs.
Cimbar Performance Minerals
Clariant Corp.
Clawson Container Co.
CMI International
Coatings World/Ink World Magazine
Color Communications Inc.
Color Corp. of America
ColorTec Associates
Columbian Chemicals Co.
Cook Composites & Polymers
Corob North America, Div. of Taotek NA
Corrosion Control Consultants & Labs
Cortec Corp.
CR Minerals Corp.
Crosfield Co.
Cytec Industries Inc.
D/L Laboratories
Daniel Products Co. Inc.
Datacolor International
DeFelsko Corp.
Degussa Corp.
Delta Colour
DistiKleen Inc.
Dominion Colour Corp.
Dover Chemical Corp.
Dow Chemical Co.
Dow Corning Corp.
Draiswerke GmbH Drais Mannheim
Draiswerke Inc.
Dry Branch Kaolin Co.
DuPont Nylon Intermediates
DuPont Performance Chemicals
Eagle Zinc Co.
Ebonex Corp.
ECC International
Eiger Machinery Inc.
Elf ATOCHEM North America
EMCO (Epworth Morehouse Cowles)
Engelhard Corp./Mearl
Engineered Polymer Solutions
Estron Chemical Inc.
European Coatings Journal
Exxon Chemical Co.
Federation of Societies for Coatings Technology
Filter Specialists Inc. (FSI)
Fischer Technology Inc.
Fluid Management
Formation Systems Inc.
Franklin Industrial Minerals
Fuji Silysia Chemical
H.B. Fuller Co.
Gamry Instruments Inc.
Paul N. Gardner Co. Inc.
GeorgiaPacific Resins Inc.
BFGoodrich Co., Specialty Chemicals
The Goodyear Tire & Rubber Co.
GormanRupp Co.
Grace Davison
Graco Inc.
Halox Pigments
J.W. Hanson Co. Inc.
Harcros Pigments Inc.
Henkel Corp.
HERO Industries Limited
Heucotech Ltd.
HiMar Specialties Inc.
Hilton Davis Co.
Hockmeyer Equipment Corp.
Hoechst Celanese Corp.
Horiba Instruments Inc.
Hüls America Inc.
HunterLab
ICI Surfactants
Ideal Mfg. & Sales Corp.
Industrial Copolymers
Industrial Oil Products Corp.
Infinium Software 2000 (formally Software 2000)
Inmark Inc.
InpraLatina
International Speciality Chems.
International Specialty Products (ISP)
ITT Marlow/ITT AC Pump
J.M. Huber Corp., Engineered Minerals Div.
S.C. Johnson Polymer
Journal of Coatings Technology
KT Feldspar Corp.
Kady International
Kelly Chemical Corp.
Kenrich Petrochemicals Inc.
King Industries Inc.
Kline & Co. Inc.
KTATator Inc.
Labelmaster
Laporte/SCP Laponite Rheological Additives
Lawter International
The Leneta Co.
Liquid Controls Corp.
Littleford Day Inc.
Longview Fibre Co.
The Lubrizol Corp.
3M, Specialty Chemical Division
Macbeth
Malvern Minerals Co.
Manufacturing Business Systems
Michelman Inc.
Micro Powders Inc.
Microfluidics Intl. Corp.
Micromeritics
MiniFibers Inc.
Minolta Corp.
Mississippi Lime Co.
Mitsubishi Chemical
Monsanto Co.
Morton International
Muetek Analytic Inc.
Myers Engineering
Nacan Products Ltd.
Nametre Co.
Neste OXO AB
Netzsch Incorporated
Neupak Inc.
New Way Packaging Mach. Inc.
Norman International
Nyco® Minerals Inc.
Occidental Chemical Corp.
Ohio Polychemical Co.
Olin Corp.
Omnimark Instrument Corp.
Paar Physica USA Inc.
Paint & Coatings Industry Magazine
Paint Research Association
Parasol Systems Inc.
Particle Sizing Systems Inc.
Peninsula Polymers Inc.
Pfaudler Inc.
Phenoxy Specialties
Polar Minerals
PolyResyn Inc.
PPG Industries Inc.
PQ Corp./ Potters Industries
Premier Mill Corp.
Purity Zinc Metals
QPanel Lab Products
K.J. Quinn & Co. Inc.
Raabe Corp.
RadTech International
Ranbar Technology Inc.
Reichhold Chemicals Inc.
Rheox Inc.
RhonePoulenc Inc.
Rhopoint Instrumentation Ltd.
Rohm and Haas Co.
RonningenPetter
Charles Ross & Son Co.
Russell Finex Inc.
S & G Technologies
San Esters Corp.
Sartomer Co.
Schenectady International Inc.
Schlumberger Industries
SEPR, Ceramic Beads & Powders
Shamrock Technologies Inc.
Shell Chemical Co.
SherwinWilliams Chemicals
Silberline Mfg. Co. Inc.
Software 2000 (see Infinium Software 2000)
Sonoco Industrial Containers
Southcorp Packaging USA Inc., NAMPAC/Bennett
Specialty Minerals Inc.
Spencer Machine & Tool Co.
Spraymation Inc.
Startex Chemical Inc.
Steel Structures Painting Council
StretchOSeal Corp.
Summit Precision Polymers Corp.
Tech Pak Inc.
Teemark Corp.
Tego Chemie Service USA
Thiele Engineering Co.
Thomas Scientific
Tikkurila/McWhorter
Toyal America Inc.
Troy Corp.
U.S. Aluminum Inc.
U.S. Zinc Corp.
UCB Chemicals Corp.
Union Carbide Corp.
Union Process Inc.
United Mineral & Chemical Corp.
United Soybean Board
VanDeMark Group
R.T. Vanderbilt Co. Inc.
VersaMatic Pump Co.
VortiSiv Div., MM Industries Inc.
Wacker Silicones Corp.
Western Equipment Co.
Wilden Pump & Eng. Co.
Witco Corp.
XRite Incorporated
Zemex Industrial Minerals
Zeneca Resins/Zeneca Biocides

FSCT Publications Order Form

Buyer Information

YOUR COMPANY: Check the one block which applies most specifically to the company or organization with which you are affiliated:

A ☐ Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants, etc.
B ☐ Manufacturers of Raw Materials
C ☐ Manufacturers of Equipment and Containers
D ☐ Sales Agents for Raw Materials and Equipment
E ☐ Government Agency
F ☐ Research/Testing/Consulting
G ☐ Educational Institution/Library
H ☐ Paint Consumer/Applicator
J ☐ Other ____________________
please specify

YOUR POSITION: Check the one block which best describes your position in your company or organization:

A ☐ Management/Administration
B ☐ Manufacturing and Engineering
C ☐ Quality Control
D ☐ Research and Development
E ☐ Technical Sales/Service
F ☐ Sales and Marketing
G ☐ Consultant
H ☐ Educator/Student
J ☐ Other ____________________
please specify

Billing Address

☐ FSCT Member ☐ Non-Member

Name ____________________
Title ____________________
Company ____________________
Address ____________________
City & State ____________________
Country __________ Postal Code __________
Phone __________ FAX __________

Shipping Address (if different)

Name ____________________
Title ____________________
Company ____________________
Address ____________________
City & State ____________________
Country __________ Postal Code __________
Phone __________ FAX __________

Method of Payment

Please check one:

☐ Charge to the following card:
☐ MC ☐ VISA
☐ AMEX ☐ DISCOVER

Exp. Date: __________

☐ Check # __________
(checks must be payable in U.S. Funds on U.S. Bank)

☐ P.O. # __________

Credit Card Number: ____________________

Name ____________________
(print cardholder's name)

Signature ____________________

Total Amount Due: __________

Add $5.00 for shipping and handling. PA residents, please add 6% sales tax.

Orders

(Less 10% for Full Series Purchase)

Series	Member $15	Non-Mem. $25	Quantity Ordered
Film Formation	☐	☐	___
Radiation Cured Coatings	☐	☐	___
Introduction to Polymers and Resins	☐	☐	___
Coil Coatings	☐	☐	___
Corrosion Protection by Coatings	☐	☐	___
Mechanical Properties of Coatings	☐	☐	___
Automotive Coatings	☐	☐	___
Coating Film Defects	☐	☐	___
Application of Paints and Coatings	☐	☐	___
Organic Pigments, Second Edition	☐	☐	___
Inorganic Primer Pigments	☐	☐	___
Marine Coatings	☐	☐	___
Sealants and Caulks	☐	☐	___
Aerospace and Aircraft Coatings	☐	☐	___
Introduction to Coatings Technology	☐	☐	___
Cationic Radiation Curing	☐	☐	___
Rheology	☐	☐	___
Powder Coatings	☐	☐	___
Introduction to Pigments	☐	☐	___
Painting of Plastics	☐	☐	___
Metal Surface Characteristics Affecting Organic Coatings	☐	☐	___
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Regulatory Update May 1997

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by National Paint and Coatings Association, Washington, D.C. The Regulatory Update is made available as a service to FSCT members, to assist them in making independent inquiries about matters of particular interest to them. Although all reasonable steps have been taken to ensure the reliability of the Regulatory Update, the FSCT cannot guarantee its completeness or accuracy.

Federal AIM Rule Upheld in Court

On Feb. 13, the U.S. District Court for the Central District of California issued a summary judgment in favor of the U.S. Environmental Protection Agency (EPA) in an action that had been brought against the agency's proposed national architectural and industrial maintenance (AIM) coatings rule. The petitioners had alleged that the proposed AIM rule, which would limit volatile organic compound (VOC) emissions for paint and coatings manufacturers, had been improperly proposed by EPA, because, among other reasons, EPA had not performed an adequate analysis of its impact, particularly on small businesses. The court ruled that the petitioners had no basis for their suit.

Consumer Product Safety Commission
February 26, 1997
Household Products Containing Petroleum Distillates and Other Hydrocarbons; Advance Notice of Proposed Rulemaking; Request for Comments and Information
Action: Advance notice of proposed rulemaking (ANPR)

The Consumer Product Safety Commission (CPSC) has issued this ANPR under the Poison Prevention Packaging Act (PPPA) to determine whether additional products that contain either petroleum distillates or other hydrocarbons or combinations of these ingredients should be in child-resistant packaging. Existing PPPA standards already require such packaging for certain products. Petroleum distillates are the primary ingredients in products such as furniture polishes, paint solvents, and adhesives. Hydrocarbons include substances like benzene, toluene and xylene.

The CPSC is soliciting comments concerning the risks of injury associated with household products containing petroleum distillates or hydrocarbons, the regulatory alternatives discussed in this notice, other possible means to address these risks, and the economic impact of the regulatory alternatives.

For additional information, contact Suzanne Barone, CPSC, (301) 504-0477, ext. 1196.

Environmental Protection Agency
March 14, 1997 - 62 FR 12185
Special Report on Environmental Endocrine Disruption: An Effects Assessment and Analysis
Action: Notice of availability of risk assessment forum report

The Environmental Protection Agency (EPA) has announced the availability of the "Special Report on Environmental Endocrine Disruption: An Effects Assessment and Analysis," which provides an overview of the current state of the science for endocrine disruption. It includes an introduction to the endocrine system and the endocrine disruption hypothesis; a review of potential human health and ecological risks; and an update of research needs. This report represents an interim assessment pending a more extensive review expected to be issued later in the year.

To obtain a single copy of the report, contact the Office of Research and Development Publications Office, (513) 569-7562, or fax (513) 569-7566. Please include your name, address, and the document number EPA/630/R-96/012. A limited number of copies are available.

For further information, contact William Wood, EPA, (202) 260-6743.

Environmental Protection Agency
March 26, 1997 - 62 FR 14430
Notice of Workshops on EPCRA Section 313 Reporting Requirements
Action: Notice

The Environmental Protection Agency (EPA) has scheduled a series of three-day training courses on the requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA), focusing specifically on Section 313 Toxic Chemical Release Inventory (TRI) reporting procedures. The course will feature a variety of hands-on exercises using the TRI reporting form and will provide guidance materials to help participants understand the reporting process.

Training courses will be held in the following locations:

May 20-22 .... Los Angeles, CA
May 21-23 .... Seattle, WA
May 27-29 .... Kansas City, MO

To register to attend one of the workshops, contact the EPCRA/TRI Training Registration Line by telephone at (301) 907-3844, by fax at (301) 907-9655, or by e-mail at cjones@tascon.com.

For further information on the training courses, contact Eileen Fesco, EPA, (202) 260-7232, e-mail: fesco.eileen@epamail.epa.gov. For information on workshops or general EPCRA requirements, contact the EPCRA Information Hotline at (800) 535-0202.

Department of Transportation
Research and Special Programs Administration
March 26, 1997 - 62 FR 14334
Performance-Oriented Packaging Standards; Final Transitional Provisions; Revisions and Response to Petitions for Reconsideration
Action: Final rule; editorial revisions and response to petitions for reconsideration

On Sept. 26, 1996, the Research and Special Programs Administration (RSPA) published a final rule which amended the Hazardous Materials Regulations to incorporate changes based on rulemaking petitions from industry, agency initiatives, and public comments. The rulemaking revised provisions relating to the classification of certain hazardous materials which are poisonous by inhalation and to the manufacture, use and reuse of hazardous materials packaging.

This final rule, effective March 26, 1997, corrects errors in the Sept. 26 regulation and responds to petitions. For further information, contact Joan McIntyre, RSPA, (202) 366-8553.

Department of Transportation
Research and Special Programs Administration
March 26, 1997 - 62 FR 14502
Hazardous Materials Transportation; Registration and Fee Assessment Program
Action: Notice of filing requirements

This notice is intended to alert persons who transport or offer for transportation certain hazardous materials of an annual requirement to register with and pay a fee to the U.S. Department of Transportation.

The persons affected by these regulations include those who offer or transport any of the following materials:

- more than one liter per package of a material extremely toxic by inhalation (i.e. a "material poisonous by inhalation" that meets the criteria for "hazard zone A");
- a hazardous material in a bulk packaging having a capacity equal to or greater than 13,248 liters (3,500 gallons) for liquids or gases, or more than 13.24 cubic meters (468 cubic feet) for solids; or
- a shipment, in other than bulk packaging, of 2,268 kilograms (5,000 pounds) gross weight or more of a class of hazardous materials for which placarding of a vehicle, rail car, or freight container is required for that class.

The 1996-97 registration year ends on June 30, 1997; the 1997-98 registration year will begin on July 1, 1997 and end on June 30, 1998. Any person who engages in any of the specified activities during the 1997-98 registration year must file a registration statement and pay $300 before July 1, 1997, or before engaging in any of the activities, whichever is later.

All persons who registered for the 1996-97 year will be mailed a registration statement form and informational brochure in May 1997. To obtain a form, contact David Donaldson, RSPA, (202) 366-4109.

Department of Labor
Occupational Safety and Health Administration
March 31, 1997 - 62 FR 15324
Abatement Verification
Action: Final rule

The Occupational Safety and Health Administration (OSHA) has published a final rule which requires those employers who have received a citation for health and safety violations to certify that they have abated the hazardous condition for which they were cited. They must also inform affected employees of their abatement actions. This regulation, which will go into effect May 30, 1997, simplifies and streamlines abatement certification procedures.

The specific abatement procedures depend on the nature of the violation identified and the employer's abatement actions. If abatement occurs during or immediately after the inspection that identified the violation, the employer is not required to submit an abatement certification letter to OSHA. If the violation is classified as other-than-serious or serious that does not require additional documentation, the employer must certify abatement using a one-page form. In cases involving the most serious violations, additional documentation is required.

For additional information, contact Bonnie Friedman, OSHA, (202) 219-8148.

Air Quality Update—Disagreement continues to escalate over EPA's proposed National Ambient Air Quality Standards for ozone and particulate matter. The proposal would lower the current concentration limit for ozone from 0.12 parts per million (ppm) to 0.08 ppm, measured over the course of an eight-hour time period. Additionally, a 2.5 micron particulate matter standard would be established. The standards have generated a firestorm of controversy between environmentalists and industry.

EPA itself has fueled the current controversy by admitting that it made an error in calculating the estimated number of premature deaths that a new, lower particulate matter limit would prevent. The number was lowered from 20,000 to 15,000, causing industry to once again raise the issue of whether the standards themselves are supported by poor scientific research. At presstime, the House Commerce Committee was holding a series of hearings on the proposed standards.

OSHA Reform Legislation Introduced—Bills that would significantly modify the Occupational Safety and Health Act and rewrite job safety laws were introduced in both the House and Senate. Senator Kay Bailey Hutchison (R-TX) sponsored S. 461, which would force the Occupational Safety and Health Administration (OSHA) to concentrate its efforts on safety consultations rather than on conducting workplace inspections and issuing citations. Workers would be required to inform their employers of any safety violations before notifying OSHA, in order to give employers time to correct the problem. Additionally, under the bill, the agency must conduct a cost-benefit analysis of any major rulemaking.

In the House, Representative Joel Hefley (R-CO) introduced the OSHA Reform Act of 1997 (H.R. 1162) which would repeal large portions of the 1970 Occupational Safety and Health Act. OSHA would be stripped of its authority to conduct inspections and issue citations. Like the Senate version, this measure would require OSHA to analyze the potential costs and benefits to employers of any new regulations.

House Convenes Superfund Discussions—A group of staff members from the House Committees on Commerce and Transportation have begun meeting in an effort to develop a bipartisan agreement on Superfund reform legislation. Representatives of the Clinton administration and the EPA are also expected to join in the negotiations.

The talks are beginning without a specific basis for discussions; participants are not using any prior Superfund reform proposal as a foundation for the new bill. Although the differences between both sides remain large, including the issue of repealing or limiting retroactive liability, Democrats and Republicans remain hopeful that a compromise can be reached. In addition, members of the Senate Environment Committee plan to hold a series of meetings to discuss Superfund reauthorization over the next few weeks.

And, in a related story, the U.S. Court of Appeals for the 11th Circuit has overturned a federal district court ruling (*U.S. v. Olin Corp.*) which had rejected the retroactive liability provisions in the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), the statutes upon which the Superfund program is based. The Court of Appeals found that CERCLA was constitutional and that retroactive liability, while not explicitly stated in the statute, was still intended by its authors. The earlier lower court ruling had renewed calls for a complete reform of the Superfund program.

States Proposed Legislation and Regulations

ARIZONA

Spray Paint Restriction—AZ H. 2396 (Marsh) increases graffiti penalties and was amended to include responsible retailing requirements for spray paint retailers. A motion to reconsider the bill was granted on April 7 after the House refused to concur with the Senate version.

ARKANSAS

Hazardous Materials Transportation—AR H. 2001 (Dietz) amends hazardous waste management requirements to redefine the word "transport" to exclude transportation by rail. On March 14, the bill was withdrawn from further consideration.

AR S. 572 (Boozman) eliminates the requirement to obtain a permit to haul hazardous materials in or through the state. The governor signed the legislation on April 2.

Water Quality—AR H. 1924 (Broadway) allows local governments to regulate storm water discharges and to impose fees for such discharges. The bill is currently under consideration by the House Committee on City, County and Local Affairs.

CALIFORNIA

Air Quality (Proposed Regulation)—A proposed regulation (97 CARR 536; 3/7/97) of the California Air Resources Board (CARB) would include inorganic lead as a toxic air contaminant and would specify that sufficient scientific evidence is not available to support the designation of a threshold exposure level below which no significant adverse health affects are anticipated. Contact Jacqueline Johnson, CARB, (916) 323-1077.

Hazardous Waste—CA A. 256 (Cunneen) requires the adoption of regulations establishing a new code system for tracking the shipment of hazardous waste subject to manifest requirements. On April 9, the measure was reported out of the Assembly Appropriations Committee.

CA A. 708 (Ackerman) revises the fee category for the disposal of hazardous waste to include any cleanup, removal or remediation of a hazardous substance or non-RCRA hazardous waste. The bill was referred to the Assembly Committee on Environmental Safety and Toxic Materials on March 13.

CA S. 658 (Sher) repeals provisions requiring the state to conduct a review of "California-only" hazardous waste policies followed by the state for the identification and assessment of chemical toxicity. The bill was referred to the Senate Rules Committee on March 18 for consideration.

Hazardous Waste (Regulation)—A final regulation (97 CARR 573; 3/14/97) of the California Department of Toxic Substances (DTSC) exempts generators of small quantity or non-RCRA hazardous waste from submitting the 1995 biennial report to the state. The rule went into effect April 2. Contact Gary Murchison, DTSC, (916) 322-0807.

Hazardous Waste (Notice)—The California DTSC has readopted an emergency rule that extends the date for implementing secondary containment requirements for existing non-RCRA tanks systems that are used to manage hazardous waste at treatment facilities. The rule went into effect Feb. 11. Contact Joan Ferber, DTSC, (916) 322-6409.

Lead (Regulation)—A final rule adopted by the California Occupational Safety and Health Standards Board (OSHSB) amends lead exposure standards, including revised definitions, modified certification requirements, and detailed specific exposure control requirements. The regulation was effective March 7. Contact Christine Demes, OSHSB, (916) 322-3640.

Occupational Safety and Health (Proposed Regulation)—A proposed regulation of the California OSHSB would establish new provisions for employee exposure monitoring criteria, ease minimum requirements for respiratory protection, and specify methods of compliance to control exposure. Contact John MacLeod, OSHSB, (916) 322-3640.

Recycling—CA A. 705 (Strom-Martin) reenacts existing law until Jan. 1, 2001 which requires state agencies to purchase recycled paint. The measure, which was introduced on Feb. 26, was sent to the Assembly Committee on Natural Resources.

Tort Reform—CA S. 143 (Kopp) requires unfair business practice actions brought by private parties on behalf of the general public to comply with certain requirements. The Senate Judiciary Committee amended and released the bill on April 2.

Toxic Substances (Notice)—The California Office of Environmental Health Hazard Assessment (OEHHA) has issued a draft policy document (97 CARR 542; 3/7/97) that addresses the management of scientific data for hazard identification, exposure analysis, risk characterization and uncertainty evaluation for hazardous chemicals. Contact Cynthia Oshita, OEHHA, (916) 445-6900.

COLORADO

Graffiti—CO H. 1125 (S. Williams) makes mandatory revocation of a driver's license one of the penalties for committing acts of graffiti. On April 3, the legislation was approved by the Senate and sent to the House for concurrence.

Lead—CO S. 136 (Blickensderfer) requires the establishment of a plan to reduce elevated blood lead levels in children and to control exposure to lead-based paint hazards in residences and child-occupied facilities. The Senate approved the measure on April 3.

CONNECTICUT

Air Quality (Regulation)—The Connecticut Department of Environmental Protection (DEP) adopted a final regulation (58 CTLJ 4D; 2/18/97) which reduces the air pollution fees for small businesses, and for the registration and inspection of sources. The rule became effective Jan. 23. Contact Ellen Walton, DEP, (860) 424-3027.

Hazardous Materials Transportation (Regulation)—A final regulation (58 CTLJ 10D; 2/25/97) of the Connecticut Department of Public Safety (DPS) provides guidelines for the safe handling, use and transportation of flammable and combustible liquids. The rule went into effect Jan. 24. Contact Janet Ainsworth, DPS, (860) 685-8300.

Lead (Proposed Regulation)—A proposed rule (58 CTLJ 1C; 2/11/97) of the Connecticut Department of Public Health (DPH) updates the methodology used to determine a toxic level of lead in paint when using spectrum ana-lyzer X-ray fluorescence instruments. Contact DPH, (860) 509-7299.

FLORIDA

Air Quality —FL H. 1647 (Gay), among other things, amends provisions regarding operating permits for major sources of air pollution; provides that a state permit is the only operating permit needed for such a source; provides a time frame for issuance of revised draft permits containing significant change; and requires the state to specify permit terms that are not federally enforceable under the Clean Air Act. The legislation was introduced on March 24.

GEORGIA

Lead—GA H.R. 467 (Thomas) recognizes Lead Poisoning Prevention Week in Georgia. Introduced on March 10, the bill was referred to the House Committee on Health and Ecology.

HAWAII

Environmental Penalties—HI H. 1247 (Yoshinaga and M. Oshiro) increases clean water and hazardous waste laws by enhancing the state's ability to punish violators and deter potential polluters. The legislation passed the Senate on April 8 and was sent to the House for concurrence.

IDAHO

Air Quality (Proposed Regulation)—The Idaho Department of Health and Welfare (DHW) proposed a regulation (1997 IDAB 3; 3/5/97) which would amend the state operating permit program to obtain full U.S. Environmental Protection Agency approval under the Clean Air Act. Contact Sue Richards, DHW, (208) 373-0502.

Hazardous Waste—ID S. 1208 (Judiciary Committee) imposes fees on wastes stored or treated at commercial hazardous waste facilities. On March 24, the bill was signed by the governor.

Solid Waste—ID H. 210 (Transportation Committee) repeals the underground storage tank certification act. The measure was signed by the governor on March 13.

ILLINOIS

Air Quality—IL H. 1386 (Hassert) extends the repeal date of provisions providing for fast-track rulemaking pursuant to the federal Clean Air Act Amendments. The House approved the bill on April 12.

IL S. 819 (Mahar) gives air quality operating permit applicants 30 days after receipt of the permit to pay the initial annual fee; and provides that sources of air pollution that are not subject to air quality permit standards shall not be required to renew an operating permit except by the request of the U.S. EPA. The Senate approved the measure on March 18; it was referred to the House Committee on Environment and Energy.

Hazardous Materials Transportation—IL S. 689 (Donahue) recommends that local governments adopt regulations for placarding the use, storage and manufacture of hazardous materials. The bill passed the Senate on March 18 and was sent to the House Committee on Rules.

IL S. 378 (Mahar) requires the implementation of the Uniform State Hazardous Materials Transportation registration and permit program. On March 20, the legislation was approved by the Senate.

INDIANA

Hazardous Waste (Proposed Regulation)—A proposed rule (20 INR 1641; 3/1/97) issued by the Indiana Department of Environmental Management (DEM) would incorporate by reference recent revisions to federal hazardous waste management requirements. Contact Elizabeth San Miguel, DEM, (317) 233-5747.

Lead—IN H. 1181 (Crawford) requires health care providers to conduct periodic blood lead testing on children between six months and six years old. On April 7, the bill passed the Senate and was sent to the House for concurrence.

Occupational Safety and Health (Regulation)—The Indiana Department of Labor (DOL) has adopted a notice (20 INR 1663; 3/1/97) which incorporates by reference federal Occupational Safety and Health Administration requirements concerning worker exposure to methylene chloride. The notice will go into effect June 9, 1997. Contact DOL, (317) 232-3325.

Water Quality (Regulation)—The Indiana DEM issued a final rule (20 INR 1347; 3/1/97) which updates the state water quality standards and the national pollutant discharge elimination system program. The regulation became effective Feb. 13. Contact Lonnie Brumfield, DEM, (317) 233-2547.

IOWA

Air Quality (Proposed Regulation)—A proposed rule (19 IAAB 1462; 3/12/97) of the Iowa Department of Natural Resources (DNR) would require sources of air pollution that are subject to emission guidelines to obtain an operating permit unless specifically exempted. Contact Scott Vander Hart, DNR, (515) 242-5094.

Labeling—IA H. 695 (Committee on Environmental Protection) adds solvent-based paint to the definition of household hazardous waste; requires the implementation of an informational program regarding the use and disposal of household hazardous waste; and repeals sections relating to mounting warning labels near displays of products in retail establishments. The bill was introduced on March 19.

IA S. 285 (Committee on Natural Resources) relates to labeling requirements for household hazardous materials. The bill passed the Senate on March 24.

Occupational Safety and Health (Proposed Regulation)—A proposal (19 IAAB 1413; 2/26/97) issued by the Iowa Division of Labor Services (DLS) would incorporate by reference federal occupational safety and health requirements limiting worker exposure to methylene chloride. Contact DLS, (515) 281-3606.

KENTUCKY

Air Quality (Regulation)—The Kentucky Department for Environmental Protection (DEP) adopted a final rule (23 ARKY 18; 3/1/97) which, among other things, (1) establishes air quality permit application procedures; (2) specifies permit content and renewal requirements; (3) sets up a process for permit amendments; (4) clarifies requirements for Part 70 permits; and (5) identifies which sources must file an application before construction or reconstruction. The regulation was effective Feb. 12. Contact Kenneth Hines, DEP, (502) 573-3382.

Lead (Proposed Regulation)—A proposed regulation (23 ARKY 3472; 3/1/97) of the Kentucky Department for Health Services (DHS) would establish training and certification requirements for individuals involved in lead abatement activities; specify permit fees for abatement; and detail criteria for performing lead abatement in target housing and child-occupied facilities. Contact Mae Lewis, DHS, (502) 564-7900.

Occupational Safety and Health (Proposed Regulation)—The Kentucky Department of Workplace Standards (DWS) plans to issue a proposed rule (23 ARKY 3186; 3/1/97) which would incorporate by reference federal occupational safety and health requirements concerning eye, face, head, and foot protection. Contact DWS, (502) 564-2778.

LOUISIANA

Air Quality (Regulation)—A final regulation (23 LAR 197; 2/20/97) of the Louisiana Department of Environmental Quality (DEQ) adopts specific requirements for the modification of sources emitting more than 100 tons of air pollutants annually by allowing sources to offset emission increases by achieving volatile organic compound (VOC) reductions from other operations, instead of complying with the lowest achievable emission levels. The rule was effective Feb. 20. Contact Patsy Deaville, DEQ, (504) 765-0399.

Hazardous Materials Transportation—LA H. 1744 (Guillory) requires inspection of rail cars carrying hazardous materials. On March 31, the legislation was introduced and sent to the House Environment Committee.

LA S. 903 (Jordan) creates the crime of criminal negligence in the storing, handling or transporting of hazardous or toxic materials. The bill was introduced on March 31 and sent to the Senate Judiciary Committee.

Hazardous Waste—LA S. 1175 (Hainkel) eliminates the collection of hazardous waste fees. On April 8, the bill was reported out of the Senate Environmental Quality Committee with a favorable recommendation.

Lead—LA H. 1776 (Damico) establishes licensing and certification requirements for lead-based paint abatement activities. Introduced on March 31, the legislation was sent to the House Environment Committee.

LA H. 1777 (Damico) authorizes licensing and certification fees for the lead hazard abatement activities. The bill, which was introduced on March 31, was referred to the House Environment Committee.

LA S. 616 (Hainkel) authorizes fees for the lead hazard reduction program. The legislation was introduced on March 31 and referred to the Senate Environment Committee.

LA S. 1276 (Hainkel) establishes licensing and certification requirements for lead abatement work. On March 31, the bill was introduced and sent to the Senate Committee on Environmental Quality.

Spray Paint Restrictions—LA H. 52 (Schneider) prohibits the selling of airbrush propellant to minors. The legislation was introduced on March 31 and sent to the House Committee on Administration of Criminal Justice.

Toxic Substances—LA S. 163 (Jordan) provides for criminal liability for wanton reckless disregard for public safety in storage, handling, or transportation of toxic or hazardous substances. Introduced on March 31, the bill was sent to the Senate Judiciary Committee.

LA S. 1259 (Johnson) increases criminal penalties for illegal discharge, emission or disposal of substances harmful to human life or health. The bill, which was introduced on March 31, was referred to the Senate Committee on Environmental Quality.

MAINE

Air Quality (Proposed Regulation)—The Maine Department of Environmental Protection (DEP) proposed a rule which would simplify air quality requirements for smaller surface coating facilities by (1) including a *de minimis* threshold that would exempt sources from regulation; (2) reducing recordkeeping requirements; (3) exempting facilities and providing other incentives for the use of powder coatings or other non-VOC coating technology; and (4) adding provisions designed to increase compliance flexibility. Contact Jeffrey Crawford, DEP, (207) 287-2437.

Lead—ME H. 1137 (S. Jones) specifies methods of lead abatement, and requires all lead abatement workers to be licensed. The bill was introduced on March 19.

MARYLAND

Graffiti—MD H. 1169 (Klausmeier) makes community service a penalty for graffiti offenses. The bill passed the Senate on April 4.

MD H.J.R. 17 (Klausmeier) urges businesses, local governments, and communities to fight graffiti. The House Commerce Committee released the bill on March 19 with an unfavorable report.

Lead—MD H. 229 (Brinkley) alters the definition of "affected property" in provisions of the insurance law relating to lead hazard coverage for certain rental property. The legislation passed the Senate on April 2.

MD H. 990 (Rosenberg and Hecht) provides for an income tax credit for the cost of a lead hazard reduction project. On March 20, the bill was released from the House Ways and Means Committee with an unfavorable recommendation.

MD H. 1068 (Guns) modifies the provisions of law authorizing a lessee to invoke rent escrow remedies if the lessor fails to eliminate lead-based paint from a residential dwelling. On April 2, the legislation was approved by the Senate.

MD H. 1138 (Hubbard) requires the establishment and administration of a lead program to assure appropriate screening of children for lead poisoning. On April 7, the Senate approved the measure.

MD H. 1231/S. 669 (Guns/Baker) alters the dates by which rental dwelling units must be registered under the Lead Poisoning Prevention Program and by which annual fees must be paid. H. 1231 passed the Senate on April 2; S. 669 was approved by the House on March 27.

MD S. 772 (Baker) modifies a provision of law authorizing a lessee to invoke rent escrow remedies if the lessor fails to remove or eliminate lead-based paint from a residential unit. The legislation was approved by the House on April 4.

Toxic Substances—MD S. 686 (Della) requires certain toxic users to provide information to the state concerning the manufacture, processing and other use of toxic and hazardous substances. On March 19, the measure was amended on the Senate floor.

MASSACHUSETTS

Hazardous Materials Transportation—MA S. 1177 (Keating) controls the transportation of hazardous materials in the Commonwealth. On March 13, the bill was reported out of the Joint Committee on Public Safety with an unfavorable recommendation.

MINNESOTA

Graffiti—MN H. 1227 (D. Swenson) creates a civil cause of action for graffiti vandalism. Introduced on March 5, the bill was referred to the House Judiciary Committee.

Hazardous Materials Transportation—MN H. 241 (Mullery) reauthorizes the uniform hazardous materials registration and permit program for one year. On April 7, the bill, which passed the House four days earlier, was reported out of the Senate Rules Committee.

Labeling—MN S. 1115 (Novak) repeals the hazardous products labeling law. On March 20, the bill was released from the Senate Environment Committee with a favorable report.

Recycling—MN H. 1751 (Munger) sets a mandatory recycled content level for rigid plastic containers with a capacity of more than eight ounces, but less than five gallons. The bill was introduced on March 19 and sent to the House Committee on Environment and Natural Resources.

MISSISSIPPI

Hazardous Waste (Proposed Regulation)—A proposed regulation of the Mississippi Department of Environmental Quality (DEQ) would incorporate federal standards regarding permitting for hazardous waste treatment, storage and disposal facilities; organic air emission limits for tanks, containers and surface impoundments; and small quantity generator requirements. Contact Jerry Banks, DEQ, (601) 961-5063.

Household Hazardous Waste—MS S. 2498 (Dearing) revises the household hazardous waste program. On April 1, the House and Senate both agreed to a conference committee report on the legislation.

Lead—MS S. 2496 (Dearing) relates to the accreditation of lead-based paint activities. The governor signed the legislation on March 19.

NEBRASKA

Air Quality (Proposed Regulation)—The Nebraska Department of Environmental Quality proposed a regulation which would, among other things, adopt federal new source performance standards and maximum achievable control technology; and amend the emission level after which sources of air pollution must obtain operating permits. Contact Joe Francis, DEQ, (402) 471-2186.

Hazardous Materials Transportation—NE L. 722 (Transportation Committee) updates the state adoption of federal regulations governing motor carrier safety and hazardous materials transportation. The governor signed the measure on March 13.

NEW HAMPSHIRE

Lead—NH S. 49 (Fraser) allows unlicensed individuals to conduct low risk lead abatement activities and permits the use of alternative methods of lead abatement. On April 3, the House Committee on Health, Human Services and Elderly Affairs amended and released the bill.

NEW MEXICO

Lead—NM H. 668 (Miera) creates a program to prevent lead poisoning in children. On March 19, the legislation was released from the Senate Judiciary Committee with a favorable recommendation.

Solid Waste (Regulation)—A final rule (8 NMR 254; 3/15/97) adopted by the New Mexico Environmental Improvement Board (EIB) updates requirements for the registration of underground storage tanks (USTs); eliminates obsolete fees; establishes provisions for new and upgraded USTs; and sets up certification criteria for tank installers. The rule went into effect April 1. Contact Gloria Miller, EIB, (505) 827-0188.

NEW YORK

Lead—NY A. 6491 (Boyland) orders a study on the impact of lead-based paint in buildings and the feasibility of removing such paint. Introduced on March 18, the bill was referred to the Assembly Committee on Environmental Conservation.

Toxic Substances—NY A. 6574 (DiNapoli) requires certain facilities to report releases of toxic chemicals on a toxic chemical release form. The legislation, which was introduced on March 24, is currently under consideration by the Assembly Committee on Codes.

Tort Reform—NY S. 2981 (Leichter) authorizes any private citizen who has an interest which is or may be adversely affected to commence civil judicial actions to remedy environmental harms. Introduced on Feb. 27, the legislation was sent to the Senate Committee on Environmental Conservation.

NORTH CAROLINA

Lead—NC S. 516 (Ballance) requires any individual involved in lead abatement activity to be certified and obtain a permit for each project. Introduced on March 26, the legislation was sent to the Senate Finance Committee.

NC S. 806 (Conder and Forrester) pertains to the control of lead exposure of children. The measure, which was introduced on April 10, was sent to the Senate Committee on Children and Human Resources.

Occupational Safety and Health (Proposed Regulation)—The North Carolina Department of Labor (DOL) intends to propose a rule (11 NCR 1817; 3/14/97) which would amend current requirements to protect employees exposed to toxic substances by updating the permissible exposure levels. Contact Peggy Morris, DOL, (919) 662-4581.

NORTH DAKOTA

Hazardous Materials Transportation—ND S. 2369 (Heitkamp and Gulleson) amends provisions relating to the illegal transportation or disposal of hazardous waste. The legislation was signed by the governor on April 2.

OKLAHOMA

Graffiti—OK S. 290 (Leftwich) authorizes certain procedures for the removal of graffiti by municipalities. On April 1, the bill passed the House and was sent to the Senate for concurrence.

Lead—OK S. 315 (Easley) removes requirements for certain lead management certification. The legislation passed the House on April 8.

OREGON

Air Quality (Regulation)—The Oregon Department of Environmental Quality (DEQ) adopted a final rule (36 ORRB 12; 3/1/97) which postpones Title V permitting requirements for sources with the potential to emit at major levels, but with low actual emissions. The requirement was deferred for an additional 18 months. The regulation was effective Jan. 21. Contact Susan Greco, DEQ, (503) 229-5213.

Inhalant Abuse—OR H. 3706 (Johnston) creates the crime of unlawfully inhaling toxic fumes, unlawful possession of a substance containing a solvent having the property of releasing toxic vapors, and unlawfully selling a substance containing solvent having the property of releasing toxic fumes. The legislation was introduced on April 7 and sent to the House Judiciary Committee.

Solid Waste—OR S. 1072 (Water and Land Committee) requires that cost effectiveness be considered in developing standards for underground storage tank release cleanup at low risk sites. The bill was introduced on March 26 and referred to the Senate Committee on Livability.

PENNSYLVANIA

Graffiti—PA H. 1249 (Ramos) amends current requirements to provide for graffiti removal and abatement. Introduced on April 8, the bill was referred to the House Judiciary Committee.

TENNESSEE

Air Quality (Regulation)—A final rule adopted by the Tennessee Department of Environment and Conservation (DEC) clarifies requirements for sampling, recording and reporting source emissions. The rule requires source owners to report all three-hour averages that exceed the applicable emission standard, or all 24-hour averages in units of the standard. The regulation was effective April 16. Contact Jeryl Stewart, DEC, (615) 532-0604.

The Tennessee DEC proposed regulations which would, among other things, amend requirements for the manufacture of high-density polyethylene, polypropylene, and polystyrene resins; would update test methods and compliance procedures for determining the VOC content of coatings; and would specify processes to evaluate the efficiency of VOC capture systems. The rules were effective April 16. Contact John Patton, DEC, (615) 532-0604.

A final regulation of the Tennessee DEC establishes air quality standards for wood furniture manufacturing facilities located in specific counties whose maximum potential emissions from all coating lines are 100 tons of VOCs or more per year. The rule will go into effect May 27. Contact Malcolm Butler, DEC, (615) 532-0600.

The Tennessee DEC has repealed a portion of a regulation related to VOC emissions from miscellaneous metal parts coatings, specifically affecting the definition of "high performance architectural coating." The rule will be effective May 5. Contact John Patton, DEC, (615) 532-0604.

Air Quality (Proposed Regulation)—The Tennessee DEC proposed regulations which would (1) amend operating permit requirements; (2) specify opt-in procedures for stationary source operating permits; (3) modify requirements concerning limits on emissions because of malfunction, startup or shutdown; and (4) amend standards regarding case-by-case determinations of hazardous air pollutant control requirements. Contact Malcolm Butler, DEC, (615) 532-0600.

TEXAS

Air Quality (Notice)—The Texas Natural Resource Conservation Commission (NRCC) has withdrawn a proposed rule (21 TXR 1797; 2/18/97) dealing with surface coating operations at wood products operations which would have simplified air quality control and recordkeeping requirements, and amended emission limits. The withdrawal went into effect Feb. 7. Contact NRCC, (512) 239-5885.

Air Quality (Proposed Regulation)—A proposed rule (22 TXR 2416; 3/4/97) issued by the Texas NRCC would exempt surface coating facilities at wood products manufacturing operations from preconstruction air quality permitting criteria. The regulation replaces a similar rule proposed earlier. Contact Lisa Evans, NRCC, (512) 239-5885.

Graffiti—TX S. 1802 (Wentworth) increases penalties for juveniles who damage property with graffiti. The measure was introduced on March 14 and sent to the Senate Committee on Criminal Justice.

Lead—TX H. 729 (Van de Putte) requires lead hazard abatement workers in target housing and child-occupied facilities to be certified. On March 26, the bill was amended and released from the House Committee on Public Health.

Occupational Safety and Health—TX H. 3459 (Chisum) allows penalties to be assessed for environmental or safety violations that were voluntarily disclosed under specific circumstances. The bill was amended and released from the House Committee on Environmental Regulation on April 8.

Spray Paint Restrictions—TX H. 1714/S. 758 (Serna/Shapleigh) relates to the retail sale of aerosol paint. The House bill was amended and released from the House Committee on Juvenile Justice on April 9; the Senate version was approved by the Senate on April 8.

UTAH

Hazardous Waste—UT S. 195 (Holmgren) amends the disposal fee for hazardous waste that has been treated so it is no longer hazardous at the time of disposal. The governor signed the measure on March 21.

VIRGINIA

Air Quality (Regulation)—The Virginia Air Pollution Control Board (APCB) adopted a final rule which incorporates by reference federal air quality requirements concerning epoxy resins, aerospace and shipbuilding operations, wood furniture manufacturing, and surface impoundments. The regulation goes into effect May 1. Contact Alma Jenkins, APCB, (804) 698-4070.

Household Hazardous Waste—VA H. 2814 (Moore) changes the definition of household hazardous waste to include solvent-based paint, paint stripper, and paint thinner. The governor signed the bill on March 12.

Lead—VA S. 1004 (Lambert) authorizes the promulgation of lead training and certification requirements that are no more stringent than federal standards. The governor signed the legislation on March 21.

Toxic Substances—VA H. 2246 (Connally) requires the state to publish a Toxic Release Inventory document. The governor signed the measure on March 6.

WASHINGTON

Recycling—WA S. 5474 (Hargrove) adopts federal standards for purposes of state and local agency purchases of recycled products, including latex paint. The bill passed the Senate on March 13 and was sent to the House Committee on Agriculture and Ecology.

Toxic Substances—WA H. 1602 (Shoesler) directs "specialty chemicals advisory committee" to advise the state concerning the accuracy and scientific content of all materials published by the state on chemical alternatives in order to assure the accuracy of and public confidence in the information. On March 14, the bill passed the House and was sent to the Senate Committee on Commerce and Labor.

WEST VIRGINIA

Air Quality—WV H. 2476 (Amores) establishes a market-based air emission banking and trading program. The bill, which was introduced on March 11, was sent to the House Finance Committee.

Hazardous Materials Transportation—WV H. 2705 (Pettit and Collins) prohibits vehicles transporting hazardous materials from parking within 1000 feet of education or health facilities. Introduced on March 24, the bill was referred to the House Committee on Roads.

Lead—WV H. 2738 (Campbell) provides for licensing of persons engaged in lead abatement projects. Introduced on March 26, the measure was sent to the House Committee on Government Organizations.

WISCONSIN

Lead (Proposed Regulation)—A regulation (494 WIAR 22; 2/28/97) proposed by the Wisconsin Department of Health and Family Services (DHFS) would adopt standards for the certification and accreditation of lead abatement service providers and training courses. Contact Gail Boushon, DHFS, (608) 266-5280.

Lead (Regulation)—The Wisconsin DHFS issued an emergency rule (495 WIAR 5; 3/14/97) which establishes procedures for the certification of lead abatement workers and for the accreditation of lead management training courses. The regulation went into effect Feb. 18, 1997 and will expire on July 17, 1997. Contact Gail Boushon, DHFS, (608) 266-5280.

WYOMING

Environmental Audits (Proposed Regulation)—The Wyoming Department of Environmental Quality (DEQ) proposed a rule which would establish requirements to waive penalties against small businesses that voluntarily disclose environmental violations during the course of compliance assistance seminars. Contact DEQ, (307) 777-7391.

Colin Powell to Keynote NPCA's Annual Meeting; NPCA Urges Companies to Review Labeling Standard

General Colin L. Powell, USA (Ret.), will present the Keynote Address at the National Paint and Coatings Association's (NPCA) Annual Meeting and Coatings Leadership Conference on November 2-4, 1997, at the Atlanta Hilton and Towers, Atlanta, GA.

Best known for his tenure as Chairman of the Joint Chiefs of Staff from 1989-1993, General Powell served as principal military advisor to the President, the Secretary of Defense and the National Security Council during his four years of service in this position.

General Powell began his distinguished military career in 1958 when he was commissioned as an infantry lieutenant in the U.S. Army upon graduating from City College of New York. He served twice in Vietnam, earned a master's degree in business administration from George Washington University, and was selected as a White House Fellow. During the 1980s, General Powell served as Senior Military Assistant to the Secretary of Defense and as Assistant to the President for National Security Affairs, prior to attaining the rank of General.

In 1993, after 35 years of service to the United States, General Powell retired and went on to become the best-selling author of his autobiography, *My American Journey*.

In addition to General Powell's keynote address, NPCA's 1997 Annual Meeting will include a welcome reception for all guests, an Opening Session with a featured speaker, the Honors Luncheon, and the annual Chairman's Reception. NPCA's meeting, titled "Strategies for Success" will incorporate a day and a half of business-related topics presented in three tracks: health, safety and environment; management and operation; and technology.

Five Gallon Bucket Labeling

NPCA has learned that the Consumer Product Safety Commission (CPSC) is evaluating compliance with the American Society for Testing and Materials (ASTM) five-gallon bucket labeling standard, as well as the extent to which the industry has embraced the standard.

While CPSC has many options available to them to promote voluntary labeling, the most likely course of action, according to NPCA, will be to communicate directly with product manufacturers who have not yet conformed to the ASTM standard. Consequently, paint manufacturers are strongly advised to review the requirements of the ASTM standard and initiate appropriate action.

In 1993, the five-gallon container child safety labeling law went into effect in California. This law requires labeling of five-gallon buckets in an effort to warn consumers of potential hazards the buckets pose to children. Also in 1993, ASTM approved a voluntary national standard for labeling five-gallon buckets.

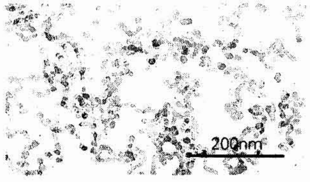
Carrs Paints Ltd. Acquired By DuPont Automotive

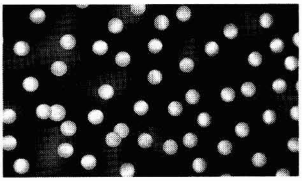
DuPont Automotive, Troy, MI, has acquired the automotive finishes business of Carrs Paints Ltd. Financial terms were not disclosed.

In addition to Carrs Paints' automotive finishes business and the Minworth manufacturing site in Birmingham, England, the acquisition includes the manufacturing and marketing of coatings for plastic parts throughout Europe and distribution of auto repair paints in Birmingham, England.

The acquisition provides DuPont with a UK manufacturing base for finishes and entry into the fast growing coatings market for plastic parts in Europe.

Simultaneously, DuPont's European Automotive OEM finishes business, IDAC, will change its name to DuPont Automotive Coatings to integrate it into the worldwide operations of DuPont Automotive.





Reconditioned/Recycled Plastic Drum Use Approved by the United Nations' Committee

A report issued by The Society of the Plastics Industry (SPI), Inc., Washington, D.C., states that the United Nations Committee of Experts on the Transport of Dangerous Goods approved a petition to recognize the use of reconditioned plastic drums and to permit the use of recycled plastics in new drums.

The petition was the result of a joint effort between SPI's Plastic Drum Institute (PDI) and the International Confederation of Drum Reconditioners and was supported by the U.S. Department of Transportation (DOT).

John Malloy, PDI Staff Director, said the U.N.'s action will place the plastic drum on a level playing field with its competitors and reduce the product's environmental impact by prolonging its useful life.

The U.N. recommendation is based on the results of research conducted by the PDI over the last several years. The research demonstrated the suitability of 55-gallon drums that had previously been used in hazardous material transport for storage and shipping of a second hazardous material. The studies also showed that drums made from recycled resin can satisfy the DOT's packaging requirements for hazardous materials.

The approval is important because member countries follow the U.N. guidelines in formulating their own regulations for the transport of hazardous materials. While the U.N. previously did not expressly prohibit the use of reconditioned or recycled content drums, its recent decision clarifies the issue and gives drum users added confidence and credibility.

As part of the U.N. recommendations, drum manufacturers are urged to maintain a quality assurance program. This includes proper sorting of drums by content, thorough recordkeeping and knowledge of contents history, and adherence to strength standards through testing.

Powder Coatings Growth Fails to Achieve Estimates

According to estimates made by The Powder Coating Institute (PCI), Alexandria, VA, production of thermoset general decorative powder coating materials in North America for 1996 fell below earlier estimates.

In the spring of 1996, PCI reported a total of 257 million pounds of thermoset decorative powder coatings were produced in 1995, a 12% increase of 1994 production of 228 million pounds. Growth estimates for 1996 were then predicted to be in the 10-12% range.

A preliminary look at industry statistics reveals that the growth in production of powder coatings was significantly below the 10-12% range previously predicted for 1996. This initial review indicates that growth for 1996 was in the range of four to six percent.

Intec Controls Acquired by Nematron Corp.

Nematron Corp., Ann Arbor, MI, has completed the acquisition of Intec Controls Corp., Walpole, MA, in exchange for up to 600,000 shares of Nematron common stock and warrants to purchase 125,000 shares of Nematron common stock.

Intec Controls has been merged into Nematron's NemaSoft subsidiary, integrating its products into the current NemaSoft product line of open architecture control and automation software products. The addition of Intec's product line significantly extends the scope of its software offerings by extending Nematron's reach into the process industries. These will include Paragon's client/server architecture and family of high performance regulatory control software solutions.

In connection with this acquisition, NemaSoft anticipates it will take a significant one-time charge against earnings relating to acquired in-process research and development costs. NemaSoft will continue to operate the unit out of its present location and continue to employ its current staff.

CCP Forms Joint Venture With Polymer Products

Cook Composites and Polymers (CCP), Kansas City, MO, has formed a joint venture with Polymer Products, Inc., Grand Rapids, MI, to provide the manufacturing base and CCP contributing technology and expanded marketing support. The agreement includes installation of a new 4,000 gallon reactor at Polymer Products' plant.

Polymer Products produces alkyd and polyester resins for the paint and coatings markets. CCP is an international company with product lines and manufacturing facilities throughout North America.

23rd Conference on Organic Coatings Slated for July 7-11 in Athens, Greece

The Institute of Materials Science at the State University of New York, New Paltz, NY, will conduct the "23rd Annual International Conference on Organic Coatings: Waterborne, High-Solids, and Powdered Coatings," on July 7-11, 1997 in Athens (Vouliagmeni), Greece.

The following topics are scheduled to be presented:

"Self-Assembling Adhesion Promoters for Corrosion Resistant Metal-Polymer Interfaces"—H.J. Adler, Technische Universitat Dresden;

"4-Methyl-Oxo-Benzene-Butanoic Acid Complexes—A New Class of Corrosion Inhibitors for Waterborne Coatings"—A. Braig, Ciba Specialty Chemicals;

"Waterborne Two-Pack Coatings for Industrial Applications: A Comparison Between Isocyanate-Free and PMR Systems"—E. Brinkman, Akzo Nobel Resins B.v.;

"Technologies for Achieving the Rapid Setting of Waterborne Coatings"—W. Brown, Rohm and Haas Co;

"Coating Systems Based on Tricarbanate Crosslinkers Derived from Triaminononane"—J. Courtier, Monsanto Specialty Resins;

"Interaction Between Styrene-butylacrylate Latex and Water-Soluble Associative Thickener for VOC Paint"—B. Emelie, Dow Deutschland, Inc.;

"Potential Low Molecular Weight for Solids Coatings"—B. Gregorovich, DuPont Co.;

"Interactions Between Light Stabilizers and Pigment Particles in Polymeric Coatings"—G. Haacke, Cytec Industries;

"The Rheological Properties of an Aqueous Acrylic Dispersion Suitable for Waterborne Automotive Basecoat"—H. Harakawa, Kansai Paint Co., Ltd.;

"Probing Polymer Interdiffusion in Carboxylated Latexes with Force Modulation Atomic Force Microscopy"—A.C. Hellgren, Institute for Surface Chemistry;

"Structural Studies on Thin Organic Coatings Built by Repeated Complexation of Polyectolytes"—A. Jonas, Universite Catholique du Louvain;

"Studies of Microhardness and Mar Resistance Using a Scanning Probe Microscope"—F. Jones, Eastern Michigan University;

"Surface Modification of Polymeric Materials by Atmospheric Plasma Treatment"—A. Iwata, Nippon Paint Co., Ltd.;

"Highly Durable Coatings for Automotive Polycarbonate Glazing"—D. Katsamberis, General Electric Plastics;

"Enzyme Catalyzed Durable and Authentic Oriental Lacquer—A Natural Microgel Printable Coating by Polysaccharides-Glycoproteins-Phenolic Lipids Complexes"—J. Kumanotani;

"Air Drying High-Solids Coatings"—J. Lindeboom, Van Wijhe Verf B.v.;

"Powder Coatings Technology: New Developments at the Turn of the Century"—T.A. Misev, DSM Resins B.v.;

"Water-Based Coatings for Automotive Refinishes"—H.P. Rink, BASF ;

"Model Epoxy Coatings and Their Adhesion to Steel"—Aart C. Rouw, Dow Deutschland, Inc.;

"Spherical Particles for Automotive Powder Coatings"—Haruhiko Satoh, Nippon Paint Co., Ltd.;

"Applications of Modern Mass Spectroscopy in Coatings Characterization"—William J. Simonsick, DuPont Co.;

"Novel Wet Adhesion Monomers for Use in Latex Paints"—Balwant Singh, Cytec Industries Inc.;

"Non-Yellowing Emulsifiers with High Chemical Resistance: A Key to High Performance Water-Based Coatings"—W. Schubert, Herberts GmbH;

(continued on next page)

BYK-Gardner to Conduct Color and Appearance Course

BYK-Gardner USA, Columbia, MD, has released its schedule for "Color and Appearance Seminars." The color and appearance theory, applications as well as measurement of other physical test properties associated with coatings, plastics and a variety of other material will be covered in this course.

Dates and locations for the half-day seminar are September 9—Chicago, IL; September 11—Minneapolis, MN; September 11—Charlotte, NC; September 18—Houston, TX; September 23—Columbus, OH; September 30—Toronto, Ontario; November 13—Orlando, FL; and December 12—Los Angeles, CA.

For additional information, contact BYK-Gardner USA, Rivers Park II, 9104 Guilford Rd., Columbia, MD 21046-2729.

Atlas Releases Schedule for Weathering Seminar

Lightfastness and weathering durability testing techniques will be emphasized during the one-day seminar, "The Fundamentals of Weathering." Conducted by Atlas Material Testing Solutions, Chicago, IL, this seminar will be held on various dates and locations throughout North America.

The schedule is as follows: June 24—Parsippany, NJ; June 26—Boston (Westborough), MA; September 9—Grand Rapids, MI; September 23—Minneapolis (Bloomington), MN; September 25—Chicago (Rosemont), IL; October 7—Houston, TX; October 9—Los Angeles, CA; October 21—Toronto, Ontario, Canada; October 23—Detroit (Novi), MI; and October 29—Charlotte, NC.

The seminar will introduce the basics of how various factors of weather and climate, such as solar radiation, heat and moisture, may affect materials and how to test the resistance of a formulation or product to them. Special attention will be given to the testing techniques of paints and protective coatings, automotive materials, architectural building products, and molded plastic materials. Textile and fiber lightfastnesses and weatherability will also be discussed.

The class is designed to benefit those involved with designing, evaluating, specifying, selling, or purchasing materials or products that may be affected by exposure to light or weather.

Tuition for the seminar is $65 and includes lunch, refreshments, and course materials.

For more information, contact Peggy Carpenter, Atlas Electric Devices Co., 4114 North Ravenswood Ave., Chicago, IL 60613.

University of Minnesota to Sponsor Two Coating Process Courses

The University of Minnesota is hosting a course on "Coating and Drying Process Technology" June 16-17, 1997. In addition, a course titled "Coating Process Fundamentals" is slated for June 18-20. Both courses will be held at the East Bank on the University of Minnesota's Minneapolis Campus.

"Coating and Drying Process Technology" will cover the technology of coating continuous webs from fluid preparation and handling to the drying of the coated web. The course is designed for coating engineers and coating operators working with the precision coating of thin films, and practiced in the photographic, magnetic media, converting, and other industries.

Course topics will include the following: roll coating, premetered coating, static electricity and electrostatic assist, coating die design, web handling and drives, and dryers and drying.

"Coating Process Fundamentals" provides an understanding of the principles of the many processes by which liquid coatings are applied and solidified.

Some of the topics to be explored in the short course include: elements of coating function and form; simple coating flows: knife, bar dip, airknife; slot, extrusion, and die coating, use of vacuum; slide and curtain coating basics: use of electrostatics; simultaneous multi-layer coating; overview of computer modeling; roll systems: gravure, rotary screen coating; flow instability and failure; rheology of coating liquids; overview of coating process visualization; blade and membrane coating basics; elements of phase behavior, mass and heat transfer in drying; and drying, curing, annealing coated films.

The fee for "Coating and Drying Process Technology" is $995 and the cost for "Coating Process Fundamentals" short course is $1,295. The fees include course materials, lunches, refreshment breaks and reception.

Contact Susan Burke, Professional Development and Conference Services, University of Minnesota, 235 Nolte Center, 315 Pillsbury Dr., S.E., Minneapolis, MN 55455 for more information.

Principles of Coatings Technology to Be Explored in Course Conducted by North Dakota State University

An intensive coatings science course designed to provide the fundamental principles of coatings technology will be conducted by North Dakota State University, Fargo, ND, on June 2-13, 1997.

Although a one-week option is available, the course is designed as a two-week event, and it is strongly recommended to attend the entire two weeks.

The first week will primarily focus on synthetic aspects of coatings, whereas the second week will be designated to topics dealing with other physico-chemical processes, applications, and measurements. In addition, approaches to improving coatings performance within cost, safety, environmental, and energy conservation constraints will be emphasized.

The following topics will be discussed:

- chain-growth/step-growth polymerization resins
- acrylic, polyester, alkyds
- film formation
- amine-formaldehyde resins; crosslinking
- epoxy resins
- urethane coatings
- solvents
- rheology
- appearance of coatings
- pigments and pigment dispersion
- coatings performance
- current research topics
- coatings formulation

The registration fee for the two-week course is $2,700 which includes room and board. The one-week option costs $1,400 which includes room and board.

For more information, contact Debbie Shasky, Program Coordinator, North Dakota State University, Dept. of Polymers and Coatings, 54 Dunbar Hall, Fargo, ND 58105; (701) 231-7633.

Datacolor Int'l Announces Color Seminar Schedule

Datacolor International, Charlotte, NC, has announced the dates and locations for its 1997 color seminar entitled "Getting Color Right. A Seminar on the Art, Science, and Application of Industrial Control Technology."

These comprehensive color seminars focus on practical color problem solving in industrial applications with an eye toward providing fresh insights on new techniques. Topics to be discussed include: colorimetry and factors affecting color; spectrophotometry and metamerism; color differences; and color quality control and color formulation and correction.

The following is the schedule for the 1997 Color Seminar:

June 4-5	Chicago, IL
July 15-16	Lawrenceville, NJ
August 6-7	Charlotte, NC
August 28-29	Columbus, OH
October 9-10	Boston, MA
November 6-7	Dallas, TX

The registration fee is $395 per person and includes course materials, breakfast, and lunch. For more information, contact Datacolor International, 3755 Beam Rd., Charlotte, NC 28217.

Organic Coatings Conference Slated for July 7-11, 1997

(continued on previous page)

"Investigation of Fluacid Based Non-Chromium Conversion Coatings on Aluminum and Galvanized Steel"—R.J. Sujdak, Betz Dearborn, Inc.;

"Process Variables and Their Influence on Shell Formation in Latex Particles"—D.C. Sundberg, University of New Hampshire;

"Reduction of the Use of Zinc and Volatile Organic Solvents in Two-Pack Anti-Corrosive Primers—A Pilot Study"—K. van Vliet, Sigma Coatings Research Amsterdam;

"Dimeric Isocyanates in Polyurethane Powder Coatings"—J.V. Weiss, Hüls AG;

"Self-Assembling Adhesion Promoters for Corrosion Resistant Metal-Polymer Interfaces"—K.H. Zabel, Akzo Nobel Coatings;

"Acrylic/Polyester Hybrid POwder Coatings System Having Excellent Weather Durability"—K. Okada, Dainippon Ink and Chemicals, Inc.;

"High Speed Powder Coating in Coil"—F.D. Graziano, Materials Science Corp.;

"Structural Studies on Thin Organic Coatings Built by Repeated Complexation of Polyelectrolytes"—M. Jonas, Universite Catholique de Louvain; and

"Advanced Methods and Models for Coating Appearance"—M.E. McKnight, National Institute of Standards and Technology.

Contact Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561, for more information; (914) 255-0757.

Study of Formulation Variables of Thermoplastic Reflecting Materials for Traffic Marking

A.C. Aznar, J.J. Caprari, J.F. Meda, and O. Slutzky—CIDEPINT*

Nine formulations of thermoplastic materials for traffic marking were prepared using a resin based on maleic anhydride modified with rosin in different proportions (18, 22, and 26%). A liquid coconut long oil alkyd resin (100% solids) was employed as a plasticizer.

Titanium dioxide was used as a hiding pigment while calcium carbonate and micronized talc were used as extenders. Coarse marble powder facilitated the incorporation of glass beads. The operation was made by employing a double Z mixer heated with oil to obtain a mass temperature of 180-190°C. The mixer was equipped with two asynchronous arms rotating at 46 rpm.

Dry and wet abrasion tests were carried out and the results obtained indicated that wearing values are three times greater in the case wet test.

It is demonstrated that plasticization degree controls hardness variation as a function of temperature; therefore, a critical point, which is the beginning of an abrupt reduction of hardness, is determined. Water absorption increases when the plasticizer content increases. A matrix correlation of tests results was used to analyze the obtained numeric values.

INTRODUCTION

Thermoplastic pavement markings are durable, high-quality marking materials. These are mixtures of either maleic-modified glycerol resin esters or hydrocarbon resins with plasticizers, pigments, and glass beads. The formula is melted at 180-190°C and can be extruded or sprayed on the surface to be marked. Solvents are not included in their formulation, so they are ecologically acceptable. Prior to their application, the surface should be cleaned and an asphaltic primer diluted with a volatile solvent should be applied to obtain a higher adhesion of the material on the base.

Reflecting thermoplastics applied on city streets, roads, or highways frequently lose their efficiency due to the wearing or the partial detachment of the used materials; the appearance and physical characteristics are modified.

The adequate lifetime is a function of different variables,[1] acting individually or as a whole: adhesion to the surface where they were applied (asphalt or concrete), resistance to abrasion and weathering (moisture due to rain and dew remaining for a long period of time in contact with thermoplastic marks), high temperatures producing deformation or low temperatures diminishing elasticity and favoring checking or cracking of the coat.

An important aspect is related to the influence of traffic intensity and the rolling action of tires, especially the pressure when the tire contacts with the line or the suction when rolling over them. A high quality result is related to the components of the formulation and to the adequate cleaning of the surface before application. Asphalt pavements yielded the best performance.[2]

The objective of this research is to determine the influence of composition variables (pigment/binder ratio, resin content, plasticizer type and content, fillers employed, and PVC) on the adhesion or wearing resistance of the thermoplastic applied on a concrete surface.

EXPERIMENTAL

Nine samples of thermoplastic reflecting materials were formulated, containing as binder (acting as agglutinant) a resin based on maleic anhydride and modified with rosin. The modified resin was used in 18, 22, or 26% on the total formulation. As a plasticizer, a coconut oil alkyd resin was employed in proportions between 2.7 and 6.5%.

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*Centro de Investigación y Desarrollo en Tecnología de Pinturas, (CIC-CONICET), Av. 52 e/121 y 122, (1900) La Plata, Argentina.

Table 1—Composition of the Thermoplastic Materials[a]

Material	IA	IB	IC	IIA	IIB	IIC	IIIA	IIIB	IIIC
Maleic resin	18.0	22.0	26.0	18.0	22.0	26.0	18.0	22.0	26.0
Alkyd resin	2.7	3.3	3.9	3.6	4.4	5.2	4.5	5.5	6.5
Titanium dioxide	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Glass beads	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Marble	22.4	20.3	18.2	22.0	19.8	17.6	21.6	19.3	17.0
Calcium carbonate	22.4	20.3	18.2	22.0	19.8	17.6	21.6	19.3	17.0
Talc	4.5	4.1	3.7	4.4	4.0	3.6	4.3	3.9	3.5

(a)g.100 g

Table 2—Physical and Composition Variables of Thermoplastic Materials

	R	P	M	C	T	W^+	AS	D	ΔS	PVC	W^-
IA	18	2.7	22.4	24.4	4.5	46.6	10.4	98	1.448	57.6	41.3
IB	22	3.3	20.3	20.3	4.1	24.9	13.2	97	1.261	51.7	21.9
IC	26	3.9	18.2	18.2	3.7	16.3	14.9	95	1.206	45.3	14.0
IIA	18	3.6	22.0	22.0	4.4	36.8	9.9	90	1.347	56.3	31.0
IIB	22	4.4	19.8	19.8	4.0	20.6	12.6	85	1.316	49.7	16.9
IIC	26	5.2	17.6	17.6	3.6	15.9	14.7	83	1.088	43.7	12.6
IIIA	18	4.5	21.6	21.6	4.3	36.4	9.1	82	1.336	55.0	30.1
IIIB	22	5.5	19.3	19.3	3.9	19.7	11.9	70	1.302	48.2	15.4
IIIC	26	6.5	17.0	17.0	3.5	13.5	14.7	69	1.060	42.3	10.4

Matrix correlation between the Different Variables

	R	P	M	C	T	W^+	AS	D	ΔS	PVC	W^-
R	1.00	0.58	–0.97	–0.93	–0.98	–0.92	0.98	–0.31	–0.89	–0.97	–0.90
P	0.58	1.00	–0.75	–0.77	–0.72	–0.71	0.43	–0.94	–0.73	–0.76	–0.75
M	–0.97	–0.75	1.00	0.97	0.99	0.95	–0.91	0.51	0.93	1.00	0.94
C	–0.93	–0.77	0.97	1.00	0.97	0.98	–0.85	0.55	0.93	0.97	0.98
T	–0.98	–0.72	0.99	0.97	1.00	0.95	–0.91	0.48	0.91	1.00	0.94
W^+	–0.92	–0.71	0.95	0.98	0.95	1.00	–0.87	0.50	0.84	0.95	1.00
AS	0.98	0.43	–0.91	–0.85	–0.91	–0.87	1.00	–0.15	–0.83	–0.91	–0.84
D	–0.31	–0.94	0.51	0.55	0.48	0.50	–0.15	1.00	0.46	0.52	0.55
Δ	–0.89	–0.73	0.93	0.93	0.91	0.84	–0.83	0.46	1.00	0.92	0.84
PVC	–0.97	–0.76	1.00	0.97	1.00	0.95	–0.91	0.52	0.92	1.00	0.95
W^-	–0.90	–0.75	0.94	0.98	0.94	1.00	–0.84	0.55	0.84	0.95	1.00

R: resin
P: plasticizer
M: marble powder
C: calcium carbonate
T: micronized talc
W^+: water absorption
AS: adhesion-strength
D: hardness at 55°C
ΔS: abrasion
PVC: PVC
W^-: water elimination

The characteristics of the resins employed in the binder composition are the following:

(a) Maleic resins, constituted by a thermoplastic polymer of low molecular weight (approximately 950), elaborated from a rosin modified with maleic anhydride and sterified with glycerin. Its properties are:

Solids content	100%
Softening point	98°C
Melting point	114°C
Acid value	14
Gardner viscosity (65% in xylol)	Z1-Z3
Gardner color (65% in xylol)	10

(b) Alkyd resin, long in coconut oil/glycerine with the following properties:

Solids content	100%
Acid value	15
Gardner viscosity (65% in xylol)	Z4-Z6
Gardner color (65% in xylol)	12

As a hiding pigment, titanium dioxide—rutile type—was employed to obtain a white color with high luminosity (Y>80). Pigment formulation was completed using fillers as calcium carbonate and talc, which are of good wearing resistance. Sample formulations are indicated in *Table* 1.

A double Z mixer (*Figure* 1) was used for the thermoplastic preparation. One of the mixer's two asynchronic arms rotated at 46 rpm. For heating, a mineral thermic fluid circulating in the heating jacket was employed (maximum temperature 300°C).

Titanium dioxide, fillers, and glass beads were incorporated at 180-190°C. Operation at this temperature

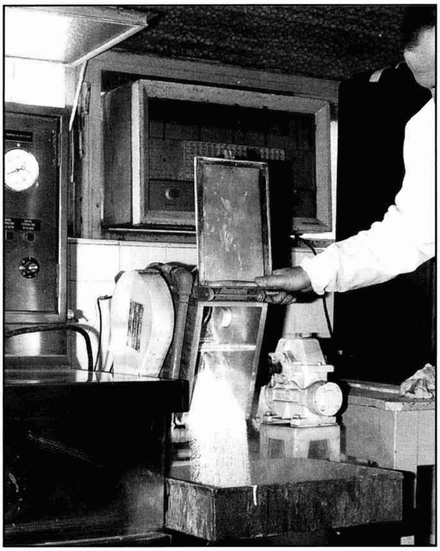

Figure 1—Double Z mixer for test samples preparation.

lasted 30 min and then the product obtained was casted in special molds.

The sample tests, performed at different temperatures, included wet and dry abrasion, Shore A hardness, adhesion-cohesion, water absorption, and water elimination rate.

For the wet and dry abrasion test,[3] disk specimens were employed (80 mm diameter and 3 mm thick). After 24 hr, samples were abraded using Taber Abraser equipment with an H-22 abrasive and 1000 g load (ASTM D 4060). The dust produced by the wearing operation was eliminated constantly by flowing pressurized air. When a track is formed as a consequence of wearing, the sample is weighed with an exactitude of 1 mg. After that, the wearing operation is continued along 100 revolutions of the equipment and weighed again. The difference between the two values obtained is expressed as dry wearing.

After finishing the previous test, distilled water is added to the track and the operation continued during 100 more revolutions. The sample is now conditioned for water elimination and weighing. The difference with the previous value is expressed as wet wearing.

Shore A hardness[4] at temperatures between 40 and 70°C was determined each 5°C, according to ASTM D 2240. In this case test plates are 50 mm diameter and 3 mm thick; the value was registered after 15 sec. Samples were stabilized during one hour at test temperature before hardness determination.

To obtain adhesion and cohesion strength values, a method developed at CIDEPINT was employed.[5,6] The melted material was put in the midst of concrete probes (3 mm thick), previously primed with an acrylic varnish and preheated at 40°C. An iron flexible wire was inserted in test probes to cluten the clamps of a dinamometer. The traction effort was performed at a velocity of 200 mm.min^{-1} and at a temperature of 20°C (*Figure* 2).

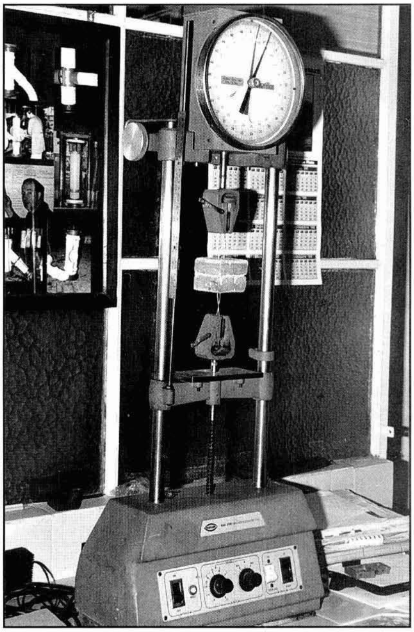

Figure 2—Adhesion-strength determination by CIDEPINT method.

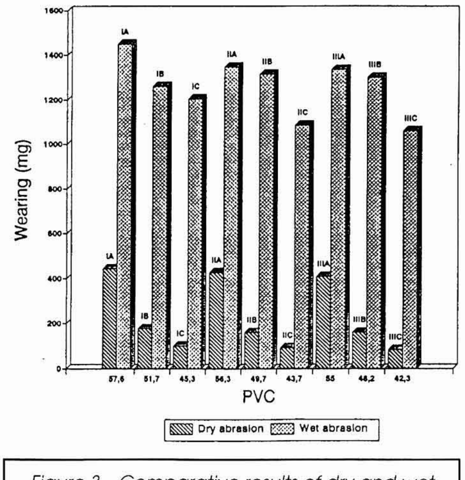

Figure 3—Comparative results of dry and wet abrasion test.

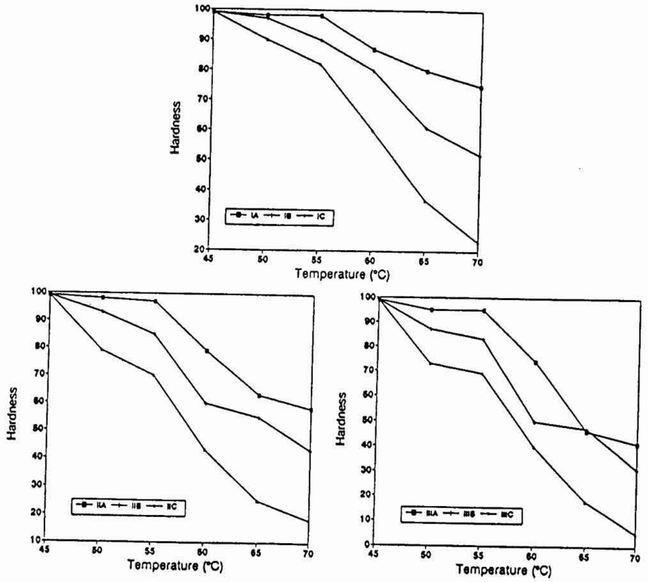

Figure 4—Variations in hardness as a function of temperature.

For the determination of water absorption and water elimination rates,[7-9] specimens 50 mm diameter and 3 mm thick were prepared and weighed to ± 1 mg. Hung by a copper wire, they were completely submerged in distilled water 20 ± 1°C for 24 hr. Then they were dried with filter paper and weighed; the operation was made after 48 and 72 hr. Absorption values were obtained by difference with the initial weight of the samples.

Afterwards, the probes were conditioned at 20°C and 50% HR. Water elimination values were obtained by weighing.

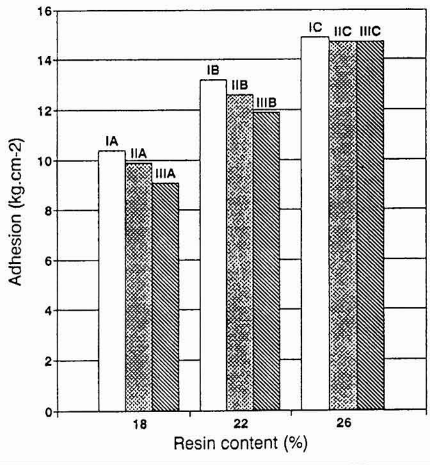

Figure 5—Variations in adhesion-strength as a function of resin content.

DISCUSSION

Maleic resin is the agglutinant used in the formation of thermoplastic traffic materials. The modification of physical properties (reduction of melting point and adequate elasticity characteristics) by means of an alkyd resin improved the system wetting, facilitating the incorporation of the hiding pigment (TiO_2), fillers, and glass beads. In those conditions a homogeneous distribution of glass beads was obtained. This is a very important aspect in field behavior; in wearing, an adequate distribution of beads in the material assures adequate night visibility during a long period.

A certain correlation was observed between the thermoplastic traffic materials composition and the values of the obtained physical properties (*Table* 2).

In the dry abrasion test, the trend of wearing values is determined by the pigment volume concentration of the different samples. Two series of wearing values were obtained (*Figure* 3).

The wet abrasion test shows greater wearing values than those obtained in the dry abrasion test.

Results of hardness test as a function of temperature

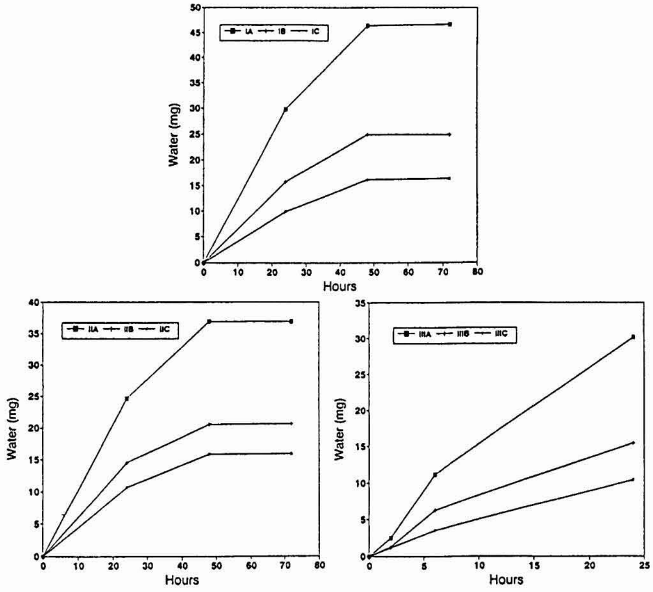

Figure 6—Water absorption values as a function of time.

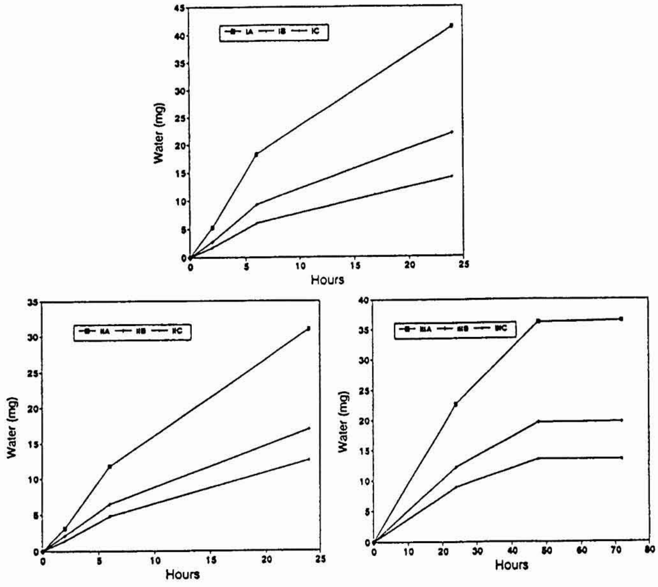

Figure 7—Water elimination values as a function of time.

are related to the plasticization degree of the agglutinant resin. This is particularly observed at the temperature of 55°C, which is considered critical; above this temperature, hardness diminishes abruptly in practically all of the samples. This characteristic is independent of plasticizer level and PVC values (*Figure* 4).

The indicated critical temperature is a harmful interactive factor in the material application due to the fact that plasticization should remain constantly independent of the temperature increase so as to avoid that the excessive softening may produce deformation of marking lines and traces due to the marks left by vehicle wheels. These factors reduce the useful life of the thermoplastic material.

Adhesion-tension values are lineally dependent on the employed resin (*Figure* 5) and are not related with the plasticizer level; the obtained values expressed in kg.cm^{-2} are of the same order than those of the standards used to qualify this type of material.

In the results of the water absorption (*Figure* 6) and water elimination (*Figure* 7) tests, the increase of weight of the thermoplastic mass during immersion is faster than the elimination value.

CONCLUSIONS

(1) The wet abrasion wearing values are higher than those obtained in the dry abrasion test. Wearing is directly dependent on the plasticizer level but independent of the maleic resin content.

(2) Plasticization degree has a high influence on hardness variation as a function of temperature. A critical point appears at 55°C with a sudden reduction of hardness values.

(3) Adhesion strength is dependent on the resin content; a higher content increases adhesion strength. This parameter is independent of the plasticization degree.

(4) Water absorption decreases when plasticizer increases independently of the resin content. Water elimination rate decreases too.

(5) The retained moisture of the thermoplastic traffic material after immersion must be considered as a harmful property in relation to the wearing resistance in service.

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OSCAR SLUTZKY studied chemistry at the Universidad Nacional de La Plata, where he graduated in 1955. Immediately after graduation, he worked in the chemical industry as a Process Chemist. For 20 years Dr. Slutsky was a Process Master Chemist in the Nylon Technical Division of DuPont in Argentina. In 1982, he was appointed by CONICET to work at CIDEPINT, where he carries out research work on paints and polymeric materials. Dr. Slutzky is author of numerous papers in specialized publications.

JORGE MEDA studied at the Industrial School where he obtained a Chemical Technicana Degree in 1957. Immediately following graduation, he worked at the Argentinian National Atomic Energy Center. In 1977, he joined CIDEPINT. At present, Mr. Meda works on paint and computation models at CONICET.

JUAN J. CAPRARI studied at the Universidad Tecnológica de la Plata (Argentina) where he graduated as a Chemical Engineer in 1966. Immediately following graduation, Eng. Caprari started working on paints at CIDEPINT. He was awarded with the Horacio Damianvoich prize of the Argentina Chemist Association. He is author of numerous publications on protection by paints, surface preparation and finishing, and paint application. In 1979, he received a fellowship from the Spain Scientific Research Council to do research on paints and cathodic corrosion at the Centro Nacional de Investigaciones Metalúrgicas (CENIM) in Spain. At present, he is head of the Paint Film Properties Area of the CIDEPINT and member of the scientific research career of CONICET.

ALBERTO C. AZNAR studied at the Universidad Tecnológica de la Plata (Argentina) where he graduated as a Chemical Engineer in 1978. Immediately following graduation, Eng. Aznar started working on paints at CIDEPINT. His research is related to paints in general, and since 1983 he had been working with thermoplastic materials for traffic marking. Eng. Aznar also studies polymeric substances and resins. He is author of numeous papers published in specialized journals.

Flame-Retardant Brominated Styrene-Based Polymers. X. Dibromostyrene Grafted Latexes

N.A. Favstritsky and J.-L. Wang—Great Lakes Chemical Corp.*

This paper describes the synthesis, characterization, and some applications of flame-retardant dibromostyrene grafted latexes. These latexes are synthesized by an emulsion polymerization technique. One of the prime factors to be considered in the choice of a commercial latex or a latex blend to be grafted is the glass transition temperature(s) of the polymer(s) in the final latex desired. The graft latexes were characterized in terms of glass transition temperature, solids content, bromine content, grafted dibromostyrene content, and flame retardancy. They are useful for a wide range of applications, including fabric backcoatings, carpetings, paints, adhesives, sealants, caulks, nonwoven binders, etc.

INTRODUCTION

Natural and synthetic latexes are commercially used in a variety of coatings. In many coatings applications, the latexes with flame-retarding properties are desired. This applies in particular where latexes are used in textiles, carpetings, paints, clearcoatings, adhesives, sealants, caulks, nonwoven binders, etc.

Until recently, coatings users have generally had to use flame retardants that were developed for other applications. All of these products, either liquid or solid, have had an adverse effect upon the quality of the coating. The usual method by which flame-retardant (FR) properties are imparted to latexes is the blending-in of flame retardant additives, but disadvantages, such as phase separation upon aging, plasticization and migration to the surface, coagulation and sedimentation, generation of strong white pigmenting and settling out effect, toxicity resulting from the presence of antimony trioxide, have been associated with this approach. The best solution of these problems appears to be the elimination of additive flame retardants by incorporating flame retardancy into the polymer used for coating.

We have previously reported[1-12] the synthesis of a variety of dibromostyrene (DBS) - based FR latexes. These latexes were prepared from DBS and other monomers such as (meth)acrylic acids and their esters, butadiene, vinyl acetate, and styrene. Some of the challenges have been cost, flame retardancy, coating properties, latex stability, and monomer reactivity. However, if a practical and useful FR latex can be produced by simply grafting the DBS monomers onto a commercial latex or mixture of latexes, then the cost of producing such an FR latex can be significantly reduced.

Although a vast number of grafted polymer latex compositions has been described,[13-29] none of them have been identified with polymer latex modification with bromine for flame retardance. Some of the grafted latexes are claimed to have value in improving bacteria resistance for use in paints or other coating compounds,[13] improving adhesion of the modified latex to silicate glass, aluminum foil, cellophane, and textiles,[20] increasing the viscosity of the latex and its activation energy of viscous flow,[23] improving impact strength,[28,29] and latexes being useful in paper coating compositions.[27]

This paper summarizes two U.S. patents[30,31] and two papers published in the *Polymer Preprints*.[32,33] It describes the synthesis, characterization, and application of DBS graft latexes. Latexes chosen for grafting are commercial latexes, such as Rhoplex HA-24 and HA-8, Hystretch V-

Table 1—Synthesis of DBS Homopolymer (PDBS) Latex

Description	Parts
Deionized (DI) water	180
SDS	3
Potassium persulfate	0.2
DBS	100
t-DDM	0-0.2

Seal under nitrogen in 8 oz. bottle. Rotate about a horizontal axis for 2-5 hr in water bath at 50°C. Remove from water bath. Cool to room temperature.

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*P.O. Box 2200, West Lafayette, IN 47906.

Table 2—Synthesis of DBS Graft Commercial Latexes (Except for PB Latex)

Description	Parts	Remarks
Commercial latex	84.5-45	Dry basis
Potassium lauroate	3	Blend
DBS	15.6-55	
CHP	0.2	
TEPA	0.4	
t-DDM	0.5	
DI water	14-57.3	Dilute to final solids of 40-65%

Seal under nitrogen in 8 oz bottle. Rotate about horizontal axis for 2-4 hr in water bath at 50°C. Remove from water bath. Cool at room temperature. The results of these preparations are set forth in *Table* 4.

29, Airflex 465, 4500, 4514 and 4530, Pliolite SBR latex and polybutadiend (PB) latex.

The graft latexes were characterized in terms of glass transition temperature (T$_g$), solids content, bromine content, grafted dibromostyrene content and flame retardancy.

They are useful for a wide variety of applications, including fabric backcoatings, carpetings, paints, adhesives, sealants, caulks, non-woven binders, etc.

EXPERIMENTAL

Materials

Dibromostyrene, a product of the Great Lakes Chemical Corp., contains about 82% DBS, 12-13% monobromostyrene, and 5-6% tribromostyrene by weight. Ethyl acrylate (EA), acrylonitrile (AN), butyl acrylate (BA), styrene (S), acrylic acid (AA), and methacrylic acid (MAA) were used directly as received from Aldrich Chemical Co. Lauric acid, potassium hydroxide, sodium dodecyl sulfate (SDS), potassium persulfate, ammonium persulfate, sodium bisulfite, tetraethylenepentamine (TEPA), t-dodecyl mercaptan (t-DDM) were also used directly as received from Aldrich. Cumene hydroperoxide (CHP) from Elf Atochem and tetrahydrofuran (THF) from Baxter were used without further purification.

Characterization

Table 4 lists composition and physical properties of DBS grafted commercial latexes. The DBS graft latex was characterized in terms of T$_g$, solids content, bromine content, and flame retardant property. The T$_g$ was measured by DSC at a rate of 10°C/min. Percent bromine was measured by Schöniger Combustion Method (ASTM E 442-91). This test covers the determination of chlorine, bromine, or iodine in organic compounds by the oxygen flask technique. Flame retardant property was measured by MVSS-302 flammability test when used in polyester fabric backcoatings.

The MVSS-302 test criteria, a horizontal burn test, must be met by materials used in the interior of passenger cars. A specimen 14 in. × 1/2 in. is marked at a point 1-1/2 in. from each end. One end of the specimen is ignited in accordance with test procedures, and the amount of time it burns measured from the time flame from the burning specimen reaches the first mark. Timing is stopped at the time flaming ceased or at the time at which the flame reaches the second mark. The test calls for a burn rate (measured as the flame processes from the first mark to the second) of less than four inches per minute. A rating of self-extinguishing (SE) requires no burn beyond the first mark (1-1/2 in.). A rating of rapid burn (RB) requires that the flame travels to the second mark or a burn length of 10.0 in. that is the distance between the first and the second marks.

Table 5 lists percent DBS grafted onto commercial latexes. Percent grafting of dibromostyrene onto commercial latexes, Pliolite SBR latex, and PB latex (Goodyear Tire & Rubber Co.) was determined by THF solvent extraction: the DBS-grafted latex, 55/45-DBS/SBR or 60/40-DBS/PB, was coagulated in a 1-3% $MgSO_4$ solution under stirring. The coagulated polymer was filtered, washed thoroughly with water, and dried overnight in a vacuum oven at 50°C to a constant weight. Two grams of the dried coagulated polymer was weighed in a cellulose extraction thimble (43 mm x 125 mm) and successively extracted with THF for 48 hr.

FLAME RETARDANCE TESTING AND RESULTS

Flame Retardancy of Physical Blend vs. Graft Latex

The PDBS latex was physically blended with an ungrafted commercial latex, Rhoplex HA-24 or HA-8 to result in a latex blend containing 30 and 25% DBS, respectively. Both latex blends, coated onto an 8 oz/yd^2, 100% polyester fabric at a weight of 1.4-1.6 oz/yd^2, failed the Motor Vehicle Safety Standard (MVSS) 302 flammability test [49 CFR Ch. V. (10-1-95 Edition)] (rapid burn (RB), worst rating). At a comparable DBS level, both DBS-grafted Rhoplex HA-24 and HA-8 passed the MVSS-302 flammability test at this add-on weight (self-extinguishing (SE), best rating).

Textile Backcoating A

The 70/30-Rhopex HA-24/DBS graft latex was coated onto an 8 oz/yd^2 100% polyester fabric at a weight of 1.6 oz/yd^2, after oven drying at 100°C for 30 min. The coating was clear and slightly firmer than the commercial latex, which is considered satisfactory. The coated fabric passed MVSS-302 flammability test with an SE (best

Table 3—Synthesis of DBS Graft PB Latex

Description	Parts	Remarks
PB latex	40	Dry basis
SDS	1	
Potassium persulfate	0.2	
Sodium bisulfite	0.2	
DI water	20	
DBS	60	
t-DDM	0.5	

Seal under nitrogen in 8 oz bottle. Rotate about horizontal axis for 6.5 hr in water bath at 50°C. Remove from water bath. Cool to room temperature. The final latex has 57.9% solids (97.6% conversion), −79°C T$_g$ and 34.34% Br (*Table* 4).

Table 4—Composition and Physical Properties of Grafting of DBS onto Commercial Latexes

		T_g, °C						
Example	Commercial Latex[a]	Comm. Latex Reported Value	Comm. Latex Observed	Graft Latex Observed	DBS Charged[b] wt%	Solids %	Br %	MVSS-302 Rating[c]
1	Rhoplex HA-24	−7	−17.2	−16.7	30.0	40-65	17.17	SE
2	Rhoplex HA-8	−10	−17.3	−15.0	25.0	40-60	14.31	SE
3	Hystretch V-29	−29	−37.6	−35.3	40.0	40-50	22.89	SE
4	Airflex 465	−5±3	—	—	25.0	40-50	14.21	SE
5	Airflex 4500	3	—	—	20.0	40-50	11.36	SE
6	Airflex 4514	12	—	—	20.0	40-50	11.45	SE
7	Airflex 4530	29	—	—	15.6	40-50	8.93	SE
8	Pliolite SBR latex	−55	−56.0	−55.2	55.0	50-60	31.35	SE
9	Polybutadiene latex	−80	−79.5	−78.9	60.0	50-60	34.34	SE

(a) Rhoplex HA-24 & HA-8 from Rohm & Haas Co.; Hystretch V-29 from BFGoodrich Co.; Airflex 465, 4500, 4514, and 4530 from Air Products and Chemicals, Inc.; Pliolite SBR and polybutadiene latex from Goodyear Tire & Rubber Co.

(b) Weight % DBS based on 100% total solids.

(c) Motor Vehicle Safety Standard (MVSS) 302 flammability test: SE = self-extinguishing.

rating) and a burn distance of 0.8 in. The same fabric backcoated with 1.6 oz/yd^2 of the commercial latex (Rhoplex HA-24) failed the MVSS-302 test with a burn distance of 10.0 in. (RB).

Textile Backcoating B

When 1.4 oz/yd^2 of 70/30-Rhoplex HA-8/DBS graft latex was coated onto the 8 oz/yd^2 fabric, an SE rating was obtained with a 1.4 in. burn length. The commercial latex without modification (Rhoplex HA-8) failed to pass the MVSS-302 test at this add-on weight and yielded a burn distance of 10.0 in. (RB).

Textile Backcoating C

When coated onto an 8 oz/yd^2, 100% polyester fabric, Hystretch V-29 latex at 3.7 oz/yd^2 yielded a failure in the MVSS-302 test (10.0 in. burned). The 60/10/30-Hystretch V-29/S/DBS graft latex produced a 1.6 in. burn length at 3.7 oz/yd^2. The graft latex had good flexibility and yet was slightly firmer than the latex ungrafted.

Contact Adhesive

The 80/20-Rhoplex HA-24/DBS graft latex was coated onto 0.5 mil Mylar polyester film. After drying 90 sec at 158°F, two pieces of film were pressed together and rolled to eliminate any bubbles. For comparison the same procedure was followed using the commercial latex (Rhoplex HA-24). Upon cooling, the films were pulled apart by hand. No significant difference in adhesion between two samples was noticed and the adhesion was judged to be adequate. Flammability was tested by wrapping the film composite loosely about a four-inch diameter cylinder of fiberglass batt insulation. A three-inch blue methane Bunsen burner flame was placed against the lower and side surfaces of the batt/Mylar construction which had been positioned at a 45°C angle from vertical. There was no observable after flame when the burner flame was removed after 10-15 sec of contact. A similar construction utilizing the commercially available latex emulsion without DBS grafted to it was also tested for flammability. When the burner flame was removed after 10-15 sec, flaming of the substrate continued until extinguished about a minute later with water.

Latex Binder

A non-woven polyester fiber filter medium weighing about 1.25 oz/yd^2 was immersed in the 84.4/15.6-Airflex 4530/DBS graft latex. Upon drying at 300°F for 90 sec, the weight of the bonded fiber increased to 2.4 oz/yd^2. A second sample of non-woven polyester fiber filter was immersed in the commercially available latex (Airflex 4530) to which DBS had not been grafted. Upon drying, the bonded fiber weighed 2.3 oz/yd^2.

Both bonded fiber samples were tested for flammability by exposure to a four-inch high, 1950°F propane flame from a Fisher burner. The filter media were held 2- 1/2 in. over the top of the burner at a 15°C angle from horizontal. The sample which was not bound with latex to which DBS was grafted burned the entire 12-in. length. The sample containing DBS graft latex burned between 8 and 9 in. prior to self-extinguishing.

Latex Sealant

Two latex sealants were prepared. The first was 95/3/2-EA/AN/AA latex prepared according to the procedure described in the Latex Sealant section of reference (33). The second was 80/20-the first latex/DBS graft latex prepared by the general procedure for synthesis of DBS graft commercial latexes.

To 100 parts of each of the two latexes mentioned previously were added 2 parts Triton X-405 (Union Carbide), 23 parts benzyl butyl phthalate, 4 parts Varsol #1 (Exxon), 2.5 parts ethylene glycol, 2 parts Composition T dispersant (Calgon), 120 parts calcium carbonate (2 micron average particle size), and 2.5 parts titanium dioxide. Both caulks showed good adhesion to substrates including wood, glass, and concrete by spot adhesion test (ASTM D 3808). In this test, a thin-bladed stainless steel spatula or probe is used to separate the caulk spot from the substrate.

The flammability of each was tested by placing a bead of caulk 1/4 in. in diameter on a 1/2 in. wide

Table 5—Percent DBS Grafted onto Commercial Latexes

		Latex Coagulated			Extract			Unextracted			
Example	Charge Ratio DBS/Latex	wt, g	Br, %	PDBS, %	wt, g	Br, %	PDBS, g	wt, g	Br, %	DBS Grafted g	DBS Grafted[a] %
10	SBR latex	2.004	—	—	0.895	—	—	1.164	—	—	—
11	55 PDBS/45 SBR latex blend	1.100 PDBS + 0.900 SBR	—	—	1.383	43.62	1.062	0.673	<0.01	—	—
12	55 DBS/45 SBR	2.000	31.67	55.74	0.726	36.75	0.469	1.273	29.23	0.655	59.5
13	PB latex	2.003	—	—	0.451	—	—	1.554	—	—	—
14	60 PDBS/40 PB latex blend	1.200 PDBS + 0.800 PB	—	—	1.447	39.90	1.016	0.624	<0.1	—	—
15	60 DBS/40 PB	2.000	34.34	60.44	1.117	34.35	0.707	0.893	22.85	0.359	29.9

(a) $\% \text{ DBS grafted} = \frac{\text{wt. of DBS grafted (unto commercial latex)}}{\text{wt. of DBS charged}} \times 100$

For example12: $\frac{29.23}{56.82} \times 100 = 51.4\%$ — % of DBS grafted unto SBR latex in the unextracted portion.

1.273 g x 51.4% = 0.655 g — wt. of DBS grafted

$\frac{0.655}{1.1} \times 100 = 59.5\%$ — % DBS grafted

(DBS monomer used contains 56.82 wt.% bromine.)

strip of asbestos cement board. The caulk was subjected to the Butler chimney flammability test (ASTM D 3014). The first caulk, which did not contain DBS grafted to the latex, burned the full 250 mm of the test specimen. The caulk containing DBS burned less than 160 mm.

Latex Paint

Two latex paints were prepared. The first was 30/68/2-S/BA/MAA latex prepared according to the procedure described in the Latex Paint section of reference (33). The second was 80/20-the first latex/DBS graft latex prepared by the general procedure for synthesis of DBS graft commercial latexes.

In an open vessel with continuous high shear mixing, 40 parts by weight water, 0.15 parts antifoaming agents, dispersants and surfactants Tamol 731 (0.4 parts), Triton X-207 (0.28 parts), and Silwet L-7602 (0.28 parts) (Tamol is a product of Rohm and Haas, Triton and Silwet are products of Union Carbide), 0.62 parts sodium polyacrylate thickener, 18 parts titanium dioxide, 28.3 parts calcium carbonate, and 7.34 parts 1-butanol were added. Mixing speed was then reduced, and 50 parts latex was added. An additional 4.6 parts water, 1.15 parts methyl cellosolve, and 3 parts sodium polyacrylate thickener were then added. Composition A contained the first latex without DBS grafted on; composition B contained latex with DBS.

Paint compositions A and B had good adhesion to the Mylar film and film forming properties (ASTM D 3730). This test measures the resistance of removal of the coating from the Mylar film when scuffed or scraped. Each was used to coat a 1 mil Mylar film to a 10 mil wet thickness. The dry film measured about 3 mils. The dry film/Mylar was tested by the limiting oxygen index test (ASTM D 2863). Composition A without DBS had a limiting oxygen index of 22. Composition B with DBS had an oxygen index of 24, a significant improvement in flame retardancy.

DISCUSSION

This paper demonstrates that commercial latexes can be grafted with DBS monomer to produce FR latex products useful in a wide range of coating applications. Criteria include the T_g, physical properties, applications, and cost. One of the prime factors to be considered in the choice of a latex or a latex mixture to be grafted is the T_g(s) of the polymer(s) in the final latex desired. Based on these criteria, we selected available commercial latexes, including acrylic latexes (Rhoplex HA-24 and HA-8, and Hystretch V-29 for binders, textile backcoatings, and adhesives), vinyl acetate-ethylene latex (Airflex 465 for adhesives), latexes of ethylene-vinyl chloride-third monomer which imparts amide functionality to the polymer (Airflex 4500, 4514, and 4530 for adhesives), SBR latex (Pliolite SBR for adhesive, foam, and rug), and butadiene rubber (BR) latex (PB latex for tires, retreads, and mechanical goods). We also synthesized acrylic latexes suitable for sealants and paints. Commercial latexes with T_gs greater than +29°C for modification were not chosen, because grafting of a high T_g (+141°C) PDBS onto commercial latexes will increase the T_gs of the final latexes. They will lose their original physical properties and become brittle, stiff, and not result in film formation upon coating.

As shown in *Table* 4, all the DBS-grafted commercial latexes (40-65% solids, 8.93 to 34.34% Br) passed the MVSS-302 flammability test with an SE rating. There is little difference between the observed T_gs of the commercial latexes and the observed T_gs of the DBS grafted latexes. We speculate that this could be attributed to the short DBS grafted side chains. It is noteworthy that DBS grafted PB latex prepared by a redox system of potassium persulfate and sodium bisulfite passed the MVSS-302 flammability test (SE), whereas the graft latex prepared by a redox system of CHP and TEPA failed (RB, worst rating). This indicates that the former has a higher grafting efficiency than the latter as shown by the data in *Table* 5.

In order to understand the DBS grafting efficiency on the commercial latexes, we must select a solvent which dissolves ungrafted commercial polymers and homopolymerized DBS (PDBS) (ungrafted), but does not dissolve DBS grafted polymers. After the solvent extraction, the grafted portion is separated from the mixture of ungrafted portion. By analyzing the bromine contents in two separated portions in each sample, we can then calculate how much DBS has been grafted on the commercial latexes.

Two out of nine DBS-grafted commercial latexes, 55/45-DBS/Pliolite SBR (ex. 12, *Table* 5), and 60/40-DBS/PB latex (ex. 15, *Table* 5), were selected for THF solvent extraction to determine the percent DBS grafted (*Table* 5). The DBS homopolymer (PDBS) can be extracted by THF completely (ex. 11 and 14, *Table* 5). Thus, the unextracted PDBS residue could be considered to be grafted onto the commercial latex. The percent DBS grafted is given by the weight of grafted (or unextracted) PDBS divided by the weight of DBS charged. As shown in *Table* 5, ~ 60% DBS was grafted onto SBR and ~ 30% was grafted onto PB. These data may explain why DBS grafted SBR latex gave better flame retardant property than did DBS grafted PB latex.

Indeed, our results indicate that DBS can be readily grafted onto commercial latexes. However, % DBS grafted may depend on reaction conditions, initiators, and the composition of the latexes.

In our past experience,[34] FR efficiency of the DBS-based latexes is higher than that of a physical blend of FR DBS latex (PDBS) and a non-FR latex. In the present work, it was observed that FR efficiency of a DBS graft commercial latex is also higher than that of a physical blend. For example, at a comparable DBS content, both DBS grafted Rhoplex HA-24 and HA-8 latex coated 8 oz/yd^2 100% polyester fabrics at a weight of 1.4-1.6 oz/yd^2, passed the MVSS-302 flammability test with an SE (best rating) while a physical blend of ungrafted Rhoplex HA-24 or HA-8 latex with DBS homopolymers latex (PDBS) failed the test (RB, worst rating) (see Flame Retardance Testing and Results Section).

We plan to carry out research on solvent extraction of every DBS grafted latex other than DBS grafted SBR and BR latexes to determine DBS grafting efficiency. The structure of the various grafted polymers can be studied by electron microscopy, selective staining, cold stage, freeze fracture, and cryomicrotomy. Sometimes these techniques are not yet sufficienctly developed to yield a conclusive picture of the polymer structure. Spectroscopy (NMR, FTIR, ESCA) and chromatography (GC, GPC, HPLC, SEC, TLC, ITP, CHDF) continue to evolve in characterizing the graft latexes.

CONCLUSIONS

Dibromostyrene can be readily grafted onto nine commercial latexes plus two acrylic latexes via an emulsion polymerization technique. For example, THF solvent extraction of DBS grafted SBR and BR latexes yielded 60 and 30% DBS grafted, respectively. These data may explain why the former latex gave better flame retardancy than did the latter latex.

NICK A. FAVSTRITSKY is Manager of Polymers Research at Great Lakes Chemical Corporation. Dr. Favstristky received the B.S. Degree from the University of California-Berkeley, M.S. Degree from Yale, and Ph.D. from Oregon State. Prior to joining Great Lakes in 1984, he had extensive industrial R & D experience in product and process development as a research scientist and technical manager. Dr. Favstritsky carried out research in catalysis, oxidation, hydrogenation, polyester synthesis, polyester waste recovery, continuous emulsion polymerization, liquid crystal polymers, epoxy resins, and textile and tire cord fiber development. While at Great Lakes, Dr. Favstritsky and his team have been active in developing new flame retardant, polymer additives, novel coatings, water treatment chemicals, specialty monomers, and polymers. He has published more than 12 papers in the dibromostyrene-based products and (co)authored more than 35 U.S. patents and a large number of foreign patents.

JIN-LIANG WANG is Project Leader at Great Lakes Chemical Corporation. Dr. Wang received the diploma in Chemical Engineering from the Taipei Institute of Technology, Taipei, Taiwan in 1958, and M.S. Degree in Physical Organic Chemistry from Kent State University in 1966 and the Ph.D. Degree in Polymer Chemistry from the Maurice Morton Institute of Polymer Science at the University of Akron in 1971. He joined the Goodyear Tire & Rubber Company in 1966 as Research Chemist. During Dr. Wang's 21-year career with Goodyear, he worked on synthesis, characterization, and application of latexes, rubber, plastics and resins, chemical modification of natural and synthetic rubber and latex, synthesis of isoprene oligomers and metathesis of olefins. Dr. Wang joined Great Lakes in 1988 and his current research involves new flame-retardant latexes and polymers, compatibilizers, impact modifiers, polymer additives, block polymers, and UV stabilized polymers. He has published 23 papers and granted 13 U.S. patents with a number of foreign patents.

All DBS grafted commercial latexes yield coatings with good flame retardancy without significant diminution of other physical properties. They are useful for a wide variety of applications in fabric backcoatings, contact adhesives, latex binders, latex sealants, and latex paints.

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Determination of Metallic Zinc Content of Inorganic and Organic Zinc-Rich Primers by Differential Scanning Calorimetry

Dwight G. Weldon and Bruce M. Carl—KTA-Tator, Inc.*

Although several methods exist for determining the metallic zinc content of the zinc dust pigment in inorganic and organic zinc rich primers, no generally recognized method exists for the analysis of the metallic zinc content in the dried films of such coatings. This paper demonstrates a rapid and precise method, based on differential scanning calorimetry, for making this determination.

INTRODUCTION

The protective properties of zinc have been well known since the mid-nineteenth century, when hot-dipped galvanizing was developed in France.[1] In the 1940s, the feasibility of applying a zinc paint (so-called "cold galvanizing") was demonstrated in Australia when such a product was used on the 250-mile long Morgan-Wyalla Pipeline. The coating applied to the Australian pipeline was cured by baking. Since that time, considerable effort has been expended by paint manufacturers to develop zinc-rich primers which cure under ambient conditions.

There are two broad categories of zinc-rich primers currently in use: inorganic and organic zinc-rich primers. The vehicle in inorganic zinc-rich primers is a silicate, often tetraethylortho silicate. This binder cures by reaction with atmospheric moisture.

The binder in organic zinc-rich primers is usually an epoxy resin, although other resins are sometimes used. A separate hardener, or activator component, is used with the epoxy zinc-rich primers in order to achieve cure of the low molecular weight epoxy resins.

By far, the largest ingredient of a zinc-rich primer is powdered zinc, or zinc dust. Zinc loadings of 80 to 90% by weight are common. To provide superior corrosion resistance, the zinc content of such primers must exceed the critical pigment volume concentration (CPVC), thus assuring good electrical contact between the zinc particles and the steel substrate. When zinc is in contact with steel, it serves as the anode in an electrochemical cell. The zinc will sacrificially corrode and protect the underlying steel. *Figures* 1 and 2 are SEM microphotographs showing the high loading of the spherical zinc dust pigment in dried coating films. As the zinc corrodes, so-called "white rust" forms (primarily basic zinc carbonate and zinc hydroxide) which fills in the pore structure of the coating, and, together with the remaining zinc, acts as a barrier coating.[2]

Since the primary protective mechanism of a zinc-rich primer is dependent on the electrical contact between the metallic zinc particles and the underlying steel, it is desirable to have an analytical method which can determine the metallic zinc content of a dried film. Although several methods exist for analyzing virgin zinc dust, including combustion,[3] oxidation-reduction titrations,[4-6] and hydrogen evolution,[7] no standard method exists for the analysis of metallic zinc in dried coating films. This paper demonstrates a simple, rapid method of determining the metallic zinc content in pigment and dried paint films by measuring the apparent heat of fusion of the sample from 415-428°C using differential scanning calorimetry (DSC), and compares the results with those obtained by the hydrogen evolution method referenced by ASTM[7] as the referee method.

EXPERIMENTAL

A Perkin-Elmer Model DSC6 differential scanning calorimeter, operated under a nitrogen purge and cooled with a Neslab RTE 140 refrigerated circulator was used. The sample was weighed with a Perkin Elmer Model AD4 microbalance and placed in a standard aluminum weighing pan, which was then crimped. The calibration standard was high purity zinc foil (Perkin Elmer Part #023190036).

The sulfuric acid and ferrous sulfate used in the hydrogen evolution method were reagent grade, obtained from Fisher Scientific. The platinum sheet, approximately 25 mm × 25 mm, was also obtained from Fisher Scientific.

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*115 Technology Dr., Pittsburgh, PA 15275.

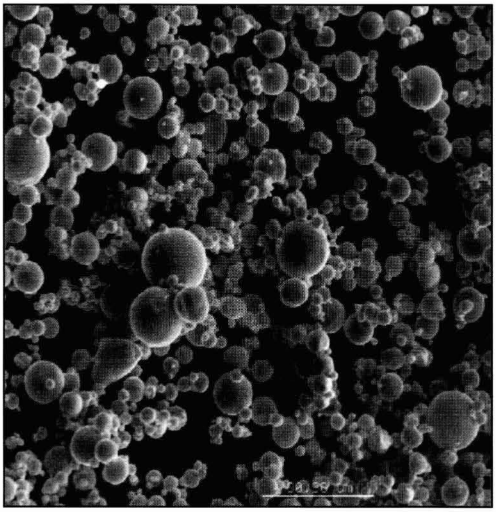

Figure 1—SEM microphotograph at 600X of virgin pigment for inorganic zinc-rich primer.

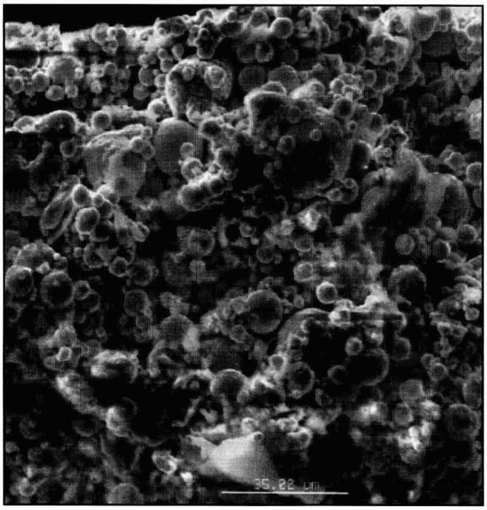

Figure 2—SEM microphotograph at 600X of inorganic zinc-rich primer, showing spherical zinc dust pigment embedded in silicate matrix.

SEM microphotographs were obtained with an RJ Lee scanning electron microscope.

The coatings used in this study consisted of an ethyl silicate inorganic zinc-rich primer and an epoxy polyamide zinc-rich primer; both of which are standard commercial products. The manufacturer's product data sheets listed a percent total zinc (not metallic zinc) in the dry film of 86% ± 2% for the inorganic zinc-rich primer, and 85% for the epoxy zinc-rich primer. The mixing of coating samples and the preparation of dried films were performed with the aid of an Ohaus model E400D top loading balance, accurate to ±1mg.

In both cases, the zinc dust pigment was supplied in a separate container, and subsequently combined at a specific ratio with the liquid component. Two liquid components were provided with the epoxy zinc-rich primer: one contained the epoxy resin, while the other contained the polyamide hardener.

Prior to analyzing the dried films, the zinc dust pigment was analyzed as received. This was performed by both the ASTM hydrogen evolution method recommended as a referee method,[7] and also by DSC.

The hydrogen evolution method has been described elsewhere.[7] Briefly, it involves reacting a known mass of pigment, typically one gram, with 1:1 sulfuric acid, and measuring the volume of evolved hydrogen by water displacement. A small sheet of platinum is used to catalyze the reaction: ferrous sulfate is used to coagulate the sample to reduce floating of it through the apparatus: and the water is saturated with hydrogen gas prior to introducing it into the displacement tube, to minimize absorption of the evolved hydrogen.

After thoroughly shaking the container of dry pigment, a small amount of pigment was removed for analysis by DSC. A spatula was used to transfer generally between four and eight milligrams of sample into a standard aluminum DSC pan. An aluminum lid was then placed on the pan, and crimped. The crimped aluminum pan containing the sample was then placed on the sample cell of the DSC, while an empty crimped aluminum pan was placed on the reference cell. The DSC was previously calibrated using zinc foil reference material. Both the calibration standard and samples were analyzed in a single dynamic step ranging from 370 to 440°C at 10°C per minute, under a nitrogen purge.

The analysis produced a very straight baseline, with a relatively sharp endothermic peak near 419°C due to the melting of the metallic zinc (see *Figures* 3 and 4). The area under the endothermic transition, in J/g, was measured by using the peak area software provided with the Perkin Elmer DSC6. The percentage of metallic zinc in the sample was then calculated by dividing the sample's apparent heat of fusion (the area under the endothermic transition, in J/g), by the value for pure zinc (108 J/g). The two pigment samples were re-analyzed at least five times each to obtain an average and standard deviation.

One of the problems involved in evaluating any analytical method is the preparation of standards. Since dry film standards of this type do not exist commercially, they were prepared in the laboratory. This was performed by pre-weighing an appropriate amount of zinc dust pigment onto weighing paper, and then using a 10cc disposable syringe to quickly weigh an appropriate amount of liquid component (or pre-mixed liquid component in the case of the epoxy zinc) into a 100cc plastic beaker. The pre-weighed pigment was then rapidly stirred into the liquid component. A small portion (approximately two grams) of the liquid paint was then poured in a bead across the top of a pre-weighed thin

Table 1—Analysis of Virgin Zinc Dust Pigment by Hydrogen Evolution Method and by DSC

Sample	Metallic Zn, H_2	Metallic Zn, DSC	% Recovery[a]	Stnd. Dev., DSC
Pigment, inorganic	96.5%	98.3%	102%	2.3[b]
Pigment, epoxy	94.2%	93.6%	99%	2.1[c]

(a) % recovery of the DSC Method Relative to the Hydrogen Evolution Method.
(b) Based on five determinations.
(c) Based on seven determinations.

gauge 75 mm × 125 mm cold-rolled steel coupon, and drawn down to obtain a wet film thickness of approximately 75-125 microns. Within approximately five seconds of performing the drawdown, the panel was weighed again to determine the weight of wet paint actually applied to the panel.

Various panels were prepared in the previously mentioned manner, and allowed to air dry for at least four days at laboratory ambient conditions of approximately 21 to 24°C and 30 to 50% relative humidity. The panels were then weighed to obtain the weight of the dried paint films. By knowing the percentage of pigment in the wet paint, the weight of wet paint applied to the panels, and the corresponding weight of dried paint, the percent pigment in the dried paint could be calculated. The percent metallic zinc in the dried paint was then calculated by using the values obtained by the hydrogen evolution method for the virgin zinc dust pigment.

Drawdowns were made at the mix ratios specified by the paint manufacturers and also by using approximately half of the recommended pigment. Additional drawdowns were made by substituting zinc oxide for a portion of the zinc dust pigment. This was done to demonstrate the specificity of the DSC method towards metallic zinc.

Once the standards had been prepared as described earlier, an X-acto knife was used to remove the dried coating down to bare steel, and these portions were briefly ground in a mortar and pestal. They were then analyzed in triplicate using the same DSC technique as described previously for the virgin pigment, and also by the hydrogen evolution method.

RESULTS AND DISCUSSION

The results of the analysis of the two virgin zinc dust pigment samples are shown in *Table* 1. Good agreement was obtained between the hydrogen evolution method and the DSC method. The DSC method produced results that were 102% and 99% those of the hydrogen evolution method, with a standard deviation of approximately 2%. An analysis by DSC required approximately 10 min, versus 1-1/2 to 2 hr by hydrogen evolution.

The results from the dried films are shown in *Table* 2. The average percent recovery for all six samples (epoxy zinc and inorganic zinc, each at three mix ratios) was 105% by the DSC method, based on the calculated percent pigment in the dry film, and using the percent metallic zinc in the virgin pigment obtained by the hydrogen evolution method. Therefore, the error of approximately 5% cannot be attributed to the DSC method, but rather is the combined error of all aspects of the experimental protocol, including the analysis of the virgin pigment by hydrogen evolution, the preparation of the "standard" dry film specimens, and the DSC analysis. Indeed, there will be a natural high bias in the results due in part to the evaporation of solvent during the mixing and drawing-down of the coating standards, estimated at approximately one percent by conducting

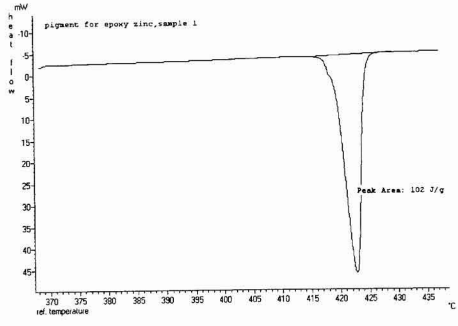

Figure 3—DSC heating curve of virgin zinc dust pigment.

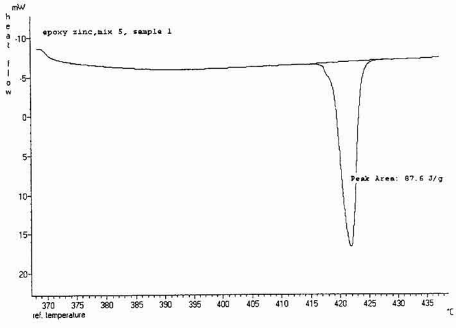

Figure 4—DSC heating curve of cured film of epoxy zinc-rich primer, corresponding to sample A in Table 2.

Table 2—Analysis of Dried Coating Films

Sample	Type	Zn^0, calculated^a	Zn^0 by DSC^d	Recovery	Zn^0, by H^2	Recovery
A	Epoxy	77.6%	81.0%	104%	N/A^e	N/A^e
B	Epoxy	66.3%	72.0%	108%	N/A^e	N/A^e
C	Epoxy	64.5%^{b}	68.1%	105%	N/A^e	N/A^e
D	Inorganic	78.4%	82.3%	105%	83.3%	106%
E	Inorganic	67.2%	69.1%	103%	72.0%	107%
F	Inorganic	70.9%^{c}	75.2%	106%	75.0%	106%

(a) Using metallic Zn (Zn^0) content of virgin pigment from H_2 method.
(b) Also contained 11.6% ZnO in dried film.
(c) Also contained 7.4% ZnO in dried film.
(d) Average of three determinations. Standard deviations from 1.0 to 2.7.
(e) Not applicable to epoxy zinc due to excessive carryover of particles into apparatus.

weight loss measurements. Furthermore, at least some hydrogen gas would have been absorbed in the tubing or the hydrogen "saturated" water of the hydrogen evolution apparatus, which would bias the results by generating a low value for the calculated metallic zinc content.

The results obtained by the hydrogen evolution method for the dried films of inorganic zinc-rich primer were very close to those obtained by the DSC method, but required approximately 2-1/2 hr to complete. However, the hydrogen evolution method was not applicable to the dried films of epoxy zinc-rich primer. Gas evolution was slower, and significant quantities of sample were repeatedly carried into the transfer tube of the apparatus. It was estimated that recoveries were 50 to 60%.

Both the DSC method and the hydrogen evolution method were specific to metallic zinc, and were not influenced by the presence of zinc oxide. This was, of course, expected, but was important to verify, since zinc oxide would be an expected impurity in the zinc dust.

CONCLUSIONS

An accurate and precise method for determining the metallic zinc content has been demonstrated for cured inorganic and organic zinc rich primer films. The method is also applicable to the virgin zinc dust pigment. The method measures the apparent heat of fusion of the sample, and compares the measured value to the known value of 108 J/g for pure zinc. This provides a simple and more basic way of determining the percentage of metallic zinc, and is unaffected by the presence of zinc oxidation products. Several different types of samples were analyzed, including those where some of the zinc dust pigment was replaced with zinc oxide, and percent recoveries were within approximately five percent of the calculated metallic zinc values for the dried coating films. Since this value is affected by the entire experimental protocol, the error of the actual DSC method is less than five percent. When applied to two samples of virgin pigment, the DSC method had recoveries of 99 and 102%, compared to the values obtained by the ASTM hydrogen evolution referee method.

The method has several advantages over the hydrogen evolution method. One major advantage of the method is its applicability to dried paint films, rather than just the virgin zinc powder. The scope of the hydrogen evolution method as described in ASTM D 521 is for the analysis of zinc-dust pigment, not dried coating films. Although the work performed in this study shows that the hydrogen evolution method produces results of comparable accuracy to the DSC method when applied to an inorganic zinc-rich primer, the method did not work when applied to an epoxy zinc-rich primer. In contrast, the DSC method produced results of similar accuracy, whether applied to an inorganic or an organic zinc-rich primer.

A second advantage of the DSC method is speed. Determinations conducted using the hydrogen evolution method took approximately 1-1/2 hr for the zinc dust pigment samples, and approximately 2-1/2 hr for dried coating films. In contrast, a single DSC analysis was conducted in approximately 10 min, including the weighing and actual running of the sample. Therefore, an analysis could be conducted in triplicate by the DSC method in only a fraction of the time that it takes to do a single analysis by the hydrogen evolution method.

A third advantage of the DSC method is its small sample size. Whereas the hydrogen evolution method requires approximately one gram of sample, the DSC method requires only a few milligrams. Although sample size is certainly not a problem when the analysis is being performed on batches of pigment, it can be a major factor if the purpose of the investigation is related to problems or deficiencies encountered in field applied coatings. In the latter case, it is not uncommon for the analyst to be provided with only a few square centimeters of sample, which may only have 20 to 50 microns of zinc-rich primer on the backside.

During the course of these experiments, it was found that the accuracy of the results improved if the calorimeter was calibrated daily with high purity zinc foil, and that the calibration standard be used only one time. Reagent grade zinc granules or zinc powder were of insufficient purity to properly calibrate the instrument, and using a zinc foil standard more than one time also resulted in inaccurate results, due to oxidation of the zinc at the high temperature in the DSC, coupled with the alloying effects of zinc metal with the aluminum pans.

Other factors associated with obtaining accurate results included very gentle tapping of the pan once the sample was added in order to distribute it relatively evenly over the bottom of the pan, and careful placement of the pan lid. A thin, even distribution of material provides better thermal contact with the bottom of the pan, and the lid must be carefully placed on the pan in order to avoid expulsion of the fine powder during crimping.

ACKNOWLEDGMENT

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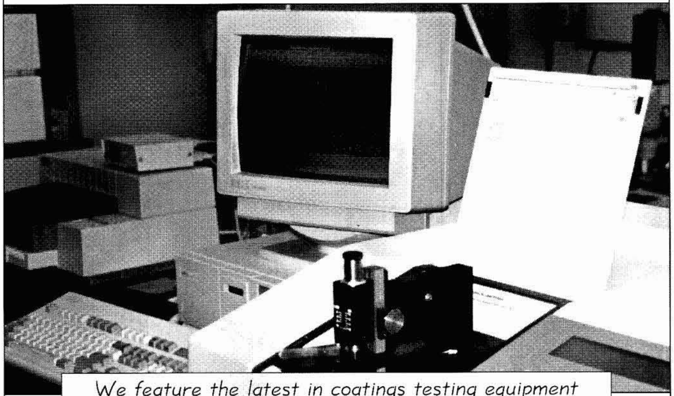
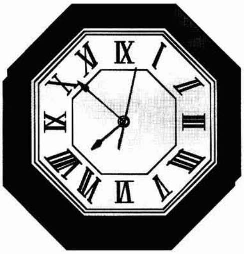
DWIGHT G. WELDON received a B.S. Degree in Chemistry from the University of Michigan and an M.S. Degree in Chemistry from Michigan Technological University. He also did doctoral level research in Raman spectroscopy at the University of Kentucky. Prior to joining KTA-Tator, Inc. as Laboratory Director in 1982, Mr. Weldon had been a Formulations Chemist for both Cook Paint and Varnish and Inmont Corporation. In addition to directing numerous projects involving the physical and analytical testing of paints and coatings, he specializes in performing failure analysis investigations of coatings. Mr. Weldon is a member of the Federation of Societies for Coatings Technology, the American Chemical Society, the Steel Structures Painting Council, and the Society for Analytical Chemists of Pittsburgh.

BRUCE M. CARL received a B.A. Degree in Chemistry from Lycoming College. He has been a Chemical Technician with KTA-Tator, Inc. since 1988 where he has performed numerous analytical and physical tests, including, ASTM, NACE, and Federal Test Methods on a variety of paints and coatings.





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Selectivity of Isophorone Diisocyanate in the Urethane Reaction Influence of Temperature, Catalysis, and Reaction Partners

R. Lomölder, F. Plogmann, P. Speier—Hüls AG*

In a model study of the selectivity of isophorone diisocyanate (IPDI) in the urethane reaction, the influence of the type of catalyst, temperature, and type of OH-group was demonstrated using primary and secondary butanol as reaction partners.

In particular, the choice of catalyst has a dramatic effect on the composition of the final product mixture. The most important conclusions of the model study were confirmed in NCO-prepolymer synthesis.

INTRODUCTION

Isophorone diisocyanate (IPDI) (*Figure* 1) is the leading cycloaliphatic diisocyanate worldwide for the preparation of light-stable, urethane-modified coating resins such as PU dispersions, urethane alkyds, radiation-curable urethane acrylates, and moisture-cure isocyanate prepolymers. One of the main reasons for the expanding use of this product in numerous applications, besides the very broad compatibility with co-reactants and solvents, is the unequal reactivity of the primary aliphatic and the secondary cycloaliphatic isocyanate groups of IPDI, which leads to low viscosity products with a narrow molecular weight distribution and a low free monomeric diisocyanate content.[1] This reactivity difference has been the subject of investigation in the past.[2-8] As a result of various assumptions, stoichiometry, reaction partners, experimental methods and interpretations, the reactivity difference between the NCO groups has been reported to be in the range of 0.2:1 to 12:1.

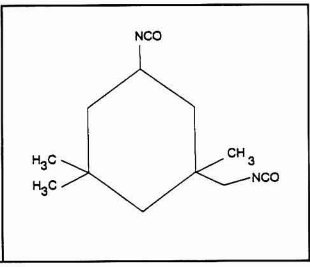

Figure 1—Isophorone diisocyanate (IPDI).

In this study the influence of various catalysts for the urethane reaction, temperature (in all previous publications a constant), steric hindrance, and/or the reactivity of alcohols on the selectivity in model reactions as well as the applicability to commercially viable systems were investigated.

Corresponding to the possible orientations of the substituents of the cyclohexane ring, IPDI is differentiated between *cis*- (Z) and *trans*- (E) isomers. Commercially available IPDI represents an isomer mixture of approximately 75:25 in favor of the cis- (Z) isomer (*Figure* 2).[9]

The reaction of IPDI with alcohols may be completely described with four rate constants (K_1-K_4), corresponding to the two unequal NCO groups (prim/sec) for each of the two IPDI isomers. In total, eight rate constants and eight products have to be considered (*Figure* 3). This very complex system can be treated with some clearly evident simplifications with regard to the reaction rates:

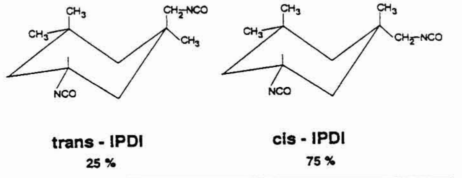

Figure 2—Cis/trans-isomers of IPDI.

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*GFB LR-AT, D-45764 Marl, Germany.

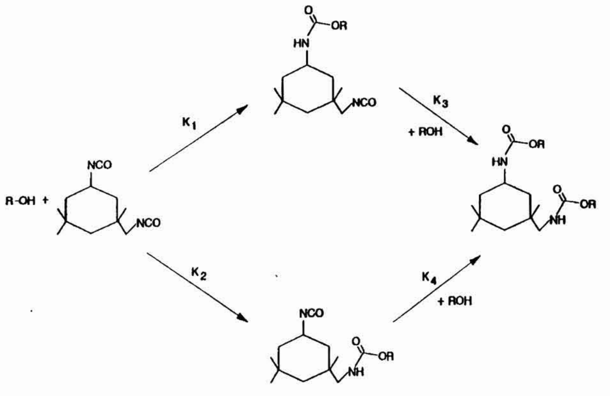

Figure 3—Rate constants for the reaction of IPDI with alcohols.

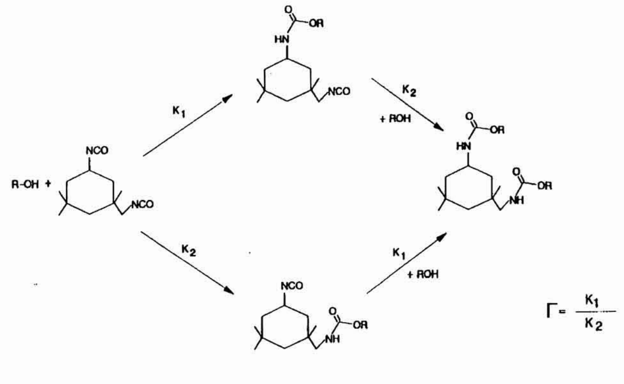

Figure 4—Simplified kinetic model for urethane reaction of IPDI (K(cis) = K(trans)).

Assume that: (a) the urethane functionality of a monourethane monisocyanate exhibits neither a catalytic or inhibitive influence on the reactivity of the remaining isocyanate group; and (b) a comparable reactivity of *cis-* and *trans-*IPDI.

Figure 3 is reduced to a system with two rate constants and four products (*Figure* 4).

In systems with excess isocyanate and a known isocyanate conversion, the ratio of the rate constants can be determined, according to Peebles,[1] from the free monomer content of the final product mixture. According to his calculations for the unsymmetrical case, a 2:1 stoichiometry of the NCO/OH reaction yields the following correlation between the conversion of diisocyanate and the quotient Γ of the rate constants K_1 and K_2 (*Figure* 5).

EXPERIMENTAL

Model reactions were carried out without solvent in a stirring apparatus under nitrogen at a constant temperature. Vestanat® IPDI (Hüls AG) and catalyst were charged and alcohol added dropwise over a five-hour period. Stoichiometry was NCO:OH=2:1. Reactions were run until the conversion was complete. Determination of the monomer content was performed by GC using tetradecane as the standard. In the case of reactions with 1-butanol, these GC-techniques permitted the resolution of the four monourethanes of IPDI and 1-butanol. Both 1-butanol and 2-butanol contained < 0.2% water, polyols <0.5% water as determined by Karl Fischer methods. Tertiary amine catalysts were supplied by Aldrich; DBTL (dibutyltindilaurate) by Elf-Atochem; zinc octoate (bis (2-ethylhexoyl) zinc) dissolved in mineral spirits: aromatics at 80:20 at a zinc level of 8% by Borchers; Iron(III)acetylacetonate(FeAcAc) by Hüls AG; and a bismuth catalyst (16% Bi) Coscat 83 by Caschem.

RESULTS AND DISCUSSION

Selectivity of IPDI by Application of Various Urethane Catalysts

Metal catalysts (Lewis acids) as well as tertiary amine types (Lewis bases) are well known in urethane chemistry. *Table* 1 shows the results of the IPDI/1-butanol reaction at an NCO:OH stoichiometry of 2:1 and a temperature of 20°C. Sn, Zn, Fe, and Bi catalysts were used at constant metal atom/ion concentration as well as four tertiary amine catalysts (Diazabicyclo[2.2.2]octane (DABCO), 1.8-Diazabicyclo-[5.4.0]-undec–7-ene (DBU), N,N-Dimethylcyclohexylamine (DMCA) and 1,5-Diazabi-cyclo[2.3.0]non-5-ene (DBN) at typical concentrations for IPDI systems (0.4%, except DBU: 0.2%). The uncatalyzed system is shown for reference (*Table* 1).

Besides the generally clear effect of catalysis, a differentiation in the effectiveness of the catalysts was recognized. With the exception of the Zn catalyzed systems, metal catalysis was found to be essentially more effective than that of the tertiary amines. Surprising, however, was the selectivity with the catalyst types utilized. DBTL is the most selective catalyst in this study, increasing Γ to 11.5 compared to 5.5 for the uncatalyzed system. In the case of the tertiary amines, DABCO led to an inversion of the selectivity, while all other tertiary amines showed no significant influence.

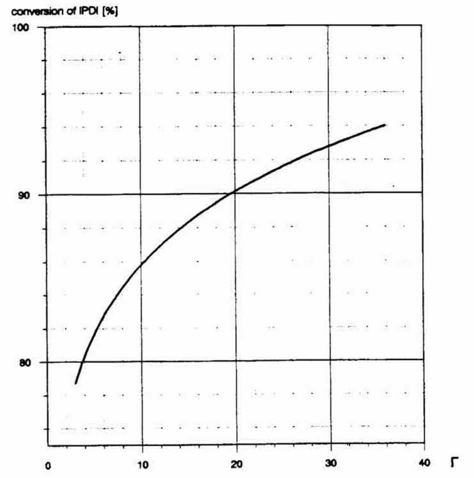

Figure 5—Relation between ratio of rate constants (Γ) and conversion of IPDI monomer (NCO:OH = 2:1).

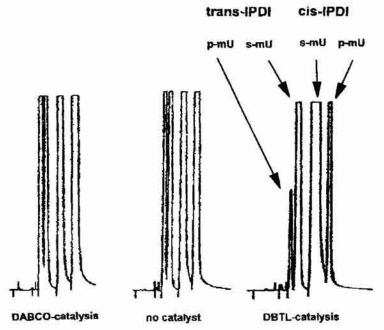

Figure 6—GC-chromatographs of the IPDI-1-butanol reaction: section of the mono-urethanes. (S-M-U = sec. NCO reacted, p - mu = prim. NCO reacted).

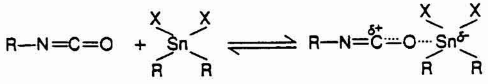

Figure 7—Lewis-acid catalyst (DBTL) in urethane reaction.

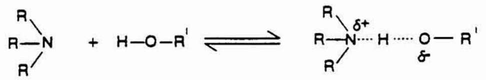

Figure 8—Lewis-base catalyst in urethane reaction.

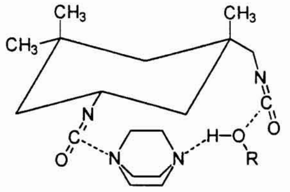

Figure 9—Possible mechanism for DABCO catalysis.

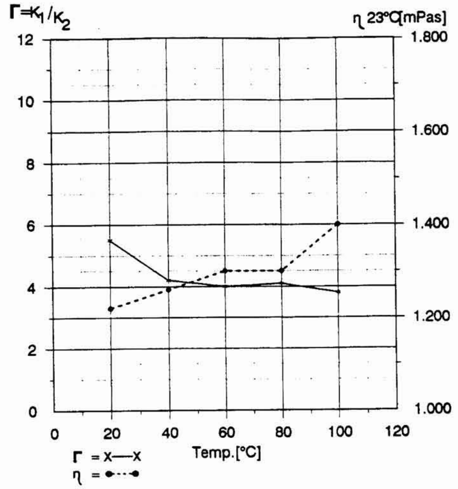

Figure 10—Urethane reaction of IPDI and 1-butanol, uncatalyzed (NCO:OH - 2:1). Selectivity of IPDI and viscosity of final products.

Table 1—Influence of Catalysts on Urethane Reaction of IPDI with 1-butanol

Catalyst	$T = K_1/K_2$	Time of Complete Conversion
none	5.5	8 d
DBTL (0.075%)	11.5	6 h
Zn-Octoate (0.42%)	7	1 d X_1
Bi-Cat. (0.135%)	2.5	6 h
Fe III AcAc (0.042%)	5.5	6 h
DABCO (0.4%)	0.18	1 d X_1
DBU (0.2%)	5.5	1 d X_1
DMCA (0.4%)	4.4	1 d X_1
DBN (0.4%)	6.2	3 d

X_1: > 6h, < 24h
Conditions: NCO:OH - 2:1; 20°C (68°F).

The clear increase of the selectivity by DBTL catalysis was also described by Hatada and Pappas.[3] They determined with ^1H and ^{13}C NMR techniques, that with DBTL catalysis, the secondary cycloaliphatic isocyanate group is without a doubt the more reactive. Apparently the primary isocyanatomethyl group is effectively shielded by the β-situated methyl substituents, the cyclohexane ring, and its neighboring methyl group.

Furthermore, Hatada and Pappas described the inversion of the selectivity by DABCO. *Figure* 6 shows the section of the gas chromatograph in the important area of monourethane for the uncatalyzed, DBTL, and DABCO catalyzed reactions. This clearly illustrates the increases as well as the inversion of the selectivity of IPDI, and confirms the results of Hatada and Pappas.

The reason for the increase in selectivity by metal catalysis can be approached by examining the mechanism of these catalysts: metals work as Lewis acids and activate the isocyanate group by a coordination of the carboxyl group.[10-13] The additional space demand of the activated transition state may be responsible for the preferential catalysis of the already more reactive and sterically less hindered cycloaliphatic NCO group (*Figure* 7).

Tertiary amines catalyze the urethane reaction mainly through activation of the OH-group of the alcohol,[11,13] but also an activation of the NCO groups has been discussed. By the activation of the OH-groups, the activated transition state requires less space than is the case with metal catalysts. This could be the reason for the absence of additional selectivity of amine catalysts. With the exception of DABCO, the tertiary amines showed no significant effect on the selectivity of IPDI. Interestingly, DABCO resulted in an inversion of selectivity causing the primary isocyanate group to become the more active (*Figure* 8). One explanation could be that the remaining free tertiary amine function of the DABCO-1-butanol complex is precoordinated by the secondary, more reactive isocyanate group. Via arrangement to an intramolecular macrocyclus (14-membered), the activated hydroxyl group could be directed to the primary NCO-group. *Figure* 9 illustrates a possible mechanism for DABCO catalysis.

Influence of Temperature on the Selectivity of IPDI

Studies of the selectivity of IPDI which have been published deal with temperature as a constant. To serve as examples of the effects of temperature, the uncatalyzed and, on the basis of its unusual effectively, DBTL catalysis were studied to determine the dependence of selectivity in the range of 20-100°C. The viscosity of the products was regarded as a further system parameter.

Figure 10 shows the course of Γ and the viscosity of the uncatalyzed urethane reaction of IPDI and n-butanol in the temperature range of 20-100°C (NCO:OH = 2:1). As expected, the selectivity varied inversely with increasing temperature going from 5.5 (20°C) to 3.9 (100°C). The lower selectivity led to an increasing proportion of bisurethanes and a corresponding increase in viscosity. In the case of uncatalyzed resin synthesis, the temperature range of 60-80°C appears to be optimal for viscosity and economic considerations (approximately eight days at 20°C versus six hours at 80°C for complete conversion).

Figure 11 clearly shows that DBTL catalyzed reactions have higher selectivity and exhibit a greater dependence on temperature compared to uncatalyzed reactions. Nevertheless, the selectivity at 100°C is greater than that of the uncatalyzed reaction at 20°C. Interestingly, the viscosity of

Table 2—IPDI–Prepolymers Based on Various Polyols

	Prepolymer			
	A	B	C	D
Basis	Polyester	p-THF	PPG	Polycaprolactone
MW of polyol	1000	1000	1000	540
Functionality	2	2	2	3
Solids content (%)	100	100	100	75 (Mop-acetate)

Table 3—Results of Prepolymer Synthesis at Different Temperatures (NCO:OH = 2:1, DBTL - Catalyst - 0.075%)

	Prepolymer							
	A		B		C		D	
T (°C)	η 23°C (Pas)	monom. IPDI (%)	η 23°C (Pas)	monom. IPDI (%)	η 23°C (Pas)	monom. IPDI (%)	η 23°C (Pas)	monom. IPDI (%)
20	206	3.9	16.7	4.3	12.2	3.2	3.4	4.8
40	216	4.0	18.7	4.4	12.5	3.3	4.2	5.0
60	219	4.1	19.1	4.4	13.0	3.6	4.2	5.2
100	264	4.3	22.8	4.5	16.0	3.7	4.3	6.5
80, no catalyst	284	6.3	27.2	6.0	15.0	5.7	5.6	8.8

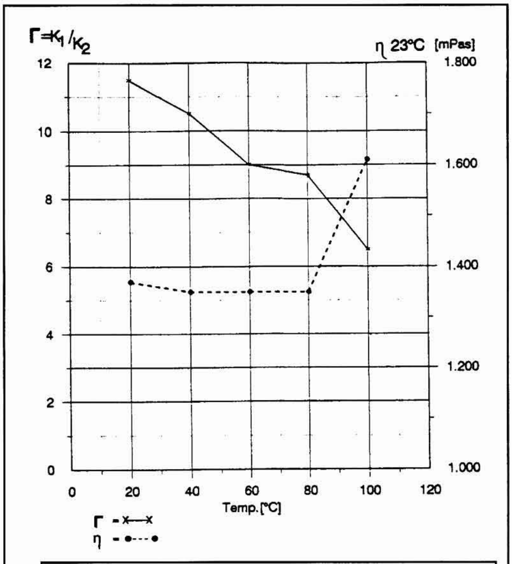

Figure 11—Urethane reaction of IPDI and 1-butanol using DBTL catalyst (0.075%) (NCO:OH = 2:1). Selectivity of IPDI and viscosity of final products.

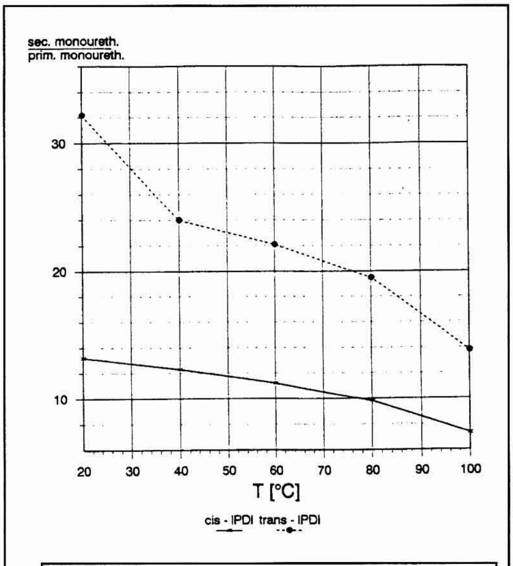

Figure 13—Ratio of sec. and prim. monourethanes of cis- and trans-IPDI in urethane reaction with 1-butanol (0.075% DBTL catalyst).

the product mixture remains nearly constant up to 80°C. As in the uncatalyzed case, we would expect the viscosity to increase with decreasing selectivity due to the higher concentration of bisurethane. Obviously, in this range of product composition of monomer, monourethane, and bisurethane, the viscosity-increasing effect of higher amounts of bisurethane is compensated by the viscosity-decreasing effect of a higher IPDI monomer concentration. Surprising is the dramatic viscosity increase observed between 80°C and 100°C. SFC methods confirm two percent of a high molecular weight component in the 100°C reaction mixture, which can either be interpreted as allophonate from bisurethane or monourethane of IPDI (*Figure* 12).

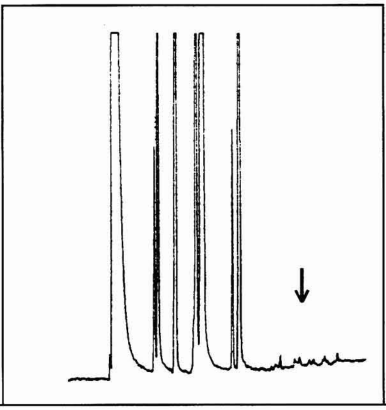

Figure 12—SFC chromatograph of DBTL catalysis at 100°C.

On the basis of by-products as well as the very specific selectivity apparent of DBTL catalysis in the range of 40-60°C, technical IPDI urethane reactions in this temperature range are most practical and are preferred over uncatalyzed versions.

By using GC techniques to separate the four monourethanes, it is possible to demonstrate the selectivity of *cis*- and *trans*-IPDI as a function of the temperature of the DBTL catalyzed reaction of IPDI and 1-butanol. *Figure* 12 shows the selectivity of *cis*- and *trans*-IPDI expressed as the ratio of secondary and primary monourethanes. In accord with expectations, both isomers display declining selectivity with increasing temperature. The *trans*-isomer exhibits a clearly higher selectivity (factor approx. 2 at 40-100°C) and shows a stronger temperature dependence. The more pronounced reactivity difference of the NCO groups of the *trans*-isomer could be explained by a more efficient shielding of the primary NCO function by the cyclohexane ring and its substituents. According to Wendisch et al,[14] the cycloaliphatic group is found to prefer an equatorial position. Resulting from that, the isocyanatomethyl group of the *trans*-isomer is in an axial position and, therefore, sterically more efficiently shielded than the equatorial pendant group of *cis*–IPDI (see *Figure* 2).

An effect which also has to be attributed to the more shielded and less reactive primary group of the *trans*-

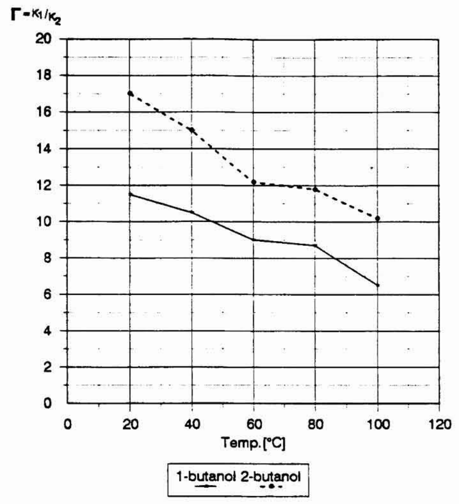

Figure 14—Selectivity of IPDI in urethane reactions with (a) 1-butanol, (b) 2-butanol. (NCO:OH = 2:1, DBTL - catalyst = 0.075%).

isomers of isophorone derivatives has recently been reported in the field of epoxy-systems: more trans-IPD (isophorone diamine) led to a longer pot life in two-pack epoxy formulations.[15]

Additional Steric Hindrance: 2-butanol

Isocyanate prepolymers for the elastomer market are often based on polypropylene glycols, having predominantly secondary OH groups. Therefore, it was of interest to further expand the study of selectivity to the more sterically hindered and less reactive 2-butanol. In *Figure* 14, the temperature dependence of the reaction of IPDI with 1- and 2-butanol under DBTL catalysis are compared.

Presumably as a result of the additional space demand by the use of 2-butanol, the selectivity of IPDI is further increased. The ratio of the rate constants at 20°C is 17, compared to the reaction with 1-butanol, which ranges from 11.5 (DBTL) to 5.5 (uncatalyzed). The conversion at 80°C with 2-butanol is even more selective than that with 1-butanol at 20°C. Both curves are seen to run in parallel, meaning that the dependence of selectivity on temperature is similar.

The selected gas chromatographic conditions used in this study did not allow separation of the monourethanes of *trans*-IPDI and 2-butanol. By reaction with 2-butanol, the selectivity of the *cis*-isomer is increased to the level of the *trans*-isomer when reacted with 1-butanol (secondary monourethane/primary monourethane = 30.1/1 at 20°C).

Back to the Practical: NCO Prepolymers

IPDI prepolymers for moisture curing coating systems are normally produced from 2-3 functional, hydroxyl-bearing polymers with molecular weights in the range of 500 to about 3000, using a stoichiometry of NCO:OH of 1.8:1 to 2.0:1. In order to demonstrate the applicability of the model system results using 1- and 2-butanol, IPDI was reacted with four different polyols in a stoichiometric ratio of NCO:OH of 2:1. The polyols chosen were linear NPG (neopentyl glycol), adipate, poly(tetramethylene glycol)ether, poly(propylene glycol)ether of molecular weight approximately and a trifunctional polycaprolactone, MW 540, the last of which was used as a 75% solution in 1-methoxypropyl-2-acetate (MOP acetate) (*Table* 2).

Table 3 summarizes the results of the prepolymer synthesis, both DBTL catalyzed at various temperatures, as well as uncatalyzed at 80°C. The results of the model studies were closely approximated: using DBTL, viscosity and monomer content increased only slightly with increasing temperature (20-60°C), while the uncatalyzed reaction carried out at 80°C led to the highest viscosity and monomer content. The somewhat surprising low viscosity of the PPG-based system produced at 80°C with no catalyst (15 Pa·s) could be traced back to the thermal degradation of the comparably weak backbone polyol. This significant viscosity increase of the catalyzed variants observed at 100°C compared to that at 60°C also paralleled the model studies and could be attributable to the formulation of allophonates.

A significant deviation from the model study was observed for the catalyzed variants at 100°C. There was only a slight increase in the monomer content (prepolymers A-C) compared to 60°C. This result is illustrated in *Table* 4 through the contrast of Γ of the model and prepolymer systems indicating that IPDI is more selective in prepolymer synthesis. Due to the higher viscosities of the prepolymers compared to the model systems, the diffusion of IPDI monomer could be

Table 4—Ratio of Rate Constants (Γ) Derived from Prepolymer Synthesis (A-D) and Model Reactions (1-butanol, 2-butanol)

	Γ					
T (°C)	1-butanol	A	B	D	2-butanol	C
20, DBTL	11.5	11.5	10.2	14.5	17.0	16.5
40, DBTL	10.5	10.9	9.5	12.9	15.0	15.7
60, DBTL	9.0	10.5	9.5	12.0	12.2	12.6
100, DBTL	6.5	9.3	9.3	7.2	10.1	12.0
80, no catalyst	4.1	3.6	4.3	3.2	3.3	4.3

more hindered, meaning that significant allophonate formation as a competing reaction must be considered. This fact lead to a lower monomer content of the final product and could be misinterpreted as a higher selectivity. This interpretation is confirmed by the result of the low viscosity 75% prepolymer solution (System D), in which a jump in monomer content was observed at 100°C.

In principle, the comparison of Γ in prepolymer syntheses with model reactions (*Table* 4) demonstrates a very good correlation: not only for the absolute values of Γ for both the primary OH/IPDI reaction (1-butanol and systems, A, B, D) and the secondary OH/IPDI reaction (2-butanol and system C), but also the temperature dependence up to 60°C and the influence of DBTL catalyst on viscosity and monomer content.

In general, these studies confirm the proven practice of carrying out IPDI prepolymer syntheses in the temperature range of 40-60°C with the use of DBTL catalysis, from viscosity and monomer content as well as economical considerations.

SUMMARY

The selectivity of isophorone diisocyanate (IPDI) in the urethane reaction demonstrates a strong dependence on temperature, catalyst type, and degree of substitution of the reaction partner.

The model study of IPDI selectivity was carried out using primary and secondary butanol as reaction partners. The influence of a series of metal catalysts (Sn, Zn, Bi, and Fe) and tertiary amines was investigated. All catalysts accelerated the urethane reaction compared to the uncatalyzed version. In principle, the use of metal catalysts resulted in an improvement of selectivity of IPDI, with DBTL as the most selective catalyst. In a series of tertiary amine catalysts, only DABCO led to an inversion of selectivity. Other tertiary amines had no significant influence.

The phenomenon of decreasing selectivity with increasing temperature was generally confirmed. Surprising, however, catalysis of IPDI with DBTL promoted a higher degree of selectivity, even at elevated temperatures, than could be achieved without catalyst at low temperatures.

Two additional factors influencing selectivity were identified. Secondary butanol yielded a higher selectivity than primary butanol, demonstrating the effect of the degree of substitution of the reaction partner. In addition, *trans*-IPDI was found to be more selective than *cis*-IPDI.

A very good correlation between prepolymer synthesis and the model reaction was observed. Recommended optimal conditions for prepolymer synthesis based on IPDI are temperatures between 40 and 60°C using DBTL catalysis.

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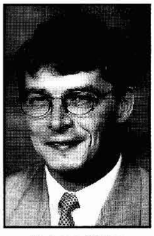
R. LOMÖLDER received a Ph.D. Degree in Chemistry from the University of Münster, Germany. Dr. Lomölder joined the research and development team for the coatings raw materials division of Hüls AG, Marl, Germany in 1989, where he worked with polyurethanes. Since 1992, Dr. Lomölder has been working with IPDI and its derivatives in Hüls AG's technical services department for polyurethane raw materials.

FRIEDRICH PLOGMANN joined Veba Chemie's technical services laboratory for polyurethane raw materials in 1976. In 1979, when Veba's chemical activities were transferred to Hüls AG, Mr. Plogmann continued to work in the laboratory.

PETER SPEIER joined the research and development department of Hüls AG in Marl, Germany in 1960, initially working with polybutadiene resins and later with saturated polyester resins. Since 1985, Mr. Speier has been working with polyurethanes raw materials in Hüls AG's technical service laboratories in Marl.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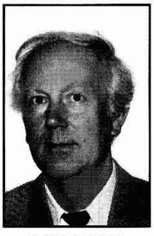
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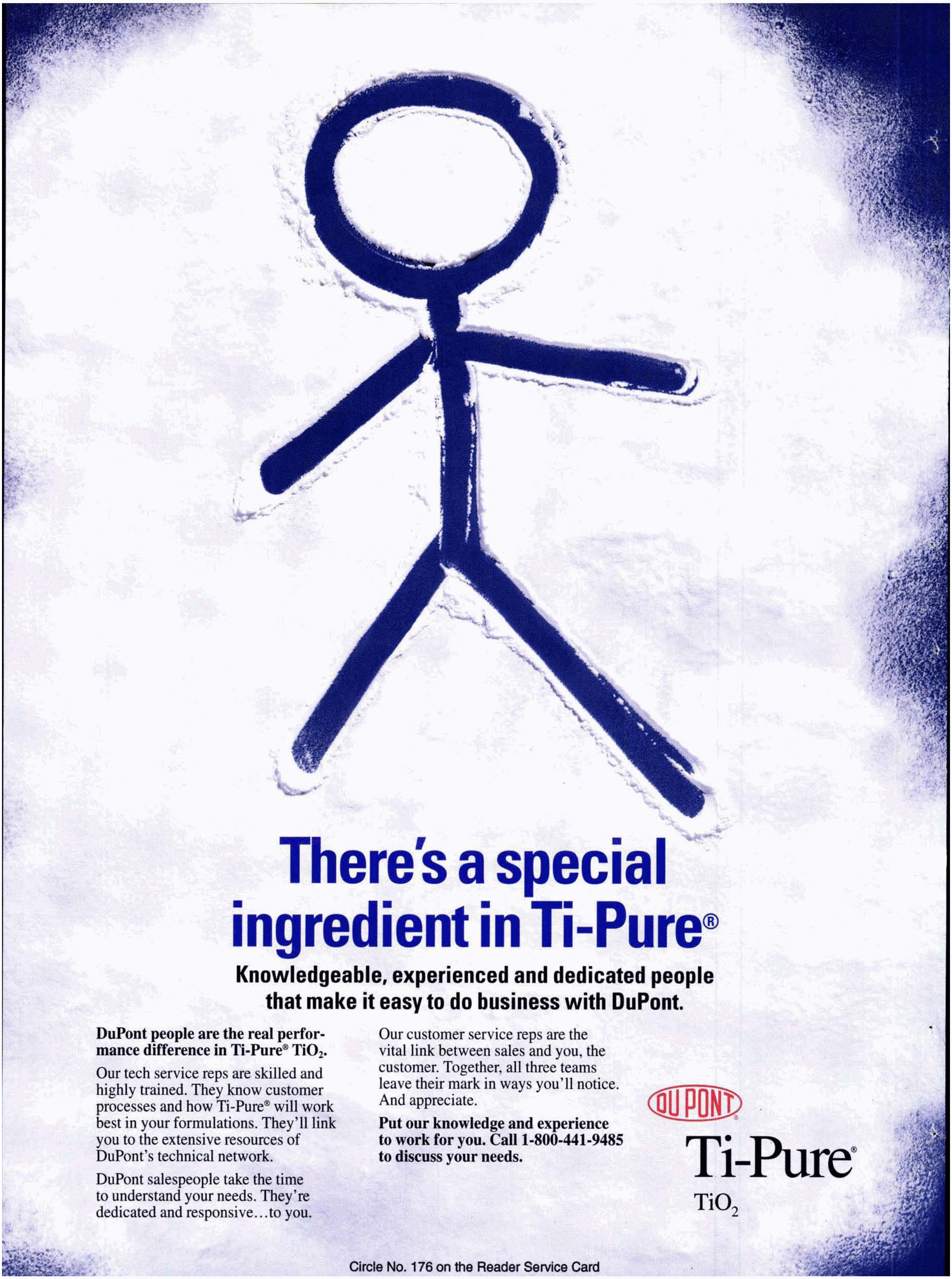

Titanium Dioxide—A Review

Juergen H. Braun—Pigment Consultants, Inc.*

The white pigment market is served almost exclusively by titanium dioxide pigments. The objective of this overview is to familiarize readers with the one ingredient that may take the lion share of costs in a coating—titanium dioxide. Issues specific to TiO_2 are discussed, including commerce, manufacture, characteristics, performance and commercial grades.

INTRODUCTION

Titanium dioxide has obsoleted all other white pigments because TiO_2 pigments hide decisively better and provide more lightness than any alternative. They are safe, effective, and inexpensive. Their characteristics are tailored to optimize the specific performance requirements of four target industries—coatings, paper, plastics, and ink—and to end uses within those industries.

Titanium is abundant in nature. It occurs as a component of many minerals. Four of them serve as ores: ilmenite ($FeTiO_3$), rutile (TiO_2), anatase (TiO_2), and leucoxene (TiO_2.x FeO.y H_2O). TiO_2 pigments are made in two crystal phases, rutile and anatase, that differ in lattice structures, refractive indices, and densities. Anatase was the first commercial titanium dioxide pigment. In coatings and plastics, anatase has now been replaced by rutile because, in polymer matrix, rutile has a scattering advantage over anatase of about 20%. Anatase continues to be used in paper and in synthetic fibers.

Two processes are used to make TiO_2—an older sulfate process based on aqueous chemistry and a newer chloride process involving flame technology. We will describe the manufacture only briefly and summarize TiO_2 commerce to underline the significance of the industry. Then the discussion will focus on the pigment, distinguishing between its characteristics and its performance.

- Characteristics are attributes of the commodity by itself: crystal phase, particle size, composition, etc. For measurement, the pigment may have to be examined in a carrier, but the data describe the commodity and are relatively insensitive to the ambiance of measurement. There are exceptions where sample preparation or conditioning matters, for example, electron microscopy.
- Pigment performance, by contrast, is a characteristic of the coating itself of which the pigment is only one component. Hiding is a characteristic of a coating. However, for the pigment, hiding is a performance measure, as are gloss, durability, etc. A satisfactory description of performance requires statements about formula and preparation.

We are inclined to refer to the performance of a paint film as if it were a characteristic of a pigment. Gloss is a case in point. Pigments do not have a gloss, paint films do; but pigment characteristics determine the gloss of paint films. All is well as long as our casual use of words does not distort our perceptions.

Occasionally, characteristics and performance overlap. Color can be a pigment characteristic as well as a performance measure of pigment in a paint film.

COMMERCE

The white pigment market is served almost exclusively by titanium dioxide pigments. The world's industries consume almost seven billion pounds of TiO_2 pigment per year.

The dominance of the TiO_2 business has two reasons: (1) among pigments, only TiO_2 and carbon black have essentially no competition and (2) white pigment goes into all colors, but any one color pigment goes only into one specific range of hues.

In the U.S. and other developed countries, half of the TiO_2 pigment is used in coatings, one quarter in paper, and 20% in plastics. All other end uses, pigmentary (inks, floor coverings, elastomers, roofing granules, fibers, fabrics, sealants, foods, etc.) and nonpigmentary (ceramics, welding rods, catalyst support, etc.), make up the remainder. In less developed countries, most of the TiO_2 pigments is consumed in paints and plastics.

MANUFACTURE (*Figure* 1)

TiO_2 particles, the active ingredient of pigment, are made by two processes:

(1) The old aqueous sulfate route consists of low-tech, labor-intensive operations performed largely in batch modes.

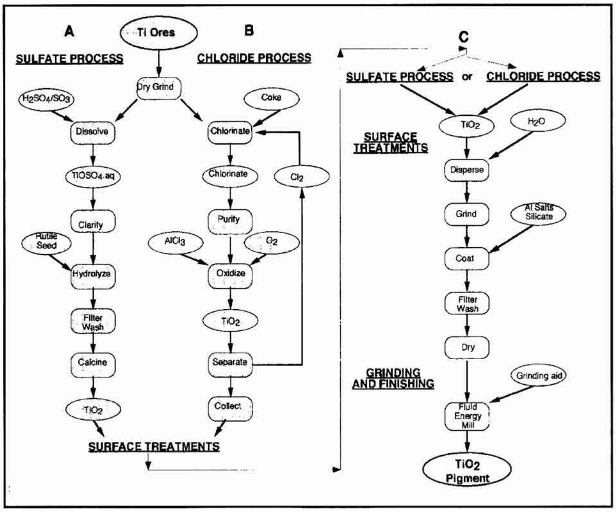

Figure 1—TiO_2 manufacture

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*614 Loveville Rd., E-1-H, Hockessin, DE 19707-1616.

(2) The newer, "greener," anhydrous chloride route is composed of high-tech, automated, mostly continuous operations.

After the primary pigment particles are made by either process, their surfaces are treated to adapt the pigment to a variety of end-uses. These treatments are carried out in aqueous suspension, followed by drying, grinding, and dry treatment operations. Some of the dry pigment is dispersed in water and converted into slurry grades.

By either process, manufacture involves five stages:

(1) Titanium ore is converted to a purified intermediate, either aqueous titanyl sulfate solution or anhydrous titanium tetrachloride;

(2) The intermediate is converted into crystalline, size-optimized pigment particles;

(3) The surface of pigment particles is coated by aqueous precipitation techniques sometimes involving a grinding step;

(4) Treated pigment is filtered, washed, and dried;

(5) Pigment is finished by dry grinding with or without after treatments.

The discharges of the TiO_2 processes, soluble iron compounds, dilute acids, and miscellaneous inorganic contaminants of the ore, have become international environmental issues, decisive to the viability of existing plants. Untreated, the acid wastes of TiO_2 manufacture would add significantly to the acid excess that plagues this earth. Costs of waste disposal have been responsible for large increases in manufacturing costs of pigment. Not all these costs have yet been passed on to the pigment customer.

Chloride Process (*Figure* 1B)

The chloride process, commercialized by DuPont in the early 1950s, offers waste disposal, quality, and energy advantages over the sulfate process. The process generates rutile crystals in a flame of titanium tetrachloride and oxygen. The product has a narrower particle size distribution than sulfate rutile. The process is more energy and waste efficient since chlorine is recycled. The waste itself is less environmentally invasive. The flow chart shows the five process steps to rutile titanium dioxide pigment: (1) beneficiation (pretreatment of an ore, sometimes removal of unwanted components) to where the ore can be chlorinated, (2) chlorination of TiO_2/FeO to titanium and iron chlorides, (3) separation of solid blow-over and gaseous iron chlorides in the exit stream of the chlorinator, (4) distillation and treatment of titanium tetrachloride ($TiCl_4$) permitting the removal of practically all impurities, (5) flame oxidation of $TiCl_4$ to rutile via a large, controlled flame reactor.

Involved are these chemical reactions:

$$TiO_{2(s)} + C_{(s)} + 2Cl_{2(g)} \xrightarrow{\Delta} TiCl_{4(g)} + CO_{2(g)}$$

$$TiCl_{4(g)} + O_{2(g)} \xrightarrow{\Delta} TiO_{2(s)} + 2Cl_{2(g)}$$

where (s) = solid; (g) = gas

Natural rutile (TiO_2), leucoxene ($TiO_2 \bullet xFeO$, a weathered ilmenite), and titania slag (TiO_2/FeO, a beneficiation product) can be chlorinated directly. Ilmenite ($FeTiO_3$) can be processed by simultaneous beneficiation and chlorination of the ore. Synthetic rutile can be obtained from ilmenite by pyrometallurgical treatment or by selective chlorination in a fluidized bed.

Dried, pulverized coke and ore are fed into the chlorinator and fluidized with chlorine at a temperature between 900-1700°C. The chlorination is exothermic and requires cooling. $TiCl_4$ and miscellaneous metal chlorides exit the reactor as gases mixed with blow-over solids composed of coke, ore, and gangue. Blow-over solids and most of the metal chlorides are removed from the gas stream.

The $TiCl_4$ is condensed and further purified by distillation and chemical treatments. Impurities can be reduced to meet all requirements. Contaminant concentrations of only a few parts per million remain. By contrast, the aqueous process liquors and colloidal precipitates of the sulfate process are more difficult to purify.

Purified $TiCl_4$ is vaporized and then oxidized in a flame reactor developed (1) not to plug by TiO_2 scale and (2) to yield the desired particle size. The patent literature lists numerous designs. Reactants must be preheated to sustain the flame because the oxidation reaction is only slightly exothermic.

Co-oxidants such as $AlCl_3$ are injected into the $TiCl_4$ stream to promote the formation of rutile and to moderate pigment aggregation. Other additives—certain metal ions in minute concentrations—can be used to control crystallite size of the product. The chloride process has rutile as its natural product. Anatase pigment can be made by the chloride process, but incentives to do so appear to be low.

Finally, the pigmentary TiO_2 is separated from the chlorine released in oxidation and collected. Most of the chlorine is recycled to the chlorination reactor. Residual chlorine associated with the solid TiO_2 is removed by aqueous hydrolysis. In some plants, the pigment is calcined in a kiln to hydrolyze chlorides and drive off hydrogen chloride.

Sulfate Process (*Figure* 1A)

The sulfate process involves aqueous chemistry. Titanium-bearing ore is dissolved in sulfuric acid, and the resulting titanyl sulfate is hydrolyzed to colloidal titanium-(IV)oxyhydroxide, which is calcined to grow titanium dioxide crystals to pigmentary dimensions. The agglomerates of pigment crystals are preground and then surface treated.

The process scheme is shown by the following chemical reactions:

$$FeTiO_{3(s)} + 3H_2SO_{4(l)} \xrightarrow{\Delta} FeSO_{4(sol)} + Ti(SO_4)_{2(sol)} + 3H_2O_{(l)}$$

$$Ti(SO_4)_{2(sol)} + 2H_2O_{(l)} \xrightarrow{H_2O} TiO(OH)_{2\cdot} \times H_2SO_{4(sol)} + (2-x)H_2SO_{4(}$$

$$TiO(OH)_{2\cdot} \times H_2SO_{4(sol)} \xrightarrow{\Delta} TiO_{2(s)} + (1+x)H_2O_{(g)} \times SO_{3(g)}$$

where (s) = solid; (l) = liquid; (sol) = solution; (g) =gas

The conversion from ore into pigment begins with the digestion of ilmenite ($FeTiO_3$) or titania-rich slag (FeO/TiO_2) in hot, concentrated sulfuric acid fortified with sulfur trioxide. Scrap steel is dissolved in the liquors, to keep iron and other impurities in their lower, more soluble oxidation states. Rutile (TiO_2) and anatase (TiO_2) ores would offer waste disposal advantages over ilmenite ($FeTiO_3$) because they contain much less iron, but these ores dissolve too slowly in acid.

The titanyl sulfate solution is hydrolyzed thermally to precipitate colloidal titanium(IV)oxyhydroxide containing 5 to 10% sulfuric acid. Calcination of this colloid yields anatase. To obtain rutile, seeds (rutile nuclei, generated by alkaline hydrolysis of titanyl sulfate or titanium tetrachloride) are added during the hydrolysis step.

The huge surface area of titanium(IV)oxyhydroxide adsorbs colored impurity ions from the ore. For a whiter product, impurities are washed out with dilute acid. Trivalent titanium ions (Ti^{3+}) in the acid reduce impurities to their lowest, more soluble oxidation states. In addition, innocuous Ti^{3+} ions displace colored impurity ions adsorbed on the colloid. All significant impurities except niobium and phosphorus can be removed.

By calcination, the subpigmentary titanium oxyhydroxide colloid is grown to pigmentary rutile or anatase crystals. The product enters a kiln into a 350°C zone, where water and sulfuric acid are driven off, and moves into a 900°C zone, where crystal growth and phase conversion takes place.

The niobium of the ore (about 0.2% as Nb_2O_5) incorporates itself in the titanium dioxide lattice. Titanium (Ti^{4+}) has four valence electrons, niobium (Nb^{5+}) has five. The extra electron of Nb^{5+} induces semiconductor characteristics in the TiO_2 lattice, causing light absorption and discoloration. In rutile pigments, the effect is pronounced. To restore whiteness, kiln feed is doped with Al^{3+} to compensate for the fifth charge of Nb^{5+}. In effect, an equivalent concentration of Al^{3+} is added to neutralize Nb^{5+}.

Phosphorus regulates crystal growth. It is not incorporated into the TiO_2 lattice, but remains on its surface. As the crystallites grow, the TiO_2 surface area decreases and the surface concentration of phosphate increases. At a critical particle size, the phosphate layer blocks further growth. Thus all crystals grow to the same particle size optimized for maximum light scattering. If the colloidal titanium hydrolysate does not contain enough phosphate from the ore, more is added. Adjustment of the hot-end temperature of the kiln and addition of a mixture of sodium and potassium sulfates serve as secondary growth regulators.

The pigment leaves the kiln in large lumps of aggregated crystals. The discharge is cooled slowly to relax the crystals, healing their defects. Otherwise, the pigment may become off-color or even photochromic. For further processing intended to improve durability, dispersion, and optical properties, the lumps are ball-milled into constituent crystals and aggregates and to form a fine suspension suitable for wet treatment.

Besides pure TiO_2 pigment, a composite pigment of titanium dioxide and calcium sulfate was once a major product of sulfate plants. The advent of emulsion paints obsoleted the composite pigments: the growth of gypsum crystals in water and the coagulation of the vehicle emulsion by calcium ions degraded the shelf stability of the waterborne paints.

Surface Treatments (*Figure* 1C):

Titanium dioxide pigments are coated to improve their performance with respect to specific end use requirements: dispersibility, durability, gloss, etc. Coating is carried out in aqueous suspension by precipitation of various oxyhydrates and oxides onto a rutile base. *The processes that are involved are colloidal. Thus, seemingly minor details of conditions and sequences have major effects on product characteristics and ultimately performance.* Optimal operating conditions are closely guarded secrets in the TiO_2 industry.

Most plants do the coating in a batch mode using huge, slowly agitated vats. Continuous operations have recently displaced a few of the process steps within batch facilities. However, huge vats are still prominent features of TiO_2 plants.

The uncoated chloride process base contains generally about 1% aluminum oxide. Most, but not all of this, is near the surface of the rutile crystals. Sulfate base contains phosphate at the surface.

Because the surface coatings on TiO_2 pigments are thin deposits, only a few atom layers thick on the surfaces of particles that are very small themselves, little has been proven about their chemical and lattice structures. They are simply too small for most techniques of structure analysis.

Uncoated pigment from either the chloride or sulfate process is slurried in water. Residual chlorine is reduced and residual acid neutralized. Sometimes the base pigment is treated with a dispersing agent as part of a premilling step, preceding wet treatment.

The most common precipitates are oxyhydrates of aluminum and silicon. Also used are oxides and oxyhydrates of zirconium, tin, zinc, cerium, and boron. Many more oxides have been advocated in the patent literature.

Inorganic oxyhydrates are precipitated from solution by hydrolysis of acidic or basic salts. Hydrochloric or sulfuric acid is used to neutralize sodium silicate and sodium aluminate; sodium hydroxide to neutralize aluminum or titanium sulfates. TiO_2 surface coatings can be applied in distinct layers, co-precipitated as mixed metal oxides or a combination of sequential precipitations and partial re-dissolutions between surface treatments. Because chloride pigments contain more aluminum ions near the rutile surface and sulfate pigments more phosphate, the nature of the surface precipitates on sulfate and chloride process TiO_2 can differ.

Oxyhydrates of silicon and aluminum do exist in various ternary and quaternary phases. If sodium aluminate or aluminum sulfate are added to a neutral slurry, an amorphous aluminum oxyhydrate gel will form initially. Unstabilized, it loses coordinately bound water converting to a pseudo-boehmite (AlOOH) which crystallizes in ribbon-like morphology. These ribbons can enhance pigment dispersibility because they prevent intimate contacts and adhesion between rutile crystallites.

The product ratios among the various silicon and aluminum oxyhydrate phases depend on many process parameters: starting reagents, ionic strengths, pHs, temperatures, rates of mixing, sequences and rates of reactant addition, slurry solid concentrations, etc.

After the inorganic coating is applied, organic or silicone treatments may be added. This is done in aqueous slurry or to dry pigment.

Numerous patents advocate less conventional surface treatments. Titanium dioxide pigment can be coated in the vapor phase, either during the oxidation step or in a fluidized bed reactor. Wet treated TiO_2 can be calcined to enhance photochemical stability. Hydrothermal surface modifications have been reported. The chemical and colloidal structures of nonconventional coatings are likely to be quite different than the structures applied in aqueous solution since, for colloidal products, reaction path is decisively important for product structure and phase characteristics.

Grinding and Finishing (*Figure* 1C)

Conventional grinding devices cannot break TiO_2 crystals into the uniform submicron size required for efficient light scattering. Bond strengths and densities within TiO_2 are far too high to grind crystals affordably. Instead, crystals are grown to proper size by chemical reactions or by ripening of sub-crystalline assemblies. Grinding of crystal agglomerates is, however, an essential part of pigment manufacture because agglomeration occurs during processing. However, broken in the process are agglomerates and some aggregates, not crystallites.

The device that breaks pigment agglomerates to aggregates and single crystals of pigmentary dimensions is the fluid energy mill. This mechanism uses the energy content of a working fluid, usually steam, to cause particles to collide at high speed and to break. Its most popular design, the micronizer, consists of a disk-shaped chamber where steam and dry pigment are injected tangentially at supersonic speeds. The incoming pigment agglomerates hit each other and fracture. Considering the enormous number of pigment particles in the grind chamber, the contribution of wall collisions to grinding is negligibly small. Fragments lose speed and are hit by other particles, resulting in further attrition.

A fluid energy mill performs some internal classification. Fluid is injected into the periphery of the grind chamber and flows to its center from where it discharges. The fluid drags particles toward the center while centrifugal force opposes the drag, thereby classifying coarser particles into the periphery where they continue to be ground while finer particles are

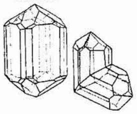
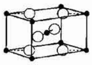
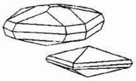
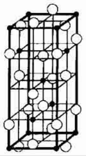
Typical Crystals	Crystal Structures	Density, g/ml	Refractive Index*
Rutile 	 ● Titanium ○ Oxygen	4.3	2.7
Anatase 		3.8	2.5

Figure 2—Titanium dioxide crystals

allowed to exit with spent steam. The aerosol then goes to gas-solid separators, such as cyclones or bag filters, where the pigment is recovered.

To achieve a uniform grind and good classification, pigment must flow into the micronizer at a uniform rate. Sticky pigment adheres to conveying equipment and flows erratically. Micronizing aids help improve dry flow. Suitable are stable, low molecular weight polyhydroxyl compounds: pentaerythritol, trimethylol propane and triethanolamine, etc.

Fluid energy mills grind small particles well but large particulate quite inefficiently. Large agglomerates must be preground. Sulfate process kiln discharge is premilled in ball mills, drums half-filled with balls. They are lifted by the rotation of the drum to cascade under gravity and fracture agglomerates. Once large agglomerates are broken, ball milling becomes inefficient.

Media mills and the sand mills from which they derive accelerate balls by impellers. In those devices, millimeter-sized grinding media cascade through slurries of pigment agglomerates, grinding them into individual crystals. Involved are complex mechanisms of attrition and shear. Media mills can reduce pigment agglomerate size to less than a micrometer. The pre-ground pigment is then surface treated to improve its pigmentary properties. Then the pigment is filtered, washed, and dried. Finally, it is ground in a fluid energy mill to deagglomerate it to single crystals and sintered aggregates.

After grinding, the pigment is allowed to cool and then packaged into paper bags, semi-bulk containers, hopper trucks, or rail cars. Because dry TiO_2 is an exceptionally effective thermal insulator, cooling takes a while. Pigment bags have been discolored or even charred in transit; customers were startled when they found themselves unloading "hot" pigment.

CHARACTERISTICS

The decisive advantage of titanium dioxide over other potential white pigments derives from its extreme optical characteristics, unique among actual and hypothetical substances. This optical advantage does combine with favorable economics. Titanium dioxide is probably the least expensive of all high-purity, particle size controlled inorganic chemicals, because titanium is a relatively abundant element with chemical characteristics that are favorable to processing.

Titanium dioxide pigments are made in two crystal phases—rutile and anatase. Their optical advantage derives from their extreme refractive index.

Crystal phase, particle size and surface, commodity composition, packing characteristics, and purity of commercial products are controlled to suit the intended applications. For-

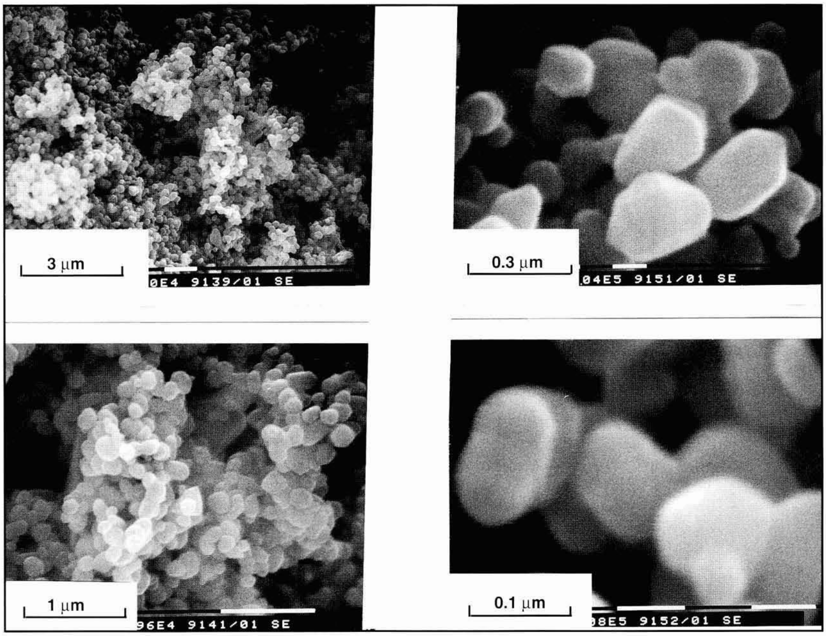


Figure 3—TiO_2—Scanning electron micrographs

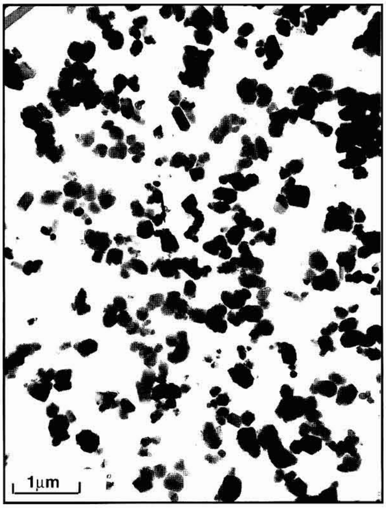


Figure 4—TiO_2—Transmission electron micrograph

tunately, TiO_2 is benign as a chemical. Its toxicity is very low. The pigment is safe in handling, in the end use, and as a waste.

Crystal Phase

The commercial crystal phases of titanium dioxide, rutile and anatase, differ in refractive indices,* densities, and UV reactivities because the titanium and oxygen ions within the crystals lattices are arranged differently. A third crystal phase of TiO_2, brookite, is not made commercially. *Figure* 2 shows crystal lattices and typical crystal habits of rutile and anatase. Rutile crystals are stubby needles, are denser, and have higher refractive indices—the highest refractive index of all ordinary, colorless, and stable substances. Anatase crystals are thick platelets.

Rutile is the stable phase. Phase conversion of anatase to rutile requires extreme temperatures, well over 500°C in the presence of effective mineralizers, even higher temperatures without. Thus, titanium dioxide cannot undergo phase transitions during paint manufacture or usage. This is in contrast to most organic pigments, many of which phase convert readily, usually with dramatic loss of optical performance.

Rutile absorbs slightly more violet light than anatase. Large, synthetic rutile crystals are thus yellowish.† However, in pigment applications, intense light scattering overcomes this slight yellowness. Because of their higher refractive indices, rutile pigments scatter light more effectively than anatase products. In organic media, the advantage amounts to about 20%.

Anatase was the first commercial titanium dioxide pigment made. It has now been replaced by rutile in all but paper applications because of rutile's scattering advantage. A pound of rutile contains fewer but more effective particles than a pound of anatase—fewer particles, because rutile is denser; more effective particles, because of a higher refractive index. As a result, rutile hides better than anatase but less so in extreme dry-hiding applications, that is, applications where some of the TiO_2 interfaces with air rather than polymer.

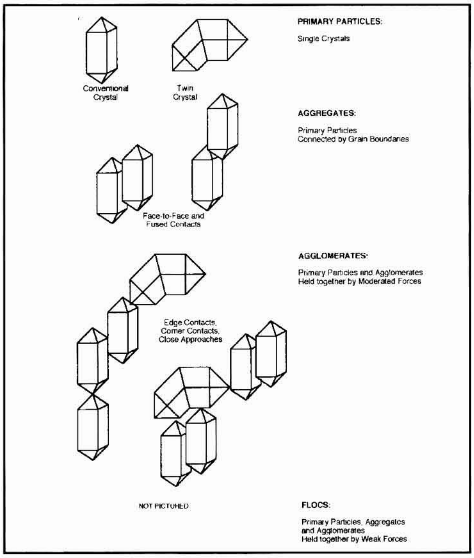


Figure 5—TiO_2 —Particle assemblies

TiO_2 is a UV-energized oxidation catalyst of organic polymer. Anatase surface is about 10 times more reactive than rutile surface. It takes only 10% anatase in rutile to reduce to one-half the life expectancy of a paint film of durable polymer. Thus, for all exterior applications, phase purity of rutile pigments is important. Any detectable amount of anatase in rutile pigment, about 1% by x-ray diffraction, is considered undesirable. The phase purity of a pigment can be taken for granted if the pigment is made by the chloride process, since rutile is its natural product. The sulfate process makes anatase as its natural product, but rutile can be made. Phase purity of sulfate process pigment used to be a problem but is no longer.

Particle Size

Particle size specifications of TiO_2 pigments were developed by trial and error. This practical particulate size conforms to the theoretical size of single hypothetical rutile spheres, calculated for optimal scattering of green and white light** from Mie theory. Agreement is as good as one could expect, given the fact that real particles and their size and shape distributions are quite unlike single, perfect spheres. *Figure* 3 shows scanning electron micrographs of dry flocs of rutile pigment at four levels of magnification. A scanning micrograph is the equivalent of human vision. We see the world by its surfaces; so does the scanning electron beam. *Figure* 4 shows a transmission electron micrograph of a rutile pigment. Transmission micrographs are the equivalent of an x-ray picture and are difficult to interpret.

The size of a sphere is easy to define and unequivocal to measure. Diameter tells all. The size distribution of a population of spheres can also be described rigorously by widely accepted statistical measures. However, the "size" of populations composed of particles of odd shapes is quite difficult to describe, let alone to measure.

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* Actually, TiO_2 crystals have two principal refractive indices each. They enter all considerations relevant to pigment optics as an appropriately weighted average.

† Crystals of the mineral contain much iron and are deep red (rutilus = Latin: "red") to occasionally black.

** Because of a pronounced maximum sensitivity of the human eye for green light, measured green reflectance corresponds to human perceptions of brightness.

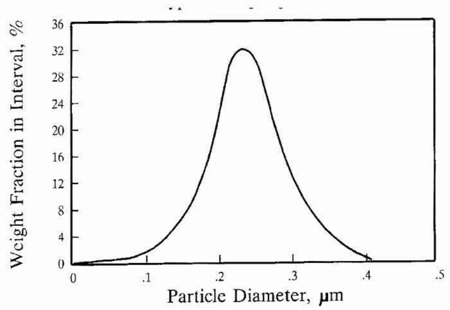

Figure 6—Particle size distribution (typical TiO_2 pigment)

Pigments are composed of complex assemblies of particles held together by forces that range in strength from very high through chemical bonding to essentially nil in casual contact. Although the spectrum of bond strengths is very wide indeed, we can not yet quantify these forces. *Figure* 5 illustrates particle assemblies, though oversimplified:

- Primary rutile pigment particles are individual crystallites and their crystallographic twins,* ranging in diameter from 0.1 to 0.3 µm with a Geometric Standard Deviation† of about 1.4. The submicroscopic crystallites have the features of macroscopic crystals but are less complex and more perfect.
- Aggregates are associations of sintered crystallites. They can be visualized as crystallites connected by crystal faces, sharing grain boundaries.
- Agglomerates are assemblies of crystallites and aggregates, bonded by weak forces, adhering to each other at edges and faces.
- Flocs are associations of smaller particle assemblies. They are bonded so weakly that they form spontaneously and disperse under modest shear. Flocs are composed of crystallites, aggregates, and agglomerates joined across corners or held together by short range attractive forces.
- Even casual contact has to be included in the definition of "particle" as it is "seen" by light, by x-ray, or by electron beams in a variety of practical and analytical settings. Casual contact links particle size to particle concentration within the setting. At low concentration, the frequency of particle overlap and contact is low, and the contact contribution to effective size is small. At high concentration, casual contact is abundant and contributes significantly to the particle size, as seen, for example, by a light beam penetrating a paint film or an electron beam magnifying pigment particles on the sample support of an electron microscope.

The strength of bonding within aggregates and agglomerates is illustrated by the effort it takes to grind the paint. Agglomerates are broken by high-speed mixers and by media mills when they are operated at high throughput. Aggregates can be ground in media mills at low throughput and in kneading equipment. Crystallites, including twins, do not break in conventional mills. They can, however, be damaged during sample preparation for microscopy where typically milligram quantities of substance are attacked by pounds of pressure.

TiO_2 pigments are not degraded in paint and plastics manufacture. By contrast, organic pigments can be overground because forces between molecules are weaker than the ionic and covalent bonding in inorganic crystals.

TiO_2 pigment particles are submicroscopic with size distributions narrower than many so-called monodisperse particulates. Appropriately ground, pigment dispersions contains less than five weight percent of particles smaller than 0.10 µm and larger than 1.0 µm. *Figure* 6 shows the frequency size distribution of a representative general purpose pigment, dispersed by ultrasonics to the size of crystallites and aggregates, as measured by settling from aqueous dispersion in the force field of an x-ray centrifuge. *Figure* 7 shows a typical cumulative size distribution of an ultrasonics dispersed TiO_2 pigment, measured as x-ray densities during gravity sedimentation in a sedigraph.

The relationship between particle size and performance characteristics is illustrated by *Figure* 8. Optical effectiveness, that is, light scattering, is controlled by the mass/volume frequency of particles in the size range from 0.1 to 0.5 µm. Gloss is diminished by a relatively small mass/volume fraction of particles larger than about 0.5 µm. Dispersibility and film fineness is degraded by a very small mass/volume fraction of particles larger than about 5 µm.

The mean particle size of pigment grades is tailored to the required optical performance. Small particle size pigment grades are made for applications at low PVC and for their blue undertone, large particle size pigment for applications at higher PVCs and for their neutral or red undertones.

Size Measurement: *Size measurement of submicroscopic particulates including pigments is a science in its own right. It is essential that the intended function of the particle be considered in the selection of an appropriate size measure.* "Size" depends very much on the perspective of the beholder. Consider the sizes of two snakes, a fat and short one and a long and thin one, from three perspectives: eagle, mouse, or monkey. In the eagle's eye, the two snakes are equal because either would be a meal for eagle chicks. To the mouse, the fat snake is too large to be a threat because it cannot follow into the mouse's hole. To the monkey, the thin snake is too small to worry about because it cannot swallow the monkey's baby. Perspective *does* matter. Other considerations equal, optical applications call for optical size analyses, settling application for sedimentation methods. Other considerations are, however, rarely equal and analysts are forced to compromise.

Results of measurement depend on the definition of "particle" within the scheme of primary particles and their associations. A bag of pigment is a single association of particles that constitutes an appropriate size class for warehousing and shipping considerations. Particles of pigment grit are the class appropriate for considerations of film fineness; pigment crystallites and aggregates are the class for light scattering considerations.

Because submicroscopic particles stick together by significant forces, *sample preparation, a grinding operation, becomes an integral aspect of measurement which has decisive impact on particle size, thus on the results of size analysis.* Unfortunately, grinding is (1) notoriously difficult to standardize and (2) as yet, almost impossible to quantify. Sample preparation and dispersion method continue to cast doubt over all size results of submicroscopic particle analysis.

Finally, *each method of measurement senses a particular aspect of size and yields results unique to itself.* Cross comparisons between methods require careful allowance for what it is that each method "sees." At that, some disagreement is likely. For an interpretation of results it is essential to know the method of measurement.

Ideally, size data should be both relevant and complete. They almost never are, for lack of analytical technology and sometimes because of ignorance.

Relevant data reflect particle size after the particulate was dispersed by processes of the intended manufacture rather

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* Twins are two or more crystals with lattices intergrown to some deducible law of symmetry.

† Geometric Standard Deviation: GSD = $0.5\ (D_{84}/D_{50} + D_{50}/D_{16})$ with: D = Diameter. 84, 50, and 16 refer to the respective mass percentiles.

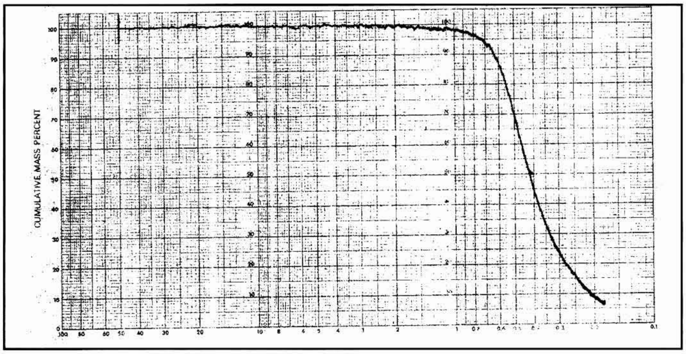

Figure 7—TiO_2 particle size distribution, Sedigraph®

than by a dissimilar sample preparation. Dispersion medium, particulate concentration, and sample geometry should approximate the intended application.

The principle of measurement should resemble the intended function of the particulate. Particles to be used for optics—pigments—are best measured by optical principles; particles made for settling—water treatment flocs—should be measured by settling. Because of compromises forced upon the analyst, pigments are measured by settling and water treatment flocs by optics.

For pigments, relevant size is the size of particles (1) as dispersed by forces of paint making equipment, (2) measured in a liquid, (3) at concentrations of a few volume percent, (4) preferably in thin films, and (5) interacting with visible light. Such particle size data would be more relevant to paint applications than size data, measured, for example, by a magnetic principle in dilute aerosols.

Complete size population data include measures of (1) some size average, (2) size distribution, (3) distribution character, and (4) third and fourth moments about the mean.

The size average may be represented by the median by weight, mass, or volume but not, for pigment purpose, by median by number because number distributions are extraordinarily sensitive to minute weight fractions of very small particles. Distributions by volume are useful for pigment characterization because pigment particles scatter light by volume. Number distributions are appropriate in investigations of number controlled phenomena, for example, nucleation. Size distributions can be quantified by the geometric standard deviation, the character by log-normal Gaussian, preferably with values for Kurtosis and Skew, that is, the third and fourth moments about the mean.

Most practical methods provide only some kind of size average. Several modern methods yield size distribution data. Log-normal character is assumed for most particle size distributions and for essentially all distributions of ground particulates. Measurement of Kurtosis and Skew requires more data on each sample than most investigators are willing or able to collect.

An old technique of TiO_2 particle size analysis, the Carbon Black Undertone test[1] meets requirements of relevancy better than the modern methods. Pigment is Hoover Muller dispersed into black grease. A thin film of the dark gray paste is drawn thick enough for total hiding. Red and blue light reflectances are measured. The ratio of reflectance readings is a function of average effective particle size of the TiO_2. Results are very precise and highly accurate, that is, reproducible and sensitive to small changes in average size.

Most traditional and modern methods of pigment size analysis are short on relevancy. Settling methods measure Stokes' diameters, that is, settling cross sections, not geometric dimensions. Optical methods measure features of light scattering. The extreme optical characteristics of TiO_2 make it particularly difficult to translate instrument signals into particle size.

White pigments are too small for measurement by sieving and electro zone measurements and too large to broaden x-ray diffraction lines. Paint grind gages reveal the presence of small concentrations of unground agglomerates and minute quantities of grit. Each grit particle is composed of thousands upon thousands of primary particles. Thus, *grind gages can reveal nothing about the particle sizes of light scattering significance.*

Electron microscopy deserves special comment because its results seem far more realistic than they really are: (1) transmission micrographs do not show actual particle dimensions but their projections,* introducing significant systematic error for needles and platelets,† (2) casual particle-particle contact or overlap can not be distinguished from bonding, and (3) *sample preparation must involve grinding which does change aggregate and agglomerate sizes.*

For lack of suitable size standards, many methods can operate only in a fingerprint mode, i.e., provide precise comparisons of similar particulates of identical composition but not size data of absolute accuracy.

Composition

Commercial pigments are complex structures designed to meet specific performance requirements. The crystallite core is the active ingredient that provides the optical functions. The surface of this core can be enriched by oxides other than TiO_2, present to a depth of a few atoms. Subsequent treatments with inorganic and organic chemicals, called coatings, adapt the pigment to the intended application. The designation "coating" refers to intentionally added components. Some so-called pigment "coatings" bear little resemblance to a macroscopic covering because they are three-dimensional crystalline structures rather than molecular layers.

Compositions of commercial products fall into one of three categories: (1) uncoated pigments, (2) coated pigments, and (3) slurries.

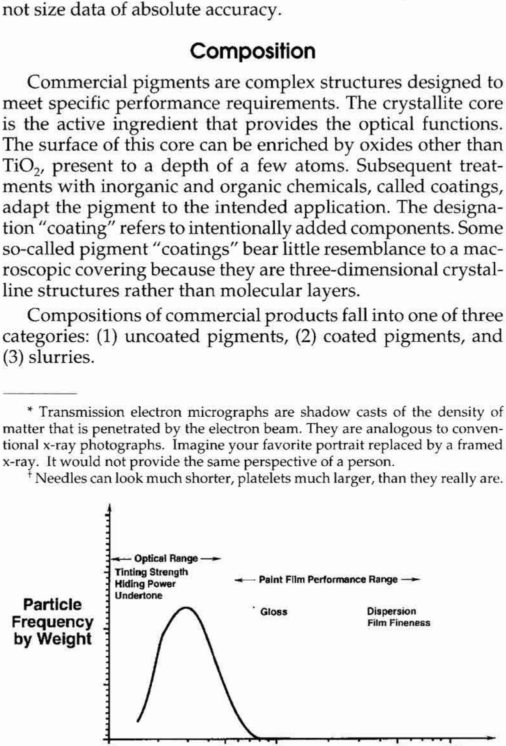

Figure 8—TiO_2 aggregate size distribution

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* Transmission electron micrographs are shadow casts of the density of matter that is penetrated by the electron beam. They are analogous to conventional x-ray photographs. Imagine your favorite portrait replaced by a framed x-ray. It would not provide the same perspective of a person.

† Needles can look much shorter, platelets much larger, than they really are.

Uncoated Pigments—*Uncoated pigments contain 98% or more titanium dioxide.* Minor constituents, either carried over from the ore or added in the manufacturing process, can affect pigment performance. Trace contaminants are unimportant except for transition metals such as iron, chromium, and vanadium which degrade color by semiconductor mechanisms.

Sulfate process pigments retain up to 0.3% niobium pentoxide and 0.3% phosphorus pentoxide from the ore. They also contain up to 0.2% alumina, added to compensate for pentavalent impurities, thus minimizing discoloration by semiconductor compensation.

Chloride process pigments contain practically no impurities from the ore in concentrations that could affect performance. They do contain about 1% pyrogenic alumina, added for better process control, and for improvement of photochemical stability.

Besides inorganic constituents, most uncoated and many coated pigments contain up to 0.5% of an organic grinding aid added to achieve a more uniform grind. The grinding aids improve dry flow characteristics in the fluid energy mill. Usually they are polyhydroxyl compounds that can undergo some pyrolytic degradation in the mill. Thus, pigments may contain traces of the decomposition products of organic polyhydroxyl compounds.

Coated Pigments—To facilitate dispersion, pigment surface is modified by "coatings" deposited in wet precipitation reactions. The coatings have profound effects on dispersibility and durability. They can affect the shelf stability of paints, the rheology of dispersions, and the gloss of paint films. In dry-hiding paints, coatings affect hiding through oil absorption and particle packing. Brightness is not affected by coatings except for a few specialized pigment grades that are treated with multivalent ions.

To be dispersible by conventional paint making equipment, TiO_2 pigments are coated with hydrous aluminum oxide particles. The presence of minute, hydrous alumina particles lowers van der Waals forces between pigment particles by several orders of magnitude, decreasing particle-particle attractions. The effect is analogous to covering wax balls with feathers to keep them from sticking. Obviously, the morphology of the particles on the surface is important. Hydrous aluminum oxide phases appear to improve dispersibility more effectively than most of the other hydroxides and oxides that have been advocated.

Nondurable grades contain a coating of up to 5% hydrous alumina. Durable grades have an additional coating of 2 to 8% silica. Some coatings contain zirconium and tin oxides. Superdurable grades of rutile pigments are made by encapsulating individual particles in glassy silica shells.

Silica treatments are widely and mistakenly considered detrimental to gloss performance. Silica on pigment comes in two distinct modifications, either "fluffy" or "dense." "Fluffy" silica, that is, submicroscopic particles of polymerized silicic acid, does indeed reduce gloss. It is deposited onto pigments intended for dry-hiding paints to increase oil absorption. "Dense" silica encapsulates the TiO_2 particle in a distinct shell to make the pigment super durable. This shell is a true glass that does not increase oil absorption nor diminish gloss. The glass is precipitated from aqueous solution by technology invented by DuPont in the 1960s.[2, 3] TiO_2 encapsulation made it practical to paint cars white and use them in subtropic climates.

Special high oil absorption products are made for paints formulated for dry-flat hiding, that is, paint films above their Critical Pigment Volume Concentration. They contain fluffy coatings, 5 to 10% fluffy, hydrous silica and 3 to 6% hydrous alumina, for better spacing and improved optical efficiency in vehicle-starved formulations. The fluffy silica increases oil absorption and water demand by the pigment and reduces its gloss.

Slurries—Slurry products are aqueous dispersions of pigments. The pigment producer disperses the pigment, a process step conventionally done by the pigment customer.

Slurries contain up to 80 wt% pigment. In addition to the coated pigment, slurries contain carboxylic acid dispersants. Because slurries must have a shelf life of weeks, the dispersant formulation must retard settling by inducing some minimal level of flocculation. Odorless amines can be added for pH control. Altogether, about 1% of organic material is present.

The slurry recipe must include biocides to inhibit microbial growth. Because microbe colonies tend to adapt to a given biocide, it is common practice to alternate biocides.

Analysis—The elemental analysis of TiO_2 pigments presents no particular problems to the expert. Many analytical principles and methods are available. Results of competently performed analyses are accurate and precise beyond the needs of pigment and coatings technologies.

The pigment industry describes its products and the hydrous oxides they contain in terms of their analytical equivalents, Al_2O_3, SiO_2, H_2O, etc. Such description does not imply structures or chemical characteristics of substances but reflects analytical results. The actual components of pigment coatings are hydrous oxides: boehmite (γ-AlOOH), diaspor (α-AlOOH), hydrargillite [γ-Al(OH)$_3$], etc.

Product descriptions in terms of elemental analyses are preferred because they are easy to verify. The precise structural analysis of colloidal coatings on pigment surfaces is always difficult even to the specialist and often beyond the capability of even the most sophisticated instrumentation. Because pigment particles themselves are submicroscopic, their coatings are sub-crystalline, always too small, and sometimes too disorganized for structural analysis by x-ray diffraction. Whatever the analytical method, results are usually ambiguous.

Surface

The surface area of a population of particles increases as the size of the individual particles decreases. This increase is inversely proportional to diameter. The smaller the particle size, the larger is the contribution of surface chemistry and surface physics to the characteristics of the particulate.

Because pigment particles are so very small, their surfaces are enormously large* and correspondingly important to the pigment's chemical performance. Thus, *surface characteristics have profound impact on interactions of pigments with all the other components of paints in the can and paint films on the substrate.* To diagnose and correct problems, it helps to understand the nature of the pigment surface.

One might presume that the surface of the TiO_2 core of the pigment particle is composed just of titanium and oxygen ions. Not so. While TiO_2 crystals grow, insoluble components accumulate on the surface. Those components are either impurities present in the ore and not removed in the purification processes or additives designed to control crystal structure, crystal growth, and particle agglomeration. The layers of foreign ions are only a few ions thick. Their structural details have not been confirmed.

Sulfate process pigments have a phosphate layer on their surface. The phosphate enhances the intrinsic water dispersibility of TiO_2. Thus, such unmodified pigments perform well in aqueous applications such as paper.

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* Roughly an acre per pound of a TiO_2 pigment, five acres per pound of a transparent organic color pigment.

The surface of chloride process pigment consists of pyrogenic aluminum and titanium oxides. It is nearly anhydrous. No water is present to evolve in high-temperature processing. This is a decisive advantage for some plastics end uses where hydrous components of the pigment cause "lacing," that is, form bubbles and blow holes into extruded films.

The bare oxide surface of untreated TiO_2 is not well suited to end use applications that require dispersion at low or moderate shear. Therefore, pigment surfaces are modified by treatments.

The TiO_2 and modified surfaces of pigments are wetted readily. They are usually hydrophilic and disperse spontaneously into water. The energy of wetting is high, aiding dispersion into water and even into organic liquids. The ease of wetting of TiO_2 pigments contrasts with wetting problems of organic color pigments, most of which are hydrophobic and have low free energies of wetting. Most organic pigments are wetted by organic solvents only sluggishly and by water not at all.

Most pigment surfaces are composites of Ti–O, Ti–OH, Al–O, Al–OH moieties; some include Si–O and Si–OH units. Silica encapsulated grades have only a few Ti–O and Ti–OH surfaces.

The calculated specific surface area of 0.2 μm rutile spheres is 7 m^2/g, close to the published values for untreated pigments. Thus, the rutile component of most TiO_2 pigments contributes 6 to 9 m^2/g of surface area. Inorganic treatments with hydrous aluminas and silicas can more than double the total surface area of a pigment.

The structure of the additive affects the surface area of the pigment. Precipitated hydrous alumina has a specific surface area of about 200 m^2/g. Thus, each percent of hydrous alumina adds about 2 m^2/g of surface area. For silica, the contribution to surface area depends decisively on the method of its preparation. The glass capsule around superdurable pigments does change the nature of the surface but does not increase the surface area of the TiO_2 core. Fluffy silica precipitated on dry flat grades, by contrast, contributes several square meters of surface area per percent of silica.

Since unmodified pigments tend to cake and flow poorly, they are treated with up to 0.5% of polyhydroxyl compounds to improve dry flow. Silicones improve dry flow even more effectively, but they make the pigment unsuitable for most coatings applications. The pigment becomes hydrophobic. Paint films with silicone treated pigment can lose adhesion to their substrates.

Packing Characteristics and Oil Absorption

To paint manufacturers, oil absorption (OA) of a pigment or an extender is a practical measure that tells a great deal about a particulate and the paint made from it: how much of the particulate can be formulated into a paint, how the paint behaves during manufacture, and how the paint film performs. The OA concept is based on artisan's practices that predate theoretical understanding. The test and the data, however useful they continue to be, have serious flaws that diminish their value to the technology.

To the coatings scientist, *oil absorption is a measure of pigment packing. Packing is the most profound of all coatings variables. Packing controls virtually all performance measures of paint and paint films.* Particulate packing could connect insights from the mechanical engineering of structural composites to coatings technologies, link film performance to fiber reinforcement, connect coatings failures to stress analysis. For the lack of such linkage, the understanding of the mechanical performance of coatings is unnecessarily vague.

To assess the significance and implications of OA, it helps to understand test limitations and packing fundamentals. OA test results measure packing but are affected by (1) the grinding that is an integral part of the procedure, (2) interfacial characteristics between oil and particulate as affected by particulate characteristics and surface active components of the oil, and (3) poor reproducibility of the test.

The characteristic of a particulate that is measured by oil absorption is its critical wet packing, the maximum density to which particles can be packed into a liquid. "Dry packing" is the bulk density of the particulate. This "dry packing" of a particulate is substantially less dense than the packing in liquid because wetting reduces particle-particle interactions, diminishing the association of particles into strings and sheets. At least for TiO_2, dry and wet packing correlate very well. Whatever process step or adjustment increases one measure will also increase the other.

Below a critical packing density, a composite of particulate in liquid is a slurry; above its critical packing density, the composite is a crumbly mass. Critical packing densities of pigmentary particulates can range widely, from less than 5 to over 50 vol%. Composites that turn into crumbly masses at solids concentrations of less than 10 vol% are obviously more difficult to process than slurries that are fluid to 50 vol% solids. Thus, the packing characteristics of a particulate have profound practical consequences that impact processing and performance.

Above all other parameters, critical packing density of a particulate is controlled by the shape of individual particles and the shape and density of those aggregates and agglomerates of individual particles that have survived dispersion. Needles and stringy agglomerates* haystack, that is, reach maximum densest packing at quite low volume concentrations. Stringy aggregates of colloidal SiO_2 spheres can reach critical packing density at less than 1 vol%; long TiO_2 needles at less than 10 vol%. Platelets and flaky agglomerates† pack more densely than needles, less densely than equant (equidimensional) particles and equant associations.** If not associated, hard spheres of identical radii pack at 74 vol%. Spheres of mixed radii can pack a bit more densely but only if radii differ by ratios larger than about eight.

Small particles are far more likely to agglomerate than large particles, thus are more likely to associate into strings and flakes and more likely to pack loosely. Because of strong, short-range attractions, submicroscopic particles will agglomerate unless treated not to do so.

The liquid medium in which the packing occurs has secondary effects. Packing densities are high in liquids into which the particulate disperses readily and low in liquids in which the particulate flocculates, i.e., associates spontaneously into loose, weakly bonded assemblies.

Surfactants and dispersants can increase packing densities of particulates in liquids in which the particles tend to flocculate. Surfactants counteract flocculation and promote dispersion. The dispersant effects on packing are chemical in nature. They can be pronounced, for instance, they can convert a paste into a thin fluid.

Grinding increases critical packing densities because stringy and flaky particle associations are broken preferentially; needles break before needle fragments do, etc. But the increases of packing densities achieved by grinding are relatively small and consume much energy, almost all of which is lost as heat.

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* Particles characterized by one long and two short axes; agglomerates of primary particles, strung together by adhesion.

† Particles characterized by one short and two long axes; agglomerates of primary particles that resemble flakes like rust, assemblies of dry leaves and fish scales.

** Particles characterized by three axes of essentially equal length and agglomerates of solids that ball up.

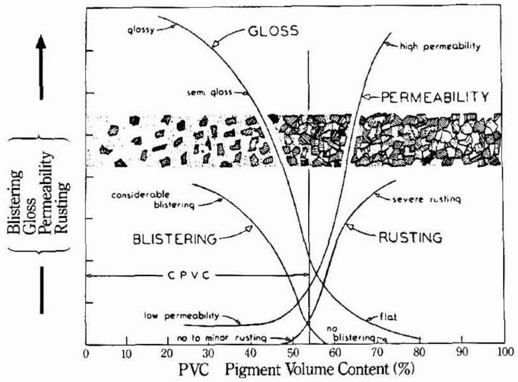

Figure 9—Pigment Volume Concentration vs performance (from: Patton, T.C., Paint Flow and Pigment Dispersion, *Interscience Publishers, New York)*

The packing density of a particulate has profound effects on the rheology of its concentrated slurries. If the particulate packs densely, its slurries have low viscosities at high solids contents; if the particulate packs loosely, viscosities are high at low solids. Critical packing density affects all slurry characteristics that involve fluid motion: pumping, mixing, heat transfer, etc. Frequently, rheological characteristics become complex, prompting hysteresis and viscoelasticity.

For paints, packing imposes severe limits on the freedom to formulate. The Pigment Volume Concentration (PVC)[*] expresses particulate packing. The maximum packing density of the pigment composite is described as the Critical Pigment Volume Concentration (CPVC). Below the CPVC, not all particles are in close mutual contact. The paint film contains excess binder. Above the CPVC, the paint film becomes vehicle starved, i.e., contains less binder than is required to fill the interstices between pigment particles. At the CPVC, all performance measures—hiding, gloss, stain resistance, rusting, blistering, etc.—attain pronounced minima or maxima or undergo large and sudden changes. (See *Figure* 9.)

High-tech paint formulation takes the Reduced Pigment Volume Concentration, the ratio of PVC/CPVC, into account. Performance of two paint films is equal in a wide range of quality measures only if they are formulated at equal Reduced Pigment Volume Concentration. Low-tech paint formulation involves pound-for-pound substitution of pigments and extenders of equal oil absorption (OA), the paint makers' measure of wet packing. *Pound-for-pound substitution of particulates of unequal OA affects most film qualities.*

Measurement

The OA test method is a titration of dry pigment with linseed oil to an endpoint where the addition of the liquid to the powder has consolidated the composite into a coherent mass. Results are expressed as pounds of oil consumed per 100 pounds of pigment.

The procedure has flaws that diminish its usefulness, accuracy, and precision:

- The measure is based on weights rather than volumes. Paint components, however, function by volume. Their densities range from less than one to larger than six. Thus, weight based data cannot be inter-compared.
- Water has become the most important liquid in paints. Even as a binder, linseed oil is now almost obsolete.
- A surfactant is required for the test but is not added in controlled concentration. Instead surfactant is present as a natural component of linseed oil. Its natural variability impacts test results.
- The pigment is ground during dispersion. The intensity of grinding affects the test result but is notoriously difficult to standardize.
- The end-point of the OA titration lacks criteria that are easy to define and describe. Thus, every operator titrates to his/her own end-point. A skilled operator reproduces his/her results quite well but operator-to-operator variance is large.

The method can be improved substantially. Yet it is unlikely that the coatings industry can be persuaded soon to change to a better measure. Within the context of paint manufacture, the range of practical data (less than 10 OA for some extenders to over 100 OA for carbon blacks) is wide enough to reduce the huge testing error (about 15% of the result) to practical insignificance. In the context of TiO_2 process control, the same experimental error is, however, significant because values for all TiO_2 grades range from 11 for uncoated pigments to about 35 for dry-hiding grades.

Contaminants and Color

Commercial pigments contain three types of contaminants: (1) transition metal ions that degrade color, (2) electrolytes that can interfere with the performance of some specialized coatings, and (3) volatiles, usually only water which does not affect coatings but can cause problems in plastics manufacture. The transition metal ions come from the ore and are incorporated in the pigment crystal in concentrations in the parts per million range. The electrolytes originate in the treatment of the pigment surface. A few hundredths of a percent can be bonded to hydrous alumina, titania, and silica surfaces, often by ion exchange mechanisms. Chemically bonded and physically adsorbed water is present on pigment in the low fractional percent range.

From the ores, pigment contains traces of metal ions: vanadium, chromium, niobium, etc. Several of these can discolor pigment by semiconductor mechanisms. The process by which the pigment was made leaves its mark. Sulfate pigment retains impurities in significant concentrations. The chloride process can be made to produce a purer TiO_2. The difference arises because anhydrous titanium tetrachloride, the chloride process intermediate, is easier to purify than titanyl sulfate, its sulfate process counterpart. Distillations and chemical treatments of liquid titanium tetrachloride are inherently more efficient than crystallizations and precipitations of aqueous, colloidal solutions.

Purity translates into brightness, a performance attribute of white pigments that is required only for pure-white coatings: coatings that are routinely applied at incomplete hiding—many coil coatings, most inks and ink-similar paints—and coatings that are intended to be as bright as possible, for example, all coatings on the insides of light fixtures.

Chloride process pigments are intrinsically brighter and whiter than their sulfate counterparts. Typical chloride pigments average 99.5%; most sulfate products average 98.5% L^* [*] brightness. A lightness difference of 1% is about ten times larger than the least visible difference. In the very first approximation, a TiO_2 pigment with an L^* lightness of 98.5% might contain a three times higher concentration[†] of colorant impurities than a pigment of 99.5% brightness.

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[*] The PVC is the volume ratio of particulate to particulate plus binder:

$$PVC = Volume_{Particulates}/(Volume_{Particulates} + Volume_{Binder})$$

The volume of pores, if any are present, is ignored.

[*] CIELAB (CIE 1978) metric of lightness.

[†] The concentration of color center is is roughly proportional to brightness difference: (100 - 98.5) / (100 - 99.5) = 1.5 / 0.5 = 3

Dry TiO_2 color is usually measured on pressed powder pellets. For well purified pigment, this dry powder color does not correlate well with end-use color because most organic polymers are much yellower than pigment.

TiO_2 particle size has an effect on color of tints, that is, mixtures of a white pigment and one or more color pigments in a binder. Smaller particles scatter blue light more efficiently.[4] As a result, pigment with a smaller average particle size will shift the color of tinted coatings and plastics (or coatings at incomplete hiding) towards blue. Pigment with larger average particle size will cause the same systems to appear redder.

Electrolytic contaminants on the pigment can interfere with the electrolysis step of electrocoating. Film defects can be generated if concentrations of electrolytes exceed a few hundredths of a percent. Effects are specific to parameters of the electrolysis and to the paint formula. They are most severe in coatings applied at high voltages. Special pigment grades have been designed for electrocoating.

Acidic and alkaline components of the pigment, not necessarily contaminants, can cause problems. In acid and in base catalyzed coatings, alkali and acid residues on pigments can neutralize some of the catalyst that initiates crosslinking of the polymer. If that occurs, catalyst is lost, cure remains incomplete, crosslink density is reduced, and the molecular weight of polymer is diminished. In effect, the binder acquires the characteristics of a thermoplastic in place of a thermoset polymer. A wide variety of serious film deficiencies are the result: solvent sensitivity, diminished durability, diminished mechanical strength, lack of hardness, etc. Pigment grades are now available that are designed for formulation into acid or base catalyzed paints.

Excessive moisture on the pigment can cause serious problems in some coatings applications but only if the pigment was drenched during shipping or storage. In plastics applications, less than one percent of moisture on pigment can cause "lacing"; that is, blow holes in massive bodies or "lace" extruded films and ribbons. Absorption of atmospheric moisture into pigment stored in shipping bags or in bulk is usually negligible. Transport of atmospheric moisture into pigment is hampered by its dry powder characteristics which all but prevent diffusion. The pigment surface does not attract moisture. It is hydrophilic but not hygroscopic.

Safety

TiO_2 creates almost no safety problems. It presents no pronounced health hazards; it is neither corrosive, nor acutely toxic by ingestion, inhalation, or skin contact. TiO_2 does not appear to be a significant carcinogen nor an embryo toxin in the workplace. As a dry powder, TiO_2 can become a nuisance dust that may require control. The hazards of TiO_2 pigment and the relative lack thereof are detailed in Material Safety Data Sheets[5] that must accompany every U.S. shipment.

TiO_2 pigment cannot burn or explode, either as a dry powder or as aqueous slurry. Neither the dry pigment nor the slurry is corrosive to equipment, nor reactive. The hazards of pigment dispersions in organic liquids reflect the characteristics of the liquids.

PERFORMANCE

The TiO_2 industry sells light scattering for the price of TiO_2. Scattering effectiveness is the primary performance characteristic of the pigment. However, the optical effectiveness of TiO_2 pigments is well optimized and near its theoretical potential.

Between TiO_2 pigments developed for similar end use, light scattering differences are too small to matter and too small to be measured by all but the most sophisticated techniques. Thus, secondary performance characteristics can be commercially decisive. Gloss and dispersibility are such decisive features. They involve the particulate nature that is common to all pigments. Durability, that is, resistance to weathering, is an issue that in practice, though not in theory, is specific to the chemistry of TiO_2. Extensive research has revealed much detail, and we will describe the picture that has emerged.

Particulates, including pigments, are detrimental to many of the performance characteristics of thin films. Particles disrupt the continuity of the polymer in which they are embedded. Mechanical performance is affected. Tensile strength and impact resistance are usually decreased, modulus usually increased. The surface is roughened and its gloss diminished.

At high particle concentration, the film can become porous. Pores are stress concentrators, diminishing mechanical film qualities. A network of pores provides pathways for chemical penetration, decreasing stain and corrosion resistance. Pigment design attempts to control these characteristics to suit whatever purpose.

Performance of paint films involves systems composed of pigments and binders. Synergisms are the rule rather than the exception. Thus, aspects of performance involve coatings directly and pigments only indirectly. Nonetheless, pigments are optimized for performance in coatings. Because of their significance, durability, gloss, and dispersibility are served by TiO_2 grades optimized for the specific attribute. Recently, universal grades have been introduced that combine the best in durability and gloss performance.

Weathering

Paint films deteriorate from the combined effects of sunlight, moisture, and oxygen. In dry darkness, some have lasted for millennia. Exposure to light, water, and oxygen can change their appearance and cause discoloration, surface roughness, and film erosion, ultimately to the substrate.

Degradation starts with light. *Only the UV content of sunlight is destructive.* Visible light does not have the energy content to break chemical bonds. UV light fractures molecules. Organic materials, organic polymers, and organic pigments are damaged irreversibly and lose function. Polymers become brittle; organic color pigments fade. Some inorganic pigments, TiO_2 among them, are in thermodynamic equilibrium on this earth. Their bonds are broken by UV light. The breakage, however, is reversed by the action of atmospheric oxygen and water. In the process, a temporary activated state is generated that causes catalytic activity. The catalytic characteristics of TiO_2 are activated by UV of more than 3.1 eV. In effect, the band gap* of TiO_2 is within the energy levels present in sunlight.

The effectiveness of white pigment is coupled to a catalytic activity that can degrade the matrix of organic polymer in which pigment finds itself in paint films. TiO_2 pigments, because they are very effective white pigments, can also be quite destructive. Anatase is more reactive and more destructive than rutile. Relative catalytic activity coefficients are approximately 10 for anatase, 1 for untreated rutile, and less than 0.1 for the most durable grades.

The mechanisms and chemistry of the TiO_2 involvement in film degradation have been studied extensively and successfully. We believe we know what happens and why.

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* The band gap is the "forbidden" energy gap between the valence band and the conduction band of a semiconductor. In the language of physics: "UV light induces semiconductor characteristics in TiO_2"; in the language of chemistry: "UV light reduces colorless TiO_2 to black Ti_2O_3."

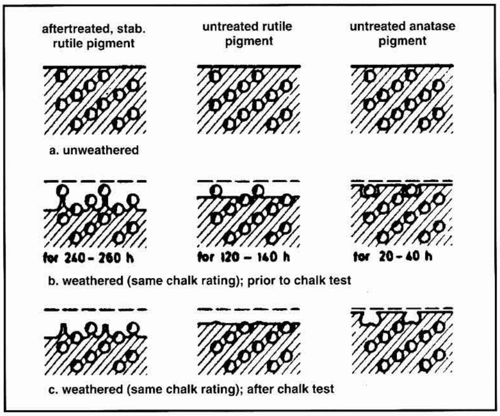

Figure 10—Model of binder degradation

TiO_2 pigment has two opposing effects on the mechanisms of film degradation. They were beautifully illustrated and interpreted by Kämpf[6] (*Figure* 10):

(1) Because TiO_2 absorbs UV light very well, each particle protects polymer in its shadow from destructive radiation.

(2) Because TiO_2 is a UV activated oxidation catalyst, organic polymer degrades where it is in contact with unprotected TiO_2 surface.

Depending on contributions from the susceptibility of the polymer and the catalytic activity of the pigment, the two mechanisms combine into a spectrum of degradation effects that range from (1) oxidative disappearance of *photo stable polymer* where it is in direct contact with the surface of *catalytically active pigment* particles to (2) massive oxidative disappearance of *photo unstable binder* except where it is in the shadow of a *deactivated pigment* particle.

In practice, cheap paints are made from cheap ingredients and expensive paints from expensive raw materials. Rarely is cheap (photosensitive) polymer combined with premium (superdurable) pigment. Thus, the degradation mechanisms of practical paint films combine in complex ways the features of contact catalysis with protection.

The chemistry of UV energized, TiO_2 catalyzed film degradation involves a sequence of reactions at the TiO_2 surface. UV photons, water, and oxygen react to generate two free radicals from each photon of more than 3.1 eV, overall:

$$H_2O + O_2 + h\nu_{(UV)} \xrightarrow{TiO_2} \bullet HO + \bullet HO_2$$

The hydroxyl and peroxyl free radicals are highly reactive agents that oxidize and thus degrade essentially any organic polymer:

$$2 \bullet HO + 2 \bullet HO_2 + CH_4 \rightarrow CO_2 + 4H_2O$$

The chain of chalking events is cyclic with respect to TiO_2 and can be disrupted by exclusion of either UV, water, or oxygen. The overall scheme seems established.[7,8] Details may well be revised by future research.

In pigment grades intended for outdoor applications, the catalytic activity of the TiO_2 surfaces and its destructive effects on the weathering resistance is inhibited by surface treatments.

The most demanding exposure combines effects of high humidity, condensation, long hours of sunshine with high UV component, and near horizontal exposure geometry. These are the exposure conditions of hoods and roofs of cars sold into the humid tropics. In the last two or three decades and through advances in both polymer and TiO_2 technology, white automotive finishes finally qualified for exposure that severe.

The required degree of durability is designed into the pigment by encapsulation of the rutile core of each pigment particle in a shell of silica glass. The shell prevents contact between catalytic surface and polymer matrix by recombining and deactivating electron-hole pairs. *Figure* 11 is a transmission electron micrograph of such an encapsulated pigment at a high magnification. The silica shell is visible as a slight halo around each (denser) rutile particle. *Figure* 12 shows the silica shells themselves after the rutile core was dissolved-out through holes that were broken into the shells by severe grinding.

Lesser levels of weathering resistance are achieved by partial encapsulation of rutile in silica, hydrous alumina, or zirconia. Alternate solutions to deactivate TiO_2 surface involve (1) manipulation of the solid state character of the TiO_2 surface, in effect semiconductor trickery, and (2) dehydroxylation of the surface. Neither approach is satisfactory for products intended for coatings applications. Semi-conductor mechanisms discolor the pigment slightly. Dehydration makes the product too gritty.

Pigment Interactions

More often than not, pigments are used in combinations. Detrimental interactions between TiO_2 and other pigments are rare but can occur. Two types of interactions are possible: (1) problems involving surface chemistry, and (2) direct chemical reactions. Neither are likely to be caused by the TiO_2.

TiO_2 pigments can also interact with resins and paint additives. The more important of these problems have been recognized and addressed by special pigment grades.

Pigment-pigment interactions are usually caused by the color pigment, more specifically the color pigment commodity, i.e., the composite within which the pigment is sold. Occasionally one of the surfactants of the paint formula is at fault. In contrast to TiO_2 and many inorganic pigments, organic pigments contain surfactants as part of the pigment commodity. Some pigment dispersions contain more than 50 wt% surfactants; pigment lakes a bit less; toners up to several percent. These surfactants can interact with the TiO_2 and cause flocculation (reversible association of pigment particles in the fluids of the paint, white with white, white with color, or color with color), flooding (stratification of pigments within the wet paint film), and floating (splotchy accumulation of one of the pigments at the wet film surface). Because surfactants are involved, the TiO_2 that contains no surfactant cannot be at fault.

Chemical interactions used to occur between TiO_2 and white lead. A thunderstorm could cause exteriors painted with mixtures of TiO_2 and white lead to discolor, sometimes quite severely. Eventually, the discoloration would fade. Involved was a photochemical reaction between the UV component of the lightning flash and TiO_2. The UV photon reduced Ti^{4+} to Ti^{3+}. The Ti^{3+} then reduced Pb^{2+} to metallic lead (Pb^o) which discolored the paint film. Eventually, atmospheric oxygen reoxidized the Pb^o to Pb^{2+}, bleaching the paint film back to its original color. Obsolescence of white lead eliminated the problem.

Occasionally, interactions occur between the components and contaminants of pigments on one side and resins or additives on the other. They are not specific to white pigments but are more serious in white paint films because white coatings contain more pigment than dark ones. Contaminants on TiO_2 pigment can thus be leveraged to significance. Problems tend to be specific to coating type. Several such problems have been recognized and resolved by designing special pigment

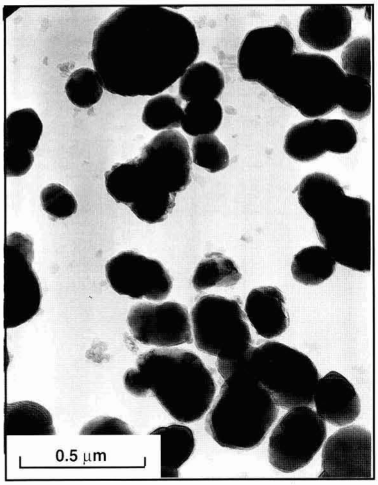

Figure 11—Transmission electron micrograph of silica encapsulated TiO_2

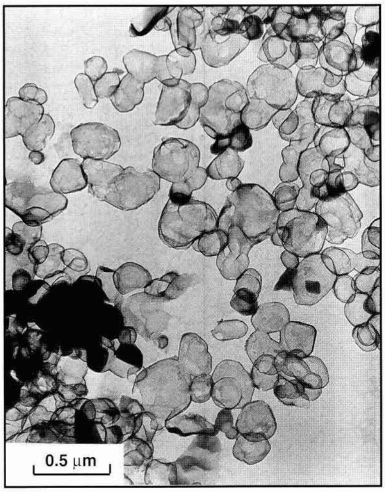

Figure 12—Transmission electron micrograph of silica shells on TiO_2

grades, for example, for electrocoatings and for acid catalyzed paints.

Coatings systems that are UV cured or brightened with fluorescent dyes are not readily compatible with TiO_2 pigments because TiO_2 absorbs and quenches essentially all UV radiation. Chemical sensitizers can sometimes help and accomplish UV polymerizations in spite of the presence of TiO_2. Fluorescent dyes do not usually work with rutile pigments but may be satisfactory with anatase.

COMMERCIAL GRADES

TiO_2 pigments are used in several industries, in a wide variety of applications, and in many environments: binder, plastic, paper, and fiber. A single TiO_2 product could conceivably serve all diverse needs but would perform only moderately well. Optimal performance in any application demands specialized pigment designs that satisfy requirements of individual industries and applications within industries. However, just as technologies overlap industries, so do product recommendations. Board coatings of the paper industry share the characteristics of cheap paints. Both are thus served by the same grades. Superdurable pigments are used in severe exposure applications of both coatings and plastics. Some inks are similar to some paints and are served by the same pigment designs.

Beyond industry orientation, grades are differentiated by durability, pigment concentration of the intended end use, color effects, and the commodity as which they are sold, powders versus slurries.

Pigment composition is the most obvious design feature. All modern TiO_2 pigments contain mostly TiO_2 and minor amounts of inorganic oxides and oxyhydrates. Some have organic additives, dispersants, or conditioners. Mixtures of TiO_2 with extenders were used extensively but now have disappeared from most markets. Calcium sulfate extended TiO_2s were the most popular of these products. They performed well in solvent-based paints but not in waterborne systems because calcium sulfate crystals grow in water to unacceptable sizes. Also, traces of calcium and sulfate ions flocculate vehicle emulsions.

Different pigment types and grades tend to differ in composition in ways obvious to appropriate analyses. However, similar performance objectives may be met by products of several designs and compositions. Some of the specific requirements of certain applications can be met only through compromise.

U.S. Federal and ASTM specifications distinguish four types of TiO_2, one anatase type and three rutiles: interior, exterior and pigment for paints formulated above the CPVC. This differentiation into only four types fails to capture the choices that are now demanded by the consumer. ASTM specifications are now being reconsidered for an update.[9]

Today's consumers can select pigments for their applications from many specific designs. Pigment grades are designed for industries: coatings, plastics, paper, and ink. Within industries, products can be described in terms of four performance dimensions: durability, gloss, dispersibility, and undertone. Then there are products aimed at specific coatings applications: enamel paints, dry hiding paints, pigment slurries, acid catalyzed coatings, electrocoated primers, etc.

The design parameters for durability of coatings are *interior, exterior*, and *severe exposure*. Interior grades are unfit for exterior applications except when used underneath top coatings that absorb all light of wavelengths below 0.40 μm. All-purpose pigments are exterior durable in appropriately durable vehicles, at moderate severity of exposure, and for moderate appearance requirements. Severe exposure grades are intended for satisfactory performance including high gloss at exceptionally severe conditions, for example, horizontal position in the humid tropics.

Gloss performance comes in two versions: *conventional* and *flashy*. Conventional pigments satisfy the gloss requirements of most architectural and trade sales applications and of many industrial coatings. High-gloss pigments are aimed at automotive and some flashy industrial finishes that are applied mechanically. High gloss calls for pigments of small agglomerate size and low oil absorption.

Dispersibility comes in *conventional* and *low shear*. Conventional pigments are designed to be dispersed by equipment developing moderate to high shear by the standards of coatings technology:* media mills, ball mills, roller mills, and high-speed dissolvers at low rates of throughput. Special pigments are available for stir-in with screening and for low shear, high rate dispersion by high-speed dissolvers. Dispersibility is promoted by surface treatments at some detriment to gloss. Unlike many color pigments, TiO_2 pigments are dispersible enough not to require predispersion. TiO_2 slurries contain fully dispersed pigment. They are ready for stir-in.

Undertone is rarely an issue in coatings, but two levels are sold—*neutral* and *blue*. Most coating grades have a neutral undertone. Blue undertone pigments are preferred in applications at very low PVC. Red undertone pigments do not appear to be in demand.

Most of these TiO_2 pigments—conventional interior and exterior grades, conventional and high gloss products, conventional and low-shear dispersible pigments, the neutral and blue undertone pigments—are intended for applications below the CPVC.

Grades for applications above the CPVC perform better in dry-hiding paints than grades made for high and moderate gloss. They are heavily treated, low gloss products. In effect, the pigment contains its own, exceptionally effective extender.

Aqueous TiO_2 pigment slurries were introduced by DuPont in the early 1970s to eliminate need for dispersion operations by the customer. Slurries need not be ground but can be mixed into paints. Pigment loss is reduced, dusting is eliminated, and bag disposal made unnecessary. Moreover, slurry facilities are readily automated. For medium and large paint plants, savings from the elimination of a process step can more than pay for slurry handling facilities.

The slurries contain up to almost 80% pigment by weight. Loading is limited by the concentration at which the slurry undergoes a transition from liquid to crumbly solid. Slurries of lightly treated grades are available at higher concentrations than slurries of heavily treated, dry flat grades. As sold, slurries are quite fluid but their unusual liquid density, as high as 3.5 g/mL, calls for special consideration in equipment design.

Other specialized grades of coating pigments are made as opportunities are recognized and solutions developed. The same products can be packaged in different ways—bag, semibulk, or bulk—or analyzed for special purposes, for example, food additive purity. Each such product may enter commerce under its own grade designation.

Minor variations of pigment design are identified by special codes in addition to grade designations by some manufacturers; others include them within their grade structure. Involved are accommodations to specific requirements of certain market segments including criteria of testing, packaging, and selection. Corresponding performance differences are generally quite subtle, sometimes detectable, never obvious.

The wrong grade of TiO_2 pigment for any specific application will still be inert, be white, and will hide well. But the inappropriate pigment will fall short of expectations on secondary performance characteristics such as durability, gloss, or rheology. This is in marked contrast to most color pigments where a grade inappropriate to an application is likely to fail grossly.

Pigment design is complicated by conflicts and compromises. Optimal performance in one dimension can come at the expense of performance in another dimension. Flashy gloss, for example, can be attained only at the expense of pigment characteristics that promote stir-in dispersibility. Premium performance can require additional process steps increasing the cost of manufacture. Some pigments for severe exposure and grades for flashy finishes are sold at a premium because they are more expensive to make.

Obviously, the multiplicity of grades is costly and creates incentives for the development of universal grades. Lately some of these attempts have been partially successful. A few "universal" products have appeared on the market. At that, these novel grades are universal only within fairly narrow parameters. They do, however, serve the needs of the bread-and-butter formulas of the coatings industry.

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*The plastics industry uses several more powerful mills.

January 1997 Subcommittee Reports of ASTM Committee D-1

The January 1997 meeting of ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications was held January 26-29 at the Embassy Suites Hotel, Ft. Lauderdale, FL. In attendance were 240 D-1 members and guests spread over 190 working task group and subcommittee meetings. The current D-1 membership as of this meeting is 647.

Highlights

The up-coming ISO/TC 35 meeting in Milan, Italy, was an important topic of discussion at the meeting of D01.09. Three subcommittees: D01.31, D01.34, and D01.51, stated they will have representatives at this international meeting.

VOC continues to be an important subject, especially within D01.08. J. Berry reported on the accomplishments of a joint EPA/ASTM August 20, 1996 meeting and progress made since then toward establishing a meaningful ongoing relationship for the future. EPA will likely appoint a D-1 contact person in the near future.

D01.38 held two meetings since we all met last June in San Francisco. Efforts to develop a general method (heating rate) for getting the Mettler softening points of hydrocarbon resins to agree with ring and ball softening points are underway. A Mettler softening point instrument was demonstrated. Interlaboratory agreement of Mettler values has been good; a liquid heating bath is not needed. Anyone having information on the effects of test variables on ring-and-ball softening point precision share them at the next meeting. Hydrocarbon resin softening point standards are needed, preferably of a hydrogenated resin.

SENRAC and the "Steel Coalition" was a major topic at the meetings of D01.23.15 and D01.53. A coalition of six trade associations, identified as OSSC (OSHA/SENRAC Steel Coalition), received a contract to do research to initially examine the root causes of slips and falls during construction on painted steel roofing and decking. The second phase will seek to identify potential options for safety improvement, quality measurement techniques, and encourage applied research.

At the meeting of D01.51, it was reported that a current PCI action item is powder dry flow properties. PCI plans to issue a technical brief by the end of February. Approval of the document is planned before the annual PCI meeting in May 1997. Gel Time was discussed. PCI might conduct a round-robin using the current PCI method. An ASTM round-robin on a ISO proposed gel time procedure is planned this spring.

A letter on behalf of D01.37 and D01.56 requested the Committee on Standards reconsider its policy on listing sources of supply in the standard. COS, in its reply, spelled out three criteria to be applied for exemptions: (1) There is no performance based specifications or other material that could be written or referenced to describe the apparatus. (2) The information for procurement of this apparatus is not obtainable using current information sources. (3) There are special issues that call for the listing of suppliers because there is no other reasonable mechanism/ or users to find this information.

Dates and Locations of Future Meetings

June 22-25, 1997 - Toronto, Canada
January 11-14, 1998 - San Diego, CA
June 6-10, 1998 - Baltimore, MD
January 24-29, 1999 - Memphis, TN
June 12-16, 1999 - Orlando, FL
January 23-28, 2000 - New Orleans, LA

DIVISION 1 ADMINISTRATION

Subcommittee D01.08 Environmental Concerns

E. A. Praschan, Chair

Chair E. Praschan reviewed the highlights of current actions on environmental test methods and other related activities in Committee D-1. M. E. Mc Knight advised that Committee E-50 continues to work on environmental assessment methods in relation to real estate matters.

J. J. Brezinski declined to be the editor for the 3rd edition of Manual 4 on Determination of VOC in Paints and a new editor(s) is being sought. W. Spangenberg outlined the status of technical/regulatory matters affecting use of lead in paints. The chair reviewed the status and timing of major current EPA regulatory efforts on clean air issues, including MACT standards, operating permits, CAM, OTAG and credible evidence. EPA has proposed tighter air quality standards (NAAQS) for both ozone and particulate that will drive the need for expanding the scope of federal and state air regulations.

The chair announced that J. C. Berry agreed to chair the new task group, D01.08.01 EPA/D-1 Coordination. Mr. Berry will send a letter to each D-1 technical subcommittee, requesting the following actions: (1) identify methods under its jurisdiction that pertain to EPA regulatory activities; (2) designate a representative to TG1 to coordinate their interests; and (3) identify retired coatings experts who would be available to assist EPA as needed

J. Berry reported on the accomplishments of the joint EPA/ASTM meeting on August 20, 1996 and the progress made since then toward establishing a meaningful ongoing relationship for the future. He advised that EPA will likely appoint a D-1 contact person in the near future.

G.L. Nelson reviewed the current status of the ISO 14000 International Environmental Standards to evaluate environmental commitments, processes, and systems. Some states are in the process of incorporating these standards into their regulatory programs. Additional information pertaining to environmental news, events, workshops, etc. was also discussed.

Subcommittee D01.09 Technical Advisory Group to ISO/TC 35/SC 9

M. E. McKnight, Chair

T.J. Sliva, Secretary of D01.09, presented a report on the various ballot actions taken on ISO/TC 35/SC 9 methods since the June 1996 meeting, as well as current working items up for review. Mr. Sliva reviewed the status of the compilation of the equivalency test method list for ISO/TC 35/SC 9 and D-1 and distributed the list of ISO methods that are up for the five-year review.

It was the decision of D01.90 to accept the invitation of ISO/TC 35 to meet with them jointly in June 1999 at the Omni Rosen Hotel in Orlando, FL.

J.C. Weaver of D-1 and Bernd Reinmüller of ISO/TC 35/SC 10 discussed the progress made on setting up a technical advisory group to SC 1 on terminology and SC 10 on test methods for binders in paints and varnishes. R. M. Schiller reported on the work being done in D01.31.13, advisory group to SC 2 on pigments.

Subcommittee D01.14 Indexing
L. Schaeffer, Chair

D01.14 chair passed around copies of the Condensed D-1 Index, as it will appear in Volumes 06.01, 06.02, 06.03 and 06.04 of the forthcoming *1997 Annual Book of ASTM Standards.* The Chair proposed that the Condensed Index be made more accessible to D-1 members by publication in the D-1 annual *Membership Handbook* as well as in the *Annual Book of ASTM Standards.* J. Weaver suggested a separate D-1 booklet as an alternative. H. Ashton suggested the possibility of including the Condensed Index along with present D-1 Internet material. It was agreed that these ideas should be presented at the D01.90 meeting in Toronto, preferably at the first (Sunday) session, to permit further review at the D01.14 meeting on the following Tuesday.

J. Weaver approved the suggestion that copies of the 1997 Condensed Index be distributed at the D01.90 meeting for the committee members to become more familiar with its structures and advantages.

Subcommittee D01.15 Lectures and Symposia
T.J. Sliva, Chair

A mini-symposia entitled "Paint Application Tools: Key Variable in Painting Success" was presented. T. Sliva served as the moderator and presented an overview of ASTM test methods developed that relate to application tools.

F. Burns presented a film and slide presentation outlining the attributes of various application tools and how paint rollers are prepared as formulated products. Mr. Burns demonstrated by a paint-out to show the effects of using a "price" formulated vs. "performance" formulated roller on various properties such as hiding and leveling using the same paint.

E. Harsch discussed the history and construction of paint brushes. Examples of the various filaments and finishes used to formulate brushes was discussed. A display table was set up containing examples of various application tools and their components.

DIVISION 20 RESEARCH

Subcommittee D01.20 Quality Assurance and Statistics
R.M. Morrison, Chair

The following items were considered. D 3980 replacement. Since D 3980 has been withdrawn, E 691 will be the method of choice for conducting interlaboratory studies in D-1. However, there are some ease of use issues around E 691 that are going to be addressed by a guide, for the use of D-1, on how to design an interlaboratory study, and use E 691 data analysis. Another issue which was discussed was trying to find a way to "qualify" laboratories before they participate in an interlaboratory laboratory study (ILS). This qualification would not be the responsibility of the subcommittee or task group conducting the study, but would instead be the responsibility of the participating laboratory. This would be a way of reducing useless precision statements in ASTM methods.

Subcommittee D01.22 Health and Safety
R.M. Osterman, Chair

Discussion focused on D01 (96-03) ballot Item 14, D 1310, "Test Method For Flash Point and Fire Point by Tag Open Cup Apparatus." The negative from E.M. Nesvig was determined not persuasive based on the following reasoning. The test method was reviewed and found not in need of modification by current users of the method. (1) The research report was found to be valid. (2) D 1310 is not comparable to D 92; each method makes use of different equipment at different temperature ranges. (3) D 1310 measures flash points of materials whereas D 4206 measures combustibility of materials.

Subcommittee D01.23 Physical Properties of Applied Paint Films
P.R. Guevin, Jr., Chair

D01.23.10—Adhesion—G.L. Nelson, Chair, reported that a revision to D 3359, "Test Methods for Measuring Adhesion by Tape Test," Section X1.6.2, will be submitted to D01.23 ballot. Two recent ballots of other standards have referenced D 3359 for coatings on plastics; namely, D 3002 and F 1164. The chair will contact those involved to insure that users of those methods recognize that D 3359 is being used beyond its scope.

A discussion was held on the status of D 2197, "Test Method for Adhesion of Organic Coatings by Scrape Adhesion," related to the chrome plated U-shaped stylus specified. It was recommended that a ballot be conducted to "specify styli agreed upon between supplier and user." Further, it was recommended that a commentary be added discussing issues with the styli.

The recent ballot on the revisions to D 5179, "Test Method for Measuring Adhesion of Organic Coatings to Plastic Substrate by Direct Tensile Testing" received a negative from H. Stoner. The negative was found to be not related, since the adhesive used was not part of the ballot.

D01.23.14—Hardness, Abrasion and Mar Resistance—A. F. Rutkiewic, Chair, reported that the newly developed "Test Method for Mar Resistance by Dry Abrasion of High Gloss Coatings" has passed society ballot and will appear in the next *ASTM Book of Standards* as D 6037.

There continues to be a desire to perform a round-robin to evaluate the effects of modifications to the mechanical design of the Taber abraser. Taber Industries will coordinate the round-robin with the participation of DuPont, Troy, Morton International, and Cytec Industries.

D 5718, "Test Method for Mar Resistance of Organic Coatings" will be revised to indicate that the specifications of the "stylus or loop" be agreed upon by the buyer and seller to assure comparable results. It will also be indicated that the method is not suitable for the evaluation of powder coatings.

D 2134, "Test Method for Determining the Hardness of Organic Coatings with a Sward-Type Rocker" will be revised to include the specific designs of the rocker rings produced by the instrument manufacturers. The designs will be identified as rockers "A" and "B". The producers will also be so identified, so that the results obtained from the specific instruments can be so identified.

D01.23.15—Slip Resistance—P. Guevin Jr., Chair, lead a discussion of comments from the negative voters on the revision of D 5859, "Test Method for Determining the Traction of Footwear on Painted Surfaces Using the Variable Incidence Tester."

J. C. Larsen reported that a coalition of six trade associations, identified as OSSC (The OSHA/SENRAC Steel Coalition), has received a contract to do research to initially examine the root causes of slips and falls during construction on painted steel roofing and docking. The second phase will seek to identify potential options for safety improvement, quality measurement techniques, and encourage applied research.

D. Berger said a paper was presented at a joint ASTM Committee D-1/SSPC symposium that discussed this problem. The paper was presented by Thomas Clarkson from the International Association of Bridge, Structural and Ornamental Workers (IASOW). Mr. Clarkson described their trade association's need for coatings with more slip resistance under wet conditions. Unfortunately, the paper, titled "Effects on Worker Productivity and Safety in Construction of Coatings on Steel," wasn't published in the proceedings, "New Concepts for Coating Protection of Steel Structures" (STP 841, edited by Dean M. Berger and Rufus F. Wint).

P. Guevin announced that D01.90 requested that he represent Committee D-1 at the Committee on Standards (COS) meeting of technical committees developing slip resistance standards. COS's initial focus group meeting will address a proposed management plan and other related items with these standards activities. The meeting will be held at ASTM Headquarters on a date to be determined.

D01.23.19—Drying Time—T. Sliva, Chair, reported that D 5895, "Test Method for Measuring Times of Drying or Curing During Film Formation of Organic Coatings using Mechanical Recorders," had successfully completed society ballot and will be published in the *1997 Book of Standards*.

The chair reported that the precision and bias statements for both D 1640, "Standard Test Methods for Drying, Curing, or Film Formation or Organic Coatings at Room Temperature" and D 5895, using a straight line recorder, have been completed. The initial results from the round-robin using the circular drying time recorders were reviewed. The chair will submit this data for development of a precision and bias statement.

As ISO will shortly begin round-robin testing to develop a precision and bias statement for their methods, it was suggested that the coatings to be used should also be sent to D01.23.19 for possible round-robin work to develop information on results obtained using the different (ASTM vs. ISO) methods.

D01.23.20—Exploratory Research—P. Guevin, Jr., Chair, read the letter from I. C. Sellars with his rationale for casting a negative vote on Draft #4 of the proposed "Test Method for Nondestructive Measurement of Dry Film Thickness of Organic Coatings Applied to a Base Using an Ultrasonic Gage."

The chair sent a copy of the test method, along with representative samples of epoxy coatings on concrete, to S.N. Rosenberg at JSR Ultrasonics. Mr. Rosenberg concluded that their Pelt Gage was not a suitable instrument for this application. He informed Mr. Guevin that he experienced difficulties getting an echo and, when he did, he was unsure of its significance.

J. Peters, Elcometer, said since round-robin studies were conducted on only organic coatings applied over concrete, the test method should be limited to this use and the scope of the method should be changed to reflect what was done in round-robin studies.

D01.23.21—Contact Angle Measurement—Acting Chair, L. Gibson, distributed Draft No. 3 of the proposed method, "Standard Test Method for Determining Water Wetability of Coatings by Contact Angle Measurement," and the data from the recently completed round-robin. There were six cooperators, three of whom submitted data in time for the meeting.

The differences between two of the data sets raised questions. First, controlled conditioning of coated test panels should be considered, including the length of time prior to contact angle measurement. Also, it was recommended that the number of test drops be lowered from 10 to 7, eliminating the highest and lowest measurements and reporting five points. This is to reduce the variability introduced by eye strain. Since various substrates were used, it was suggested that glass be used in the next round-robin to further check test reproducibility.

T. Sliva, D/L Labs, recommended that there be an addendum to the method explaining the effects of substrates and coating properties on contact angle. This addendum will be submitted as a draft for review at the next meeting. The next round-robin will include instructions for controlled conditions for storing test panels.

Other suggestions for changes included revising the Significance and Use statement to include some of the limiting factors associated with measuring contact angles on coatings. Following review of the method, the chair asked for cooperators to initiate a round-robin. The results will be discussed at the next meeting.

Subcommittee D01.24 Physical Properties of Liquid Paints

R.D. Brockhaus, Chair

D01.24.19—Viscosity of Efflux Cups—R. D. Brockhaus, Chair, reviewed the background of the negative ballot by B. G. Meadors on Item 21 of D01 (96-03) ballot for the revision of D 5125-91. D01.24.19 found his negative not persuasive as D01.24 lacked documentation or original knowledge as to the precision and bias of the ISO 8-mm efflux cup design. D01.24 found his negative not persuasive. The ISO 8-mm will remain referenced in a footnote until appropriate data are developed to permit its inclusion as a main referenced testing device.

A second negative, submitted by C.J. Ray, was found persuasive on Item 21 of D01 (96-03) ballot for the revision of D 5125-91. However, the negative was on an issue which is plainly editorial (the word "or" in section 13.1.2, should read "on").

D01.24.19 voted to proceed with a round-robin to develop the required data if enough participants can be generated. Cannon Instruments will provide testing oils appropriate for the study. Test cup devices will come from a variety of supply sources. The study should begin before the summer meeting. We will be discussing the equations used for the various efflux cups during the summer meeting.

D01.24.20—Rotational Viscometers—R.D. Brockhaus, Chair, reviewed the latest ASTM legal ruling which requires supplier names to be removed from the test method titles. D01.24 has D 2196, D 4287 and D 562 test methods which fit this category. D01.24.20 feels that current users identify each of these test methods with a "device type" instrument unique from the other type rotational viscometers. Yes, multiple vendors produce each of the type instruments but they have no problem with marketing as "equivalent to." D01.24.20 members moved and passed a motion to retain the names Stormer, ICI, and Brookfield in the test method titles, while replacing reference to equipment source as "available" from commercial sources.

The three test methods will be placed on the D01.24/D-1 ballots for reapproval with the only footnote changes opened up for discussion.

R. Brockhaus will work on D 2196 for other technical or editorial changes D01.24 should address for the June meeting. This will be an attempt at describing the instruments in a generic, performance driven form. A "B" section will be developed to better discuss the digital instruments. "A" section will remain the older, analog display type instruments. J. Peters will do the same on D 4287.

New business: A. Rutkiewic would like D01.24.20 to investigate rheology issues with a specific starting target range of 100 sec^{-1} to 500 sec^{-1} for characterization use. This is a spray system type range for the modern day waterborne paint systems. Other ranges may be needed to characterize paint sag or effects of circulation system of automobile paint system in OEM or large refinish body shops. The chair welcomes all input on this, pro or con. We will look for our planning on this at the June meeting.

D01.24.21—Viscosity by Stormer Viscosity—R. Brockhaus, Chair, tackled the issue of trademark names in test method titles. Our solution addresses the current "state of the test industry" in terms of association of equipment to what actions a test is to take or do. We will begin to address rewrites which can define the performance standards the instruments are to meet in as generic a set of terms as possible, to remain as neutral as non-biased as possible.

D01.24.22—Density—R.D. Brockhaus—Chair, reviewed the ballot item 20, D01 (96-03) for revision of D 1475-91. The item received comments, but no negatives. The revised D 1475 will be published with some editorial changes noted in the comments. Issues arise from these comments will be discussed at the June meeting. The method now goes on to publication.

Sherwin-Williams offered a procedure to add use of a centrifuge to process the sample prior to measurement. The purpose is to minimize air entrapment to add precision. D01.24.22 intends to add this in an appendix. Changes will be circulated to D01.24 members and visitors of record. We will discuss a possible round-robin to generate reproducibility and repeatability values for these type samples where air entrapment is a significant problem during the summer meeting in Toronto.

We can also look to trying a MONK pressurization device as an alternative technique. Anyone having experience with this type instrument please attend or write to D01.24.22 to share your communication with our group.

D01.24.30—Practice for Calculating Formulation Physical Constants of Paints and Coatings—E. Praschan, Chair, reviewed the background of the negative ballot by R. Metejka on D01 (96-01) for reapproval of D 5201. Mr. Matejka had withdrawn his negative with the understanding that his comment would be addressed. The chair distributed a draft revision of the method clarifying technical matters and incorporating Mr. Matejka's suggestions concerning rounding of numbers and definition of VOC. In the meeting, it was suggested that reference should be made to the appropriate government document that describes and defines volatile organic compound (VOC). Mr. Metejka agreed that his comments were adequately addressed. Revisions will be incorporated and the method will be forwarded to D-1 ballot.

D01.24.33—Odor Evaluation—D.E. Darr, Chair. In the absence of D. Darr, R. Brockhaus was the active chair. The acting Chair reviewed the background of the three negative ballots by R. Diem, D. Darr, and Lawniczak on item 7, D01 (96-04), New Standard Guide to Comparison Detection and Identification of the Odors of Paint, Inks, and Related Materials. The three members present found each of the negatives persuasive. Chair Darr had prepared a new version dealing with each of the negatives cast. The entire 12-member D01.24.33 reviewed copies provided and agreed the spirit of the negatives had been addressed. Comments by H. E. Ashton and G. F. Downs III have also been addressed in the new version. D01.24.33 agreed a new paragraph 11 should be written and change the current paragraph 11 to paragraph 12. This new paragraph will address the actions necessary to take following the conclusions made from paragraph 10. D01.24.33 voted unanimously to submit the new, revised version for D01.24/D-1 ballot.

A one-page article titled "Artificial Nose Uses Fiber Optics to Emulate the Real Thing," *Phonics Spectra*, November 1996, p. 31, was circulated to identify current research being conducted on the subject of odors as alternatives to exposure of human lungs and sense organs.

We concluded with a presentation by J.L. Massingill, Director for Coatings Research Institute at Eastern Michigan University. The research discussed centered on Human Odor Quantification of Solvents as focused on by direction of a consortium of automotive, coating, and solvent manufacturers. The project used a Devlin olfactometer and characterized 19 common paint solvents for their odor stimulation to humans. The work demonstrates a value for the proposed new practice and provides an initial database and methodology. It also identifies the scale of financial and manpower staffing commitments required to conduct the fundamental studies. A copy of the presentation is submitted to ASTM with these minutes for the record. Dr. Massingill has been asked to submit the research to ASTM in the form of an ASTM Research Report to document this effort in a strong consumer/supplier focused forum.

D1.24—R.D. Brockhaus, Chair. Reports of six task groups were accepted by the chair. D 1210 was accepted for publication. D 1475 passed all ballots with no negatives. Editorial comments made will be worked in as found appropriate. Work continues on how to most appropriately present precision data. Investigation will begin into a method for testing dispersions using high-speed dispersing equipment. We will be reactivating D01.24.18 beginning in January 1998 for this purpose. D1.24.20 will be looking into automotive OEM paint circulation systems paints for characterization tests. Any companies or universities willing to have their rheologists join us in this work?

Subcommittee D01.25 Evaluation of Weathering Effects

M.J. Crewdson, Chair

D 1654, "Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments" is due for review, and G. Rommal will head up an Ad Hoc group to look at areas of the standard that need revision. Y. Koropov and S. Pikul have volunteered to assist. The recent ballot of the revisions to D 4214, "Evaluating Degree of Chalking of Exterior Paint Films," received one negative from J. Martin and one comment from W. Elfring. Mr. Martin's negative was regarding the restriction of the rating of the "Wet finger" tape chalk method to three rating points. This was done because it was believed that this was the level of precision of this method. After discussion, Mr. Martin withdrew his negative, based upon agreement that he will submit wording for an immediate revision. This wording will indicate that the restriction to three levels is not mandatory. The comments by W. Elfring will be addressed by R. Morrison.

D 4214 is close to the final deadline when it will be automatically withdrawn, and therefore these revisions must be through in order to keep D 4214 active. The next revision as indicated above will be minor and will go to D01.25/D-1 ballot.

A copy of a recent ballot to combine the standards D 660, "Evaluating Degree of Checking of Exterior Paint Films," with D 661, "Evaluating Degree of Cracking of Exterior Paint Films," was distributed. This draft was last balloted in 1991 and was dropped for lack of action. Several comments from the floor were discussed, and the chair will issue a D01.25 ballot of this item.

A copy of a recent ballot for revision to D 772, "Evaluating Degree of Flaking (Scaling) of Exterior Paint Films," was circulated. This draft was last balloted in 1991 and was dropped due to lack of action. Several comments from the group were discussed and the chair will submit this revision for ballot.

The chair of D01.25.03 Image Analysis has resigned. F. Lee will take over as chair of D01.25.03. He will check with his predecessor to determine the next course of action.

Subcommittee D01.26 Optical Properties

R. Kumar, Chair

D01.26.02—Color Measurement—J. Throckmorton, Chair. The origins of the chromaticity coordinates, (x, y, and Y) used in D 1544 was discussed at length. The consensus of the group was to review data collected by J. Peters and attempt to locate the 30 sets of color disks Tintometer, Ltd. had provided for his use. If found, a round-robin would be developed to evaluate the disks and verify the chromaticity coordinates.

D01.26.06—Hiding Power—L. Schaffer, Chair. A revision of D 2805 has passed concurrent ballot with no negatives or comments. A revision of D 344 passed with no negatives and four comments. Two comments objected to the brush specification. A statement was drafted to broaden permissible brush types. One comment recommended substituting E 1347 for E 1349 and more detailed illuminant conditions. It was agreed to add E 1347 along with E 1349 and not modify the illumination section. The last comment was editorial and accepted.

D01.26.11—Gloss—A.F. Rutkiewic, Chair. Both ISO-10215:1992 and ISO-10216:1992 were brought up for discussion. It was agreed that the former lacked in discrimination for high-gloss systems. The chair will solicit D-1 and E 12 for interest level of developing standards. The latter method, ISO 10216:1992, is not at optimum view and illumination angle for high-gloss systems. The chair will distribute both of the above ISO standards for D01.26 review and comments. A draft standard for Measurement of Orange Peel of High-Gloss Coatings will be ready for consideration at the June 1997 meeting.

D01.26.24—Tint Strength—R. Morrison, Chair. Method D 3022 passed the ballot and society review. A new test method for Evaluating the Relative Tint Undertone of Titanium Dioxide Pigments received two negatives. It was agreed to change the method and resubmit for concurrent ballots. The ISO method for color and strength by high-speed disperser will be investigated for possible adoption by ASTM.

D01.26—Optical Properties—R. Kumar, Chair. Prospective speakers for a mini-symposium on "Color and Appearance" to be held in 1988 at the San Diego meeting are being contacted by the chair. J. Throckmorton was elected Chair of D01.26.02, Color Measurement and A. Pigoni was elected Secretary for D01.26.

Subcommittee D01.28 Biodegradation

J. Hinkle, Chair

D01.28.01—Package Stability—J. Hinkle, Chair. Minor changes to D 2574-96 agreed upon at the January 1996 meeting need to be approved and will be balloted before the June 1997 meeting.

D01.28.02—Rapid Determination of Enzymes—L. Sadasivan agreed to assume chairmanship of D01.28.02. Under C. W. Vanderslice's chairmanship, a method was developed for distinguishing between cellulase and chemical degradant contamination in latex paints and raw materials. The method now needs to be validated in a round-robin test.

D01.28.03—Microbial Quality of Raw Materials—J. Hinkle, Chair. The growth rating system in D 5588-94 was changed in 1996 by D01.28 to agree with the rating system adopted in D 2574-96. Changes will be balloted before the June 1997 meeting.

D01.28.04—Resistance of Paint Films to Algae Attack—K. Roberts, Chair. D01.28 finalized proposed revisions to D 5589-94. The list of suggested algal species was expanded to include additional common isolates from paint and coating films. A culture maintenance procedure for growing algae in broth cultures was added along with the recipe for Bold's Basal Medium. We agreed the topic of weathering does not come under D01.28's purview. We will not add any comments regarding other methods except to include weathering methods under referenced documents. The revised test method will be sent to all D01.28 members for balloting before the June 1997 meeting.

D01.28.05—Correlation of Exterior versus Accelerated Fungal Tests—J. Hinkle, Chair. A small round-robin test was conducted to compare coating performance in the humidity chamber (D 3273) with exterior performance. Some correlation was observed, especially with pigmented paints. Although this method was designed to test interior coatings, many laboratories use the method for exterior coatings. We need to determine if the profile of activity is the same. L Sadasivan mentioned a paper, Bravery, A. F., et al., "Further Collaborative Experiments on Testing the Mould Resistance of Paint Films," *JOCCA*, 1984, 67(1), 2-8, which describes prediction of field performance from laboratory data. Further discussion was deferred until the June 1997 meeting.

D01.28.07—Revision of D 3274 (Defacement Ratings)—J. Hinkle, Acting Chair. B. Matta, Chair and Liaison to D01.25, was unable to attend. There was no report on what progress D01.25 has made in improving visual aids for defacement rating. At the June 1996 meeting we agreed to work closely with this committee, since our needs and concerns are similar. The present photos are generally considered unsatisfactory for defacement rating. J. Hinkle agreed to try to attend the D01.25 session to learn if any progress has been made within D01.25.

D01.28—Biodeterioration—J. Hinkle, Chair. L. Weinert suggested we need a method for removing microorganisms from wood before painting, since microbial growth can interfere with coating adherence. We reviewed cleaning standard D 4610 which calls for a bleach wash and was originally intended for use in distinguishing dirt from microbial growth. The use of bleach can, however, be a problem on colored paints. We agreed to add a disclaimer to the effect that the bleach method should be used prior to recoating and washed off before repainting. J. Hinkle will draft a revision addressing the concerns expressed regarding the use and misuse of this method for review. This has been a very active subcommittee, and members were encouraged to take on other responsibilities within ASTM.

DIVISION 30 PAINT MATERIALS

Subcommittee D01.31 Pigment Specifications

D.E. Kesatie, Chair

D01.31.08—Titanium Dioxide—C. Tatman, Chair. A discussion took place regarding revisions to D 476, Standard

Specifications for Titanium Dioxide Pigments, and D 3926, Percent Solids in Titanium Dioxide Slurries. Following a survey of federal and state agencies and architectural firms specifying titanium dioxide (TiO_2), the task group initiated development of a "Guideline for TiO_2 Product Selection" to replace the current standard, D 476. The goal is to make the guideline more user friendly and bring it and ISO 591 (European Specification for TiO_2 Pigments) into closer agreement. We anticipate completing the federal/state agency-architectural firm survey and have a draft document ready for discussion at the June 1997 meeting. Since the implementation of D 3926, there have been improvements in the equipment available to measure the solids content of TiO_2 slurries. The present procedure will be revised to reflect those changes.

D01.31.10—ISO Pigment Coordination—R. Schiller, Chair, introduced B. Reinmüller representative for ISO/TC 35/SC 2. It was announced that ISO/TC 35 will meet in Milano, Italy on June 2-5. Experts are invited to attend. D01.90 approved the concordance efforts and ASTM staff will initiate the work to publish in Volume 6 by 1998. D01.31 will submit to ISO/TC 35/SC 2 the jurisdiction list of test methods so that a concordance can be made with respective ISO test methods. D01.31 will also review the non-existing test methods found in the concordance and will decide whether they should be adopted or developed.

D01.31.12—Zinc Pigments—D. Leggett, Chair. The 0.06 lead level in zinc dust test information will not be available until March. A paper will be given during the SSPC Lead Abatement Conference. An article will be published in the June or July *Journal of Protective Coatings and Linings* regarding this test method. SSPC will update their zinc dust specification to explain the difference between ASTM Type I and II Specifications and where each can be used. SSPC will not address pigment issues. Copies of their article will be made available at the next meeting. The specification for zinc phosphate requires some minor changes. Once these changes have been completed, the specification will go to D01.31 ballot.

D01.31—Under Old Business—M. Denesha informed those present that an error had been made in the minutes from the June meeting in San Francisco. The minutes stated that the negative vote received for D 1208 was found to be not persuasive. The minutes were corrected to state that the negative vote was found to be persuasive. ASTM was notified of the error, however the minutes had already gone to print.

Under New Business, a request was made to establish a specification for aluminum pigments used in waterborne systems. Times were requested for the June meeting in Toronto, Canada. There are 27 standards requiring action: D 34-91, Guide for Chemical Analysis of White Pigments; D 85-87, Specification for Ochre Pigments; D 126-87, Test Method for Analysis of Yellow, Orange, and Green Pigments Containing Lead Chromate and Chromium Oxide Green; D 210-81a, Specification for Bone Black; D 279-87, Test Method for Bleeding Pigments; D 478-86, Specification for Zinc Yellow (Zinc Chromate) Pigments; D 602-81, Specification for Barium Sulfate Pigments; D 715-86, Test Method for Analysis of Barium Sulfate Pigment; D 716-86, Test Method for Evaluating Mica Pigment; D 717-86, Test Method for Analysis of Magnesium Silicate; D 718-86, Test Method for Analysis of Aluminum Silicate Pigment; D 719-91, Test Methods for Analysis of Diatomaceous Silica Pigments; D 765-87, Specification for Raw and Burnt Sienna Pigments; D 970-86, Test Methods for Para Red and Toluidine Red Pigments; D 1135-86, Test Method for Chemical Analysis of Blue Pigments; D 1199-86, Specification for Calcium Carbonate Pigments; D 1301-91, Test Methods for Chemical Analysis of White Lead Pigments; D 1366-86, Practice for Reporting Particle Size Characteristics of Pigments; D 1394-76, Test Methods for Chemical Analysis of White Titanium Pigments; D 1844-86, Test Method for Chemical Analysis of Basic Lead Silicochromate; D 1845-86, Test Method for Chemical Analysis of Strontium Chromate Pigment; D 3256-86, Test Methods for Chemical Analysis of Phthalocyanine Blue and Green Pigments; D 3721-83, Specifications for Red Iron Oxide Pigment; D 3722-82, Specification for Natural Red and Brown Iron Oxide Pigments; D 3872-86, Test Method for Ferrous Iron in Iron Oxides; D 3872-86, Test Method for Percent Solids in Titanium Dioxide Slurries; D 4139-82, Guide for Determining Volatile and Nonvolatile Content of Pigments.

Subcommittee D01.32 Drying Oils

J.C. Weaver, Chair

Five attendees were pleased with the appointment, by the D-1 chair, of Dr. Gary F. Seymour, of Cargill, Inc. as Vice Chair of D01.32. An October 1, 1996 letter by this chair and its attached reconstitution and divisionalization of D01.32 was offered. It was adopted without objection. D01.32's 58 standards are reapportioned as follows: D01.32.10 Guides and Practices, four standards, G.F. Seymour, Task Group leader; D01.32.20 Chemical Methods, six standards; D01.32.30 Physical Methods, eleven standards; D01.32.50 Oils, general; D01.32.51, Soybean, four standards, G. F. Seymour, Task Group leader; D01.32.52, Linseed, five standards; D01.32.53, Castor Oil, five standards; D01.32.54, Tung and Oiticica, five standards; D01.32.55, Miscellaneous, six standards; D01.32.60, Fatty Nitrogen Products, 13 standards; and D01.32.80, Exploration and Planning. New task group leaders are being recruited from six or more producers of these categories.

Carbon tetrachloride, used for decades as a solvent in the procedures for test methods for iodine value of drying oils and fatty acids, has been banned as too hazardous in the United States. Appropriate revisions of the iodine value methods D 1541 and D 1959, using isooctane or cyclohexane as solvents are now offered for D01.32 and D-1 ballots.

Precision and bias sections of these older standards, not required in earlier decades, will be pursued either via new round-robins, from parallel standards in the American Oil Chemists Society or from producer/user test data to be accumulated from commercial shipments of these oils and their derivatives.

Subcommittee D01.33 Polymers and Resins

J.G. Lamberton, Chair

Review of Ballots—Twenty-three standards were balloted for reapproval and were reapproved. There was one editorial comment and one negative; however the negative was received after the deadline. The negative was from J. Reid, on D 4143, "Guide for Testing Latex Vehicles." Mr. Reid felt that density should be expressed as mass per unit volume, not weight. It was decided by consensus to treat the negative as an editorial comment and add "or mass" to the first sentence of paragraph 7. The other editorial comment was also adopted.

Standards Due for Review—The following standards are due: D 237, "Specification for Orange Shellac"; D 1650, "Test Method for Sampling and Testing Orange Shellac"; D 1979, "Test Method for Free Formaldehyde Content of Amino Resins"; D 2354, "Test Method for Minimum Film Formation Temperature of Emulsion Vehicles"; D 2456 "Test Method for Identification of Polyhydric Alcohols in Alkyd Resins"; D 2572 "Test Method for Isocyanate Groups in Urethane Materials and Polymers." It was moved, seconded, and passed unanimously to ballot the following standards for reapproval: D-0237, D-1979, D-2354, D-2572. It was moved, seconded, and passed unanimously to ballot D-1650 for withdrawal, on grounds that it is in need of development of a precision statement, and there is nobody to do the work.

R. Sherill, of McWhorter Technologies, agreed to head a task group to develop a precision statement for D 2456. The chair will determine if a ballot can be postponed in this case.

Review of Standards Requiring Changes or Review—D 1396, "Test Methods for Chemical Analysis of Polyvinyl Butyral"— this standard consists of three methods, all of which lack precision statements. L. Black, of Union Carbide, will seek a volunteer from her company to work on this standard. D 4758, "Test Method for Non-Volatile Content of Latexes"—J.J. Brezinski will be asked to review this standard. D 1652, "Test Method for Epoxy Content of Epoxy Resins"—a letter was received pointing out a decimal error in paragraph 15.1.2, which apparently originated from a printer's error a few years ago. It was moved, seconded, and passed unanimously to ballot the standard to correct the error. D 1469, "Test Method for Total Resin Acids of Coating Vehicles," and D 1542, "Test Method for Qualitative Detection of Resin in Varnishes"—chair will seek a steward for these two standards, or ballot to have them removed.

Proposal to Restructure—Chair will send J. Weaver's proposal for reorganization of task groups to D01.33 for comment.

Proposal for New Standard—A new standard method for VOC in latexes is being completed by the Emulsion Polymer Council. L. Mink or L. Linder, of Rohm & Haas, will chair D01.33.26 at the next meeting, to introduce this standard to ASTM. ISO/TC 35 is working on a similar standard (involves headspace GC).

Other Business—In D 5910, "Test Method for Determination of Free Formaldehyde in Emulsion Polymers by Liquid Chromatography," a column referred to has become unavailable. Standard will be edited to specify the generic equivalent. B. Freeze, of Georgia Pacific Resins, has agreed to review and update the standards involving phenolic resins.

Subcommittee D01.34
Naval Stores
J. Russell, Chair

D01.34.01—Capillary Gas Chromatography of Rosin and Fatty Acids—W. Trainor, Chair, announced that the text of this new method had been edited and published as D 5974-96.

D01.34.05—Softening Point of Rosin and Rosin Derivatives—P. Zawislak, Chair, reported on the status of the text of the Mettler Cup & Ball method for measuring softening point of rosin and rosin derivatives. This new method had been included in the last D-l ballot and had received one negative vote. This negative vote was received from M. Sherratt and included nine parts. The key negative vote pertained to the inclusion of a trade name (Mettler) in the title of the method.

A motion was made by P. Zawislak to find this negative vote not persuasive and the motion was seconded by A. Kravetz. After detailed discussion the motion was approved by unanimous vote. A motion was then made by J. Daust that the remaining eight parts of the negative vote be considered as one unit and collectively found not persuasive. This motion was seconded by P. Zawislak. Each of the eight parts of the negative vote was discussed and, although most of the comments appeared to have merit, none of them was sufficiently serious to warrant a negative vote. After the discussion, D01.34 voted on the motion and it was approved by a vote of seven in favor, one against, with two abstentions.

D01.34.06—Color Measurement of Rosin and Fatty Acids—W. Mark, Chair, reported that this new method had been the subject of a D01.34 ballot in late 1996 and had been approved with no negative votes. Two affirmative with comment votes had been cast, one from M. Sherratt and one from J. Bryson. These comments were all discussed and several of the comments were felt to be sufficiently relevant that they would be reconsidered the next time this method is revised. The method will be included in the next D-l ballot.

D01.34.7—Capillary GC of Turpentine—W. Trainor, Chair, reported that prior to the meeting the text of this new method had been sent to some GC experts for comment. Some of the suggestions had been incorporated into the latest text and others were discussed by the committee. It was agreed that a round-robin would be carried out on this new method. Samples of turpentine, dipentene and pine oil would be distributed prior to the June meeting. The experimental work would be done in July and August and the results sent to W. Trainor no later than the end of August. The results will then be discussed at the October meeting.

D01.34.08—Analysis of Naval Stores Products by Near Infra Red Measurements—R. DePriest, Chair, introduced representatives of three companies that offer near IR instruments. Each made presentations indicating applications in the naval stores industry. It was apparent from these and earlier presentations that near infra red measurements have great potential for applications in the naval stores industry. The discussion during the D01.34 meeting centered on whether test methods based on near infra red measurements could be developed. In general, it was concluded that as near infra red measurements are only secondary measurements, they do not lend themselves to the development of standard methods. The measurements need to be correlated with the results obtained by existing standard methods and cannot replace those existing methods.

Other D01.34—Activities—J. Russell, Chair, reported on the developments of closer cooperation with ISO/TC 35/SC 10. He reported that since our October meeting he had corresponded with B. Reinmüller, Secretary of SC 10, regarding closer cooperation between D01.34 and ISO/TC 35/SC 10. It had been agreed that probably the most effective approach would be to establish a working group in SC 10 with responsibility for naval stores test methods. It was agreed that the chair would invite European and other international industrial representatives to attend an inaugural meeting to discuss the interest in forming such a working group and what the scope and operation of such a working group might be. This meeting would be held as part of the next TC 35/SC 10 meeting in Milan in June. In other activities some 10 current methods were reviewed in detail and will be submitted for balloting during 1997.

Subcommittee D01.35
Solvents, Plasticizers, and Chemical Intermediates
R.G. Montemayor, Chair

D01.35.10—Hydrocarbon Solvents and Ketones—S.A. Yuhas and R.L. Hinrichs, Co-Chairs the subcommittee, is up-to-date and on schedule with the review/reapproval of the 24 standards for which it is responsible. (1) Four standards passed D-1 ballot with no negatives or comments. These are: D 1353, "Nonvolatile Content of Volatile Solvents," D 1720, "Dilution Ratio of Active Solvents and Diluents," D 2916, "Specification for Isophorone," and D 3735, "Specification for VM&P Naphthas." (2) Two revised standards and one new standard were approved at the D01.35 ballot with no negatives: (a) D 3257, "Aromatics in Mineral Spirits by GC," a capillary GC method was incorporated in the method. J. Lamberton brought to the attention of the task group that the current and revised ASTM policy regarding supplier listing would probably prohibit the helpful and useful reference to Chromosorb P and the manufacturer in Table 2 and in footnote 6. It was decided to leave the wording as it is in the present published ASTM text. (b) D 3735, "Specification for VM&P Naphtha." Two comments were received. P. Hudson suggested that the KB value of Type III be lowered from 38 to 32. J. Lamberton suggested that the dry point of Types I, III, and IV be lowered from 310°F to 290°F max for air quality concerns. He also suggested that minimum and maximum limits be set for KB value. It was decided that since the new revised D 3735 has already passed D-1 ballot, these comments/suggestions will be given more careful consideration at the next revision/reapproval cycle. (c) D XXXX, "New Method for Trace Benzene in Hydrocarbon Solvents by Capillary GC." J. Dewitt, of Eastman Chemicals, and J. Lamberton expressed comments requesting clarification of the units "vppm" in the method. This will be done editorially by adding in parenthesis "(parts per million by volume)". (3) Three standards were reviewed and will appear in the D-1 and/or D01.35 ballots: (a) D 740, "Specification for Methyl Ethyl Ketone" will be balloted for reapproval by concurrent D-1 and D01.35 ballots. (b) D 1133, "Kauri-Butanol Value of Hydrocarbon Solvents." A note will be added to Section 5.5 which describes the print specimen to be used in the test. The note will indicate that "the text in this published standard is satisfactory." In addition, "solvency power" will be added to the Keywords section. (c) D 2804, "Purity of Methyl Ethyl Ketone by GC" was reviewed. After much discussion concerning ASTM's current/new revised policy regarding listing of suppliers and brand names, it was decided to revise Table 1 and use generic column packing materials and remove specific brand names of columns and suppliers information in the footnotes that followed the table. However, it was unanimously decided that such column identities are critical information, especially to chromatographers. Hence a revision will be made to Section 5 on Apparatus stating that in the interlaboratory study done to generate the precision of the method, references to the specific columns used will be made. No supplier information will be given. (4) Two standards were assigned for review for the next meeting: D 1153 and D 1363. (5) I. S. Rhee, of the U.S. Army, reported on the results of recent field tests (candidate P-D-680 mineral solvents at Army and Air Force locations). Solvency power of odorless mineral spirits in terpene (limonene) were found to be acceptable in the field. Although I. S. Rhee originally asked the task group to develop a D-limonene specification, he is now asking for a specification for blends of D-limonene and odorless hydrocarbon solvents. The task group discussed the impracticality of doing this due to the varieties of limonene products, hydrocarbon solvents, and blend proportions. The task group will continue to develop a solvent-grade D-limonene specification. (6) A proposed new specification for D-limonene was drafted and circulated. The task group decided on specifying D-limonene instead of a racemic mixture. It will be designated as "Solvent Grade D-Limonene." It was suggested that an optical rotation value and a purity by GC should be included in the specification. The latter may be adapted from a GC method for pinene. A check of ASTM methods will be made. (7) The development of a capillary GC method for MAK/MIAK purity is put on hold. R. Montemayor will draft R. Bartram's latest GC procedure in ASTM format and circulate for review. (8) P. Krieger of Shell requested that the bromine number limit for D 235 be raised to include Shell's odorless mineral spirits which contains up to 3.5% olefins. He will provide the task group with bromine number data on Shell's OMS before the next meeting in June 1997. (9) A reply to a concern made by the Argentina Standards Organization regarding the n-hexane and benzene content on hexane solvents were discussed. (10) A request was received from P. Bevilacqua, of the Naval Air Warfare Center, to add specifications on chlorine content, phenol content, and non-volatile residue to D 235 which are now part of P-D-680. He also requested another type of mineral spirits to be added to D 235—a high flash (142°F min) odorless mineral spirits. These requests were tabled for a future meeting.

D01.35.20—Reactive Monomers—J. E. Frugé, Chair. There are no standards under the responsibility of this task group that are overdue. There were no standards at the D-1 or D01.35 ballots. (1) Four standards were reviewed and will be submitted for D01.35 and/or D-1 ballots: (a) D 1290 "Specification for Vinyl Acetate." J. Morrison reported that the specification limits were not close to the product currently on the market, and that the current test methods cited were not sensitive enough to measure the current commercial limits. He will revise the limits to the capability of the current test methods and work will begin on new methods capable of measuring the commercial specification levels. (b) D 2191 "Acetaldehyde Content of Vinyl Acetate." This standard will be balloted with a revision to the bias statement and some minor editorial changes. (c) D 2193 "Hydroquinone in Vinyl Acetate." This standard will be balloted with a revision to the bias statement and some minor editorial changes. (d) D 3125 "Monomethyl Ether of Hydroquinone." This standard will be balloted with a revision to the bias statement and a deletion of suppliers information as required by the new ASTM policy. (2) Four standards were assigned for review: D 2194, D 2378, D 2379, and D 2380. (3) A request was received from P. Barnard, of Quantum Chemicals, to make some modifications to D 2086, "Acidity in Vinyl Acetate" regarding the use of different titrant concentrations. J. Morrison will summarize the results of additional tests and proposed modification to the method. Union Carbide and Quantum Chemical's results will be submitted to ASTM in the form of a Research Report. (4) Two standards previously reviewed will be submitted for D01.35 ballots: D 1078 and D 2087.

D01.35.30—Chemical Intermediates—J. Morrison, Chair. All Standards under the responsibility of this task group are up-to-date and on schedule for review. There were no standards in the D01.35 and D-l ballots. (1) There were four standards reviewed and will be submitted for D01.35 and/or D-l ballots: (a) D 330, "Specification for 2-Butoxyethanol," for reapproval with no changes; (b) D 1152, "Specification for Methanol," revised to make the odor requirement optional and the hazard section eliminated; (c) D 1257, "Specification for High-Gravity Glycerin," for reapproval with no changes; (d) D 2627, "Specification for Diacetone Alcohol," revised to lower the IBP from 145°C to 135°C and the odor requirement to be made optional. (2) The following standards were assigned for review: D 600, D 2693, D 3128, D 4837, and D 5008. (3) A gas chromatographic method for determining formic acid in acetic acid had been forwarded to the Methods Development Task Group. No progress has been made since the D01.35.30 chair has resigned. R. Montemayor will explore the possibility of drafting the proposed method into ASTM format and submitted for review.

D01.35.40—Plasticizers and Ester Solvents—J.E. Lawniczak, Chair. All Standards are up-to-date and on schedule for review. No negatives were received on any of the balloted items for this task group. There were no standards in the D01.35 or D-1 ballots. (1) Six standards will be balloted at the D01.35 level: (a) D 1209, "Color of Clear Liquids." There will be two ballot items regarding this standard. One ballot item will be a concurrent D01.35 and D-1 ballot on Section

6 to incorporate a statement regarding the commercial availability of color stock solution. A second ballot item will be a revision to Section 9 to incorporate changes to the precision statement. (b) D 1721, "Permanganate Time of TCP." The bias statement will be updated. (c) D 2634, "Specification of Methyl Amyl Acetate" will be balloted for reapproval. (d) D 3131, "Specification Isopropyl Acetate." The distillation range will be made optional because the GC purity requirement provides equivalent purity information. (e) D 3728, "Specification for 2-Ethoxyethyl Acetate." The odor requirement will be deleted because of marginal benefit of odor testing. The distillation range is not needed and will be deleted. (f) D 4773, "Purity of PM, DPM, and PMA by GC." This standard will be balloted for reapproval with no changes.

D01.35.50—Coordination—L. Forrest, Chair. D-1: D 1310, "Flash Point and Fire Points by TAG Open Cup Apparatus" received several negatives on the ballot for its withdrawal with no replacement. The negatives were considered persuasive and this standard will be reballoted for reapproval with no change. D-2: D 86 was balloted at the D02.08 level. A substantial number of negatives were received due to a general opposition to a metric only standard as well as other technical concerns. The standard will be redrafted and submitted for D01.35 balloting. D 56 and D 93 were balloted at the D01.35 level together with other flash point standards. The revision included new Apparatus Verification Section which incorporate verification fluids acceptability tolerances. A number of negatives were received but all were resolved. These standards will move on to D-2 ballot. A report was received from the IP on the modified D 93A and D 93B procedures for residual fuels. D16: D 841 was revised to removed requirements for acidity, relative density, density, and sulfur dioxide and hydrogen sulfide, because all benzene manufactured routinely meets these specifications. D 848 "Acid Wash Color": discussion was conducted on the interpretation of "pass with 2 or other number". Some thought that a 2+ would wound to 2 and pass while other thought that a 2+ would fail. After careful reading of the standard, it was interpreted that anything darker than 2, i.e. 2+, is a fail result. D 853 was balloted for withdrawal with no replacement. It was considered obsolete due to the availability of more sulfur detection method. D-16 passed a motion at the June 1996 meeting to combine D 1555 and D 1555M. However, a January 1997 agenda contains the findings that combining the standards could lead to confusion in the American and European market. E 12 was withdrawn and replaced by E 1547. E 180 will be reviewed for potential improvements. E 200 will be reviewed for changes regarding titrations and matrix effects. E 299 was withdrawn with no replacement.

D01.35.60—Method Development—Chair vacant; R. G. Montemayor presided over the task group meeting. He reported that he has written to various chromatographic supply organizations soliciting their interest and participation in D01.35 by providing someone from their organization. He is still awaiting any response. He suggested that in order to move along with the identified methods under development, he will take the methods as submitted and put them into ASTM format for review and balloting. Specifically, he referred to the GC method for formic acid in glacial acetic acid, submitted by Hoechst Celanese and the MAK/MIAK capillary method submitted by Eastman Chemicals and previously evaluated by Supelco. The repeatability data obtained by Hoecsht Celanese and Supelco will be used in the drafted new method. He expressed hope that within five years of having these new methods adopted that there will be sufficient number of laboratories who can participate in an interlaboratory study for reproducibility values to be obtained.

D01.35 wishes to welcome three new members: P. J. Krieger, of Shell U.S.A., M. Setzer, of Quality Analytical, and J. Massingill, of Eastern Michigan University. J. LeBeau, P. Hudson and J. Fulmer have resigned. It was with regret that the news that Zatis Murphy passed away was received. A moment of silence was observed in his honor. D01.35 is still soliciting the interest of any member to become secretary of D01.35 or chair of D01.35.60.

Subcommittee D01.36 Cellulose and Cellulose Derivatives

G.Y. Moore, Chair

All standards administered by D01.36 are current with no ballot actions necessary in 1997. The following standards were approved on the D01 (96-03) ballot: D 817, "Methods of Testing Cellulose Acetate Propionate and Cellulose Acetate Butyrate"; D 871, "Methods of Testing Cellulose Acetate"; D 1695, "Terminology of Cellulose and Cellulose Derivatives"; and D 1795, "Test Method for Intrinsic Viscosity of Cellulose."

Even though they are not yet due for review, G. Moore indicated that he had found some necessary changes in the following two standards: D 1439, "Methods for Testing Sodium Carboxymethylcellulose" and D 3876, "Test Method for Methoxyl and Hydroxypropyl Substitution in Cellulose Ether Products by Gas Chromatography." He will have revisions ready for review at the next meeting in June in Toronto.

J. Morton has submitted a third draft for a proposed "Test Method for Viscosity of Cellulose by Cuprammonium Ball Fall." L. Gutman reviewed the draft and it has been returned to J. Morton for what are expected to be final revisions before D01.36 ballot. B. Reinmüller from DIN has been working on an ISO/TC 35/SC 10 method for viscosity of industrial cellulose nitrate solutions. He was interested in having U.S. manufacturers participate in preparing the document. G. Moore will send the document to U.S. manufacturers for comment. G. Moore had noted that in the scope section of several methods the sections were numbered incorrectly. L. Gutman stated these could be corrected editorially if someone would send her the list. G. Moore agreed to do so. G. Moore reported that the stewards list for all D01.36 standards has been updated and given to ASTM staff (S. Orthey).

Subcommittee D01.37 Ink Vehicles

A.N. Scarlatti, Chair

D01.37.06—Pigment Dispersability—M. Fuchs, Chair. A second pass rewrite of the method entitled "Standard Practice for the Evaluation of Vehicles for Pigment Wetting by Flushing Using a Sigma Blade Mixer" was reviewed. Suggested changes will be incorporated and an updated version will be circulated to D01.37. Members are asked to send comments to M. Fuchs prior to our next meeting.

D01.37.07—Resin/Solvent Compatibility—D. Frisch, Chair. D 6038 "Method for Determining the Compatibility of Resin/Solvent Mixtures by Precipitation Temperature" has been completed and will appear in the next publication of Volume 06.03. P. Zawislak forwarded a copy of an automated cloud point test method. This method is widely used in Europe and is based on the Chemotronic unit manufactured by Novocontrol GmbH. Repeatability and reproducibility of the automatic test is slightly better than the manual one just developed (D 6038). After discussion on the value of a test method based on a test instrument which is not widely used in the U.S., D01.37 voted to table further consideration until a need was identified for an automated cloud point test.

D01.37.08—New Membership—D. Frisch, Chair. A. Scarlatti requested that

D01.37 members submit a brief personal profile to D. Frisch by February 10. He would like to publish these profiles in *American Inkmaker* or *Ink World* as a way to promote the quality of the membership that exists in D01.37 and to encourage subcommittee growth. D. Frisch gave an overview of D01.37 activities to the recent NAPIM Technical Conference and asked interested parties to contact him.

D01.37.09—Alkyd Compatibility—J. Zerkel, Chair. In his absence, J. Daust presented a revision of the method. Since D01.37 had no opportunity to review it prior to the meeting, copies will be circulated to the members and they are asked to send comments to Jim Zerkel by April 1. It was agreed that the scope should be broadened to encompass liquid resins as well as alkyd compatibility. Suggested new title is "Standard Test Method for Alkyd and Liquid Resin Compatibility of Ink Resins by Direct Cut Method." Those interested in participation in a round-robin of this method were asked to submit names to J. Daust.

D01.37.10—Rheology of Ink Vehicles—D. Weisel, Chair. A new standard entitled "Test Method for Viscosity and Yield of Vehicles and Varnishes by the Automated Rising Collar Viscometer" was submitted for D01.37 consideration. This method was developed for the Duke automated high shear rod and collar viscometer. D01.37 members who have this unit in their labs are asked to submit comments to D. Weisel by February 15. A preliminary round-robin will be conducted to evaluate test method with a Newtonian standard and a gelled varnish.

J. Daust noted that the falling rod (D 4040) and the rising collar viscometers are preferred for high shear measurements but that there were no methods covering low shear oscillatory techniques. D01.37 agreed that we should begin to examine these more sophisticated methods and that a good place to start would be by defining some of the standard terminology used in the area. D. Weisel agreed to pull together a list of important terms and definitions for review at our next meeting.

D01.37—Ink Vehicles—A. Scarlatti, Chair. Many questions were raised about the revision of D 5062. Major ones focused on D01.37's desire to expand the method to include a volumetric determination of dilutability. To address these questions, it was decided to reopen D01.37.02 on Resin Dilutability. J. Daust agreed to serve as leader.

D 5166-91, "Practice for the Laboratory Preparation of Gelled Vehicle Samples Using a Microwave Oven" is up for review. A. Scarlatti agreed to review the method for possible revision/reapproval without change.

D. Aynessazian, Kustom Blending, drafted a letter on behalf of D01.37 and D01.56 on Printing Inks requesting the Committee on Standards reconsider its policy on listing sources of supply in the standard. COS, in its reply, spelled out three criteria to be applied for exemptions: (1) there is no performance based specifications or other materials that could be written or referenced to describe the apparatus; (2) the information for procurement of this apparatus is not obtainable using current information sources; and (3) there are special issues that call for the listing of suppliers because there are no other reasonable mechanisms/or users to find this information.

Subcommittee D01.38 Hydrocarbon Resins

A. Kravetz, Chair

[The following minutes are from the October 10, 1996 meetings]

D01.38.01—Terminology—J. Silcox, Chair, submitted a revised draft list of terms and definitions. D01.38 members are to rank these terms as: A (needed), B (can include), or C (omit), and send to him.

D01.38.01—Softening Point—P. Zawislak, Chair, asked members to send her any additional data they have on the effect of sample preparation on the softening point of hydrocarbon resins. It is intended that a new softening point method for hydrocarbon resins will give less scatter between laboratories than does E 28. A round-robin study is needed on hydrocarbon resins in the 80-100°C region.

An effort will be made to develop a general method (heating rate) for getting the Mettler softening points of hydrocarbon resins to agree with ring and ball softening points. This is desired because the interlaboratory agreement of Mettler values has been good, and a liquid heating bath is not needed.

It is planned to move the appendix "Preparation of Sample by the Powder Method" from method E 28 to the hydrocarbon softening point method. However, the only known uses of the powder method are for gilsonites and some phenolic resins. Gilsonites could be regarded as either hydrocarbon resins or bitumens. R. Janike of D08.03 (in charge of D 36 "Softening Point of Bitumen") is willing to put this appendix onto D 36, if this would be more appropriate.

D01.38.03—Color determination—A. Kravetz (substituting for R. Allen, Chair) noted that Mr. Allen had sent several recommendations for an instrumental method for determining the color of light-colored resins. D01.38 decided that a less-stringent method (based on the new E 313 yellowness index) would be preferred for resins with solution E 313 yellowness index values above about 5 and solution Gardner colors below 2. This method will use a 2 degree observer and illuminant C. Any instrument that gives acceptable agreement with the results of a round-robin study would be accepted. At least one NIST-referenced transmission light-amber color standard will be needed to comply with ISO 9000 certification and to standardize colorimeters. Solutions for color determination can be made at a 50/50 wt% in toluene, or at the equivalent wt/vol concentration in another solvent (e.g., xylene). The solution must be filtered if cloudy. A solvent blank will be required only for referee determinations. Liquid resins can be run neat.

D01.38.04—Compatibility—L. Graves, Chair, reported that Testprint has an instrument that determines precipitation temperature for resins used in printing inks. Testprint is working with Exxon and Hercules to modify this unit and procedure to determine cloud points of hydrocarbon resins.

D01.38.05—Viscosity—P. Zawislak, Chair, had sent out copies of a draft method for viscosity determination with a Brookfield Thermosel. Comments on this method are to be sent to Ms. Zawislak.

D01.38.06—Stability—L. Graves agreed to chair this task group. It was agreed that oven-aged color and weight loss would be dealt with first. The Exxon oven-aging test was described. Other companies were requested to send their resin aging methods to Mr. Graves.

D01.83.07—New Instrumental Test Methods—W. Trainor, Chair, asked for suggested methods. The computational method for determining T_g needs to be agreed on. Molecular weight by GPC is also of interest to tackifier users; a standard practice for running this determination on hydrocarbon resins is needed. Ms. Zawislak will gather information for developing a draft standard practice.

D01.38—A. Kravetz, Chair discussed plans to publicize the activities of D01.38. The next meeting will be January 26 and 28, at the D-1 meeting in Ft. Lauderdale.

[The following minutes are from the January 1997 meetings]

D01.38.01—Terminology—J. Silcox, Chair, distributed an updated draft list of terms and definitions, for discussion.

D01.38.02—Softening Point—P. Zawislak, Chair, asked that anyone having information on the effects of test variables on ring-and-ball softening point precision share them at the next meeting. Hydrocarbon resin softening point standards are needed (about 1 kg per laboratory, preferably of a hydrogenated resin). L. Graves will ask Exxon if they would be willing to provide and support such standards. A Mettler softening point instrument was demonstrated.

D01.38.03—Color Determination—R. Allen, Chair, asked for comments. At the last meeting, it was agreed that for resins with solution E 313-96 yellowness index values of about 5 to about 20 (the approximate equivalent of Gardner 2), a method based on these yellowness index values would be recommended for external reporting. Other color values could be reported where needed. A path length of about 10 mm, and a repeatability standard deviation of 2 YI units seem adequate for such resins. For resins with lower colors, a more exacting method might be preferred by tackifier users. A draft method for color determination will be drawn up.

D01.38.04—Compatibility—L. Graves, Chair, noted that Testprint has an instrument (the Chemotronic) that determines the precipitation temperature of a 10% solution of a resin in an oil. For hydrocarbon resins, a special oil (Estisol) has been developed. Testprint is working with Exxon and Hercules to optimize the test conditions, so that precipitation temperature values can be correlated with those from (for example) EVA/wax cloud point values.

D01.38.05—Viscosity—P. Zawislak, Chair, led a discussion of a draft viscosity method for molten hydrocarbon resins. Since at least one equivalent instrument is available, "Brookfield" will be replaced with "rotational," and "Thermosel" will be replaced with a more generic term.

D01.38.06—Stability—L. Graves, Chair, distributed copies of an Exxon test method for solid resins. Resin samples (10.0 g) are weighted into 8-oz jars, and the jars set in holes in a metal block. After five hours at 175°C, 10.0 g of toluene is added to prepare a sample for determination of aged color. Hercules runs 24 hours at 175°C, and Eastman runs 24 hours and 72 hours at 177°C.

D01.38.07—New Instrumental Test Methods—W. Trainor, Chair, noted that a standard practice is needed for determination of the T_g of hydrocarbon resins, using DSC. P. Zawislak distributed copies of a general method for determination of T_g (D 3418). A draft standard practice will be written.

Molecular weight of hydrocarbon resins is also of interest to resin users. Method D 5296 has a low molecular weight cutoff of 2000, so a standard practice is needed for a range of 400-20,000. A second standard practice for a range of 400-100,000 was also requested, for resins with high polydispersities. Draft standard practices will be written.

D01.38—A. Kravetz, Chair, discussed plans to publicize the activities of D01.38. The next meeting will be June 23 & 25 in Toronto (with the rest of Dl). A September meeting is tentatively planned for Longview, TX.

DIVISION 40 PAINT PRODUCTS APPLIED ON SITE

Subcommittee D01.42 Architectural Finishes

A. A. Leman, Chair

D01.42.03—Porosity of Paint Films—C. Tatman, Chair, reviewed the current draft of the "Standard Test Method for Porosity of Paint Films." On completion of the following, the task group chair will submit the method for D01.42 ballot. (1) Modify the definition of porosity as it pertains to this method; the present technique is used to determine the presence of minute non-encapsulated voids. (2) Investigate the affect of mineral oil application and removal on ultra-high PVC latex flat paint films (80 PVC) and modify the procedure, if necessary. (3) Review the formula for the calculations of porosity and modify if needed.

D01.42.04—Wet Adhesion of Latex Paints—L. Mullen Chair, reviewed the methodology and preliminary results for the recent round-robin. With four of the seven cooperators reporting, initial results indicate consistent trends. A discrepancy in early wet adhesion results, between four hours and 24 hours, was resolved. Statistical analysis will be completed by the June meeting. The size of the crosshatch array will be reviewed per feedback from the cooperators, as well as the necessity for the 1000 cycle run time. Editorial changes to the method itself will include a modification to allow varied soak times as agreed upon by participating parties and wording to more generically describe a suitable alkyd paint for the substrate.

D01.42.05—Adhesion of Latex Paints to Chalky Surfaces—A. Leman, Chair, reviewed the test results from the round-robin evaluation. Five laboratories participated as cooperators in the evaluation. Four test paints were evaluated over a naturally weathered chalky latex paint substrate. Two methods of dry adhesion and three methods of wet adhesion were used to evaluate the test paints. The results from the round-robin were inconclusive to establishing a precision and bias statement for the proposed test method. The reasons for this are attributed to: problems with the stability of two of the test paints, the lack of a severe chalked surface supplied to run the experiment, and not enough cooperators to factor out any one set of discrepant test results. The recommendations of the chair and the consensus of the task group was to repeat the round-robin evaluation. This repeat experiment will be redesigned to include more cooperators, use two different types of chalky substrates which include, substrates with a lower ASTM chalk rating, and stable test paints.

D01.42.20—Water Repellency of Wood—L. Gibson, acting Chair, distributed the current method, D 4446, for the discussion. Test conditions specified are 80°F and 65% RH, and a round-robin was conducted to determine feasibility of including alternate conditions of 73.5°F and 50% RH. Test material was 5% paraffin in mineral spirits, and was provided by the chair. Four cooperators submitted data collected at the two conditions mentioned. There was little enough variation in the results from the two conditions for the task group to conclude that pursuing this course is useful. The alternate condition of 73.5°F and 50% RH will enable more laboratories to perform the test without the purchase of an additional chamber. The task group decided to perform another round-robin with various materials supplied by the cooperators, and will include a solvent-based clear water repellant, a water-based clear water repellant, and a solvent-based semitransparent stain. Test wafers, materials, and procedures will be distributed by the task group chair, and results discussed at the next meeting. Also, it was decided to remove the word "preservative" from Section 1.1, as water repellents are not necessarily preservatives. It was suggested by H. Ashton that water be specified in the method as "reagent water."

D01.42.22—Guides for Testing Architectural Coatings—H. Ashton, Chair, reported that the first revision to D 1546 had passed society review and has been published as D 1546-96. He also circulated a figure, based on the suggestion of A. Leathers, to clarify the arrangement for coating the test panels. The ad hoc group concerned with points that still need resolving, had received a mini-ballot, but only one member had replied at the time of the meeting. The other two will be contacted shortly. The chair reported that D 1641 had been revised as agreed at the June meeting, except for the replacement of MIL-V-16399 by TT-V-119 for use in preparing the aluminum pigmented sealer and also as an unpigmented exposure content. The revision had been submitted for D01.42 ballot as two items. However, they were moved to D-1 ballot and, unfortunately, the figure that illustrated the reason for adopting TT-V-119 had been omitted. The chair said that in his natural and accelerated weathering tests, the durability on red cedar peaked with an oil control in the nonvolatile of about 65%. The lower content of 50% straight tung oil gave poorer performance than with 65 and 75% oil variations. It was also agreed to delete the obsolete term "oil-length," not only because of decreased usage but also owing to the difference between U.S. and Imperial gallons. The proposal to include CGSB Marine Varnish 1.99-92 as an "agreed material of known performance" in the event of TT-V-119 becoming unavailable was discussed. The chair said he would supply L. Gutman with the source of the standard and would consult with CGSB on the availability of a qualified product (*The revised paragraph 3.5 will be submitted to D-1 ballot in time to be included with the main part of the practice). With regard to D01.42 (94-05) and D01.42 (94-06) ballots with closing dates of January 30 and 31, 1995, the results are still lost. Consequently, the revision to D 3730, D 5146 ,and D 5324 will again be sent to D01.42 ballot with a few additions to make the three guides more similar, if appropriate. At the D01.42 meeting the D01.42.22 chair suggested that inclusion of CGSB 1.99-92 not be included on the next ballot. Prior to the June meeting he will confirm the availability of the product.

D01.42.25—Scrub Resistance of Latex Paints—T. Sliva, Chair, distributed copies of the latest revision to D 2486, which incorporated instructions on storing of the test brush and other changes. The Chair then distributed Draft No. 2 of the next proposed revision to D 2486. This revision will include a method for running scrub resistance on two paints, a test and reference paint, simultaneously. The group reviewed the document and suggested the following: (1) expand Significance and Use section to specify the advantages of Method B; (2) clarify section on leveling of brush bristles; (3) revise section on brush holder to accommodate new washability testers. It was the decision of the task group to run a round-robin using the proposed Method B of D 2486. Five cooperators have agreed to participate. The chair will revise the document incorporating suggestions received at the task group meeting and report the results of the round-robin at the June meeting.

D01.42.28—Paint and Coating Removers—L. Gibson, Chair, distributed copies of the current draft for review. No changes were made to the method. Several editorial changes were made, and included revising the word "rank" to "rate" as it is possible to test only one product. Also, the title "Efficiency of Chemical Coating Removers for Clear or Pigmented Coatings" was shortened to "Efficiency of Chemical Removers for Organic Coatings," since the former was thought to be redundant. Panel preparation will defer to manufacturer's recommendations for application. The editorial changes will be made and reballoted before the next D01.42 meeting.

D01.42.29—Guide to Testing Exterior Wood Stains—A. Leathers, Chair, will be receiving the status of the D16 ballot on definitions from ASTM before the next meeting. Revision 2 of the guide was distributed. Two tannin stain resistance test methods were also distributed. The group recognized the need for a task group to finalize a new test method to test tannin stain resistance. Volunteers were sought to write remaining sections of the guide. The chair will contact these authors prior to the June 1997 meeting. The guide will also be sent to outside reviewers for their comments. Modifications to the guide with regards to order of sections will be made to be consistent with changes to other guides. Revision 3 will include new sections and appropriate outline modifications. Revision 3 will be distributed prior to or at the June 1997 meeting.

D01.42.30—Wet Edge Time of Latex Paints—J. Cogar, Chair, discussed test parameters with the task group. The initial procedure will use a sealed chart as the substrate. The round- robin will include both drawdown and brush application of the initial painted area. Work will be done before the June meeting to determine the film thickness and the appropriate number of brush strokes for the test sections. A circular dry time test will be included in the round-robin to determine if any of the dry times correlate with wet-edge. The initial procedure(s) will be written for the June meeting and round-robin cooperators will be identified at that time.

D01.42.33—Scrub Resistance by Abrasion Weight Loss—L. Schaeffer thanked H. Ashton for acting a pro-tem chair in his absence last June. Copies of D 4213-96, Scrub Resistance by Abrasion Weight Loss were circulated, showing proposed additional revisions for balloting. The most important change was to add a statement to the section on Significance and Use as follows: "The use of calibration panels is most relevant for interlaboratory comparisons." Other technical changes included a more detailed description of the test substrate and a correction to the description of the sponge employed in the scrubbing procedure. The proposed revisions were debated vigorously to obtain as much consensus as possible before submission to subcommittee letter ballot. H. Ashton reported that his recalculation on the basis of the 95% confidence level, of the precision statement in D 2486-95, showed intralaboratory and interlaboratory maximum acceptance difference (M.A.D.) values of approximately 30 and 58% respectively, as compared with 13 and 20% for the current version of D 4213.

D01.42—Architectural Finishes—The new Chair, A. Leman, stated that he will review member status at the June meeting. The chair asked each task group chair how long they needed for the June meeting. Each chair responded. The Color Development of Latex Paints meeting was canceled and will be taken off the June 1997 schedule. The chair brought up the new policy regarding the referencing of equipment in standards. He noticed that this policy gets confusing when it comes up in task group meetings. He thought the policy had been revised and will get the details from S. Orthey. A. Leathers mentioned that in other subcommittee task group meetings, they are referencing the equipment they used for the round-robin in the precision statement. J. Weaver suggested disregarding the policy. The chair expressed an interest in having a planning meeting in June to review which standards are due for revision as well as to review what types of task groups other subcommittees have formed. The meeting concluded with T. Sliva's suggestion to attend the symposium on Application Tools later that afternoon.

Subcommittee D01.45 Marine Coatings

R. Gangi, Chair

The first topics discussed at the meeting, chaired by R. Gangi, was the development of a standard for the rate of release of copper from an antifouling paint in sea water. Drafts were submitted by Case Consulting Labs and Courtaulds Coatings. Discussion ensued regarding their value, purpose, repeatability, analytical procedures and equipment sensitivity. Comments were made about the global interest for such a standard, and that British Standards and International Standards Organization (ISO) were also testing (round-robin) and preparing a similar standard. A decision on quantitative limits was not agreed upon nor were the analysis procedures. There are three possible methods of analysis: GFAAS, Flame AAS and ICP. In addition, there was little agreement on the sample testing procedures. C. Anthony was given the responsibility to work on a revised draft that can be submitted to all D01.45 members for comments.

In other actions, D 5063-90, "Certification of Coatings Conformance Form," was withdrawn. For new business, C. Perez reviewed a proposed procedure to determine the ease of fouling release from foul-release bottom paint compositions. Mr. Perez explained the procedure and the equipment operation. Discussion continued on the method, but no decisions were made to pursue. E. Haselbach commented on a control surface for such testing. She recommended C. Perez examine an FEP Teflon surface for control and will send a sample to C. Perez to evaluate.

It was also agreed to continue D01.45 meetings on a semi-annual basis.

Subcommittee D01.46 Industrial Protective Coatings

G. W. Gardner, Chair

D01.46.02—Surface Preparation—S.K. Boocock, Chair, reported that W.C. Johnson had completed the round-robin on D 4940, "Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives" using portable meters. W.C. Johnson is compiling the information and will provide a written report. S.K. Boocock will work with Mr. Johnson to determine the correlation coefficient between the pocket meter and the null point meter using the large number of data points available in published SSPC reports.

S.K. Boocock reported that D 4940 and ISO 11127-6 use different ratios of abrasive to water and that D 4940 uses volume measurement for both abrasive and water whereas 11127-6 uses weight measurement for abrasive and volume measurement for water. Therefore, it is not practical to provide a conversion factor from one to the other. S.K. Boocock will draft a note to be added to D 4940 that explains this difference. In addition, he will add conversion factor information for converting the μmho/cm used in D 4940 to millisiemens/metre used in 11127-6.

T. J. Langill has prepared a new "Standard Guide for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting." S.K. Boocock reviewed this excellent first draft with the task group and only minor changes were made. The task group debated the use of SI units without reaching consensus, but will default to current practice of using the SI units as the standard. A definition of "Zinc Ash" will be added to the guide along with a more complete description on the appearance of partially weathered galvanized steel and the appearance of weathered galvanized steel. J. Peters requested that the reference document section state which documents are mandatory. The task group agreed that this would be helpful, but mandatory documents varied with different uses of the guide. Additional thought will be given to this request. Suggested changes will be incorporated and sent to the task group prior to our June 1997 meeting.

D01.46.03—Repainting—G.W. Gardner, Chair, reported that R. K. Morrison (Chair of D01.20 on Quality Assurance and Statistics) indicated that the only way to incorporate the round-robin results on D 4752, "Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub," was to include the information in an appendix. ASTM does not have an approved statistical technique to determine precision of test methods involving ratings, rankings, categorization, and pass/fail assessment. However, Committee E-11 has started a program to determine the appropriate statistical method(s). Since this may require some time, B. Mysza has prepared an appendix to D 4752 that details information on the round-robin observations, raw data and scatter plots of the data. The task group reviewed this information and recommended submitting it to D01.46 ballot.

G.W. Gardner reviewed the background and strategy for D 0610, "Test Methods for Evaluating Degree of Rusting on Painted Steel Surfaces," pictorial standards. S. K. Boocock reported that SSPC member representatives have supported the concept of SSPC producing the photos with various rust dispersities. SSPC will produce various examples of rust grade dispersities, review them with appropriate SSPC membership and present them to our task group at the June 1997 meeting.

G.W. Gardner circulated two examples of machines that could possibly be used to run solvent rub tests in the laboratory. The task group will review various current test methods to determine if any current methods or modification on these methods could be used for mechanical solvent rub testing. Additional refinement to D 4752 and D 5402, "Practice for Assessing the Solvent Resistance of Organic Coatings using Solvent Rubs," will be postponed pending E-11's new statistics work.

D01.46.07—Inspection—G.W. Gardner reported that D 3276 "Guide for Painting Inspectors (Metal Substrates)" passed the D01 (96-03) ballot. D 3276 was approved in November 1996 and will be published in January 1997. Gardner commended L.M. Smith (D01.46.07 task group chair) and the task group for this excellent, extensive guide. Ballot comments by K.S. Spielman and F.S. Gelfant will be considered in future revisions of the guide.

G.W. Gardner reported that the new "Guide for Painting Inspectors (Concrete and Masonry Substrates)," received two negatives on the D01 (96-03) ballot. L.M. Smith, task group chair, discussed the negatives with the task group. The H. R. Stoner negative stated that section 11.3 was in conflict with D 4787, "Standard Practice for Continuity Verification of Liquid or Sheet Linings applied to Concrete Substrates," because D 4787 referred to non-conductive linings and 11.3 refers to "conductive membrane." However, the task group found H.R. Stoner not persuasive because D 4787 does refer to "conductive underlayment" in section 3.1.2. Item 2 of Stoner's negative pointed out that NACE RPO 188-88 had not been replaced with D 5162 as was done in D 3276. The task group found H.R. Stoner persuasive on this item and it is withdrawn from ballot. L. Smith will make correction and submit to D01 (97-02) concurrent D01.46/D-1 ballot. The C. T. Grimm negative recommended changing the words "caulk," "caulks" and "caulking" to "sealant." The task group found C.T. Grimm not persuasive because caulk is the generally accepted term in Industrial Protective Coatings. Item 2 of C.T. Grimm's negative recommended adding a statement "Do not paint over elastic sealant joints." The task group found Grimm not persuasive because this is an inspectors guide not an engineering or specification document.

D01.46.10—Condition Assessment—M. McKnight, Chair, reviewed a proposed revision to D 5043, "Standard Test Methods for Field Identification of Coatings," that had changes suggested by H.R. Stoner. After a lengthy discussion, the task group could not develop an acceptable revision to D 5043 and unanimously agreed to ballot to withdraw D 5043.

D01.46.12—Sampling—L. M. Smith, Chair, reviewed Draft #2 of the new "Standard practice for Sampling of Coating Films." The scope of this practice is to cover methods to remove samples of coating films for subsequent analysis related to identification of generic coating type and failure analysis or other reasons. The task group recommended a few changes to this practice and that it should be sent out for D01.46 ballot.

D01.46.13—Guide for Testing—J. T. Cheng, Chair, reviewed Draft #5 of the new "Standard Guide for Testing Industrial Protective Coatings." This guide covers the selection and use of test methods and procedures for testing industrial protective coatings. It references ASTM standards (two B's, 94 D's, one E and 11 G's), Federal Test Methods (11) and NACE Standards (1). It discusses: in-service conditions affecting coating performance, sampling and test conditions, liquid coating properties, application and film formation, appearance of dry film and performance evaluation. Table 1 of this guide contains a list of test methods by properties. The task group suggested a few changes. Additional information on slip resistance, transfer efficiency and chemical immersion will be supplied to J.T. Cheng by L. M. Smith, S. K. Boocock, and Y. Korbov, respectively. Task group members will provide J.T. Cheng with any additional comments/changes and the guide will be sent for D01.46 ballot.

D01.46.14—Chemical Immersion—S. K. Boocock, Chair, reviewed Draft #3 of the new "Standard Test Method for Immersion Resistance of Industrial Protective Linings." Draft #3 covers three methods of testing: (1) Method A. Evaluation of specimens under constant temperature and atmospheric pressure; (2) Method B. Evaluation of specimens under conditions of elevated temperatures with a temperature gradient across the sample; and (3) Method C. Evaluation of specimens under conditions of constant temperature and increased pressure.

The task group reviewed Draft #3 and suggested a few changes and additions. S.K. Boocock will incorporate these changes and send out for D01.46 ballot.

D01.46—G. W. Gardner, Chair, welcomed members and guests. Task group chairs reported on their meetings. H.R. Stoner voted negative on D-1 ballot (96-03) item 59 the new "Standard Guide for Painting Inspectors (Concrete and Masonry Substrates)." D01.46 upheld the task groups recommendation to find H.R. Stoner not persuasive on item 1 of his negative. D01.46 upheld the task groups recommendation to find C. T. Grimm not persuasive on both items of his negative on this guide.

R. Schwab presented a first draft on a new "Standard Test Method for Graffiti Resistance Coatings." This test method covers procedures for determining ease of graffiti removal and effect on coating appearance.

D01.46 reviewed briefly and suggested several changes. A more detailed review is planned at the next D01.46 meeting on June 24, 1997 in Toronto.

Items for D01 (97-01) ballot are due by February 21, 1997; for D01 (97-02) ballot by March 31, 1997. D01.46 ballots are due by February 7, 1997 to make the D01 (97-02) ballot and April 28, 1997 to be balloted by the June 1997 meeting.

Subcommittee D01.47 Masonry Treatments

E. McGettigan, Chair

D01.47.01—Water Repellency of Treated Masonry—L. Gibsoni, Chair, took V. Scarborough's place in her absence. The chair distributed copies of the current draft of the method "Evaluating Clear Water Repellents on Masonry Units." The last round-robin used masonry units cut into cubes and were thought to cause the variability in round-robin results. It was decided to use 1/4" by 3" by 6" panels for the second round-robin. This size also would provide a subsequent accelerated weathering option. Also, it was decided to coat all sides of the panels rather than leave one face uncoated. This will reduce the possibility of human error, and variability introduced with accidental contact with water. Also, it was decided to change "immerse in the test material" to "apply per manufacturers instructions." It was desired by those present to consider an alternate method of immersion, specifically the edge soak method as described in D 2065.

The second round-robin will be performed with four cooperators. One lab will treat all panels as necessary and distribute to cooperators. Panels will be tested per current draft of method and with alternative soak method as previously mentioned. Testing will be done in triplicate and results will be discussed at the next meeting.

D1.47.05—Water Vapor Transmission of Treated Masonry Substrates—D. Berg, Chair, replacing temporary Chair E. McGettigan. The group decided that water vapor transmission testing would model after E 96 method and may be applied to penetrating treatments as well as film formers. The group also agreed to the "wet method" variation of E 96 in which water is placed in the test cup and the desiccant on the outside. The new method will specify that the treated surface be placed face down on the cup where a standard surface area can be attained. In addition, difficult edge sealing is avoided. Results will be reported specifying substrate and coverage rate or mil thickness. The first round-robin will be done on C 109 prepared concrete panels obtained from the Masonry Test Block Company. In the method, a note will be added to "protect the substrate from airborne contamination." The round-robin testing and writing of the subsequent method will be organized by the new D01.47.05 Chair D. Berg.

D01.47.07—Alkali Resistance of Masonry Treatments—met in the absence of the Chair B. Bergland. The previous work on this method was reviewed to bring everyone up-to-date. The results on typical green concrete were the same as on concrete of different alkalinity. Most treatments that are not alkaline stable will fail after a 21-day soak in normal tap water or deionized water. E. McGettigan will contact B. Bergland to determine how the chair wants to proceed with the method. Discussion will continue at the next meeting.

D01.47.10—Evaluation of Field Applied Treatments—E. McGettigan, Chair, distributed a revised version (Draft #4) of the method. The procedures were identical to the last draft with a few additions. A section on evaluating the permeability of the sealing material and notes on acceptable sealing material were added. In addition, in the next draft, a note after section 8.6 will be added regarding recommendations on how to address chips or defects on the treated face of the specimen. In section 10, "reporting" a line will be added on the gross amount of water absorbed by each specimen and the unsealed area of the treated face in cm^2.

D01.47.11—Research and Planning—E. McGettigan, Chair, lead discussion on new task group opportunities. The procedure used in NCHRP (National Cooperative Highway Research Program) Report 244 which evaluates materials for use as concrete sealers was distributed. It was concluded that the 244 procedure is a "defacto" standard test method even though it is not a standardized test procedure. E. McGettigan will contact the various testing labs which regularly run this test to see if they would be interested in chairing a task group to develop a test method based on this procedure.

A new task group was formed as D01.47.12 " Water Repellent Performance using a Water Uptake Tube." This task group will write a practice/test method based on RILEM PEM 25 11.4. This method uses a water uptake tube to measure the absorption of water into a substrate. J. Linert will be the D01.47.12 Chair.

D01.47—Masonry Treatment—E. McGettigan, Chair, lead the discussion on new business. A letter was received from R. Brown, C-15 Chair. They would like jurisdiction over the method D 5703-95. It was agreed upon by all members in attendance that they can have jurisdiction as long as the method remains in Volume 6.02. In addition, all coatings on masonry will remain under the jurisdiction of D01.47. E. McGettigan will join C-15 to obtain member correspondence.

C. Taylor would like to chair a task group on measuring hydrocarbon resistance of porous surfaces using contact angle and a subjective rating scale. This method would be a screening evaluation to indicate hydrocarbon resistance of a coating. E. McGettigan, D01.47 Chair, will mail proposed method out with the minutes to get feedback and determine the level of interest in a method of this type. If there is interest in a method of this type a new task group will be formed, D01.47.13.

Subcommittee D01.48 Pipe Line Coatings

R. Geary, Chair

R. Herenrother, a new member, accepted the position of D01.48 Secretary. The negatives on Z6629Z New Standard, "Test Method for Cathodic Disbondment of Pipeline Coatings by Laboratory Simulation of Soil Burial," were resolved. This will go to print. Changes were proposed for the new standard "Determination of Shear Resistance of Pipeline Coatings." D01.48.01 and D01.48.02 reviewed the status of their methods. D01.48.01 is planning round-robin testing. D01.48.02 is rewriting "Determination of Shear Resistance of Pipeline Coatings."

D01.48 determined that another VOC test is not required and that electrical methods of determining moisture penetration into pipe coatings were too expensive and ambiguous to run. Suggestions were made to correct schematic drawings in G 18. Modifications were recommended for G 6, G 8, G 9, G 12, G 17, G 18, and G 55 as part of the scheduled review process. G 62, G 70, G 80, and G 95 will be reviewed during the June meeting.

DIVISION 50 PAINT FOR FACTORY APPLICATION

Subcommittee D01.51 Powder Coatings

J. R. Hagerlin, Chair

D01.51.01—D 3451-92—"(Guide for) Testing Coating Powders"—J. Hadden, Chair, reported that D 3451 is due for revision and balloting by 1999. He provided a draft revision including many proposed changes. Each member is to review the document and provide further suggestions to him by April 30. S. Orthey accepted his proposal that this "practice" become a "guide." The name will change, but not the document identification number. Section 16, Viscosity of Molten Powder by Weissenberg Rheogoniometer, will be removed unless E. Waddles determines that the method is still used at Ford or GM. Section 18, Density & Specific Gravity, will be replaced with a reference to D 5965-96, Standard Test Methods for Specific Gravity of Coating Powders. Section 19, Relative Deposition Efficiency, will be replaced with a reference to ISO 8130-10. When non-ASTM procedures (e.g., ISO, PCI, and NACE) are referenced, a footnote will be included to identify the source of the referenced document(s). Section 37, Safety & Handling Precautions, will be removed as Section 1.4 addresses the subject. Section 38, Data Report, will be removed due the change from practice to guide. During review, suggestions were made to identify suppliers of equipment and/or supplies. The group was reminded that ASTM no longer allows such references unless there is a single supplier. A discussion ensued regarding the disservice this is for potential users of the methods.

D01.51.02—Z5953Z—"Hiding Power of Powder Coatings"—M. Sharma, Chair, [reported that Draft #6 of June 1996, was reviewed by members between meetings and he concluded comments in Draft #7 for review at this meeting. Footnote 2 will be revised by L. Schaeffer to make it relevant to "visual opacity" versus measured contrast ratio. Footnotes 5 through 7 had to be removed as they referenced equipment or material suppliers. Again, members were dissatisfied with the new rule to not list suppliers of materials used in the procedure. Other comments regarding Draft #7 are to be submitted to M. Sharma by February 15. He will then prepare Draft #8 for D01.51 ballot by March 30, so the procedure can potentially be ready for D-1 ballot after the next meeting in June 1997. M. Sharma will provide details of the round-robin to be used in the precision and bias statements and in the research report. The current information will be modified to include test parameters and specific materials used in the round-robin.

D01-51.03—Spray Characteristics of Powder—M. Theis, Chair, reported on his results using the transfer efficiency test draft of June 1994. He found it less precise than ISO/DIS 8130-10: Determination of deposition efficiency. Due to this finding, the planned round-robin did not occur. It was agreed that the ISO 8139-10 be referenced in D 3451 (see above) when published and that work cease on a similar ASTM procedure. Past participation was acknowledged and appreciated, especially the work of C. Merritt, former Chair.

J. Hagerlin provided copies of the draft ISO procedure for comment. Attendees recommended several additional changes: control and recording of the test environment; the use of controls in each test; recording of the gun tip type; an illustration of the apparatus; and a narrower air flow range. J. Hagerlin will present proposals during the next ISO ballot.

D01.51.07—New Subjects—J. Hagerlin presiding, reported that a volunteer was needed as Chair and E. Waddles agreed to do so for future meetings. *Dry Powder Thickness*—The round-robin using the Gardner "roller gage" to determine correlation between uncured, dry powder and cured film thickness was discussed. L. Waddle, J. Hedden, and R. Boni had been disappointed with the results. After discussion, it was agreed that the round-robin would cease and the devise was returned to Gardner.

E. Waddles introduced a comb style device with stepped, separated points and a flat edge base for consideration in determining dry powder thickness. It received good initial reviews and devices were given to M. Sellars, D. Montenaro, and J.D. Pont for evaluation and comment at the June meeting.

M. Sellars reviewed an Elcometer digital film thickness gauge with a special base that may work for determining dry powder thickness. The device may not be cost effective and there was concern about varying pressure by the operator affecting results. D. Montenaro agreed to review the device for comments at the next meeting.

Another devide that may be suitable for dry powder thickness is from Electrophysique. E. Waddles will contact the company to determine its existence and potential use. *Compatibility*—R. Boni reviewed ISO/DIS 8130-12: Determination of compatibility, to advise how it might fit with ASTM and PCI. He proposed changes and these were reviewed with no further additions made. J. Hagerlin has submitted the comments to ISO for the current ballot. Once ISO has approved the document, the procedure will be referenced in D 3451 (see above). *Sampling*—L. Waelde reviewed ISO 8130-9: Coating Powders - Sampling. He found several problems with the procedure and many in attendance agreed that the procedure was time consuming and not cost effective. When L. Waelde said that he must drop the project due to business constraints, J. Hadden volunteered to pick it up as part of the revision to D 3451. *Test Methods Cross Reference*—J. Hagerlin provided an updated cross reference table of ASTM, ISO, PCI, DIN, BSI and miscellaneous methods that relate to Powder Coatings. Additions or corrections to the information should be returned to him. L. Waelde mentioned an older EMS cross reference to ISO, DIN and ASTM procedures. A copy will be included with the minutes to attendees and D01.51 members. *New Suggestions*—There were no further suggestions for new methods or future work.

D01.51.08—Liaison to PCI Test Methods—E. Marx, Chair, reported that a current PCI action item is powder dry flow properties. PCI is planning to issue a technical brief as drafted by L. Waelde and B. Fawer. A copy of the current draft was reviewed and changes made. B. Fawer will submit the next draft to PCI by the end of February. Approval of the document is planned before the annual PCI meeting in May 1997. Gel Time was discussed and it was suggested that PCI might want to conduct a round-robin using the current PCI method. J. Hagerlin stated that a round-robin on the proposed ISO gel time procedure is planned this spring and provided copies for comment. Full details were not available, but he will follow the activity and report results at the June meeting.

D01.51—Powder Coatings—J. Hagerlin, Chair, reported that S. Orthey advised specific equipment and supply sources found to be important in round-robin testing could be in a Research Report, but not in Precision and Bias statements. M. Sharma will follow that advice for the Hiding Power procedure. The proposal that D01.51.03 cease work on powder transfer efficiency and adopt ISO 8130-10 was passed by a unanimous vote of members present. J. Hagerlin proposed a new task group: D01.51.09, Liaison to ISO TC 35/SC 9/WG 16. He will invite D. Chambers, Convenor of WG 16 to chair the group. The purpose will be to review and comment on ISO draft procedures and to further coordinate the activities that are common to ASTM and ISO. J. Hagerlin stated that eight ISO Powder Coating procedures published in 1992 are up for five year review. He asked that we review them and submit comments by March 10, 1997. Copies of final draft ISO/DIS 8130-11, Inclined Plate Flow, were provided. J. Hagerlin asked that comments be sent by February 10 to be included in the current ballot. J. Hagerlin proposed revision to the D01.51 scope. It was reviewed, changes were made, and it was approved by a unanimous vote of members present. The lack of success in bringing powder coating users to the meetings was discussed and D. Montenaro volunteered to look for new ways to promote D01.51. He will make proposals at the meeting in June.

Subcommittee D01.52 Factory Coated Wood Products

S. B. Schroeder. Chair

D01.52b—Hardboard—S. B. Schroeder, Chair, reported that comments received on the main committee ballot of D 2830,"Standard Test Method for Exterior Durability of Factory Primed/ Field Finished Wood Products," were discussed. Some were felt to have merit and will be reviewed with the D-1 editor for possible inclusion before publication. Several members also agreed to review D 2793-93A, "Test Method for block Resistance of Organic Coatings on Wood Panel Substrates," for reapproval and will report at the summer meeting.

A round-robin for D 2065 was also discussed in order to provide data on alternative surfactants to the nonyl phenol of questionable toxicity that is now specified in this method. Several attendees volunteered for the round-robin, and the chair will solicit others at the spring Hardboard Association Meeting.

D01.52.18—Accelerated Exposure—S. Schroeder, acting Chair in place of T. Rieth, reported that data from 2,423 hours of QUV modified with a soak/ freeze/thaw procedure and 119 cycles of xenon arc W-O-M with a similar soak/ freeze/thaw, have produced insufficient degradation of the primed hardboard specimens to allow a meaningful comparison with the two-year 45° South Florida fence exposure data. The accelerated exposures will continue. Additional primed panels selected from retains of an American Hardboard Association study will be submitted to exposure per D 5722-95, "Standard Practice for Performing Accelerated Outdoor Weathering of Factory Coated Embossed Hardboard Using Concentrated Natural Sunlight and a Soak-Freeze-Thaw Procedure." This will provide another measure of the degree of correlation between this method and slower test fence exposures. Several attendees will also review D 358 for reapproval and report at the summer meeting.

D01.52.15—Film Thickness—S. B. Schroeder, Chair, discussion of the negative ballot cast by D. McCunn and comments on reapproval of D 5235, "Standard Test Method for Microscopical Measurement of Dry Film Thickness of Coatings on Wood Products." Mr. McCunn agreed to withdraw the part of his negative which suggested a different sample preparation technique. His other comments were resolved editorially. The liquid N freeze/fracture preparation technique will be addressed at the summer meeting. The rest of the meeting discussed promising new data from the DeFelsko Corp. using their latest model, ultrasonic film thickness gauge to nondestructively measure primer film thickness on smooth surfaced hardboard siding samples. These results will be presented to the technical committee of the American Hardboard Association in April to determine their interest in participating in a round-robin.

D01.52—Factory Coated Wood Products—S. B. Schroeder, Chair. The minutes of the last meeting and task group reports were approved. The new business discussed was the possible establishment of a new task group to address the development of test methods for coatings on fiber cement siding and roofing.

Subcommittee D01.53 Coil Coated Metal

R. J. Tucker, Chair

D01.53.01—Pretreatment of Substrates—H.E.G. Rommel, Chair, discussed the progress made toward setting up a round-robin to establish a precision and bias statement for D 5723-95, "Determination of Chromium Treatment Weight on Metal Substrates by X-Ray Fluorescence." Approximately eight treatment/substrate combinations will be used at 2 Cr levels each. Substrates will include aluminum sheets, Galvalume coated steel sheet, and a limited amount of hot-dip galvanized steel sheet. Treatments will range from conventional chromate paint pretreatments to dried-in-place pretreatments to chromate passivates. A special effort will be made to include at least one of the new acrylic film chromate passivates on Galvalume, as it is expected to complicate the preparation of a blank specimen by abrasion. Round-robin test coupons will likely be a mixture of materials produced on pilot treatment lines and actual commercial production. Three separate Cr determinations and one blank determination will be made on each test coupon. For pilot - produced materials, untreated blank coupons will also be included in the study for comparison to the blanks made by abrasion. D. Fudge agreed to accept the responsibility for coordinating the round-robin. Twelve candidate laboratories with Portaspec units were identified as candidates to participate. We are hopeful that some testing will be complete by the June 1997 meeting, where D. Fudge agreed to give a status update.

D01.53.04—Measurement of Dry Film Thickness of Coil Coatings—G. R. Pilcher, Chair. M. Lagowski, coordinator, reported that she had sent out invitations to 17 sites which are thought to own and use the Boring device in their laboratories to participate in the round-robin for the new D 5796-95, "Measurement of Dry Film Thickness of Thin Film Coil-Coated Systems by Destructive Means Using a Boring Device." Seven qualified laboratories have responded positively and the remaining 10 have not responded to date. A minimum of 10 laboratory participants are recommended. It would be advisable to start with more to allow for attrition. M. Lagowski will follow up on this.

J. Larsen reported that he and R. Olszewski will be supplying the coated materials for the round-robin. These materials consisting of three different coil coated systems of three different colors each over HDC, Galvalume, and CRS substrates will be obtained from the center of the coated coil clips. The test samples cut 4" x 4" will be sent to M. Lagowski for labeling and distribution to the participants. The samples will be coded for objectivity.

The target date for the materials to be sent to M. Lagowski is the end of February 1997, and distributed to the round-robin participants before the June 1997 D01.53 meeting.

Subcommittee D01.55 Factory Applied Coatings on Preformed Products

R. S. Diem, Chair

D01.55.06—Coating on Plastics—M. Lutterbach, Chair, indicated that the revision of D 3002, "Practice for Evaluation of Coatings for Plastics," was balloted first at the subcommittee and then the main committee level. Two negatives and three editorial comments were received at the main committee ballot level. Both negatives were deemed persuasive and two of the three editorial comments were deemed valid. The practice will be revised these the actions and submitted for concurrent subcommittee/main committee balloting.

D01.55.11—Mar Resistance of Automotive Clear Coatings—A. Rutkiewic, Chair, indicated that Z4875Z Standard Rub Test Method for Abrasion and Mar Resistance of High Gloss Coatings was revised to include the two negatives and two editorial comments generated by the last ballot. The revised standard has been submitted for D-1/D01.55 ballot.

D01.55.13—Exposure of Automotive Coatings to Fleet Service Conditions—A. Rutkiewic, Chair, reviewed a draft of the proposed Standard Guide for the Vehicle Service Exposure of Automotive Coatings in detail to develop recommendations for improvement from the meeting participants. The draft will be upgraded and expanded by the chair to include the recommendations. The intent is to review the proposed Guide at the June 1997 meeting and then ballot at the subcommittee level.

D01.55—R. Diem indicated that there continues to be a major effort in the automotive industry in the area of uniforming test methods. At present, each user has its own method for evaluating various properties. R. Diem will maintain contact with a member of that committee charged with this task to determine if there is interest in preparing ASTM standards for some of the automotive test methods. There are no standards that are overdue for review. One standard, D 5327 Standard Practice for Evaluating and Comparing Transfer Efficiency Under General Laboratory Conditions, is due for review. The chair indicated that the title will be revised (Standard Practice for Evaluating and Comparing Transfer Efficiency of Spray Applied Coatings Under General Laboratory Conditions), and the practice will be submitted for placement on the D01 (97-01) ballot.

Subcommittee D01.56 Printing Inks

J. M. Fetsko, Chair

D01.56.02—Lightfastness of Printed Matter—J. Fetsko, Chair, distributed copies of a revised version of D 3424, in which the test will be changed to a relative comparison versus a reference print. A draft of the revisions will be ready for discussion at the June meeting.

D01.56.04—Viscosity of Paste Inks—J. M. Fetsko, Chair, reported that D 4040 "Standard Test for Viscosity...by the Falling Rod Viscometer," was revised to delete supplier references and passed the fall D01.56/D-1 ballot. Due to reported differences in computer-calculated values, a round-robin will be conducted by distributing the same raw data to 15 cooperating laboratories.

D01.56.06—Apparent Tack—L. D. Ness, Chair, reported that the Kershaw and Go-Tech Instruments have rollers with the same dimensions and weight as the Thwing-Albert. The title of D 4361 will be changed to "Apparent Tack...by a Three-Roller Tackmeter," and sources will be deleted. Revisions will be discussed at the June meeting,

D01.56.09—Tinting Strength of Paste Inks—J. M. Fetsko, Chair, reported that D 2066 is due for five-year reballoting. The title will be changed to "Tinting Strength of Paste-Type Printing Ink Dispersions," and commercial sources removed. M. Fuchs offered to test the new NPIRI Bleaching White 95 on flushed pigments.

D01.56.10—Water Pickup of Litho Inks—D. Weisel, new Chair, reported that he will investigate the Kershaw and Duke Automated instruments as new possible test methods.

D01.56.14—Setting of Heatset Inks—D. Ness, Chair, reported that the new test method "Setting of Heatset Printing Inks by the Sinvatrol" passed the society ballot and was assigned the number D 6073.

D01.56.17—Guide for Printing Inks—J. M. Fetsko, Chair, reported that D 5010 "Guide for Testing Printing Inks" will be updated to include the new Sinvatrol Method and other relevant new ASTM standards.

D01.56.20—Technical Coordinator—B. Blom, Chair, reported that National Printing Equipment Supplies (NPES) has specification for testing blankets and other materials. P. Ford offered to obtain additional information.

D01.56.21—Print Abrasion—J. Vandermeersche, Chair, reported that D 5181 "Abrasion Resistance...by the CA-CAT..." is up for five-year review. It will be submitted for D01.56/D-1 ballot without change.

D01.56.25—Degree of Radiation Curing—E. Kobylarz, Chair, reported that he has obtained production prints subjected to differing degrees of UV curing. The prints will be tested in-house with the Atlas Crock Tester prior to distribution to round-robin participants.

D01.56.26—Chemical Resistance—M. Fuchs, Chair, reported that he conducted an in-house study of chemical resistance wherein a soaked cheese cloth was placed in contact with test prints between glass. Additional testing will be conducted with filter paper.

D01.56.28—Tinting Strength of Liquid Inks—D. Ness, Chair, distributed test results of a round-robin utilizing spectrophotometric determination of tinting strength. After statistical data are added and other changes made, a final draft of the document "Relative Tinting Strength of Aqueous Printing Inks" will be prepared.

D01.56.37—Print Transparency—J. Fetsko, Chair, reported that the method developed by an NPIRI Task Force for

ISO will be put into ASTM format and checked out with an ink diluted with clear varnish and opaque white. A spectrophotometer with the ability to calculate ΔE will be procured.

D01.56.32—Laboratory Printing—D. Ness, Chair, distributed revised copies of the method utilizing the Little Joe. A round- robin will be conducted in which one sheetfed quickset red will be printed twice on each of two days.

D01.56.33—Print Gloss—J. Daugerty Chair, distributed results of a pilot study in which the gloss of 16 prints was measured at 20°, 60°, and 7°. From the data, six prints will be selected for a round-robin.

D01.56.34—Print Problem Terminology—S. Edlein, new Chair, divided the list of terms that need to be defined amongst D01.56 members. Definitions and their sources are to be submitted by April 30.

D01.56.35—Ink Tack Change on Substrates—N. Plowman, Chair, reported via J. Jacques that the procedure utilizing an instrumented flat-bed press will be written according to ASTM protocol. Available data will be examined for applicability to a precision statement.

D01.56—Printing Inks—J. Fetsko, Chair, reported that J. Daugherty, D01.56 Secretary, received an ASTM Certificate of Appreciation during the ISO/D-1 reception this past June. V. Waltz announced his retirement at the D01.56 dinner, which he hosted.

Subcommittee D01.57 Artists' Paints and Related Materials

M. P. Gottsegen, Chair

D01.57.02—Lighfastness of Pigments—T. Vonderink, Chair. Extensive revisions of D 4303, Test Methods for Lightfastness of Pigments Used in Artist Paints, received a negative from N. Searle. All of the time set aside for D01.57.02 was devoted to proposed changes to resolve the negative. All parties agreed to the new changes. A new D-1/D01.57 ballot has been prepared for re-voting.

L. Carlyle, a conservator with the Canadian Conservation Institute, described the lightfastness testing apparatus they have available for user and producer testing, at reasonable cost per sample. Several producers expressed immediate interest, and even some users were raising their eyebrows in anticipation of the possibilities.

D01.57.04—Specifications for Artists' Paints—B. Gavett, Chair. An addition to Table 1 of D 5098, Specification for Artist's Acrylic Emulsion Paints, was offered, and has been sent for D- 1/D01.59 balloting.

D1.57.07—Physical Properties—R. Gamblin, Chair. In R. Gamblin's absence, M. Gottsegen described continuing efforts to interest MOLART (Amsterdam) in the proposed Grounds/Primers Project. MOLART is primarily interested in historical art, not contemporary art, but R. Merrill of the National Gallery of Art has been working on gaining their confidence in our work. He and Gottsegen are optimistic that some sort of research program can be put together; Gamblin, Merrill, and Gottsegen have produced an outline of the protocol.

R. Merrill and M. Gottsegen also conducted a short discussion about further funding. D01.57 agreed that neither outside support for research projects of interest to D01.57 will be sought. Private and public funds will be pursued.

D01.57.09—Watercolors—W. Upchurch, Chair. In W. Upchurch's absence, M. Gottsegen reported on the establishment of the D01.57 Testing Fund and the money collected so far. Several hundred dollars have been given by consumers and users. W. Upchurch has been working on a fund-raising letter to get contributions from producers.

G. Stegmier proposed several complicated changes and additions to Table 1 of D 5067 on watercolor paints. The terminology was minutely examined, several corrections were made, the changes passed by vote of D01.57.09 and the item will be sent for D- 1/D01.57 balloting. A prior negative on a similar ballot was voted persuasive, the item was withdrawn, satisfactory resolution was made, and the item will be re-submitted for D-1/D01.57 balloting.

D01.57.10—Consumer Evaluation—J. T. Luke, Chair. A third revised draft of proposed changes to D 5383 and D 5398 was distributed for contemplation prior to the next meeting of D01.57, in May, with NAMTA. There was not time for significant discussion at this meeting.

D01.57.11—Gouache Paints—T. Takigawa, Chair. No business, though M. Gottsegen distributed cleaner copies of D 4303 results that had been faxed to him and included with the last D01.57 minutes, but which looked awful when photocopied. The mailed copy looked better, and M. Gottsegen spent good money having copies made; however, G. Stegmeir preempted Gottsegen's noble effort at equity by distributing clean copies of the same document during the meeting of D01.57.09.

D01.57.12—Determination of Toxicity—W. Stopford, Chair. A proposed Provisional Standard Test Method for Measuring Maximum Spontaneous Heating Temperature of Art Materials, with its accompanying Research Report, was distributed by W. Stopford. C. Stopford, who did the actual work and writing, presented the document and research. Following heated discussion, the proposed PS was revised and approval to develop was granted by vote of D01.57.12. (Later, D-1 also granted approval to develop by unanimous vote.) An explanatory cover letter will be prepared and the item will be sent for D01.57 letter ballot. If it passes, it will be published forthwith and D01.57 will have two years from the date of publication to convert it into a consensus standard.

D01.57.14—Colored Pencils—L. Armstrong, Chair. This meeting was dominated by discussion of a grant application made by D01.57 to the National Center for Preservation Technology and Training for the funding of a study to analyze the pigment content of colored pencils, which will be administered (if funded) by the Institute for Standards Research at ASTM. The producers of this art material raised significant questions about the objectives of the study, the application process, possible publications resulting from the study (if funded), and ASTM's involvement and interest; the principal investigators answered the questions to the satisfaction of D01.57.14, and permission to go ahead with the application was granted by vote. This marks the first time D01.57 has sought outside funds for research work.

D01.57—M. Gottsegen, Chair. All votes of the task groups were re-confirmed by D01.57. A presentation in absentia was made to A. Spizzo, who has retired from Hunt Manufacturing and stepped down from D01.57 after 18 years of service; a plaque with an inscription and a clock given by Golden, a handmade pottery bowl given by ACMI, and an art history book with color reproductions inscribed with calligraphy and signed by all members present, given by M. Gottsegen. A collection was taken up to pay for the gifts, and all of the money collected was donated to the D01.57 Testing Fund at the suggestion of D01.57's able and generous treasurer.

A Treasurer's report was given, in which it was noted that ASTM is having trouble keeping up-to-date with our finances. The treasurer opined that this situation might reflect badly on his work, but it does not.

The next meeting date was set: Sunday, May 11, 1997, in Chicago, with the National Art Materials Trade Association, at their annual International Trade Show. D01.57 will, for the first time, have a booth at the show, with display materials provided by ASTM and producer members. M. Gottsegen will sit at the booth, which is a good thing for the producers because it will keep him and his clipboard off the show floor.

On Wednesday, February 5, 1997, M. Gottsegen and J. T. Luke swooped down on A. Spizzo at his residence in Conover, NC, and presented him with his D01.57 gifts in person, as a surprise. And he was surprised!

DIVISION 60
PAINT APPLICATION

Subcommittee D01.61
Paint Application Tools
F. B. Burns, Chair

D01.61.01—Paint Brushes—T. Sliva, Chair, distributed copies of D 5913, "Standard Test Method for Evaluation of Cleanability of Paint Brushes." The method will appear in the 1997 edition of Volume 6.02. A discussion followed on the use of drawdown bars within the proposed new test method on the Leveling Efficiency of paint brushes. It was the opinion of the members who participated in a mini-round-robin, that the drawdown bar method limited the evaluation area to too small in size. G. Harsch commented on a method of applying the paint to the test chart and brushing out. It was the decision of the task group to initiate a round-robin of the Leveling Efficiency Test, incorporating Mr. Harsch's comments. The chair then led the group in a discussion on the need to develop a test method to supersede Method 2141.1, "Application of Brush Films," of Federal Test Method Standard 141 C, and a need to add an annex to Method D 5068 to include information on brushes and their importance when evaluating properties of wet paint. Several members of the task group have offered to assist the chair in this endeavor. A draft of the above proposals and the results of the Leveling Efficiency round-robin will be presented at the June meeting.

D01.61.02—Paint Rollers—B. Martin, Chair, led a discussion on a test method to measure the amount of paint picked up by a roller. One suggestion was to measure by mil thickness of paint deposited by the roller. The majority of the group suggested a weight measurement will be more accurate. The chair will follow the weight method in testing and present the revised procedure to the members for further discussion at the next meeting. Volunteers for testing included E. Harsch, B. Polzin, and D. Grant.

D01.61.03—Woven Paint Applicator Fabrics—M. Dodd, Chair, led a discussion of Draft #5 of the Standard Practice for Physical Characterization of Woven Paint Applicator Fabrics by the task group. The following modifications were made: (1) Definition of fiber was changed to include "continuous filament yarns." (2) Sections pertaining to dyelots were deleted. (3) Due to the fact that this is a standard practice, not a test method, sections 10 (Report) and 11 (Precision & Bias) were deleted. (4) The keywords "woven paint applicator fabrics" and "physical characterization" were added. (5) Other minor wording changes. For the next meeting the section on measuring shearable pile density will be complete. Figures will be incorporated into the document. Draft #6 will be mailed to task group members in early to mid May 1997 to review for the June 1997 meeting in Toronto.

D01.61.05—Bulk Density of Filaments and Bristle—J. Feathers, Chair, reviewed Draft #1 of Bulk Density of Tapered Filaments and voiced concerns over the proposed procedure. Task group members also suggested a number of revisions to consider. Included are changing the equipment to provide digital readout of the bundle diameter and assuring that adequate air volume can be supplied to the clamping cylinder. The optimum air pressure for best reproducibility will be explored. Due to the number of potential procedure changes, round - robin testing will be delayed. T. O'Brien provided details on a NASA procedure for measuring circumference and equipment review. The group agreed to continue procedure development with the current equipment.

D01.61.06—Buckling Resistance of Filaments—T. O'Brien, Chair, presented Draft #1 of proposed Standard Test Method for the Buckling of Fracture Resistance of Level Paint Brush Filaments. The proposed method was reviewed and initial comments and recommendations were received. Draft #2 will be presented for review at the next meeting. Screw clamping attachments will be supplied to the two cooperators who do not have them.

D01.61.07—Symposium Planning—T. Sliva, Chair, led a rehearsal of the symposium entitled "Paint Application Tools- Key Variables In Painting Success." Presenters included F. Burns, G. Harsch, and T. Sliva. Visual aids were reviewed. The symposium was scheduled for January 28, and supplier materials were to be made available.

D01.61—F. Burns, Chair, announced that M. Dodd, of Collins & Aikman, a new member, has volunteered to become Chair of D01.61.03 Woven Applicator Fabrics. Two other potential new members were introduced. They were B. Polzin, of EZ Paintr, and S. Hall, of Rubberset.

A discussion was held on methods of measuring filament curl. It was a consensus that this should be discussed in greater detail at the next meeting in Toronto. Members were reminded about our symposium scheduled for Tuesday at 5 p.m.

January 1997 Subcommittee Reports of ASTM Committee G-3

Subcommittee G03.02 Natural Environmental

J. Robbins, III, Chair

G03.02.01—Black Panels—J. Martin, Chair. G03.02.01 has been working for many years towards the development of a standard black panel that can be used to provide an indication of minimum material temperature during outdoor testing. A research report on the work of G03.02.01 over the past 5 to 10 years will be presented at the meeting in Toronto.

G03.02.02—Outdoor Tests—J. Robbins, Chair, G 24, "Standard Practice for Conducting Exposures to Daylight Filtered Through Glass," received a negative vote at the main committee level which was found persuasive, and the standard will be reballoted. G 7, "Standard Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials," passed sub and main ballot with no negatives. Comments received during this ballot will be incorporated into a new draft and balloted prior the next meeting.

G03.02.03—Accelerated Outdoor Weathering—J. Robbins, Chair, G 90. "Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight" passed society ballot in 1994. However, a new draft of this standard will be balloted prior to the next meeting to remove a test supplier footnote.

G03.02.04—Climate Data Reporting—R. Brockhaus, Chair. The preliminary work of G03.02.04 is to develop a list of recommended core weather data that could be reported by laboratories performing outdoor weathering.

Subcommittee G03.03 Simulated and Controlled Environmental Testing

R. M. Fischer, Chair

G03.03.02—Performance Standards—W. Ketola, Chair, discussed the G03.03 ballot results for the new Standard Practice for Exposing Nonmetallic Materials to Laboratory Light Sources. P. Brennan discussed the subcommittee ballot results for four proposed Standard Practices for Operating Open Flame Carbon Arc Light Apparatus, Enclosed Flame Carbon Arc Apparatus, Xenon Arc Light Apparatus, and Fluorescent UV Light Apparatus for Exposure of Nonmetallic Materials. In summary, there were 167 negative items addressed in the task group meetings held on these performance standard drafts. The resolution of the negatives comprised 130 found persuasive, 16 voted non-persuasive, 13 were withdrawn, and 8 were deemed non-germane. The subcommittee hopes, that after this intense review, the revised standards should move rapidly through the next round of ballots. All five documents will be resubmitted for G03.03/G03 ballot.

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006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
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011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
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- A **Complimentary subscription** to the *Journal of Coatings Technology* is included with your membership dues. The JCT, published monthly, is respected around the world for the quality of its technical information. Each issue features papers on the cutting edge of technology, as well as information covering regulatory updates, people in the news, new products, etc.
- The Year Book, the **Who's Who in the Coatings Industry** provides names, addresses, phone and fax numbers of over 7,400 coatings professionals. Included with dues, the spiral-bound desk reference lists FSCT's 26 Constituent Societies and Affiliated members. (a $150 value)
- FSCT's reference materials including the *Coatings Encyclopedic Dictionary, SciQuest,* and the *Series on Coatings Technology* are available to members at discounted prices - you can **save up to 25%** .

EDUCATIONAL PROGRAMS

- Gain **useful ideas and methods** to implement on the job by attending FSCT's regional seminars.
- Network with industry peers at the **FSCT Technology Conference** featuring training sessions and courses for both veterans and beginners in the coatings industry.
- Evaluate the newest trends in technology at the **International Coatings Expo (ICE)**. Held in conjunction with the Technology Conference, the Expo is the largest international trade show for the coatings industry.
- Receive **mailings on FSCT programs**, including updates on the ICE and other FSCT- sponsored events.

SERVICES

- Further your **leadership skills** by serving on Society/FSCT Committees.
- **Save over 25% on registration rates** when attending the FSCT International Coatings Expo and Technology Conference.
- Obtain discounted travel rates through the **FSCT Travel Desk** by calling 800-448-FSCT or 215-628-2549.
- Request information from FSCT's Fax on Demand Service by calling 800-838-5445. International callers please use 215-953-7893.

JCT
JOURNAL OF COATINGS TECHNOLOGY

For more information, contact:
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Blue Bell, PA 19422-2350
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ice
INTERNATIONAL
COATINGS EXPO
NOVEMBER 3-5, 1997
ATLANTA, GA

Fillers/Extenders/Containers

WG 325

FRANKLIN INDUSTRIAL MINERALS

Franklin Industrial Minerals' WG 325 is a finely ground high aspect ratio functional pigment consisting of wet ground pure muscovite mica. This product reportedly provides physical reinforcement that helps resist cracking and checking, decreases blistering, and reduces staining from the substrate in industrial primers. In addition, WG 325 improves the brushing and application characteristics of coatings, promotes improved adhesion to the substrate, increases the opacity of white opaque pigments, intensifies colored pigments, as well as stays uniformly dispersed.

Circle No. 51 on Reader Service Card

Bartex®

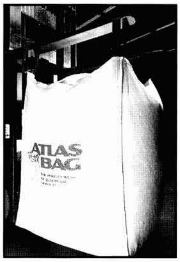
HITOX CORP.

Bartex®, barium sulfate, is a white extender pigment with a fine particle size designed for use in general paint and coatings applications. Hitox Corp. offers two barium sulfate products for use in the different paint systems where whiteness and fine particle size are needed. Bartex 10 is a fine white extender with a median particle size of 1.0 microns. Bartex 65 is a fine, white extender with a median particle size of 1.6 microns. Both grades are fluid energy milled resulting in a narrow particle size distribution curve.

Circle No. 52 on Reader Service Card

Intermediate Bulk Containers

ATLAS BAG INC.



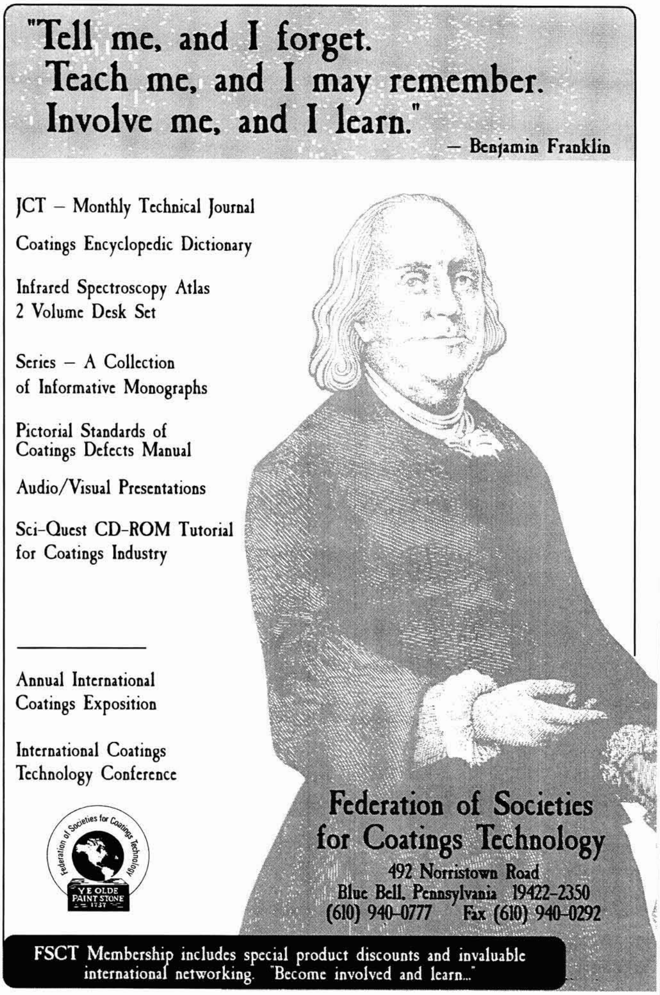
Atlas Bag Inc. manufactures flexible intermediate bulk containers from two plants in the Greater Chicago area, and plants in Houston, TX, and Cordoba, Mexico. Atlas bags are custom made and range in sizes from 200 pound to 8,000 pound capacities. These containers meet the industry standard safe working lift load of 5:1 safety factor. Other bags available are United Nations certified, Department of Transportation approved, Crohmiq-Blue static protective, sift proof, baffled, gussetted lined, form fitted lined attached or loose.

Circle No. 53 on Reader Service Card

Don't miss these upcoming topics in *Product Overview:*

June	Ink Production Equipment
July	Color Measurement
August	Materials Handling
September	Lab Apparatus
October	Regulatory Services
November	Testing Equipment
December	Adhesives/Caulks

Send us your news releases and black and white photographs to appear in the *Product Overview* section. Contact JCT at (610) 940-0777 for more information.



BALTIMORE—MARCH

"Environmental Permits and Approvals"

The evening's speaker was Lorrie Del Pizzo, of the Maryland Department of the Environment. She discussed "ENVIRONMENTAL PERMITS AND APPROVALS."

Ms. Del Pizzo stated that the Maryland Department of the Environment is developing electronic permit processing to streamline the permit process that companies face each year. The speaker recommended the booklet "Business Guide to Environmental Permits and Approvals" to clarify the particulars and parameters for companies applying for permits.

In addition, Ms. Del Pizzo noted that the organization's web site provides information on ozone forecasting, a newsletter, and dates and times for monthly health and public hearings. The Maryland Department of the Environment also includes the Pollution Prevention Office.

COLIN CROWLEY, *Secretary*

CHICAGO—APRIL

Officer Nominations

Nominating Committee Chair C. David Stromberg, of United Coatings Inc., announced the officers nominated for 1997-98. They are: President—Gerry K. Noren, of DSM-Desotech; Vice President—William C. Bellman, of The Valspar Corp.; Secretary—Susan A. Simpson, of ChemCEPT; Treasurer—Michael A. Beland, of Ashland Chemical Co., Drew Division; Membership Chair—Thor Jondahl, of INX International; and Associate Representative—Suzanne M. Farnsworth, of BYK-Chemie USA.

Educational Chair Susan DiSantis, of Fitz Chem, announced the recipients of the two CSCT scholarships.

Philip Heidt, of Eastman Chemical Co., discussed "GENERAL INDUSTRIAL MELAMINE CROSSLINKED POLYESTER COATINGS."

VIC WILLIS, *Publicity*

See Pages 13-25

for Information on

ice '97

CLEVELAND—FEBRUARY

"Modern Spectroscopic Methods"

The evening's speaker, Jack L. Koenig, of Case Western Reserve University, presented "MODERN SPECTROSCOPIC METHODS FOR CHARACTERIZING COATINGS AND INTERFACES."

Dr. Koenig stated that there are many advantages to using vibrational microprobes to study materials including chemical mapping of samples, high sensitivity and specificity, rapid acquisition of data, and the automation of the experiment. Improved vibrational microscopes, computer controlled micropositioners, and fast computers with large storage disks have made these applications possible.

The speaker detailed a mapping spectroscopic experiment. The infrared images are two-dimensional intensity functions displayed at different frequencies. The measures, according to Dr. Koenig, allow the construction of a two-dimensional and three-dimensional map. This mapping reveals contamination or defects found in the coating.

Dr. Koenig discussed the four basic steps involved in digital imaging microscopy. The first being the acquisition of the image. The second step is image restoration and the ability to reverse the distortion induced by the object. The third step is image feature extraction and the final step is the visualization and interactive analysis of the image.

In conclusion, Dr. Koenig stated that spectral imaging is here to stay and new applications will be developed.

JENNIFER RUMBERG, *Secretary*

CLEVELAND—MARCH

FSCT Officer Visit

Nominating Committee Chair Michael Wolfe, of Seegott, Inc., announced the slate of officers for 1997-98. The officers include the following: President—James Currie, of Jamestown Paint Co.; President-Elect—Lamar Brooks, of Coatings Research Group, Inc.; Secretary—Patricia Wagle, of The Flood Co.; Treasurer—Sara Rodts, of The Sherwin-Williams Co.; Assistant Treasurer—Tom Pyzoha, of Marroon Chemical; Member-at-Large—Phil Haagensen, of Chem Materials; and Society Representative—Brenda Carr, of Coatings Development Co.

FSCT President-Elect Thomas Hill discussed the reorganization and restructuring of the FSCT. Mr. Hill reported that the Pan-American Coatings Expo attracted over 2,000 attendees. In addition, he noted that the 1996 International Coatings Expo was successful.

Mr. Hill informed the membership that the FSCT's Mission Statement for 1997 is "The Education and the Professional Development of its Members."

FSCT's Director of Meetings and Conventions Victoria Graves stated that the theme for the 1997 International Coatings Expo, in Atlanta, GA, will be "Seventy-Five Years of Tradition, Discovery, and Opportunity."

In addition, Ms. Graves reported that the 1998 Spring Board of Directors Meeting will be held in Cleveland, OH.

The guest speaker of the meeting, Piedmont Society member Ilona Nemes-Duvall, of Red Spot Paint & Varnish Co., Inc., presented "FORMULATING-MANUFACTURING-PAINTING THE FUTURE THROUGH COLOR SCIENCE."

Ms. Nemes-Duvall began with a summary of the development of color science history beginning with Aristotle and continuing through Kubelka and Munk.

The speaker defined color science and its purpose and role in coatings. According to Ms. Nemes-Duvall, the chemist, designer, color matcher, and producer all interpret color differently.

Designers get together each year to forecast the future color trends that will influence the industry. Often these forecasts are conducted two to ten years in advance. According to the speaker, the trend for 1997 will be towards blackened colors for automobiles, communications, and home interiors. Bright and vibrant colors will be for fashion.

The chemist must decide which pigments will work to obtain these colors and must know pigment chemistry and achieve the correct calculation of the ratio of pigments, the proper dispersing aid, the order of addition, and a successful scale-up for production.

Ms. Nemes-Duvall stated that production must select the proper type of milling, the correct media type, and amount and control of the speed and temperature of the milling execution. Quality control, raw material consistency, and instrumentation is essential for successful batches. The color matcher must understand the four pigment concepts, the light source, and the database which is generated by the computer.

JENNIFER RUMBERG, *President*

GOLDEN GATE—MARCH

"Efficient Use of TiO_2"

Educational Committee Chair Marnie Hartmann, of Jones-Hamilton Co., announced that courses on "Polymer Coatings" will be held April 11-12 at the Moscone Center in San Francisco, CA.

Scholarship Committee Chair Ray Benedetti, of Triangle Coatings Inc., reported that scholarship forms had been mailed out to all members.

Manufacturing Committee Chair Don Mazzone, of Western Equipment Co., stated that the June Manufacturing meeting will consist of a plant tour and supplier tabletop displays.

Glenn Davis, of DuPont Pigment Co., presented "EFFICIENT USE OF TiO_2 IN ARCHITECTURAL COATINGS."

Mr. Davis provided background and results from a computer program that his company developed. This program reportedly calculates optical properties.

According to Mr. Davis, the program requires reflectance over black and white, wet paint weight, per measured area, % TiO_2, and density. In turn, the output yields the following values: contrast ratio, scattering power of coating, scatter coefficient, and spreading rate.

The values determined would differentiate the effect of reflectance and grades of TiO_2 for white paints. He illustrated the value of this program with real-world tests from the marketplace. Several semiglosses and flats were purchased for two studies. In both studies, the values were found to allow a better match to a given point of opacity or quality.

Q. Can the program compare the influence of the latex on the hiding power?

A. The program was developed to look at the TiO_2 basis but it will show a difference if it changes the optical properties.

TIM SPECHT, *Secretary*

GOLDEN GATE—APRIL

"Rheology"

A moment of silence was observed for the passing of Alex Pickering.

Hal Harlan, of Harlan Associates, Inc., announced that the 24th Biennial West Coast Symposium is slated for February 16-18, 1999, at John Ascuaga's Nugget in Sparks, NV.

Scholarship Committee Chair Ray Benedetti, of Triangle Coatings Inc. reported that scholarship forms had been mailed out to all members.

Golden Gate Society member Scott Krane, of Haake Instruments spoke on "RHEOLOGY."

Mr. Krane defined rheology as the deformation of solids and the flow of fluids under stress. In addition, he stated that viscosity can be thought of as the internal resistance of a liquid to flow. It is the dissipation of mechanical energy into thermal energy.

According to Mr. Krane, viscosity depends upon temperature, pressure, shear stress, shear rate, elasticity, and shear time. He noted that viscosity behavior is described by six terms—Newtonian, pseudoplastic, dilatant, and viscoplastic. These types are all shear dependent. On the other hand, thixotropic and rheopectic are both time dependent.

Mr. Krane stated that these behaviors are most often depicted by diagrams. The flow curve plots the shear stress versus the shear rate, while the viscosity curve plots viscosity versus shear rate. Viscosity is dependent upon the conditions at which it is measured. Absolute viscometers can measure both shear rate and shear stress; however, most viscometers in the paint industry—Stormer and Brookfield— measure the shear rate but not stress. Since the shear rate and shear stress are so important to how the coating is applied, Mr. Krane recommended measuring both.

TIM SPECHT, *Secretary*

KANSAS CITY—MARCH

FSCT Officer Visit

J.C. Leslie, a Kansas City Society Honorary Member, was presented with a 50-year Federation pin.

Technical Committee Chair David Hazlett, of Tnemec Co., Inc., announced that Yasmin Sayed-Sweet, of Cook Composites and Polymers, has agreed to Co-Chair the Technical Committee.

The Technical Committee will be working on the following projects: (1) developing Internet yellow pages for the coatings industries, including companies, producers, and suppliers; (2) developing a paper for the FSCT Annual Meeting; and (3) educating the members.

Dr. Hazlett also reported that the American Chemical Society will conduct a one-day symposium in October at the Lake of the Ozarks.

Educational Committee Chair, Kim Nee, of Mozel Inc., is seeking volunteers to judge the April Science Fair.

The evening's speakers, Frank and Pete Cerra, of Tnemec Co., Inc., spoke on "COMPUTERS TODAY."

The speakers demonstrated their company's software package. In addition, personalized connecting office, phone handling system, and the point cast network were also highlighted.

DEBBIE KOSS, *Secretary*

LOS ANGELES—MARCH

Past-President's Night

The following Los Angeles Society Past-Presidents were in attendance: John Kulnane (1995), of ICI; Philip C. Bremenstuhl (1994), of Zeneca Resins; Bud Jenkins (1993), Consultant; Sandra Dickinson (1992), of Tri-iso, Inc.; James Hall (1991), ICI Paints; Melinda Rutledge (1988), Rheox, Inc.; Ray DiMaio (1987), Kop-Coat Inc.; Henry Kirsch (1986), of Trans Western Chemicals; Mike Gildon (1985), retired; Albert Seneker (1979), retired; Fred Croad (1978), retired; Ken O'Morrow (1975), retired; Bob McNeil (1974), of RAM Consulting; and Johnny Gordon (1973), of Pacific Technical Consultants.

A moment of silence was observed for the passing of members Mort Eisner and Willie Turnen, of Reliance.

Society President Bud Jenkins noted that there are two vacancies on the Board. Joe Evans and Bob Skarvan both resigned. Sandra Dickinson and Henry Kirsch were named as replacements.

Educational Committee Chair John Gordon detailed the history of the LASCT's educational efforts.

Dane Jones, of Cal Poly State University San Luis Obispo noted that a short course in polymer and coating technology will be given on August 26-30, 1997.

Don Padget, of Continental Coatings, reviewed the fire that occurred on February 21, 1997 at the company's Fontana, CA, facility. The manufacturing facility was not damaged except for an electric distribution board which has since been repaired.

According to Mr. Padget, the cause of the fire was a drum of uncut isopropyl wetted nitrocellulose which dropped from a fork lift onto a concrete pad.

Mr. Padget thanked everyone in the industry for their offers to support them in maintaining supply to their customers.

Bert Osen, of Advance Finishes Inc., stated that the Society's Bylaws regarding the replacement of a departed board member need to be reviewed. He suggested that perhaps the number of directors could be reduced to an odd number to avoid possible ties in voting and to reduce time through the chairs as well. In addition, Mr. Osen suggested that the Directors could be moved up to fill the vacancy and a special election could be held later to fill the last spot. Furthermore, he stated that the three non-elected directors need not necessarily have to be past-presidents. Mr. Osen asked the Bylaws Committee to review this request for the Board and to make a recommendation for change.

Environmental Committee Chair Dave Muggee, of E.T. Horn Co., Inc., reported on regulations regarding DOT, U.S. EPA, U.S. OSHA, and California Proposition 65. He noted that DOT's rule for a single class of hazard placarding has been changed to cover as little as 2,205 pounds where previously it covered down to 5,000 pounds. DOT published a list of fines so that one knows what one owes for an error. Also, DOT has pushed through a rule which states that interstate regulations now cover all intrastate transporting of materials. This makes little difference in California where local DOT regulations are usually more stringent.

U.S. EPA rejected a request to remove barium compounds from EPCRA Section 313 list of toxic chemicals. U.S. OSHA reduced permissible exposure limit for eight hours for methylene chloride from 500 ppm to 25 ppm. The U.S. Supreme Court refused to hear a case changing a previous ruling that found California Proposition 65 warning for dental amalgam as not being in conflict with the Federal Food, Drug, and Cosmetic Act.

The evening's speaker, Jack Dickinson, of DuPont, spoke on "HIDING EFFICIENCIES OF TiO_2 IN ARCHITECTURAL COATINGS."

Mr. Dickinson reported on a test to measure hiding efficiencies based on the Kubelka-Munk equation that describes the optical behavior of materials containing small particles which scatter and absorb radiant energy. According to the speaker, this method allows a coating to quantitatively determine hiding efficiency of TiO_2 in different formulae. This procedure can be used to predict formulation changes necessary to achieve given optical properties. A software program that generates scattering coefficients for TiO_2 and paint spreading rates at complete hiding is also available.

Using this test, Mr. Dickinson's lab obtained 60 commercial paints from the West Coast supplied by 10 manufacturers and characterized them for TiO_2 efficiency (S), spread rate (sq.m/g), hiding, contrast ratio, PVC, brightness, etc. These represent gloss and semi-gloss for alkyd and latex type binders. He reviewed a number of concepts such as TiO_2 crowding at high loadings, TiO_2 efficiency number of 0.3, toning with carbon black to improve spread rates and methods to do measurements on paints with poor film integrity. His bottom line was that there are a number of cases where TiO_2 was not being used as efficiently as it might be but that there could be valid reasons for doing this such as in one case of a high gloss enamel made at four pounds TiO_2 /gallon because it did not require toning.

JOE REILLY, *Secretary*

NEW YORK—MARCH

"High-Speed Dispersion Techniques"

A moment of silence was observed for the passing of Art Nortman.

The first speaker of the evening was Philadelphia Society member, D.T. Wu, of DTW Associates. He discussed "COMPUTER-AIDED FORMULATION OF COATINGS, INK, AND ADHESIVES WITH PC-BASED SOFTWARE."

Dr. Wu reviewed computer-aided formulation with emphasis in the following three areas: polymer design, solvent selection, and formulation and design of formulation to meet formulation variable constraints.

In addition, Dr. Wu presented theories and methodologies which can be used in conjunction with PC-based software for effective formulation.

Dennis P. Stephens of ITW Ransburg Electrostatic Systems, spoke on "ELECTROSTATIC FINISHING EQUIPMENT INTO THE NEXT MILLENIUM."

Mr. Stephens discussed the benefits of each technology and their related processes including electrostatic guns, HVLP electrostatics, electronic fluid metering systems, rotary atomizers (bells and disks), PLC controls, and other ancillary products.

The next speaker was New York Society member George M. Schmitz, of S.P. Morell & Co. Mr. Schmitz presented "BASIC PAINT CALCULATIONS."

Mr. Schmitz provided a basic understanding of fundamental paint calculations. He stated that basic paint calculations are used to formulate efficiently, comply with authority specifications and optimize around the most cost effective results. According to Mr. Schmitz, this results in the sale of high performance paint and coatings with increased profitability for the coatings manufacturer.

Ana Maria Fernandez, of Rhone-Poulenc discussed "NEW APE ALTERNA-

1997-98 SOCIETY OFFICERS & CHAIRS

Birmingham

President—Brian A. Fowler, Resiblend Services Ltd.
President-Elect—Rex A.J. Slatter, Trimite Ltd.
President-Elect Designate—Graham H. Jones, Hydro Coatings Ltd.
Immediate Past-President—Joe E. Brown, Blagden Chemicals Ltd.
Secretary—Graham W. Fowkes, Technivelopments Co.
Treasurer—Susan Roy, BASF Coatings & Inks Ltd.
Society Representative—Gerry J. Gough, ICI Packaging Coatings (Holden Surface Coatings Ltd.)
Technical—Roland L. Staples, Nortax
Social Officer—Gina Walker, Ellis & Everard Specialties Ltd.
Program and Publicity—Rex A.J. Slatter

Chicago

President—Gerry K. Noren, DSM Desotech Inc.
Vice President—William C. Bellman, The Valspar Corp.
Secretary—Susan A. Simpson, Chemcept Services
Treasurer—Michael A. Beland, Drew Industrial Div., Ashland Chemical Co.
Society Representative—Evans Angelos, Omya, Inc.
Bylaws—Natu Patel, Ace Hardware Corp., Paint Div.
Educational—Susan DiSantis, Fitz Chem Corp.
Membership—Thor P. Jondahl, INX International Inc., Co.
Program—William C. Bellman, The Valspar Corp.
Publicity—Victor M. Willis
Technical—Keith M. Moody, Eastman Chemical Co.

Houston

President—Ken Mundy, Ribelin Sales, Inc.
Vice President—Vic Santamaria, Champion Coatings
Treasurer—Lee Bower, Seegott Southwest
Secretary—Steven Ragsdale, Intercoastal Paint

Southern

President—Eve V. Irvine, Huber Engineered Minerals
Vice President—Greg Scharfetter, Thompson-Minwax Co.
Secretary—Dale Kenknight, Akzo Nobel Coatings Inc.
Treasurer—To be announced.
Society Representative—James Geiger, Consultant
Alternate Society Representative—Dan Dixon, Engelhard Corp.
Bylaws—Ken Haagenson, Cimbar Performance Minerals
Educational—Ken Espeut, Center for Applied Engineering
Environmental—Marty Baloga, Azalea Color Co.
Manufacturing—Al Crego, ICI Paints
Membership—Stan Harshfield, Consultant
Publicity—Jack McMahon, Jr., Majemac Enterprises Inc.
Technical—Walter Naughton, Scott Paint Corp.

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tive Surfactant Systems for Emulsion Polymerization."

Dr. Fernandez reported that surfactants constitute a small part of the emulsion polymerization system; however, they play an important role in the products' final properties. The speaker stated that selecting the proper surfactant can provide the desired latex results obtained using new functionality formulated surfactants designed to meet the challenging requirements of the coating industry for high performance products and increasing regulatory pressures.

According to Dr. Fernandez, these surfactants, based on aliphatic hydrophobes, offer alternatives to alkyl phenol ethoxylate (APE)-based systems and can be used in the production of industrial vinyl-acrylic, styrene-acrylic latexes.

Larry Waelde, *Secretary*

NEW YORK—APRIL

"Dispersion in a Pressurized Mill"

President John Du, of Hüls America Inc., announced that Mildred Leonard will be granted an Honorary Membership in the New York Society.

Cary Grobstein, of LBL Sales, announced the following nominations to serve as Officers and Members of the Board for 1997-98: President—Bob Schroeder, of Daniel Products, Co.; President-Elect—Larry Waelde, of Troy Chemical Co.; Secretary—Bob Cardin, of Rohm and Haas Co. (retired); Treasurer—Edward Doenges, of Courtauld Coatings; Society Representative—George Amrich, of The Benjamin Moore and Co.; Technical Chair—Jack Hickey, of Courtauld Coatings; Board Member—Samuel P. Morell, of S.P. Morell Co., Inc.; Board Member—Edward C. Webb, of Sun Chemical Corp.; and Board Member—David M. White, of Cardinal Color and Chemical.

Society Secretary, Larry Waelde, announced that the Society's Third Biannual Symposium "Additives and Modifiers for Modern Coatings" will be held on April 30-May 1 at the Holiday Inn North, Conference Center, in Newark, NJ.

Louisville Society member, Gerald Amback, of SEPR, discussed "Dispersion in a Pressurized Mill with Electrofused Ceramic Beads."

Mr. Amback reported on a study that showed the influence of total dispersion time and number of mill passes on degree of dispersion and bead wear. These tests were performed using a horizontal mill with ceramic beads compare to glass beads.

Larry Waelde, *Secretary*

PACIFIC NORTHWEST (VANCOUVER SECTION)—MARCH

"TiO_2 in Architectural Finishes"

Technical Committee Chair Yoichi Seo, of Flecto Coatings Ltd., stated that the committee has mailed the request for funding for the testing program.

Educational Committee Chair Tom Fairley, of Calcoast Labs Canada Inc., reported that the spring course was cancelled. Mr. Fairley is in the process of formulating a level two course for September. He also noted that he has received only one application for the Bill Biddle Memorial Scholarship.

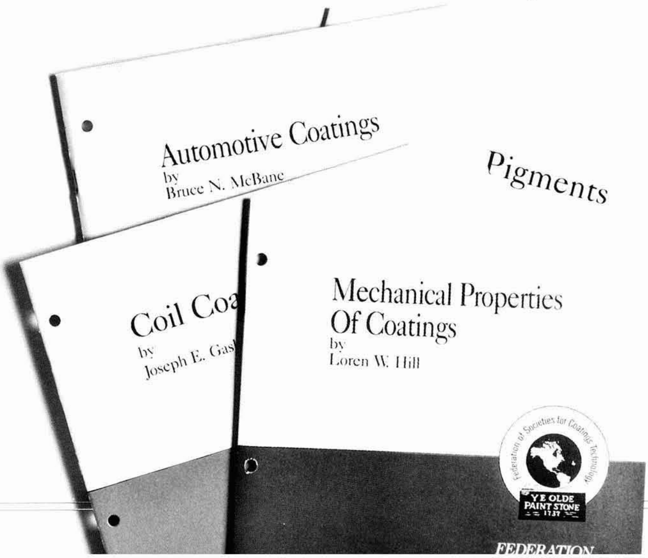
Letters from the Cleveland and Toronto Societies were received congratulating the Society on our 50th Anniversary.

It was reported that the Western Coatings Societies' Symposium and Show attracted 1,800 attendees, down from over 2,000 who attended the 1995 event.

In addition, the Western Coatings Societies' meeting is slated for September 5-6, 1997.

Jack Dickinson, of DuPont White Pigments and Mineral Products, spoke on "Efficient Use of TiO_2 in Architectural Finishes."

Kelvin J. Huget, *Secretary*


Automotive Coatings
by
Bruce N. McBane
Pigments
Coil Co
by
Joseph E. Gas
Mechanical Properties
Of Coatings
by
Loren W. Hill
Federation of Societies for Coatings Technology
YE OLDE PAINT STONE 1737
FEDERATION

New FSCT Members

BALTIMORE

Active

Escarsega, John A.—U.S. Army Research Lab., Fort Belvoir, VA.
Hisghman, Dianne B.—Allied Colloids Inc., Suffolk, VA.
Stewart, Kenneth C.—Reynolds Metals Co., Richmond, VA.

Associate

Healey, Jeanne E.—Allied Colloids Inc., Suffolk, VA.

CHICAGO

Active

Bloom, Paul D.—The Valspar Corp., Wheeling, IL.
Cadiz, Ulfredo—Rust-Oleum Corp., Pleasant Prairie, WI.
Casciato, Nathalie—Industrial Coatings Group, Inc., Chicago, IL.
Cole, Harold F.—Dexter Packaging Products, Waukegan, IL.
Demant, Sandra J.—S.C. Johnson Polymer, Racine, WI.
DiSantis, Dirk—Lawter International, Pleasant Prairie.
Dong, Chenkong—China Industries (USA), Darien, Il.
Faridi, Zaid F.—CPF, Div. Courtaulds, Gary, IN.
Farrington, Nancy K.—Angus Chemical Co., Buffalo Grove, IL.
Gailbreath, Steven C.—Eastman Chemical Co., St. Charles, IL.
Gregg, David E.—Cabot Corp., Tuscola, IL.
Herring, William M.—Da-Lite Screen Co., Warsaw, IN.
Huff, Douglas Z.—The Valspar Corp., Wheeling.
Janette, Mark D.—PPG Industries Inc., Gurnee, IL.
Leung, Victor—Industrial Coatings Group, Inc., Chicago.
Li, Junping—Halox Pigments, Hammond, IN.
Lin, Paul S.—Industrial Coatings Group, Inc., Chicago.
Montgomery, Eva J.—DSM Desotech, Elgin, IL.
Moskal, John J.—Kraft Chemical Co., Homewood, IL.
McNamara, John J.—Sherwin-Williams Autmotive Finishes Corp., Chicago.
McShane, Gerard T.—American Industrial Tech., Batavia, IL.
Palanca, Edith C.—Industrial Coatings Group, Inc., Chicago.
Sampath, P.R.—S.C. Johnson & Sons Inc., Racine.
Szumski, Daniel M.—CFC International, Chicago Heights, IL.
Silvestre, Recto L.—United Coatings Inc., Kankakee, IL.
Watkins, Kenneth R.—Industrial Coatings Group, Inc., Chicago.
Wentworth, Gary—The C.P. Hall Co., Bedford Park, IL.

Associate

Dalton, Sonja June—Kemira Pigments Inc., St. Charles, IL.
Kallal, David A.—Hüls America Inc., Chicago, IL.
Kistenfeger, David A.—U.S. Silica Co., Ottawa, IL.
McColgan, Mary Beth—SCM Chemicals, Olympia Fields, IL.
Swart, Harold E.—Van Waters & Rogers, Schaumburg, IL.
Williams, Elmer—Rohm and Haas Co., Naperville, IL.

DETROIT

Active

Warren, Jonathan N.—PPG Chemfil, Troy, MI.

Associate

Walter, Michael L.—Occidental Chemical, Amherst, NY.

Educator/Student

Chen, Meng-Jiu—University of Detroit-Mercy, Detroit, MI.
Suthar, Bhikmu—University of Detroit-Mercy, Detroit.

Retired

Adesko, Paul—Bloomfield Hills, MI.

LOUISVILLE

Associate

Wright, Michael W.—D.A. Campbell Co., West Chester, OH.

NEW YORK

Associate

Perez, Augustus J.—Hi-Mar Specialties, Mahopac, NY.
Smith, Thomas G.—Rohm and Haas Co., North Olmsted, OH.

NORTHWESTERN

Active

Erickson, Jerimy R.—The Valspar Corp., Minneapolis, MN.
Harelstad, Wayne—Fremont Industries, Shakopee, MN.
Vandevoorde, Michelle—ADM Linseed Oils, Red Wing, MN.

Eductor/Student

Soucek, Mark D.—North Dakota State University, Fargo, ND.

PIEDMONT

Active

Buyalos, Thomas B.—Lomas International, Charlotte, NC.
Chen, Spurgeon—Rexam Custom, Matthews, NC.
Holley, Leonard—Rexam Custom, Matthews.

Associate

Weaver, David L.—Sartomer Co., Inman, SC.

PHILADELPHIA

Active

Bichaylo, Fred E.—Colorcon, West Point, PA.
Freeston, J. William—Rohm and Haas Co., Spring House, PA.
Gumrot, Michael J.—ICI Surfactants, Wilmington, DE.
Hegh, Charles R.—Rohm and Haas Co., Spring House, PA.
Louie, Ming K.—LMW Pharmatech, Salisbury, MD.
Randazzo, Cynthia M.—Rohm and Haas Co., Spring House.
Ross, Jeffrey S.—Armstrong World Industries, Lancaster, PA.

Associate

Gilbert, Andrew E.—Energis Resources, Somerset, NJ.
Young, Lisa J.—Jesse S. Young Co., Inc., Elizabeth, NJ.

SOUTHERN

Active

Brogan, Kern W.—Akzo Nobel Coatings Inc., Birmingham, AL.
Godbey, E. Floyd—American Automotive Products, Inc., Tampa, FL.
Pollano, Gail M.—Zeneca Resins, Wilmington, MA.
Washbaugh, Donald L.—Chemarco Inc., Sumter, SC.

Associate

Baker, Joseph M.—First Chemical Corp., Pascagoula, MS.
Hornick, Heather M.—Chemcentral, Doraville, GA.
Hurley, Timothy P.—Arco Chemical Co., Alpharetta, GA.
Mack, Edward W.—Tioxide Americas Inc., Duluth, GA.
McDuffie, Gregory C.—Burks Inc., Tampa, FL.
Santobianco, John G.—First Chemical Corp., Pascagoula.
Wilhelm, Madison H.—Ropak, Altanta, GA.

M. Chen Grant

R.H. Lance

Hüls America Inc., Piscataway, NJ, has promoted **Mae Chen Grant** to Technical Manager, Industrial Colorants. In this position, Dr. Grant will oversee all customer-related and manufacturing technical support services for the company's industrial colorants, including Chroma-Chem® 844, Aqua-Trend® 896, and Uni-Cal 66® lines. She is a member of the New York Society.

In other news, **Robert H. Lance** was named Vice President, Technology for Hüls America Inc. Mr. Lance will be responsible for the company's engineering, technical planning, corporate quality, purchasing, and logistics functions.

Richard M. Scott has joined the sales team at Hunter Associates Laboratory, Reston, VA. Mr. Scott will represent the company's products and services in Michigan, northern Ohio, and western Pennsylvania. He is a member of the Cleveland Society.

Also, **Brian V. Sciullo** has become a member of the company's sales force. Mr. Sciullo will represent HunterLab in California, Arizona, Nevada, and Hawaii.

BASF Corp., Mt. Olive, NJ, has announced the retirement of **J. Dieter Stein** as Chairman and Chief Executive Officer. Dr. Stein has led BASF Corp. since May 1988 and has been a member of the Board of Executive Directors of its German-based parent company BASF Aktiengesellschaft, since January 1988. **Eggert Voscherau** will succeed Dr. Stein.

Mr. Voscherau has been President of BASF since November 1996 and also serves as Executive Vice President of BASF Corp. and President of its Consumer Products & Life Science Division.

James H. Phillips has joined Ruco Polymer Corp., Hicksville, NY, as New Business Development Manager for the firm's global operations. Mr. Phillips will be responsible for the company's acquisitions, joint ventures, and licensing agreements.

Matthew A. Kosior has been promoted to the position of Assistant Vice President of Technical Operations for American Colors, Inc., Sandusky, OH. Mr. Kosior joined the company in 1989 and has served as Director of Technical Operations from 1993-97. In addition, he has been a member of the American Colors' Executive Committee since 1993. Mr. Kosior is a member of the Cleveland Society.

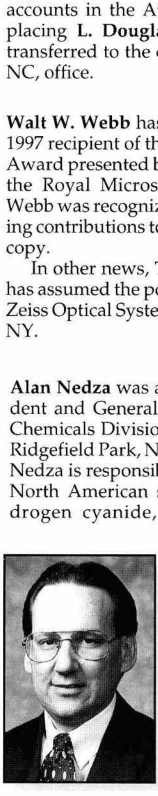
Penny Nicolas has joined the staff of Lansco Colors, Passaic, NJ, as Technical Service Manager. Ms. Nicolas will provide technical support to the company's customers and national network of sales agents. She is a member of the New York Society.

McCullough & Benton, Atlanta, GA, has announced the appointment of **David A. Roth** as Technical Sales Representative. A member of the Southern Society, Mr. Roth will be responsible for Southern Georgia, Southern Alabama, Mississippi, the Florida Panhandle, and select accounts in the Atlanta area. He is replacing **L. Douglas Loudin** who was transferred to the company's Charlotte, NC, office.

Walt W. Webb has been selected as the 1997 recipient of the Ernst Abbe Lecture Award presented by Carl Zeiss, Inc. and the Royal Microscopical Society. Mr. Webb was recognized for his wide-ranging contributions to quantitative microscopy.

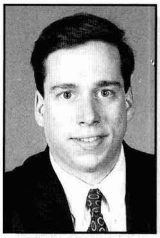
In other news, **Thomas J. Miller, Jr.**, has assumed the position of President of Zeiss Optical Systems, Inc., Thornwood, NY.

Alan Nedza was appointed Vice President and General Manager, Industrial Chemicals Division for Degussa Corp., Ridgefield Park, NJ. In this position, Mr. Nedza is responsible for the company's North American sodium cyanide, hydrogen cyanide, cyanuric chloride, Quab® cat-ionizing reagents, Degadur® industrial flooring, Durferrit® nitrocarburizing process, and resin and coatings intermediates, including methanol derivatives and Degamin IPDA™ isophorone diamine business areas.



A. Nedza

Raabe Corp., Menomonee Falls, WI, has added **Tim Horneck** to its Precision Color™ sales force. Mr. Horneck's background lies in retail sales and he has previously served the company as Market Development Coordinator.



T. Horneck

Ann Druffner has been promoted to Director of Intermediates and Additives for ANGUS Chemical Co., Buffalo Grove, IL. In this capacity, Ms. Druffner is charged with worldwide marketing and growth of the company's intermediates and additives through market extension, new product development, and developing global business strategies.

Engelhard Corp., Iselin, NJ, has appointed **Charles R. Eggert** as Vice President, Marketing in its Pigments and Additives Group. Mr. Eggert will lead the newly formed marketing group charged with achieving growth in the coatings and inks, personal care and cosmetics, automotive coatings, plastics and rubber, industrial specialty markets, and iridescent films.

Obituary

Arthur I. Nortman, a member of the New York Society, passed away on February 27, 1997.

Mr. Nortman graduated from New York University in 1941 with a B.S. Degree in Chemistry. He began his career in the coatings industry as a chemist with Barsky and Strauss. Thereafter, Mr. Nortman joined Adelphi Paint Co. and worked in the laboratory.

In the early 1950s, Mr. Nortman was employed by Falk and Co. in technical sales. Eventually, he formed Arthur I. Nortman Co. in 1959 and Arthur I. Nortman Associates in 1968.

Mr. Nortman was a member of the New York Society since 1949. As a member, he served on several committees including Good and Welfare, Mattiello Library and Nominating Committee. In addition, Mr. Nortman was Chairman of the Employment, Membership, Resolutions, Year Book, and Floor Committees.

Owen Carpenter passed away on January 16, 1997. He was a member of the Chicago Society.

New Products

Laboratory Apparatus

Motorized Sample Wheel

A computer controlled, motorized FTIR sampling accessory for unattended transmission analyses of multiple solid samples is available from Spectra-Tech, Inc. The Sample Wheel Accessory has 30—13 mm diameter sample positions. These holders are capable of holding Kbr pellets, thin films, salt windows, and any other transitive samples that can be mounted in the holder. Additionally, there are special 3M IR cards for the product to automate liquid analyses utilizing these cards.

Circle No. 30 on Reader Service Card

Hand-Held Thermometer

The Type K Digital Thermometer, designed for portable temperature-monitoring applications, accepts all type K thermocouple probes having ANSI mini-connectors. Introduced by Barnant Co., this product features a large 0.5 in. digital LCD display that can be switched between Fahrenheit and Centrigrade, to display a temperature measurement range of –50°F to +1999°F or –50°C to +1300°C. Also included are a hold button to freeze readings and a field calibration function.

Circle No. 31 on Reader Service Card

Simulated Distillation Analysis

The availability of a new thin-film, stainless steel GC column for extended temperature (430°C) simulated distillation analyses, has been announced by J&W Scientific. The DB™-HT Sim Dis features a thin film designed to extend the boiling point distribution range. This polydimethylsiloxane column, with a DB-1 (100% methyl silicone) stationary phase, achieves a distribution range of 156°F (60°C) to 1355°F (735°C).

Circle No. 32 on Reader Service Card

Process Characterization

WYKO Corp. has introduced the WYKO IR6 Disk and Blank Substrate Flatness Inspection System. This non-contact instrument has been designed to improve substrate process characterization by making accurate, two-sided flatness and parallelism measurements on disks in one pass. Created specifically for disk and drive manufacturers, the system's laser optics measure global flatness of an extremely rough substrate, such as unpolished aluminum, with runout to 53.0 mm across one radius.

Circle No. 33 on Reader Service Card

Viscometer

Viscosity and temperature may be measured simultaneously with Brookfield's new programmable digital viscometer. The DV II+ viscometer, with many new features, allows the user to create and download up to four test programs from a PC. With 54 user selectable speeds from .01 to 200 RMP, the instrument reportedly provides variable shear rate capability and precise viscosity testing.

Circle No. 34 on Reader Service Card

Laser Scanning Microscope

The LSM 510 Laser Scanning Microscope from Carl Zeiss combines the LSM 510 scanning module with the axioplan 2 and inverted axiovert microscopes. With the two microscopes, the user reportedly achieves a high level of system integration and short light paths, which ensure optical precision and stability.

Circle No. 35 on Reader Service Card

Testing Equipment

Mar Tester

The MT-1 mar tester has been provided by Atlas Electric Devices Co. as an alternative for determining mar resistance for automotive and high-gloss topcoats. This portable device offers the user the flexibility to check the mar resistance and related cure state of a finish while the automobile is on the production line. Mar resistance is determined on smooth, flat surfaces.

Circle No. 36 on Reader Service Card

Corrosion Test Chamber

Singleton Corp. provides a line of corrosion test chambers, including cyclic corrosion, salt fog, cass, humidity, dust and immersion tanks. Standard designs include digital temperature controls, automatic feed systems, and see-through cover. An all new plastic salt fog chamber which can be upgraded for cyclic testing is also available.

Circle No. 37 on Reader Service Card

Books/ Publications

Emulsion Polymers

A brochure available from Air Products and Chemicals Inc. highlights emulsion polymers for interior and exterior water-based paints and coatings. The literature discusses how the use of Airflex® and Flexbond® vinyl acetate- and acrylic-based emulsion polymers can provide interior and exterior architectural paint formulations which may result in flexibility, abrasion resistance, scrub, gloss, water resistance, and durability.

Circle No. 38 on Reader Service Card

Ultraviolet Transmittance Analyzer

A four-page brochure describing a new ultraviolet transmittance analyzer designed to meet rigorous quality assurance needs involved in formulation, development, and testing of sunscreens, has been published by Labsphere, Inc. The brochure gives operational features and specifications for the UV-1000S ultraviolet transmittance analyzer.

Circle No. 39 on Reader Service Card

Reactive Silicones

A brochure titled "Reactive Silicones—Forging New Polymer Links" is available from Gelest, Inc. This new 48-page publication describes reactive silicones that can be formulated into coatings, membranes, cured rubbers, and adhesives for mechanical, optical, electronic, and ceramic applications. The detailed text provides starting-point formulations, references, and application information.

Circle No. 40 on Reader Service Card

Colorants Brochure

Plasticolors, Inc., has published a four-page brochure entitled "Color That's Customer Driven." The literature describes the company's thermoset product line, including custom color pigment and chemical dispersions for urethane, polyester, epoxy, vinyl, and other resin systems. Highlighted are technological and manufacturing resources which provide custom color matching.

Circle No. 41 on Reader Service Card

Air Collection and Filtration

The third in an on-going series of technical white papers that focus on various topics relating to industrial in-plant air collection and filtration has been published by Aercology, Inc. Topics discussed include regulatory, technical, maintenance, and applications information. This issue specifically discusses the nature of clean air in industrial applications.

Circle No. 42 on Reader Service Card

Thermal Analysis Newsletters

Three new Perkin-Elmer Thermal Analysis Newsletters focus on low temperature (subambient) phase transition applications using the Pyris™ differential scanning calorimeter (DSC). Materials tested in these applications include polybutadiene, siloxanes, and acrylonitrile butadiene styrene (ABS) resin. Each application example outlines a convenient, routine method for determining subambient phase transitions with speed and simplicity, providing insight into the effect of molecular modifications.

Circle No. 43 on Reader Service Card

Raw Materials

Specialty Products

Ishihara offers a full range of ultrafine TiO_2 products and 1/10 the particle size of standard pigmentary grades (TTO series) and three lines of anti-electrostatic materials for control of static electricity and heat (FT.SN/Et series). TTO products reportedly provide transparency and UV shielding capabilities in ranges from UV-A to UV-B. When applied to the topcoat of an automobile coatings, a flip-flop effect is created resulting in desired changes in color.

Circle No. 44 on Reader Service Card

Silicone Additives

A 20-sample kit of silicone additives for paints, inks, coatings, and adhesives is available from Dow Corning Corp. The new three-tiered rack keeps samples convenient without taking much bench space. Dow Corning® 62 additive, a water-based antifoam, and Dow Corning 55 additive, a surfactant for mar resistance are new to the kit.

Circle No. 45 on Reader Service Card

Foam Control Agent

Rhone-Poulenc has announced a new application for its Rhodoline™ DF 6681 foam control agent, formerly known as Bevaloid® 6681. The product is available for use as a microfoam suppressant in low-VOC industrial finishes based on latex polymers or dispersions. Rhodoline DF 6681 is used to control foam in high-gloss paints, clearcoats, aqueous urethane, epoxy coatings, flexographic inks, and pressure-sensitive adhesives.

Circle No. 46 on Reader Service Card

Equipment

Cleanroom Oven

The No. 781 is an electrically heated, 500°F cleanroom oven from The Grieve Corp. for use in drying truckloads of glass flasks. This oven has overall workspace dimensions of 48" W × 48" D × 60"H. A 30 kw power input, installed in Incoloy-sheathed tubular heating elements, provides operating temperatures to 500°F maximum. A 1500 CFM, 2 hp recirculating blower provides full horizontal air flow to the loads.

Circle No. 47 on Reader Service Card

Dump Valves

Dump valves, designed for unloading bulk solids from a variety of collection hoppers where pressure differentials exist, are available from William W. Meyer and Sons, Inc. With standard flap and seat material providing high wear resistance for abrasive materials, typical applications include ash, cement, mined ores, and bulk powders and chemicals. Other options include high temperature models for operating conditions to 1800°F and pressures up to 15 psi and 30" Hg.

Circle No. 48 on Reader Service Card

Water Jet Stack Cleaners

Two new rotary swivels from NLB Corp. feature adjustable speeds for cleaning of blocked pipes and stacks. The force of the high pressure water jets, combined with the offset angle of the nozzles, creates rotation speeds of up to 3,000 rpm. Model NLB7420 weighs 9.5 lb and delivers an operating pressure of up to 12,000 psi with flows up to 20 gpm. Model NLB7500 operates at pressures of up to 10,000 psi with flow of up to 100 gpm.

Circle No. 49 on Reader Service Card

Customized Cooler Systems

Lepel Corp. presents water cooling recirculators for use with heat induction generators. The RWWEX Series water-cooled closed-system models uses distilled water through a heat exchanger cooled by ordinary tapwater. Hot distilled water emerging from the induction generator flows into the storage tank, is cooled, then pumped back into the generator, always maintaining a constant pressure and flow. A single RWWEX recirculator of sufficient capacity can be used to service several induction generators of almost any make.

Circle No. 50 on Reader Service Card

Calendar of Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (610) 940-0777, FAX: (610) 940-0292. Web site: http://www.coatingstech.org

1997

(June 20-21)—FSCT Incoming Society Officers Meeting. June 20—FSCT Headquarters Visit, Meeting, and Reception; June 21—Society Officers Meeting. Marriott West, Conshohocken, PA.

(June 25-26)—"Practical Paint Formulation for Raw Material Suppliers." Symposium sponsored by the FSCT Professional Development Committee. Park Hyatt, Philadelphia, PA.

(June 27)—"Winning Technical Presentations." Symposium sponsored by the FSCT Professional Development Committee. Park Hyatt, Philadelphia, PA.

(Nov. 3-5)—ICE '97—FSCT Annual Meeting and International Coatings Expo and Technology Conference (Formerly Annual Meeting and Paint Industries' Show). Georgia World Congress Center, Atlanta, GA.

1998

(Oct. 14-16)—ICE '98—FSCT Annual Meeting and International Coatings Expo and Technology Conference (Formerly Annual Meeting and Paint Industries' Show). Ernest N. Morial Convention Center, New Orleans, LA.

SPECIAL SOCIETY MEETINGS

1997

(May 22-23)—40th Annual Technical Symposium. "Waterborne Coatings: Sink or Swim." Symposium sponsored by the Cleveland Society. Case Western Reserve University, Cleveland, OH. (Vicki Fisher, Jamestown Paint Co., 108 Main St., Jamestown, PA 16134; (412) 932-3101).

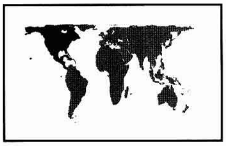
(June 13-15)—RMSCT's June Outing. Steamboat Sheraton, Steamboat Springs, CO. (Charlie Schroeder, Fel-Pro Chemical Products, L.P., 6120 E. 58th Ave., Commerce City, CO 80022; (303) 289-5651).

(Sept. 12)—"Corrosion Control Through Coatings." Conference co-sponsored by the Los Angeles Society and California State Polytechnic University at Pomona. Kellogg West Conference Center, Pomona, CA. (LASCT, 11278 Los Alamitos Blvd., #104, Los Alamitos, CA 90720; fax: (310) 594-6862).

1998

(May 11-14)—Eastern Training Conference II. Sponsored by the Philadelphia Society. Valley Forge Convention Center, King of Prussia, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808).

OTHER ORGANIZATIONS



1997—North America

(May 19-21)—"Waterborne Short Course." Sponsored by The Adhesive and Sealant Council, Inc. Quaker Square Hilton, Akron, OH. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(May 19-22)—"Finishing '97 Conference and Exposition." Sponsored by the Society of Manufacturing Engineers (SME). Rosemont Convention Center, Rosemont, IL. (SME, One SME Dr., P.O. Box 930, Dearborn, MI 48121-0930).

(May 19-23)—"Corrosion and Its Control by Protective Coatings." Short course sponsored by Lehigh University. Bethlehem, PA. (Richard Granata, Lehigh University, Sinclair Laboratory, 7 Asa Dr., Bethlehem, PA 18015-3192).

(May 19-23)—"Physical Testing of Paints & Coatings." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(May 20-23)—"Coatings Science for Coatings Technicians." Short course sponsored by The University of Southern Mississippi (USM). Hattiesburg, MS. (Dr. Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(May 22-23)—40th Annual Technical Symposium. "Waterborne Coatings: Sink or Swim." Symposium sponsored by the Cleveland Society. Case Western Reserve University, Cleveland, OH. (Vicki Fisher, Jamestown Paint Co., 108 Main St., Jamestown, PA 16134; (412) 932-3101).

(June 2-4)—"Advances in Flame Retardancy of Polymeric Materials: Applications, Materials, Industry Developments, Markets." Conference sponsored by Business Communications Co., Inc. Holiday Inn Select, Stamford, CT. (Business Communications Co., Inc., 25 Van Zant St., Norwalk, CT 06855).

(June 2-4)—"Quality Assurance Management for the Chemical and Allied Industries." Conference sponsored by The Center for Professional Advancement. New Brunswick, NJ. (Registrar, The Center for Professional Advancement, P.O. Box 1052, East Brunswick, NJ 08816).

(June 2-6)—"Advances in Emulsion Polymerization and Latex Technology." Short course sponsored by Lehigh University. Emulsion Polymers Institute, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 2-13)—"Intensive Coatings Science Course." Sponsored by North Dakota State University (NDSU). Fargo, ND. (Debbie Shasky, Program Coordinator, NDSU, Dept. of Polymers and Coatings, 54 Dunbar Hall, Fargo, ND 58105).

(June 3-5)—"Marine and Offshore Coatings Conference '97." Sponsored by the National Paint and Coatings Association (NPCA). Ramada Plaza Resort Oceanfront, Virginia Beach, VA. (Melina Jiminez, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597).

(June 8-13)—"Adhesion Science Short Course." Sponsored by The Adhesive and Sealant Council, Inc. Blacksburg Marriott, Blacksburg, VA. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(June 13-15)—RMSCT's June Outing. Steamboat Sheraton, Steamboat Springs, CO. (Charlie Schroeder, Fel-Pro Chemical Products, L.P., 6120 E. 58th Ave., Commerce City, CO 80022; (303) 289-5651).

(June 16-17)—"Coating and Drying Process Technology." Course sponsored by the University of Minnesota. East Bank, Minneapolis Campus, University of Minnesota, Minneapolis, MN. (Susan Burke, Professional Development and Conference Services, University of Minnesota, 235 Nolte Center, 315 Pillsbury S.E., Minneapolis, MN 55455-0139).

(June 17-20)—"Coatings Science for Coatings Formulators." Short course sponsored by The University of Southern Mississippi (USM). Hattiesburg, MS. (Dr. Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(June 18-20)—"Coating Process Fundamentals." Short course sponsored by the University of Minnesota. East Bank, Minneapolis Campus, University of Minnesota, Minneapolis, MN. (Susan Burke, Professional Development and Conference Services, University of Minnesota, 235 Nolte Center, 315 Pillsbury Dr., S.E., Minneapolis, MN 55455-0139).

(June 22-25)—ASTM Committee D-1 on Paint and Related Coatings, Materials, and Applications. Sponsored by The American Society for Testing and Materials (ASTM). Holiday Inn on King, Toronto, Ontario, Canada. (Scott Orthey, ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(June 23-27)—"Applied Pump Technology." Conference sponsored by The Center for Professional Advancement. San Francisco Bay area, CA. (Registrar, The Center for Professional Advancement, P.O. Box 1052, East Brunswick, NJ 08816).

(June 24)—ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Holiday Inn at the King, Toronto, Ontario, Canada. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

(June 24-25)—"Purchasing/Order Entry Course." Sponsored by BatchMaster Software Corp. Chicago, IL. (BatchMaster Software Corp., 13001 Seal Beach Blvd., Seal Beach, CA 90740).

(June 24-27)—"Coatings Science for Coatings Chemists." Short course sponsored by The University of Southern Mississippi (USM). Hattiesburg, MS. (Dr. Shelby F. Thames, Director, USM, Box 10037, Hattiesburg, MS 39406-0037).

(June 25-26)—"Practical Paint Formulation for Raw Material Suppliers." Symposium sponsored by the FSCT Professional Development Committee. Park Hyatt, Philadelphia, PA.

(June 27)—"Winning Technical Presentations." Symposium sponsored by the FSCT Professional Development Committee. Park Hyatt, Philadelphia, PA.

(July 14-16)—"Layman's Introduction to Coatings." Short course sponsored by University of Missouri-Rolla (UMR). St. Louis Airport Marriott Hotel, St. Louis, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(July 27-Aug. 1)—"Intersociety Energy Conversion Engineering Conference." Sponsored by the American Institute of Chemical Engineers (AIChE). Hilton Hawaiian Village, Honolulu, HI. (AIChE, 345 E. 47th St., New York, NY 10017).

(Aug. 7-8)—"Spectroscopy Instrumentation and Application Seminars." Sponsored by Labsphere, Inc. North Sutton, NH. (Labsphere, Inc., P.O. Box 70, Shaker St., North Sutton, NH 03260).

(Aug. 11-13)—"International Symposium on Polymer Analysis and Characterization (ISPAC-10)." (Stephen T. Balke, Dept. of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, Ontario, Canada M5S 1A4).

(Sept. 4-5)—"Engineering and Construction Contracting Conference." Sponsored by the American Institute of Chemical Engineers (AIChE). Sheraton Harbor Island, San Diego, CA. (AIChE, 345 E. 47th St., New York, NY 10017).

(Sept. 8-12)—"Basic Composition of Coatings." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Sept. 9-11)—"Industry-On-Campus Tour." Sponsored by The Adhesive and Sealant Council, Inc. Virginia Tech, Blacksburg, VA. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Sept. 10-11)—Sixth Annual Advanced Radiation (UV/EB) Curing Marketing/Technology Seminar. Sponsored by Armbruster Associates, Inc. Marriott Hotel, Newark Airport, Newark, NJ. (David C. Armbruster, Armbruster Associates Inc., 43 Stockton Rd., Summit, NJ 07901).

(Sept. 12)—"Corrosion Control Through Coatings." Conference co-sponsored by the Los Angeles Society and California State Polytechnic University at Pomona. Kellogg West Conference Center, Pomona, CA. (LASCT, 11278 Los Alamitos Blvd., #104, Los Alamitos, CA 90720; FAX: (310) 594-6862).

(Sept.14-15)—Inter-Society Color Council (ISCC) Annual Meeting. - Marriott Inner Harbor, Baltimore, MD. (Robert T. Marcus, ISCC Publici y Chairman, D&S Plastics International, 100 S. Mitchell Rd., Ma sfield, TX 76063).

(Sept. 14-19)—"A Systems Approach to Service Life Prediction of Organic Coatings." The Village at Breckenridge, Breckenridge, CO. (Jonathan W. Martin, NIST, Bldg. 226, Rm. B350, Gaithersburg, MD 20899).

(Sept. 15-17)—"Fine Powder Processing." Sponsored by The Particulate Materials Center of The Pennsylvania State University in cooperation with Hosokawa Micron Powder Systems. Penn State Scanticon Hotel and Conference Center, State College, PA. (Particulate Materials Center, 147 Research Bldg. W., University Park, PA 16802-6809).

(Sept. 22-25)—"Safety in Ammonia Plants and Related Facilities." Sponsored by the American Institute of Chemical Engineers (AIChE). Fairmont Hotel, San Francisco, CA. (AIChE, 345 E. 47th St., New York, NY 10017).

(Sept. 22-26)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (UMR Coatings Institute, 1870 Miner Circle, Rolla, MO 65409).

(Sept. 29-Oct. 1)—"Fundamentals of Corrosion and Its Control." Sponsored by LaQue Corrosion Services, Wrightsville Beach, NC. (Sherree Darden, LaQue Center for Corrosion Technology, Inc., P.O. Box 656, Wrightsville Beach, NC 28480).

(Oct. 7-9)—"ISA Tech/97." Sponsored by International Society for Measurement and Control. Anaheim, CA. (ISA, 67 Alexander Dr., P.O. Box 12277, Research Triangle Park, NC 27709).

(Oct. 7-9)—Powder Coating '97. Sponsored by The Powder Coating Institute. Charlotte Convention Center, Charlotte, NC. (Vicki Thatcher, Conference Coordinator, P.O. Box 54464, Cincinnati, OH 45254).

(Oct. 14-16)—17th Aerospace Testing Seminar. Sponsored by the Institute of Environmental Sciences and The Aerospace Corp. Los Angeles, CA. (Institute of Environmental Sciences, 940 E. Northwest Hwy., Mount Prospect, IL 60056).

(Oct. 16-17)—"Spectroscopy Instrumentation and Application Seminars." Sponsored by Labsphere, Inc. North Sutton, NH. (Labsphere, Inc., P.O. Box 70, Shaker St., North Sutton, NH 03260).

(Oct. 24-25)—"Fall Decor '97: Paint & Decorating Show." Sponsored by the National Decorating Products Association (NDPA). Cervantes Convention Center, St. Louis, MO. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Oct. 26-29)—Fall Convention. Sponsored by The Adhesive and Sealant Council, Inc. Hyatt Regency Dearborn, Dearborn, MI. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Oct. 26-29)—"Adhesive Short Course II." Sponsored by The Adhesive and Sealant Council, Inc. Hyatt Regency Dearborn, Dearborn, MI. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Oct. 26-29)—"End Use Applications Short Course." Sponsored by The Adhesive and Sealant Council, Inc. Hyatt Regency Dearborn, Dearborn, MI. (The Adhesive and Sealant Council, Inc., 1627 K St., N.W., Ste. 1000, Washington, D.C. 20006).

(Nov. 2-4)—110th Annual Meeting and Industry Leadership Conference of the National Paint and Coatings Association (NPCA). Atlanta Hilton and Towers, Atlanta, GA. (NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597; (202) 462-6272).

(Nov. 3-5)—ICE '97—FSCT Annual Meeting and International Coatings Expo and Technology Conference (Formerly Annual Meeting and Paint Industries' Show). Georgia World Congress Center, Atlanta, GA.

(Nov. 6-8)—Second North American Research Conference on Emulsion Polymers/Polymer Colloids. Sponsored by the State University of New York. Hilton Head Island, SC. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Nov. 12)—"Effects of Surface Finish on Corrosion Testing." Sponsored by the American Society for Testing and Materials (ASTM). San Diego, CA. (ASTM, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959).

(Nov. 17-20)—ICALEO '97. Sponsored by The Laser Institute of America. Catamaran Resort Hotel, San Diego, CA. (Laser Institute of America, 12424 Research Pkwy., Ste. 125, Orlando, FL 32826).

(Dec. 8-10)—Electroless Nickel '97. Sponsored by *Products Finishing* Magazine. Hyatt Regency, Cincinnati, OH. (Cindy Goodridge, Gardner Management Services, 6915 Valley Ave., Cincinnati, OH 45244-3029).

1998—North America

(Jan 13)—PCI Technical Subcommittee on Test Methods and ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials. Sheraton Harbor Island Hotel, San Diego, CA.

(Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041).

(Feb. 22-24)—"Color and Design: 21st Century Technology and Creativity." Williamsburg Conference sponsored by the Inter-Society Color Council. Williamsburg, VA. (Robert T. Marcus, ISCC Publicity Chairman, D&S Plastics International, 100 S. Mitchell Rd., Mansfield, TX 76063).

(Mar. 8-12)—AIChE Spring National Meeting/Petrochem and Technochem '97." Sponsored by the American Institute of Chemical Engineers (AIChE). Sheraton New Orleans, New Orleans, LA. (AIChE, 345 E. 47th St., New York, NY 10017).

(May 11-14)—Eastern Training Conference II. Sponsored by the Philadelphia Society. Valley Forge Convention Center, King of Prussia, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808).

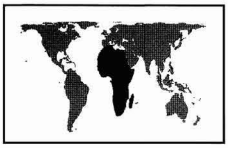
(June 9)—ASTM D01.51 on Powder Coatings. Sponsored by the American Society for Testing and Materials (ASTM). Omni Inner Harbor Hotel, Baltimore, MD. (Jeffrey Hagerlin, O'Brien Powder Products, 9800 Genard Rd., Houston, TX 77041-7624).

(Aug. 31-Sept. 3)—"Safety in Ammonia Plants and Related Facilities." Sponsored by the American Institute of Chemical Engineers (AIChE). Charleston Place, Charleston, SC. (AIChE, 345 E. 47th St., New York, NY 10017).

(Sept. 10-11)—"Engineering and Construction Contracting Conference." Sponsored by the American Institute of Chemical Engineers (AIChE). The Phoenician, Scottsdale, AZ. (AIChE, 345 E. 47th St., New York, NY 10017).

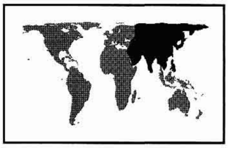
(Sept. 22-24)—Powder Coating '98. Sponsored by The Powder Coating Institute. Indiana Convention Center, Indianapolis, IN. (Vicki Thatcher, Conference Coordinator, P.O. Box 54464, Cincinnati, OH 45254).

1998—Africa



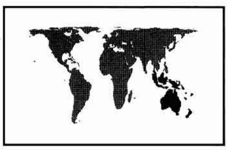
(Mar. 6-8)—"Coatings for Africa '98." Sponsored by The Oil & Colour Chemists' Association's (OCCA) South African Division, the Natal Section, and Surfex Ltd. International Convention Centre, Durban, South Africa. (Christopher Pacey-Day, OCCA, 967 Harrow Rd., Wembley, Middlesex, England HA0 2SF).

1997—Asia



(Oct. 22-24)—"New Developments in Colour Material Science and Technology." 70th Anniversary Conference on Colour Materials Tokyo sponsored by the Japan Society of Colour Material. Arcadia Ichigaya (Shigaku Kaikan), Tokyo, Japan. (Shuichi Hamada, Japan Society of Colour Material, Kitamura Bldg. 5F, 9-12, 2-chome, Iwamoto-cho, Chiyoda-ku, Tokyo 101, Japan).

1997—Australia



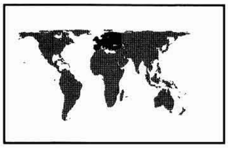
(July 17-19)—"Asset Protection Through Surface Coatings." 39th Annual Conference sponsored by Surface Coatings Association Australia, Inc. Burswood Resort Convention Centre, Perth, Western Australia. (Surface Coatings Association Australia Inc., P.O. Box 1109, Canning Vale, Western Australia, 6155).

(July 24-27)—"Replacement, Refurbishment & Renewal." SCANZ '97. Sponsored by Surface Coatings Association, New Zealand, Inc. Wairakei Resort. (Derek Taylor,c/-Coates NZ Ltd., P.O. Box 12748 Penrose).

1998—Australia

(July 29-Aug. 1)—"Coatings for the Future." Second Trans Tasman Surface Coatings Conference. Co-sponsored by Surface Coatings Association, New Zealand, Inc., and Surface Coatings Association, Australia, Inc. The Carlton Hotel, Auckland, New Zealand. (98 Transtas Conference, P.O. Box 5192, Wellesley St., Auckland, New Zealand).

1997—Europe



(May 15-16)—"Transatlantic Coatings Technology—Diverging or Converging." Sponsored by the Birmingham Paint, Varnish and Lacquer Club. Solihull, N. Birmingham, England. (Joe Brown, Blagden Chemicals Ltd., Piperell Way, Haverhill, Suffolk, CB9 8PH; Telephone: 01440 62821).

(May 17-18)—FSCT Spring Board of Directors Meeting. May 17—Social Tour; May 18—Board Meeting. Hyatt Regency, Birmingham, England.

(May 19-22)—"Paint Technology." Training course sponsored by the Paint Research Association. Teddington, Middlesex, United Kingdom. (Heena Mehta, PRA, 8 Waldegrave Rd., Teddington, Middlesex, TW11 8LD, United Kingdom).

(May 29-June 1)—15th SLF-Congress. Sponsored by the Skandinaviska Lackteknikers Förbund (SLF). Lillehammer, Norway. (Bent Haflan, Jotun A/S, P.O. Box 2021 Hasle, N-3235 Sandefjord, Norway; or Svein Singstad, Scanox A/S, P.O. Box 42 Ainabru, Norway).

(June 2-4)—"Printing Ink Technology." Training course sponsored by the Paint Research Association. Teddington, Middlesex, United Kingdom. (Heena Mehta, PRA, 8 Waldegrave Rd., Teddington, Middlesex, TW11 8LD, United Kingdom).

(June 9-11)—19th Annual International Conference on the Degradation and Stabilization of Polymers. Sponsored by the State University of New York. Luzern, Switzerland. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(June 9-11)—"Radiation Curing Technology." Training course sponsored by the Paint Research Association. Teddington, Middlesex, United Kingdom. (Heena Mehta, PRA, 8 Waldegrave Rd., Teddington, Middlesex, TW11 8LD, United Kingdom).

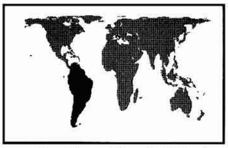
(June 16-18)—RadTech Europe '97. Sponsored by Vincentz Verlag. Palais de Congrés, Lyon, France. (Esther Schwencke, Vincentz Verlag, P.O. Box 67 42, D-30062 Hanover, Germany).

(June 17-20)—International Intensive Short Course on the Science and Technology of Pigment Dispersions. Sponsored by the State University of New York. Luzern, Switzerland. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(July 7-11)—23rd Annual International Conference on Organic Coatings: Waterborne, High-Solids, and Powdered Coatings. Sponsored by the State University of New York. Athens, Greece. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Aug. 18-22)—"Advances in Emulsion Polymerization and Latex Technology." Short course co-sponsored by the Emulsion Polymers Institute, Lehigh University and Georgia Institute of Technology. Berghotel Schatzalp, Davos, Switzerland. (F. Joseph Schork, School of Chemical Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0100).

1997—South America



(Sept. 15-17)—Fifth International Paint Congress and Exhibition on Paint Industry Suppliers. Sponsored by the Brazilian Association of Paint Manufacturers (ABRAFATI). Palacio de Convenções do Anhembi, São Paulo, Brazil. (Congress Organization Secretariat, Específica S/C Ltda., Rua Augusta, 2516-2° andar-cj. 22, 01412-100-São Paulo, SP-Brazil).

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Humbug from Hillman

Here are some excerpts from a couple of columns written by columnist Carl Strock that Fred Billmeyer found in the *Schenectady Sunday Gazette*:

Word Watch

In the *Homonym Hopper* I find "not spent in vein," from a local paper and the warning, "Ohio residence and 5 1/2% sales tax," from an ad for a T-shirt.

I also see, in an Associated Press report, a complaint about government medical benefits going to the "well-healed," which surely is not what was meant but which manages to be quirkily apt nevertheless.

In Mrs. Malaprop's Basket, meanwhile, we have "imminent domain," "marital arts," and an ad for "portable office petitions," collected from various local newspapers, as well as my favorite, from a letter to a local government leader regarding a hiking trail: "What was public sediment at the conception of the trail and what has been the public sediment now that the trail is in full use."

We also have the wife of a criminal suspect telling an Associated Press reporter, "I'm not into answering any questions right now. I'm very distorted." (Which she may have been actually.)

We have the writer of a letter to a local paper raising the possibility of Glenville "succeeding from Schenectady County."

In the department of translingual embarrassments, we have the obituary from this newspaper stating that a certain party was "born in Gerburtsurkunde, Germany," which illustrates the danger of taking information off unfamiliar documents, since Gerburtsurkunde means "birth certificate."

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I think that Dave Platt has just about completed his graduate course in whatever it is he has been learning. Here are a few items from his doctorate thesis:

—I've learned to be generous with praise but cautious with promises.

—I've learned you shouldn't buy cheap shoes, cheap tools or cheap toilet paper.

—I've learned that people who lie for you will lie to you.

—I've learned that the trick is to live a long time without growing old.

—I've learned that I don't understand women and never will. (Doris, please note—his doctorate is being withheld).

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Sid Lauren writes:

An article in *The New York Times* described the incredibly shoddy construction that was being observed recently on houses that were built for as much as $600,000. That reminded me of a story that I heard during the post war building boom, when hundreds of tract houses were being thrown up overnight.

At one of these tracts, during an inspection by the general contractor, he saw a house collapse before his eyes when a crew began to pound the nails into the exterior siding. "Dammit!" he shouted at the nearby siding contractor. "Didn't I tell you not to start nailing on the siding until the interior wallpaper has been applied?"

As in our industry, "order of addition can make all the difference."………Funny??

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From our dear friend, Lois Price, another questionable story:

There is a funeral in San Francisco. The casket rolls away from the pall bearers and goes careening throughout the streets, gaining speed as it winds downhill through the town. At one point it goes through a major intersection, without damage, but causing all the cars trying to avoid it to collide. Turmoil, and nobody can catch the coffin.

Ultimately it ends up crashing through the window of a pharmacy. The box springs open, the corpse sits up and says, "Do you have anything to stop my coffin?"

Alright, I apologize—I apologize—I apologize!!!

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Actual Newspaper Headlines sworn to by Steve Garger:

—Something Went Wrong in Jet Crash, Expert Says

—Police Begin Campaign to Run Down Jaywalkers

—Survivor of Siamese Twins Joins Parents

—Iraqi Head Seeks Arms

—Is There a Ring of Debris around Uranus?

—Miners Refuse to Work After Death

—Killer Sentenced to Die for Second Time in 10 Years

—War Dims Hope for Peace

—Enfield Couple Slain: Police Suspect Homicide

—Local High School Dropouts Cut in Half

—Red Tape Holds Up New Bridge

—Some Pieces of Rock Hudson Sold at Auction

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