November 1995

JCT
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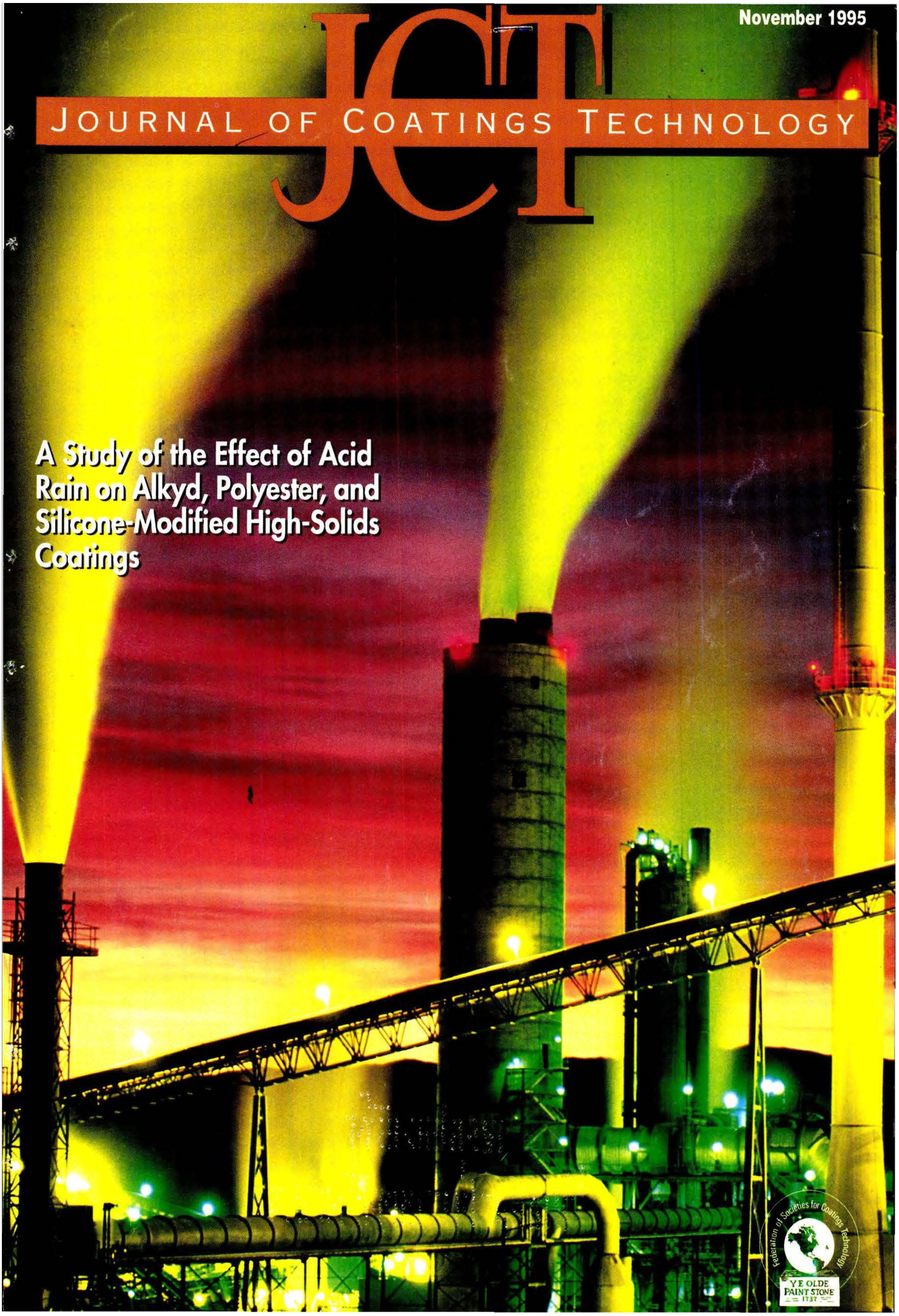

A Study of the Effect of Acid Rain on Alkyd, Polyester, and Silicone-Modified High-Solids Coatings

Federation of Societies for Coatings Technology
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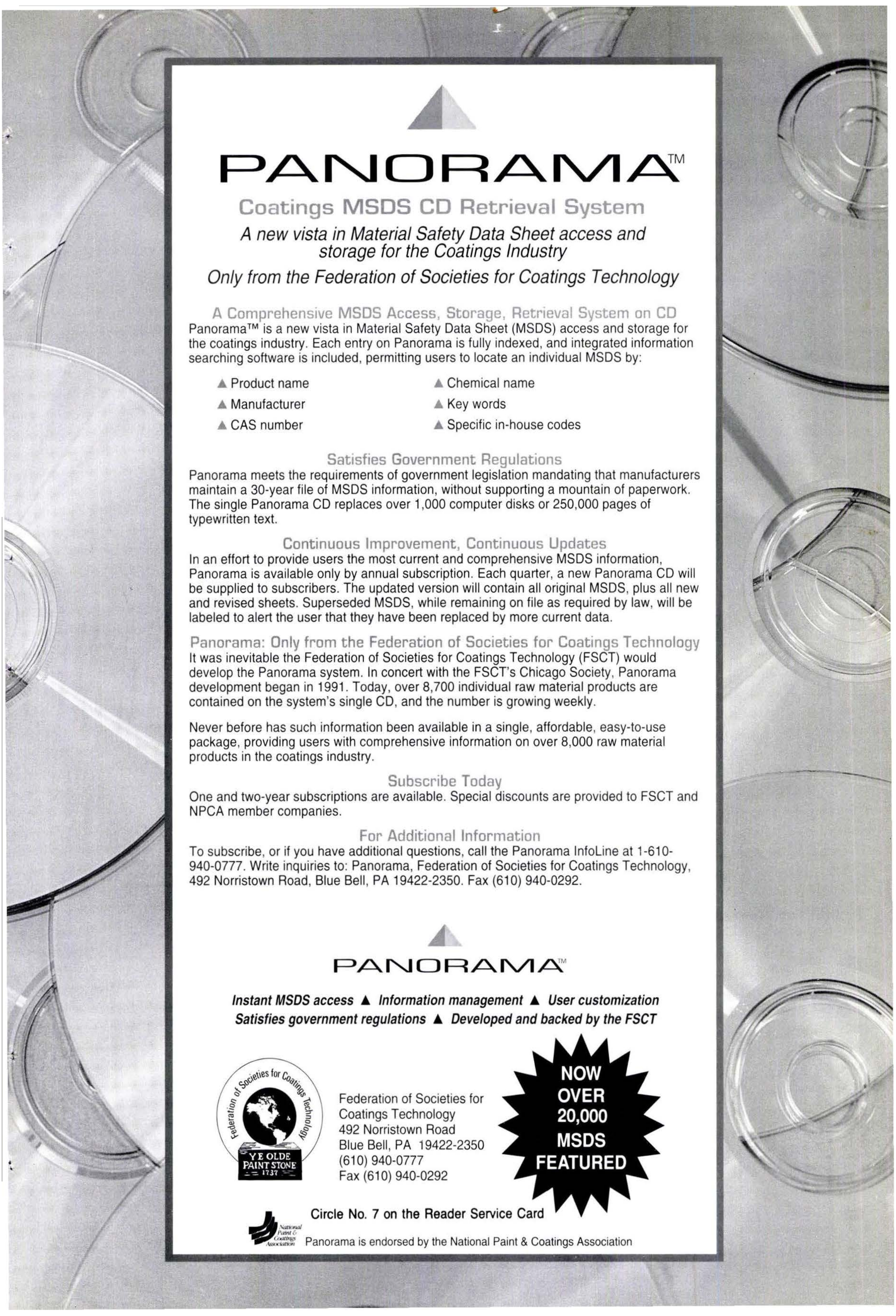

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JOURNAL OF COATINGS TECHNOLOGY

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 All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere.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.

SUBMISSION OF MANUSCRIPTS...

...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 1995 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). Another excellent reference work is "How to Write and Publish a Scientific Paper," by Robert A. Day (ISI Press, 3501 Market St., University City Science Center, Philadelphia, PA 19104).

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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FSCT and NPCA: A Question of Cooperation

The future relationship between the Federation and the National Paint & Coatings Association has been the topic of stories recently in industry press, and talk among industry members during the recent conventions. At the center of this controversy is the false rumor of a potential merger of the organizations, and the all too true threats by some NPCA-member companies to withdraw support of FSCT membership and activities and NPCA's call for a share of the Federation trade show revenue. While the FSCT and NPCA have held many discussions on the topic of "cooperation" in seeking a resolution of differences, in all of the debate there is the same concern shown by both parties for their respective organizations, their memberships and the industry as a whole.

A Cooperative Past and Hope for the Future

Lost somehow in the shuffle of rumors and talk is the fact that the two organizations have agreed, not only in principle but in practice, on a variety of forms of cooperation: the joining of our separate manufacturing committees into a joint industry committee; the rescheduling of Annual Meetings so that they are held over the same dates in the same city (a most needed benefit to our suppliers!); and, significant FSCT funding grants in the past to support the NPCA State Paint Council network.

In its discussions with the NPCA the FSCT has continually maintained its obligation to its primary mission: that of providing to its membership and to the industry the educational and professional development programs required to maintain technical proficiency. The FSCT's objectives can be said to extend to advance further the technical competence of personnel on whom the coatings industry relies to meet those environmental regulations which NPCA, for all of its efforts, may be unable to moderate.

For its part, NPCA has maintained that regulatory issues are at the heart of the industry's future and that the resources of the industry, including the revenues generated by the industry's trade shows, should be used to alleviate onerous legislation.

Are these missions mutually exclusive? Does any organization "owe" it to another to support at its expense programs which do not fall within its mission? Can a compromise of cooperation be reached that both organizations find acceptable?

FSCT Seeks to Serve the Entire Industry

Good questions . . . and further discussion among the various industry organizations may produce a solution, for the topic encompasses not just the FSCT and NPCA but truly *all* associations which serve the coatings industry. However, while pursuing a solution the Federation is committed to the implementation of its strategic plan to extend its services to all aspects of this broad ranging industry. No longer limited to liquid coatings, FSCT's membership requires a continuing series of programs and educational resources in the development, manufacture and use of inks, powder coatings, UV/EB coatings, thin films, etc., as well as traditional paints and coatings.

Meanwhile, the inevitable tide of corporate mergers has made international business commonplace and distance inconsequential. Through its affiliation with its sister technical organizations around the world, the Federation seeks to cooperate internationally in sharing the technical information resources of the world's coatings personnel. In implementing this segment of its strategic plan, the FSCT is fulfilling its commitment to its international membership and to the multinational manufacturers and industry suppliers which its serves.

New Directions, New Name

In asserting this dual commitment, the Federation has approved a new format to its Annual Meeting and Paint Industries' Show. The 1996 event will feature a focused technical conference at which attendees can participate in a number of educational tracks in coatings technology and manufacture. The convention will include exhibits featuring products and services covering the spectrum of industry needs, and will seek to include as broad a range of current and cutting edge research as can be found anywhere. To highlight these significant changes, the Federation has renamed the events the "International Coatings Technology Conference" and "International Coatings Expo."

The Federation has prided itself in its ability to answer the needs of its membership and the industry; its perseverance in seeking a solution to the industry relations questions posed above only underscores the commitment to the entire industry that the FSCT serves.

Robert F. Ziegler
Executive Vice President

Translations provided by: French—Montreal Society Member Mario Côte, of Eastman Chemical Canada Inc.–Montreal; and Spanish—Jesús Camacho, of Instituto Mexicano de Tecnicos en Pinturas y Tintas.

A Study of the Effect of Acid Rain on Alkyd, Polyester, and Silicone-Modified High-Solids Coatings—Northwestern and Montreal Societies for Coatings Technology

JCT, Vol. 67, No. 850, 19 (Nov. 1995)

Acid rain has been recognized as a factor in the degradation of applied coating materials. Mechanisms of degradation reported in the literature show a synergism when acid rain, sulfur dioxide, and UV light interact with certain coatings. The study reported here evaluated chemical as well as physical changes that occurred when alkyd, polyester, and silicone modified polyester high-solids coatings were exposed for nearly three years at five precipitation monitored sites in the United States and Canada. In addition, a simulated acid rain chamber that precludes the influence of UV light and a high concentration of sulfur dioxide was used to expose the panels.

The results clearly show degradation to be enhanced as the average pH of rainfall decreases. Evidence also indicates a difference in the chemical changes on the surfaces of coatings that are dependent on the components of the formulation, as well as variations in exposure conditions that are dependent on location. These observations and the changes that were recorded with Weather-O-Meter exposures are consistent with reports of synergistic behavior in the presence of UV light and sulfur dioxide.

Un Estudio de el Efecto de la lluvia Ácida Sobre Recubrimientos de Altos Sólidos Modificados de Silicona, Poliéster y Alquidálicos—Northwestern y Montreal Societies for Coatings Technology

La lluvia ácida ha sido reconocida como factor en la degradación de materiales de recubrimiento aplicado. Los mecanismos de degradación reportados en la literatura muestran un sinergismo cuando la lluvia ácida, el dióxido de azufre y la luz ultravioleta interactúan con ciertos recubrimientos. El estudio aquí reportado evalúa cambios físicos como químicos que ocurrieron cuando recubrimientos de altos sólidos de poliéster modificados de silicona, poliéster y alquidálicos fueron expuestos aproximadamente por tres años en cinco sitios monitoreados de precipitación en los Estados Unidos y Canadá. Además, un cambiador de lluvia ácida simulada que previene la influencia de luz UV y altas concentraciones de dióxido de azufre fue usado para exponer los paneles.

Los resultados muestran claramente degradación para ser encarecido como el PH promedio de la caída de agua disminuye. La evidencia también indica una diferencia en los cambios químicos sobre la superficies de recubrimientos que son dependientes de los componentes de la formulación, así como las variaciones en las condiciones de exposición que dependen de la localización.

Estas observaciones y los cambios que fueron registrados con exposiciones al medidor o clima son consistente con los reportes del comportamiento sinergístico en presencia de luz UV y dióxido de azufre.

Solution and Solid C^{13} NMR Studies of Multifunctional Polyolacrylate Networks—Adrian Lungu and D.C. Neckers

JCT, Vol. 67, No. 850, 29 (Nov. 1995)

Most photopolymerizable coating materials employed in various applications throughout industry are comprised of crosslinkable polyolacrylates. On a molecular level, these systems are difficult to characterize when polymerized, mainly because they are insoluble and intractable. Just a few techniques provide fundamental structural information or can be used to characterize the dynamic features of these complex, crosslinked gels.

We introduce the use of several C^{13} NMR techniques to address the problem of structural determination of photopolymerized polyolacrylates. We have used these techniques to study both the liquid and solid states of acrylic monomers and oligomers, and the network structure formed upon their photopolymerization. High resolution NMR has allowed us to consider the molecular structure of the acrylic groups belonging to each of a series of polyolacrylate monomers. In photopolymerization experiments, by measuring the relative integration of specific peaks in the carbon spectra as a function of time of irradiation and laser power, it is possible to determine the relative reactivity of monomers/oligomers used in the early stages of polymerization. By monitoring the variation of the proton $T_{1\rho}$ relaxation time, changes in the crosslink density, and in the mobility of the polymeric chains, can be followed throughout the photopolymerization process. The degree of crosslinking is correlated to the relaxation times and increases with an increasing power of the irradiating laser even under conditions where the degree of conversion, as measured by quantitative infrared absorption of the 810 cm^{-1} band of the acrylate is almost unchanged.

Solución y Estudios de NMR C^{13} Sólido de Redes de Poliolacrilato Multifunctional—A. Lungu y D.C. Neckens

La mayoría de los materiales de recubrimiento fotopolimerizable empleados en varias aplicaciones en la industria están comprendidas de poliolacrilatos entrecruzables. A un nivel molecular, estos sistemas son dificiles de caracterizar cuando polimerizan principalmente porque son insolubles e intratables. Solo pocas técnicas proporcionan información estructural fundamentalmente o pueden ser usadas para caracterizar las apariencias dinámicas de esos complejos, geles entrecruzados.

Presentamos el uso de varias técnicas de NMR C^{13} para direccionar el problema de la determinación estructural de poliolacrilatos fotopolimerizados. Hemos usado estas técnicas para estudiar tanto estados sólidos como líquidos de monómeros acrílicos y oligómeros, y la estructura de red formada sobre su fotopolimerización. La alta resolución NMR nos ha permitido considerar la estructura molecular delos grupos experimentos de fotopolimerización, por medición de la integración relativa de picos específicos en el espectro de carbono como una función del tiempo de irradiación y el poder del láser, es posible para determinar la reactividad relativa de monómeros/oligómeros usados en la etapas tempranas de la polimerización. Por monitoreo de variación del protón $T_{1\rho}$ tiempo de relajación, cambios en la densidad de entrecruzamiento y en la movilidad de las cadenas poliméricas, pueden ser seguidas a través de todo el procesos de fotopolimerización. El grado de entrecruzamiento está correlacionada con los tiempos de relajación e incrementos con un poder de incremento de láser de irradiación, aún bajo condiciones donde el grado de conversión, como se midió por absorción infrarroja cuantitativa de la banda de 810 cm de el acrilato, casi no presenta cambio.

Computer Simulation of Particle Packing in Acrylic Latex Paints—G.T. Nolan and P.E. Kavanagh

JCT, Vol. 67, No. 850, 37 (Nov. 1995)

Computer simulation of the random close packing of hard pigment particles and deformable latex particles in acrylic latex paint systems is described. The simulation requires only the particle size distribution of the pigment, the particle size distribution of the latex, and the deformation or softness of the latex. If the data are known, the packing density can be determined from the simulation. If paints with a range of pigment volume concentrations (PVC) are simulated, the critical PVC can be predicted from plots of packing density against PVC. The predicted values are in good agreement with experiment.

Simulación Computarizada del Empaquetamiento de Partículas en Pinturas de Látex Acrílico—G.T. Nolan y P.E. Kavanagh

La simulación computarizada de el empaquetamiento de cierre aleatorio de partículas de pigmento duro y partículas de látex deformable en sistemas de pinturas de látex acrílico es descrita. La simulación requiere solamente de la distribución de tamaño de las partículas de el pigmento, la distribución del tamaño de partícula de látex y la deformación y blandura de densidad de empaquetamiento puede ser determinada a partir de la simulación. Si las pinturas con un rango de concentraciones de volumen de pigmento (PVC) son simuladas, la PVC crítica, puede ser predicha a partir de gráficas de densidad de empaquetamiento contra PVC. Los valores predichos están acorde con el experimento.

FSCT Announces New Convention Format and Name: International Coatings Technology Conference and Expo

The Federation of Societies for Coatings Technology, in implementing its strategic plan to expand its services to all areas of the paint and coatings industry, is pleased to announce the new format of its 1996 Annual Convention, which will take place at McCormick Place North, in Chicago, on October 23-25.

With the "International Coatings Technology Conference" and "International Coatings Expo" the FSCT will develop programs and opportunities for technical coatings personnel and industry suppliers which will address the current needs and future challenges faced by the coatings industry internationally. The new format will take the place of the former Annual Meeting and Paint Industries' Show.

The format, approved by the Federation's Board of Directors at its recent meeting in St. Louis, will include two separate, but overlapping, segments. Invited to exhibit at the International Coatings Expo (ICE) will be suppliers to all aspects of coatings technology, manufacture, and application. Raw material, manufacturing and application equipment, instrumentation manufacturers, and environmental and computer software service suppliers will feature a variety of products and services for powder coatings, inks, low energy cure (UV/EB) coatings, thin films, adhesives, sealant, and other specialized coatings, as well as traditional liquid coatings.

A few of the categories of products and services to be featured at the International Coatings Expo include:

Additives
Application Equipment and Processes
Automation Equipment
Colorants
Computer Software
Consulting Services
Containers
Emulsions
Environmental and Regulatory Services
Filtering and Straining Equipment
Grinding Mills
Lab Mills
Manufacturing and Production Equipment
Material Handling
Measurement Instruments
Packaging Equipment
Pigments
Process Control Systems
Resins
Rheological Testing Instrumentation
Solvents
Surface Preparation
Testing Laboratories
Waste Disposal
Weathering and Exposure Services

Complementing the Expo will be a general program of technical presentations on a variety of topics. Included in the program will be the Mattiello Memorial Lecture, the annual Roon Awards Competition presentations, technical presentations by FSCT Constituent Societies, and several papers sponsored by international coatings organizations.

Held in conjunction with the International Coatings Expo, the FSCT International Coatings Technology Conference will feature programming on specific topics of interest to the many segments of coatings formulation, manufacturing and application. Presented in a format of educational "tracks," presentations will lead the attendees through a specific subject with the result being an overall knowledge of that topic. Currently under discussion are a series of four one-day and four two-day "tracks."

While the convention will require separate registration fees to attend the events, the International Coatings Technology Conference fee will include attendance at the Expo and technical programs. Registration fees to attend the Expo will include the exhibits as well as the accompanying general technical program.

Information on exhibiting at the International Coatings Expo may be had by contacting the FSCT Headquarters at 610-940-0777.

Information on registration and programming for the International Coatings Technology Conference, or general programming at the Expo, will be available in early 1996.

Federation of Societies for Coatings Technology
YE OLDE PAINT STONE
1737

ice
INTERNATIONAL COATINGS EXPO

FSCT
Int'l Coatings Technology Conference

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Society Representative—Michael DePietro, Pratt & Lambert, Inc.

WLF Urges Court to Uphold Dismissal of Superfund Case Against Chemical Companies

The Washington Legal Foundation (WLF) filed a brief with the United States Court of Appeals for the Ninth Circuit in San Francisco, CA, urging it to uphold a lower court's dismissal of a major environmental case brought by the U.S. Justice Department and the State of California against several chemical companies. WLF argued that the statute of limitations had expired before the lawsuit was filed.

In *United States v. Montrose Chemical Corporation of California, et al.*, WLF argued that the three-year statute of limitations for natural resource damage actions set forth in the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) began to run on August 1, 1986. That was the date when the Department of the Interior promulgated its final rule establishing the essential framework for the natural resource damage assessment process under CERCLA. Consequently, the lawsuit filed by the Justice Department in early 1990 was too late as the district court ruled.

The government argues on appeal, along with a number of states, that although the final rule was promulgated in 1986 with respect to certain resource damage issues, other regulations involving minor resource damages, not directly applicable to this case, have not been finalized. Accordingly, they argue that the statute of limitations does not begin to run for any case until regulations covering all situations are completed.

Report from The Society of the Plastics Industry Reveals Decrease in Plastics Resins Production

According to The Society of the Plastics Industry (SPI), Washington, D.C., production of plastics resins totaled 5.5 billion pounds in July 1995, a 0.9% decrease from July of 1994.

The figures for July 1995 were down one percent from those of June 1995, while overall production in 1995 has totaled 40.2 billion pounds so far. This amount is a 6.6 percent increase over the same seven month period in 1994.

Sales and captive (internal) use of plastics resins in July 1995 totaled 5.3 billion pounds, a decrease of 5.5% from the same month one year ago. July 1995 sales and captive use was down 5.8% from the total of the previous month, June 1995. Sales and captive use in 1995 year-to-date totaled 40 billion pounds, a 1.4% increase from the same seven-month period in 1994.

The July 1995 figures are based on primary data on selected major plastics materials as compiled by Ernst & Young, Washington, D.C., for SPI's Committee on Resin Statistics.

August Construction Contracts Rebound from July

In a report released by the F.W. Dodge Division of The McGraw-Hill Companies, New York, NY, it was stated that the rate of new construction starts climbed six percent in August to an annualized $305.7 billion, bouncing back from July's modest downturn. Each of the building industry's three main sectors showed improvement, ranging from a 14% surge for nonresidential building to more moderate two to three percent growth for housing and nonbuilding construction (public works and utilities).

The latest's months data lifted the Dodge Index to 118 (1987=100), up from July's 111 as the Index posted its second highest reading so far in 1995. The year's high was achieved in June at a revised level of 119.

Nonresidential building's 14% increase in August lifted the pace of contracting to 111.1 billion, with gains registered in most nonresidential structure types. Store construction advanced from an already strong position with a 22% rise, which was matched by 23% growth for warehouses. Hotels were up 48%, and new factory construction climbed 27%. However, office building retreated eight percent during August.

Residential building in August rose two percent to $125.2 billion with an 11% pickup for the smaller multifamily segment. Regionally, only the West reported lower residential construction with a two percent decline.

Nonbuilding construction in August climbed three percent to $69.4 billion. Growth was shown by the environmental public works categories—water supply systems, up 19%; sewers, up 14%; and river/harbor development work, up 10%. Bridge construction also advanced in August with a four percent gain, but highways fell 13% from the exceptional volume of the previous two months.

At the end of 1995's first eight months, total construction on an unadjusted basis came in one percent below the previous year. By sector, residential construction was down nine percent, but nonresidential building was up eight percent and nonbuilding construction was up four percent. By geography, total construction was lower in the West, down four percent from a year ago, and the Midwest, down three percent. Slight improvement was shown in the Northeast with a one percent gain, and the South Atlantic and South Central regions, each with two percent improvement.

Daniel Products Announces Expansion for Jersey City Site

A multi-million dollar expansion is being planned for Daniel Products Co., Inc., Jersey City, NJ. The expansion will double the production capability of the company.

Construction is scheduled to begin in the fall of 1995 with completion expected by the third quarter of 1996.

Hazox Enters Agreement with Software 2000

An agreement between Hazox Corp., Media, PA, and Software 2000, Hyannis, MA, has been reached enabling Hazox to develop and market rights to Software 2000's HM2000 software applications.

Netzsch Inc. Acquires Condux Maschinenbau GmbH

Netzsch Inc., Exton, PA, has acquired Condux Maschinenbau GmbH & Co. KG, Hanau, Germany, by its affiliate company, Netzsch-Feinmahltechnik GmbH, Selb, Germany. Netzsch-Condux, the newly formed company, is a manufacturer of dry grinding and milling equipment.

New Address

The Mearl Corp., Briarcliff Manor, NY, has opened a new subsidiary office and warehouse at the following address:

The Mearl Corp.
Avenida Gustavo, No. 176-2,
Col. San Jeronimo Teptlacalco,
Tlalnepantla, CP 54090,
Edo. de Mexico, Mexico
Phone: 525-361-7091
Fax: 525-361-7409

Five Industrial Protective Coatings Standards Pass Society Ballot

Five standards from American Society for Testing and Materials (ASTM) Committee D-1 on Paint and Related Coatings Materials and Applications, specifically Subcommittee D01.46 on Industrial Protective Coatings, have passed society ballot and seven others are still under consideration within the task groups of the subcommittee.

The following five standards were approved by the society:

D 2200, Pictorial Surface Preparation Standards for Painting Steel Surfaces;

D 2092, Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting;

D 4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers;

D 4752, Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic Zinc-Rich Primers) by Solvent Rub; and

D 5702, Standard Practice for Field Sampling of Coating Films for Analysis for Heavy Metals.

The Surface Preparation Task Group D01.46.02 is reviewing D 4417, Test Methods for Measurement of Surface Profile of Blast Cleaned Steel; D 4940, Test Method for Conductimetric Analysis of Water-Soluble Ionic Contamination of Blasting; and D 2092, Guide for Preparation of Zinc Coated (Galvanized) Steel Surfaces for Painting.

Task Group D01.46.03 on Repainting developed standard D 610, Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces, which is at the society ballot stage. An additional standard that the task group has reviewed and updated is D 5064, Standard Practice for Conducting a Patch Test to Assess Coating Compatibility.

The Inspection Task Group D01.46.07 has revised D 3276, Guide for Painting Inspectors (Metal Subtrates) and the new Guide for Paint Inspectors (Concrete and Masonry Substrates).

Within Task Group D01.46.10 on Condition Assessment is the conversion of D 5065, Guide for Assessing the Condition of Aged Coatings on Steel Surfaces into a practice. The task group is seeking the withdrawal of D 5043, Test Methods for Field Identification of Coatings, since it is out-of-date.

Task Group D01.46.12 on Sampling is developing D 5702, Practice for Field Sampling of Coating Films for Analysis for Heavy Metals.

Two new standards are being developed within Task Groups D01.46.13 on Guide for Testing and D01.46.14 on Chemical Immersion. D01.46.13 has developed a Guide for Testing Industrial Protective Coatings and D01.46.14 on Chemical Immersion has developed a Test Method for Immersion Resistance by modifying D 3912, Chemical Resistance of Coatings Used in Light-Water Nuclear Power Plants.

For additional technical information, contact Subcommittee Chairman, Gary Gardner, The Sherwin-Williams Co., 549 E. 115th St., Chicago, IL 60628.

ISO Certification. . .

ISO 9002 registration was issued to **U.S. Silica's** Mill Creek, OK, plant. This makes the Mill Creek plant the fourth silica sand plant to receive the award.

Varian's Instruments business U.S. field organization has received ISO 9002 registration encompassing sales, service, administrative, and training operations in the United States.

The Pigments Business Unit of **Hoechst Celanese Corp.**, Coventry, RI, has attained ISO 9001 certification through Det Norske Veritas.

Lancer Dispersions, Inc., Akron, OH, was awarded ISO 9002 certification after an audit and assessment of the company.

Three of **Datacolor International's** (DCI), Lawrenceville, NJ, manufacturing/technical centers have been granted ISO 9001 certification. The three facilities recognized are located in Lawrenceville, NJ; Stockport, Cheshire, United Kingdom; and Salvis, Reussbuhl, Switzerland.

The Transelco Division of **Ferro Corp.**, Cleveland, OH, received ISO 9001 certification by the Ceramic Industry Certification Scheme Ltd.

The Parts Company of **W.W. Grainger, Inc.**, Chicago, IL, has achieved ISO 9002 certification.

Rhone-Poulenc, Cranbury, NJ, has completed ISO 9002 certification for its manufacturing facility located in St. Catharines, Ontario, Canada.

Universal Chemicals & Coatings, Inc. (Unichem), Elk Grove Village, IL, has achieved ISO 9001 certification. Unichem is a manufacturer of specialty coatings to the coil coating, steel shipping containers, and automotive industries.

The quality management systems of the **Empire Die Casting and Industrial Castings Divisions of Empire Die Casting Co., Inc.**, Cleveland, OH, have earned ISO 9002: 1994 certification. These divisions produce finished parts in aluminum, zinc, zinc aluminum, and magnesium for various market sectors.

Witco's manufacturing operations in Bergkamen and Steinau, Germany have completed registration to the ISO 9001 standard, extending their ISO 9002 registration to include all manufacturing, research and development, and sales and adminstration.

ISO 9002 registration has been granted to **Engelhard Corp.'s**, Louisville, KY, facility for manufacturing organic color pigments and aqueous dispersions.

Chemcentral Corp. Opens Morrisville, PA, Facility

Following 18 months of construction, Chemcentral Corp., has opened their newest facility in Morrisville, PA.

Situated on 7.2 acres, the new facility contains approximately 5,600 square feet of finished office space, expandable up to 11,200 square feet, an enclosed warehouse of 22,000 square feet, and 8,200 square feet of temperature controlled storage. In addition, the facility includes an aboveground tank farm with total storage capacity of 460,000 gallons, as well as two 8,000 gallon blend tanks.

The covered dock area can accommodate up to three tanker trucks for loading and unloading purposes, and features a drum refurbishing area and container fill room. Rail service is also available from the new site.

Gibson-Homans to Purchase Wallcovering Adhesive Line

The Gibson-Homans Co., Twinsburg, OH, has entered into a definitive agreement to purchase the wallcovering adhesive line of Custom Building Products. The sale includes Custom's complete line of wallcovering adhesives, and Wallpaper Pal®, and Border Buddy® wallcovering installation systems.

Philadelphia Society's Coatings Newcomers Training Course Planned for May 8-9 1996

All technical and nontechnical newcomers to the coatings industry are invited to attend the Philadelphia Society for Coatings Technology's Eastern Training Conference and Show on May 8-9, 1996. Slated for the Valley Forge Convention Center, Valley Forge, PA, this course is designed to help attendees understand the challenges and opportunities in the coatings industry.

Participants will learn the basic principles of coatings technology during a two-day series of lectures. The program will consist of 10 speakers covering the following topics:

- Composition of coatings/resins;
- Composition of coatings/pigments;
- Composition of coatings/additives;
- Trade sales paints;
- Industrial finishing;
- Laboratory testing;
- Coatings formulation concepts;
- Handling customer complaints;
- Environmental considerations—MSDS; and
- Coating specifications.

In addition to the conference, exhibit spaces are also available for a nominal fee.

The tentative cost for both the Training Conference and Show is $125, which includes lunch and course notes. Registration is limited to 150 attendees.

For more information, contact Wayne Kraus, Hercules, Inc., Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435. For show information and booth reservations, contact Sam Firestone, S.E. Firestone Associates, Inc., 101 Surrey Rd., Melrose Park, PA 19207-2931; (215) 635-1366.

ISCC Annual Meeting Set for May 5-7, 1996 in Florida

On May 5-7, 1996, the Inter-Society Color Council will hold its annual meeting at the DoubleTree Guest Suites Resort at Walt Disney World Village, Lake Buena Vista, FL.

The first two days of the meeting will focus on the special interest groups on fundamental and applied color research (I), industrial applications of color (II), and Color in Art, Design and Psychology (III); and of project committees on improved colorimetry (#49) and illuminants for commercial lamps (#50).

The final day will feature a symposium on color and appearance measurement sponsored in conjunction with ASTM Committee E-12 on Appearance.

For additional information, contact Robert T. Marcus, ISCC Publicity Chair, c/o Pantone, Inc., 590 Commerce Blvd., Carlstadt, NJ 07072-3098.

Lehigh University Hosts 27th Annual Short Course on Emulsion Polymerization June 3-7, 1996

The 27th annual one-week short course, "Advances in Emulsion Polymerization and Latex Technology," will be offered at Lehigh University, Bethlehem, PA, during the week of June 3-7, 1996. This course is designed for engineers, chemists, other scientists, and managers who are actively involved in emulsion work and for those who wish to develop expertise in the area.

The course is an in-depth study of the synthesis and properties of high polymer latexes. The subject matter includes a balance of theory and applications as well as a balance between chemical and physical problems. Lectures, given by leading academic and industrial workers, begin with introductory material and review, and progress through recent research results.

The fee for the course is $950 for the entire week or $300 per day for any part.

For additional information, contact Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015.

ASTM to Conduct Symposium on Durability Testing

The American Society for Testing and Materials Committee G03 on Durability of Nonmetallic Materials will host a symposium on this subject January 23-24, 1996 at the Crown Sterling Suites, Fort Lauderdale, FL.

Papers on the characterization of natural and accelerated exposure environments and correlation studies comparing natural and instrumental durability testing will be presented. Additional papers will discuss the use of these test results to predict service life.

Registration for the symposium is $75 in advance, $100 on-site for non-ASTM members and is free to all ASTM members. For additional information, contact Symposium Chair, Robert J. Herling, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613.

Call For Papers

Prospective authors are invited to submit papers for presentation at the 22nd International Conference in Organic Coatings—Waterborne, High Solids, Powder Coatings—slated for July 1-5, 1996 in Vouliagmeni (Athens), Greece.

Topics to be emphasized in the technical sessions include, but are not limited to the following: polymers (waterborne, emulsion, powder, cure studies); rheology; films: formation properties, surface characterization, and testing; and coatings technology.

In addition, the organizing committee for the 18th International Conference in Stabilization and Controlled Degradation of Polymers, which is scheduled for June 17-19, 1996 in Luzern, Switzerland, have issued a call for posters.

The deadline for submissions is April 1, 1996. Send titles and one-page abstracts to A.V. Patsis, Institute for Materials Science, State University of New York, New Paltz, NY 12561.

Biochemical Replacements Topic of ILSR's Conference

The Institute for Local Self-Reliance (ILSR), Minneapolis, MN, will host a conference on "Industrial Use of Biochemicals: A Strategy for a Cleaner Future," in Chicago, IL, on November 29.

This conference will focus on biochemical substitutes available to some of the more polluting industries in the Great Lakes basin.

To obtain additional information, contact Jonathan Hamlow, Institute for Local Self-Reliance, 1313 5th St., S.E., Ste. 306, Minneapolis, MN 55414-1546.

PRA Conference on "Silicones in Coatings" Slated for January 29-31, 1996, in Brussels, Belgium

"Silicones in Coatings," the second conference in The Paint Research Association's, Teddington, England, series on "High Performance Coating Materials," is scheduled for January 29-31, 1996, at the Palace Hotel, Brussels, Belgium.

This conference is designed to provide international development in silicones and related products and a unique opportunity for cross-fertilization of ideas between industrial chemists, academic researchers, formulators, specifiers, and end users in order to accelerate progress.

The following papers will provide a forum to encourage discussions between those with expertise in silicone, fluoro-silicone, and related chemistry, with those seeking high-tech, high performance products to maintain and advance their position in the market:

"Silicones in Coatings—An Overview"—William Finzel, of Dow Corning USA;

"Silanes in Coatings"—William Herdle, of OSi Specialties S.A.;

"The Characterization of Silicones in Coating Applications"—Andrew Goodwin, of Dow Corning UK;

"Silicone Additives for Aqueous Coating Systems"—Karl-Heinz Käsler, of Bayer, Germany;

"The Use of Silicone-Based Additives in Coatings and Inks"—Wernfried Heilen, of Tego Chemie Service, Germany;

"Foam Control in Waterborne Coatings"—Thomas Easton, of Dow Corning UK;

"Silicone Modified Binders"—Ekkehard Patrick, of Wacker Chemie;

"Effect of Modified Silicone Copolymer Structures on Surface Tension"—András Szabó, of Technical University of Budapest;

"Silane Emulsions as Masonry Water Repellents"—Michael Wilson, of PCR Division of Harris Specialty Chemicals;

"Film-Forming Semi-IPNs as Anti-Graffiti Coatings for Various Building Materials"—Maria Zielecka, of Industrial Chemistry Research Insitute;

"Anti-Graffiti Coatings: A New High Performance Coating System"—Walter Schubert, of Herberts;

"Silicone Emulsion Paints and Silicone Microemulsion Primer: Long-life Facade Coating System"—Hans Mayer, of Wacker Chemie;

"Silicone Resin Emulsions: Application in Water Repellent Paint"—Eric Garcin, of Rhône-Poulenc;

"Silicones as Sealers for Masonry Coatings"—Hermann Kober, of Bayer;

"Adhesive Polysiloxanes with Hydrogen Bond Donors or Acceptors"—Dominique Teyssie, of Université de Cergy Pontoise;

"New Surface Coatings from Siloxane"—Janis Matisons, of Ian Wark Research Institute;

"New Siloxane Polymers for Stable, Flexible Film Coatings with Polyfunctional Properties and Perspectives of Their Applications"—S. Dolgoplosk, of Research Institute of Synthetic Rubber;

"Siloxane Oligomer Diols as Potential Intermediates for Novel Durable Coatings"—Janusz Kozakiewicz, of Industrial Chemistry Research Institute;

"Evaluation of Different Behavior Between Conventional Organically Modified Polysiloxanes and Reactive Polysiloxanes in Solvent-Borne Industrial Coatings"—Claudio Castiglione, EFKA Chemicals;

"Silicate Sources of Polyorganosiloxane Materials"—Dafydd Kendrick, of University of Greenwich;

"Release Liners for Self-Adhesive Products"—Peter Greenway, of Phazer Technologies;

"Surface Properties of Silicone Release Coatings"—M. Owen, of Dow Corning;

"New Low Surface Energy Materials Based on Fluorinated Polysiloxanes"—Sylvie Boileau, of CNRS;

"Hybrid Fluorinated Silicones: Influence of the Spacer Between the Silicon Atom and the Fluorinated Chain onto the Preparation and the Thermal Properties"—Francine Guida-Pietrasanta, of University of Montpellier;

"Release Coatings in the Printing Industry by Means of UV Curing"—Hardi Döhler, of The Goldschmidt;

"Waterborne Silicones as Water Repellents"—Dymphna Ormonde, of Dow Corning UK;

"New Developments in Silicone-Based High Temperature Resistant Coatings"—Colin Hull, of Ameron;

"Polysiloxanes for Powder Coatings"—Thomas Laubender, of Wacker Chemie;

"Organosilanes in High Performance, High Solids, and Powder Coatings"—Shelby Thames, The University of Southern Mississippi;

"Silicone Technology for Marine Fouling Release Coatings Systems"—Gregory Bausch, of Dow Corning, USA;

"Environmental Fate and Effects of Silicones from Coatings, Inks, and Polish Applications"—Christine Stevens, Dow Corning Belgium;

"Recent Developments in Radiation Cured Silicone Coatings"—Dave Gross, of GE Silicones Europe;

"Silanes, Silicones, and Silica in UV Curing Organic Hard Coats"—James Tonge, of Dow Corning USA; and

"Surface Control Additives for Radiation-Curing Systems"—Jay Adams, of Tego Chemie Service.

For additional information, contact Dip Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD England.

Mexico City to Be Site of CPMA's Color Pigments 1996

The Color Pigments Manufacturers Association (CPMA) Inc., Alexandria, VA, is sponsoring "Color Pigments 1996: Trade, Technology, and Regulation in the Americas" on February 6-8, 1996, at the Hotel Presidente Inter-Continental Mexico, in Mexico City, Mexico. The latest information on organic and inorganic color pigments and regulations and trade matters affecting those pigments of interest to both manufacturers and users of pigments throughout the Americas will be presented.

The symposium will review technological, regulatory, and legislative developments concerning the industry primarily in Canada and the United States to also include those developments throughout the Americas, especially in Mexico. In addition, trade, technological, and commercial areas of interest to those who manufacture color pigments and users of color pigments in the paints, inks, plastics, packaging, ceramics, cement, and cosmetics will also be addressed.

The registration fee for the first participant from a company is $550, with each additional registrant from the same company paying $150. This fee includes all educational seminars and receptions, breakfasts, refreshments, lunch, and proceedings.

For further information or registration materials, contact CPMA, P.O. Box 20839, Alexandria, VA 22320-01839.

Regulatory Update November 1995

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.

Environmental Protection Agency (EPA) September 29, 1995—60 FR 50804

Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities

Action: Final Rule

The U.S. Environmental Protection Agency (EPA) has issued a final NPDES general permit for storm water discharges associated with industrial activity in the following regions: Region I—the states of Maine, Massachusetts, and New Hampshire, and federal facilities located in Vermont. Region II—the Commonwealth of Puerto Rico and federal facilities located in Puerto Rico. Region III—the District of Columbia, and federal facilities located in Delaware and the District of Columbia. Region IV—the state of Florida. Region VI—the states of Louisiana, New Mexico, Oklahoma, and Texas. Region IX—the state of Arizona and federal facilities located in Arizona, and territories of Johnston Atoll and Midway and Wake islands. Region X—the state of Idaho, and federal facilities located in Idaho and Washington.

The permit covers storm water discharges associated with industrial activity to waters of the United States, including discharges through large and medium municipal separate storm sewer systems, and through other municipal separate storm sewer systems. The permit is intended to cover discharges from several types of industrial activities including chemical and allied products manufacturing facilities (paint).

This general permit became effective on September 29, 1995. Notices of Intent (NOIs) to be covered under this permit and Notices of Termination (NOT) to terminate coverage under this permit must be sent by December 28, 1995 to Storm Water Notice of Intent (4203), 401 M Street, S.W., Washington D.C. 20460. The complete administrative record is available through the Water Docket MC-4101, U.S. Environmental Protection Agency, street address above.

For further information, contact EPA's Water Office at (202) 260-9541.

Department of Labor Occupational Safety and Health Administration (OSHA) September 28, 1995—60 FR 50218

National Advisory Committee on Occupational Safety and Health; HazCom Workgroup Meeting

Action: Notice

The Occupational Safety and Health Administration (OSHA) has asked the National Advisory Committee on Occupational Safety and Health (NACOSH) to form a workgroup to identify ways to improve chemical hazard communication (HazCom) and right-to-know in the workplace.

OSHA has asked the committee to provide NACOSH with recommendations in approximately six months to simplify material safety data sheets, reduce the amount of required paperwork, improve the effectiveness of worker training, and revise enforcement policies so that they focus on the most serious hazards. Four members of NACOSH have been assigned to the HazCom Workgroup, which will be assisted by a variety of specialists in all aspects of hazard communication.

In addition, two of the workgroup meetings will be devoted to hearing from representatives of labor organizations, employers, and the public. The workgroup will meet approximately once a month for several months and will prepare draft recommendations which will be submitted to the full committee for its deliberation in public session.

At press time, the agenda for the first meeting, to be held October 19 and 20, was to include a review of issues to be covered by the HazCom Workgroup and the confirmation of dates and agenda items for the remaining workgroup meetings. A verbatim transcript will be made of the proceedings which will be available to the public in the OSHA Technical Data Center (TDC) located in Room N2625 of the Department of Labor Building; (202)-219-7500.

For additional information, contact Joanne Goodell, Director of Policy, Occupational Safety and Health Administration, Room N-3641, 200 Constitution Avenue, N.W., Washington, D.C. 20210; (202) 219-8021.

Environmental Protection Agency (EPA) September 27, 1995— 60 FR 49835

Dialogue Process on Identification of Lead-Based Paint Hazards

Action: Notice of Open Meetings

The U.S. EPA has established the schedule for meetings of the dialogue process to support the forthcoming rulemaking under section 403 of the Toxic Substances Control Act (TSCA). Section 403 directs the agency to "...promulgate regulations which shall identify...lead-based paint hazards, lead contaminated dust and lead contaminated soil." Through the dialogue process, the agency seeks to obtain information and individual perspectives on specific policy questions related to the rulemaking.

The meetings, which are open to the public, will be held from 10 a.m. to 6 p.m. on December 14, 1995 and January 18, 1996. The meetings will be held at the Grand Hyatt Washington, 1000 H Street, N.W., Washington, D.C. 20001.

All comments should be submitted in triplicate to: TSCA Document Receipts (7407), Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, Room E-G99, 401 M Street, S.W., Washington, D.C. 20460. All comments should be identified by the docket number OPPTS-62151.

Comments and data may also be submitted electronically by sending electronic mail (e-mail) to: ncic@epamail.epa.gov. Electronic comments must be submitted as an ASCII file avoiding the use of special characters and any form of encryption. Comments and data will also be accepted on disks in WordPerfect 5.1 file format or ASCII file format. All comments and data in electronic form must be identified by the docket number OPPTS-62151. No confidential business information (CBI) should be submitted through e-mail. Electronic comments on this proposed rule may be filed online at many Federal Depository Libraries.

For information on the dialogue process or the schedule, please contact Andrea Yang, Chemical Management Division (7404), Office of Pollution Prevention and Toxics, U.S. Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460; 202-260-4918, e-mail: yang.andrea@epamail.epa.gov.

Department of Transportation (DOT) Federal Highway Administration
September 22, 1995— 60 FR 49322
Controlled Substances and Alcohol Use and Testing; Foreign-Based Motor Carriers and Drivers
Action: Final rule

The U.S. Department of Transportation's Federal Highway Administration (FHWA) is extending the applicability of rules on controlled substances and alcohol use and testing to include foreign-based drivers of motor carriers operating in the United States. This action is taken pursuant to the Omnibus Transportation Employee Testing Act of 1991 and is consistent with the international obligations of the United States. The rules will apply to all foreign-based drivers and employers, who are predominantly from Canada and Mexico, to the same extent as those based in the United States.

This rule was effective October 23, 1995.

For information regarding FHWA alcohol and controlled substances testing requirements regarding 49 CFR part 382, contact the Office of Motor Carrier Research and Standards, (202) 366-1790. For information regarding alcohol and controlled substances testing legal issues, contact the Office of the Chief Counsel—Motor Carrier Law Division, (202) 366-0834. For requests for presentations on implementation of the alcohol and controlled substance testing requirements in foreign countries, contact the International Program (HPS-1), (202) 366-5370, Office of Motor Carrier Planning and Customer Liaison, Federal Highway Administration, Department of Transportation, 400 Seventh Street, S.W., Washington, D.C. 20590.

Department of Transportation (DOT) Research and Special Programs Administration
September 21, 1995— 60 FR 49048
Crashworthiness Protection Requirements for Tank Cars; Detection and Repair of Cracks, Pits, Corrosion, Lining Flaws, Thermal Protection Flaws and Other Defects of Tank Car Tanks
Action: Final rule

The Department of Transportation's Research and Special Programs Administration (RSPA) is amending the hazardous materials regulations (HMR) to, among other things, require facilities that build, repair, and ensure the structural integrity of tank cars, to develop and implement a quality assurance program (QAP); increase the frequency for inspection and testing of tank cars for added safety; require the use of protective coatings on insulated tank cars; remove "grandfather" provisions allowing certain uses of tank cars; and improve the puncture resistance of tank cars used for certain high hazard materials, including those that are poisonous-by-inhalation (PIH) and those determined by the U.S. Environmental Protection Agency to pose health and environmental risks.

Voluntary compliance with these regulations, as amended, is authorized November 1, 1995.

For further information, contact Ed Pritchard at (202) 366-0509 or James H. Rader at (202) 366-0510, Hazardous Materials Division, DOT, Washington, D.C.

Superfund Bill Quashed by Senator Dole—A Republican-sponsored bill that would extend liability relief to parties potentially responsible for Superfund cleanups through an accelerated cleanup tax credit was denounced by Senate Majority Leader Robert Dole (R-KS) on October 6.

The legislation, S. 1285, introduced by Senator Robert Smith (R-NH) would allow PRPs to be assessed only for the costs of cleanup associated with their actions, and would be given a 50% tax credit for their pre-1980 cleanup costs. This provision deviated substantially from Smith's original proposal which called for full retroactive liability repeal at non-federal Superfund sites.

Senator Dole's opposition to the bill lead to the cancellation of a hearing on the measure before the Senate Environment and Public Works Subcommittee on Superfund, Waste Control and Risk Assessment, scheduled for October 12. Reportedly, Dole is opposed to the funding mechanism in the Smith bill and would rather see a partial repeal of retroactive liability.

Senator Smith was reportedly "shocked" by Dole's response to his bill, and he said that during negotiations he had no indication that Dole would not support the tax credits. Senator Smith also suggested that the Senate Finance Committee is discussing a provision that he said could kill Superfund reform. Reportedly, the committee is discussing the possibility of extending Superfund taxes for the next seven years (with no tax credits). The extension would include the environmental income tax, the petroleum tax, and the chemical feedstock tax.

Apparently, many of the Superfund bills currently in both Houses of Congress are being revised to tone down complete liability repeal. Shortages in the budget are being cited as the reason for letting go of the original repeal proposals.

Regulatory Reform Efforts by Chemical Industry Rebuked by EPA—In a recent statement made by an official at the U.S. EPA, the "cooperative" relationship between EPA and the U.S. chemical industry is at risk of unraveling over the chemical industry's strong support of regulatory reform.

Reportedly, EPA is frustrated and displeased by what it terms as "intentional " efforts to impair the agency by the attachment of special provisions to appropriations bills and "neglectful" actions to undermine EPA, such as substantial funding cuts, that have been supported by chemical industry groups.

The official indicated that the push to pass regulatory reform legislation, which would have changed the process EPA used to promulgate rules, was so convoluted it would have made a "mockery of environmental protection."

Another alleged bone of contention is the chemical industry's legal challenge seeking to stop EPA from adding chemicals to the list of substances for which annual reporting to the Toxic Release Inventory (TRI) would be required. Reportedly, EPA believes it has been more than fair in dealing with the industry's petitions to delist chemicals from the TRI, and cannot understand why the industry worked so hard to add a provision to the regulatory reform legislation that would change the process for TRI listings.

Some consider EPA's complaints at this juncture to be moot, because regulatory reform appears to be dead. However, the apparent strain on the relationship between the chemical industry and EPA may remain a cause for concern.

OSHA Reform Bill Could Be Finalized this Year—Comprehensive legislation that would move the Occupational Safety and Health Administration away from its traditional enforcement emphasis could be approved by the House before the December recess.

Introduced by Rep. Cass Ballenger (R-NC), HR 1834 emphasizes consultation and training rather than enforcement programs. The bill also reforms OSHA's regulatory process, takes the "quota" mentality out of the penalty system, adds fairness to the inspection program, increases employee participation, and consolidates/eliminates related or duplicate programs. Proponents of the measure argue that OSHA's 25-year emphasis on enforcement has largely failed to improve safety and health in that nation's workplace.

Several hearings have been held on the bill, but it has not yet been scheduled for a markup before the Economic and Educational Opportunities Subcommittee on Workforce Protection. The bill has over 100 cosponsors and is supported by much of the small business lobby and other employer groups.

Still, many changes have to be made to the bill before President Clinton reportedly would sign it into law. Ballenger has indicated that he does not intend to present the president with any bill that may be vetoed.

States Proposed Legislation and Regulations

ALABAMA

Hazardous Waste (Regulation)—A proposal issued by the Alabama Department of Environmental Management (DEM) would incorporate federal revisions to organic air emission standards for tanks, surface impoundments, and containers into the hazardous waste program, including the addition of 58 chemicals to the list of products that are considered hazardous waste. Contact DEM, (205) 271-7726.

Water Quality (Regulation)—A final rule of the Alabama DEM revises requirements for the national pollutant discharge elimination system in order to make them consistent with federal standards. The regulation went into effect September 7. Contact DEM, (205) 271-7726.

CALIFORNIA

Environmental Marketing—CA S. 426 (Leslie) provides that it is unlawful for a person to make any untruthful, deceptive, or misleading environmental marketing claims. On October 5, the governor signed the legislation.

Hazardous Materials Transportation (Regulation)—A regulation adopted by the California Department of Highway Patrol (DHP) requires shippers and transporters of hazardous materials to comply with federal emergency response information standards. The rule became effective August 30. Contact Steve Brown, DHP, (916) 327-3310.

CA S. 1191 (Calderon) revises specified provisions regulating hazardous waste, the storage of hazardous substances in underground storage tanks, and the handling of hazardous materials. The legislation was signed by the governor on October 4.

Occupational Safety and Health (Regulation)—The California Occupational Safety and Health Standards Board (OSHSB) proposed a regulation which would amend current standards concerning process safety management of acutely hazardous materials, including the establishment of labeling requirements. Contact John Macleod, OSHSB, (916) 322-3640.

Solid Waste—CA A. 1434 (Firestone) revises eligibility requirements for loans to upgrade, replace, or remove underground storage tanks to meet applicable standards and to take corrective actions. On September 25, the legislation was sent to the governor for signature.

COLORADO

Air Quality (Regulation)—A proposal of the Colorado Air Quality Control Commission (AQCC) would add federal maximum achievable control technology (MACT) monitoring and reporting requirements to current standards, affecting halogenated solvent degreasers and epoxy resin producers. A hearing on the rule was held on November 16. Contact Technical Secretary, AQCC, (303) 692-2000.

Hazardous Waste (Regulation)—The Colorado Department of Public Health and Environment (DPHE) adopted a rule which adds specific chemicals to the list of products that are considered hazardous waste and which incorporates federal regulations banning the disposal of any liquid in a hazardous waste landfill. The rule was effective September 30. Contact Karen Osthus, DPHE, (303) 692-3321.

ILLINOIS

Air Quality—IL S. 460 (Mahar and Rauschenberger) requires the provision of an emissions reduction trading program in any state implementation plan for ozone attainment submitted to the U.S. EPA. The governor signed the legislation on July 19.

INDIANA

Air Quality (Regulation)—The Indiana Department of Environmental Management (DEM) plans to issue a proposal which would revise MACT standards in order to lessen the environmental impact of sources of hazardous air pollutants. Contact Patricia Troth, DEM, (317) 233-5681.

The Indiana DEM announced its intention to add equivalent emissions limitations and compliance determination methods for dip or flow operations at miscellaneous coatings facilities. A hearing on this subject will be held on December 6 in Indianapolis. Contact Patricia Troth, DEM, (317) 233-5681.

The Indiana DEM intends to propose a regulation which would amend the definition of "nonphotochemically reactive hydrocarbon" to include acetone. Contact Phil Doyle, DEM, (317) 232-8420.

IOWA

Air Quality (Regulation)—A final rule of the Iowa Environmental Protection Commission (EPC) specifies situations under which fugitive emissions must be considered when determining eligibility for a voluntary permit. In addition, it restricts sources who are required to obtain a federal Title V operating permit from operating under a voluntary permit. The regulation went into effect October 18. Contact Catharine Fitzsimmons, EPC, (515) 281-8941.

A rule adopted by the Iowa EPC incorporates by reference federal requirements concerning hazardous air pollutants for source categories. The rule was effective October 18. Contact Catharine Fitzsimmons, EPC, (515) 281-8941.

Hazardous Materials Transportation (Regulation)—A final regulation of the Iowa Department of Transportation (DOT) incorporates by reference federal standards for motor safety and hazardous materials transportation. The rule became effective October 18. Contact DOT, (515) 239-1362.

KANSAS

Air Quality (Regulation)—A proposal of the Kansas Department of Health and Environment (DHE) would amend the definition of volatile organic compound (VOC) to include compounds not subject to regulation and would clarify that applications for class I operating permits must contain information on fugitive emissions. A hearing is scheduled for November 8, and written comments must be received by that date. Contact Chuck Layman, DHE, (913) 296-1579.

LOUISIANA

Air Quality (Regulation)—The Louisiana Department of Environmental Quality (DEQ) proposed a regulation which would add acetone to the list of compounds excluded from the definition of VOC on the basis that it has been determined to have negligible photochemical reactivity. Contact Patsy Deaville, DEQ, (504) 765-0399.

A rule adopted by the Louisiana DEQ modifies current standards to make reporting requirements for continuous emission monitoring consistent with federal regulations. The rule was effective August 20. Contact Patsy Deaville, DEQ, (504) 765-0399.

A final regulation of the Louisiana DEQ revises the fee schedule for air quality control programs by raising fees for annual maintenance, new permit application, and major and minor modified permits by 79%. The rule went into effect August 20. Contact Patsy Deaville, DEQ, (504) 765-0399.

Community Right-to-Know (Regulation)—A proposal of the Louisiana DEQ would adopt requirements for responding to emergency incidents, standards for recordkeeping and reporting, and provisions for creating emergency response storage facilities. Contact Patsy Deaville, DEQ, (504) 765-0399.

Water Quality (Regulation)—The Louisiana DEQ adopted a rule which increases the maximum annual fee assessed to operations under the state's water discharge permitting system by 40%. The regulation became effective August 20. Contact Patsy Deaville, DEQ, (504) 765-0399.

MAINE

Air Quality (Regulation)—A final regulation of the Maine Department of Environmental Protection (DEP) amends the definition of VOC to conform with the federal standard, excluding acetone, parachlorobenzotrifluoride, and volatile methyl siloxanes from that definition. The rule was effective July 25. Contact Jeffrey Crawford, DHE, (207) 287-2437.

MASSACHUSETTS

Environmental Legislation—MA H. 5452 (Committee on Natural Resources and Agriculture) makes an investigation and study of certain Senate and House documents concerning the environment, pollution, conservation, and waste disposal. The omnibus legislation was introduced on September 14 and referred to the House Committee on Rules. The following bills have been included as part of the study:

Packaging—MA H. 2618 (Marzilli) requires that only recyclable packaging be used in commerce in Massachusetts.

Recycling—MA H. 2799 (A. Scaccia) promotes recycling and waste reduction in the Commonwealth.

Household Hazardous Waste—MA S. 1116 (Keating) authorizes the promulgation of regulations that require retailers to place stickers on items containing household hazardous waste.

A proposal of the Massachusetts Department of Environmental Protection (DEP) would govern the management of Class A regulated recyclable materials and would revise the requirements for centers that accept household hazardous waste. Contact James Paterson, DEP, (617) 556-1096.

MICHIGAN

Lead—MI H. 5150 (Clack) provides insurance coverage, screening, and statistical reporting for lead poisoning. Introduced on September 26, the legislation was referred to the House Committee on Regulatory Affairs.

MI H. 5151 (Clack) provides credit for lead abatement. On September 26, the bill was sent to the House Committee on Regulatory Affairs.

MI H. 5152 (Clack) provides for lead abatement of certain child care organizations as a condition of licensing or certification. The legislation was introduced on September 26 and referred to the House Committee on Regulatory Affairs.

MI H. 5153 (Clack) provides for health insurance coverage for lead poisoning. Introduced on September 26, the House Committee on Regulatory Affairs is currently considering the legislation.

Solid Waste—MI H. 5138 (Middaugh) provides for liability in underground storage tanks. Introduced on September 26, the bill was sent to the House Committee on Conservation, Environment and Great Lakes.

MINNESOTA

Occupational Safety and Health (Regulation)—A proposed rule of the

Minnesota Department of Labor and Industry (DLI) would update the list of standard industrial classifications of employers who must comply with state workplace accident requirements. Contact DLI, (612) 297-3254.

MONTANA

Air Quality (Regulation)—A proposed regulation of the Montana Department of Environmental Quality (DEQ) would allow facilities to install replacement machinery temporarily without obtaining an air quality permit in the event of equipment malfunction. Contact Yolanda Fitzsimmons, DEQ, (406) 444-2544.

The Montana DEQ has proposed regulations which would update the definition of VOC to be consistent with federal requirements, and would increase the fees for air quality operations and permit applications. Contact Yolanda Fitzsimmons, DEQ, (406) 444-2544.

NEVADA

Water Quality (Regulation)—A proposed rule issued by the Nevada State Environmental Commission (SEC) would update current water pollution control requirements to make them consistent with federal standards, including adding compliance schedules to water pollution discharge permits. Currently, the proposal is in effect as a temporary regulation. Contact David Cowperthwaite, SEC, (702) 687-4670.

NEW HAMPSHIRE

Air Quality (Regulation)—The New Hampshire Department of Environmental Services (DES) adopted a regulation for sources required to obtain operating permits which establishes permitting standards, permit application procedures, and monitoring and recordkeeping requirements. The rule was effective June 30. Contact Craig Wright, DES, (603) 271-6791.

A final rule of the New Hampshire DES sets compliance standards for VOC-emitting facilities, including coating operations in the following new categories: plastic parts, wood furniture, gunstocks, and metal coils. The regulation went into effect August 31. Contact Susan Collins, DES, (603) 271-7874.

NEW JERSEY

Environmental Penalties—NJ A. 1521 (Solomon and Corodemus) provides a grace period of 30 to 90 days for industry to correct minor environmental violations. On September 18, the bill was conditionally vetoed by the governor, who recommended specific changes to the legislation, including amendments to prevent repeat offenders from escaping penalties. The Assembly adopted the governor's recommendations on September 18.

Water Quality (Regulation)—The New Jersey Department of Environmental Protection (DEP) proposed regulations which would readopt requirements concerning wastewater discharge, surface water quality, and groundwater quality that will currently expire on January 18, 1996. Contact Janis Hoagland, DEP, (609) 292-0716.

NORTH CAROLINA

Water Quality (Regulation)—The North Carolina Department of Environment (DOE) adopted an emergency rule which establishes an interim maximum allowable concentration for isopropyl ether (Diisopropyl Ether), which can be used as a solvent for dyes and as a paint or varnish remover, in class GA and GSA groundwaters. The regulation was effective August 7 and will expire on February 7, 1996. Contact David Hance, DOE, (919) 733-3221, ext. 428.

OHIO

Lead (Regulation)—A proposal issued by the Ohio Department of Health (DOH) would update the definition of "lead abatement" in the state lead program and would extend the application period for grandfathered licenses. Contact Jacqueline Vermillion, DOH, (614) 466-4882.

OKLAHOMA

Air Quality (Regulation)—The Oklahoma Department of Environmental Quality (DEQ) adopted an emergency amendment which decreases the annual air quality operating fee from the current $15.65 per ton of regulated pollutant. The rule was effective September 15 and will expire on January 15, 1996. The reduction is a one-time only event. Contact Scott Thomas, DEQ, (405) 271-5220.

OREGON

Air Quality (Regulation)—A proposal of the Oregon Department of Environmental Quality (DEQ) would, among other things, (1) amend the definition of VOC to include the federal delisting of acetone and expected delisting of perchlorethylene; (2) incorporate by reference federal waste conversion regulations; and (3) clarify fugitive emission standards applicability. Contact Susan Greco, DEQ, (503) 229-5213.

PENNSYLVANIA

Labeling (Regulation)—The Pennsylvania Department of Labor and Industry (DLI) adopted a rule concerning suppliers' responsibilities for labeling chemical containers and for providing customers with the same medical and scientific information maintained by manufacturers. The rule was effective September 16. Contact James Tinney, DLI, (717) 783-2071.

RHODE ISLAND

Air Quality (Regulation)—A rule adopted by the Rhode Island Department of Environmental Management (DEM) establishes an operating permits program for major air pollution sources. Among other things, the regulation establishes (1) emissions caps for sources; (2) application submission procedures; (3) required information for applications; (4) an emission trading program; and (5) specific provisions for issuing general permits. The regulation was effective May 18. Contact DEM, (401) 277-2808.

Automotive Refinishing (Regulation)—A final rule of the Rhode Island DEM increases the emissions limit for primer/primer surfacer coatings for automobiles from 3.8 pounds of VOCs per gallon to 4.8 pounds. The regulation became effective July 11. Contact Barbara Morin, DEM, (401) 277-2808.

SOUTH CAROLINA

Solid Waste (Regulation)—The South Carolina Department of Health and Environmental Control (DHEC) adopted a regulation which requires owners and operators of underground storage tanks to provide assurance that they would be able to pay for damages resulting from accidental releases from the tanks. The rule went into effect September 22. Contact Stanley Clark, DHEC, (803) 734-5331.

SOUTH DAKOTA

Solid Waste (Regulation)—A proposed rule of the South Dakota Department of Environment and Natural Resources (DENR) would update requirements for corrosion and overspill protection, as well as for overfill control for underground storage tanks. Contact Doug Miller, DENR, (605) 773-3296.

TENNESSEE

Solid Waste (Regulation)—A final rule adopted by the Tennessee Department of Environment and Conservation (DEC) amends standards for the underground storage tank program by requiring owners to report new tanks within 15 days of operation and by revising compliance dates to make them consistent with federal regulations. The regulation was effective October 10. Contact Donna Washburn, DEC, (615) 532-0987.

TEXAS

Air Quality (Regulation)—The Texas Natural Resource and Conservation Commission (NRCC) proposed a regulation which, among other things, would change the basis for all surface coating emission limitations from pounds of VOCs per gallon of solids to pounds of VOC per gallon of coating; add current terminology to more clearly define operations which include "air or forced air driers"; and delete an exemption for customized top coating of automobiles because this category is already regulated under the exemption for vehicle refinishing. Contact Heather Evans, NRCC, (512) 239-1970.

A proposed regulation of the Texas NRCC would revise current requirements for new construction and modification permits. Under the proposal, the NRCC would not be allowed to impose more stringent permit conditions when the permit is renewed, unless it is necessary in order to ensure compliance with air quality standards. Contact Sam Wells, NRCC, (512) 239-1441.

A proposal of the Texas NRCC would update the definition of VOC by excluding acetone, parachlorobenzotrifluoride and volatile methyl siloxanes to conform with the federal standard. Contact Ann Hammer, NRCC, (512) 239-6255.

Hazardous Waste (Regulation)—The Texas NRCC proposed a rule which would simplify reporting and recordkeeping requirements for small quantity generators of hazardous waste. Contact Hygie Reynolds, NRCC, (512) 239-6825.

VIRGINIA

Hazardous Materials Transportation (Regulation)—A proposed rule issued by the Virginia Department of Environmental Quality (DEQ) would incorporate by reference federal regulations concerning the transportation of hazardous materials. Contact Julia King-Collins, DEQ, (804) 762-4247.

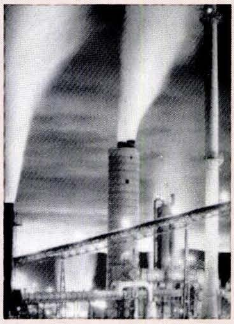
WASHINGTON

Air Quality (Regulation)—The Southwest Air Pollution Control Authority (SWAPCA) intends to issue a proposal which would limit VOC emissions from architectural coatings operations, automotive refinishing operations, and spray painting in order to reach attainment status for ozone. Contact Jennifer Brown, SWAPCA, (360) 574-3058.

✳ *1994 Constituent Society Paper* ✳

A Study of the Effect of Acid Rain on Alkyd, Polyester, and Silicone-Modified High-Solids Coatings

Northwestern Society for Coatings Technology* and
Montreal Society for Coatings Technology



Acid rain has been recognized as a factor in the degradation of applied coating materials. This study evaluates chemical and physical changes that occurred when alkyd, polyester, and silicone modified polyester high-solids coatings were exposed for nearly three years at five precipitation monitored sites in the United States and Canada. In addition, a simulated acid rain chamber that precludes the influence of UV light and a high concentration of sulfur dioxide was used to expose the panels.

The results show degradation to be enhanced as the average pH of rainfall decreases. The evidence also indicates a difference in the chemical changes on the surfaces that are dependent on the formulation and exposure conditions.

INTRODUCTION

In 1858, Robert Angus Smith, a London chemist, wrote: "It has often been observed that the stones and bricks of buildings . . . crumble more readily in large towns, where much coal is burnt, than elsewhere. I was led to attribute this effect on the slow but constant action of the acid rain." He did not publish his thoughts until 1872 in his *Air and Rain, The Beginnings of a Chemical Climatology.*[1]

"Acid rain" is a term that had been used prior to the 1980s to describe the constituents of precipitation and the effect on the environment. It was used initially by environmental scientists and was little known to the public. Today acid rain is perceived by the public as an environmental threat. The perception of acid rain causing ecological and commercial damage has led to studies to understand the scope of the acid rain problem. It has also resulted in federal legislation which began in 1980 with passage of the Acid Precipitation Act (Title VII of the Energy Security Act of 1980, Public Law 96-294). An interagency task force established by the U.S. Congress presented the National Acid Precipitation Program (NAPP) after a two-year study.[2]

Natural sources that tend to increase the acidity of rainwater include dissolution of carbon dioxide (results in a water solution with pH 5.6) and release of sulfur dioxide by bacteria in the seas (which can result in water with pH 4.6). Alkaline substances such as ammonia and alkaline soil derived dust, which are naturally present in some areas, also influence the pH of rainwater. Normal background materials from natural sources result in rainwater which can have a pH range of 5 to 7.[3]

Acid rain is also related to human activities that result in emission of sulfur oxides and nitrogen oxides and these vary widely with geography and seasonal distribution. In 1990, the Clean Air Act was amended to include provisions that would substantially reduce sulfur dioxide and nitrogen oxides emitted from fossil fuel-burning electrical utilities. Research provisions as well as control measures were included in the amendment which is intended to implement a suitable regulatory program.

The NAPP 1992 Report to Congress stated that factory coated metallic materials have been found to be very resistant to acidic deposition. However, alkyd resins represent the most widely used coating type for metal substrates. This class of coating undergoes accelerated degradation in the presence of sulfur dioxide and water condensation. Even short-term exposures to a high concentration of sulfur dioxide (less than one percent) and ultraviolet light promote degradation of organic

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This paper was presented at the 72nd Annual Meeting of the Federation of Societies for Coatings Technology, October 12-14, 1994, New Orleans, LA, and it was the third place winner in the A.F. Voss/*American Paint & Coatings Journal* Award competition.

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binders. This would lead to major paint failure, such as cracking.[3]

Studies supported by the Environmental Protection Agency (EPA) and the automotive industry indicate that the etched spots on automotive finishes are caused by the interaction of coatings with sulfur compounds and soil particles deposited from the atmosphere.[3]

The U.S. and Canada signed a trans-boundary air pollution agreement, the U.S.-Canada Air Quality Accord, on March 13, 1991.[4] A bilateral Air Quality Committee was established to implement the terms of the agreement which builds on the U.S. Clean Air Act of 1990 and Canada's Acid Rain Control Program of 1985.

Spence and Lemmons of the U.S. EPA and Hou et al. of North Carolina State University[5] used a chamber study to determine the effect of acidic deposition on latex and alkyd architectural coatings. Results of the exposure study revealed that $CaCO_3$ containing latex and alkyd coating films undergo changes in surface features and concluded that polymeric changes occurred in the alkyd film structure.

Svoboda and Mleziva[6] studied the penetration of inorganic compounds and ions into coatings. The study represents a supplement to the diffusion problems reported by Kittelberger[7] and Lowrey and Broome.[8] According to Svoboda, it is not possible to ensure full barrier protection of a metallic surface by organic coatings. According to Kumins,[9] the diffusing compound is presumed to be adsorbed on the coating film surface, dissolved in it, diffused into the film, and released or desorbed on the other side of the film. Under certain atmospheric conditions, an adsorbed water film is formed on the coating surface.[10,11] The sulfur dioxide contained in the atmosphere is dissolved in this water film and can penetrate through the coating as far as the metal surface.

The relatively fast rate of SO_2 penetration into an alkyd coating film as reported by Svoboda may be due to the fact that sulfur dioxide diffuses into the coating film in the form of free SO_2 molecules. The rate of sulfur dioxide penetration is also influenced by aging under solar radiation and other dissolved substances such as sodium chloride and sodium sulfate. It is also evident that the presence of pigment reduces the rate of sulfur dioxide penetration into the coating by 50 to 70% as compared with non-pigmented varnish film.

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Patil et al.[12] investigated the environmental effects on latex paint coatings that were exposed to various combinations of $UV/SO_2/H_2O/air$. This work indicates a synergistic interaction between UV and SO_2.

Edney et al.[13] studied atmospheric weathering caused by dry deposition of acidic compounds. They concluded that degradation is either initiated by a photodegradation process and/or uptake and subsequent reaction of gas phase pollutants soluble in the polymer. Such reactions could initiate microscopic changes in paint films, such as increases in crosslinking or chain scission. This could lead to formation of microscopic cracks and destruction of the protective nature of the film and result in exposure of the substrate to the environment.

In a study of solubility and diffusivity of SO_2 in latex paint films, Hendricks and Balik[14] concluded that sorption of SO_2 occurs only in the polymer, with the inorganic pigment particles acting as impenetrable fillers.

A controlled environment chamber study conducted by Spence et al.[15] to determine the effects of gaseous pollutants on paints showed that oil-based house paints have high erosion rates and attributed this to high SO_2 concentrations, relative humidity, and the effects of NO_2 and NO_2/SO_2 interaction. Ozone was the only pollutant studied that led to a significant effect on the acrylic coil coating.

An assessment of air pollution damage to coatings conducted by Campbell et al.[16] showed in the presence of 1 ppm SO_2 for 1000 hr and UV exposure, oil-based coatings, followed by the alkyd, urea-alkyd, acrylic latex, and nitrocellulose-acrylic coatings showed some breakdown of the binders.

A study of the literature shows the major contributors, i.e., SO_2 and UV light in the presence of humidity, influence the chemical changes that occur in the polymer structure of coatings when they are exposed to acid rain. In the present study, the main focus was to demonstrate the chemical changes that occur with coatings exposed to the environmental conditions that exist in different parts of the North American continent.

In addition, a simulated acid rain chamber exposure was conducted to reveal changes that can be attributed to acid rain without the influence of UV light and SO_2 exposure. This part of the study is significant since it may help to reveal the weak links in chemical bonding that initiate polymer degradation with exposure to UV light and SO_2.

EXPERIMENTAL

Sample Preparation

Three coating types were formulated in a white and clear for a total of six coatings (*Table* 1):

181A White and Clear—30% silicone modified polyester baking enamel.

181B White and Clear—High-solids polyester baking enamel.

181C White and Clear—High-solids coconut oil alkyd baking enamel.

Table 1—Summary of the High-Solids Formulations

181A High-Solids Silicone Modified Polyester Baking Enamel

	White		Clear	
	Pounds	Gallons	Pounds	Gallons
Cargill 57-5786 silicone mod. polyester	154.1	16.74	154.1	16.74
Ti-Pure R-902 (Dupont)	403.1	11.79	0.0	0.00
Methyl Iso-amyl ketone	58.5	8.63	58.5	8.63
Cargill 57-5786 silicone modified polyester	315.8	34.33	315.8	34.33
Cargill 23-2347 methylated melamine	95.4	9.45	95.4	9.45
Byk-Catalyst-451 (Byk Chemie)	13.9	1.83	13.9	1.83
Methyl iso-amyl ketone	116.8	17.23	116.8	17.23
	1157.6	100.00	754.5	88.21
% Nonvolatile by weight	75.85			
by volume	59.58			
Pigment to binder ratio	0.85			
Pigment volume concentration	19.78			
Weight per gallon (lb)	11.58			
Theoretical VOC (lb/gal)	2.80			
(g/l)	335			

181B High-Solids Polyester Baking Enamel

	White		Clear	
	Pounds	Gallons	Pounds	Gallons
Cargill 57-5789 high-solids polyester	136.8	14.71	136.8	14.71
Ti-Pure R-902 (Dupont)	380.3	11.12	0.0	0.00
Methyl iso-amyl ketone	55.2	8.14	55.2	8.14
Cargill 57-5789 high-solids polyester	312.5	33.60	312.5	33.60
Cargill 23-2347 methylated melamine	90.0	8.92	90.0	8.92
Byk-Catalyst-451 (Byk Chemie)	13.1	1.73	13.1	1.73
Methyl iso-amyl ketone	147.7	21.78	147.7	21.78
	1135.6	100.00	755.3	88.88
% Nonvolatile by weight	75.34			
by volume	60.22			
Pigment to binder ratio	0.80			
Pigment volume concentration	18.46			
Weight per gallon (lb)	11.36			
Theoretical VOC (lb/gal)	2.80			
(g/l)	336			

181C High-Solids Coconut Alkyd Baking Enamel

	White		Clear	
	Pounds	Gallons	Pounds	Gallons
Cargill 57-5717 high-solids coconut alkyd	132.0	14.83	132.0	14.83
Ti-Pure R-902 (Dupont)	366.9	10.73	0.0	0.00
Methyl iso-amyl ketone	53.3	7.85	53.3	7.85
Cargill 57-5717 high-solids coconut alkyd	294.4	33.08	294.4	33.08
Cargill 23-2347 methylated melamine	92.9	9.20	92.9	9.20
Byk-Catalyst-451 (Byk Chemie)	13.4	1.77	13.4	1.77
Methyl iso-amyl ketone	152.8	22.54	152.8	22.54
	1105.7	100.00	738.8	89.27
% Nonvolatile by weight	74.68			
by volume	59.93			
Pigment to binder ratio	0.80			
Pigment volume concentration	17.90			
Weight per gallon (lb)	11.06			
Theoretical VOC (lb/gal)	2.80			
(g/l)	336			

Five identical exposure racks were constructed for field exposures. The racks were constructed of white pine and capable of holding 24 panels at a 45° angle. The racks were designed to shade the bottom portion of the panels. Four panels of each coating were placed in the rack using a random numbering scheme. The racks at each location were placed facing south, approximately 60 cm off the ground.

Panel Preparation

Panels were prepared by spraying coatings with a Binks air spray gun model 18 using 3.5 kg/cm^2 (50 psi) atomizing pressure onto Q-Panel Type A bare aluminum 7.62 cm × 12.70 cm × 0.6 mm panels (Alloy 3003 H14, ASTM D 1730, Federal Specification QQ-A-250/2b). Coatings were applied at a dry film thickness of 1.0 +/– 0.1 mil measured with a Fisher permascope type D 211D. Sprayed panels were allowed 10 min flash time at ambient temperature and then baked 15 min at 149°C in a Despatch gas fired oven, then aged a minimum of one week before being exposed.

Site Locations

Five monitored rural sites were used for outdoor exposure:

(1) Camp Ripley, MN, maintained by the National Atmospheric Deposition Program/National Trends Network (NADP/NTN).
(2) Delaware, OH, maintained by NADP/NTN.
(3) Mt. Mitchell, NC, maintained by NADP/NTN.
(4) Dorset, Ontario, Canada, maintained by Ontario Ministry of the Environment.
(5) Sutton, Quebec, Canada, maintained by the Canadian Air and Precipitation Monitoring Network (CAPMON/RCEPA).

Each site has an automated wet/dry precipitation collector, and a rain gauge equipped with an event pen available. The instrumentation was placed in a clean area at least 23 meters away from trees.

Once a week samples from the wet/dry precipitation collector were collected by the site monitors. A portion of the wet sample was taken for a field pH measurement, the balance was then sent to a designated laboratory for chemical analysis for SO_4^{-2}, NO_3^-, Cl^-, PO_4^{-3}, Na^+, K^+, Ca^{+2}, Mg^{+2}, NH_4^+, and pH. A comparison of 1990-1993 exposure site averages for SO_4^{-2}, NO_3^-, and NH_4^+ ions is shown in *Table* 2a.

Multiple sets of panels were exposed at each location so that specimens could be removed from the field and examined at varying intervals. The first set of panels was removed from exposure sites after approximately two years, and a second set after almost three years.

Simulated Acid Rain (SAR)

To preclude the effects of UV, SO_2, and weathering, a chamber was constructed to expose the panels to an acid rain solution. The chamber consisted of a five-gallon polyethylene pail with a removable lid and a 360° sprinkler head attached. An acid rain solution was pumped with a 1/25 HP March Manufacturing MDX pump through 1.27 cm Tygon® tubing. All connectors were 1.27 cm PVC. General Electric silicone caulk was used to seal any leaks.

Specimens were prepared by covering unpainted surfaces of the panels with transparent tape, and held in place against the side of the chamber with nylon fishing line.

The chamber was charged with four liters of acid rain solution and pumped continuously, recirculating the solution being sprayed on the specimens. The panels were inspected biweekly, and the acid rain solution was changed bimonthly.

The simulated acid rainwater was formulated according to guidelines in the U.S. Department of Commerce National Bureau of Standards Special Publication 260-106. The initial formulation was based on target values referred to as Reference Material 8409 and Standard Reference Material 2694. The formulation is listed in *Table* 2b. This formulation was used for initial exposure of panels in the simulated acid rain chamber, and the panels were exposed for 122 days.

A second formulation was made at four times the initial concentration of components shown in *Table* 2b. The panels exposed to the higher concentration formulation for 21 days were used for the reported evaluations.

Concentrations of cations Na^+, Ca^{+2}, and Mg^{+2} were measured in the higher concentration formulation with a Beckman Spectraspan V direct current plasma emission spectrometer. The anions Cl^-, NO_3^-, and SO_4^{-2} were measured with a Waters Associates 740 ion chromatograph and model 430 conductivity detector.

Weather-ometer (WOM)

Accelerated weathering tests were performed in a commercially available xenon arc weather-ometer, model Ci-65, with a 6000 watt water-cooled light source, quartz optical filter, spectral irradiance of 0.45 w/m^2 at 340 nm, and 1.62 KJ/m^2 irradiation units. The panels were tested for a period of 800 hr of continuous exposure to light and intermittent exposure to water spray as suggested by Test Method 1 of ASTM G-26. Conditions of the test were constant light at 340 nm, black-panel temperature 60°C, air temperature 60 +/– 3°C, dry bulb temperature 31°C, and relative humidity 40 +/– 3%. The cycles were 120 min, and consisted of 18 min of spray and 102 min of non-spray.

Appearance

Visual inspections of the site exposed panels were made to evaluate for gloss, dirt collection, mildew growth, and blistering. Visual evaluations for gloss, checking, and blistering were conducted for the SAR and WOM exposed panels.

Measurements

Specular gloss was measured with a Multi Gloss M (Byk-Chemie). The instrument was calibrated to the high gloss standard at the 60° and 20° angles as specified by the manufacturer. The panels were washed with 0.1% Joy (commercial product, Proctor and Gamble, 1988) in deionized water and a cotton cloth using medium pressure. The panels were rinsed, then dried with a cotton cloth. Panels were allowed to stand in a rack for at least one hour. Gloss at 60° and 20° was measured in the center of the top (unshaded) and bottom (shaded) halves of the panels. Checks were made around the area to assure the measurements were reasonable representations of the entire halves.

Table 2a—Site Precipitation Chemistry Averages for 1990-1993

Exposure Site	mg/L SO_4^{-2}	NO_3^-	NH_4^+
Camp Ripley, MN	1.02	1.10	0.48
Delaware, OH	2.79	1.77	0.40
Mt. Mitchell, NC	1.18	0.57	0.26
Sutton, Quebec	2.24	1.49	0.33
Dorset, Ontario[a]	1.99	0.54	0.29

(a) 1990 data only.

Table 2b—Target Values of RM 8409 and SRM 2694 Simulated Rainwater

pH	3.6
Specific conductance, μS/cm	130
Acidity, meq/L	0.28
Fluoride, mg/L	0.1
Chloride, mg/L	1.0
Nitrate, mg/L	7
Sulfate, mg/L	11
Sodium, mg/L	0.4
Potassium, mg/L	0.1
Ammonium, mg/L	1.0
Calcium, mg/L	0.05
Magnesium, mg/L	0.05

Table 3—Results of Acid Rain Study (Outdoor exposures 26 - 33 months)

Site	Coating Samples	pH-Rain water	pH Panel Surface	Δ 60° Gloss (unshaded portion)	Δ 20° Gloss	Total Cations in ppm	Total Anions in ppm	Blistering	Checking	Delamination
Camp Ripley, MN	181A clear	5.3	5.5	−20	−18	1.64	1.8	No	No	No
Delaware, OH	181A clear	4.2	5.3	−23	−20	1.36	2.3	No	No	No
Dorset, Ontario	181A clear	4.5	5.4	−21	−34	0.47	6.3	No	No	No
Mt. Mitchell, NC	181A clear	4.6	5.7	−24	−19	0.52	10.1	Yes	No	No
Sutton, Quebec	181A clear	4.5	5.4	−24	−18	1.28	8.2	No	No	No
Simulated acid rain	181A clear	3.1	5.5	−34	−18	0.46	9.4	No	No	No
Unexposed	181A clear	NA	7.6	NA	NA					
Camp Ripley, MN	181A white	5.3	5.6	−3	−1	1.12	4.4	No	No	No
Delaware, OH	181A white	4.2	5.5	−14	−4	1.44	6.4	No	No	No
Dorset, Ontario	181A white	4.5	5.5	1	0	0.72	5.8	No	No	No
Mt. Mitchell, NC	181A white	4.6	5.4	3	1	0.41	3.4	Yes	No	No
Sutton, Quebec	181A white	4.5	5.6	−13	−4	1.19	0	No	No	No
Simulated acid rain	181A white	3.1	5.4	−3	−3	0.32	8.5	No	No	No
Unexposed	181A white	NA	7.6	NA	NA					
Camp Ripley, MN	181B clear	5.3	5.4	−24	−17	1.99	20.4	No	No	No
Delaware, OH	181B clear	4.2	5.5	−29	−21	1.23	1.5	No	No	No
Dorset, Ontario	181B clear	4.5	5.7	−23	−20	0.41	8.9	No	No	Yes
Mt. Mitchell, NC	181B clear	4.6	5.3	−29	−22	0.55	5.6	No	No	No
Sutton, Quebec	181B clear	4.5	5.7	−28	−21	1.44	47.7	No	No	No
Simulated acid rain	181B clear	3.1	5.4	−88	−55	0.6	14	No	No	Yes
Unexposed	181B clear	NA	7.7	NA	NA					
Camp Ripley, MN	181B white	5.3	5.8	−7	−2	2.02	5	No	No	No
Delaware, OH	181B white	4.2	5.7	−13	−1	1.38	8.2	No	No	No
Dorset, Ontario	181B white	4.5	5.8	−9	−5	2.85	19.5	No	No	No
Mt. Mitchell, NC	181B white	4.6	5.2	−11	−2	0.43	3.5	No	No	No
Sutton, Quebec	181B white	4.5	5.5	−4	0	0.85	2.7	No	No	No
Simulated acid rain	181B white	3.1	5.3	−10	−3	0.62	9.4	Yes	No	No
Unexposed	181B white	NA	8	NA	NA					
Camp Ripley, MN	181C white	5.3	5.2	−16	−4	1.76	4.6	No	No	No
Delaware, OH	181C white	4.2	5.2	−19	−5	1.53	4.1	No	Yes	No
Dorset, Ontario	181C white	4.5	5.5	−13	−2	1.83	73.9	No	No	No
Mt. Mitchell, NC	181C white	4.6	5.3	−11	−2	0.8	5.5	No	No	No
Sutton, Quebec	181C white	4.5	5.5	−54	−18	1.46	30	Yes	Yes	No
Simulated acid rain	181C white	3.1	5.7	−35	−12	0.42	9	Yes	Yes	No
Unexposed	181C white	NA	7.7	NA	NA					
Camp Ripley, MN	181C clear	5.3	5.5	−31	−21	1.38	1.1	No	No	No
Delaware, OH	181C clear	4.2	5.3	−16	−1	3.29	18.6	No	No	No
Dorset, Ontario	181C clear	4.5	5.4	−31	−20	0.83	18.6	No	No	No
Mt. Mitchell, NC	181C clear	4.6	ND	ND	ND	ND	ND	ND	ND	ND
Sutton, Quebec	181C clear	4.5	5.5	−33	−20	1.67	6.1	No	No	No
Simulated acid rain	181C clear	3.1	5.4	−27	−23	0.37	5.4	No	No	No
Unexposed	181C clear	NA	7.7	NA	NA					

NA= Not applicable; ND = not determined; and Δ gloss represents changes in gloss compared with unexposed panels.

Table 4—Summary of Correlation Coefficients 0.9 or Greater

Coating Sample	Camp Ripley, MN	Delaware, OH	Dorset, Ontario	Mt. Mitchell, NC	Sutton, Quebec	Simulated Acid Rain	Coating Sample	Camp Ripley, MN	Delaware, OH	Dorset, Ontario	Mt. Mitchell, NC	Sutton, Quebec	Simulated Acid Rain
181A white		•					181A clear						•
181B clear		•				•	181A clear		•				
181B white		•		•		•	181A white		•				
181B white				•			181A white					•	
181B white			•				181A white						•
181B white			•				181B clear					•	
181C white	•	•					181B clear						•
181C white		•		•	•	•	181B white		•				
181C white				•		•	181B white					•	
181C white						•	181B clear		•		•		•
181C white				•			181B white	•					
181C white				•			181B white		•				
181C white			•				181B white			•			
181C white	•	•		•		•	181B white				•		
181C white				•			181B white						•
181C clear	•		•		•	•	181B clear	•	•		•	•	•
181C clear			•				181B clear	•					
181C clear	•				•	•	181B clear			•	•		•
181C clear		•					181B white		•				
181C clear		•					181B white			•			
181C clear	•		•		•		181C white						•
181C clear		•					181B white						•
181C clear	•				•		181C white		•				

• = Correlation 0.9 or greater.

To read this table: compare coating samples across the table, i.e., line 1, 181A white and 181A clear show 0.9 or > correlation coefficients for Delaware (181A white), and simulated acid rain (181A clear).

The gloss of the simulated acid rain panels was measured without washing the panels.

Surface pH was measured by placing 1.0 ml HPLC grade water (Fisher Scientific) on each panel with an Eppendorf pipette. The water was stirred, allowed to equilibrate for five minutes, and the pH determined using a Fisher Accumet Model 810 pH meter with a flat surface combination electrode (Corning). The pH meter was calibrated at pH 7.0 and 4.0 using standardized buffer solutions.

For anion and cation analysis, the panels were rinsed with 10 ml HPLC grade water (Fisher Scientific) and the surface washings stored in 20 ml polystyrene vials. The cation analysis was conducted on the surface washings with a Beckman Spectraspan V direct current plasma emission spectrometer using a multi-element cassette. Calibration standards were made from certified reference standard solutions (Fisher Scientific, Spex Industries).

The anion analysis was conducted after filtering the surface washing solutions through a 0.45 μm filter (Acrodisc, Gelman) with a Waters 740 Ion Chromatograph and a Model 430 conductivity detector. Calibration standards were made from certified ACS reagents (Fisher Scientific, Aldrich Chemical).

Table 5a—Total Average Na + K Contents for Selected Panels and Locations

Positive Secondary Ion Mass Spectrometry

	Total Average Sodium plus Potassium for Selected Panels		
Location	Pigmented Coating Panels	pH Location	Total Avg. Na + K mg/sq. in.
Unexposed	181C	na	8.72
Camp Ripley	181B	5.3	25.74
Sutton	181C	4.5	17.07
Delaware	181A 181B 181C	4.2	11.57
SAR	181B 181C	3.2	11.26

Secondary Ion Mass Spectrometry (SIMS) and Ion Scattering Spectroscopy (ISS)

Samples were analyzed under identical conditions using a Kratos/3M Model 535 BX combined ISS/SIMS System equipped with a Balzers 100 $\sec^{-1}$ turbomolecular pump on the sample insertion chamber. Data were obtained automatically using an Advanced R&D computer data system.

Table 5b—Clear Coating Panel B Na + K Contents for Selected Locations

Positive Secondary Ion Mass Spectrometry—181B Clear

Location	pH Location	Total Avg. Na + K mg/sq. in.
Camp Ripley	5.3	51.7
Dorset	4.5	39.7
Delaware	4.2	20.4
SAR	3.2	9

Table 6—H,C,O Contents at Increasing Depths Showing Differences in Saturation

Ion Scattering Spectroscopy—181C White

		Concentration Milligrams per Square Meter					
		8 Angstrom Depth			80 Angstrom Depth		
Exposure	pH Location	H	C	O	H	C	O
Unexposed	na	3.53	43	14.9	32.8	746	130
Sutton	4.5	4.77	26	17.6	50.6	48	248
Delaware	4.2	3.94	30	21.7	43.2	51	245
SAR	3.2	4.23	26	24.1	43.4	52	251

na means not applicable.

The sample holder containing a set of samples for analysis was placed in the insertion chamber of the instrument, evacuated to 4 × 10^{-8} torr using a turbomolecular pump, and inserted through a vacuum isolation valve into the analysis vacuum chamber. The vacuum chamber was re-evacuated to 4 × 10^{-8} torr before starting the analysis. Prior to sample insertion, the base pressure was 2 × 10^{-8} torr.

Four spectra were obtained for each sample, each spectrum representing a successively greater depth into the sample.

Microscopy

Photomicrographs were taken to characterize the condition of the coatings on the panels. Each sample was placed under a Leitz Wetzler microscope and photomicrographs were taken at a magnification of 58X using a nonpolarized light source at a medium setting. The camera was set to a shutter speed of 0.10 sec and ASA 200 Kodak film was used.

Statistical Analysis

Gloss, precipitation pH, surface pH, cations and anions in the surface washings, physical characteristics (checking, blistering, delamination), and location were tabulated with Microsoft Excel® v. 4.0. Statistical analysis was obtained using the Microsoft Excel correlation function.

Analysis of Fungal Organisms on Exposed Panels

Sterile cotton swabs were dipped in sterile buffered distilled water and wiped across the surface of the panels onto 150 mm × 15 mm inhibitory mold agar. Plates were incubated at 25°C.

Fungal organisms were removed from the edge of a fungal colony with clear adhesive tape and placed on a slide with a small amount of lactophenol aniline blue mounting fluid. The gross morphology of the fruiting body was examined under a microscope and identified.

RESULTS

Data were collected for panels exposed at different locations as well as panels exposed in the simulated acid rain chamber. A summary of the data is shown in *Table* 3.

Correlation coefficients were calculated for the data that includes the pH measured at the surfaces of the panels, change in gloss (compared with unexposed panels), total cations and anions (ppm concentrations), observations of blisters, checking, and delamination. In addition, the correlation coefficients were determined separately for each of the locations, for each formulation, and for pigmented and clear coatings.

A tabulation was made of the coatings listed in *Table* 3 that show the correlation coefficients using the previously mentioned parameters versus the same list of coatings and locations (tabulated on the X versus Y axes). Those coatings and locations that intersect with correlation coefficients 0.9 or greater were selected for further consideration.

A summary of the panels that have correlation coefficients with values 0.9 or greater is shown in *Table* 4. The coatings that show high correlation coefficients (0.9 or greater) were evaluated to determine whether there are similar trends evident based on the parameters measured. Thus, coatings at different locations that have shown similar response to the environmental exposure conditions were selected from this group to study surface chemical changes.

The study was structured in this fashion to limit comparisons to parameters that may show a relationship either with the environmental exposure conditions (location), coating formulation, or pH of the precipitation. This systematic sam-

Table 7—Comparison of Chlorine Concentration as a Function of Depth Penetration

Negative Secondary Ion Mass Spectrometry

		Chlorine Concentration Milligrams per Square Meter		
		Depth Angstroms		
Location	Coating Panel	8	40	80
A. Pigmented Coatings				
Sutton	181C	0.41	1.98	4.69
Delaware	181A	0.03	0.21	0.70
	181B	0.85	2.63	5.33
	181C	0.16	0.21	0.89
SAR	181B	0.04	0.27	1.18
B. Clear Coatings				
Camp Ripley	181B	0.07	0.13	0.95
Dorset	181B	0.02	0.21	1.10
Mt. Mitchell	181A	0.06	0.27	1.41
Sutton	181C	0.04	0.12	0.98
SAR	181B	0.11	0.65	1.62

Table 8—Summary of Total Cations and Anions on Panels from All Locations

	Concentration ppm		
	Washed From Surface Total All Locations		
Coating	Cations	Anions	Cations + Anions
181A white	5.2	28.5	33.7
181B white	1.47	48.3	49.8
181C white	1.95	127	129
181A clear	5.73	38.1	43.8
181B clear	6.22	98.1	104
181C clear	7.54	49.9	57.3

pling procedure was selected to limit the study to the collection of pertinent data.

It was of interest to determine from *Table* 4 which locations showed the greatest number of high correlation coefficients. This evaluation may indicate the exposure conditions that have the greatest impact on the parameters measured.

The panels from sites that have correlation coefficients that are 0.9 and above were grouped. The simulated acid rain (SAR) and Delaware sites had panels with the greatest number of correlation coefficients in this range. These exposure sites had the two lowest average pH values of the exposure environments and have 17 specimens with correlation coefficients in the range of 0.9 and above. The next highest number of panels with correlation coefficients in this range (12 specimens) occurred at Mt. Mitchell, which has high ozone and SO_2 levels. Camp Ripley, Dorset, and Sutton (9 specimens each) are all in the mid to high range of total sodium plus potassium contents (*Tables* 5a and b).

The Sutton exposed 181C white and simulated acid rain data for 181C white were compared with ISS and SIMS since these panels showed a physical change (in addition to correlation coefficients in the range of 0.9 and above). The Sutton exposed, SAR exposed, and unexposed panel for 181C were compared by measuring hydrogen and carbon at the surfaces. The values obtained at 80 angstrom depth were compared for each of the exposed panels with values for the unexposed panel. This comparison showed a change in the abundance of carbon and hydrogen. There is less hydrogen (more unsaturation) for the SAR exposed panel and more hydrogen (less unsaturation) for the Sutton exposed panel at the 8 and 80 angstrom depths (*Table* 6).

As the depth of penetration is increased with sputtering, negative SIMS indicates an increase in the chlorine concentrations for outdoor exposed panels as shown in *Table* 7. The Delaware 181B pigmented and Sutton 181C pigmented panels have high chlorine contents at 80 angstroms depth. Note that 181C pigmented also has a very high cation and anion content compared with the other panels examined as shown in *Table* 8.

These observations may explain the change in the 181C pigmented gloss measurements, which were in the same range as the clear coating. The high content of saturated oils present in the coconut oil used in the formulation of the 181C coatings may be responsible for the breakdown of the coating because of lower crosslink density (less reactive initially). The accumulation of high contents of anions and cations is consistent with this hypothesis. The penetration of chlorine ions appears to enhance degradation of the film. There is a change in the sodium concentration observed with positive SIMS within the films. The total sodium and potassium contents decrease as the pH decreases. This is shown for the pigmented and clear coatings in *Figures* 1 and 2.

Positive SIMS shows much higher sodium plus potassium concentrations for Dorset and Camp Ripley. The Camp Ripley site has the highest average pH (5.3 to 5.4)[17] of all the exposure sites. Dorset is at an average pH 4.5[18] and is in the same range as Mt. Mitchell (4.6).[17] However, the SO_2 values at Mt. Mitchell are higher (8.38 mg/m^3 for 1988) than for Dorset (5.14 mg/m^3 for 1989) and this may have some effect on the physical and chemical properties. The average pH of precipitation at Sutton was 4.5.[19]

In addition to the correlation coefficients discussed previously, parameters that show relationships for the different formulations of pigmented and clear coatings were compared. A summary of the correlation coefficients that are above 0.6 is shown in *Table* 9. This evaluation demonstrates grouping of the chemical

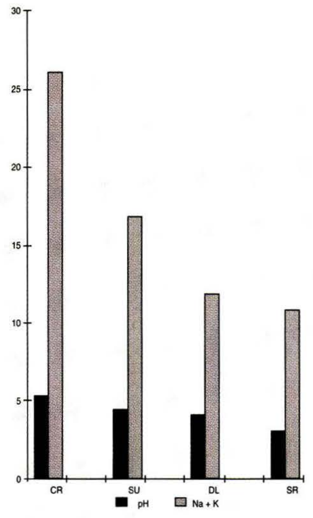

Figure 1—Pigmented coatings Na + K comparison with pH.

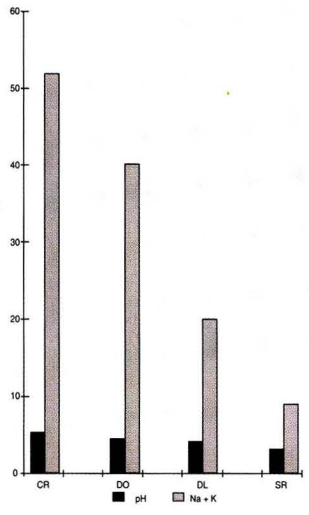

Figure 2—Clear coatings Na + K comparison with pH.

Table 9—Summary of Correlation Coefficients Grouped According to Formulation

			Selection of Measurements Compared and Correlation Coefficients							
Coating Panel	60° Gloss Difference	20° Gloss Difference	Panel pH	Location pH	Total Cations	Total Anions	Blister	Check	Delamination	Correlation Coefficient
A. Pigmented Coatings										
181A	•	•								0.92
			•		•					0.80
	•				•					0.78
181B			•		•					0.89
		•				•				0.86
		•		•						0.77
				•	•					0.77
181C	•						•			0.92
		•					•			0.93
	•		•				•			0.77
		•						•		0.74
								•		0.77
B. Clear Coatings										
181A			•				•			0.80
181B				•					•	0.64
		•	•							0.99
	•								•	0.57
		•							•	0.61
181C	•		•							0.91
		•	•							0.75
	•			•						0.63
		•		•						0.72
	•	•								0.88

and physical changes, that are dependent on environmental conditions, occurs with different formulations. It can be seen in *Table* 9 that there are reasonable correlations for the gloss differences, pH values of the panels, average pH values of the locations, total cations, total anions, blistering, checking, and delamination that tend to be grouped according to the formulation and whether pigmented or clear.

The evidence suggests that the environment strongly influences not only the degree of change that occurs in a coating, both physical and chemical, but also the mechanism that results in such changes. Thus, locations that provide different physical and chemical environments (rainfall, pH, chemical pollutants, temperature, sunlight, etc.) for the same coatings cause subtle but measurable differences as the coatings age.

Similar to the work of Campbell et al.,[16] an assessment of coating damages was performed on panels exposed in the WOM. Unlike the Campbell study, the presence of SO_2 was excluded, and only the influence of UV and moisture on coating degradation was studied. HunterLab colorimeter L/a/b measurements shown in *Table* 10 suggest yellowing of the binder occurred (+ Δb) due to a degradation induced by the UV radiation. These observations are in line with previously reported results that UV radiation is one of the variables responsible for chemical and physical changes in coatings. The WOM panels were not evaluated with surface analysis techniques (SIMS, surface pH, anion and cation analysis), but it would be of interest to determine whether such changes differ from acid rain exposed coatings.

Table 10—Color Changes of Pigmented Coatings after 800 hr WOM Exposure

Coating Sample	ΔL	Δa	Δb
181A white	–0.2	0.0	+0.6
181B white	–0.1	+0.1	+0.5
181C white	+0.5	0.0	+0.4

SUMMARY

The experiments included evaluation of simulated acid rain in a chamber study to determine whether any aspect of chemical or physical change can be attributed to the acid nature of the rainfall. The data indicate that there is an influence of lower pH on the degradation of films. There is also a tendency for unpigmented films to degrade more rapidly than pigmented films, but there are exceptions that are dependent on composition. The presence of a high concentration of saturated oils appears to result in polymer degradation that may also lead to high anion contents. Chlorine migration through the film is suspected to further degrade the polymer. Although there is no single measurement to signify a common cause of degradation, these observations are consistent with literature that reports chemical activity of degradation to be accelerated with UV light activity and/or SO_2 adsorbed by the film.

The data obtained with surface analysis techniques show some trends that can be summarized and appear to apply to the coatings studied. There is a relatively high ratio of saturated hydrocarbon to unsaturated hydrocarbon for the unexposed 181C white sample compared with most of the other samples examined. It was also observed that there is a significant variation in the amount of nitrogen at the surface, the unexposed 181C white sample having the highest level. It is suspected that this is due to preferential degradation of the melamine formaldehyde during exposure. The melamine formaldehyde may migrate to the surface when the coating is cured. The increase in melamine formaldehyde resin at the surface due to migration may be a result of lower crosslink density of the film, which is attributable to the presence of less reactive saturated oils in the formulation.

The positive SIMS experiments indicate that the unexposed film has more Na and K at the immediate surface whereas other samples have higher concentrations at greater depth. The groupings that show the greatest number of correlation coefficients 0.9 and above are in the following order: low pH, high ozone and SO_2, and mid to high range of sodium plus potassium contents. These alkaline elements were also found to decrease as pH decreases.

The summaries indicate that there is entry of cations and anions into the coating films. The permeation of ionic species most likely can cause changes in physical properties such as embrittlement that can lead to checking and delamination. Blistering may occur due to water permeation and the effects of osmotic pressure buildup in the presence of ionic species. The migration of cations and anions over an extended period of time may lead to corrosion effects that include blistering, delamination, and corrosion of the substrate.

In the course of this study it was observed that after an exposure of approximately two years, a green fungal growth developed on the shaded portion of the panels at all locations. This was not anticipated but work was conducted to analyze and identify the fungal species. This part of the study was not included in the correlation coefficients.

The fungus *Alternaria sp.*, a common fungal organism in outdoor air, was found at all locations. Other fungi observed were *Epicoccum sp.*, *Penicillium sp.*, *Cladosporium sp.*, *Trichophyton sp.*, and yeast.[20]

Only the pigmented coatings exhibited fungal growth. The pigmented panels showed an original surface pH of 7.6 to 8.0. The pH of the exposed panel surfaces showed a range of 4.2 to 5.4. It is widely known that fungi thrive in acidic conditions (pH 5).

A possible mechanism for this fungal growth is that as the coated surfaces degrade, pigment particles are exposed which collect and retain dirt. The soiled surfaces may provide an environment for the fungi to thrive. Further study would be required to test this hypothesis.

There are two additional sets of panels on exposure at each of the five outdoor sites. It is planned to evaluate longer term chemical changes and also use surface analysis techniques (ISS and SIMS) to compare the chemical changes that occur in weather-ometer exposure where no acid rain is present. This would be of value in choosing new resin materials for development.

The work presented here has utilized sensitive chemical and surface analysis techniques to evaluate the effect of acid rain in the natural environment and compare results with the coatings exposed to accelerated tests under controlled conditions.

The study has identified conditions that have impact on the degradation of the coatings studied. The conclusions agree with conceptions that have evolved from many other studies.

The analysis of the chemical changes that occur at the surfaces has contributed to the insight of differences observed under varying conditions. The surface analysis studies reflect the suggestions by Dr. Ray Dickie in his 1993 Mattiello Lecture and July 1994 article entitled "Chemical Origins of Paint Performance," published in the JOURNAL OF COATINGS TECHNOLOGY (Vol. 66, No. 834, Page 28), in which he outlined analysis of chemical changes at the surfaces as a logical and necessary procedure to understand the nature of degradation and changes in properties of exposed coatings.

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Solution and Solid C^{13} NMR Studies of Multifunctional Polyolacrylate Networks

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Several C^{13} NMR techniques are introduced to address the problem of structure determination of photopolymerized polyolacrylates, and to study both the liquid and solid states of acrylic monomers and oligomers, as well as the network structure formed upon their photopolymerization. By measuring the relative integration of specific peaks in the carbon spectra as a function of the time of irradiation and laser power, the relative reactivity of monomers/oligomers used in the early stages of polymerization is determined. Changes in crosslink density and in the mobility of the polymeric chains can be followed throughout the photopolymerization process by monitoring proton $T_{1\rho}$ relaxation times. The degree of crosslinking is correlated to the relaxation times and it increases with an increasing power of the irradiating laser even under conditions where the degree of conversion, as measured by quantitative infrared absorption of the 810 cm^{-1} band of the acrylate is almost unchanged.

INTRODUCTION

Coatings, such as those widely used in various industrial radiation polymerized systems, often consist of crosslinked polymer networks which are mainly polyolacrylates. The introduction of multifunctional polyolacrylates for the formation of clear polymers traces to Plambeck, at DuPont, who developed them for use in preparing relief images for printing plates. According to a critical patent, 'one of the most widely used photoengraving processes at the time (1956) was to expose metals coated with very thin layers of gelatins photosensitive to light through an image bearing transparency, thus forming a reverse image in the photosensitive layers...'.[1] Plambeck's seminal contribution was to recognize that multifunctionality in an acrylate would produce a more rapid photoresponse. He also recognized that benzoin ethers absorb UV radiation at the principle lines of the mercury resonance lamp and undergo radical forming reactions which we now know to be of Norrish Type I series. Plambeck's work was built on an earlier British patent[2] which taught that relief-forms for printing could be produced from methyl methacrylate, the primary monomer for the formation of Plexiglas®, in an image forming manner, which also often required a subsequent thermal forming step. In a typical DuPont system, various polyolacrylates were photopolymerized. Examples cited were polyethylene glycol diacrylate and various polyolacrylates formed from glycerol, pentaerythritol, triethylene glycol, and others. Among the many characteristics of photopolymers formed from such materials are their clarity and hardness. Such materials also undergo very rapid photopolymerizations, a point stressed as being important in printing applications by Plambeck.

Polyolacrylate monomer polymerizations have many other applications. For example, they provide the shiny coats in thin films such as those found on the cover of magazines like *National Geographic*. They are used as printing inks, for coatings, in lithography, for three-dimensional imaging/stereolithography, and for near photographic speed color copying systems such as Cycolor®.[3] Several hundreds of monomers used in such applications are available. Among the more common multifunctional acrylates are trimethylolpropane triacrylate and dipentaerythritol pentaacrylate (*Figure* 1).

As critical as polyolacrylates are in commerce,[4] very little actual structural information on the photopolymers formed from them is available. This is in direct contrast to the photopolymerized systems created by crosslinking of poly(vinyl cinnamates) developed by Minsk, van Deusen, and Robertson at Eastman Kodak.[5] These photoproducts have been characterized completely and in detail by Resier, in a series of now classic works in photopolymer science.[6]

Understanding the molecular structure of formed polymer networks is a complex problem, because the many processes which occur in the formation of photopolymers from polyolacrylates do not always go to completion, and the reactions by which they are formed sometimes continue for long periods of time. For example, it is not unusual for the various processes to start in the nanosecond time domain after light absorption, and to continue in time frames ranging from many

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Table 1—Chemical Shifts (δ) of the Carbon Peaks in C^{13} NMR for the Monomers Used

PEGA 400		HDDA		BuAc		TMPTA		DPHPA	
C_1	130.22	C_1	130.45	C_1	130.58	C_1	129.75	C_1	129.9
C_2	132.77	C_2	132.3	C_2	132.2	C_2	133.21	C_2	133.37
C_3	167.7	C_3	167.97	C_3	168.13	C_3	168.9	C_3	167.31
C_4	72.35	C_4	66.2	C_4	66.24	C_4	66.26	C_4	71.78
C_5	70.83	C_5	30.36	C_5	32.6	C_5	43.14	C_5	45.0
		C_6	27.47	C_6	21.06	C_6	20.25	C_6	64.61
				C_7	15.57	C_7	9.46	C_7	62.82

minutes to many hours. Both early occurring and late occurring polymerization processes can impact photopolymer properties. The individual reactions can be followed independently by a combination of solution phase and solid C^{13} NMR spectroscopy, thus allowing the quantitative analysis of both monomer/oligomer and the final crosslinked polymer.[7] NMR can be applied to the various elements by polymeric systems, for example, carbon, hydrogen, and silicon. Besides providing static structural information, NMR also allows the determination of parameters related to the polymer dynamics like T_1 and $T_{1\rho}$ parameters.[8,9]

EXPERIMENTAL

General

An Ar + laser (Omnichrome 543-200 MGS) was used as the radiation source. Carbon-13 NMR spectra for the liquids were obtained at room temperature using a Varian Gemini 200 spectrometer operating at 50.3 MHz. A Varian UnityPlus 400 spectrometer operating at 100.6 MHz was used for the solid samples.

The monomers and oligomers used (*Figure* 1) were:

(1) Polyethylene glycol-400, diacrylated [PEGA-400], Monomer-Polymer Laboratories, Inc.;

(2) Butyl acrylate [BuAc], Aldrich Chemical Co.;

(3) 1,6-Hexanediol diacrylate [HDDA], Aldrich Chemical Co.;

(4) Trimethylolpropane triacrylate [TMPTA], Sartomer 357, Sartomer Co.;

(5) Dipentaerythritol penta-acrylate [DPHPA], Sartomer 399, Sartomer Co.; and

(6) The monomer mixture, STDR, consisted of, in weight percent, PEGA (20), TMPTA (40), DPHPA (40).

We estimate the monomer purity to exceed 93.5%. Monomer stabilizers were not removed because it has been observed that doing so generates an instability in the reaction mixture, with the polymerization starting before it is intended.

The dye used as photoinitiator was a fluorone derivative (2,4-diiodo-6-butoxy-3 fluorone) hereafter DIBF[10] at concentrations from 2 × 10^{-4} M to 1 × 10^{-3} M. N,N-dimethyl-2,6-diisopropylaniline [DIDMA], Carbolabs, Inc., was used as the electron donor at concentrations from 3 × 10^{-3} M to 0.1M.

Sample Preparation

The monomers and the mixtures of monomers were dissolved in *d*-chloroform (200 mg monomer in 1 ml *d*-chloroform) for the liquid phase NMR determinations. For the relative reactivity measurements, the irradiation was carried out directly in an NMR tube. The laser power was varied from 10 to 70 mW, and the scan speed was 11.0 mm/sec.

For the solid-state experiments, the reactive mixtures were poured into dog bone-shaped Teflon® molds. The laser beam was directed toward the sample by mirrors positioned above the molds. The mirrors were controlled by x-y scanners (DX-series servo controller, from General Scanning, Inc.) driven by digitized computer data from a special file which traced over a bit more than a 200.0 × 200.0 mm square region. The laser power was varied from 40 to 150 mW, and the scan speed was 9.0 mm/sec.

After the irradiation was complete, the photopolymerized dog bones were immersed in liquid nitrogen and crushed. Silicon nitride rotors were filled with sample powder, and the samples were spun at the magic angle with a spinning rate of 7.0 kHz at 290° K. Standard CPMAS, and $T_{1\rho}$ measurements[9,11] were carried out.

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Dr. Neckers was named National Science Foundation Fellow at the University of Kansas (Ph.D.–1963). He was a Fellow of the Harvard Corporation (1964) and the only Alfred P. Sloan Foundation Fellow ever appointed based on research work done in a predominantly undergraduate institution, Hope College, where he started his teaching career. He is a member of the American Chemical Society, a Fellow of the American Association for the Advancement of Science, and the first appointed University Distinguished Research Professor.

Dr. Neckers is the author of approximately 198 research papers, several books, and approximately 20 patents. His work is currently supported by the National Science Foundation, the Ohio Department of Development (Edison Industrial Systems Center) and the Office of Naval Research.

Matched spin-lock (SL), single-contact cross-polarization (CP), or Hartmann-Hahn experiments were performed using a four-part procedure. First, the proton spins were polarized in H_0. Then they were placed in the rotating frame by a 90° pulse followed by a 90° phase shift and continuous application of a strong H^1 rf field. The third part of the experiment was to establish C^{13}-H_1 contact for variable times by placing the C^{13} spins into the rotating frame by continuous rf irradiation of the carbon spins such that $\gamma_{carbon}(H_1)_{carbon}=\gamma_{proton}(H_1)_{proton}$. The final step was to sample the C^{13} magnetization by turning off (H_1) carbon, but still with dipolar decoupling of the H_1 spins.[11] All spectra were accumulated at a spinning rate of 5 kHz.

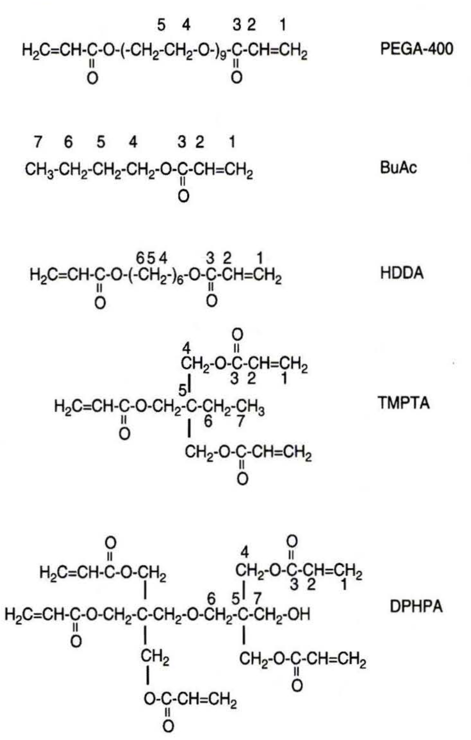

Figure 1—Molecular structures for the monomers used in the experiments.

RESULTS AND DISCUSSION

Liquid Phase

Relative Reactivity: The C^{13} NMR spectra of BuAc, HDDA, PEGA, TMPTA, and DPHPA are summarized in *Table* 1. Since the carbon atoms of the acrylic double bonds for each monomer have specific chemical shifts, one may follow the reactivity of these monomers in homogeneous solution and their relative reactivity in mixtures. HDDA was mixed with each monomer in different proportions (1:1 by weight with PEGA, TMPTA, DPHPA, and 1:3 with BuAc), and the changes in the integration of the peaks corresponding to carbon-carbon double bonds as a function of laser power measured. DIBF [2×10^{-4} M] was used in combination with co-initiator [3×10^{-3} M] in every case. *Figure* 2 compares the integration of the methylene carbon resonance of the acrylic double bond of each monomer (BuAc, PEGA, TMPTA, DPHPA) with that of the methylene carbon resonance of the acrylic double bonds from HDDA. By increasing the laser power, the ratio between the integration of the peak corresponding to the C^{13} resonance of the acrylic double bonds in PEGA and that of the similar C^{13} resonance in HDDA peak decreases. This indicates that the rate of polymerization of PEGA is higher than that for HDDA under these reaction conditions. The variation in the integration ratio of C^{13} peaks corresponding to the methylene carbons in the acrylic double bonds of HDDA:BuAc with laser power for the mixture HDDA:BuAc is also given in *Figure* 2. It is observed that the change in the integration ratio is bigger when the laser power is incremented from 0 to 30 mW. At higher power levels, the rates of reaction have almost the same value. This suggests that the rate of polymerization for BuAc is only slightly less than the one for HDDA, since the concentration of BuAc is controlled in such a way that there are three acrylic groups in the BuAc system for the two acrylic groups of HDDA (the molar ratio is 3:1, and the BuAc has one acrylic group, and the HDDA has two acrylic groups).

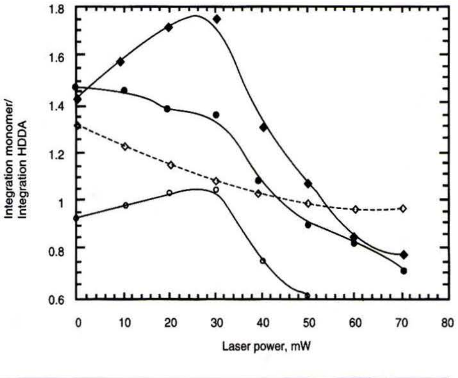

Figure 2—The variation with the laser power of the ratio between the integration of the methylene peak of each monomer and that of the methylene peak from HDDA. —●—: PEGA; —○—: DPHPA; —◆—: TMPTA; and --◇-- : BuAc.

For mixtures of DPHPA:HDDA and TMPTA:HDDA a different behavior is observed. At laser powers from 10 to 30 mW, the ratios between the integration of the C^{13} resonance of the vinyl carbons and the integration of the $=CH_2$ carbon for HDDA, increase in both cases, suggesting that HDDA is more reactive than either DPHPA or TMPTA (*Figure* 2). If the laser power is increased beyond 30 mW, the integration ratios of the C^{13} methylene carbons of the acrylic groups decrease. In the case of DPHPA, the integration ratio of this resonance drops from 1.047 at 30 mW to 0.74 at 40 mW. Data were obtained up to a laser power of 50 mW beyond which the

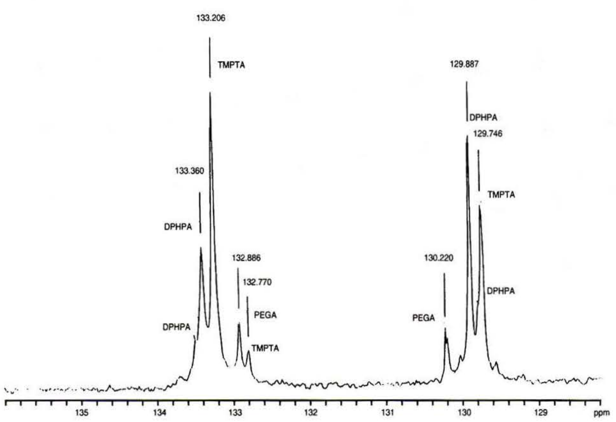

Figure 3—The peak assignments of the C=C region in the STDR mixture.

mixture changed to a gel rendering the NMR technique inaccurate. After a specific laser power, it appears that DPHPA and TMPTA have higher rates of polymerization than HDDA. At laser powers lower than the threshold value, HDDA is more likely to react than DPHPA and TMPTA. We presume this is due to the differences in molecular weight and relative molecular size since radicals from it would be expected to be more mobile in solution. When the number of DPHPA and TMPTA radicals formed reach this threshold value (by increasing the laser power, more radicals are produced), the photopolymerization of these two multifunctional monomers (DPHPA has five acrylic groups and TMPTA has three acrylic groups) becomes very fast.

The following relative reactivity order can be established from the data in *Figure* 2: DPHPA > TMPTA > PEGA > HDDA = BuAc. DPHPA is the most reactive, due to its five acrylic groups, and BuAc the least reactive.

By measuring the distances between the peaks in the C^{13} NMR spectra corresponding to the CH_2 and CH of the acrylic double bonds in each monomer, and by matching these distances in the STDR mixture (20% PEGA, 40% TMPTA, and 40% DPHPA), all the peaks could be identified as shown in *Figure* 3.

The increase in the ratio between the integration of the C–O peak and the integration of the CH_2 peak from the double bond carbon system for each monomer could be monitored during the photopolymerization process. This gives a measure of relative rates of polymerization. These experiments were carried out on two separate samples: DIBF = [1.0×10^{-3} M]; DIDMA = [1.5×10^{-2} M]. The experiments were done as follows: the to-be-polymerized mixture was introduced, respectively, into two NMR tubes and dissolved in $CDCl_3$. One sample, (sample B) was kept in room light without any prior irradiation. As expected, the relative integration (the ratio between the integration of the C–O peak and the integration of the CH_2 peak from the acrylic double bond) increased with time for all of the monomers (*Figure* 4). After 1.5 hr the mixture became a gel and no more determinations were possible. The second sample (sample C) was kept in the dark after irradiation. All monomers behaved in a similar manner (*Figure* 5). In the first four hours after irradiation, the ratio of integration of C–O peak to that of the CH_2 increased rapidly. After that, the increase was much slower. For example, in the case of PEGA, the ratio increased from 2.67 to 3.55 in the first four hours and after that from 3.55 to 4.9 in a 68-hour period. In the case of TMPTA, the

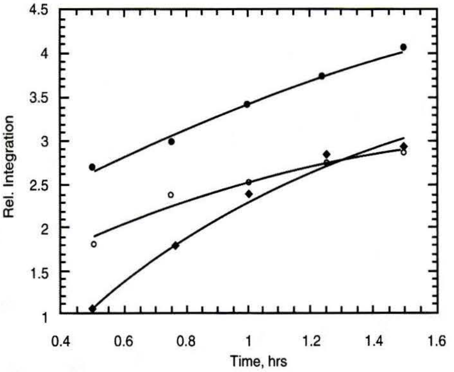

Figure 4—The variation in time of the relative integrations of the monomers which are forming the STDR, when the NMR tube was kept in the room light.
—●—: PEGA; —○—: DPHPA; and —◆—: TMPTA.

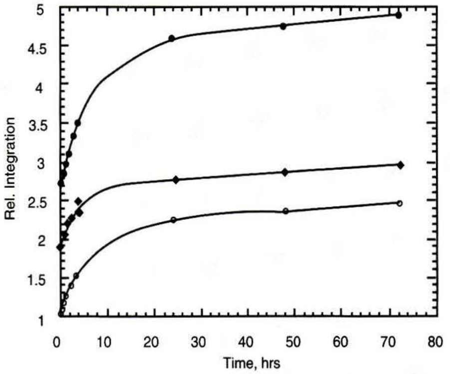

Figure 5—The variation in time of the relative integrations of the monomers which are forming the STDR, when the NMR tube was kept in the dark after irradiation.
—●—: PEGA; —○—: TMPTA; and —◆—: DPHPA.

ratio increased from 1.04 to 1.56 in the first four hours, and from 1.56 to 2.47 during the rest of the experiment. In the case of DPHPA, the same ratio increased from 1.81 to 2.45 in the beginning and from 2.45 to 2.91 during the remaining 68 hr of the experiment. These results suggest that, even for the sample kept in the dark, polymerization continues even after the laser is turned off, because of the presence of radicals formed in the early stages of the polymerization process.

After the double bond conversion reaches a value of 4-5%, liquid becomes gel, and the sample no longer remains soluble in $CDCl_3$. Therefore, to follow the photopolymerization process after the early stages, one must use solid-state C^{13} NMR.

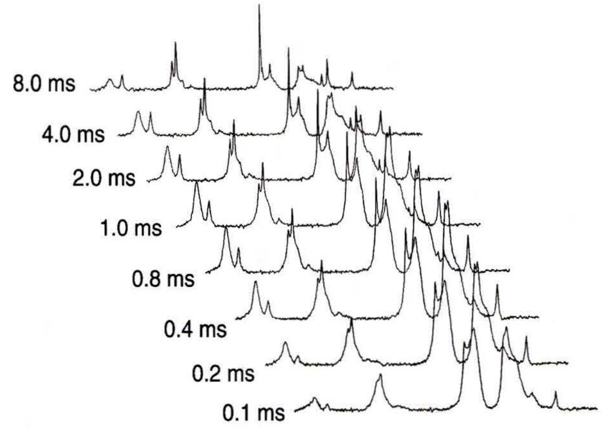

Figure 6—The build-up of the carbon magnetization as a function of contact time for the STDR.

Solid-State Studies

MOBILITY: The build-up of carbon magnetization as a function of spin-lock CP contact with polarized protons is shown for the STDR (20% PEGA, 40% TMPTA, 40% DPHPA) in *Figure* 6. The polymerized sample was obtained with a laser power of 100 mW. The mixture contained some residual monomer, and not every double bond was converted to a single bond. The peak assignments for the mixture, from *Figure* 7, made from the spectra of the monomer in solution, are: 175 ppm for the carbonyl group of the nonpolymerized acrylic groups, 165 ppm for the carbonyl group of the polymer, 131 ppm for the CH_2 carbon of the residual acrylic double bonds, 128 ppm for the CH carbon from the residual acrylic double bonds, 70 ppm for the CH_2–O carbons from DPHPA and PEGA, 64 ppm for the CH_2–O carbon from TMPTA, 45 ppm for the quaternary carbon from DPHPA, 41 ppm for the quaternary carbon from TMPTA, 24 ppm for the –CH–carbon from the polymerized acrylate double bonds, 18 ppm for the –CH_2– carbon from the polymerized acrylate double bonds, and 7.5 ppm for the methyl carbon of TMPTA. The difference between the carbon resonance of the C=O group in the nonpolymerized acrylic groups and the carbon resonance of the carbonyl group of the polymer is due to the loss of conjugation in the second case. This causes a downfield chemical shift of about 9-10 ppm.

After about 4 ms of CP contact, the intensity of all the carbon lines decreases (see *Figure* 6). The time constant describing this decay is the proton $T_{1\rho}$, which can be correlated with the motions of protonated carbon atoms in the polymeric network. The mobility of these carbons depends on the degree of crosslinking as well. Large values for proton $T_{1\rho}$ means the carbon atom has substantial mobility and a relatively low degree of crosslinking. Six different samples were studied at different values of the contact time (from 0.2 ms to 10 ms). The photoreactive mixture was photopolymerized with six different laser powers (40, 60, 80, 100, 120, and 150 mW) but with the scan speed maintained. The initiator, DIBF [3 × 10^{-3} M] and DIDMA [0.1 M] served as the initiating system.

Figure 8 presents the variation of the proton $T_{1\rho}$ with laser power for each protonated carbon. In every case, we observed an increase in the proton $T_{1\rho}$ with an increase of laser power from 40 mW to approximately 80 mW, and a decrease in proton $T_{1\rho}$ at higher laser powers. This implies that the mobility of the carbon atoms are increasing with laser power until

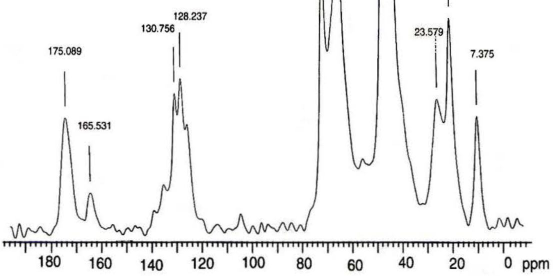

Figure 7—The solid-state spectra for the photopolymerized STDR.

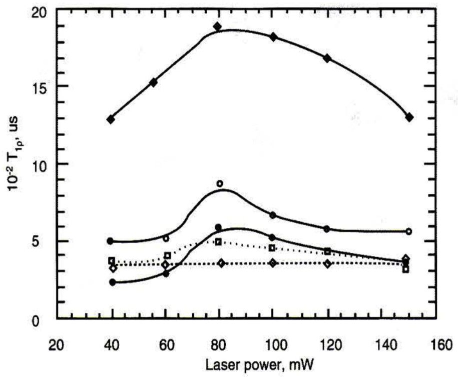

Figure 8—The variation of the proton $T_{1\rho}$ with the laser power for each protonated carbon in the STDR mixture.
—●—: 7.2 ppm; —○—: 18.2 ppm; —◆—: 128.3 ppm; --◇--: 64.1 ppm; and · ·□· · : 23.6 ppm.

the mobility reaches a maximum around 80 mW, which it decreases. This can be explained if one assumes that the degree of crosslinking is low at reduced laser power and each of the carbons have sufficient space to move about in the polymeric network. An increase in the laser power causes an increase in the degree of crosslinking, and the polymer chains become more rigidly held. This limits the mobility of the individual carbon atoms, which causes a decrease in the $T_{1\rho}$ values. As was determined from the IR spectra, the C=C conversion does not increase significantly with an increase in laser power over 80 mW, but the degree of crosslinking still appears to increase. The % C=C conversion was determined by squeezing a few drops of resin between NaC1 windows separated with 1.5 mm Teflon spacers. The IR transmission spectrum was measured before irradiation. The sample was then irradiated and the FTIR transmission spectrum taken again. The % C=C was determined by comparing the area of the 810 cm^{-1} absorption peak of the acrylic group before and after irradiation and using the equation:

$$\% \, C{=}C{=} \, (S_0 - S_1) \times 100 \, / \, S_0$$

where S_0 corresponds to the area of the band before irradiation and S_1 is the area after irradiation.[7] A comparison between the double bond conversion and the degree of crosslinking is presented in *Figure* 9.

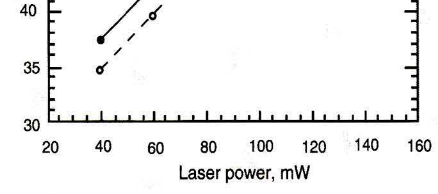

Figure 9—The variation of the degree of double bond conversion and the degree of crosslinking with the laser power in the case of STDR resin.
—●—: C = C coversion, %; and —○—: Degree of crosslinking, %.

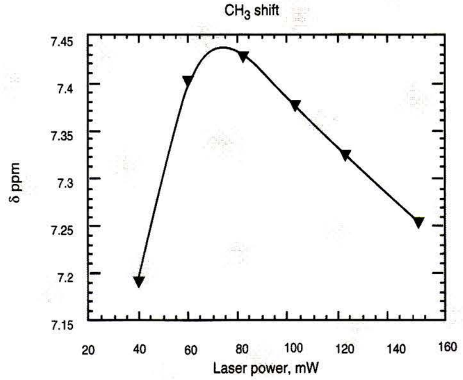

Figure 10—The chemical shift of the methyl peak with the laser power.

The variation of the chemical shift of the methyl carbon from TMPTA with the laser power is presented in *Figure* 10. With an increase in the laser power from 40 to 80 mW, this peak is shifted downfield. An additional increase in power causes the peak to shift in the reverse direction, or upfield. This peak shift is due to the fact that a change in environment occurs during the photopolymerization process.

CONCLUSION

C^{13} NMR in liquid and solid state is proving to be a most useful technique for the characterization of polyolacrylate networks. The relative rates of polymerization between the components of most complex mixtures as a function of laser power may be determined by following the variation of the integration ratio of the carbon peak resonance of C–O carbon atom and the carbon peak resonance of CH_2 carbon derived from the acrylic double bonds. The disadvantage of the solution method is that such monitoring can be carried out only until five percent of the double bonds are converted to single bond centers. At higher values of double bond conversion, the polymers formed are insoluble in the required NMR solvents such as chloroform.

By following the variation of the relaxation times of individual carbon resonance as a function of laser power, information concerning the mobility of specific groups in the polymer can be obtained. For example, carbons from the residual acrylic double bonds have greater mobility than the corresponding carbons from the polymerized double bonds. The CH_2–O carbons have less mobility than the CH_2 and CH carbons from the polymeric chain, and the value of $T_{1\rho}$ does not change appreciably with laser power. The CH_2 carbons from the polymerized acrylic double bonds and the CH_3 carbons appear to have comparable mobility by using this analysis.

In the particular system studied in this work (an acrylic network), the degree of crosslinking continues to increase above 100 mW laser power though variations in the degree of double bond conversion are very small.

A combination of solution phase and solid state C^{13} NMR studies promise important new information about the three dimensional structures of polymer networks. Our work is presenting only some general conclusions about the structure of the acrylic networks, and our research is continuing.

ACKNOWLEDGMENT

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Computer Simulation of Particle Packing in Acrylic Latex Paints

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Computer simulation of the random close packing of hard pigment particles and deformable latex particles in acrylic latex paint systems is described. The simulation requires only the particle size distribution of the pigment, the particle size distribution of the latex, and the deformation or softness of the latex. If these data are known, the packing density can be determined from the simulation. If paints with a range of pigment volume concentrations (PVC) are simulated, the critical PVC can be predicted from plots of packing density against PVC. The predicted values are in good agreement with experiment.

INTRODUCTION

Since the seminal work of Asbeck and Van Loo in 1949,[1] the critical pigment volume concentration (CPVC) has been recognized as being of fundamental importance in paint formulation. Many film properties change abruptly at the CPVC, and it is a true transition point.[2] The CPVC has been defined[1] as the volume percentage of pigment in the film which has just sufficient binder to completely fill the voids left between the pigment particles. This CPVC is seldom aimed for by a formulator but rather it is a reference point. Paints may be formulated below the CPVC to minimize air voids and optimize film properties or formulated just above the CPVC to take advantage of the increased opacity due to air voids. To maintain similar film properties when alternate pigments and binders are substituted in a formulation, substitutions should be made in a way which maintains the same reduced pigment volume concentration (PV).[2]

Bierwagen[3] has shown that, for solvent-based paints, the CPVC can be determined by assuming random close packing of the pigment particles plus adsorption of the oil or polymer onto the surfaces of the pigment particles. The total volume of oil plus pigment at the end of an oil adsorption test was assumed to be the sum of the pigment volume, the interstitial oil volume, and the adsorbed oil volume. The adsorbed oil was assumed to increase the effective size of the pigment particles. The CPVC was then the random close packing density of the pigment plus adsorbed oil. For uniformly sized, spherical pigment particles with no surface adsorption of oil, this reduces the packing density of uniform spheres at 64% PVC.[4] Surface adsorption of polymer, pigment porosity, and irregular shape would tend to lower this figure, while a broad particle size distribution would tend to increase the CPVC.

In water-based latex paints, the latex particles are not infinitely deformable, as is the solvated polymer in solvent-based paints. Therefore, surface adsorption in a manner which increases the effective particle size of the pigment is not expected. Adsorption of low molecular mass components, such as surfactant, is also not expected to increase the effective particle size of the pigment significantly. Hence, as pointed out by Rowland and Steig,[5] this results in both the pigment particles and the latex particles packing together to form the film from their dispersed state in the paint. In the film the pigment particles are held apart by the latex particles to various extents depending on the relative sizes of latex and pigment and also the deformation of the latex particles. The deformation of latex particles will depend on properties and conditions such as the minimum film forming temperature (MFFT) of the polymer, temperature of film formation, and amount and type of coalescing agents. Thus, the CPVC of a latex paint will generally be lower than a solvent-based paint with the same pigment formulation. In the limit of zero relative size of latex to pigment particle size and/or infinite deformability of the latex particles, the CPVC of the latex paint would be expected to be the same as a solvent-based paint with the same pigment formulation and no oil adsorption.

The CPVC of a latex paint can be determined by observing the variation of some property in a PVC ladder. Virtually any property can be used. Asbeck and Van Loo[1] measured gloss, blistering, rusting, and permeability. Schaller[6] measured enamel holdout, scrub resistance, tensile strength, contrast ratio, and corrosion. Hesler[7] measured gloss, stain porosity, and recommended contrast ratio. Anwari et al.[8] used contrast ratio and 85° sheen as well as other methods. To make the number of paints required for a PVC ladder and measure the properties is a tedious process. However, Berardi's binding

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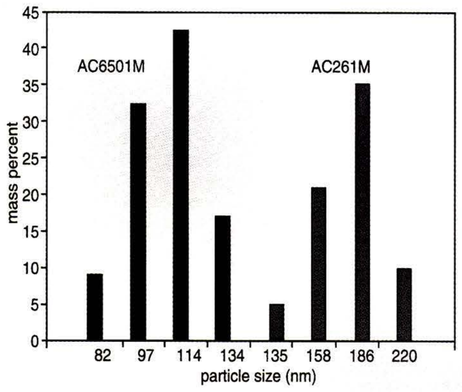

Figure 1—Particle size distribution of latices.

power index,[9] once known for a given latex, allows the CPVC of any formulation using this latex to be determined.[10,11]

Experimentally, the CPVC of latex paints has been found to decrease with increase in size of the latex particles,[6,12,13] to decrease with increase in MFFT or glass transition temperature(T_g),[6,13] and to increase with amount of coalescing agent.[6,13] However, Becker and Howell[12] found no change in CPVC with amount of plasticizer in polyvinylacetate latices. Anwari et al.[14] found that dry hiding above the CPVC in acrylic latex paints, and by inference, the size and number of air voids, decreased with decrease in latex particle size, decrease in T_g, and increase in amount of coalescent. These results are mostly consistent and support the ideas of Rowland and Steig[5] that small soft latex particles allow pigment particles to pack together with minimum air voids and large hard latex particles introduce air voids at a lower PVC.

The aim of this paper is to present an algorithm which simulates the packing of pigment and latex particles in a paint film. The algorithm uses only three pieces of information. These are the particle size distributions of both pigment and latex and a deformation which is related to the MFFT or softness of the latex particles. This allows the CPVC to be predicted without making PVC ladders, provided the required information is known.

EXPERIMENTAL

The CPVCs for some titanium dioxide/acrylic latex paints and some calcium carbonate/acrylic latex paints were determined using acrylic latices and pigments for which particle size distributions were supplied by the manufacturers. The CPVCs were estimated from PVC ladders using 60° gloss versus PVC. In the case of the calcium carbonate pigmented films, we were able to visually observe the increase in opacity due to air voids at the CPVC and to confirm this observation by light transmission of the films.

The titanium dioxide was RHD2 (Tioxide Australia Pty. Ltd., Burnie, Tasmania, Australia). A typical particle size distribution, determined by a sedimentation method, was provided by the suppliers, and this was used in the simulations. The calcium carbonate used was Omyacarb 1 (Omya Southern Pty. Ltd., Melbourne, Victoria, Australia). The nominal particle diameter was 1 um. A typical particle size distribution, determined by a sedimentation method, was provided by the suppliers, and this was used in the simulations. The latices used were Primal AC6501M and Primal AC261M (Rohm and Haas Australia Pty. Ltd., Geelong, Victoria, Australia). The MFFT and particle size distribution of each latex were provided by the supplier. The MFFT of both latices was 16°C. The mean particle diameters of each of these latices were 119 nm and 193 nm, respectively. Particle size distributions of the two latices and titanium dioxide are shown in *Figures* 1 and 2. The particle size distribution, by mass and by number, of the calcium carbonate used is shown in *Figure* 3. Sixty percent PVC paints at 40% volume solids were made by dispersing the required amount of pigment in water with a recommended surfactant system.[15] This was 1% Orotan 731SD (Rohm and Haas Australia Pty. Ltd.), 0.5% Triton CF10 (Rohm and Haas Australia Pty. Ltd.), and 0.5% Teric N40 (ICI Australia Pty. Ltd., Ascot Vale, Victoria, Australia) based on weight of pigment. The pigment was dispersed using a Sardik Hi-Speed Dissolver (Sardik Engineering, Gladesville, NSW, Australia). The PVC ladder was prepared by diluting this dispersion with latex at 40% volume solids. The pH was kept at 8-9 with ammonia. No coalescing aids or other additives were used, excepting a viscosity control additive at one percent volume solids based on total volume solids. This was RM5 (Rohm and Haas Australia Pty. Ltd.). The paints were drawn down in films of 0.38 millimeter wet film thickness and allowed to dry at 30°C for 24 hr. Further drying at 25°C for one week took place before 60° gloss readings on the films were taken (Micro TRI Glossmeter, Byk-Gardner, Silver Spring, MD). Visible light transmissions, at a wavelength of 550 nm, of the calcium carbonate pigmented films were measured by a Hitachi U-3200 spectrometer (Hitachi Ltd., Tokyo, Japan).

THE ALGORITHM

The algorithm is based on previous work by the authors concerned with the random packing of spheres[16-18] and

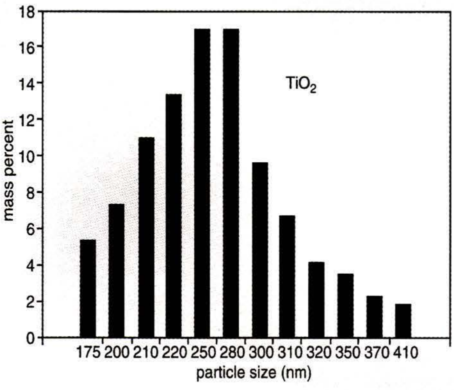

Figure 2—Particle size distribution of titanium dioxide.

nonspherical particles.[19] Coated titanium dioxide particles were approximated as hard spheres with a known size distribution. It is known[19,20] that broad particle size distributions have different random close packing densities to uniformly sized particles and so distributions were used in preference to average particle sizes, especially as the extra program coding required is trivial. Latex particles were approximated as deformable soft spheres with a known particle size distribution. The deformation D, of a latex particle, is defined as

D = mean radius lost due to coalescence/
original radius of latex particle.

A latex particle is also considered to be deformed by an equivalent amount when in contact with adjacent pigment particles. The deformation can have a value ranging from 0 (hard) to 1 (infinitely soft). The deformation of a latex is determined by its MFFT and different latices with the same MFFT are considered to have the same deformation value D. Ideally, the deformation would be able to be estimated from the MFFT and the CPVC determined from just three experimentally known values. However, insufficient data were available to determine the relationship between deformation and MFFT.

A latex particle is considered to be slightly compressible. For ease of simulation, it was assumed that the particle absorbs the volume associated with its deformation when coalescence occurs and does not redistribute this volume in the form of bulges or a greater sphere radius. For an assembly of latex spheres with a deformation value of 0.13 (the value estimated for the latices used in these simulations), the volume of the latex deformation in each sphere was calculated to be approximately four percent of the sphere volume. This was regarded as sufficiently too small to neglect. The photographs by Kendall and Padgett of coalesced latex particles[21] show no indication of "bulging" as a result of deformations.

A simulated packing comprised of spherical particles of both latex and pigment in the correct numbers to give the required PVC and which obey the specified size distributions is randomly generated within a spherical container. These particles can initially exist in overlapping configurations due to the random placements, but are gradually transformed by an iterative process which causes the packing to converge to an overlap free state. Within each iteration, every particle is moved a small increment under the net action of the forces resulting from its overlaps with neighboring particles. This type of simulation has successfully modeled random packings of hard, equal sized spheres,[16] hard spheres with sizes that obey a lognormal distribution,[17] and hard, nonspherical particles.[19] A packing comprised of pigment and latex particles was considered to be overlap free when the pigment particles had an insignificant mean overlap (less than one percent of mean pigment radius), and the mean latex overlap was less than or equal to its deformation D.

To simulate the coalescence of latex particles, the mean latex overlap was required to equal the deformation D. When the aforementioned iterative process was used alone, the mean latex overlap was always less than the deformation due to the large starting volume. An increase in the mean latex overlap was accomplished by compressing the latex. In this process the centers of all particles were moved closer together vertically. This caused more overlaps to occur which were removed by allowing it to reconfigure, using the same iterative technique, until the pigment particles again had an insignificant mean overlap, and the latex particles had a mean overlap equal to the deformation D. The simulated formation of the paint film was a product of both the iterative technique and the compression process. These operations were performed in conjunction with two constraints. First, the initial packing was constructed so that it was less dense than the final packing. This simulates the compression of particles in the film formation process as described by Vanderhoff and Bradford.[22] Secondly, the PVC of the initial packing was uniform. The uniformity in concentration was maintained throughout the compression process by selectively allowing migration of particles into and out of the region used for analysis. Once the simulated film formation process had been completed, many of the geometric properties of the packing could be determined from the coordinates and radii of the particles. These properties include the packing density and coordination numbers. The packing density is that fraction of the total volume of the film occupied by the latex and pigment particles. The remaining fraction is assumed to be air. Coordination numbers are the number of particles surrounding a given particle. For example, the latex to latex coordination number is the average number of latex particles surrounding a given latex

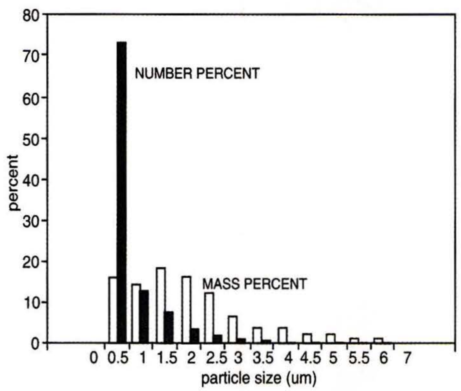

Figure 3—Size distribution of calcium carbonate by particle mass and particle number.

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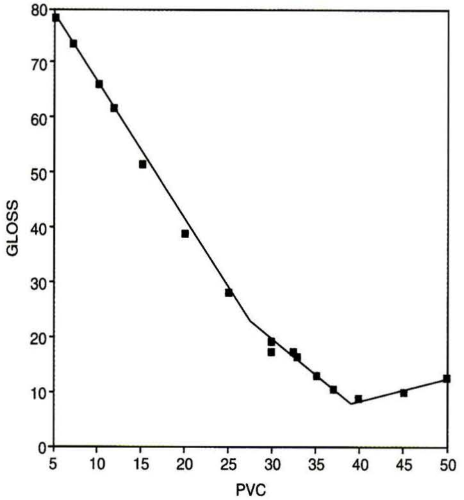

Figure 4—60° gloss against PVC for 119 nm latex/titanium dioxide paint.

particle. Simulations of paints comprised of hard pigment particles and soft latex particles were performed with packings of approximately 1000 particles made up of the required number of latex and pigment particles to give a particular PVC. A separate simulation was performed for each PVC. PVC values ranged from 0 to approximately 70%. The size distribution of each set of particles was modeled on the distributions described in *Figures* 1-3.

The average time for each simulation and subsequent analysis of a paint with a specified PVC was of the order of four hours. At the present time, the simulations are limited to pigments and latices with relative particle size differences of less than the same order of magnitude. This is because the volume of a particle depends on the cube of the radius and hence, particles which differ in radius by a factor of 10, differ in number by a factor of 1,000. For example, the introduction of a single extender particle with large diameter would require thousands more of small latex and/or titanium dioxide particles which would not allow the simulation to finish in reasonable time. Because of this, it was necessary to truncate the size distribution used in the calcium carbonate simulations. The maximum diameter in the distribution used for simulation was 800 nm. As can be seen from *Figure* 3, this represented approximately 90% of the particles by number but considerably less by mass. It was assumed that the missing number of larger particles were spread randomly throughout the film and would not affect the results in a major way. We expect this deficiency will be overcome in time, with the advent of more powerful computers. The programs were written in Turbo Pascal (Borland International, Scotts Valley, CA) and run on an IBM compatible 386 with a math coprocessor. Executable versions of the programs used in these simulations are available to researchers and can be obtained by writing to the authors. A pseudocode listing of the algorithm is given in *Appendix* 1.

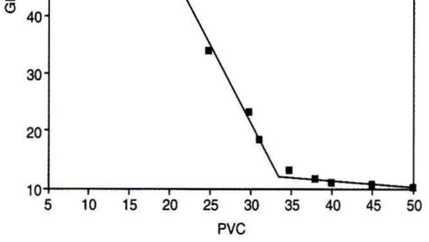

Figure 5—60° gloss against PVC for 193 nm latex/titanium dioxide paint.

RESULTS AND DISCUSSION

The experimental results of gloss versus PVC for the 119 nm latex/titanium dioxide system are shown in *Figure* 4. From this graph it can be seen that the CPVC is about 40%. The experimental gloss results of the 193 nm latex with titanium dioxide are shown in *Figure* 5 and with calcium carbonate in *Figure* 6. Percentage transmissions of visible light at 550 nm are also shown in *Figure* 6. The rapid fall off in percent transmission at a PVC of 53% is a better indicator of the CPVC in these films than the gloss readings. The difference in CPVC due to latex particle size is small and of the same order as the experimental error. However, it agrees with the work of Schaller[6] who found a change of about 15% in PVC per micron change in latex particle size. The difference in CPVC on changing from titanium dioxide pigment to calcium carbonate pigment is more significant due to the larger difference in particle size. The calcium carbonate is about five times the diameter of the titanium dioxide pigment and the experimental CPVC of this formulation is 53%. In comparison, the CPVCs for the 119 nm latex/titanium dioxide and the 193 nm latex/titanium dioxide paints are 40 and 35%, respectively.

The shape of our experimental graphs at low PVC does not agree with the shape obtained by Asbeck and Van Loo[1] for solvent-based paints. The shape obtained by Asbeck and Van Loo shows a small slope at low PVCs, a change to a larger negative slope before the CPVC, and small slope after CPVC. This curve has been reproduced by Floyd and Holdsworth[23] and used by them to tentatively assign another transition point, called the percolation threshold (PT), at the PVC below the CPVC where this change in slope occurs. Only the 193 nm latex/titanium dioxide paints show any similarity to this curve. The 119 nm latex/titanium dioxide and the 193 nm latex/calcium carbonate systems both show a rapid fall off in gloss with increase in PVC below the PT and less slope between the PT and the CPVC. Hesler[7] and Anwari et al.[8] have shown similar experimental curves to the 119 nm latex/

titanium dioxide and 193 nm latex/calcium carbonate curves reported here.

The computer simulation of these paints, using the method outlined in the algorithm section, required the deformation value of the latices. To estimate the deformation of the latices, a series of simulations were performed with mixtures containing titanium dioxide pigment and Primal AC6501M latex particles (119 nm latex particle size) with varying deformation values and various PVCs. The packing density at each PVC was determined from each simulation and plotted against PVC. The CPVC for a paint using a latex with a particular deformation value was predicted from inflection points on this graph. The CPVCs predicted for each deformation value of the latex were plotted against the deformation and shown in *Figure* 7. Thus, *Figure* 7 allows the unknown deformation D to be estimated for one latex (AC6501M) by finding the deformation required to give the experimental CPVC found from a PVC ladder. This deformation D was then used to predict the CPVC of paints made with a different particle size latex (AC261M) but same deformation, with titanium dioxide and with calcium carbonate as separate pigments. Agreement of the predicted and experimental CPVCs for these last two paints should indicate the validity of the algorithm. From *Figure* 7, the deformation required to give the experimental CPVC of 40% is 0.13. This deformation was taken to be the deformation of both the 119 nm latex and the 193 nm latex and used in all subsequent simulations. This method of determining the deformation of a latex detracts somewhat from the ability of the algorithm to estimate the CPVC of a formulation from first principles; however, it is the only method available. Once the deformation of a latex with a particular MFFT is known, that deformation should apply to all latices with the same MFFT. *Figure* 7 can also be used to show the simulated effect of softness or deformation of the latex particles on the CPVC. For the given particle size distributions of the AC6501 latex and RHD2 titanium dioxide pigment, this graph shows that the CPVC increases with deformation in agreement with known experimental results.[6,13]

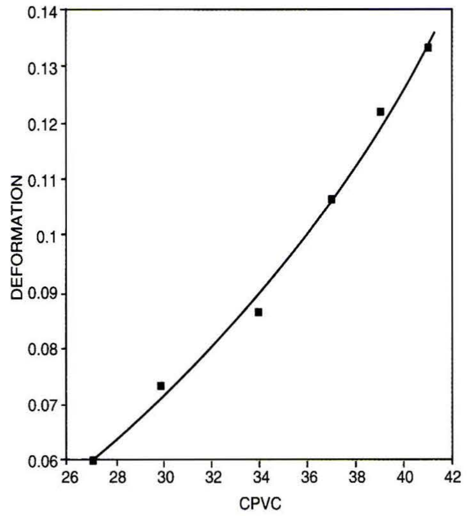

Figure 7—CPVC dependency on deformation.

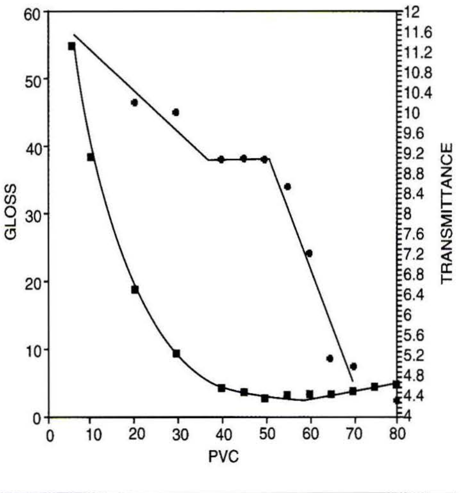

Figure 6—60° gloss and percentage transmission against PVC for 193 nm latex/calcium carbonate paint.

The 119 nm latex/titanium dioxide, 193 nm latex/titanium dioxide, and the 193 nm latex/calcium carbonate paints were simulated at various PVCs using the algorithm described. The deformation found experimentally for the 119 nm latex was resubmitted to this simulation. The deformation for the 193 nm latex was assumed to be the same as the MFFT is the same. Hence, the simulation of the 193 nm latex used independently determined data. Two properties were determined from the three sets of simulated packings. The first was the packing density which should indicate the CPVC as the onset of air voids will cause a rapid lowering of the density. The second property was the latex to latex coordination number. This is one of a number of theoretical parameters, such as the latex to pigment coordination number, which can be easily estimated from the simulation. These numbers might be expected to have an important bearing on paint film properties such as tensile strength, scrubability, etc. Plots of the two properties in turn, versus PVC, are shown in *Figures* 8 and 9. The inflection points in these graphs are collected and compared with the experimental CPVCs in *Table* 1. The agreement between the two sets of results is good, especially considering the approximations made in the simulations. Not all graphs show an inflection point for the CPVC. The latex/latex coordination number plotted against PVC did not detect the CPVC for the 193 nm latex/titanium dioxide system. This is not unexpected that in this system both the latex and titanium dioxide particles have very similar particle sizes.

The effects of the approximations and assumptions made in these simulations are in general unknown. However, some comments can be made. First, all particles were assumed to be spheres. For pigments this is, at best, only approximate. Some pigments, such as mica, may not even be approximately spherical. For those pigments that are close to spherical, the errors are not expected to be large as it has been shown by simulation[19] that cylindrical and bean shaped particles, whose axial

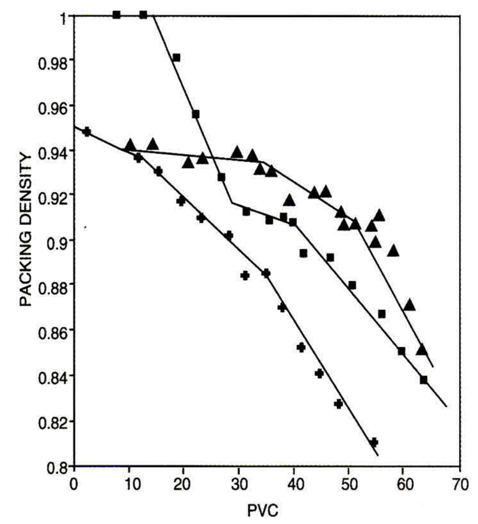

Figure 8—Simulated packaging density against PVC. (■) 119 nm latex/titanium dioxide; (+) 193 nm latex/titanium dioxide; and (▲) 193 nm latex/calcium carbonate.

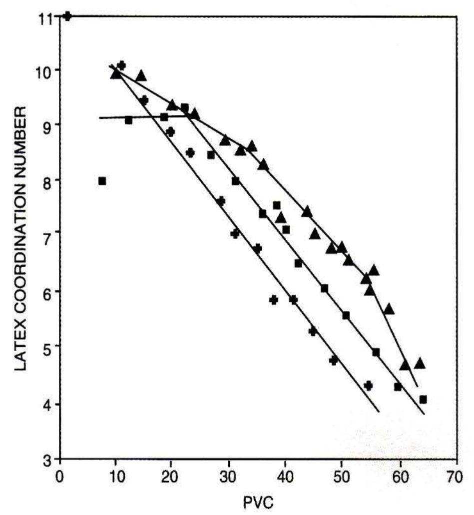

Figure 9—Simulated latex/latex coordination numbers against PVC. (■) 119 nm latex/titanium dioxide; (+) 193 nm latex/titanium dioxide; and (▲) 193 nm latex/calcium carbonate.

lengths do not vary greatly, have random close packing densities and coordination numbers not too different from those of spheres. Second, larger errors can be expected as the deformation of the latex increases. This is because the algorithm does not allow for a redistribution of that part of the latex volume which is lost in deformation. It has been shown that the lost volume is small for the deformation used in the simulations reported. However, the error in neglecting this volume increases as the deformation increases. It is expected to be able to reduce this error by increasing the complexity of the algorithm. Third, the effect of truncating the calcium carbonate particle size distribution and using only particles of less than 800 mm in the simulation is expected to be small, provided the small number of larger particles neglected are insuffficient to form a network and begin their own large particle packing. This appears to be the case as good agreement was found between the experimental and predicted CPVC for this system. The elimination of this approximation is a matter of computing power.

An additional factor which reduces the usefulness of the algorithm in its present form is that most acrylic latex paint formulations include some coalescing agent. A coalescing agent will increase the deformation of the latex. Thus, the CPVC will vary depending on the type and amount of coalescing agent. This factor could be taken into account if the variation in deformation for a particular latex that the amount of coalescing agent varied was known.

Table 1—Experimental and Simulated CPVC

	Experimental		Simulated	
	60° Gloss	Percent Transmission	Packing Density	Latex/Latex Coordination
	CPVC	CPVC	CPVC	CPVC
119 nm latex/titanium dioxide	40%	—	41%	—
193 nm latex/titanium dioxide	35%	—	35%	—
193 nm latex/calcium carbonate	55%	53%	53%	55%

CONCLUSION

It has been shown that simulations of the packing of pigment and latex particles can predict the CPVC of simple latex paint systems. The simulations require the particle size distributions of both the latex and pigments. Also required is the deformation value of a latex. This deformation value, at the present time, has to be determined from a PVC ladder but should be the same for all latices with the same MFFT. New data such as latex to latex, latex to pigment, and pigment to pigment coordination numbers are able to be estimated from the simulations. These parameters might be expected to have strong influences on such properties as tensile strength, elongation, scrubability, etc. We have not pursued such relationships or the extension of the algorithms to extenders which have a much larger size than latex particles in this preliminary paper. However, we intend to investigate these possibilities at a later stage.

ACKNOWLEDGEMENTS

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Appendix 1

```
Begin (program paint)

    if new packing then
    begin (if)
        input particle population and lattice size
        randomly place particles
    end else
    begin (if)
        load existing lattice
    end (if)

    analyze packing parameters
    begin (packing analysis)

        begin (packing density)

                for every lattice particle
                begin (loop)
                    find volume of particle within or
                    partially within analysis region
                    adjust volume of latex particles due
                        to deformations
                end (loop)

                packing density = aggregate particle
                        volume/analysis region volume

    end (packing density)

    begin (PVC)

        for every lattice particle
        begin (loop)
            find volume of particle within or partially
            within analysis region
        end (loop)

        PVC = pigment particle volume/
                analysis region volume

    end (PVC)

    begin (deformation)

        for every latex particle
        begin (loop1)
            for every overlapping particle
            begin (loop2)
                latex deformation = overlap/particle radius
                store in distribution array
            end (loop2)
        end (loop1)

        deformation = mean of distribution array

    end (deformation)

end (packing analysis)

set iteration = true
while iteration = true
begin (while)

    for every lattice particle
    begin (loop1)

        analyze particle
            begin (particle analysis)

                set net restoring force to zero (fx,fy,fz)
                for every contacting particle
                begin (loop2)
                    find overlap between particle and contact
                    calculate magnitude and direction of
                        restoring force
                    add to net restoring force (fx,fy,fz)

                end (loop2)

            end (particle analysis)

        move particle under action of net restoring force

    end    (loop1)

        analyze packing parameters
        (packing density, PVC, deformation)
        If iterations are a multiple of 100 and deformation
            < desired value then compress lattice vertically.
        if deformation = desired value
        then set iteration = false

    end (while)

    store coordinated of packing

end (paint)
```

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Aliphatic Epoxy Emulsion Crosslinker for Waterborne Coatings

Delano R. Eslinger—Cook Composites and Polymers*

Many waterborne polymers and dispersions have carboxyl functionality in their structure. These carboxyl groups are multifaceted in their utility. They are often necessary to introduce water solubility or water dispersibility characteristics to waterborne resins, impart stability to waterborne vehicles, and often offer advantages in dried film properties, especially with respect to substrate adhesion. However, due to the hydrophilic nature of these carboxyl groups, films from waterborne coatings often exhibit high water vapor permeability and poor wet adhesion properties.

Attempts to overcome these deficiencies generally involve crosslinking the waterborne vehicles through these carboxyl groups. Crosslinking aqueous carboxylated polymers can impart or improve the following properties: (1) non-blocking characteristics; (2) chemical or detergent resistance; (3) film hardness; (4) water soak or humidity resistance; and (5) mar resistance.

Examples of crosslinking agents or resin modifiers that have traditionally been used for this purpose and lead to either two-component coatings or one-package coatings for cure at elevated temperatures are: (1) divalent cations[1,2]; (2) carbodiimides[3]; (3) epoxy[4] resins; (4) melamine-formaldehyde[5,6] resins; and (5) polyaziridine resins.[7,8] Each of the crosslinkers listed has its particular advantages and disadvantages depending upon the customer's requirements. It is not the intent of this paper to evaluate the effectiveness of each product but to introduce a new product within the class of epoxide crosslinkers.

EPOXY CROSSLINKERS

The use of carboxylic acid-aromatic epoxy crosslinking reaction has been well known for many years.[9] This crosslinking mechanism has been employed in solvent-borne one-component thermosetting coatings where cure is achieved at high baking temperatures (325°F or higher) and often in combination with melamine/formaldehyde resins. Recently, waterborne acrylic resins have been crosslinked with aromatic epoxy emulsions.[10] These systems can be air dried or baked but have some disadvantages, mainly yellowing upon UV exposure and chalking/gloss loss during long-term weathering.

CCP has found that aliphatic epoxy resins react readily at low temperatures with certain aliphatic carboxylic acids. Depending on the molecular weight and acid values of the waterborne resin, crosslinking is achieved at temperatures of 75°F-300°F. The disadvantages exhibited by aromatic epoxy emulsions are eliminated by use of an aliphatic epoxy. Toward this goal CCP has introduced a new aliphatic epoxy emulsion Chempol® 20-1642 to the coatings industry.

Table 1—Chempol® 20-4301 High Gloss Black Test Enamel

	Pounds	Gallons
Chempol 20-4301	44.72	5.08
Butyl cellosolve	5.38	0.72
Surfynol® 104BC	1.08	0.14
Surfynol DF-75	0.11	0.01
Triethylamine	0.81	0.13
Deionized water	32.27	3.88
Lampblack pigment	10.76	0.72
Pebble grind to Hegman 7^{1}/2+ and let down with		
Butyl cellosolve	21.51	2.86
Butyl carbitol	21.51	2.71
Nuocure® CK	2.15	0.26
Di-isodecyl phthalate	6.45	0.78
Triethylamine	1.72	0.27
Deionized water	78.74	9.46
Chempol 20-4301	552.90	62.83
Adjusting deionized water	84.37	10.15
	864.48	100.00

Chempol 20-1642 is a low viscosity (15-20 seconds #4 Ford cup) epoxy emulsion designed for easy handling and fast stir in capability as a B component for two-package formulations. The product is a zero VOC ~55% weight solids emulsion. Laboratory studies have shown that Chempol 20-1642 is stable to inadvertent freeze thaw and survives at least 70 days @ 130°F without loss of epoxide content or emulsion stability. Some syneresis (phase separation) is evident with time, ~1/4 in. in a one-gallon container.

NATURE OF THE CARBOXYLIC ACID GROUP

The use of Chempol 20-1642 as a potential crosslinker for waterborne air dry and/or thermoset coatings has been investigated for the last two years. The development effort was focused on the carboxyl-epoxy reaction and towards this end a number of water-reducible vehicles were evaluated for reactivity with Chempol 20-1642 aliphatic epoxy emulsion. These studies have shown little to no reactivity towards aromatic carboxylic acids, especially those of o-phthalic, isophthalic, terephthalic, or trimellitic character. Even when baked at temperatures up to 300°F, little crosslinking is observed between Chempol 20-1642 and aromatic acids. As a result, many of today's water-reducible alkyds and polyesters which are often solubilized into water via a neutralizing amine due to presence of aromatic acid functional groups cannot be used with Chempol 20-1642. Carboxylic acid functionality based on (meth)acrylic acid, on the other hand, does show very good reactivity with Chempol 20-1642. This aliphatic type of carboxylic acid is found in many acrylic emulsions, polyurethane dispersions, and water-reducible thermoset acrylic resins.

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*217 Freeman Dr., Port Washington, WI 53074.

Table 2—Chempol 20-4301 High Gloss Black Enamel. Test Two-Component with Emulsified Epoxy

	Pounds	Gallons
Chempol 20-4301	51.19	5.82
Butyl cellosolve	6.16	0.82
Surfynol 104BC	1.23	0.16
Surfynol DF-75	0.12	0.01
Triethylamine	0.92	0.15
Deionized water	36.90	4.43
Lampblack pigment	12.31	0.82
Pebble grind to Hegman $7^{1}/_{2}$+ and let down with		
Butyl cellosolve	24.62	3.28
Coroc A-2678-M	2.46	0.28
Deionized water	36.94	4.43
Ammonia (28%)	1.23	0.16
Chempol 20-4301	521.54	59.27
Adjusting deionized water	106.44	12.76
Add before using		
Chempol 20-1642	66.43	7.61
	868.52	100.00

ACRYLIC EMULSIONS AND DISPERSIONS

For ambient cure coatings, one of the central tenets for a successful product is fast and early dry to handling. The carboxyl-epoxy reaction is not as fast as the polyol-isocyanate reaction and usually requires 8-16 hr before tack-free coatings are achieved. Therefore, for ambient cured coatings, one must use a resin vehicle which by itself will lacquer dry to the desired handleability state. This is most easily achieved by using high molecular weight dispersions or emulsions with carboxylic acid functionality. In this case, the carboxylic acid group must be present in sufficient concentration and of the right type so that enough crosslinking density occurs in order to obtain enhanced film properties. For some emulsions this implies that the carboxyl group cannot be buried in the interior of the particle and consequently, unavailable for reaction with the emulsified epoxy crosslinker.

Experimental

Chempol 20-4301 is a styrene free acrylic hydrosol emulsion with an acid value ~40 on polymer solids. This product is currently used for high quality industrial finishes over wood, plastic, and metal. Its primary features are fast dry, early hardness development, outstanding color, and gloss retention. When crosslinked with Chempol 20-1642 aliphatic epoxy emulsion, outstanding film properties are achieved, especially with respect to: solvent resistance; water soak or humidity resistance; exterior durability; and salt spray resistance.

Resin and film properties are best illustrated in test formulations that contain little or no pigment in order to minimize potential pigment interactions and effects. This is most easily done in high gloss black finishes using formulations as illustrated in *Tables* 1 and 2. *Table* 3 delineates film properties obtained with and without epoxy modification from these test formulas. Modification of Chempol 20-4301 high gloss black enamels with Chempol 20-1642 epoxy confers the following improved film properties:

- Improved VOC—coalescing solvent can be replaced by epoxy resin.
- Solvent resistance—200+ MEK double rubs to substrate versus 11.
- Humidity/water resistance—reduces or eliminates blisters and rust spots.
- Enhances gloss—especially 20° and improves QUV durability.
- Corrosion resistance—reduces face rust/blisters and scribe undercut.

Illustrations of improved humidity and water soak resistance are displayed in *Figures* 2 and 3, respectively. *Figure* 1 shows an example of improved corrosion resistance. Chempol 20-1642 can exhibit similarly improved film properties when used to crosslink most commercially available acrylic emulsions. Examples will be provided later in the discussion.

EPOXY INDEX

The amount of epoxy required to achieve these enhanced properties can be estimated by the acid value of the resin being modified by Chempol 20-1642. The formulation listed in *Table* 2 is indexed 1:1 for epoxy:carboxyl equivalents (including acid value from Coroc® A-2678-M). If one reduces epoxy modification relative to acid value for the formulation given in *Table* 2, one observes a gradual reduction of film properties (see *Table* 4). The first property to be lost is corrosion resistance, followed by water/humidity resistance and, finally, MEK solvent resistance. As a general rule, it appears that epoxy modification to ~30% of resin acid value is sufficient to provide MEK resistance, ~50% epoxy modification for water resistance, but a full index of 1:1 is required to realize improvement in corrosion resistance.

EVALUATION OF COMMERCIALLY AVAILABLE ACRYLIC EMULSIONS

Further studies in similarly pigmented formulations with commercially available acrylic emulsion vehicles indicates that the overall acid value of the resin is critical to achieving desired film enhancement properties. Experimental emulsions prepared in our laboratory and commercially available

Table 3—Paint and Film Properties for *Tables* 1 and 2

	Control 20-4301	+ Aliphatic Epoxy
% Weight solids	27.1	30.3
% Volume solids	23.8	26.8
VOC, theory less water	1.71	1.12
pH	7.7	7.8
#4 Ford Cup, secs.	14	16
PVC, %	3.0	3.0
P/B wt. ratio	0.05	0.05
Properties after 10 days air dry: Spray applied to Bonderite 1000 CRS Index = 1.0 COOH/Epoxy equivalents		
Mils, DFT	1.1	1.2
Pencil hardness	H	H
Crosshatch adhesion (ASTM D 3359)	5B (0% flaking)	5B
Direct impact; inch-lbs.	45	45
Reverse impact; inch-lbs.	4	4
Cleveland humidity, 500 hr	M8, face rust	NE
MEK double rubs to metal	11	200+
QUV (313B) 60°/20° gloss	79/48	83/54
500 hr	62/26	78/45
1000 hr	60/23	76/42
1500 hr	54/20	72/36
2000 hr	46/15	57/21
Salt spray, 100 hr		
Face	Heavy rust	F8, F6 blisters
Creep	1-2 mm	1 mm
Undercut	Spotty 5-10 mm	1-2 mm

Table 4—Effect of Index on Selected Film Properties. Bonderite® 1000 CRS Substrate

Index	Pencil	1 week MEK[a]	2 weeks MEK[a]	48 hr Salt Spray[b]	48 hr Water Soak[b]
1.0	H	70	200+	Clean	No effect
0.5	H	30	200+	M8, lt. rust	No effect
0.25	H	14	150	Mod. face rust	M8-rust spots
0.125	H	10	25	Heavy rust	M4, D6, face rust
0	H	10	10	Heavy rust	VD8, face rust

(a) Double rubs to metal.
(b) 10 day air dry before testing.

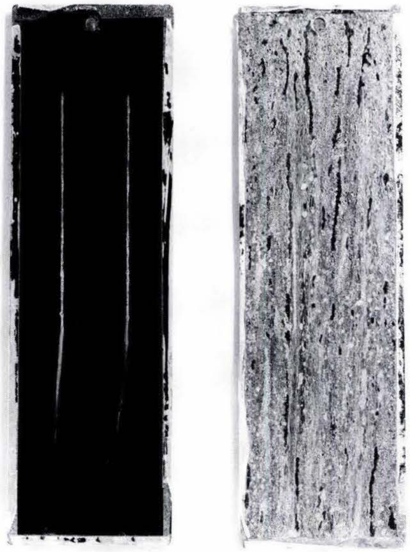

Figure 1—Corrosion resistance of black enamel. 100 hr in 5% salt spray.

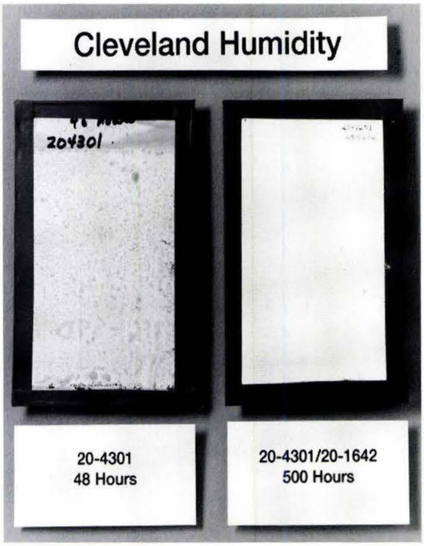

Figure 2—Cleveland humidity of white enamel. Control: 48 hr. Epoxy modified: 500 hr.

Table 5—Epoxy Modification of Commercial Emulsions

		<---10 days--->		<---48 hr soak --->		<---100 hr --->	
Emulsion	AV	MEK	MEK+	Water	Water+	Salt Spray	Salt Spray+
A	27	20	84	D8, blush	NE	Mod. rust	F6-2 mm
B	40	6	6	Stain, F8	NE	Heavy rust	D8-5 mm
C	31	20	200+	Stain, M6	NE	lt. rust, D6	Clean 1 mm
20-4301	40	10	200+	Stain, F8	NE	Heavy rust	F6-3 mm
PUD#1	36	60	150	NE	NE	Sl. rust, F6	Clean $^{1}/_{4}$ mm
PUD#2	47	64	200+	Rust spots	NE	M6, 2mm	Clean 2 mm

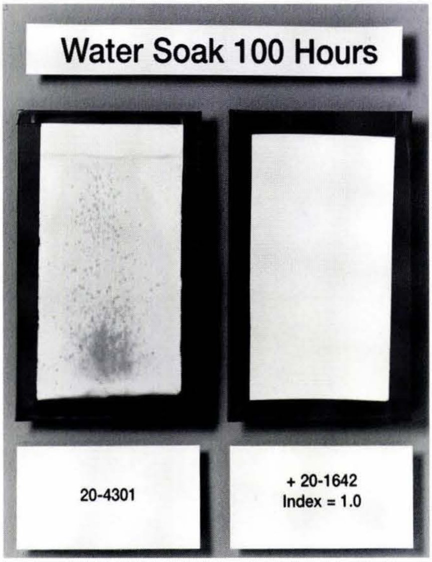

Figure 3—Water soak of white enamel. 48 hr.

products vary widely in their response to modification with epoxy emulsion Chempol 20-1642. However, all of the competitive emulsions evaluated exhibit improved water resistance and salt spray resistance to a greater or lesser degree when modified with Chempol 20-1642.

These films were indexed 1:1 with published acid values. Data is reported in *Table* 5 for solvent resistance (MEK double rubs to substrate), water soak, and salt spray where the + sign indicates data for paints modified with Chempol 20-1642. Blister reports for water soak and salt spray data are face values per ASTM D 714 and the mm designation in the salt spray data reports undercut from the scribe. All of the films were applied to Bonderite® 1000 CRS and air dried for 10 days before film testing.

Acrylic emulsion B has sufficient acid value for crosslinking with Chempol 20-1642, yet does not display improved solvent resistance although water and salt spray resistance are moderately improved. The acid groups in this emulsion appear to be buried in the interior of the particle and unavailable for reacting with epoxy or may be, in part, of aromatic character. Consequently, published acid values are not always an indicator of significant film property enhancement upon epoxy modification.

EFFECT OF CATALYST

Studies have also been done investigating effectiveness of catalyst on cure response. Cure response is evaluated by MEK double rubs to metal under various cure conditions. *Figures* 4 and 5 illustrate MEK solvent resistance when the formulation given in *Table* 2 is uncatalyzed or catalyzed with triethylenediamine (DABCO). MEK double rubs to substrate are given initially and after four days and seven days ambient cure. Uncatalyzed ambient cured coating, in this case, exhibits a faster cure response than force dry coatings. The reason for this may be due to presence of certain neutralizing amines which are often present in commercial samples of acrylic emulsion. A force dry may remove this catalytic amine and consequently, one observes reduced cure response with force dry. *Figure* 2 shows that these coatings do not respond strongly to tertiary amine catalysis unless the force dry (bake) temperature is ~200°F or higher. In fact, presence of tertiary amine catalyst appears to slightly retard cure response at force dry temperatures ≤ 180°F. If one does a similar study with water-reducible acrylics, catalysis is paramount to achieve cure. Cure of water-reducible acrylics will be discussed later in the formaldehyde free baking enamels discussion.

POT LIFE CONSIDERATIONS

Although the epoxy modified formulation in *Table* 2 is defined as being a two-component system, this is not true in the traditional sense. Once the epoxy and acrylic emulsion are mixed, an apparent infinite pot life is observed in that the mixture does not gel. Pot life is redefined in this formulation to indicate mix time before loss of cure occurs. Cure response is defined as time required for the coating to develop 100+ MEK double rubs to metal solvent resistance. The Chempol 20-4301/20-1642 mix air dries essentially as Chempol 20-4301 with the epoxy resin behaving as a coalescent agent. It is the development of MEK solvent resistance that requires time.

For example, one week after mixing, the formulation in *Table* 2 still maintains equivalent dry to 100+ double rubs MEK solvent

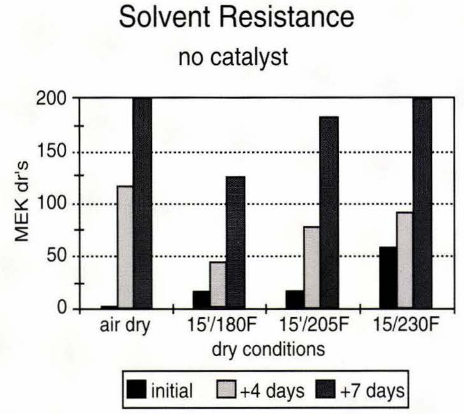

Figure 4—Solvent resistance development of formulation in Table 2. No catalyst.

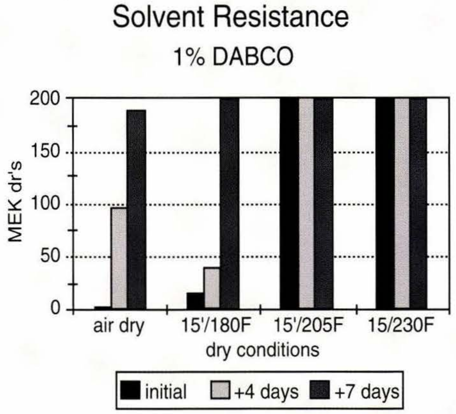

Figure 5—Solvent resistance development for formulation in Table 2. 1% DABCO catalyst.

resistance as the initial mix. A mix time of two weeks will also air dry to 100+ MEK double rubs, but that requires considerably more time. On the other hand, the initial mix and the one-week mix achieve 100+ MEK double rubs to metal in five to 10 days. The two-week mix now requires three to four weeks. This may or may not be a problem depending on the coater's requirements. At least, an addition of fresh mix after several days is a feasible option.

For formulations different than described in *Table* 2, a more traditional pot life behavior can sometimes be observed. In general, acrylic emulsion/Chempol 20-1642 mixtures may gel in two to four weeks depending on: (1) pigmentation and (2) presence or absence of a catalyst. However, pot lives in excess of one week are typical before viscosity or cure difficulties are evident.

In the presence of acrylic emulsions such as Chempol 20-4301, the epoxy seems to be slowly hydrolyzing and/or homopolymerizing. Films from such mixtures, aside from the aforementioned loss of MEK solvent resistance cure response, also exhibit increasing hydroxyl content with time. The increasing OH content certainly comes from the opening of the epoxide ring either through reaction with COOH or water or self-condensation. The loss of solvent resistance indicates hydrolysis or homopolymerization being the dominant reactions in solution. Interestingly, Chempol 20-1642 alone appears to be stable towards these side reactions.

FORMALDEHYDE FREE BAKING ENAMELS

Acrylic emulsions are highly suited for air dry coatings because of their ability to lacquer dry out of water. This occurs even for low T_g polymers because of the high molecular weights typical of emulsion polymerized acrylics. It is possible to design a water-reducible acrylic to have a high T_g and, consequently, the ability to also lacquer dry out of water. However, lower molecular weight results in different cure behavior at ambient conditions with Chempol 20-1642 aliphatic epoxy crosslinker. Laboratory studies at CCP show that lower molecular weight water-reducible acrylic polymers, even if designed with high T_g for lacquer dry out of water, do not react at reasonable rates with Chempol 20-1642 to be useful for ambient cured coatings. However, outstanding film properties can be achieved when these types of coatings are catalyzed and baked at temperature ≥ 250°F.

Since the carboxyl-epoxy reaction is an addition reaction, by-products are not emitted during cure. Lack of by-product during cure can significantly reduce VOC level, which is not the case for melamine-formaldehyde thermoset enamels. Unfortunately, formaldehyde free coatings using a water-reducible acrylic crosslinked with Chempol 20-1642 must be considered as two-component systems. Pot lives to gel or plastic viscosity are typically one week or better depending on pigment choice and catalyst level. However, in practice, formulations are attainable with pot lives of 3-5 days before an unacceptable increase in application viscosity.

Tables 6 and 7 illustrate this formaldehyde free baking enamel concept using water-reducible acrylic resins available from CCP. The coatings were spray applied to Bonderite 1000 treated CRS and baked for 30 min/250°F. Film properties are dependent upon the water-reducible acrylic chosen as the main vehicle (see *Table* 8). Chempol 10-1744 gives outstanding impact/flexibility and very good QUV performance, but is a soft resin. Chempol 10-0509 gives good hardness but poor impact/flexibility and poor QUV. All formulations give very good adhesion and outstanding water resistance properties.

Table 6—High Gloss Formaldehyde Free Yellow Baking Enamel Formulation Example

	Pounds	Gallons
Chempol 10-0509	30.7	3.6
Rhodafac® RE-610	2.0	0.2
Byk® 035	0.4	0.1
DPG monobutylether	4.0	0.5
AMP-95™	2.6	0.3
Deionized water	88.2	10.6
Titanium dioxide	39.9	1.2
Yellow iron oxide	89.8	2.7
High speed disperse to Hegman $7^{1}/_{2}$+ and let down with		
Chempol 10-0509	184.1	21.4
Butyl cellosolve	3.0	0.4
Triethylamine	16.6	2.6
Triethylenediamine	1.0	0.1
Coroc A-2678-M	8.0	0.9
Deionized water	359.1	43.1
Before application of the coating add epoxy modifier and mix well		
Chempol 20-1642	107.7	12.3
	937.1	100.0

Table 7—High Gloss Black Formaldehyde Free Baking Enamel

	Pounds	Gallons
Chempol 10-1744	8.6	1.0
Surfynol 104BC	0.3	0.0
Surfynol DF-75	1.7	0.2
Butyl carbitol	1.7	0.2
Triethylamine	1.5	0.2
Deionized water	26.4	3.2
Lampblack pigment	8.6	0.6
Pebble grind with zircoa beads to Hegman $7^{1}/_{2}$+ and let down with		
Chempol 10-1744	151.1	18.0
Triethylamine	16.6	2.6
Coroc A-2678-M	6.8	0.8
Butyl cellosolve	2.6	0.3
Triethylenediamine	0.9	0.1
Deionized water	427.9	51.3
Before application add epoxy crosslinker		
Chempol 20-1642	92.4	10.6
Adjusting deionized water	90.2	10.8
	837.3	100.0

As with acrylic emulsions, proper indexing of epoxy/COOH content is critical to achieving desired film properties. Preliminary work in our laboratory indicates that formaldehyde free coatings must be indexed > 0.75 in order to achieve good MEK resistance. Higher catalyst levels can reduce cure temperatures and indexing > 1 may improve corrosion resistance relative to the properties indicated in *Table* 8.

Not all water-reducible resins are acceptable candidates for formaldehyde free coatings. The carboxylic acid used for water solubilization upon neutralization with a tertiary amine must be aliphatic in nature, i.e., (meth)acrylic acid, etc. As previously discussed, water-reducible resins containing aromatic carboxyl functionality such as phthalic or trimellitic are unreactive with Chempol 20-1642 at reasonable rates even at temperatures as high as 325°F.

Summary

Lower VOC—Chempol 20-1642 behaves as a coalescent for acrylic emulsions and aids in film formation before any crosslinking occurs. The epoxy emulsion can replace some of the traditional slow evaporating cosolvent.

Improved Chemical Resistance—Acrylic emulsions crosslinked with Chempol 20-1642 epoxy emulsion give superior MEK solvent resistance relative to unmodified formulations.

Improved Water Resistance—Significant improvement in Cleveland humidity

Table 8—Film Properties Formaldehyde Free Baking Enamels

	Yellow 10-0509	Black 10-1744
Viscosity, #4 Ford Cup	31 secs.	20 secs.
VOC, less water	2.55 lbs/gal	2.19 lbs/gal
pH	8.4	8.2
Theory wt. solids	35.9%	22.1%
Theory Index	1.0	0.97
Pencil hardness	H	B
DFT, mils	2.1	0.8
MEK double rubs	200+	200+
Direct/Reverse impact	10/<10 inch-lbs	160/100
Water soak, 100 hr	No effect	No effect
Humidity, 250 hr	No effect	No effect
Salt spray, 100 hr	Clean face 1 mm creep 4 mm undercut	Clean face 1 mm creep 4 mm undercut
QUV (313B) 60°/20°		
Initial	87/76	89/81
300 hr	88/72	84/70
570 hr	94/75	81/59
850 hr	74/36	82/57
1000 hr	42/5	78/50

ASTM D 4585 is obtained over unmodified formulations. This is especially noticeable for early rust stains and blister formation on direct to metal coatings.

Improved Exterior Durability—QUV (313B) data on Chempol 20-4301 high gloss black formulas which were modified with Chempol 20-1642 epoxy emulsion maintain higher gloss readings after 2000 total QUV hours.

Improved Corrosion Resistance—Salt spray results show considerable improvement over unmodified formulations due to better film integrity and adhesion to metal. However, not all acrylic emulsions will give satisfactory results due to insufficient carboxylic acid content or presence of unreactive aromatic carboxylic acid.

Epoxy Demand—An index ratio of epoxy/COOH equivalents equal to one appears to give optimum film properties. It can sometimes be difficult to accurately determine this point in that various additives or other film modifiers can introduce undetermined amounts of carboxyl or amine value. Addition of extra epoxy may be necessary in these cases.

Lower epoxy content, an index ~ 0.50 or larger, continues to provide enhanced film properties especially with respect to water resistance but full realization of corrosion resistance requires index equal to 1 or better. If indexing is > 1 further crosslinking occurs via epoxy-epoxy self-condensation reactions. In this case a tertiary amine catalyst is necessary to promote a full cure response.

Ambient cured coatings with acrylic emulsions usually do not require addition of extra 3° amine catalyst for good cure response. Presence of neutralizing amine can be sufficient to observe catalytic effect on cure response. Addition of non-volatile amine may be necessary for force dry coatings. However, for coatings using water-reducible acrylic resins solely, i.e., formaldehyde free thermosets, or as modifiers for acrylic emulsions, a tertiary amine catalyst is necessary to achieve a reasonable cure response.

Fast Dry—The epoxy modified acrylic emulsion coatings retain the speed of dry, hardness development, and early handling characteristics typical of the acrylic emulsion only product before full cure of the epoxy is realized.

Cure Response—Defined as time required to achieve 100 MEK double rubs to metal. Air dry and mild force dry conditions usually achieve this degree of cure in five to 10 days. For force dry or formaldehyde free baking enamels using water-reducible resins, it is recommended to add an external 3° amine catalyst such as triethylene diamine or a quat salt such as benzyltrimethylammonium chloride. Recommended levels are 0.5%-1.0% on total vehicle solids.

Excellent Pot Life—Acrylic emulsion/Chempol 20-1642 mixtures exhibit long pot life and may be handled in the field as a single-component epoxy. The mixtures may gel in two to four weeks depending on pigmentation and presence or absence of a catalyst. However, a pot life in excess of one week is typical before viscosity increase or loss of cure becomes evident.

Formaldehyde free formulations using water-reducible acrylic resin/Chempol 20-1642 mixtures show similar behavior. In these cases gelation usually occurs in two to three weeks rather than loss of cure response. However, in practice these formulations have long pot lives of three to five days before viscosity increases make application difficult.

Formaldehyde Free—Thermoset water-reducible acrylic resins which are crosslinked with Chempol 20-1642 usually give much lower VOC than typically achievable using melamine-formaldehyde crosslinkers. This is due to the partial cosolvent replacement with aliphatic epoxy resin and because the carboxyl-epoxy reaction is an addition reaction and by-products are not emitted during cure.

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(4) Shell Chemical Co./Epi-Rez® brand water-reducible epoxides.
(5) Monsanto Chemical Co./Resimene® brand melamine-formaldehyde resins.
(6) Cytec Industries/Cymel® brand melamine-formaldehyde resins.
(7) Sybron Chemicals, Inc./Ionac® PFAZ-322.
(8) ICI Resins/NeoCryl® CX-100.
(9) Solomon, D.H., *The Chemistry of Organic Film Formers*, John Wiley & Sons, pp. 260-265, New York, 1967.
(10) Shell Chemical Co./Eco-Cryl® acrylic resin dispersion 9790.

June 1995 Subcommittee Reports of ASTM Committee D01

The June 1995 meeting of ASTM D01 on Paint and Related Coatings, Materials, and Applications was held June 25-28 at the Atlanta Airport Hilton, Atlanta, GA. During this time, 180 members and guests met in about 190 scheduled subcommittee and working task group meetings. The current membership of D01 is about 600.

Highlights

D01 Participating Representative of ISO TC 35—D01 was pleased to have two ISO TC 35 members in attendance; Prof. E.L.J. Bancken, Chairman and J.S. Paap, Secretary. Prof. Bancken presented his ideas for D01/TC 35 cooperation to D01 members. Two special events highlight the increased cooperation. D01 has been accredited to become the participating representative from the United States to TC 35/SC 9 and D01 and TC 35 will hold a joint meeting in June 1996 in San Francisco, CA. D01.09 has been formed to be the Technical Advisory Group (TAG) to ISO TC 35/SC 9. People interested in participating in the TAG are encouraged to contact T. Sliva, D/L Laboratories, 116 E. 16th St., New York, NY 10003.

Pipeline Coatings Subcommittee—The subcommittee on Pipeline Coatings has been transferred from G03.06 to D01.48, along with its nearly 20 methods. D01 members interested in joining this subcommittee should contact Scott Orthey, 215-299-5507.

D01.19—Gardner-Sward Handbook—The Fourteenth Edition of the *Gardner-Sward Handbook, Paint and Coating Testing Manual*, edited by J.V. Koleske, was published by ASTM in June 1995. It contains about 900 pages with 78 chapters, each written by a coating specialist. Copies can be obtained from ASTM.

D01.21.56—Development of standards for measuring hazardous air pollutants in paints was initiated. The technique being used is headspace/gas chromatography-mass spectrometry. It is a sensitive technique for identifying and quantitating volatile materials (including water) in paints and coatings. A draft method is being prepared and a mini round-robin is planned.

D01.25—This subcommittee was reactivated with an expanded scope and a new name "Evaluation of Weathering Effects." Several paint defect evaluation standards will be moved from D01.27 to D01.25, including those for cracking, blistering, and erosion. The subcommittee will also begin drafting standards using imaging or other scanning procedures and computer analysis to characterize weathering effects.

D01.57—The subcommittee sponsored a booth at the exhibit of a college educators' meeting in San Antonio that was well received. Because of the success, additional exhibits are being planned at future artists' meetings to promote the work of D01.57.

Awards

D01 was pleased to present the following awards:

D01 HONORARY MEMBER—Kenneth A. Trimber.
OUTSTANDING SUBCOMMITTEE CHAIRMAN AWARD—Norman D. Emily.
OUTSTANDING TASK GROUP CHAIRMAN AWARD—Douglas M. Grossman.
CERTIFICATES OF APPRECIATION—Jeffrey S. Hinkle and Edward McGettigan.

Dates and Locations of Future Meetings

January 21-24, 1996—Fort Lauderdale, FL.
June 23-26, 1996—San Francisco, CA.
January 26-29, 1997—Fort Lauderdale, FL.
June 22-25, 1997—Toronto, Canada.

DIVISION 1 ADMINISTRATION

Subcommittee D01.05 ASTM Internal Coordination

J.C. Weaver, Chair

D01.48—Pipe Coatings—This subcommittee is newly transferred from being G03.06, with approval of the G03.90 and D01.90 executive subcommittees. Nearly 20 standard methods of test for pipe coatings have been developed since organization of G03.06 in about 1968. These 20 include six specialized tests on cathodic disbonding as well as more general physical tests.

Subcommittee D01.08 Environmental Concerns

E.A. Praschan, Chair

The group reviewed and approved proposed revisions to the scope of this subcommittee to clarify the intent and focus. The revisions will be submitted to D01.90 for approval and adoption.

E.A. Praschan summarized current environmental-related method developments and other activities of interest within D01. M. McKnight provided an update on ASTM E50 on Environmental Assessment, which is addressing environmental performance standards, pollution prevention, recycling, etc. H. Fujimoto advised that the VOC training workshops continue to be successful—the next two workshops are scheduled for August 9-10 and November 1-2, 1995, with others being planned for 1996. J.J. Brezinski has agreed to be the editor of the next updated edition of ASTM manual MNL4, "Determination of VOC in Paints."

No new information was available concerning the effect of VOC content on paint durability, and this subject will be dropped. The chairman will contact W. Spangenberg about contributing future updates on legislation, regulations, and new test methods pertaining to the use of lead in paints at local, national, and international levels.

Systems for Steel (SC 9 and SC 12 have TAGs assigned to the National Association of Corrosion Engineers).

Subcommittee D01.09 Technical Advisory Group to ISO TC 35/SC 9

T. Sliva, Chair

D01.09—T. Sliva, Chair, reported that in April 1995, ASTM D01 on Paint and Related Coatings, Materials, and Applications was accredited to become the "P" (participating) representative from the United States to the International Standards Organization (ISO), Technical Committee 35 on General Test Methods for Paints and Varnishes. ISO TC 35/SC 9 consists of ten working groups with responsibilities on developing standards for mechanical, environmental, and performance tests on paints.

The following members of D01 have accepted oversight responsibility for reviewing and forming a position on the following working groups under the jurisdiction of SC 9:

W.G. No.	Committee Structure	ASTM Liaison
3	Drying Time	T. Sliva
15	Powder Coatings	N. Emily/ B. Boni
19	Wash/Scrub Resist.	L. Schaeffer
21	Fire Tests	B. Nesvig
22	Color & Optical	B. Morrison/ L. Schaeffer
23	Mechanical Tests	P. Guevin
24	Sampling & Application	C. Schoff/ F. Burns
25	Environmental Tests	M. McKnight
26	Performance Tests	D. Grossman
27	Anti-Fouling Paints	R. Gangi

J.S. Paap, Secretary of ISO TC 35, and Prof. E. Bancken, Chairman of TC 35, attended the meeting and made presentations to the group outlining the workings of ISO and recommended ways D01 and ISO members can pursue cooperation in the development of widely accepted international standards.

ISO TC 35 has agreed to meet jointly with D01 during their meeting in June of 1996 in San Francisco. A proposed meeting schedule is being arranged that will allow both ASTM and ISO members to meet, attend each others' meetings, and exchange ideas and information to support standards development in both ISO and ASTM.

It is in the interest of the U.S. paint and coatings industry to have input into the development of ISO standards. Meetings are open to all who attend. All interested parties should contact J. Sliva, D/L Laboratories, 116 E. 16th St., New York, NY 10003 for further information.

Subcommittee D01.06 International Coordination

J.C. Weaver, Chair

D01.06—Fifteen members and guests met to implement increasing cooperation between D01 and ISO TC 35 on Paints and Varnishes. Especially welcome was J.S. Paap, Secretary of TC 35, who manages all of TC 35 from her staff position in Nederlands Normalisatie Institute (NNI), Delft, Netherlands (NL) and Prof. E.J. Bancken, Chairman of TC 35, of AKZO-Nobel, Sassenheim, NL. He had graphically presented to earlier meetings of D01.90 and D01 subcommittee chairs the structure of TC 35 and its relationships to the hierarchies of both ISO and CEN. This structure is shown in great detail in the eight-page, "1994 Annual Review of TC 35 and CEN's Technical Committees 139 on Paint and Varnish and 298 on Pigments and Extenders."

Prof. Bancken formally presented to D01 Chair, K.A. Trimber, the 1994 three-volume bound set of TC 35's 186 standards. Melding these ISO standards with D01's 660 standards is a huge challenge. It will require diplomacy, persistence, and the detailed attention of many technical specialists in both TC 35 and D01. Mr. Trimber noted that the key to commonality of ASTM/ISO standards in paints and related materials is the cooperation of D01 task groups and TC 35 working groups in developing mutually acceptable draft standards before the very different balloting protocols are begun in the two standards' bodies.

The June 1996 meetings of D01 in San Francisco may be augmented by the welcome participation of TC 35 members at the TG/WG levels, while TC 35 and its subcommittees will necessarily keep their voting protocols separate in that week of joint meetings. ISO TC 35 has five large subcommittees. They are: SC 2 on Pigments (D01.31 has named R.M. Schiller, of Kerr-McGee, to coordinate D01 activities with SC 2); SC 9 on General Test Methods (See D01.09 minutes for D01 liaisons); SC 10 on Binders; SC 12 on Preparation of Steel Substrates; and SC 14 on Protective Paint.

The group discussed recent events concerned with Clear Air Act regulations and related reform activities, including air quality standards, air toxics, operating permits, trading, and enforcement matters. G. Nelson reviewed the major elements of ISO 14000, which is the international environmental process planning guide issued by ISO Committee TC 207. A report on this program is available from NIST.

The chairman distributed copies of the recent *Federal Register* announcement of the U.S. EPA's final rule adding acetone to the list of solvents exempt from the definition of VOC. Additional information pertaining to environmental news, events, workshops, etc. was also discussed.

Subcommittee D01.19 Gardner Handbook

J.C. Weaver, Chair

D01.19—The newly published ASTM *Manual 17, Paint and Coating Testing Manual*, comprises nearly 1000 pages with 78 chapters, each written by a specialist and all edited by J.V. Koleske. It succeeds the 1972 ASTM STP *500 Gardner–Sward Paint Testing Manual*, which in turn succeeded 12 editions from about 1920 by famed H.A. Gardner, Sr. and G.G. Sward. Manual 17 complements and supplements the nearly 700 standards under D01 jurisdiction and published in standards Volume 6.

DIVISION 20 RESEARCH

Subcommittee D01.21 Chemical Analysis of Paints and Paint Materials

K.H. Fujimoto, Chair

D01.21.10—Lead Paint Policies—J.C. Weaver, Chair, reviewed lead hazard activities in ASTM and elsewhere. Subcommittee D01.57 on Artists' Paints and Related Materials is reacting to recurring challenges to the bioavailability aspects of D 5517, "Test Method for Determining Extractability of Metals from Art Materials." This challenge doubts the correlation of extraction with dilute hydrochloric acid of finely ground samples to in vivo digestion time cycles in stomach and successive parts of the digestive tract. Significance and use statements will be drafted for D 5517.

E06.23 on Abatement of Lead Hazards in Buildings, M.E. McKnight, Chair, has an accelerated schedule of four meetings per year from 1991 to develop 30 or more standards to cover all aspects of detection, sampling, removal or "encapsulation," worker safety, risk assessment, and quality control. A newly published compilation of the first 12 of these standards will likely be succeeded by a more complete volume when the 13 task groups complete most of their work.

A Coalition of Lead Safe Communities, 1150 Connecticut Ave., N.W., Washington, D.C. 20036, (202) 861-1287, represents paint and other lead-producing and using interests. It aims to counterbalance claims of militant environmentalists in the complex scenarios of paint abatement in buildings, dust and soil control hygiene practices, and community actions.

"Lead, A Community Concern," an international conference, held July 5-7, 1995, Trail, B.C., Canada, attracted over 20 worldwide specialists to discuss protection of residents, especially children, who live near lead or zinc mines and smelter operations.

The ability of food fibers to protect children from assimilating lead in dust and aerosols has only preliminary recognition thus far, e.g. in Mexico (private communication) and in bioavailability studies of ingestion of leaded soils, e.g. Wixom and Davies. Chemical speciation of lead compounds in aerosols by Buseck et al. and in soils by Ruby et al. give belated recognition of lead from gasoline as a dominant source of lead in and around homes. These works also support the slogan of this chairman on the mythology of the 1970s "lead-based paint" hysterics, " 'Taint Paint, 'Tis Petrol which tainted the blood of small children" espoused in his "White Paper on White Lead" in the *Standardization News*, April 1989.

D01.13—Coordination of VOC Standards & Information—Co-Chairs, M.K. Harding and R.C. Matejka, distributed a table that indicated actions taken by 18 states regarding VOCs in architectural coatings. It was announced that the new Federal proposal regarding VOC content of AIM coatings may be as late as May 1996.

The discussion on VOC RECLAIM, an emissions trading program in Southern California, was postponed due to the absence of M. Harding who has been actively involved in the program.

The announcement of the ruling on acetone, which will be made an exempt solvent, i.e. non-VOC, and a non-SARA 313 reportable chemical for 1994 reporting year and future years, generated a lively discussion. This ruling was effective June 16, 1995. Some concern was voiced regarding the loss in the ability to track volatile chemicals with extensive use. The other concern was the effect this would have on the future 39-city study, since the increased use of acetone and subsequent increase in its presence in the air will skew the results in future years.

R.C. Matejka stated the second draft of the wood furniture CTG had been issued in May, and the emission format for VOCs of lbs/gallon minus water has been kept open as an option by the states, in contrast to the intent of the Reg-Neg Committee. Additional discussion with the U.S. EPA by selected Reg-Neg Committee members convinced them the lbs/gallon minus water calculation was not an allowable option for this CTG.

Subjects pertaining to Title V, operating permit emission forms, photochemical reactive volatile content (Rule 66) of coatings, and permit flexibility relating to VOC content of coatings were discussed.

Table 1

	RR Precision		Published Precision	
Standard	**Repeatability**	**Reproducibility**	**Repeatability**	**Reproducibility**
D 1475	(not developed—not enough data)		0.6%	1.8%
D 2369	0.99%	2.29%	1.5%	4.7%
D 4017 (K.F.)	2.84%	12.96%	4.7%	15.0%[a]
D 3792 (GC)	2.46%	7.97%	2.9%	7.5%
D 3960 (K.F.)	55.91%	251.13%	2.86%	9.75%[b]
D 3960 (GC)	78.42%	162.21%		

(a) A revised precision for D 4017 is undergoing Letter Ballot. It is based on a round-robin run by four laboratories experienced in running K.F. titration. The repeatability is 2.39% and the reproducibility is 5.0%.

(b) Shown in the Appendix of D 3960.

D01.21.14—New Publication & Paint VOC Measurement Workshop—K.H. Fujimoto, Chair. Since J.J. Brezinski has renewed his activities in the ASTM, he has agreed to take over as the editor of ASTM's Manual MNL4, "Determination of Volatile Organic Compound (VOC) Content in Paints, Inks, and Related Coating Products." He will bring the publication up-to-date on new and revised VOC test methods and related subjects.

A successful VOC workshop was held at the Reichhold Chemical Company's Headquarters, Research Triangle Park, NC, on May 3-4, 1995. Thanks to the efforts of Jack Lamberton, the meeting facilities were par excellence and the laboratory demonstrations were professionally executed.

Arrangements have been made with the 5th U.S. EPA Regional Division, through Steve Rosenthal, of U.S. EPA, to hold a special ASTM VOC Measurement Workshop at its Chicago Headquarters' facilities on August 9-10, 1995. About 30 of the staff members are expected to participate in the workshop. We hope this is a harbinger of things to come, that is, EPA personnel who are knowledgeable and well-informed on ASTM Test Methods used in Reference Method 24.

The instructors will be J. Benga, W.C. Golton, and K.H. Fujimoto. The laboratory demonstrations will be held at the U.S. EPA's laboratory facilities.

Future VOC workshops are scheduled for: November 1-2, 1995, in Philadelphia, PA, with DuPont's Marshall Laboratories as the host laboratory; and May 1-2, 1996, in Cleveland, OH with The Glidden Company as the host laboratory.

Interested parties can contact: Scott Murphy, ASTM, (215) 299-5516.

D01.21.24—D 2369, Volatile Content of Coatings—M.E. Sites, Chair. As planned, a round-robin was started to ascertain the viability of ASTM test methods used in U.S. EPA's Reference Method 24 to determine the VOCs of today's low VOC and high water containing paints and coatings. This round-robin was undertaken after D 2369 had been criticized as inadequate for some of today's new paint technologies.

Early on, D01.21.24 decided to include only low VOC and high water containing (40-60%) coatings. This included three architectural and two industrial coatings. Instead of concentrating only on running D 2369, the nine collaborators were asked to determine the VOC of the test samples as specified in Reference Method 24 so that a precision statement could be developed.

J. Benga took the data and developed the precision statement using ASTM E180. Results for D 2369 show the precision obtained are two times better than the present precision statement published for the method. The precision data for all test methods used and the VOCs obtained are shown in Table 1.

The VOCs were calculated also without subtracting the water from the denominator with the following results: repeatability of 53.98% and reproducibility of 201.22%. Precision data for each of the individual method run is shown to be as good as or better than existing precision data. However, when the VOCs are calculated, the precision is poor. The reason for calculating the VOCs without subtracting the volume of water present was to see if the results calculated in this way would give better precision since this had been shown to be true in previous round-robins. However, with these low VOC products, the results are no better than those calculated following Reference Method 24. J. Benga gave a short presentation to show why this is true for the low VOC containing paints.

D01.21.24 discussed what to do with these results, including placing the information in an addendum. It was decided to run another round-robin to test a wider variety of new paint technologies.

The most recent revision of D 2369, which was balloted in 1994, has proceeded to society ballot. This revision deleted reference to D 4713, "Test Method for Nonvolatile Content of Heatset and Liquid Printing Ink System," since it had not been approved by the EPA. Also, use of 2-ethoxyethyl acetate was deleted. A new revision of D 2369 will be balloted concurrently by D01.21 and D01. This will be done to clarify Paragraph 7.2.

D01.21.24A—Determination of Anions in Cathodic Electrocoat Permeates by Ion Chromatography—J. Furar, Chair. J. Benga presided in the absence of Mr. Furar. On a recent D01 ballot, a negative was received from J.H. Phillips and comments were received from J.J. Brezinski on the guide. Mr. Phillips led a discussion on the technical part of his negative. He proposed that the standard bracket the sample in time and that a standard curve generated from the standard calibration standards be included. After a lengthy discussion, J.H. Phillips withdrew his negative and agreed to work with J. Furar to incorporate these changes in a future version. The guide will proceed now to society ballot.

D01.21.25A—VOCs Available for Abatement—L.E. Pattison, Chair. A draft method was developed originally by J. Kamjathy. However, the method was placed on "inactive" status when the chairman retired. Recently, D01.21 was requested to resurrect the proposed method. L. Pattison volunteered to chair this task group and sent the draft for D01.21 ballot.

Due to negatives received from J. Phillips, D. Entrekin, P. Guevin, and E.A. Praschan; comments received from W. Zimmt, J.J. Brezinski, and W.C. Golton; and the need to reorganize the method, it was decided to withdraw it from the ballot. The proposed method will be rewritten to incorporate the comments, be reviewed by J. Phillips, E.A. Praschan, J.J. Brezinski, and J. Berry, and resubmitted to D01.21 ballot.

D01.21.26—Review of D 2697 % VNV, Helium Gas Pycnometer—K. Leavell, Chair. The endeavor of D01.21.26 is to replace the disk method, which is based on Archimedes' buoyancy effect, with a helium gas pycnometer method for the determination of the density of paint films. The pycnometer takes less time and is more accurate, especially with paint products having a high PVC. The biggest problem has been in the preparation of paint films. This was overcome when B. Neff made a video demonstrating the procedure and distributed it to all of the collaborators.

The proposed method has been rewritten and a precision statement, which was developed to determine the density of the baked films with the helium gas pycnometer, has been incorporated. The revised method will be submitted for August's ballot.

D01.21.27A—VOC of Aerosols—R. Osterman, Chair. With the use of exempt solvents, such as dichlorotrifluor methyl benzene and other chlorofluoro compounds in aerosols, D01.21 voted to reactivate this group with R. Osterman as Chair. The BAAQMD Laboratory has developed Method 41, "Determination of Volatile Organic Compounds in Solvent-Based Coatings and Related Materials Containing Parachlorobenzotriflouride." R. Zerrudo has agreed to share this method with us and to participate in a round-robin. A round-robin will be initiated before the next meeting in January 1996.

D01.21.49—Sample Preparation for Trace Metal Analyses—M.J. Mahon, Chair. K.H. Fujimoto acted as temporary chairman due to the absence of M.J. Mahon. The rewritten and revised acid digestion methodology for analyses of metals and some non-metals in resins and coatings by M.J. Mahon was distributed for discussion with a request for approval to place this proposed method on concurrent D01.21 and D01 ballot.

Comments made during a lengthy discussion included: (1) A copy of the diagram for the reflux set-up is needed in the method; (2) Is the test data from the first round-robin available since a precision statement is needed?; (3) Is this method needed since the way it is proposed, there is no proof of any advantage obtained in using it?; (4) The method is not applicable to lead since it forms an insoluble sulfate; (5) Is another round-robin necessary to spell out the limitation of the method?; (6) Microwave digestion should be investigated, especially equipment marketed in the last 12 months; and (7) Is the method applicable to tin. If not, can it be modified to be applicable?

D01.21.49 voted to approve submission of the method for D01.21 ballot. In the meantime, the previous questions can be resolved.

D01.21.51—Determination of Formaldehyde in Paints—D. McCunn, Chair, reviewed the mission of D01.21.51. It is to develop a method to measure the formaldehyde which is evolved from a paint sample. This procedure will be used to compare paints during R & D efforts, and EPA may accept it as a method to measure formaldehyde as a hazardous air pollutant (HAP).

A draft of the proposed method and an outline of the round-robin was distributed for discussion. Data were submitted which indicate that this approach is promising.

D01.21.52—Paint Solvent Analysis by Gas Chromatography—J. Benga, Chair, presented data from a recent interlaboratory study related to the proposed EPA Method 311, "Analysis of HAP Compounds in Paints and Coatings by Direct Injection into a GC." The proposed method is "specific" for coatings used in the wood furniture industry, but with a strong possibility of also being suitable for other coatings. The study included four wood furniture paints, one automotive coating, and a solvent blend. Six laboratories participated in the round-robin. Although the proposed method was modified to reflect current practices in the industry, the over-all precision was poor, with a reproducibility of 52-130%.

Most of the lab to lab variability appears to be due to equipment variations (non-specific analytical conditions), thermal instability of the coatings, and the general complexity of the samples. It was also confirmed that no one single method is applicable for the determination of every HAP. Specific examples cited included formaldehyde, phenol, organic acids, and diisocyanates. Issues related to glycol ethers and HAPs introduced as part of petroleum distillates were raised. Based on the lesson learned from the Method 311 study, D01.21.52 will attempt to tighten up the capillary GC procedure to improve reproducibility.

D01.21.52A—Hazardous Air Pollutants (HAPS) in Paints by Headspace/Gas Chromatography/Mass Spectrometric Detector (HS/GC/MS)—S. Ramesh, Chair, noted that this task group was formed to complement the work being done by D01.21.52. He presented information showing that HS/GC/MS offers a number of advantages over the GC method for determining volatile organic compounds (VOCs) and HAPs in paints and related materials. As with GC, this is a direct method for measuring VOCs and HAPs, but HS/GC/MS offers the possibility of identifying compounds by their mass spectral fingerprints. This is valuable when overlapping or merged peaks are present; unknowns are present which are not mentioned in the paints' MSDS sheet; and when contaminants are present.

By keeping the volatilization separate from the chromatographic analysis phase, the headspace technique can closely follow the U.S. EPA's Reference Method 24 test conditions, i.e. equilibrium at 110°C for one hour. If these test conditions for VOCs were to be modified in the future due to changing paint technology, it can be easily accommodated without compromising the optimized GC parameters. Since the injection port of the GC is usually kept at 250°C, there could be decomposition. HS avoids this potential problem. Also, use of headspace provides a way to determine the VOCs and HAPs of powder coatings and fast cure multi-component paints.

Since HS is a static sampling technique (compared to total volatilization by GC method or dynamic volatilization in the forced draft oven used in D 2369), some challenges have to be overcome before its full potential can be utilized. For example, different compounds will have different relative response ratios (RRR), when compared to an internal standard, depending upon the matrix, the amount of specimen used, and the equilibrium temperature.

Matrix effects can be reduced by lowering the specimen size, ca 20 mg seems to be a good compromise between reducing the matrix effects and errors associated with weighing. Again, for paints which contain 1-5% solvents, the specimen amount may have to be increased to get reproducible values. The requirement to obtain RRR for every different matrix may be manageable if the concept of representative compounds proves true. It was noted that compounds of the same class (e.g., hydrocarbon, alcohols, etc.) have similar RRR up to a certain point, usually defined by their molecular weights and boiling points.

The conditions to be used for the HS/GC/MS were presented. The discussion centered on quantitations based on one internal standard (multiple standards and bracketing the entire range may be a good option), solvent delay (use of cryogenic cooling can help avoid turning on the mass spectrometer during the air peak), and whether equilibrium in a vial truly represents the "real" situation.

When combined with the possibility of determining water with this technique, the HS/GC/MS method offers a direct way to determine the VOCs and HAPs by one technique. Also, it was recognized that the negative VOCs obtained using EPA's Reference Method 24 can be resolved using the HS/GC/MS. The chairman has found, in many cases, that negative VOCs are due to retained water or solvents in the film of the nonvolatile fraction.

The task group decided the procedure should be written into an ASTM format and a mini round-robin set up. Five laboratories have shown interest in participating in a round-robin. The results will be presented at the January 1996 meeting.

D01.21.54—Water in Paints and Paint Materials by Karl Fischer Titration Method—R. Osterman, Chair, reported that the method was rewritten by J. Benga and W.C. Golton. It was distributed to the task group for discussion. Changes in the draft included updating Note 2 because the Brinkman instrument mentioned is no longer marketed, changing Note 6 to read "Hydranal Composite #5®" or comparable reagent available from any scientific supply company, and moving the methanol extraction method to an Appendix. In addition, the precision statement generated from a round-robin in which the Hydranal Composition #5® was used will be included. W.C. Golton has volunteered to chair this group. The group expressed its appreciation to R. Osterman for the excellent job he has done.

D01.21.56—D 3960, Determining Volatile Organic Compounds (VOCs) of Paints and Related Coatings—M.E. Sites, Chair, reported that D 3960 will be revised to include D 5403, "Test Method for Volatile Content of Radiation Curable Materials," under the Referenced Document paragraph. This Standard has been approved for use by the U.S. EPA in determining the VOC of these types of compounds. This revision will be placed on the next D01 ballot.

A discussion followed on how to obtain EPA approval for test methods for determining VOC. A test method has to be developed, a round-robin run, data collected and evaluated, and then, the EPA can be approached. D 5403 is an example of this kind of effort.

D01.21.80—Exploratory Analytical Chemistry—K.H. Fujimoto, Chair, noted that Brinkman is supplying a homogenizer which is attached to the cap of a Karl Fischer titration vessel. When the homogenizer is turned on, it pulverizes paint specimens for a specified time and extracts the water from even the most difficult paint samples. Preliminary results from two laboratories indicate good precision and reproducibility. K.H. Fujimoto used a demo-loaner from Brinkman with mixed results.

A round-robin will be initiated to run the homogenizer with six collaborators.

With the exemption of acetone as a non-VOC and the use of chloro-flouro compounds, the task group on halohydrocarbons in paints was reactivated with J. Benga as Chair. The name of the group will be changed to "Exempt Solvents in Paints." Also the task group on exempt solvents used in aerosol paints will be reactivated with R. Osterman as Chair.

Subcommittee D01.22 Health and Safety

R. Osterman, Chair

D01.22.01—*Flammability and Flash Point*—M. Harding, Chair. R. Montemayor reported that verification fluids for flash point testers will be available from NIST in the fall of 1995. The package will contain 4 to 20 ml ampuls of different solvents. Contact NIST for pricing and availability.

We are directed by the ASTM Committee on Standards to replace trademark names in titles of standards with generic description names. The replacement name for "Setaflash" will be "small scale" in an effort to be uniform. The revision of D 3278 and D 4206 contains this change and was unanimously approved to be submitted to ballot.

D01.22—It was decided by the members present to submit the following six methods to D01.22 ballot for renewal:

D 1310, "Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus"; D 1360, "Test Method for Fire Retardancy of Paints (Cabinet Method)"; D 3806, "Test Method for Small Scale Evaluation of Fire Retardant Paints (2-FT Tunnel Method)"; D 3934, "Test Method for Flash/No Flash Test Equilibrium Method by a Closed-Cup Apparatus"; D 3941, "Test Method for Flash Point by the Equilibrium Method with a Closed-Cup Apparatus"; and D 4359, "Test Method for Determining Whether a Material is a Liquid or a Solid."

Subcommittee D01.23 Physical Properties of Applied Paint Films

P.R. Guevin, Jr., Chair

D01.23.10—Adhesion—G.L. Nelson, Chair, reported on the five items that were submitted to D01.23 ballot on the revision to D 3359, "Test Method for Measuring Adhesion by Tape Test." Several editorial suggestions received on Items 1, 4, and 5 will be incorporated. A negative submitted, referencing suggested additions to the current Appendix, was found to be persuasive. The item will be reballoted on the next D01.23 ballot with replacement language agreed upon by the task group.

It was recommended that the next D01.23 ballot of D 3359 include a reference to ISO 2409, "Cross-Cut Adhesion Test," and that D 5179, "Test Method for Measuring Adhesion of Organic Coatings to Plastic Substrates by Direct Tensile Testing," include a reference to ISO 4624, "Pull-off Test for Adhesion," in Section 2, as the methods are similar.

It was the recommendation of the task group to ballot D 2197, "Test Method for Adhesion of Organic Coatings by Scrape Adhesion," for withdrawal. The purpose of this action is to identify current users of the method who may be interested in working on a revision.

D01.23.12—Dry Film Thickness—S.K. Boocock, Chair. The meeting was chaired by R. Weaver in the absence of the chair. R. Weaver reported that the revisions to both D 1186, "Test Method for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base," and D 1400, "Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base," received negative votes on a D01 ballot. The negatives were found to be persuasive. P. Guevin and D. Beamish will review the items and remove information on shims and calibration of thickness gauges where applicable before resubmitting the item to ballot. R. Weaver reported that there was no status report on the round-robin testing to obtain a Precision and Bias statement on either method at this time.

D01.23.14—Hardness, Abrasion, and Mar Resistance—A.F. Rutkiewic, Chair, reported that revision to D 2134, "Test Method for Determining the Hardness of Organic Coatings with a Sward-type Hardness Rocker," received one negative and three comments on the recent D01.23 ballot. During the discussions on the comments, the task group uncovered numerous poorly defined issues in the current method. Since the method is not up for reapproval in the near future, it will be reviewed by P. Guevin and G.

MacKenzie to identify all the potential nonspecific or poorly defined parts. Their goal is to develop a comprehensive revision.

A revision of the proposed "Test Method for Dry Abrasion Mar Resistance of High Gloss Coatings" will be submitted for D01.23 ballot before the next meeting. ASTM D 5178, "Test Method for Mar Resistance of Organic Coatings," will be balloted for withdrawal in the next D01.23 ballot.

R. Boni reintroduced the issue of inconsistencies in D 4060, "Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser." Specific mechanical aspects of some models, instructions for use by the manufacturer, and what is written in the test method do not agree. R. Boni and F. Underhill will reconcile these differences with the manufacturer.

D01.23.15—Slip Resistance—P.R. Guevin, Jr., Chair, reported that the three new test methods for measuring slip resistance received two negatives on D01 ballot. The negatives were found to be persuasive, and the items will be removed from ballot and revised accordingly.

R. Hopkins suggested that the task group should reballot these proposed test methods quickly based upon prior involvement with the iron workers. P. Guevin reported on OSHA activity within the Steel Erector Negotiated Rulemaker Advisory Committee (SENRAC). He showed bar graphs illustrating the results of tests using the English XL and Mark II instruments. These slip resistance testers determined the values needed to provide a safe painted walking surface under wet conditions. G. Rommal reported Subcommittee D01.53 on Coil Coatings was discussing the same government activity, and that OSHA was getting ready to establish a minimum value of 0.6 for the English XL and 0.75 for the Mark II instruments. These values must be met for coil coatings applied to roofing panels.

D01.23.19—Drying Time—T.J. Sliva, Chair, distributed Draft 5 of the proposed "Standard Test Method for Measuring Times of Drying or Curing During Film Formation of Organic Coatings using Mechanical Recorders" for review. Draft 4 of the method received a negative from the recently completed D01.23 ballot. The negative was reviewed by the task group and found to be persuasive. The method was revised by T.J. Sliva to include comments and suggestions received.

The chair reported that the revision to D 1640, "Test Method for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature," had successfully completed society ballot. A new Precision and Bias statement for the method is now under development. The chair reported that a Precision and Bias statement on the straight line mechanical drying recorders was also under development.

The results from the first round-robin using circular drying time recorders were distributed and reviewed. The cooperators evaluated four coatings, including an architectural latex flat and alkyd paint, alkyd flat floor finish, and an air dry white acrylic lacquer, each of varying drying times. While results were only available from two cooperators, it was the decision of the task group to run an additional round-robin. The chair will report the results of this testing at the January meeting.

D01.23.20—Exploratory Research—P.R. Guevin, Jr., Chair, reported that the "Proposed Test Method for Nondestructive Measurement of Dry Film Thickness of Organic Coatings Applied to a Base Using an Ultrasonic Gage" had received negatives on both D01 and D01.23 ballots. Both negatives were found to be nonpersuasive. R. Matejka reported that results obtained in D01.52 on Factory Coated Wood Products using a microtome test method indicated thinner film thickness readings than those obtained with the ultrasonic gage. D. Beamish stated that the results from the work were being reviewed and compared to those obtained with destructive dry film thickness tests.

D01.23.21—Contact Angle Measurement—V. Scarborough, Chair, reviewed the scope of the task group to develop a method using a goniometer apparatus as a means of measuring contact angle. L. Gilman demonstrated the use of this instrument and discussed various important attributes that must be considered when measuring contact angles. V. Scarborough passed out copies of ASTM C 813, "Hydrophobic Contamination on Glass by Contact Angle Measurement," and the task group discussed using this method as a starting point for methods development.

The scope of the method the group is interested in developing will be broad to encompass the wettability by water of smooth surfaces. The definition for smoothness will be defined more specifically in roughness average (RA) units. The significance and use statement will cover the usefulness of the method in determining the cleanliness of an untreated substrate, and the ability to measure the surface wettability characteristics of a substrate. Surface energy estimations can be useful as a quality control tool to discriminate differences in the same/different surfaces. The chair will present a first draft of a method to the group at the January meeting for review and discussion.

Subcommittee D01.24 Optical Properties

C.K. Schoff, Chair

D01.24.18—Dispersion Phenomena—R.K. Morrison, Chair, discussed the recent ballot to withdraw D 1210, "Fineness of Dispersion of Pigment-Vehicle Systems," which drew about 20 negatives. D 1210 is safe for another year while the group completes a major revision. The task group had not requested the withdrawal ballot. The action was the result of the lack of ballot action on the method. It is hoped that the revision will be ready for the next D01 ballot.

D01.24.19—Efflux Cups—C.K. Schoff, Chair, discussed the revision of D 5125, "Viscosity of Paints and Related Materials by ISO Flow Cups," which now will include the new 5 mm orifice ISO cup listed in ISO 2431-1993. A rough draft of a revision of D 4212, "Viscosity by Dip-Type Viscosity Cups," was presented and discussed. The revision will undergo some rewriting, then will be submitted for D01.24 ballot and as an informational ballot to D01.56 since it would include a precision statement for inks. Another topic was Ford cups and the lack of fit of two commercial No. 4 Ford cups to the viscosity equation in D 1200, "Viscosity by Ford Viscosity Cup." The equations in the method and their history will be reviewed. New equations may need to be developed.

D01.24.20—Rotational Viscometers—The task group discussed D 2196, "Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer," and a possible generic method for low speed/low shear cone and plate viscometers, including the Brookfield cone/plate viscometer. D 2196 is up for revision or reapproval. It will be reviewed for possible changes and information on the new digital Brookfield viscometers will be added. The new method for low shear cone/plate viscometers is only an idea at this point, but it was felt that work should proceed on it.

D01.24.21—Viscosity by Stormer Viscometer—The group discussed the major revision of D 562, "Viscosity by Stormer™ Viscometer," and the recent D01 ballot which resulted in a persuasive negative and a long list of comments, both technical and editorial, from H. Ashton. The method will be revised, submitted to H. Ashton for comment, and balloted as appropriate. In other action, it was voted to change the title to Stormer™-type Viscometer since the method includes the Brookfield KU-1 as well as the Cannon Electronic Stormer and the standard (manual) Stormer™.

D01.24.24—Particle Size—The group met to see whether there was any interest in developing methods for determining particle sizes of pigments, latexes, or other particulate matter in liquid paints. The discussion ranged from these materials to dirt in paint, and hence to detection of foreign matter, and finally to microscopy as a diagnostic tool. The group wondered if a guide or practice for microscopy would be of use, and questioned whether this would fit in D01.24 or another subcommittee.

D01.24.33—Odor Evaluation—D. Darr, Chair, discussed the proposed "Guide to the Detection, Identification, and Characterization of the Odors of Paints, Inks, and Related Materials." Draft 2 has been expanded and work will continue on the guide. Interested individuals are encouraged to attend the next meeting of the group in Fort Lauderdale in January 1996. In addition to writing the guide, this group acts as a conduit for information on odor and odor testing. At this meeting a paper on odor emission from beer and beverage can manufacturing was handed out along with information on Electronic N.O.S.E., Neotronics Olfactory Sensing Equipment.

D01.24—C.K. Schoff, Chair, led a lively discussion on D 1475, "Density of Paint Varnish Lacquer and Related Products." Several negatives on the recent D01 ballot and a number of comments had been received. D01.24 judged the negatives to be persuasive and the method was removed from the ballot. Changes will be made, and the method will be resubmitted for ballot.

Subcommittee D01.26 Optical Properties

R. Kumar, Chair

D01.26.11—Gloss and Goniophotometry—A.F. Rutkiewic, Chair, reported that the method for instrumental measurement of distinctness-of-image gloss of coating surfaces passed D01 ballot and will be sent to society ballot. It was unanimously agreed to develop a method to measure orange peel of high gloss coatings. It was established that there are two instruments available that operate on the same electro-optical principle that are capable of making such measurements. G. Kigle-Boeckler and C. Higgins will cooperate to develop a draft method. In addition, they will generate data on their respective instruments using the GM orange peel standard reference panels in their possession and will switch sets so that four data sets will be generated (2 instruments and 2 standard sets). They will bring the draft method, data sets, and one GM orange peel set to the next meeting for the task group to discuss.

Subcommittee D01.27 Accelerated Tests for Protective Coatings

D. Grossman, Chair

D01.27.04—Light and Water Exposure Apparatus—L.E. Thieben, Chair. W. Ketola discussed negatives to D 822, "Open Flame Carbon Arc," and D 5031, "Enclosed Carbon Arc," regarding significance, use, precision, and bias. Changes will be made for D01.27 ballot.

J. Robbins discussed negatives to new "Xenon Arc," including many parallel to negatives on the carbon arc standard. Changes will be made for D01.27 ballot.

D 4587, "Fluorescent UV," is due for reapproval. D. Grossman will draft revisions for D01.27 ballot. Because significance, use, precision, and bias are so similar for all these standards, the wording on these sections will be standardized to avoid endless haggling over wording. Furthermore, the wording will be harmonized with new drafts of the underlying standards for carbon arc, xenon, and fluorescent in G03.03 on Laboratory Durability Tests for Non-metallic Materials.

D01.27.10—Accelerated Outdoor Weathering—J. Robbins, Chair, reported that the revision of D 4141, "Accelerated Outdoor Exposure Tests," has passed society ballot. The previous ballot had a negative vote which was withdrawn, with the understanding that the issues would be reballoted. J. Robbins will draft another revision for ballot.

D01.27.17—Evaluation of Weathering Effects—M. Crewdson, Chair. D01.90 voted to transfer the standards in D01.27.17 to D01.25, which will be renamed Evaluation of Weathering Effects. M. Crewdson was appointed D01.25 chair by D01 Chair K. Trimber. The change will simplify administration of D01.27 by reducing the number of standards in this subcommittee. Also, it will allow more latitude for the large amount of new work on Evaluation of Weathering Effects.

D 714, "Evaluation of Blistering," passed society ballot for reapproval. However, D 714 still needs major revisions, and D01.25 is looking for volunteers to help with them. A new combined standard is proposed, encompassing D 660, "Evaluation of Checking," D 661, "Cracking," D 662, "Erosion," and D 772, "Flaking." The purpose of the combination is to eliminate duplication of effort, in balloting, since all of these documents share a common significance and use, and very similar procedures. L . Jacques volunteered to work with M. Crewdson and J. Martin on this project.

D 4214, "Evaluating Degree of Chalking of Exterior Paint," is due for major revisions. R. Morrison will draft a revision for D01.27 ballot. This standard includes several methods. Some of these methods will be balloted for withdrawal, and others will be significantly revised.

New technologies for computerized video image analysis were discussed. These techniques involve capture of an image via video camera or scanner, manipulation with graphics software, and quantitative analysis of blistering, cracking, rusting, etc. via specialized software. L. Jacques will draft a protocol for a preliminary round-robin to explore issues that might need to be addressed in a draft standard. This technology has great promise for reducing subjectivity in evaluations, and a great deal of future work is expected.

D01.27.18—Outdoor Exposure Tests—J. Martin, Chair, reported that D 1014, "Outdoor Exposures of Paints on Steel," passed society ballot for a revision as a practice not as a method. This task group will be inactive until further work is needed.

D01.27.29—Test Substrates—D. Grossman, Chair, noted that a revision to D 3891, "Glass Test Panels," received one negative and several comments on a D01.27 ballot. The draft will be revised for further ballot. The revision addresses the differences in adhesion and composition between the sides of glass that are in contact with molten tin or air during manufacture.

D01.27.30—Corrosion Tests–Automotive—W. van der Linde, Chair, led a discussion of the revisions in the draft of the new standard for Outdoor Salt Accelerated Corrosion Test. Additional changes suggested in the meeting will be incorporated before the new standard will be reballoted.

The results of the round-robin on Accelerated Outdoor Cosmetic Corrosion Testing show considerable differences between the sets exposed at different sites, but the ranking of the paint systems from best to worst was consistent. Important contributors to the differences may be the fineness of the salt solution spray and the quantity deposited on the panel. This was also brought up as an important factor in the discussion of the new practice for Accelerated Outdoor Cosmetic Corrosion Testing. An additional round-robin is being considered to include paint systems and substrates used in the OEM automotive market. The new Guide to Laboratory Cyclic Corrosion Tests will be revised by P. Brennan for D01.27 ballot.

The SAE Corrosion round-robin has been delayed, pending selection of cyclic test protocol and electrolyte solutions. The round-robin is scheduled for this summer.

D01.27.31—Corrosion Tests–Non-Automotive—G. Rommal, Chair. R. Weaver chaired this meeting. G. Rommal has been appointed the new chair starting with the next meeting. Progress was reported on the cyclic corrosion round-robin. There are two parallel round-robin projects: industrial maintenance coatings and coil coatings. The procedures will be somewhat different for the two types of coatings.

S. Boocock and the SSPC have finished preparation of the industrial maintenance coatings, and they are now on outdoor exposure, at seven different outdoor sites of various kinds. There are 10 different industrial coatings, and five replicates of each coating is exposed at each site (total of 50 specimens per site). There are 80 replicates of each coating left for the accelerated tests. Because of the variability among the replicates, S. Boocock strongly recommends that five replicates be used for each accelerated exposure. This means that only 16 accelerated exposures can be done with replicates directly comparable to the outdoor sites. Because of the limited number of replicates, the task group decided to use them very carefully and only for correlation tests with promising accelerated cycles. After correlation has been established for a particular cycle, repeatability and reproducibility studies will be conducted with a different set of specimens. At present, accelerated exposures will be conducted only on a few protocols: (1) B 117 Continuous Salt Fog, as a historical benchmark; (2) "Prohesion" alternating with fluorescent UV, because of the good correlation published by several investigators; and (3) a cyclic test including a simulated acid rain electrolyte and UV. G. Rommal will get information from the SSPC, Sherwin-Williams, and Weiss about work they have done with simulated acid rain electrolytes.

The coil-coated specimens are not yet on outdoor exposure. G. Rommal and D. Grossman have been working on a scribing jig which will allow a reproducible scribe through the paint, but not through the zinc coating. A final modification to the scribing jig has been made, and the coil coatings are in the process of being scribed and impact dimpled. There are eight different coil coating systems, and several hundred replicates of each system will be produced in the next few weeks. Fifteen replicates of each system will be exposed at each outdoor site. Five replicates will be removed for evaluation after each of three intervals, such as two years, five years, and ten years. The removal interval will be adjusted depending on the severity of the site. Future work includes: (1) writing detailed procedures for evaluation; (2) organizing various accelerated tests for comparison; (3) possibly adding an eighth outdoor site for the coil coatings. Because of the nearly unlimited number of replicates, the coil-coating project can do much more extensive testing of accelerated test protocols.

The industrial maintenance paints will be rated for rusting according to D 610, for scribe creep according to D 1654, and for blistering according to D 714. Each outdoor site will do its own ratings. Because of the large inter-laboratory variability between raters, it will probably be necessary to covert the ratings to ranks for statistical analysis. The coil-coated samples will in addition require rating of the creep from the cut edges, and rating of corrosion at the impact dimple.

The proposed new standard for "Cyclic Salt Fog, Dry Off, and UV/Condensation" went through its third D01.27 ballot. Several negatives were received on the significance and use wording. This section will be revised in concert with other similar D01.27 and G3 standards, and will be resubmitted for D01.27 ballot.

The proposed new standard on "Cyclic Immersion and UV" is being withdrawn from ballot, because the manufacturer of the device is redesigning it to operate by a different mechanical principle.

Subcommittee D01.28 Biodeterioration

M.C. McLaurin, Chair

D01.28.01—Package Stability—M.C. McLaurin, Chair. Suggestions for improving D 2574 were submitted by L. Sadasivan. Discussion included remarks concerning the rating and reporting of results, and the appropriateness of using spore forming organisms such as *Bacillus subtilis* in the inoculum. It was decided that the suggestions are beneficial and that the recommended changes would be submitted for balloting in the next D01 ballot.

D01.28.02—Rapid Determination of Enzymes—C.W. Vanderslice, Chair, distributed preliminary test data obtained using a modified procedure from a 1991 proposed test method for detecting low levels of cellulase enzyme in latex paints and raw materials. In this method a highly substituted hydroxycellulose (HEC) and a moderately substituted sodium carboxymethylcellulose (CMC) are degraded at different rates by cellulase, but at similar rates by oxidizing agents like tert-butyl hydroperoxide (TBHP).

The test data using both PVA and acrylic paints contaminated with varying concentrations of a fungal enzyme showed that levels as low as 0.01 ppm could be detected within 24 hours in the PVA paint and within 48-72 hours in the higher-pH acrylic paint. A bacterial cellulase initially evaluated was of apparently low purity and had virtually no activity in either paint. The same paints contaminated with 120 ppm TBHP caused much slower polymer degradation.

A higher concentration of 500 ppm TBHP was suggested to be for addition to both latexes alone by cooperators for a round-robin, which will be run following this modified procedure with both types of paint. If the bacterial enzyme can be purified for increased activity, it will be used, or else the fungal derived one from *Aspergillus niger* will be utilized. The chairman will supply all materials. Five cooperators will participate in the round-robin.

D01.28.04—Resistance of Paint Film to Algae Attack—K. Roberts, Chair, presented the objective of this new task group. It is to develop a method to determine the algal resistance of paint films. Attendees reviewed method D 5589 and agreed the list of test algae should be expanded to include typical field isolates. A list of representative organisms including unicellular and filamentous green and blue-green algae will be compiled. Recommendation for standardizing inocula and including a control paint without biocide (algicide) will also be included. In a discussion of sample substrates, L. Sadasivan and S. Sherba said that they paint both sides of the filter or Leneta paper and have no bacterial contamination. K. Roberts has heard of individuals having contamination problems and suggested adding an inert substrate (fiberglass filters) to the suggested list of substrates. The pros and cons of the rating system and ability or inability to predict field results based on lab study was discussed. M. McLaurin pointed out that the physical characteristics of paints such as chalking might result in differences between lab and outdoor exposure studies.

The pros and cons of the SISIR test method were also discussed. The primary concern was that the water layer is not representative of environmental conditions. This may also favor more soluble biocides. The optimum leaching time and methods were also discussed but not resolved. The task group agreed the first step should be a round-robin lab study comparing D 5589 performance with SISIR. L. Sadasivan and K. Roberts will prepare a round-robin test protocol for discussion at the January 1996 meeting. All agreed the ultimate goal is to have our lab methods predict field performance.

D01.28.05—Non-Soil Humidity Chamber—Exterior Paints—J. Hinkle, Chair, reported that the name of this task group has been changed from Environmental Chamber-Exterior Paints to the above. The objective of the group is to develop an accelerated method for determining the fungal resistance of exterior paints that effectively incorporates *Aureobasidium pullulans* as one of the attack organisms. Discussion included comments about the use of the Zabel test, humidity cabinets (without soil), and petri dish methods among others. The chairman will prepare a draft of a proposed method and circulate it to the group before the next meeting.

D01.28.07—Revision of D 3274 (Defacement Ratings)—B. Matta, Chair. M.C. McLaurin presided in B. Matta's absence. Proposed revisions of D 3274 were balloted and approved with no negatives. However, this task group will continue to remain active and will work toward developing computer imaged photographic plates as standards to replace the photographs currently being used as standards in D 3274. A.F. Rutkiewic presented examples of computer generated standards to the group and discussed the various ways these could be manipulated to reflect the desires of the committee. He will contact B. Matta and produce a proposal for improving D 3274 to be discussed at our next meeting.

D01.28—Biodeterioration—M.C. McLaurin, Chair. Activities of the task groups were summarized, and progress was noted in a number of areas. Suggested revisions to D 2574 will be balloted before our next meeting. D 3456 is due for ballot. All of the other methods for which D01.28 is responsible are current and do not require any ballot action at this time.

DIVISION 30
PAINT MATERIALS

Subcommittee D01.32 Drying Oils

J.C. Weaver, Chair

Two negative votes on two items in a D01 ballot were recognized as persuasive. Revisions to accommodate these were formulated toward reballoting. D 1959 on "Iodine Value" will allow solvents deemed safer than long used carbon tetrachloride. D 1963 on "Specific Gravity" will rationalize its terminology with D 1475 on "Density."

Subcommittee D01.34 Naval Stores

J. Russell, Chair

D01.34.01—Capillary Gas Chromatography of Rosin and Fatty Acids—W. Trainor, Chair, reported on the results of the recent concurrent D01.34/D01 ballot. One negative vote had been received. That vote, by P. Zawislak, expressed the concern that it was premature to publish the method until more information had been developed concerning the precision and the limitations of the method. After extensive discussion the consensus of the members was that it was indeed premature to publish the method without any indication of its limitations and precision and so W. Trainor withdrew his motion that the negative was not persuasive.

It was agreed to run a further round-robin on both the area percentage and internal standard methods. T. Woods will supply the samples of rosin, fatty acids, and distilled tall oil for the round-robin and some 15 laboratories are expected to participate. W. Trainor will develop the protocol to follow. Dehydroabietic acid will be used as the only rosin acid internal standard and the dehydroabietic acid response factor will be used for abietic acid content calculations. Results will be discussed at the next subcommittee meeting scheduled for October.

D01.34.04—Iodine Value of Tall Oil Fatty Acids Using Isooctane as a Solvent—J. Bowers, Chair, reported that the proposed standard method had been submitted for a D01 ballot and passed with no negatives. The method will be included in the August society ballot.

D01.34.05—Softening Point by Ring and Ball Apparatus—P. Zawislak, Chair, announced that there had been two negative votes on a recent D01.34 ballot. Also, many suggestions were made to improve the clarity of the method. J. Bryson cast a negative vote because the precision statement used in the text did not include all the information required by ASTM guidelines. The task group found it persuasive. Extensive discussion followed on the text of the method and a number of changes were agreed to. P. Zawislak agreed to incorporate the changes into the text and distribute the amended text prior to the October meeting.

The preliminary results of the recent round-robin were distributed by the Chair. Five resins ranging in softening point from 70°C to 170°C had been tested using manual ring and ball, automatic ring and ball, and the Mettler automatic method. Some results had not yet been received and August 31 was established as the final date for receipt of additional data. The final results will be available for discussion at the October meeting. After extensive experimental work by several member companies, it was agreed that no simple correlation could be found between the ring and ball method and the Mettler method. The rate of heating required for the Mettler method to give the same result as the ring and ball method varied with the type of resin and its softening point. P. Zawislak will add a section to the current draft of the Mettler method describing this limitation and circulate it to the committee at or before the October meeting.

D01.34.06—Color Measurement by Instrumental Methods—W. Mark, Chair, reminded participant that the goals of this project were to identify instrumental methods that would measure color and report Gardner numbers of liquids more precisely than the current Gardner color disc method. Nick Barnes of Tintometer then demonstrated and described Tintometer's PFX 190/G instrument. He also described the basis used to convert the colors measured into a Gardner value.

W. Mark had compared the Tintometer instrument with the Minolta instrument and found good agreement. Both instruments appeared capable of reporting Gardner units to 1/10 of a unit, but neither instrument was yet equipped to handle molten samples.

BYK-Gardner Inc. also has an instrument in the same intermediate price range and has agreed to describe and demonstrate that instrument at the October meeting. They also agreed to supply W. Mark with a loaner instrument so that he can evaluate the instrument prior to the October meeting. It was agreed to run a round-robin between the October and January meetings. W. Mark will prepare the protocol to be used and Union Camp, Exxon, and Eastman Chemicals will provide the test samples. A wide variety of instruments will be used and Minolta, Tintometer, and BYK-Gardner will provide loaner instruments. Final details and logistics will be settled at the October meeting with the expectation that the conclusions will be available for discussion at the January 1996 meeting in Fort Lauderdale.

D01.34—J. Russell, Chair, reported that a negative vote had been received on each of three methods submitted for a D01 ballot. The three standards were for the determination of acid number, fatty acid content, and rosin acid content respectively and in each case the negative vote concerned the precision statement. Specifically, the proposed precision statement did not satisfy the requirements of the ASTM guidelines.

J. Russell reported that he had examined the examples of precision statements given in D 177, "Use of the Terms Precision and Bias in ASTM Test Methods," and confirmed that the Precision and Bias statements on the three methods being balloted were inadequate. There was no motion to find the negative votes not persuasive and so the methods will be withdrawn from balloting. The chairman will prepare new Precision and Bias statements using example 1 from D 177, and the standards will be resubmitted for balloting.

No action was taken on D 3008, "Resin Acids in Rosin by Gas Liquid Chromatography," which requires ballot action in 1995. W. Trainor had studied the standard and found the Precision and Bias statement to be confusing and lacking in supporting evidence. He also reported that, to his knowledge, the method described was obsolete and recommended that the standard be withdrawn when the capillary GC method currently under development is published. This approach was agreed to by D01.34.

At the January meeting in San Antonio, P. Zawislak had indicated that some confusion existed regarding the best solvent for use in the determination of unsaponifiable matter in tall oil products. D 1065 specifies diethyl ether and the AOCS standard specifies petroleum ether. Ms. Zawislak reported that she had contacted AOCS and had received background information on both the AOCS method and a corresponding ISO method. The results presented were conflicting but there was no evidence to indicate that D 1065 should be converted from a diethyl ether extraction to a petroleum ether extraction. No further work in this area is planned. It was agreed that the next three meetings of D01.34 would be in Charleston, SC on October 6, Fort Lauderdale in January 1996, and San Francisco in June 1996.

Subcommittee D01.35 Solvents, Plasticizers, & Chemical Intermediates

R.G. Montemayor, Chair

D01.35.10—Hydrocarbon Solvents and Ketones—S.A. Yuhas and R.L. Hinrichs, Co-Chairs. This task group is on schedule with the review/reapproval of the 24 standards for which it is responsible. One standard, D 3734 "Specification for High Flash Naphtha," received 3 negatives at the D01.35 level. Jim LeBeau, Rey Montemayor, and Steve Yuhas all objected to the proposed change in terminology used for Type I and Type II solvents (i.e., C_9 aromatics for Type I and C_{10} aromatics for Type II). It was felt that the change in the description is misleading since other aromatic hydrocarbons are present in these solvents. It was agreed that the method would be reballoted retaining the existing terminology for the two types of solvents with two notes saying that Type I are predominantly C_9 aromatic hydrocarbons, and Type II are predominantly C_{10} aromatic hydrocarbons. J. LeBeau also proposed that the flash point specification for Type II (aromatic 150) be changed to meet the flash point minimum (142°F) specified by DOT regulations contained in HM181. Also to be removed is the statement "having a flash point typically 150°F" since typical flash point nowadays of these solvents is lower than 150°F.

The status of method development on a capillary version of D 3893, "Test Method for Purity of Methyl Amyl Ketone and Methyl Isoamyl Ketone by GC," was reviewed. The initial robustness test was completed, and participants indicated the need for further work. Other columns may be tried due to some separation problems encountered.

A report on a capillary GC version of D 4367, "Test Method for Benzene in Hydrocarbon Solvents by GC," was submitted for review by Montemayor. This new method allows the trace analysis of benzene in the range of 0.1 to 2400 vppm of benzene in hydrocarbon solvents which is more in line with the minimum requirement seen today, often at a 10 vppm maximum. The existing packed column technology in D 4367 is not capable of trace level benzene analysis. It was agreed that, because there is considerable difference in the methodology, a separate and new method dealing with trace benzene analysis in hydrocarbon solvent will be drafted and submitted for D01.35 ballot. An interlaboratory study to generate a precision statement for the new method will be undertaken when sufficient participating laboratories can be found.

D01.35.20—Reactive Monomers—J.E. Frugé, Chair, noted that there are three standards under the responsibility of this task group that are overdue: D 2192, D 3845, and D 4416. These will be balloted for reapproval with editorial changes later this year. The status of method development work on a capillary version of D 3362, "Purity of Acrylate Esters by GC," was reviewed. The results from the robustness testing indicated that there will be a need to try other columns due to separation problems encountered.

D01.35.30—Chemical Intermediates—J. Morrison, Chair, reported that all standards under the responsibility of this task group are on schedule for review. Nine standards passed D01 ballot without negative votes. They will proceed to society ballot. Five standards were reviewed and will be submitted for reapproval with minor editorial changes. These standards were: D 1969, D 2635, D 2636, D 2694, and D 5164.

J. Lawniczak submitted a GC method for the Determination of Formic Acid in Glacial Acetic Acid (from J. Frugé). It is hoped that this method might be a suitable replacement for lead tetracetate method currently specified.

D01.35.40—Plasticizers and Ester Solvents—J.E. Lawniczak, Chair, reported that all Standards are on schedule for review. Six standards, D 363, D 3130, D 3545, D 4614, D 4615, and D 5137 passed society ballots and will be published next year. D 1209, "Pt-Co Colour of Hydrocarbons," has been revised to show recalculated precision data. The revision will be circulated to the membership for comments and balloted this year.

D01.35.50—Coordination—L. Forrest, Chair, reported that D01 reapproved D 1615, "Test Method for Glycerol, Ethylene Glycol, and Pentaerythritol in Alkyd Resins. In D02 the test protocol and samples for the interlaboratory study involving the Continuously Closed Cup Flash Point (CCCFP) tester or Graebner Mini-flash were approved. Revisions to D 93, "Flash Point by Pensky-Martens Closed Cup Tester," were balloted by D02.08. A number of negatives were received but were all resolved except four. The D 93 ballot items will proceed to D02 ballot. Among changes which will require reballoting at the subcommittee level is the removal of p-xylene as a calibration fluid. P-xylene will be replaced by four new Standard Reference Materials (SRM): n-decane, n-undercane, n-tetradecane, and n-hexadecane available fro NIST. The use of secondary standards for more frequent verification of apparatus performance will also be allowed as long as they are traceable to NIST SRM's.

From D15, D 841, "Nitration Grade Toluene," was recently balloted at the Society level. D 848, "Acid Wash Color of Industrial Aromatic Hydrocarbon," was extensively reviewed with many aspects such as effect of overmixing and shear being carefully examined. It was reported that the color of the oil layer increased as the acid strength decreased. D 850, "Distillation of Industrial Aromatic Hydrocarbons," was revised to include new glassware standards of D 1272 and E 1405. D 1555, "Method for Calculation of Volume and Weight of Industrial Chemicals," was revised with editorial changes. D 2360, "Trace Impurities in Monocyclic Aromatic Hydrocarbons by GC," now includes a fused silica capillary column, a newly defined calibration procedure, new precision data, and the use of an internal standard. Benzene analysis was deleted from the method. D 3505, "Method for Density or Relative Density of Pure Liquid Chemical," will be balloted for reapproval.

D01.35.60—Method Development—R. Bartram, Chair, reviewed four methods being developed: (1) Capillary GC Method for Acrylate Esters—The robustness testing has shown problems with the separation of some impurities from the major compound. New column will be tried; (2) Capillary GC Method for Purity of MAK/MIAK—The robustness testing has shown problems with the separation of some impurities from the major compound. New columns will be tried; (3) Capillary GC Method for D 3545 Alcohol Content and Purity of Acetate Esters—A preliminary method has been established and samples and participants are being sought; and (4) Capillary GC Method for Trace Benzene for Hydrocarbons—R. Montemayor reported that scope and linearity have been demonstrated from 0.1 to 2400 vppm benzene in hydrocarbon solvents. The method was accepted and will be submitted for D01.35 ballot. An interlaboratory study will be performed when sufficient participating laboratories become available.

D01.35—Chair R.G. Montemayor reported that D01.35 has two new members: Wyatt J. Mills of DuPont and Austin J. Silcox of American Gilsonite Co. One new affiliate member, Mary F. Toro of Consumer Product and Safety Commission, was approved. David L. Pytynia of Nalco Chemicals has resigned.

Subcommittee D01.36 Cellulose and Cellulose Derivatives

G.Y. Moore, Chair

The following methods have passed D01 ballot and will be on society ballot. D 301, "Test Method for Soluble Cellulose Nitrate," D 914, "Methods for Testing Ethylcellulose," D 1696, "Test Method for Solubility of Cellulose in Sodium Hydroxide," D 2929, "Test Method for Sulfur Content of Cellulosic

Materials by X-ray Fluorescence," D 3516, "Test Methods for Ashing Cellulose," and D 3971, "Test Methods for Dichloromethane-Soluble Matter in Cellulose."

Two methods passed society ballot for withdrawal with no replacement: D 1787, "Test Method for Pentosans in Cellulose," and D 2438, "Test Method for Silica in Cellulose."

Three methods received negatives. J. Morton will review TAPPI definitions of alpha, beta, and gamma cellulose, and G. Moore will add R. Wint's comments about lacquers for a revision of D 1695, "Terminology of Cellulose and Cellulose Derivatives." D 2364, "Method of Testing Hydroxyethylcellulose," received two negatives which will be addressed by G. Moore. D 3876, "Test Method for Methoxyl and Hydroxypropyl Substitution in Cellulose Ether Products by Gas Chromatography," received a persuasive negative from D. Kiesel on a 1994 ballot. A promised revision has not been done, and the document will be balloted again.

The following methods will be submitted for D01.36 ballot: (1) D 1343, "Test Method for Viscosity of Cellulose Derivatives by the Ball-Drop Method," after a minor revision of changing the distance of the lower mark from the bottom of the tube to accommodate sample requirements; (2) D 1915, "Method for Chromatographic Analysis of Chemically Refined Cellulose," for withdrawal to be replaced by J. Morton's new method "Test Method for Carbohydrate Distribution of Cellulosic Materials;" (3) D 1926, "Test Method for Carboxyl Content of Cellulose," has been provided keywords and a TAPPI precision statement by J. Morton; and (4) new method by J. de Wit titled "Determination of Percent Hydroxyl on Cellulose Esters by Potentiometric Titration—Alternative Method."

Methods D 1347, "Test Method for Methyl Cellulose," and D 2363, "Test Methods for Hydroxypropyl Methylcellulose," have no stewards to review them and will be balloted for reapproval as is. Method D 2641, "Test Method for Chlorine in Cellulose" will be submitted for withdrawal without replacement. Methods D 817, "Methods of Testing Cellulose Acetate Propionate and Cellulose Acetate Butyrate," and D 871, "Method of Testing Cellulose Acetate," will be reviewed by J. de Wit. J. Morton is preparing a draft for a new method entitled "Test Method for Cuperammonium Viscosity of Cellulose by the Ball-Drop Method."

Subcommittee D01.37 Ink Vehicles

A.N. Scarlatti, Chair

D01.37.01—Resin Solutions—A.N. Scarlatti, Chair, reviewed the negative vote on the proposed "Standard Practice for the Preparation of Oil-Based Resin Dispersions." Editorial changes were made, and the negative vote was withdrawn. The proposed method will be submitted for D01 ballot. No other methods are being inaugurated by this task group at this time.

D01.37.04—Standard Ink Oil—E.W. Casserly, Chair. Through J. Daust, B. Reutz reported that ASTM approved Standard Linseed Oil (Cargill Supreme Linseed Oil, fully refined, bleached, and winterized) has been made available to the industry. Several members of the subcommittee are now using this as their standard ARLO. A. Scarlatti will look into advertising the availability of this standard ARLO in the *American Ink Maker* and *Ink World* magazines.

E. Casserly reported that 30 to 35 drums of the original 60 drums of ASTM approved Standard Magiesol 47 that were set aside are still available for sampling to the industry. D. Frisch reported that the comparable standard heat-set ink oils are also available from Exxon. The group is still in search of a soybean oil supplier who will provide a similar service for our industry.

D01.37.05—Quality Control of Ink Oils—J.B. Sardisco, Chair. A. Scarlatti reported that D 5661, "The Relative Solvency of Petroleum Oils by PKP," has passed all required ASTM ballots and will appear in the next Annual Book publication.

D01.37.06—Ink Vehicle Wettability—M. Fuchs, Chair. The subcommittee voted to change the name of task group D01.37.06 from "Pigment Dispersibility of Paste in Vehicles" to "Ink Vehicle Wettability." M. Fuchs distributed a proposed "Standard Guide for Laboratory Flushing" for review by the subcommittee. It was agreed that the word "Guide," in the title of this proposal, should be changed to "Practice" since this proposal describes a technique and is not a list of techniques or methods. Subcommittee members were asked to review the proposed practice and return edited copies back to M. Fuchs so that the method can be revised before the next meeting.

D01.37.07—Resin/Solvent Compatibility—D.P. Frisch, Chair, distributed the results of the latest round-robin on precipitation temperature (cloud point). Available data will be statistically analyzed by P. Zawislak. The subcommittee agreed on several revisions to the proposed method, "Determining the Compatibility of Resin/Solvent Mixtures by Precipitation Temperature." Suggestions are: (1) the procedure should include a specified time to heat the resin and solvent mixture at 200°C; (2) the method should be recommended for resin and solvent mixtures exhibiting a precipitation temperature between 50°C and 180°C or changes in resin concentration (e.g. 20%) or solvent is recommended; and (3) include a footnote regarding safety aspects concerning solvent flash points.

During this meeting G. den Dulk, of Novocontrol Company, Germany, and P. Massolt of Testprint Incorporated provided us with a demonstration of the Chemotronic (automatic precipitation temperature) and Thermotronic (automatic solution making) instruments. Several task group member companies are already using this equipment. If interest in these instruments grows, as we expect, the subcommittee will consider writing a method incorporating one or both of these instruments.

D01.37.08—New Membership—D.P. Frisch, Chair, reported that no new members joined at this meeting. D. Frisch was asked to contact a number of prominent ink vehicle scientists suggesting membership in ASTM and on D01.37. We expect that NAPIM will continue to be represented at our meetings and that there will be increased interest in our subcommittee once it is publicized that a new task group on the "Rheology of Ink Vehicles" has been formed.

D01.37.09—Alkyd Compatibility of Ink Resins—J. Zerkel, Chair, has volunteered to become chair of this task group. A. Scarlatti distributed the revised proposed "Standard Method for the Determination of Alkyd and Vegetable Oil Compatibility of Ink Resin." J. Zerkel will review this proposal and suggest revisions and round-robin proposals at the next meeting.

D01.37.10—Rheology of Ink Vehicles—D. Weisel, Chair, announced that a new task group titled "Rheology of Ink Vehicles" has been formed. The scope of this task group is not precisely defined at this time. However, the general scope of the group will be to investigate methods for determining rheological properties of gelled and ungelled ink vehicles (e.g., viscoelastic measurements, yield value, shortness ratio, Tan delta, etc.). One objective of this task group will be to investigate the use of the Laray viscometer on high viscosity gelled vehicles. Members of the group know that, although this instrument is not designed for this application, highly gelled and viscous vehicles are commonly tested on this apparatus. It was also mentioned that the Duke viscometer is becoming more common and that a proposed ASTM method for utilizing this instrument correctly should be considered in the near future.

DIVISION 40
PAINT PRODUCTS APPLIED ON SITE

Subcommittee D01.42 Architectural Finishes

C.W. Vanderslice, Chair

D01.42.03—Porosity of Paint Films—C.W. Vanderslice, Acting Chair. The group reviewed and critiqued the first draft of the proposed test method. It was suggested that the scope be limited to white and light-tint paints since dark-colored paints cannot be evaluated by this technique. It was further recommended that D 3258 for measuring porosity be included in the "Referenced Document" section since it reportedly correlates well with this proposed test method. In accordance with current ASTM guidelines, a clarification is needed on whether references to "weight" in the method should actually be "mass." Questions were raised on the accuracy of the balance specified in the method and whether one weighing to less than +/- 1 mg was necessary. Changes in the procedure to remove extraneous mineral oil were suggested. A question was posed about the response of the method to two paints of varying density which absorb the same mass of mineral oil. Finally, discussion centered on whether the method should be converted to volume or the name changed to reflect the current use of mass difference. Once these changes are resolved by the chair, a revised draft will be submitted for D01.42 ballot.

D01.42.04—Wet Adhesion of Latex Paints—C.W. Vanderslice, Chair, reviewed the latest draft of a proposed test method similar to one used by Union Carbide. Comparative data for two semigloss paints applied over a standard industrial gloss alkyd-primed scrub panel versus a developmental UV-cured coated plastic panel from The Leneta Company were reviewed. The purpose of the UV-cured coated panel is to provide a stable surface that simulates the surface of an alkyd. Two acrylic semigloss test paints containing different latexes and reportedly having significantly different degrees of wet adhesion were tested. For reasons as yet unclear, correlation between the two panel types was poor, unlike past data with other types of latex semigloss paints. This unexpected result will be resolved before proceeding to a round-robin. It was agreed that a round-robin comparing the two types of panels be run using five semigloss paints having varying degrees of wet adhesion. Cooperators will prepare their own gloss alkyd panels from paint supplied by the chairman, using both ambient cure and an accelerated oven cure. Leneta will supply additional special panels.

D01.42.05—Adhesion of Latex Paints to Chalky Surfaces—A. Leman, Chair. The group agreed on a specific substrate to represent a standard chalky surface for testing. This substrate is an exterior latex paint formulation containing anatase TiO_2 that weathers relatively rapidly to a chalky surface. The paint will be weathered naturally over primed cedar panels to an ASTM chalk rating of 5. The group also agreed to include a description of other types of chalky surfaces in the test method, such as weathered aluminum and vinyl siding, that may also be used for testing. Various test methods that could be used to evaluate the adhesion of a latex topcoat applied over a chalky surface were reviewed. It was agreed that conditions of wet adhesion were the most important to study. A round-robin will be initiated by the chair in order to evaluate the various adhesion test methods for the purpose of establishing repeatability and reproducibility precision statements. Round-robin testing will include test paints that have demonstrated both good and poor adhesion over chalky surfaces.

D01.42.09—Color Development in Latex Paints—L. Schaeffer, Chair, presented a proposed revision of D 5326 in which color development would be reported on a percentage basis in addition to the CIELAB color difference as called for in the current standard. The percentage value would be derived from the Kubelka-Munk Absorption Coefficients (K) of sheared and unsheared paint films. In reviewing the proposed method it was pointed out by several members that when incompatibility occurs between colorants and tint base paints, the white or scattering coefficient S, as well as K, is frequently subject to considerable increase. Since the Kubelka-Munk calculation depends on a constant value for S, the procedure was found inapplicable. It was, therefore, agreed to withdraw the proposed revision and to deactivate the task group, since its original and primary objective has been completed with the publication of the current version of D 5326.

D01.42.20—Water Repellency of Wood—V. Scarborough, Chair, announced that this group has been reactivated in a joint effort with D07 (Wood Committee) to develop a Precision and Bias statement for ASTM D 4446, "Anti-Swelling Effectiveness of Water-Repellent Formulations and Differential Swelling of Untreated Wood When Exposed to Liquid Water Environments." The group will work to revise the method, and it will be balloted in D07. Discussion for possible revisions include adding density and growth rings per inch specifications for the wood. The conditioning temperature and humidity will be changed to standard conditions in the first round-robin in order to make the method easier to run. Labs that can run the test at the specified conditions of 80°F, 65% RH will run a comparison study to see how the change in conditions affects the results. An internal standard of five percent wax in mineral spirits will be used in the first round-robin. The chairman will provide wood wafers, the internal standard, and a revised method to all cooperators. The results will be reported at the next meeting as well as to D07.06 members. Other areas of interest included weight gain and pre-swelling untreated controls with water when testing water-based formulations.

D01.42.22—Guides for Testing Architectural Coatings—C.W. Vanderslice, Acting Chair. The fourth draft of a revision to Method D 1546, "Practice for Testing the Performance of Clear Floor Sealers," was distributed and reviewed. A number of editorial changes were made, including a recommendation that an "edge-on" drawing of the wood and coating order be made to illustrate the written procedure. One technical question raised in the procedure involved lengthening the time between applying the sealer and burnishing the surface in treating worn spots. The current directive to "immediately burnish" was thought to be too rapid versus actual practice. A number of other procedural questions still need to be decided, such as the type of staining medium, if water-spotting should be added, and whether a rating system is necessary.

Once these changes are resolved by the chairman and a "Precision and Bias" section is added, the revised draft will be submitted for D01 ballot. In other business, two negatives from a D01 ballot for reapproval of D 1641, "Test Method for Exterior Durability of Varnishes," were found to be persuasive. Once the recommended changes are made, the method will be resubmitted for D01 ballot.

D01.42.25—Scrub Resistance of Latex Paints—T. Sliva, Chair, reported that the reapproval of D 2486 had passed society ballot and then presented the group with a list of suggestions for changes to be included in the next revision. These changes included not limiting the method to interior latex paints; standardization of materials and apparatus between this method and D 3450, D 4213, and D 4828; and inclusion of a note giving guidance on the conditioning of the brush. Equipment manufacturers will be contacted to see if a statement on brush specifications can be developed; whether the brushes can be sold prelevelled and attached to holders; and whether shims can be sold attached to the glass plates.

J. Cogar suggested that a round-robin be run in which two paints are applied to each panel perpendicular to the length of the panel. This round-robin will also investigate the use of a control paint in testing. Six cooperators have agreed to participate. The results of the round-robin and other suggestions received from task group members will be reviewed at the January meeting.

D01.42.26—Burnish Resistance of Latex Paints—C.W. Vanderslice, Acting Chair, reviewed the latest draft of, and single-lab test data from, a proposed test method utilizing a cheese-cloth wrapped "sand-paper" attachment with the Gardner straight-line and washability machine. Comments to finalize the procedure for an initial round-robin were invited. A number of technical changes were made, including a recommendation that only one, rather than three, 85° readings be made before and after rubbing a centrally-marked area on the test panel. Another proposal was to express the change in 85° gloss or burnish resistance as a percentage of the original reading and attempt to score the magnitude of the change on the standard ASTM 0-10 scale. A comment was made that instrumental changes of only 2 units were clearly visible. It was suggested that three paints judged to be widely different in their burnishing characteristics be selected by the acting chair and sent to the eight cooperators along with the necessary auxiliary test equipment and copy of the amended draft.

D01.42.28—Paint and Coatings Removers—V. Scarborough, Chair, reviewed the round-robin results in which three laboratories evaluated three coatings removers. All three labs successfully ranked the products' performance the same using the standardized ASTM scoring scheme described in the proposed method. The proposed method will be sent for D01.42 ballot.

D01.42.29—Guide to Testing Exterior Wood Stains—A. Leathers, Chair, distributed the scope and outline of the guide. Several editorial changes were suggested and will be adopted. The two present guides, D 5146 and D 5432, will be revised to agree with this guide's outline. The draft of this guide will be distributed to D01.42.29 committee members prior to the January 1996 meeting. Members are to forward the name of persons in their companies who can serve as test method reviewers concerning their applicability to stains.

D01.42.32—Whole Paint Specifications—T. Sliva, Chair protem, distributed a tabulation of responses to the questionnaire on interest in developing a specification for "Flat Interior Paints" that had been distributed to D01 members. As of June 5, the chair has received 31 responses in favor of developing a specification and 19 responses opposed. T. Sliva reported that the questionnaire is currently being published in *Standardization News* and other periodicals that target the paint industry. Comments from responders were discussed and distributed. The chair will report on the responses received from the previously mentioned periodicals at the January meeting. At that time, a decision will be made on setting up a working group to investigate the possible mechanisms that could be used to develop a specification for low-VOC flat paints using multiple categories for their classification.

D01.42.33—Scrub Resistance by Abrasion Weight Loss—L. Schaeffer, Chair, presented the results of the round-robin. Seven cooperators had tested four paints using a suitable calibration panel as a comparator in each test. The results showed an interlaboratory 95% mean average deviation value of approximately 16% compared with 30% for the current standard. This improves the precision by nearly a factor of two. The revised method will now proceed to D01.42 ballot.

D01.42—Architectural Finishes—C.W. Vanderslice, Chair, announced that the D01.42 membership now consists of 28 producers, four users, 34 general interest, and 11unclassified. Five new members were welcomed. The chair reported the following standards had passed society ballot: D 1849, D 2243, D 2486, D 3793, and D 4213. A reminder was given that methods and practices are due for reapproval or revision every seven years, with the process preferably starting in the fourth year. C.W. Vanderslice will contact members to serve as stewards for any unassigned methods due for review. Two negatives cast by F. Winkleman and H. Ashton on the reapproval of D 1641, "Exterior Durability of Varnishes," were found to be persuasive. This method will be withdrawn from ballot, revised by A. Leathers, and resubmitted for ballot. D 1736, "Efflorescence of Interior Wall Paints," has been withdrawn. However, since this phenomenon is still a concern with exterior masonry paints, another group will be formed to revise the method. D01.42.21, "Long Range Planning," is interested in forming a new group to develop a method for dirt pick-up of exterior paints. The chair will conduct a literature search on this subject and requested that any references on this subject be sent to him. The method would be an extension of D 3719 on dirt pick-up developed within D01.52. D01.42.03 on "Porosity" will submit a revised draft for D01.42 ballot after suggested changes are incorporated. D01.42.25 reported that D 2486, D 3540, D 4213, and D 4828 on various measurements of washability or cleanability will be reviewed for consistency and submitted for D01.42 ballot. A final draft from D01.42.28 on coatings removers will be submitted for D01.42 ballot.

Subcommittee D01.44 Traffic Markings

A.R. Barrow, Chair

D01.44—A.R. Barrow reported that D01.44 has only one method needing action, namely D 713, "Practice for Conducting Road Service Tests on Fluid Traffic Marking Materials." It will be reviewed and submitted for D01.44 ballot. A new method, "Determination of Drying Speed of Waterborne Traffic Marking Paints," received one negative. It will be revised and submitted for concurrent D01.44 and D01 ballots. Initiating a round-robin to obtain a Precision and Bias statement was discussed.

Two items of new business were discussed. One relates to the new waterborne technology for traffic paints. Revisions to existing methods may be needed to encompass waterborne technology. The other relates to D 1155, "Method for Roundness of Glass Spheres." This method is not suitable for measuring bead sizes of > 30 mesh. Since many users are looking at larger sizes of glass beads, D01.44 decided to revise the method or develop a new one as appropriate to meet this need.

Barrow reported that he is tracking a possible problem between ASTM and AASHTO. AASHTO is publishing references to ASTM methods in their test method and specification book and writing methods in ASTM format. Barrow will provide liaison between the two committees.

Subcommittee D01.46 Industrial Protective Coatings

G.W. Gardner, Chair

D01.46.02—Surface Preparation—G.W. Gardner reported that both D 2200, "Pictorial Surface Preparation Standards for Painting Steel Surfaces," and D 2092, "Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting," passed society ballot and are scheduled to be published in June 1995.

Gardner thanked chair K.A. Trimber and the task group for their efforts on these standards. K.A. Trimber reported that W. Johnson's review of D 4417, "Test Methods for Measurement of Surface Profile of Blast Cleaned Steel," indicated that there is no need to make changes to the Precision statement or use Dixon outliers because the statistics are adequate for this test method. Mr. Trimber added that ISO has a test method and their own comparator for measuring surface profile. K.A. Trimber will review this method to determine what changes/additions to D 4417 should be considered to make it consistent with the ISO method.

K.A. Trimber reviewed the status of the round-robin on portable conductivity meters testing in accordance with D 4940, "Test Method for Conductimetric Analysis of Water-Soluble Ionic Contamination of Blasting Abrasives." Two collaborators at KTA and one at SSPC have run the tests and sent in their results. Collaborators D. Griffin, D. Chance, and C. Ray need meters to conduct the tests. W. Johnson will coordinate testing and meter availability.

A prior comment from B.R. Appleman on changing D 2200, "Pictorial Surface Preparation Standards for Painting Steel Surfaces," Paragraph 4.2 from "in the U.S." to "in North America" unless evidence can be given to indicate that the SSPC method is the preferred method in North America. Trimber noted that SSPC/NACE have approved joint abrasive blasting standards. It does not appear that SSPC/NACE and ISO will come to an agreement on a commercial blast cleaning standard.

Discussions on modifying D 2092, "Guide for Preparation of Zinc Coated (Galvanized) Steel Surfaces for Painting," to expand the chromate hazard statement (prior W.S. Zimmt comment) and expanding the scope were considered. T. Langill will review and make recommendations at the January 1996 meeting.

D01.46.03—Repainting—G.W. Gardner, Chair, reported that D 4752, "Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub," passed society ballot and is being reviewed by the Committee On Standards. Discussions on a round-robin and changing the rating scale were deferred to a future meeting.

G.W. Gardner reported that D 610, "Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces," passed D01.46/D01 ballot. Editorial comments by B.C. Stinnett, J.J. Brezinski, and K.B. Tator were reviewed and may be incorporated into the society ballot. Previous affirmative comments by D.M. Berger, D.H. Kenicga, W. Spangenberg, and K. Haagenson will be addressed in the expanded version under consideration by the task group. This expanded version will show three or four different pictorial standards for each rust grade. K. Trimber and R. Weaver will select and photograph appropriate panels. K. Trimber and R. Weaver in cooperation with SSPC and A.F. Rutkiewic, will produce computer enhanced images for discussion at the January 1996 meeting. These new pictorial standards will probably be incorporated into D 610 as a Method B.

D 5064, "Standard Practice for Conducting a Patch Test to Assess Coating Compatibility," has been reviewed and updated. D 5064 will be sent out for D01.46 ballot.

D01.46.07—Inspection—L. Smith, Chair, has revised both D 3276, "Standard Guide for Painting Inspectors (Metal Substrates)," and the new "Guide for Painting Inspectors (Concrete and Masonry Substrates)" to make them more similar to each other. Both were reviewed and minor changes will be made before sending to D01.46 ballot.

D01.46.10—Condition Assessment—M.E. McKnight, Chair, reported that D 5065, "Standard Guide for Assessing the Condition of Aged Coatings on Steel Surfaces," has been changed to a practice, updated, and will be sent out for D01.46 ballot.

M.E. McKnight reviewed D 5043, "Standard Test Methods for Field Identification of Coatings," and recommended to ballot this method for withdrawal. This method contains many procedures that are out-of-date and are no longer used. They have been replaced with newer ASTM methods. The task group unanimously agreed to ballot for withdrawal.

D01.46.12—Sampling—The new D 5702, "Standard Practice for Field Sampling of Coating Films for Analysis for Heavy Metals," passed the March 1995 society ballot and is scheduled to be published in June 1995. This task group started in January 1992, and the first draft was completed in May 1992. G.W. Gardner commended K.A. Trimber for the excellent work he and his task group have put forth to get this practice completed in a timely manner.

K.A. Trimber recommends that this task group should not write a practice on sampling soil for analysis. E06.23 has written a practice that fits D01.46 needs except the sample size and depth specified in the coring method. M.E. McKnight will work with E06.23 to change this practice to allow the sample size necessary for D01.46.

The task group unanimously agreed that writing a practice for sampling blast debris (waste) is outside the scope of D01.46.

A new practice on sampling of coatings for general analysis is needed. M.E. McKnight will provide K.A. Trimber with the Navy practice, and he will draft a practice.

D01.46.13—Guide for Testing—J. Cheng, Chair, has drafted a new "Standard Guide for Testing Industrial Protective Coatings" based on the outline provided by M.E. McKnight. About one-half of this guide was reviewed by the task group and some changes/additions were made. J. Cheng will incorporate these changes and send them to the task group for review.

D01.46.14—Chemical Immersion—C. Ray, Chair, drafted a new "Test Method for Immersion Resistance" by modifying D 3912 to meet D01.46 needs. The task group reviewed this draft and recommended changing it to use ASTM methods and include effects of the coating on the cargo in the test method. Ray will write a revised draft and sent it to the task group for review.

D01.46—G.W. Gardner, Chair, welcomed seven new members to the D01.46 subcommittees: James M. Delaney, of Ciba-Geigy Corp.; David A. Dubowik, of Air Products and Chemicals; Christopher L. Farschen, of Ocean City Research; Mark A. Morris, of Coopers Creek Chemical Corp.; Austin J. Silcox, of American Gilsonite Co.; Gene A. Wayenberg, of Tnemec Company, Inc.; and Hugh L. Williams, of British Coatings Federation.

D01.46 has 83 members (59 official voting members and 24 unofficial voting).

Updates from each task group meeting can be found in the preceding minutes. In addition D 4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," passed society ballot and was published in April 1995. D01.46.04 Chair, M.E. McKnight, and the task group were commended for their efforts on D 4541. There were four additional standards that passed society ballot since January 1995: D 2200, D 2092, D 4752, and D 5702.

Overdue standard D 4752 should be published after Committee On Standards review in July 1995 so that it can be included in 1996 ASTM volumes. D 610 should pass the August 1995 society ballot.

Subcommittee D01.47 Masonry Treatments

E. McGettigan, Chair

D01.47.01—Water Repellency of Treated Masonry—V. Scarborough, Chair, presented the water absorption test results of treated and untreated 3" × 6 " × 1/4" concrete slabs. The results were very consistent for the products tested. The group suggested that it move to round-robin testing with the following procedure. Dip treat the entire slab with product to a coverage rate of 150 ft^2/gal. Let the slab dry to a constant weight at standard conditions. Immerse the slabs to 1/8 in. depth in water and measure weight gain at 1, 4, 8, and 24 hr. The chair will acquire and treat the slabs with selected water repellents and send them to the six cooperators. The results will be reported at the next meeting.

D01.47.05—Water Vapor Transmission of Treated Masonry Substrate—E. McGettigan, Temporary Chair, led a discussion on the merits of using a paint film method, such as D 1653, versus a building material method, such as E 96. The group decided to use a building material test, and cementitious slabs (3" × 6" × 1/4") would be used as the substrate. The task group felt that it was more important to compare treated slabs versus untreated slabs instead of calculating a perm rating. A draft of a water vapor transmission method will be presented at the next meeting.

D01.47.06—Freeze/Thaw Resistance of Treated Masonry—L. Stark-Kasley, Chair, led a discussion about the responses to McGettigan's letter asking D01.47 members to review the method before the next ballot. One response was received from R. Gates. The letter discussed water repellent treatments as integral water repellent mortar additives. Integral water repellent mortar additives are not covered by this method. To further clarify this issue, the definition for water repellent in the method was modified to exclude these additives. Another clarification to the method was under test materials. A statement was added to explain how the mold release agent could be removed from the cubes. This method will be submitted for balloting at D01.47 and D01 levels and the outcome will be discussed at the next meeting.

D01.47.07—Alkali Resistance of Masonry Treatments—B. Berglund, Chair, summarized previous test method development efforts and the status of the current test method development. A rough draft of a procedure for determining alkali resistance of coatings resulting from alkalinity within standard concrete specimens was presented. The group suggested that standard conditions be identified and wet and dry cycling be considered. Results of testing using this procedure will be provided at the next meeting.

D01.47.10—Evaluation of Field Applied Treatments—E. McGettigan, Chair, reviewed data obtained using three different procedures to measure the water absorption of concrete cores. One method consisted of placing a 2 1/2" ring 2 3/4" high on top of the specimen and sealing with a putty. This method gave inconsistent results due to variations in the effective diameter because the putty migrates under the ring. The most consistent results were obtained when the entire circumference was sealed with a wax, and the top and bottom surfaces were unsealed. Round-robin testing will be initiated using the wax sealing method. Data will be presented at the next meeting.

D01.47.11—Research and Planning—E. McGettigan, Chair, opened the discussion on stain testing. J. Linert demonstrated a method for testing the strain resistance of surface applied treatments. Materials such as motor oil, transmission fluid, and red wine were applied to treated and untreated substrates. Methods used by the National Tile Institute and substrates, such as 2" cubes, saw-cut and broom finished 3" × 6" × 1/4" panels were discussed. J. Linert will chair 47.02 on method development of stain resistance testing on masonry.

DIVISION 50 PAINTS FOR FACTORY APPLICATION

Subcommittee D01.51 Powder Coatings

N.D. Emily, Chair

D01.51.01—Polymeric Powders and Powder Coatings—E. Waddles, Chair, with N. Emily, presiding, noted that D 3451 is up for revision in 1997. D01.51 intends to update the document, perhaps changing it to a guide. Sections expected to change are Referenced Documents, Terminology, Particle Size and Distribution, Viscosity, Density and Specific Gravity, Relative Deposition Efficiency, and Abrasion Resistance. Examples of changes include referencing Powder Coating Institute (PCI) methods and D 4060. R. Brockhaus will update all ASTM volume references in D 3451 before the January 1996 meeting.

D01.51.02—Hiding Power of Powder Coatings—M. Sharma, Chair, with L. Schaeffer, presiding, presented the information generated in the fifth round-robin for hiding power, for which there were four collaborators. The results confirmed that the Powder Coating Institute (PCI) method for determining hiding power based on the thickness of the coating is valid. The data indicates that film thickness measuring devices may create significant variability in interlaboratory tests. A round-robin for film thickness gauges was proposed. When all of the test specimens were evaluated using one thickness gauge, the results showed minimal variability. L. Schaeffer will prepare a draft of the proposed ASTM method and circulate it for review prior to the January 1996 meeting.

D01.51.03—Spray Characteristics of Powder—C. Merritt, Chair, with N. Emily, presiding, reported that the new apparatus for a transfer efficiency round-robin is planned for trial in August. Proposed collaborators in order of testing are C. Merritt, J. Hadden, R. Boni, J. Jernigan, J.D. Pont, J. Hagerlin, R. Jabon, E. Waddles, and B. Smith.

D01.51.05—Specific Gravity of Powder—D. Schneider, Chair, with N. Emily, presiding, reported that the proposed Standard Test Methods for Specific Gravity of Coating Powders received two negatives in D01.51 ballot. Both negatives were reviewed and considered persuasive. The task force reviewed the document, making several technical and editorial changes. R. Boni recorded all of the changes and will provide a copy of the changes to D. Schneider so the document can be resubmitted to D01.51 ballot.

D01.51.06—Particle Size Distribution of Powder—J.D. Pont, Chair, reported the guide for particle size distribution was given to L. Gutman for editing, the appropriate changes were made and it was submitted to D01.51 ballot and approved. J. Hagerlin will submit the official request for submitting the guide to D01 ballot in 1995.

D01.51.07—Exploratory Projects—N. Emily, Chair, noted that the evaluation of film thickness of uncured powder using specially designed shims has been temporarily tabled until E. Waddles can provide the proposed shims. D01.51 members are to bring ideas for incorporating other industry methods and practices into ASTM methods as future task groups. A discussion lead by J. Berry of the EPA regarding cooperation on projects such as identification of VOCs in powder resulted in no immediate action but the agreement to consider such an activity for a future task group.

D01.51—N. Emily announced that he is retiring from General Electric and resigning as Chair of D01.51. Jeff Hagerlin of O'Brien will be the new Chair of D01.51.

Subcommittee D01.52 Factory Coated Wood Building Products

S.B. Schroeder, Chair

D01.52b—Hardboard—S.B. Schroeder, Chair, reported that an extensive negative ballot was cast on the new "Cobb Ring" test method for Determination of Liquid Water Permeability of Applied Coatings on Hardboard and other Composite Wood Products. The bulk of this ballot by T. Slivas' was found nonpersuasive and was subsequently withdrawn by him. However, Mr. Sliva suggested editorial change to clarify the use of this method as a water absorption measurement instead of a permeability test was adopted. The method will now be submitted to society ballot.

D01.52.13—Prefinished Hardboard—T. Rieth, Chair, reported that D 5722, "Standard Practice for Performing Accelerated Outdoor Weathering of Factory Coated Embossed Hardboard Using Concentrated Natural Sunlight and a Soak-Freeze-Thaw Procedure," has passed society ballot. Future work to extend this method to primed hardboards will be under a new task group, D01.52.18, "Accelerated Exposure." Unexposed primed panels from recently completed test fence exposures will be evaluated as pass-fail references in D 5722 and several proposed methods which add freeze-thaw cycles to QUV, xenon arc, etc.

D01.52.15—Film Thickness—S.B. Schroeder, Chair, reported that initial test data using the new ultra sound instrument from DeFelsko Corp. appeared biased toward the high side. However, D. Beamish from DeFelsko suggested repeating with a better control. This will be supplied. Expansion of D 5235 to include video image microscopes as well as optical instruments was discussed. A round-robin to compare data generated by both was outlined and will be initiated this summer.

D01.52—S.B. Schroeder, Chair. It was agreed to form a new task group, D01.52.18, Accelerated Exposure, to continue work to extend D 5722, "Standard Practice for Performing Accelerated Outdoor Weathering of Factory Coated Embossed Hardboard Using Concentrated Natural Sunlight and a Soak-Freeze-Thaw Procedure," to primed hardboard. Another new task group, D01.52.19, Furniture, was also formed.

Negative ballots cast on the withdrawal of D 2571, "Standard Guide for Testing Wood Furniture Lacquers," were found persuasive, and it will be balloted for reapproval.

Subcommittee D01.53 Coil Coated Metals

R.J. Tucker, Chair

D01.53.01—Task Group on Pretreatments—H.E.G. Rommal, Chair, reported that method D 5723-95, "Standard Practice of Measuring Chrome Treatment Weight on Metal Substrates by X-ray Fluorescence," passed society ballot. Plans are being made for round-robin testing to establish a Precision and Bias statement.

D01.53.03—Task Group on Accelerated Weathering—D.A. Cocuzzi, Chair, reported that the initial set of real-time exposure panels have been submitted for South Florida weathering. A similar set will be sent to Phoenix for real-time weathering also. At least two more years of real-time weathering will be needed before accelerated weathering can begin.

D01.53.04—Task Group on Dry Film Thickness Measurements—G.R. Pilcher, Chair, reported that language within the method has been modified per various comments, and that the next draft will be ready for D01.53 balloting within two weeks. A round-robin will be scheduled to establish a Precision and Bias statement.

D01.53—R.J. Tucker, Chair, asked for reports from the three task groups. Three methods were discussed: D 3281, "Standard Test Method for Formability of Attached Organic Coatings with Impact-Wedge Bend Apparatus," will be recommended for withdrawal (lack of use); D 4146, "Standard Test Method for Formability of Zinc-Rich Primer/Chromate Complex Coatings on Steel," will be submitted for D01 balloting without revision; and D 4145-83, "Standard Test Method for Coating Flexibility of Prepainted Sheet," will be submitted for D01 balloting without revision. C.A. Milburn discussed the activities of the Steel Erectors Negotiation Rule Advisors Committee (SENRAC) and the recommendations of two consultants retained by SENRAC. Their recommendation is that OSHA immediately institute the following requirements:

> *All structural steel parts that can foreseeably be walked on by field erection personnel at elevations above grade level shall have a finish that is slip resistant under wet conditions, using a standard Neolite slider pad on a surface that is wet with an unbroken film of water.*
>
> *Surfaces shall have a slip index of 0.75 as measured with an English XL Slip-Resistance tester operated at 25 psi, or a slip index of 0.60 as measured with a Brungraber, Mark II Slip Tester.*

Hearings are being held June 26-28 at the Department of Labor. Should such a recommendation be adopted, there would need to be a dramatic change in the way the preengineered building industry constructs buildings.

Subcommittee D01.55 Factory Applied Coatings on Preformed Products

R. Diem, Chair

D01.55.09—Transfer Efficiency Under General Production Conditions—R. Diem, Chair, reported that there were no activities and that this would be the last meeting of this task group.

D01.55.11—Mar Resistance of Automotive Clear Coatings—A. Rutkiewic, Chair, reviewed the negatives and comments from a D01.55 ballot for "Standard Rub Test Method for Abrasion and Mar Resistance of High Gloss Coatings." The task group agreed that the negatives and comments had merit. The proposed method will be revised and resubmitted for D01.55 ballot. The group also discussed the Atlas rub tester that will be specified in the method. J. Wineburg and C. Schoff will work with Atlas to specify the model number of an instrument suitable for the method.

D01.55.12—Non-Conductive Coatings for Electrical Protective Equipment—L. Thieben, Chair, indicated that he had been in contact with the chair of F18.40 on Protective Equipment for Workers concerning F 711, "Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used in Live Line Tools." Since F 711 is up for review, the task group chair will see if paint specification for FRP can be included in the F 711 update.

D01.55—Chair R. Diem announced that he will prepare a list of standards related to wood finishes since there has been difficulty getting involvement from wood finishes producers and users. This list will be reviewed with D01.52 at the January 1996 meeting.

R. Diem indicated that there continues to be a major effort in the automotive industry in the area of etch resistant finishes. At present, each user has their own method for evaluating etch resistant finishes. The need for a guide to summarize the method for measuring etch resistance was discussed. R. Diem agreed to contact PPG, BASF, and the users to determine if there is interest in participating in the preparation of such a guide.

Subcommittee D01.56 Printing Inks

J.M. Fetsko, Chair

D01.56.02—Lightfastness of Prints—J. Robbins, Chair, proposed that D 3424 be retitled, "Relative Lightfastness and Weatherability of Printed Matter" and be rewritten as a pass-fail method. The test print would be run along with a reference standard and rated visually or instrumentally as equal, better, or worse than the standard.

D01.56.12—Viscosity of Liquid Inks—J. Daugherty, Chair, reported that round-robin data with inks on the Shell and EZ Zahn cup were passed on to C. Schoff, D01.24 Chair, for incorporation into D 4212, "Viscosity by Dip-Type Cups."

D01.56.14—Setting of Heatset Inks—D. Ness, Chair, distributed a draft copy of the proposed test method for running comparative setting tests using the Sinvatrol on prints made with a constant film thickness gauge.

D01.56.15—Density (wt/gal) of Paste Inks—P. Ford, Chair, reported that round-robin data on inks were incorporated in D 1475, "Density of Paint, Varnish and Related Products" and reballoted through Subcommittee D01.24.

D01.56.19—Printing Strength—J. Daugherty, Chair, reported that a pilot study conducted in two labs exhibited wide variability in one lab and lack of sensitivity at lower ink film weights. A new study at higher film thicknesses will evaluate metal versus rubber discs and endpoints based on reflectance rather than optical density values.

D01.56.20—Technical Coordination—B. Blom, Chair, reported that F. Ford recommended that the proposed changes to D 4017, "Test Method for Water in Paints and Paint Material by Karl Fischer Method," not be supported because they involve sample manipulation, such as distillation, which may constitute additional sources of error. A proposed list of print tests has been transmitted to the TAPPI Printing and Imaging Committee in an effort to get more paper related industries involved in the development of these tests.

D01.56.22—Drying of Oxidizable Inks—B. Blom, Chair, reported that the subcommittee ballot of the proposed new method for the drying of oxidizable inks by squalene resistance elicited one negative vote and a number of comments. The negative was considered persuasive and, after suitable revisions are made, the method will be submitted for a combined subcommittee D01 ballot.

D01.56.23—Degree of Dispersion by Microscopy—R. Dix, new Chair, will review the studies conducted to date. B. Blom offered to run image analysis, if appropriate.

D01.56.25—Degree of Radiation Curing—E. Kobylarz, Chair, reported that he conducted an in-house study comparing the GTA Abrasion Tester to the Crock Tester (Image Fastness Tester) and found that the GTA was satisfactory provided that a lighter weight arm was used. A round-robin is planned in which sets of prints cured to varying degrees will be circulated along the same Crock Tester.

D01.56.26—Chemical Resistance—M. Fuchs, new Chair, distributed copies of proposed methods for Bleed Resistance and Alkali Resistance. Members offered to provide copies of wall paper resistance tests and in-house methods utilized by the soap industry.

D01.56.27—VOC40 of Non-Heatset Paste Inks—P. Ford, Chair, reported that the round-robin data discussed in D01.56.15 will be the basis of a revised Precision statement for D 5328, "Test Method for VOC40 of Non-Heatset Paste Inks at 40°C."

D01.56.28—Tinting Strength of Liquid Inks—D. Ness, Chair, reported that a revised draft of a test method for spectrophotometric determination of tinting strength was submitted to cooperating laboratories. A round-robin will be conducted using four blue inks at known strength levels. The white base is Sherwin Williams super base coat white latex paint.

D01.56.29—Membership—J. Daugherty, Chair, noted that, as a result of his solicitation, a number of new members were in attendance. The need for representation from printing houses was mentioned.

D01.56.31—Print Opacity—J. Fetsko, Chair, reported that plans are underway to work with the test method for transparency developed by a NPIRI Task Force for ISO.

A pilot study will be conducted with inks diluted with varnish and an opaque white.

D01.56.32—Laboratory Printing—D. Ness, new Chair, distributed a draft of the "Standard Practice for Preparing Prints of Printing Inks with Model S and Model H Little Joe Color Swatcher." The procedure was reviewed and a number of revisions suggested.

D01.56.33—Print Gloss—J. Daugherty, Chair of this new task group, requested that members send him their internal test procedures.

D01.56.34—Print Problem Terminology—J. Daugherty, Chair of this new task group, requested that members send him their definitions for describing printing problems for all processes.

D01.56.35—Ink Tack Changes on Substrates—N. Plowman, Chair of this new task group, described the procedure developed for use on a flat-bed proof press. She will put the method into ASTM format and conduct a pilot study.

D01.56—J. Fetsko, Chair, reported that three test methods are up for five-year review: D 4040, "Falling Rod Viscometer," D 4361, "Apparent Tack of Inks and Vehicles," and D 4942, "Water Pickup". Since no recommended revisions were received, the tests will be balloted for reapproval.

Subcommittee D01.57 Artists' Paints and Related Materials

B. Gavett, Chair

D01.57.11—Gouache Paints—B. Gavett, Chair, reviewed the status of the gouache standard which had received no negatives on a D01.57 ballot, but had received one negative on a D01 ballot from R. Johnston-Feller. D01 had upheld a motion by the subcommittee to find the negative not persuasive. R. Johnston-Feller had appealed the decision. She objected to the separation of her comments and the passing of the standard with the comments to be discussed during the present meeting, as new business.

T. Takigawa reviewed comparisons of spectrometric measurements of previously exposed gouache samples. His results indicated that it did not make a significant difference whether specular gloss was included or excluded from the measurement. It was suggested that (1) the gouache standard be published as is; (2) to incorporate sample preparation into the next draft of D 4303, "Standard Test Methods for Lightfastness of Pigments Used in Artists' Paints," as suggested by R. Johnston-Feller; and (3) to consider allowing either method of measurement where evidence indicates it does not affect the calculated color changes. It was agreed that measurements taken before and after exposure needed to be consistent, in terms of the geometry selected and the machine used. In further discussions of R. Johnston-Feller's comments, it was agreed that it is appropriate to leave the Kubelka-Munk method as non-mandatory, as long as the prerequisite reflectance is reached and verified. T. Vonderbrink said he would work on incorporating into the next draft of D 4303 the comments reviewed, including the "rub-up" test. T. Takigawa also offered to test watercolor samples under xenon-arc and fluorescent exposure, if he is supplied drawdowns by August. D. Chartier offered to validate other fluorescent bulbs for use in UV exposure apparatus.

D01.57.14—Colored Pencils—J. Beauchene, Chair. In the chair's absence, L. Armstrong and A. Morrow reviewed a comparative analysis of blue wools and colored pencil test samples and said they were trying to equalize variables so that competitive comparison could be made. They hoped to use the blue wools once to get an irradiance rating and then use the ratings to rate pencil results. After discussion, it was agreed to proceed and see what the results are, to consider if borderline cases need to be repeated, to determine if sun tests are necessary for some pigments because of the difference between xenon arc and sun tests, to decide if lightfastness levels should be the same as for paints, and to use small group statistics with explanations. It was agreed to send out additional results with the notice of the next meeting.

D01.57.10—Consumer Evaluation—In a discussion of the problem with the white felt's cover allowing light to leak through in the blue wool test, D. Chartier suggested using aluminized mylar or acetate and agreed to supply a sample to J. Luke.

D01.57.04—Specification for Artists' Paints—Suggested changes to label requirements for substituted and mixed pigments were presented and discussed. T. Vonderbrink reported that he had tested three additional pigments for inclusion in D 5098. The group approved adding the following three pigments: (1) PY184, Category I, Bismuth Vanadate Yellow, bismuth vanadate; (2) PR202, Category I, Quinacridone Magenta, quinacridone (Hue designation); and (3) PR 255, Category I, Pyrrole Scarlet, pyrrolopyrrol.

G. Stegmeier reported that a small group (Z. Pinney, J. Luke, R. Gamblin, and G. Stegmeir) has begun to develop shortened names for certain Table 1 pigments. It was agreed to have the group finish their deliberations and distribute them for review prior to the next meeting. It was noted that PR242 does not have a common name but is a pigment.

D01.57.10—Solubility and Removal of Varnishes—J. Luke recommended an article by Mr. Whitmore regarding the removal of varnish from acrylics. There was considerable discussion of the solubility of acrylic paint when removing varnish. R. Merrill said that acrylics are not consistently soluble, that crosslinking can continue for longer than six months, and that temperature affects the solubility. D. Chartier commented that varnishes should be removable, but that removability was affected by the kind of varnish, the substrate (i.e., acrylics), and the composite (i.e., canvas). R. Merrill recommended that a solubility chart for varnishes and for paints be determined to help decide which varnish to use for each paint type. It was agreed to investigate with M. Mechlenburg at the Smithsonian and R. de la Rie at the National Gallery what information is currently available.

R. Gamblin reported that comments received about the feasibility of producing a gesso performance standard would be difficult. He agreed to investigate whether any other ASTM standard could be modified to include gesso. D. Chartier said that Mr. Mecklenburg and Mr. Karpowitz at a museum in Nova Scotia had done some research. M. Gottsegen said that he was doing visual lightfastness rating of gesso. It was reported that pre-primed canvas, economy gesso, and oil grounds would pose problems. R. Gamblin agreed to propose a course of action for the January meeting.

D01.57.08 and D01.57.12—Toxicity Labeling and Determination of Toxicity—W. Stopford, Chair. B. Gavett reported that approximately 20 toxicologists, as well as C. Jenkins, M. Rossol, and W. Stopford, attended a session at the meeting of the Society of Toxicology in March. He said that W. Stopford felt that the discussion gave him valuable direction in proceeding further, while M. Rossol felt the discussion confirmed her viewpoint that the standard should be permanently withdrawn. Ms. Rossol had cast a negative on the ballot for revision of D 5517, "Standard Test Method for Determining Extractability of Metals from Art Materials," which added a significance and use section. A lengthy document supporting her negative was distributed. B. Gavett also said that W. Stopford would respond to this document in writing to M. Rossol. There was considerable discussion on this issue, and it was agreed that W. Stopford must respond so that D01.57 can better understand the issues. D. Chartier indicated he would be willing to do a literature search and that it was permissible to say in the standard that there is a variation. The matter was tabled until W. Stopford and M. Rossol are both present at a meeting.

D01.57.09—Watercolors—In a discussion of collectively-funded testing to provide incentives to test, M. Gottesgen suggested an ASTM fund be investigated, provided interest is shown by manufacturers in responding to T. Takigawa's offer to test manufacturer-supplied drawdowns of watercolors and gouaches. It was noted that the Wilcox book had an effect and that some of the publication had been based on our standards testing. It was generally agreed to add lightfastness categorized III, IV, and V rating information to all our standards for informational purposes only. It was suggested that most of the expense of testing was in the preparation of the samples which the manufactures have to do for any testing. It was also suggested that manufacturers make numerous samples at once which can be used for additional types of tests.

It was agreed that two errors in the standard—PG 36 should be PB 36 and Mansa Yellow should be Hansa Yellow—could be changed editorially. C. De Soto submitted a list of pigments for the task group to consider providing lightfastness ratings. It was also suggested that Mars black, titanium white and possible others should be grandfathered.

D01.57—Chair B. Gavett reported that the presentation to the College Educators group in January in San Antonio was well-received, as well as the booth in their exhibit area. It was suggested that there be an ASTM booth at NAMTA, and possibly the American Institute of Conservators, next year. After discussion, a task group to prepare a video that could be used at such exhibit booths was formed to include D. Chartier, M. Gottsegen, Z. Pinney, and R. Woody.

A request was made to add additional information to the report on D 4674. The suggested addition was approved and reads: "It was reported that D 4674, referenced in the revision of D 4303, was itself being revised. G24 is being reviewed because of changes in the amount of ultra-violet radiation reaching the test specimens due to solarization of the glass cover. This problem is mitigated somewhat by the fact that D 4303 limits exposure in Florida to October through May, avoiding the summer months, when the problem is worse. The changes in the glass can make a 50% difference in the amount of UV reaching test specimens. Over time the changes in the glass taper off."

DIVISION 60 PAINT APPLICATION

Subcommittee D01.61 Paint Application Tools

F.B. Burns, Chair

D01.61.01—Paint Brushes—T. Sliva, Chair, reported that the D01.60 ballot on the proposed "Test Method for Evaluation of the Cleanability of Paint Brushes" had received one negative. The negative vote called for the inclusion in the method of a pre-washing step prior to painting to remove any residual finishes of pretreatment on the filaments. The negative was found to be persuasive. In addition, the scope of the method will be modified to state that the method is applicable to all brushes up to four inches in width. This method will be revised and submitted to concurrent ballot before the next meeting.

T. Sliva distributed Draft 6 of the proposed "Test Method for Comparison of Leveling Efficiency of Paint Brushes." Several cooperators reported work that had been done since the last meeting evaluating the use of primed upsom boards in the method. G. Harsch distributed data developed on the method using upsom boards as well as sealed charts. A further discussion followed on the need to include illustrations for paint application, application of black stripes for use on the upsom boards, and the possible use of Leneta brushout standards in the method.

D01.61.02—Paint Rollers—J. Price, Chair, explained that his recent major surgery and recuperation had delayed any significant progress with this task group.

D01.61.03—Woven Paint Applicator Fabrics—M. Murray, Chair, distributed Draft 3 to the task group for review. The definitions for "dyelot" and "reel" will be added. Illustrations including a pile height micrometer, and a tuft showing the pile, filling, and backing have been added. Weave construction needs to be better defined and diagrams will be added. Work on the standard will continue.

D01.61.05—Bulk Density of Filaments and Bristle—J.D. Feathers, Chair, reviewed comments received during ballot and editorial format changes. These changes were incorporated into Draft 10 and discussed by the task group. Minor wording changes were suggested and will be reflected in Draft 11 which will be submitted to concurrent balloting.

Equipment modifications necessary to measure bulk density on tapered filament have been identified, fabricated, and tested by C. Martin. The "Bill of Materials" for these modifications was distributed to members to allow for modifying equipment prior to the next meeting.

Another potential instrument for measuring tapered bundle bulk density, based on digit measurement and developed by NASA, was introduced by Tim O'Brien. Equipment drawings should be available at the next meeting.

D01.61.06—Buckling Resistance of Filaments—T. O'Brien, Chair, reviewed the solution to the filament slippage in the clamps. This involves using a screw tightening clamp, which fixes the filaments in the clamp. This method resolves the filament slippage problem, but it is a slow process. Faster techniques are being evaluated by Ketema and EZ Paintr. A report will be made at the January 1996 meeting. Ketema has designed a modification to increase the speed of the stroke. If these enhancements show promise, drawings will be distributed at the January 1996 meeting. EZ Paintr has made a modification eliminating the need to cut the level filaments to fit into the fixture. Experience will be reported at the January 1996 meeting.

D01.61—F. Burns, Chair, discussed plans to simultaneously ballot updated versions of two proposed new standards. One is "Evaluation of the Cleanability of Paint Brushes." The other is "Bulk Density of Level Paint Brush Filaments." It was agreed to schedule a noon meeting for D01.61.07 Symposium Planning, at the next D01 session in January.

F. Burns acknowledged with appreciation the active participation of C. Nelson, who has been assigned other product line duties. J. Feathers will serve as chair of D01.61.05.

June 1995 Subcommittee Reports of ASTM Committee G03

Subcommittee G03.03 Simulated and Controlled Environmental Testing

R.M. Fischer, Chair

G03.03.07—Performance Standards—P. Brennan and W. Ketola, Chairs. The task group discussed the G03 ballot results for the new Standard Practice for Exposing Nonmetallic Materials to Laboratory Light Sources. There were two negative votes along with five affirmative with comment submissions. The negatives were generally found to be persuasive. The document will be redrafted and submitted for concurrent ballot. The performance standards relating specifically to carbon arc, xenon arc, and fluorescent devices will be submitted for G03.03 ballot only.

G03.03—The draft Guide for Addressing Variability in Natural and Accelerated Testing of Nonmetallic Materials ballot results included three negatives and four comments. Significant progress was made in resolving technical issues raised in ballots on past drafts of this document. The current draft will be revised to include the concerns raised in the negatives and will be submitted for concurrent main and subcommittee ballot.

The subcommittee ballot results for revision of G 23, G 26, and G 53 Precision and Bias statements received three negative votes and several comments. The negatives were found persuasive except for one issue concerning the ASTM *Blue Book* requirement for quantitative data in a Precision and Bias statement. S. Orthey (ASTM G03 staff manager) stated that it was up to the committee to decide as to where qualitative warning information was placed and that its inclusion in the Precision and Bias section was not inappropriate. This ballot item was withdrawn, will be redrafted, and again be submitted for G03.03 ballot.

The requirement by Building Officials and Code Administrators, International (BOCA) to make G03 standard practice language mandatory was discussed. The general consensus is that the BOCA codes relate to specific materials while the G03 standards give general guidance on running exposure tests. BOCA should reference specific material standards such as those in D01 or D20. Changing the G03 standards to mandatory language would not be appropriate and may well change the intention of the standard practice.

The subcommittee ballot on the revision of G 26 for including new device models returned with three negatives. The negatives were found to be persuasive, and the ballot item was withdrawn. The addition of new equipment to G03 standards should follow the guidelines listed in the by-laws (appendix).

Subcommittee G03.05 Reference Materials for Exposure Tests

W. Ketola, Chair

W. Ketola reviewed results from an IFAI round-robin where blue wool and polystyrene reference materials were exposed by each of the participating labs. No reduction in between-laboratory variability for the ΔE data for the fabrics exposed could be achieved by normalizing the laboratory data using results for the blue wool or polystyrene reference materials. This indicated that using reference materials to normalize data between laboratories in order to improve reproducibility is not feasible. Results from the same round-robin showed that ranking 23 fabrics to one fabric arbitrarily chosen as a reference material resulted in excellent between-laboratory rank correlation, even with the large between-laboratory variability in the actual ΔE for each of the 24 fabrics tested. Ranking the fabrics to the arbitrarily chosen reference fabric resulted in a 3% rank error rate. During the discussion, K. Scott pointed out that one of the reasons for the large between-laboratory variability for the ΔE data in the IFAI round-robin was because both air cooled and water cooled xenon arc devices were used by participants. Results from the IFAI round-robin did not indicate which laboratory used which device.

An initial draft of a new Standard Practice for Characterizing Reference Materials Used to Monitor or Control Operating Conditions in an Exposure Test was discussed. Work will concentrate on developing this standard instead of the proposed Standard Guide for Characterizing Reference Materials for Exposure Tests, which considered all uses for reference materials.

As a result of a major reorganization of the G03 Committee, G03.05 was dissolved and made a task group of G03.01, General Methods.

Subcommittee G03.08 Service Life Prediction of Non-Metallic Materials

J.W. Martin, Chair

Terms commonly used in Reliability Analysis were compiled from several sources and listed in a draft standard entitled "Terminology Standard." The document was balloted by G03.08 and several negatives were obtained. The negatives were discussed and the question was raised as to whether ASTM approval of a Terminology Standard should be considered a top priority of G03.08. By vote, G03.08 decided that a terminology standard was not a high priority. The subcommittee felt, however, that a Terminology task group for G03.08 should be established.

Negatives for a draft standard entitled "Statistical Lifetime Distributions: New Standard Practice for Weibull Analysis of Uncensored Data and of Singly Censored Data" were discussed. J. Lechner, the task group chair, will make changes to the draft and resubmit it for subcommittee ballot.

B. Murray agreed to lead a task group that would create a standard describing how to set up and conduct reliability-based experiments.

CDIC—SEPTEMBER

Election of Society Officers

The Society Officers for 1995-96 were announced as follows: President—Jack Avery, of Cintech Industrial Coatings, Inc.; Vice-President—William Jelf, III, of Akzo Nobel Coatings Inc.; Secretary—Teresa Case, of Fibreglass Evercoat Co., Inc.; Treasurer—John Imes, of DuPont; and Society Representative—Bill Hollifield, of Perry & Derrick Co., Inc.

Prior to the committee reports, President Avery stated the Society's primary goal for 1996: to improve the combined efforts and activity of the Educational and Technical committees.

The CDIC Society's Manufacturing Committee sponsored a tour of the Reynolds Metal Co., Ashville, OH.

According to Technical Committee Chair, Ken Pendleton, of K.A. Pendleton, Co., Inc., a meeting was held in Washington, D.C., for Technical Committee Chairs to generate and share ideas for promoting technical activity within the Societies. Mr. Pendleton stated that two future projects have been planned. They include a joint venture with the St. Louis Society to study "The Effects of Varying Stoichiometry on VOC" and a project with the Louisville Society to publish a paper on "Waterborne Coatings for Polypropylene."

Elected Officers of the CDIC Society for the coming year (from left): Treasurer—John Imes; Vice President—William Jelf III; Secretary—Teresa Case; President—John Avery; and Society Representative—William Hollifield

Mr. Avery was presented with an honorary gavel and plaque, compliments of Hüls America Inc. Immediate Past-President, Alan Machek, of Dow Corning, received the Past-President's Pin from Mr. Avery.

Society Representative Bill Hollifield reported on the highlights of the Board of Directors Meeting held in Cancun, Mexico, on May 20. Mr. Hollifield stated that a new Marketing Director has been hired by the Federation. In addition, a change has been made in the Bylaws that increases the Federation's annual dues to $25.

A report on the Ohio Paint Council activities was given by Hugh Lowery, of Perry & Derrick Co., Inc. An advisory committee for lead abatement has proposed a tax on any items containing lead that have been produced in the past 50 years. This is only a draft and a final report is not expected to be issued soon. Mr. Lowery also revealed that acetone has been removed from the federal EPA SARA list since it is no longer considered a volatile organic chemical; however, the State of Ohio has not ruled on this matter yet.

Educational Committee Chair Laura Miller, of Perry & Derrick Co., Inc., reported on the Educational Committee meeting held at FSCT headquarters, in Blue Bell in June. The representatives met to discuss similarities, differences, and possible improvements for their respective educational programs. In addition, while at the meeting, Ms. Miller received a copy of the high school science kit "Presenting Science Through Coatings: A Spectrum of Possibilities."

Ms. Miller suggested that members of the Manufacturing Committee join the group to coordinate a joint venture.

Laura Miller was one of the 1994-95 recipients of the Lew Larson Educational Grant. Ms. Miller attended a course on powder coatings at the University of Southern Mississippi. The second grant was awarded to Jadwiga Wojtowicz, of Akzo Nobel Coatings Inc. She completed a course on experimental design held by the DuPont Co.

Scholarship Committee Chair, Andrew Nogueira, of Hunting Industrial Coatings, announced that the 1995-96 Lew Larson Educational Grant application is available to interested applicants.

It was announced that the Society is seeking a Historian.

Alan Machek reported on the plans for the upcoming "Bosses Night." There will be one bosses night held at each of the meeting cities. Final details will be confirmed at the October meeting.

TERESA CASE, *Secretary*

CDIC—OCTOBER

"Photoreactivity of Titanium Dioxide"

President Jack Avery informed the membership that Don Roettker, of B.H. Roettker Co., Inc., has accepted the position of Society Historian.

Paul Guevin, of P.R. Guevin Associates, introduced the following three proposals for the Society's Bylaws: (1) one reading for new members; (2) reimbursal of social expense for immediate past president and spouse; and (3) clarification that meetings are to be held on the second Monday of each month, unless the Executive Committee determines that an alternate date is more suitable.

Society Representative Bill Hollifield, of Perry & Derrick Co., Inc., stated that he will be attending the FSCT Board of Directors meeting in St. Louis. Some of the topics scheduled to be discussed during the meeting include the completion of the 1996 budget and the second reading of the dues notice proposal.

Hugh Lowrey, of Perry & Derrick Co., Inc., updated the members on recent Ohio Paint Council (OPC) activities.

He reminded members that an advisory committee for lead abatement has been meeting for approximately one year and has proposed a tax on any lead containing items that have been produced in the past 50 years. This issue is still in draft status and has heard some opposition. An upcoming meeting is planned to reconsider options.

In other news, the city of Columbus has adopted a graffitti control ordinance which prohibits the sale of aerosol paint to minors.

The September meeting of the Chicago Society featured Sharon Anderson who spoke on "Laboratory Safety Standard"

A report on the Educational Committee was heard from Chair Laura Miller, of Perry & Derrick Co., Inc. Ms. Miller stated that the Committee is seeking additional members, as well as non-technical speakers for meetings. In addition, the committee is contacting local high schools regarding presentations for career days. In an attempt to increase education of the membership, training on coating related topics is also being considered.

Manufacturing Committee Chair Dave Sellers, of PPG Industries, Inc., announced that there will be a plant tour of Sun Chemical in April 1996.

Mike Diebold, of DuPont, delivered the evening's presentation on "THE PHOTOREACTIVITY OF TITANIUM DIOXIDE."

According to Dr. Diebold, a major consideration when formulating paint is the effect of titanium dioxide pigments on paint durability. Light energy causes the electrons in the atoms of the titanium dioxide molecules to be excited to higher energy molecular orbitals, which affects the durability of the coating. The excited electrons lead to free radicals which can cause the film binder to degrade, leading to chalking and coating breakdown.

The speaker offered two approaches that enable the formulator to enhance the durability of coatings that contain titanium dioxide. One approach is to include a hindered amine light stabilizer (HALS) in the formulation to act as a free radical scavenger. Another option is to use TiO_2 that has been encapsulated with a material, such as hydrated silica or alumina, to act as an insulator to reduce free radical formation.

Dr. Diebold noted that most of the new developments in titanium dioxide pigments have been directed toward improving dispersability and gloss.

TERESA CASE, *Secretary*

CHICAGO—SEPTEMBER

"Laboratory Safety Standard"

The 1995-96 year marks the 75th Anniversary of the Chicago Society. A Year Book will be produced in honor of this special occasion.

The evening's speaker was Sharon Anderson, of Occupational and Safety Health Administration. She discussed the "LABORATORY SAFETY STANDARD."

Ms. Anderson outlined the specific requirements for implementing a chemical hygiene plan (CHP) for laboratories coming under CFR 29-1910.1450 (one employee) and handling subpart Z materials. She also addressed employee training and information, medical consultation and examinations, and recordkeeping.

VICTOR WILLIS, *Publicity*

CHICAGO—OCTOBER

"Improved Test Method for Corrosion"

Charles Simpson, of The Sherwin-Williams Co., spoke on "IMPROVED TEST METHOD FOR CORROSION."

Mr. Simpson outlined the use of a prohesion QUV test chamber featuring a cyclic salt spray in conjunction with UV and condensation cycles. This combination offered the highest correlation with seaside rack exposure—coefficients were on the order of 0.6-0.7 compared to 0.2-0.3 for salt spray alone.

VICTOR WILLIS, *Publicity*

CLEVELAND—SEPTEMBER

"Accelerated Exposure Testing"

Dr. John C. Weaver, longtime Cleveland Society member, was honored for his many years of service to both the Society and Federation.

The Nuodex gavel was presented to Incoming President Michael Wolfe, of Seegott, Inc.

Mr. Wolfe then presented the Past-President's Pin to Constance Williams, of The Lubrizol Corp.

The first speaker of the evening was Ben Carlozzo, of Mameco International, who delivered the Technical Committee's 1995 Annual Meeting presentation, "CORRELATION OF ACCELERATED EXPOSURE TESTING AND EXTERIOR EXPOSURE SITES."

According to Mr. Carlozzo, test panels were placed in nine locations across the United States and were monitored for two years. The objectives of this study were: (1) to investigate weathering differences between different exposure sites; (2) to investigate differences in accelerated test methods; and (3) to determine the existence, if any, of correlations between exterior exposures and the accelerated methods.

Nine different paint systems were applied to the test panels. The salt fog tester, prohesion type cycle, prohesion type cabinet, a combination of cyclic spray chamber and UV/condensation exposure, and Envirotest were used to analyze the systems.

The Technical Committee observed the following during the two-year evaluation:

- statistically significant correlations are present for surface rust and blistering;
- only inverse correlations remain between some exterior exposure sites and some accelerated test methods when evaluated by rust creep;
- site-to-site correlations have begun to vary for rust creep testing;
- correlations between some exterior sites and some methods are probably an artifact due to the limited degree of system to system differences seen at that site, or that method.

The second technical speaker of the evening was Mike Diebold, of DuPont. He discussed "TITANIUM DIOXIDE PHOTOCATALYTIC ACTIVITY."

Dr. Diebold divided his topic into two sections: (1) origin of photocatalytic activ-

In the left photo, incoming President of the Cleveland Society, Michael Wolfe (left), receives the President's Gavel from Hüls representative Dave Kallal. The right photo shows Immediate Past-President Constance Williams accepting a Past-President's Pin from Michael Wolfe.

Incoming Kansas City Society President Lawrence J. Murphy (left) receives the official presidential briefcase from outgoing Society President William Porter.

The September meeting of the Kansas City Society featured speaker Dick Hine of Mooney Chem/OMG, Inc.

ity; and (2) prevention of photocatalytic degradation.

To minimize photocatalytic activity, the speaker proposed the following durability strategies: remove UV light or water; prevent excited titanium dioxide from forming; prevent holes from reacting to form radicals; prevent electrons from reacting to form radicals; and prevent radicals from reacting with binder. Dr. Diebold also suggested the following as ways to enhance durability: protect titanium dioxide from UV light; increase the band gap energy; immobilize electron; immobilize electron hole; trap and recombine electron/electron hole; encapsulate by an insulator; cover an insulator with a monolayer; and cap active sites.

The speaker concluded by stating that photocatalytic degradation can be understood in terms of band structure. Based on this understanding, a number of strategies can be used to decrease photocatalytic activity. Finally, the most practical strategy is to passivate with an insulating oxide. Superdurable grades are made using silica.

James J. Currie, *Secretary*

KANSAS CITY—SEPTEMBER

"What Are Driers?"

Incoming President Lawrence Murphy, of Tnemec Co., Inc., exchanged the gavel and briefcase with Immediate Past-President William Porter, of Hillyard Industries, Inc.

Society Vice President Randall Ehmer, of Walsh & Associates; Secretary, Curry Sanders, of Tnemec Co., Inc.; and Treasurer, Debbie Koss, of Davis Paint were also introduced.

Society Representative, Mark Algaier, of Hillyard Industries, Inc., updated the members on FSCT's Spring Meeting in Cancun, Mexico. Mr. Algaier reported that the Board voted to uphold the Bylaws which state that only active members in the Federation can serve as Society Representatives.

Dick Hine, of Mooney Chem/OMG, Inc., explored the topic "What Are Driers?

Mr. Hine defined the following three types of driers: carboxylic acid, natural acid, and synthetic acids (saturated). He also noted what was used for surface driers, through driers, and auxiliary driers. According to Mr. Hine, rare earth driers and Dri-Rx (accelerator) have become popular in the cure marketplace.

Curry Sanders, *Secretary*

MONTREAL—SEPTEMBER

"Ropaque Polymer— Why Use It?"

President Alain Charbonneau, of Bayer Canada, Inc., presented the Past-President's Pin to Jason Hart, of Stochem Inc.

The meeting's speaker was Jane Bailey, of Rohm & Haas Canada, Inc., who spoke

Birmingham Club Officers for 1995-96 are (seated from left): Secretary—David C. Morris; Social Officer—Brian A. Fowler; President—Bernard E. Myatt; and President-Elect—Joe Brown. Standing (from left): Society Representative—Gerry J. Gough; Bob McD. Barrett; Technical Chair—Roland L. Staples; and Membership Chair—Garnett C. Simmons.

Incoming President of the Montreal Society Alain Carbonneau (left) presents the Past-President's Pin to Jason Hart.

on "Ropaque Polymer—Why Use It?"

According to Ms. Bailey, the rising costs of titanium dioxide has led the paint industry to seek alternatives. The speaker proposed a synthetic pigment comprised of a styrene acrylic polymer shell surrounding a water-filled center void as an alternative. This product can be used as a partial replacement for TiO_2.

Horace Philipp, *Secretary*

PHILADELPHIA—SEPTEMBER

"Reactive Diluents for High-Solids Polyurethane Coatings"

A moment of silence was held in memory of Bob Washburne, of Rohm and Haas Co.

President Howard Salmon, of Akzo Nobel Coatings Inc., received the President's Gavel from Frank Gaffney, of Harry W. Gaffney Co.

Neil Shearer, of The 3E Group, outlined the Technical Committee's schedule for the upcoming year.

Wayne Kraus, of Aqualon Co., reviewed the plans for the Eastern Training Conference slated for May 8-9, 1996, in Valley Forge, PA. The training conference is an introductory course for technical and non-technical personnel designed to help them understand the challenges and opportunities of the coatings industry.

Chicago Society member Michel J. Hourani, of ANGUS Chemical Co., delivered the presentation "Reactive Diluents for High-Solids Polyurethane Coatings."

Dr. Hourani listed the following as properties of a reactive diluent: low viscosity, good solvency, relatively high equivalent weight, balance of pot life/cure response, and good film performance. He also described the types of reactive diluents as low molecular weight polyols, hindered amines, aldamines, ketamines, and oxazolidines, the latter being the focus of his presentation.

Oxazolidines are five-membered ring compounds, which can act as moisture scavengers and UV absorbers, as well as diluents for two-component urethane systems. For example, Zoldine RD-20, a fused bicyclic oxazolidine offers the following benefits at 20 to 30% modification in a pigmented 2K polyurethane system: significant VOC reduction, lower system viscosity, flexible pot life and cure response, improved abrasion and impact resistance, and improved flow and leveling. QUV performance is enhanced; exterior exposure tests are ongoing.

In automotive coatings, modification of up to 70% can lead to a VOC of less than 2.0 lb./gal. All VOCs were measured by EPA Method 24, taking advantage of the 24 hour induction period.

Patricia M. Peterson, *Secretary*

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's West, Woodlawn, MD). Joseph Schilare, The Valspar Corp., 1401 Severn St., Baltimore, MD 21230 .

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). David C. Morris, PPG Industries (UK) Ltd., P.O. Box 359, Rotton Park St., Birmingham, B16 0AD, England.

CDIC (Second Monday—Location alternates between Cincinnati, Columbus, Dayton, and Indianapolis). Theresa Case, Fibreglass Evercoat Co., Inc., 6600 Cornell Rd., Cincinnati, OH 45242.

CHICAGO (First Monday—Sharko's Restaurant, Villa Park, IL). Gerry K. Noren, DSM-Desotech, Inc., 1122 St. Charles St., Elgin, IL 60120.

CLEVELAND (Third Tuesday—Monthly meeting site TBA). James Currie, Jamestown Paint Co., 108 Main St., Jamestown, PA 16134.

DALLAS (Second Thursday following first Wednesday—Dallas Medallion Hotel, Dallas, TX). Mike Templin, Hilton-Davis Co., 1696 Dickerson Dr., Arlington, TX.

DETROIT (Second Tuesday—meeting sites vary). Ray Stewart, Akzo Nobel Coatings, Inc., 1845 Maxwell St., P.O. Box 7062, Troy, MI 48007-7062.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). Don Mazzone, Dowd & Guild, Inc., 14 Crow Canyon Ct., #200, San Ramon, CA 94583.

HOUSTON (Second Wednesday—Medallion Hotel, Houston, TX). Ken Mundy, Ribelin Sales, Inc., 7786 Blankenship Dr., Houston, TX 77055.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). Curry Sanders, Tnemec Co., Inc., 123 N. 23rd Ave., N. Kansas City, MO 64116.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, Commerce, CA). Arthur W. Lorenz, Sinclair-Ameritone Paint Corp., 6100 S. Garfield Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). Paul Baukema, Akzo Nobel Coatings, Inc., R&D Div., 4730 Crittenden Dr., P.O. Box 37230, Louisville, KY 40233.

MEXICO (Every fifteen days—Gabriel Mancera, Mexico City, Mexico). Sergio Rojas, Pinturas International, S.A. De C.V., Ganaderos 234, Col. Granjas Esmeralda, 09810 Mexico, D.F., Mexico.

MONTREAL (First Wednesday— Restaurant Le Bifthèque, St. Laurent, Quebec). Robert Benoit, KRONOS Canada Inc., 3390 Marie Victorin, Varennes, Que., J3X 1T4 Canada.

NEW ENGLAND (Third Thursday—Best Western TLC, Waltham, MA). Richard Twomey, Kronos, Inc., 68 Fisher St., Medway, MA 02053-2004.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). Robert W. Schroeder, Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304.

NORTHWESTERN (Tuesday following first Monday—Jax Cafe, Minneapolis, MN). Michael D. Coad, McWhorter Technologies, 1028 S. Third St., Minneapolis, MN 55415.

PACIFIC NORTHWEST (Portland Section—Tuesday before third Wednesday—Tony Roma's, Mall 205, Portland, OR; Seattle Section—Third Wednesday—Wyndham Gardes Hotel, Sea-Tac, WA; Vancouver Section—Thursday after third Wednesday—Abercorn Inn, Richmond, B.C.). Kenneth Wenzel, Chemical Distributors, Inc., P.O. Box 10763, Portland, OR 97210.

PHILADELPHIA (Second Thursday—DoubleTree Guest Suites, Plymouth Meeting, PA). Patricia M. Peterson, ARCO Chemical Co., 3801 West Chester Pike, Newtown Square, PA 19073-3230.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). Alex Blahnik, Chemcraft Sadolin, Inc., P.O. Box 669, Walkertown, NC 27051.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). James Giammarco, Lockhart Chemical Co., 2873 W. Hardies Rd., Gibsonia, PA 15044.

ROCKY MOUNTAIN (Monday following first Wednesday—Monthly meeting site TBA). John Elverum, Hauser Chemical Research, 5555 Airport Blvd., Boulder, CO 80301.

ST. LOUIS (Third Tuesday—The Salad Bowl Restaurant, St. Louis, MO). Robert Phelps, P.D. George Co., P.O. Box 66756, St. Louis, MO 63166.

SOUTHERN (Gulf Coast Section—third Thursday; Central Florida Section—third Thursday after first Monday; Atlanta Section—third Thursday; Memphis Section—bi-monthly on second Tuesday; and Miami Section—Tuesday prior to Central Florida Section). Eve De La Vega-Irvine, J.M. Huber Corp., One Huber Rd., Macon, GA 31298.

TORONTO (Second Monday—Speranza Restaurant & Banquet Hall Convention Centre, Brampton, Ont., Canada). Mike Molnar, CIBA Pigments, P.O. Box 2000, Mississauga, Ont., L5M 5N3 Canada.

WESTERN NEW YORK—Marko Markoff, 182 Farmingdale Rd., Cheektowaga, NY 14225.

New FSCT Members

CDIC

Active

Hancock, Ronald L.— Egyptian Lacquer Mfg. Co., Lafayette, IN.
Richardson, Robert A.—Egyptian Lacquer Mfg. Co., Lafayette.
Shah, Arun D.—Egyptian Lacquer Mfg. Co., Lafayette.

Associate

Johansen, Dana S.—Lawter International, West Chester, OH.
Panozzo, Andrew J.—Hilton-Davis Co., Cincinnati, OH.
Smith, Stephanie J.—Rohm and Haas Co., Canal Winchester, OH.

CHICAGO

Active

Boje, Gwen J.—McWhorter Technologies, Carpentersville, IL.
Brown, Kent A.—Cookson Pigments Inc., Oswego, IL.
Bussjaeger, Steve L.—H.I.S. Paint Mfg., Oklahoma City, OK.
Cogar, Jennifer L.—McWhorter Technologies, Carpentersville.
Cole, Barbara J.—Halox Pigments, Hammond, IN.
Faci, Hocine—Finishes Unlimited, Sugar Grove, IL.
Fleckstelner, Richard J.—McWhorter Technologies, Carpentersville.
Gardner, Gary W.—The Sherwin-Williams Co., Chicago, IL.
Getts, Susan A.—The Testor Corp., Rockford, IL.
Giaudrone, Charles T.—Union Carbide Corp., Alsip, IL.
Gockley, Barbara J.—The Dexter Corp., Waukegan, IL.
Gooday, Christine C.—Union Carbide Corp., Alsip.
Johnson, Bruce A.—EPS, Inc., Marengo, IL.
Kollenberg, Tim W.—Polar Minerals, Chicago, IL.
Labuda, Helen—The Sherwin-Williams Co., Chicago.
Li, Rosita T.—The Testor Corp., Rockford.
Mueller, Jim—McWhorter Technologies, Carpentersville.
Osterman, Richard D.—Rust-Oleum Corp., Pleasant Prairie, WI.
Owen, Dianne G.—Ashland Chemical Co., Countryside, IL.
Patel, Ken—Mautz Paint Co., Madison, WI.
Pagor, Dave J.—CB Mills, Buffalo Grove, IL.
Pease, Joseph P.—Halox Pigments, Hammond.
Peterson, Philip E.—Halox Pigments, Hammond.
Rex, Raymond C.—Halox Pigments, Hammond.
Rich, Art F.—Tru-Test Mfg. Co., Cary, IL.
Roberts, James A. Jr.—Chem-Serv of Illinois, Chicago.
Simpson, Susan A.—Chemcept Services, Batavia, IL.
Walter, Mark C.—McWhorter Technologies, Carpentersville.
Wentworth, Gary—The C.P. Hall Co., Bedford Park, IL.

Associate

Banks, Jack A.—Hickson Specialties, Inc., Milwaukee, WI.
Bishop, Bill—Sacco Mid-States Inc., Forest Park, IL.
Clinger, Robert W.—Neville Chemical Co., Northfield, IL.
Dugan, Michael T.—Tab Chemicals, Inc., Chicago, IL.
Freeman, Heather C.—Creative Art Products, Knoxville, IL.
Graczyk, Thomas Z.—Dietzgen Corp., Des Plaines, IL.
Konie, Ralph—Tab Chemicals Inc., Chicago.
Leen, Brian E.—Sun Chemical Corp., Des Plaines.
Lighthart, Lane S.—Luzenac America Inc., Galena, IL.
Longfield, Sandy H.—Morton International, Lansing, IL.
Lozanoski, Paul—Fitz Chem Corp., Elmhurst, IL.
McDaniel, Sandra L.—Sacco Mid-States Inc., Forest Park.
Papousek, Ted J.—Sacco Mid-States Inc., Forest Park.
Richmond, Dale L.—Air Products & Chemicals, Inc., Batavia, IL.
Whiting, Thomas E.—G.R. O'Shea Co., Itasca, IL.

CLEVELAND

Active

Brady, Deborah J.—Sprayon Products, Bedford Heights, OH.
Brothers, Roland M.—Sentco Paint Mfg., Youngstown, OH.
Dreshar, Janice K.—The Sherwin-Williams Co., Cleveland, OH.
Hsu, Helena S.—The Sherwin-Williams Co., Cleveland.
Jewett, Theresa A.—The Sherwin-Williams Co., Cleveland.
Kimbler, Charles L.—The Sherwin-Williams Co., Cleveland.
Meyers, Joseph A.—The Sherwin-Williams Co., Cleveland.
Milos, Jerry A.—Coatings Research Group, Inc., Cleveland.
Profitt, Laura M.—Sprayon Products, Bedford Heights.
Waters, Deborah, J.—Sprayon Products, Bedford Heights.
Wolf, Joseph J.—X-I-M Products Inc., Westlake, OH.

Associate

Beaudry, Paul S.—Etna Products Inc., Chagrin Falls, OH.
Miller, James A.—J. Miller & Associates, Silver Lake, OH.
Murphy, Paul—Seegott Inc., Fairview Park, OH.
Riley, Michael E.—The Georgia Marble Co., Kennesaw, GA.
Salas, Mark S.—Nacan Products Ltd., Lakewood, OH.
Saltzman, Barry M.—ISP, Solon, OH.
Sanders, L. Dean—Rohm Tech Inc., North Canton, OH.

Educator/Student

Alessandro, Steven J.—Parma, OH.
Wisniewski, Scott B.—Cleveland State University, Eastlake, OH.

DETROIT

Active

Aldridge, Toni Kay—BASF Corp., Whitehouse, OH.
Benish, Mary M.—Chrysler Corp., Auburn Hills, MI.
Blaszczyk, Michelle L.—BASF Corp., Southfield, MI.
Davis, Thomas E.—Visuron Technologies, Bay City, MI.
Dickerson, Mary D.—BASF Corp., Southfield.
Gardner, Kent—Finish Technologies, Walled Lake, MI.
Izirein, Ehi A.—Seibert-Oxidermo Inc., Romulus, MI.
Kia, Sheila F.—General Motors Corp., Warren, MI.
Kramer, Kirk J.—Ziebart International Corp., Redford, MI.
McKulka, Frank E.—BASF Corp., Troy, MI.
Reinhard, Donald L.—GE Plastics, Southfield.
Setty, Yenkateshkumar—BASF Corp., Southfield.
Suss, Naomi R.—PPG Industries, Inc., Troy.
Szczepanik, Michael P.—Ebonex Corp., Melvindale, MI.
Williamson, Lawrence A.—Morton International, Rochester Hills, MI.
Yu-Hallada, Lorraine—BASF Corp., Southfield.

For more information on how to become a member of the Federation of Societies for Coatings Technology, contact Tori Graves or Marie Wikiera at FSCT Headquarters — call 610-940-0777 or fax 610-940-0292!

Associate

Bohn, Paul F.—Fausone, Taylor & Bohn, Northville, MI.
Brandt, Chris J.—Fusion Systems Corp., Brighton, MI.
Cyranski, Michael T.—Boehle Chemicals Inc., Southfield, MI.
Fried, Leslie A.—Herberts Color Research & Development, Plymouth, MI.
Hirsch, Marc S.—Dow Chemical Co., Midland, MI.
Liedtke, Greg J.—Baker and Collinson, Detroit, MI.

LOS ANGELES

Active

Barnes, James R.—Behr Process Corp., Santa Ana, CA.
Beach, Bill—Day-Glo Color Corp., Cudahy, CA.
Chen, Andy—Deft, Inc., Irvine, CA.
Chu, Richard—Deft, Inc., Irvine.
Corbin, Daniel L.—Dancor, Inc., Irvine.
Coulter, Kenneth W.—Old Quaker Paint Co., Victorville, CA.
Crick, Denese R.—W.L.S. Coatings, Inc., Los Angeles, CA.
Franusiak, Walter J.—Sinclair Paint Co., Commerce, CA.
Garrett, Thomas M.—MCP Industries Inc., Corona, CA.
Ivanilova, Olga T.—Dunn-Edwards Corp., Los Angeles.
Kim, Hubert H.—A&H Enterprise, Torrance, CA.
Lim, Juliette—Deft, Inc., Irvine.
Mallgrave, Fred J.—Formulabs, Inc., Escondido, CA.
Montferrand, Mario—Ace Hardware, Paint Div., El Paso, TX.
Montoya, Rolando M.—Day-Glo Color Corp., Cudahy, CA.
Ornelas, Rachel—Dunn-Edwards Corp., Los Angeles.
Osen, Lambert—Advance Finishes, Inc., Wilmington, CA.
Perez, Jorge—Sinclair Paint Co., Commerce.
Smiland, Bob M.—Conco Paint Co., Commerce.
Smith, Michael—Deft, Inc., Irvine.
Tarng, Ming-Ren—Dunn-Edwards Corp., Los Angeles.
Thompson, Carl V.—Stabond Corp., Gardena, CA.
Uwnauich, Steve L.—Continental Coatings, Inc., Fontana, CA.
Vilbar, Nerissa L.—Dunn-Edwards Corp., Los Angeles.

Associate

Anderson, Vincent P.—E.F. Whitmore & Co., Claremont, CA.
Berger, Mark—McWhorter Technologies, Lynwood, CA.
Calka, G. Suzanne—Tavco Chemicals Inc., Laguna Hills, CA.
Donoho, Bruce—Wm. Barr & Co., Inc., Mission Viego, CA.
Emami, Mehrdad—McWhorter Technologies, Lynwood.
Fitzpatrick, Jay K.—E.T. Horn Co., La Mirado, CA.
Gardiner, Alan—McWhorter Technologies, Lynwood.
Hagge, Don R.—Peninsula Polymers, Inc., Alisio Viejo, CA.
Hodges, Lance L.—Eco Paint Co., Tustin, CA.
Kohn, Eva M.—Zeneca Inc., Los Angeles, CA.
Lopez, Eddie—Sinclair Paint Co., Los Angeles.
Loundy, Donald J.—Rohm Tech Inc., Carlsbad, CA.
Perkins, Bradley C.—The C.P. Hall Co., Torrance, CA.
Richardson, Bobby N.—Union Carbide Corp., Torrance.
Stevens, John M.—Synergistic Performance Corp., Fullerton, CA.
Stoner, Robert—McWhorter Technologies, Lynwood.
Tangen, Danny L.—Dorsett & Jackson, Los Angeles.
Thompson, Jacalyn L.—Rohm and Haas Co., North Olmsted, OH.
Willenbrink, Joseph L. III—West EnviroNomics, Venice, CA.
Zhang, Jack Yongfeng—Applied P & Ch Lab., Chino, CA.

Educator/Student

Benitez, Vince O.—Altawood Inc., Upland, CA.
Berghouse, Joshua—Altawood Inc., Upland.
Bet-Pera, Fred—Cal Poly University, Pomona, CA.
Porrero, Christie M.—Altawood Inc., Upland.

LOUISVILLE

Active

Kaczmarski, James P.—GE Plastics, Mt. Vernon, IN.
Moya, Jose A.—Devoe & Raynolds Co., Inc., Louisville, KY.
Zepka, David J.—Michelman, Inc., Cincinnati, OH.

Associate

Arkedis, George J.—Etna Products Inc., Chagrin Falls, OH.
Brooks, Michael K.—BFGoodrich Co., Parma, OH.
Merman, Jeffery M.—Automotive Controls Co., Louisville, KY.
Remissong, Jon W.—Color Corp., Louisville.

NEW ENGLAND

Active

Boghossian, Razmik—Bostik Inc., Middleton, MA.
Gulla, Ernest S.—Mace Corp., Dudley, MA.
Lutz, Mitchell E.—Titleist & Foot-Joy Worldwide, Fairhaven, MA.
Repetti, Ronald V.—Cuno, Inc., Meriden, CT.
Simmons, Warren J.—Soluol Chemical Co., West Warwick, RI.
Taylor, Dene H.—Rexam Graphics, South Hadley, MA.
West, Peter—Lepage's Inc., Gloucester, MA.
Williams, James R.—Polyonics, Inc., Westmoreland, NH.

Associate

Murphy, George J.—Netzsch Inc., Exton, PA.
Olmstead, Hugh D.—Intertech Corp., Portland, ME.
Penney, Debbie M.—The Truesdale Co., Brighton, MA.

NORTHWESTERN

Active

Buenzle, Thomas M.—Frost Paint & Oil Corp., Minneapolis, MN.
Chiarelli, Phyllis R.—The Valspar Corp., Minneapolis.
Crowley, Shirvalen R.—The Valspar Corp., Minneapolis.
Davies, John M.—McWhorter Technologies, Minneapolis.
Gustafson, Mike S.—The Valspar Corp., Minneapolis.
Hamilton, Lynette S.—Diamond Vogel Paints, Marshalltown, IA.
Kappenman, David P.—McWhorter Technologies, Minneapolis.
O'Callaghan, Kevin J.—McWhorter Technologies, Minneapolis.
Schwan, Joseph F.—McWhorter Technologies, Minneapolis.
Soleim, James C.—The Valspar Corp., Minneapolis.
Theis, Brenda J.—Loes Enterprises Inc., St. Paul, MN.

Associate

Ficke, James K.—Eagle-Picher Minerals, Champlin, MN.
King, Gina M.—Worum Chemical Co., St. Paul, MN.
Kirby, Tim—Dow Chemical Corp., Lakeville, MN.
Korte, Steven L.—Frost Paint & Oil Corp., Minneapolis, MN.
O'Hagan, Curtis H.—Dow Chemical Corp., Lakeville.
Richmond, Dale L.—Air Products & Chemical Co., Batavia, IL.
Torborg, Chuck J.—H.B. Fuller Co., Oakdale, MN.

PIEDMONT

Active

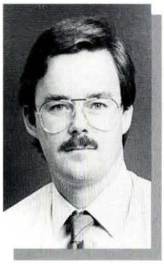
Galbraith, Albert D.—Hudson, NC.
Simmons, Raymond II—Union Carbide Corp., Cary, NC.
Slusher, Thomas E.—BFGoodrich Co., Moore, SC.
Waters, Gary L.—Premium Coatings, Inc., Conover, NC.

SOUTHERN

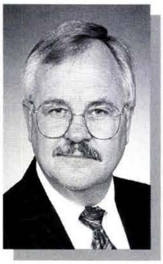
Active

Daniel, L. Michael—Pave-Mark Corp., Atlanta, GA.
Williams, Maury—DMC-Calhoun, Calhoun, GA.
Thyer, Marlin R.—Ingels Paint, Inc., Jonesboro, AR.

People in the News



M. Holt



G.E. Bilek

Mark Holt has been named Director of Technical Services and Development for Velsicol Chemical Corp., Rosemont, IL. The New York Society member will be responsible for planning, implementing, and managing technical service and development programs for the company's products.

The company has also appointed **Glenn E. Bilek** as Marketing Manager for adhesives, sealants, and coatings plasticizers. In his new position, Mr. Bilek will develop and implement marketing strategies for the company's plasticizers business.

William Miller has joined the sales staff of Spraylat Corp., Mt. Vernon, NY. Based in Chicago, IL, Mr. Miller will direct the sales, marketing, and new product development in all areas of sign coatings. He brings over 15 years of sales and marketing experience in the chemical coatings industry to the position.

SCM Chemicals, Baltimore, MD, has announced the appointment of **Donald C. Abbott** as Senior Vice-President and Chief Operating Officer. He will be charged with providing direction and guidance to the company's three regional TiO_2 business units of the Americas, Europe, and Asia/Pacific.

The National Board of Registration of Nuclear Safety Related Coating Engineers and Specialists, Leola, PA, has certified **Michael Crapps** as a Nuclear Coating Specialist. Mr. Crapps is Quality Assurance Manager for Underwater Engineering Services Inc., Port St. Lucie, FL.

Tony L. White has been elected Chairman, President, and Chief Executive Officer of The Perkin-Elmer Corp., Norwalk, CT. He was formerly Executive Vice President of Baxter International, Inc.

Marco Lubrano has become Director, Customer Service for Rotomec America, Inc., West Hartford, CT. Mr. Lubrano has been with the company for 16 years.

Frederick W. Gebarowski has joined the International Society for Measurement and Control, Research Triangle Park, NC, as Director, Marketing and International Development. He will be responsible for developing, integrating, and implementing the marketing plans of the society's business units into organization-wide strategies for both the domestic and international marketplace.

Ropak Corp., Fullerton, CA, has named **David A. Williams** Chairman and Chief Executive Officer and **James R. Connell** President. The two succeed **William H. Roper** and **Robert E. Roper** who, with **C. Richard Roper**, established the company in 1978.

Estron Chemical, Inc., Parsippany, NJ, has added Cleveland Society member **Charles David Green** to its management staff as Technical Director. Dr. Green will supervise the company's additives and resins development program.

Hüls America Inc., Piscataway, NJ, has appointed **J. Roger Taylor** as Business Manager, Europe. He will take charge of activities aimed at expanding the company's colorants business in Europe.

Michele J. Hooper has been elected to the Board of Directors of PPG Industries, Pittsburgh, PA. Ms. Hooper is Vice-President of Caremark International, Northbrook, IL, and President of its International Business Group.

Michael R. Sestrick has been added to the staff of Grace Davison, Baltimore, MD, as Technical Service Manager for coatings for the silicas/adsorbents line. In his new role, Mr. Sestrick will support marketing and sales efforts for the company's silica and absorbent products.

Margaret Welsh has joined Ribelin Sales, Garland, TX, as a Technical Sales Representative. Her territory includes Central and South Florida.

M. Welsh

Ronald J. Bazar has been elected to the position of Vice President, Sales, Formulator Chemicals Division of Buckman Laboratories, Memphis, TN. In this capacity, Mr. Bazar will assume the overall responsibility for the operations of the division and associated market support functions.

David S. Parisi has joined ICI Surfactants Household Business, Wilmington, DE, as Account Manager. Located in Lincolnwood, IL, his sales territory covers the Southeastern region of the United States.

Columbiana Boiler Co., Columbiana, OH, and Anderson Columbiana Trading, McKinney, TX, jointly announce the hiring of **Aris Antoniou** as Vice President to both of these companies. His responsibilities lie in the areas of product engineering, regulatory compliance, and client support.

The Inter-Society Color Council, Fairport, NY, has announced its new directors. Elected to three-year terms are: **Mark Fairchild**, Rochester Institute of Technology, Rochester, NY; and **Wade Thompson**, Southwest Missouri State University, Springfield, MO.

The membership recruitment and retention activities of The Society of the Plastics Industry, Inc., Washington, D.C., are being managed through a new department headed by **Jerry Taylor**. Mr. Taylor was promoted from Director/Membership Marketing to Vice President/Membership.

Dymax Corp., Torrington, CT has hired **Mark Blitshteyn** as Vice President, Equipment. His duties include general management of the equipment group, including design, marketing, and sales.

The company has also appointed **Janice van Deusen** Corporate Controller. In addition to the Controller's responsibilities, Ms. van Deusen will have a leadership role in future planning.

Witco Corp., Greenwich, CT, has hired **Drew J. Talley** as Director of Insurance and Risk Management. He will manage all aspects of the company's insurance and risk exposure as well as policy negotiations, claims, and relationships with insurance brokers and carriers.

Books/ Publications

Problem Solving

A reference book covers 42 common interior and exterior painting problems, including adhesion, application, and discoloration. Each situation is illustrated with color photographs and text explaining its causes and how it can be corrected or avoided. The National Decorating Products Association's *Paint Problem Solver* has added four new topics since the last edition: painting over aniline stains, algae, touch-up at different temperatures, and painting over areas where wallcoverings have been removed.

Circle No. 30 on Reader Service Card

Craftsman's Manual

The *Painting and Decorating Craftsman's Manual and Textbook* has been revised. This 300-page illustrated reference book for the painting and decorating industry covers such topics as history, coatings materials, equipment, rigging, safety, color, wallcoverings, application techniques, surface preparation, and coatings failures/remedies. This text is available from the Painting and Decorating Contractors of America.

Circle No. 31 on Reader Service Card

Lead Studies

ASTM offers a volume presenting current, wide-ranging data on the effects of exposure to lead from paint, soil, and dust. Featured are results of health effects studies, environmental assessments, control and intervention studies, analytical methods development, and evaluation and quality assurance program development. *STP 1226/Lead in Paint, Soil and Dust: Health Risks, Exposure Studies, Control Measures, Measurement Methods, and Quality Assurance* includes 28 comprehensive peer-reviewed papers.

Circle No. 32 on Reader Service Card

Personal Safety

A new catalog features safety products for the chemical environment. Included in the guide are eyewear, face masks, respirators (SCBA/PAPR), chemical resistant gloves and clothing, NFPA certified responder suits, confined space entry products, warning signs, gas detectors, monitors and chemical analyzers, waste disposal and storage containers, spill control, emergency showers, safe lighting, and safety training products. Copies of the 52-page guide are obtainable from Direct Safety Co.

Circle No. 33 on Reader Service Card

New Technology

A publication entitled "New Technology Products in Surface Coatings W. Europe 1994-2004" is available from Irfab Chemical Consultants. Analyzing recent technologies and different market segments of major West European countries, the study is intended for an audience of paint manufacturers and raw material suppliers. The multi-client study is based on more than 500 personal interviews.

Circle No. 34 on Reader Service Card

Bioremediation

Eleven new books on bioremediation are available from Battelle Press. The first 10 books collectively contain more than 380 peer-reviewed articles contributed by scientists, engineers, and bioremediation practitioners representing an international variety of public and private sector organizations. The 11th book contains cumulative indices for these 10 books as well as others.

Circle No. 35 on Reader Service Card

Air Quality

A report is intended to help managers understand and address air quality problems in the industrial workplace. Published by Aercology Inc., the eight-page report attempts to aid in understanding governmental standards for allowable levels of air pollutants and what to do about them. Topics covered include occupational exposure limits for various pollutants generated by welding operations, lead dust and fumes from soldering operations, and current/proposed oil mist regulations when using fume extraction equipment.

Circle No. 36 on Reader Service Card

Customer Fulfillment

A pamphlet details Hercules Inc.'s customer fulfillment process. The publication outlines the goals and functions of this program, designed to address the information needs of customers. Functions of this process are listed, including customer questions, order entry, sample and literature requests, and managing warehouse inventory.

Circle No. 37 on Reader Service Card

Color Quality

X-Rite, Inc. has released "By the Numbers: The Return on Investment Advantages of Color Quality and Control." This book is designed to help estimate the return on investment possible through the use of color measurement and control technology. The publication details how waste due to bad or inconsistent color can be avoided through proper application of color measurement technology.

Circle No. 38 on Reader Service Card

Raw Materials

Pearlescent Pigment

A pearl paste dispersion, 48% pearlescent pigment powder dispersed in a typical offset vehicle, has been developed specifically for offset printing inks. Mearlin® Litho-Brite™ Pearl 3100/SET reportedly eliminates the problem of piling, resulting in improved ink transfer between rollers and offset plates as well as facilitated cleanup. Another reported feature of this Mearl Corp. product is reduced pigment settling.

Circle No. 39 on Reader Service Card

New Pigment Shades

Five new shades are introduced by Cerdec Drakenfeld's Mixed Metal Oxide Division for use in industrial paints and coatings, plastics, flexible and rigid polyvinylchloride, and polyolefins. Yellow 10410 is a reddish, clean shade yellow; yellow 10411 is a greenish, clean shade yellow; brown 10421 is a high strength brown; black 10430 is a red/yellow shade black; and black 10466 is a reddish black pigment.

Circle No. 40 on Reader Service Card

Antifoam Emulsion

Wacker Silicones Corp. has added antifoam emulsion SE 27 to its line of foam control agents. The water-dilutable, chemically stable product is designed to help prevent and control foam buildup over a pH range in industrial and agricultural aqueous foaming systems. The emulsion features a 10% active ingredient for lasting foam control and rapid foam knockdown.

Circle No. 41 on Reader Service Card

Methacrylate Monomer

A new monomer reportedly enables acrylic emulsions to bond to old, difficult-to-remove alkyd surfaces. Rohm Tech Inc.'s Rohamere® 6844-0 is a methacrylate monomer formulated to promote wet adhesion. The product is also recommended for bonding latex emulsions to untreated wood surfaces.

Circle No. 42 on Reader Service Card

Flatting Agent

A flatting agent intended for use in waterborne finishes that require an extremely fine particle size distribution is available. Syloid® W 300 has an average particle size from 5.3 to 6.3 microns to provide surface smoothness for waterborne finishes. The Grace Davison product reportedly can be post-added with no product loss or waste.

Circle No. 43 on Reader Service Card

Hydrocarbon Resins

Hercules Resins Division has made Regalite® hydrogenated hydrocarbon resins available in the United States. Previously exclusive to the European market, these resins are designed for tackifying applications such as ethylene-vinyl acetate and polyolefin copolymers. They are compatible with SIS, SEBS, and SEPS block copolymers, as well as with polyisoprene, polyethylene, amorphous poly(alpha-olefins), and microcrystalline waxes and naphthenic and mineral oils.

Circle No. 44 on Reader Service Card

Brown Dispersions

Two synthetic Van Dyke brown in-plant dispersions for wood stains are highlighted. G-P-D® 824-1615 and Aquasperse II® 877-1615 colorants are designed to evenly enhance wood grain without hiding it. The Hüls America Inc. dispersions are designed for agglomeration elimination, a Hegman grind of six minimum, and shelf stability.

Circle No. 45 on Reader Service Card

MDI Variants

Specialty MDI variants for high-performance coatings, adhesives, sealants, and encapsulants are highlighted. These products are engineered for low viscosity, light color, low-temperature storage stability, crosslinking capabilities, controlled reactivity, and enhanced chemical and solvent resistance. Information on these products is available from ICI Polyurethanes.

Circle No. 46 on Reader Service Card

Software

Fatigue Testing

Instron Corp. highlights a fatigue testing program designed for servohydraulic users who require block loading and complex fatigue sequences. WaveMaker, part of the Windows®-based FastTrack® software family, is commonly used for high and low cycle fatigue, creep fatigue, service simulation, and product durability. A simple graphical technique is utilized for designing tests.

Circle No. 47 on Reader Service Card

Color Analysis

Windows®-based color quality control software from Minolta Corp., Instrument Systems Division provides color plots, spectral graphs, and pass/fail assessments using simple or elliptical tolerancing in CMC DE. With WinShades, the user can display color difference data for multiple trials or can evaluate metamerism by looking at color coordinates under three illuminants simultaneously.

Circle No. 48 on Reader Service Card

Miscellaneous

Manufacturing Video

Cellular Manufacturing in a Global Marketplace is a five-part video package providing an overview of manufacturing cells. Produced by the Society of Manufacturing Engineers, the video is accompanied by a 52-page booklet presenting views of experts and experiences of people whose companies are using cells successfully.

Circle No. 49 on Reader Service Card

Can Crusher

The CanDoo! PCC1 paint can crusher pierces one-gallon paint cans and squeezes them empty by EPA definition. Features of this TeeMark Corp. product include a 10-second operating cycle and typical compaction ratios of 15 to 1. The explosion-proof unit can be powered by shop air or a 115/230V electric motor.

Circle No. 50 on Reader Service Card

IBC Washer

Recycle Inc. has announced a new automated intermediate bulk container washing system. The system is designed to increase the efficiency of its IBC/Tote cleaning operation, minimize wastewater generation, and reduce turnaround times for IBC reuse customers. Personalized container cleaning programs can be created for each customer through the computerization of the washing system.

Circle No. 51 on Reader Service Card

Drum/Pail Liners

New England Plastics Corp. introduces a full line of drum liners, pail inserts, dust caps, and cover sheets that are thermoformed from FDA-approved polyethylene. Featuring a product selection guide, the ValuLiner® line includes 55- and 30-gallon drum liners in various styles, constructions, and wall thicknesses; five-gallon pail inserts; elasticized dust caps; and cover sheets.

Circle No. 52 on Reader Service Card

Pail Inserts

CDF Corp. offers custom-made steel and plastic pail inserts. The liners are engineered to reduce container cleaning, reconditioning, and replacement costs, and are 15 mil thick using FDA-approved LDPE or HDPE. The line includes tapered and taller inserts for plastic pails, as well as the traditional straight-sided liners for steel pails.

Circle No. 53 on Reader Service Card

Bonding Agent

A new polymer from Rohm Tech Inc. reportedly provides strong adhesive bonding of heat transferable film to a variety of substrate materials. PM709/P28 butyl methyl methacrylate polymer is the key ingredient that enables metal foils to be applied to such substrates as leather, paper, fabrics, plastics, and textiles. Applications include applying foil films to books, toys, fabrics, and cups.

Circle No. 54 on Reader Service Card

Bag Filters

Hayward Industrial Products, Inc. offers one-piece, glass-reinforced polypropylene bag filter bodies, rated to 225 psi. Reportedly providing filtration down to five microns, these vessels are designed for chemical resistance. The nonmetallic bag filters, which feature simplified bag changeout, are available in single- and double-length sizes, with both styles including an integrally molded support flange.

Circle No. 55 on Reader Service Card

Dust Collection

Filtered bag/drum dump work stations feature a dust collection system which draws dusts away from the operator. After filtering out the dust particles from the air by an exhaust blower, the dust is dropped back into the hopper for product recovery. Meyer's work stations are suitable for such applications as calcium carbonate, carbon black, starch, titanium dioxide, and pigments.

Circle No. 56 on Reader Service Card

Paints/Coatings

Powder Coatings

Vitralon® powder coatings are highlighted by Pratt & Lambert Industrial Coatings. Available coating types include epoxies, polyesters, polyurethanes, and hybrids. A brochure, including 60 color chips replicating standard colors and a performance characteristics table, is available.

Circle No. 57 on Reader Service Card

Moisture Cure

A line of single-component, moisture curing urethanes is available in primers, intermediate, and topcoats. These Sherwin-Williams, Industrial and Marine Coatings products can be applied in cold, damp weather conditions, with application down to 20°F and at relative humidities up to 99%. All of the Corothane I products are VOC compliant.

Circle No. 58 on Reader Service Card

Equipment

Used Equipment

The Western Equipment Co. has Kewaunee lab furniture and work benches available in many configurations which are designed for laboratory use. They are almond-colored with black chemical-resistant tops.

Circle No. 59 on Reader Service Card

Laboratory Apparatus

Viscometer

The new PVT-230 portable process viscometer measures and controls viscosity and pH of fluids. The Brookfield instrument can operate in stand-alone mode with an optional viscosity readout built into its head.

Circle No. 60 on Reader Service Card

NMR Spectrometer

Varian Associates, Inc. has introduced UNITY*INOVA*, a research NMR spectrometer which is designed for improved data acquisition by incorporating digital technology into a real-time advanced computer subsystem. The system comprises a Motorola 68040-based computer and VxWorks™, a real-time operating system; 500 kHz spectral width digital filtering; 16 Mbyte standard data memory; and pulse sequence control.

Circle No. 61 on Reader Service Card

Balances

The T and XT series are toploading, multi-functional, single or dual range balances available from Thomas Scientific. The ceramic load cell technology reportedly provides linearity and reproducibility of results. Features include metal housings, LED displays, and RS232 interfaces.

Circle No. 62 on Reader Service Card

Gloss Meter

The Model 811A automatic gloss meter is designed to measure the gloss of paints, coatings, and materials. The system uses up to 240,000 data points across the measured area to provide readings. The Tricor Systems Inc. instrument reportedly measures gloss regardless of a surface's shape, texture, or color.

Circle No. 63 on Reader Service Card

Coating Thickness

Fast, accurate, and nondestructive thickness measurement of thin coatings on nonferrous substrates is reportedly possible with the Fischer TM85 Test Station System. The new apparatus can be used on the production line, and is engineered to provide such measurements as inside and outside diameters of cylindrical objects without indenting the coating or substrate.

Circle No. 64 on Reader Service Card

Testing Equipment

Accelerated Weathering

Atlas Electric Devices Co. highlights the S3000 Xenon Weather-Ometer®, designed to be compact and economical. This equipment features the 4500W water-cooled xenon arc lamp coupled with a built-in light monitor for manual irradiance control. Interchangeable lamp filters permit tailoring of the xenon spectrum for simulating end-use conditions, such as sunlight through window glass or direct sunlight.

Circle No. 65 on Reader Service Card

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Act of August 12, 1970: Section 3685, Title 39, United States Code)

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1. Sales Through Dealers and Carriers, Street Vendors and Counter Sales	0	0
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1. Office Use, Left Over, Unaccounted, Spoiled After Printing	1,140	1,122
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G. Total	10,387	10,225

I certify that the statements made by me are correct and complete. (signed) Patricia D. Viola, Editor

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.

1996

(May 3-5)—FSCT Spring Week. Held in conjunction with the Pacific Northwest Society's Annual Spring Symposium. Seminar on the 3rd and 4th. Incoming Society Officers Meeting on the 4th. Board of Directors Meeting on the 5th. Doubletree Suites Hotel, Seattle, WA.

(Aug. 15-17)—Pan-American Coatings Expo. Co-sponsored by Federation of Societies for Coatings Technology, ANAFAPYT, and Instituto Mexicano de Téchnicos en Pinturas y Tintas. Sheraton Maria Isabel Hotel, Mexico City, Mexico.

(Oct. 23-25)—International Coatings Conference and Expo (Formerly Annual Meeting and Paint Industries' Show). McCormick Place North, Chicago, IL.

1997

(Nov. 5-7)—International Coatings Conference and Expo (Formerly Annual Meeting and Paint Industries' Show). Georgia World Congress Center, Atlanta, GA.

SPECIAL SOCIETY MEETINGS

1996

(Feb. 14-16)—23rd Annual Waterborne, High-Solids, and Powder Coatings Symposium. Sponsored by the Southern Society and The University of Southern Mississippi (USM). New Orleans, LA. (Robson F. Storey or Shelby Thames, Co-Organizers, WBHS&PC Symposium, Dept. of Polymer Science, USM, P.O. Box 10076, Hattiesburg, MS 39406-0076).

(Mar. 20-22)—Southwestern Paint Convention. Sponsored by Houston and Dallas Societies. Del Lago Resort, Houston, TX. (Thomas Fitzgerald, Monarch Paint Co., P.O. Box 55604, Houston, TX 77255; (713) 462-5313).

(May 8-9)—Eastern Training Conference and Show. Sponsored by the Philadelphia Society for Coatings Technology. Valley Forge Convention Center, Valley Forge, PA. (Wayne Kraus, Hercules Incorporated, Research Center, 500 Hercules Rd., Wilmington, DE 19808; (302) 995-3435. Booth reservations: Sam Firestone, S.E. Firestone Associates, Inc., 101 Surrey Rd., Melrose Park, PA 19207-2931).

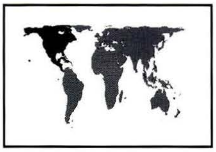
(May 8-10)—Southern Society Annual Meeting. Hyatt Regency-West Shore, Tampa, FL. (Walter R. Naughton Jr., Scott Paint Corp., P.O. Box 10218, Sarasota, FL 34278-0218; (813) 371-0015).

(June 14-15)—Joint Meeting of the St. Louis and Kansas City Societies. Holiday Inn, Lake of the Ozarks, MO. (Randall Ehmer, Walsh & Associates, Inc., 500 Railroad Ave., N. Kansas City, MO 64116; (816) 842-3014).

1997

(Feb. 18-20)—Western Coatings Societies' 23rd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Disneyland Hotel and Convention Center, Anaheim, CA. (Bruce Cotton, Pluess-Staufer (California), Inc., P.O. Box 825, Lucerne Valley, CA 92356; (619) 248-7306; or Ron Elliott, J.R. Elliott Enterprises, Inc., 300 Thor Pl., Brea, CA 92621; (714) 529-0711).

OTHER ORGANIZATIONS



1995—North America

(Dec. 5-6)—"Fundamentals of Color." Course sponsored by Macbeth®, Division of Kollmorgen Instruments Corp. The Regal Constellation Hotel, Etobicoke, Ont. (Wanda F. Smith, Macbeth, 405 Little Britain Rd., New Windsor, NY 12553-6148).

(Dec. 6-8)—"Iron Oxides in Colorant and Chemical Applications." Conference sponsored by Intertech Corp. JW Marriott Hotel, Houston, TX. (Melanie Briggs, Intertech Corp., 411 U.S. Route One, Portland, ME 04105).

(Dec. 12-13)—"Fundamentals of Color." Course sponsored by Macbeth®, Division of Kollmorgen Instruments Corp. MGM Grand Hotel Casino & Theme Park, Las Vegas, NV. (Wanda F. Smith, Macbeth, 405 Little Britain Rd., New Windsor, NY 12553-6148).

(Dec. 12-13)—"Thermal Analysis Method Development Course." Sponsored by The Perkin-Elmer Corp. Norwalk, CT. (Customer Training Administrator, The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0200).

(Dec. 12-16)—Fourth Pacific Polymer Conference. Sponsored by the American Chemical Society, Division of Polymer Chemistry. Hyatt Regency Kauai Resort and Spa, Koloa, Kauai, HI. (ACS, Meetings Dept., 1155 16th St., N.W., Washington, D.C. 20036-4899).

1996—North America

(Jan. 14-17)—1996 RCMA Annual Conference. Sponsored by the Roof Coatings Manufacturers Association (RCMA). Westin Caesar Park Cancun Beach & Golf Resort, Cancun, Mexico. (Joe Hobson, RCMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Jan. 23-24)—ASTM Symposium on Durability Testing of Nonmetallic Materials. Sponsored by the American Society for Testing and Materials. Crown Sterling Suites, Fort Lauderdale, FL. (Robert J. Herling, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(Jan. 23-24)—"Science and Technology of Pigment Dispersion." Vitznau (Luzern), Switzerland. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12651).

(Feb. 2-4)—"Spring Decor '96." Sponsored by the National Decorating Products Association (NDPA). The Opryland Hotel, Nashville, TN. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Feb. 5-7)— SPI Composites Institute's 51st Annual Conference and Exhibition. Cincinnati Convention Center, Cincinnati, OH. (Peggy Stabach, SPI Composites Institute, 355 Lexington Ave., New York, NY 10017).

(Feb. 6-8)—"Color Pigments 1996: Trade, Technology, and Regulation in the Americas." Sponsored by the Color Pigments Manufacturers Association, Inc. (CPMA). Mexico City. (CPMA, P.O. Box 20839, Alexandria, VA 22320-1839).

(Feb. 15-16)—"Coatings Application Training Seminar." Sponsored by Madison Chemical Industries Inc. Milton, Ont. (Madison Chemical Industries Inc., 490 McGeachie Dr., Milton, Ont. L9T 3Y5).

(Feb. 24-26)—"Interiors Decor Showcase '96." Sponsored by the National Decorating Products Association (NDPA). Toronto Congress Center, Toronto, Ontario. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Mar. 4-6)—"Toughening of Polymers." Sponsored by The American Chemical Society: Division of Polymeric Materials: Science and Engineering. Hilton Head, SC. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

(Mar. 11-13)—Ninth Annual Industrial Lead Paint Abatement and Removal Conference. Sponsored by Steel Structures Painting Council (SSPC). Pittsburgh Hilton and Towers, Pittsburgh, PA. (Dee Boyle, SSPC, 40 24th St., Pittsburgh, PA 15222).

(Mar. 11-15)—27th Annual Spring Program in Polymers. Sponsored by the Institute of Materials Science. The Grosvenor Resort Hotel-Disney World Village, Lake Buena Vista, FL. (Angelos V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Mar. 20-22)—"Electrocoat '96." Conference sponsored by *Products Finishing*. Clarion Plaza Hotel, Orlando, FL. (Cindy Goodridge, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

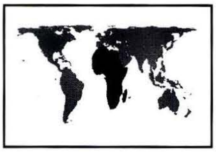
(Apr. 13-14)—"Eastern Education & Trade Fair." Sponsored by the National Decorating Products Association (NDPA). Sturbridge Host Hotel, Sturbridge, MA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Apr. 28-May 1)—American Oil Chemists' Society (AOCS) Meeting. Indiana Convention Center and RCA Dome, Indianapolis, IN. (AOCS Education/Meetings Dept., P.O. Box 3489, Champaign, IL 61826-3489).

(Apr. 28-May 2)—Radtech North America. Exhibition and Conference sponsored by RadTech International North America. Nashville, TN. (Christine Dionne, RadTech International North America, 60 Revere Dr., Ste. 500, Northbrook, IL 60062).

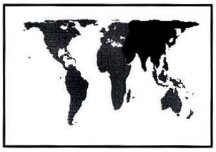
(May 1-2)—"Paint Volatile Organic Compounds (VOC)." Training course sponsored by the American Society for Testing and Materials (ASTM). Cleveland, OH. (Tina Falkenstein, ASTM, 1916 Race St., Philadelphia, PA 19103).

1996—Africa



(Mar. 25-29)—"Coatings for Africa '96." Sponsored by Oil & Colour Chemist's Association (OCCA). Cape Town Civic Centre, Cape Town, South Africa. (Chris Pacey-Day, SURFEX Ltd., Priory House, 967 Harrow Rd., Wembley HA0 2SF, England).

1996—Asia

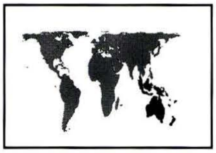


(Mar. 12-13)—Middle East Coatings Show. Exhibition and conference sponsored by FMJ International. Dubai, United Arab Emirates. (Mike Tarrant, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS).

(May 28-31)—China Coat. Exhibition sponsored by Sinostar International Ltd. Guangzhou, China. (Sinostar International Ltd., 1001 Shiu Lam Bldg., 23 Luard Rd., Wanchai, Hong Kong).

(June 5-6)—Asia-Pacific Coatings Show. Exhibition and conference sponsored by FMJ International. Hong Kong. (Mike Tarrant, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS).

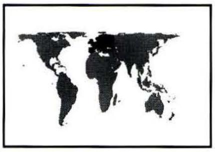
1996—Australia



(Jan. 18-25)—International Schools and Conference on X-ray Analytical Methods—AXAA '96. Sponsored by the Australian X-ray Analytical Association (AXAA), Inc. Sydney, Australia. (The Secretariat, AXAA '96, GPO Box 128, Sydney, NSW 2001, Australia).

(Aug. 11-16)—Third International Hydrocolloids Conference. Cosponsored by the CSIRO and the Cooperative Research Centre for Industrial Plant Biopolymers. Landmark Park Royal Hotel, Potts Point, Sydney, Australia. (Gail Hawke, Third International Hydrocolloids Conference, P.O. Box N399, Grosvenor Place, Sydney, NSW 2000, Australia).

1995—Europe



(Dec. 13-15)—"Speciality Plastics '95." Sponsored by Maack Business Services. Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

1996—Europe

(Jan. 29-31)—"Silicones in Coatings." Sponsored by The Paint Research Association (PRA). Hotel Palace, Brussels, Belgium. (Dip Dasgupta, PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

(Mar. 18-22)—"Globec '96." Sponsored by Maack Business Services. Davos, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(June 3-5)—"Styrenics '96." Sponsored by Maack Business Services. Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(June 10-14)—FATIPEC. Conference sponsored by the Belgian Association of Coatings Technicians. Brussels, Belgium. (Michael Kuhn, Vincentz Verlag, Postfach 6247, 30062 Hannover, Germany).

(June 11-13)—European Coatings Show '96. Exhibition and conference sponsored by Vincentz Verlag. Brussels, Belgium. (Michael Kuhn, Vincentz Verlag, Postfach 6247, 30062 Hannover, Germany).

(June 10-13)—"Science and Technology of Pigment Dispersion." Vitznau (Luzern), Switzerland. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

(June 17-19)—18th International Conference in Stabilization and Controlled Degradation of Polymers. Luzern, Switzerland. (Angelos V. Patsis, Director, Institute for Materials Science, State University of New York, New Paltz, NY 12561).

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Humbug from Hillman

Early last summer, my good friend Saul Spindel, ever on the alert for amusing material to feed the Humbug mill, kindly sent me a copy of Roger Axtell's new book, *Do's and Taboos of Using English Around the World*, published by John Wiley & Sons. Axtell uses stories, mostly highly amusing, to illustrate "advice for dealing with everything from brand names to boardrooms to bathrooms around the world" . . . a delightful way to prepare the first-time international traveler for what lies abroad. Here is just a sampling:

In a chapter to "demonstrate that American English can often take common sense and kick it around like an empty can on a deserted street," Axtell gives several examples:

—A child praying: Our father who art in Heaven, Howard be thy name.

—Former President Ford: If Lincoln were alive today, he'd roll over in his grave. - - - - And: Things are more like they are now than they have ever been before.

—Toronto Maple Leaf Coach Frank Smith: I have nothing to say and I'm only going to say it once.

—Then there is the oft told story of the man who approached a public bathroom and was greeted with the sign: "Toilet out of order. Please use the floor below." So he did.

The following statements have been culled from the hallowed halls of state legislatures around the country.

—I smell a rat and intend to nip it in the bud.
—If it weren't for the Rural Electric Association, we farmers would be watching television by candlelight.
—Let's not beat a dead horse to death.
—There comes a time to put principles aside and do what's right.
—It's time to swallow the bullet.
—This body is becoming too laxative about some matters.

One stereotype of English is that to make something quaint and veddy British, one need only add an 'e' to a word. For example, Ye Olde Antique Shoppe. Even though 'foode' is not one of these, there are several differences in the food category worth noting.

Let's start with 'bubble and squeak.' In truth this is just another word for casserole. It originates from the English custom of having a proper midday meal each Sunday, where the main meal is usually a 'joint,' meaning a roast or joint of meat, such as lamb. Then the leftover meat plus the leftover vegetables and potatoes can be saved and mixed for the Monday meal. When heated in the oven, as the various juices and flavors fuse together, this mixture issues little bubbles and squeaks.

An American business man, addressing a Chinese audience, mentioned in his opening remarks that he was ". . . tickled to death to be in China." After his interpreter converted his words, there was a murmur from the audience. It seems his interpreter had explained, "The American gentlemen says he scratched himself until he died in order to be here."

From a brochure of a car rental firm in Tokyo: When passenger of foot have in sight, tootle the horn. Trumpet him melodiously at first, but if he still obstacles your passage then tootle him with vigor.

A Houston businessman tells of one occasion when he and an American associate were visiting oil-drilling customers in Saudi Arabia. The Houstonian's associate was experiencing digestive problems, and, during the meetings and later at dinner, frequently excused himself, asking "Where is the little boy's room?" Toward the end of the evening, during one of these absences, the Saudi host turned to the Houstonian and gently inquired, "Am I to take it that your friend likes little boys?"

To appreciate what Spanish-speaking people (and others) go through when trying to learn the mysteries of pronunciation of American English, consider this little ditty:

Beware of heard, a dreadful word
That looks like beard but sounds like bird.
And dead: it's said like bed, not bead,
For goodness sake don't call it deed.
Watch out for meat and great and threat
(They rhyme with suite and straight and debt).
A moth is not a moth as in mother
Nor both in bother, nor broth in brother,
And here is not a match for there
Nor dear and fear, for bear and pear.

* * *

Had a very pleasant letter from Russ Licciardello in which he included this report: "At a recent Philadelphia Society 75th Anniversary dinner our, Master of Ceremonies, Dick Kiefer, gave a most wonderful and entertaining "reflections speech." It allowed old and young alike to look back on the many developments of the organization and industry.

It is difficult to say how or in what context he was referring, but a new word ready for the next edition of Webster's dictionary was born. He somehow referred to a MANTINI in his discussion. The only definition that can be given in his defense is that he was referring to a combination MANhattan and a marTINI."

And a great time was had by all!!! Well, I guess you had to be there.

* * *

People think all I have to do is to stand up and tell a few jokes. Well, that's not as easy as it looks. Every year it gets to be more of an effort to stand up. —George Burns

—Herb Hillman, Humbug's Nest,
P.O. Box 135, Whitingham, VT 05361.