jct JOURNAL OF COATINGS TECHNOLOGY

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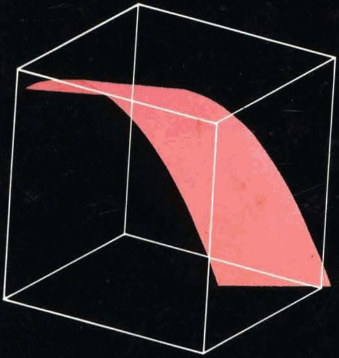
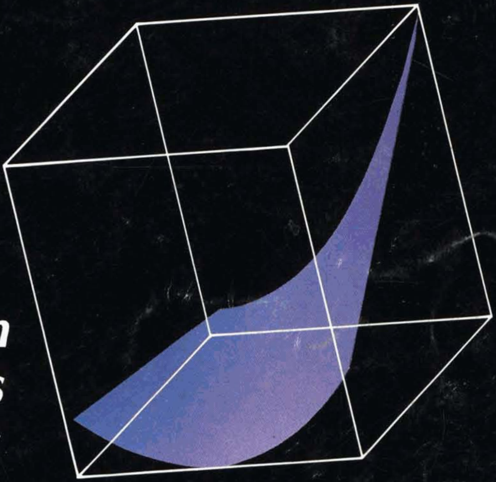
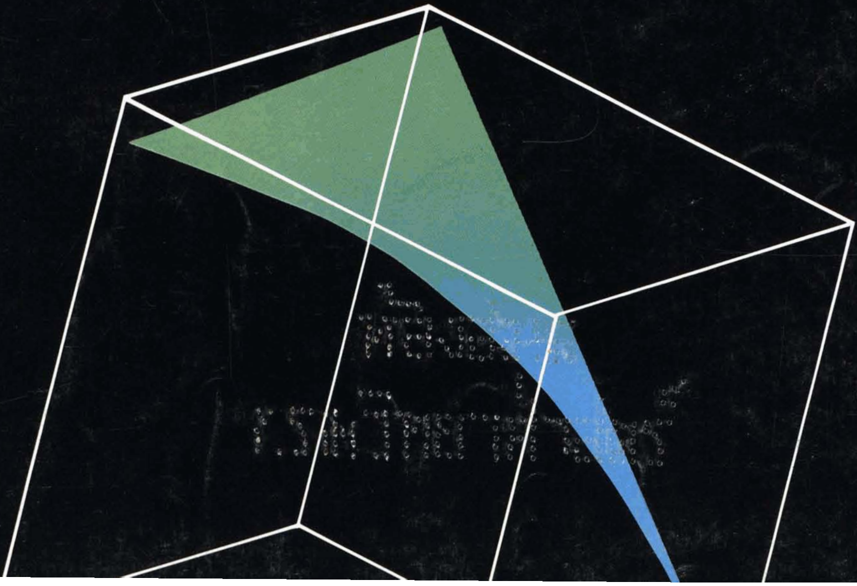




Coatings Characterization Using Multiple Techniques and Statistically Designed Experiments



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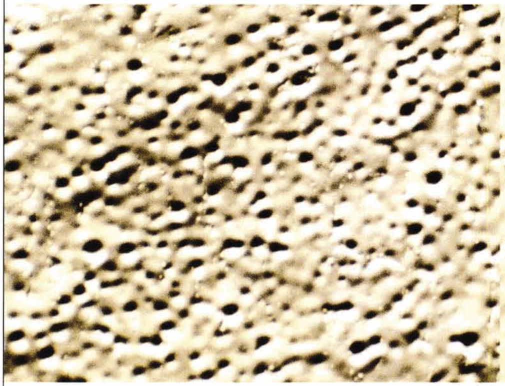

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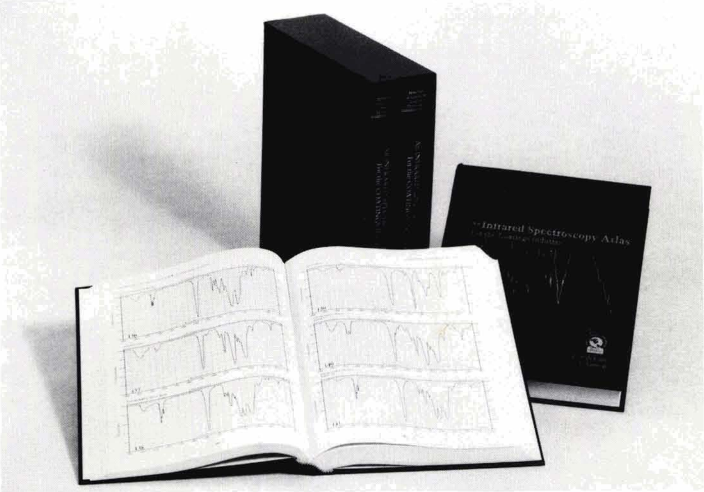

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JOURNAL OF COATINGS TECHNOLOGY

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 All manuscripts will be assumed to be previously unpublished writing of the authors, not under consideration for publication elsewhere.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

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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 the Editor at the address listed previously.

...for Roon Foundation Award Competition

Ten complete copies of the manuscript are required, and should be submitted to the Chairman of the 1994 Roon Awards Committee, N. Bradford Brakke, Lilly Industries, Inc., 521 W. McCarthy St., Indianapolis, IN 46225. (For complete details, see "Roon Awards" section of the JOURNAL in the January 1994 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 8¹/2 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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Comment

What's the Big Idea?

Disturbed by reports of an arsonist tormenting his grandfather's neighborhood, my son arrived at a simple solution. *"I'm going to invent a special paint that we can spray on homes. It will turn into a protective shield to keep out all the bad stuff—even fires!"*

Now, it may take him quite a while to achieve this goal—force field technology isn't part of the second-grade curriculum yet. However, he is starting with the fundamental ingredient needed for all inventions—an idea.

On a more sophisticated (and realistic) level, ideas that are used to create technologies, produce new materials, and promote innovative procedures are the central focus of the FSCT. A mission of the Federation—to disseminate information that contributes to the advancement of its members in general and the industry as a whole—is the driving force of this organization.

While this is evident in its publication of technical literature, bringing new ideas to the forefront of the coatings industry is most significantly achieved through the FSCT's "main event"—the Annual Meeting & Paint Industries' Show. This event not only features the largest exhibition of materials, equipment, and services related to the manufacture of paints and coatings, it also provides technical programming designed to help attendees respond to the problems facing their industry.

The theme of the 1994 convention is "Excellence Through Innovation," and presenters from the most progressive and dynamic coatings companies will provide information on developing new competitive technologies for the future. Ideas . . . Innovations . . . Solutions—the Federation event may provide your company with the key to unlocking the challenges of the 1990s and beyond.

Details of the 1994 Annual Meeting & Paint Industries' Show, to be held in New Orleans on October 12-14, are highlighted on pages 19-26 of this issue. Why not make plans today to attend this premier event of the coatings industry. It's an idea you won't regret!

(In the meantime, if you hear about the development of a "paint shield" please let me know!)

Patricia D. Viola

Patricia D. Viola
Editor

Abstracts of Papers in This Issue

(Translations provided by: French—Montreal Society Member Alain Brisson, of Hoechst Canada, Inc. and Spanish—Mexico Society Member Cesar Fuentes Carrasco, of Instituto Mexicano de Tecnicos en Pinturas y Tintas.)

Coatings Characterization Using Multiple Techniques and Statistically Designed Experiments—M. Neag, P. Wilson, and G. Skerl

JCT, 66, No. 832, 27 (May 1994)

This research centered on discovering individual relationships between formulation variables and the coating's performance. Variations in properties related to changes in catalyst, crosslinker, pigment, and an additive were studied using controlled stress rheometry, dynamic mechanical analysis, and tensile tests. A statistical design combining the elements of both a screening design and a response surface design significantly reduced experimental time, while fulfilling a broad array of experimental objectives. Among other things, this work revealed that the coatings were incompletely cured under typical bake conditions, the catalyst had the strongest influence on properties, and pigmentation reduced the performance properties. The results of this work led to significant improvements in the products performance and cost.

Mechanical Stability of Alkyd Emulsions—Part 1: Influence of Emulsion Droplet Size and the Emulsifier—G. Östberg, B. Bergenståhl, and M. Huldén

JCT, 66, No. 832, 37 (May 1994)

The limited colloidal stability of alkyd emulsions compared to that of organic solventborne alkyd paints is a well-known problem. For environmental reasons, however, the alkyd emulsions have a great advantage since they are waterborne. In this study, the influence of emulsifier and initial droplet size on the mechanical stability of alkyd emulsions was investigated. Anionic emulsifiers have been shown previously to be more effective than nonionic emulsifiers in the formation of alkyd emulsions. This study showed that an anionic emulsifier also gave more stable emulsions at lower concentrations than did the nonionics. If the concentration was increased, emulsions stabilized with a nonionic emulsifier showed the same stability as the one with the anionic emulsifiers. However, too high a concentration of surfactants is undesirable in paints, since it increases the water sensitivity of the paint film. The mechanical stability of anionically stabilized emulsions was less sensitive to the initial droplet size than emulsions stabilized with a nonionic emulsifier.

Caractérisation des Revêtements Avec L'Utilisation de Techniques Multiples et de Designs Expérimentaux Statistiques—M. Neag, P. Wilson, et G. Skerl

JCT, 66, No. 832, 27 (May 1994)

Cette étude est centreé sur la découverte de relations individuelles entre les variables de formulations et la performance des revêtements. Les variations dans les propriétés reliées aux changements de catalyseur, d'agent réticulant, de pigment et d'additifs ont été étudiées avec l'aide de la rhéométrie avec contrôle du stress, l'Analyse Mécanique Dynamique et les Tests de Tensions. Un design statistique combinant les éléments de la combinaison d'un design filtré et un design de surface de réponse a considérablement réduit le temps d'expérmentation en plus de permettre une large gamme d'expérimentations objectives. Entre autre, ce travail a révélé que les revêtements ont été sous-réticulés lors de conditions de cuisson typiques. Le catalyseur a le plus influencé les propriétés et la pigmentation a réduit les performances. Le résultat de ce travail a démontré des améliorations significatives dans la performance et le coût des produits.

Stabilité Mécanique des Emulsions Alkydes. Partie 1: Influence de la Taille de la Gouttelette et de L'Emulsifiant—G. Östberg, B. Bergentståhl et M. Huldén

JCT, 66, No. 832, 37 (May 1994)

La stabilité colloidale limitée des émulsions alkydes comparativement aux revêtements alkydes á base de solvants est un problème bien connu. Par contre, pour des raisons reliées au domaine de l'environnement, ils ont un avantage marqué puisqu 'ils sont à base d'eau. Dans cette étude, nous avons étudié l'influence de l'émulsifiant et de la taille initiale de la gouttelette sur la stabilité mécanique des émulsions alkydes. Par la passé, les émulsifiants anioniques ont démontré être plus efficaces que les émulsifiants non-ioniques lors de la formation des émulsions alkydes. Ici, nous avons trouvé que l'émulsifiant anionique a également procuré une plus grande stabilité de l'émulsion à basse concentration que les émulsifiants non-ioniques. Les émulsions stabilisées avec un émulsifiant non-ionique ont démontré la même stabilité que celle obtenue avec les émulsifiants anioniques si la concentration était augmentée. Par contre, une trop forte concentration des surfactants

Caracterizacion de Recubrimientos Usando Experimentos de Tecnicas Multiples y Diseños Estadisticos—M. Neag, P. Wilson, and G. Skerl

JCT, 66, No. 832, 27 (May 1994)

Esta investigación esta centrada en descubrir las relaciones individuales entre las variables de formulación y el desarrollo del recubrimiento. Las variaciones en las propiedades fueron relacionadas a los cambios en catálisis, entrecruzamiento, pigmentación y un aditivo que fueron estudiados usando reometría controlada, un análisis mecánico-dinámico además de pruebas de tensión. Un diseño estadístico combinado con los elementos de diseño de tamizado y un diseño de superficie de respuesta redujeron significativamente el tiempo experimental. Entre otras cosas, este trabajo revelóque el recubrimiento fue incompletamente curado bajo condiciones tipicas de horneo, la catálisis tuvo la influencia mas fuerte en las propiedades, y la pigmentación reduce las propiedades de desarrollo. El resultado de este trabajo conduce a significantes mejoras en el desarrollo de los productos y costo.

Estabilidad Mecanica de Emulsiones Alquidalicas. Parte 1: Influencia del Tamaño de la Gota de Emulsion y el Emulsificador—G.Östberg, B. Bergenståhl, and M. Huldén

JCT, 66, No. 832, 37 (May 1994)

El líminte de la estabilidad coloidal de emulsiones alquidálicas comparada a la de pinturas alquidálicas base solvente orgánico es un problema muy conocido. Por razones ambientales, sin embargo, estas han tenido grandes ventajas desde que son base aque. En este estudio, se ha investigado la influencia de emulsificadores y el tamaño inicial de la gota de entrada en la estabilidad mecánica de emulsiones alquidalicas. Emulsificadores aniónicos han sido previamente mostrados para ser mas efectivos que los emulsificadores nonionicos en la formación de emulsiones alquidálicas. Aquí se ha encontrado que el emulsificador anionico también da emulsiones más estables a bajas concentraciones que los que dieron los nonionicos. Emulsiones estabilizadas con un emulsificador no-nionico mostró la misma estabilidad que la de los emulsificadores aniónicos cunado se incremento la concentración. Una alta concentración de surfactantes es indeseable en pinturas, sin embargo, estó incrementó la sensibilidad al

Rheologically Effective Organic Pigments—E.E. Jaffe et al.

JCT, 66, No. 832, 47 (May 1994)

Environmental considerations have stimulated research in organic pigment surface modification as well as polymeric dispersant application to lower the viscosities of modern high-solids pigment dispersions. The approach involves adsorption of specific substituted pigment derivatives (anchors) onto the pigment surface to maximize interaction with selected polymeric dispersants. More effective anchors have been found which further lower the viscosities of high-solids solvent-based paint systems.

The Dynamic Contact Angle—A Characteristic to Predict the Lifetime of a Wood Topcoat—G. Hora

JCT, 66, No. 832, 55 (May 1994)

Documentation of changes in liquid water protection is of utmost importance for the characterization of the durability of an exterior wood coating. The use of the water uptake coefficient, w_t, and the dynamics of a liquid water drop contact angle, ϑ, for the determination of lifetime expectation is described. Both methods are found to give equivalent information regarding changes in water protection of six mainly waterborne unweathered and six-month weathered exterior wood coatings. The advantages of the contact angle method are outlined. Furthermore, a theoretical approach is presented to relate the observed proportionality of the contact angle with square root of time to diffusion controlled processes on the coatings surface.

est non recommandée dans un revêtement puisqu'elle augmente la sensibilité à l'eau des feuils. La stabilité mécanique des émulsions stabilisées anioniquement a été moins sensible à la taille initiale de la gouttelette, comparativement aux émulsions stabilisées avec un émulsifiant non-ionique.

Pigments Organiques Rhéologiquement Efficaces—E.E. Jaffe et al.

JCT, 66, No. 832, 47 (May 1994)

Les considérations expérimentales ont stimulé la recherche pour la modification de la surface de pigments organiques et de l'application de dispersants polymériques afin de diminuer la viscosité de préparations pigmentaires à haute teneur en matières solides. L'approche implique une adsorption de dérivés spécifiques (ancres) sur la surface des pigments afin de maximiser l'interaction avec les dispersants polymériques. Des ancres plus efficaces ont été trouvés, lesquellés ont diminué les viscosités de revêtements à base de solvants et possédant une haute teneur en matières solides.

L'angle de Contact Dynamique—Une Caractéristique Pour Prédire la Durée de Vie D'une Couche de Surface Pour le Bois—G. Hora

JCT, 66, No. 832, 55 (May 1994)

La documentation des changements de la protection contre l'eau est d'une grande importance pour la caractérisation de la durabilité d'un revêtement de bois pour l'extérieur. L'utilisation du coefficient d'absorption d'eau w_t et la dynamique de l'angle de contact d'une goutte d'eau pour la détermination de l'espérence de vie est décrite. Les deux méthodes ont démontré donner une information équivalente pour les changements de la protection contre l'eau de six revêtements aqueux extérieurs non-traités pour le bois, et de six revêtements pré-exposés pour une période de six mois. Les avantages de la méthode de l'angle de contact sont soulignées. De plus, une approche théorique est présentée pour relier de proportionnalité de l'angle de contact avec le racine carrée du temps pour les procédés de diffusion sur la surface des revêtements.

agua de la película de pintura. La estabilidad mecánica de emulsiones estabilizadas aniónicamente fue menos sensitiva al tamaño inicial de la gota comparadas con emulsiones estabilizadas con un emulsificandet no-nionico.

Pigmentos Organicos Reologicamente Efectivos—E.E. Jaffe et al.

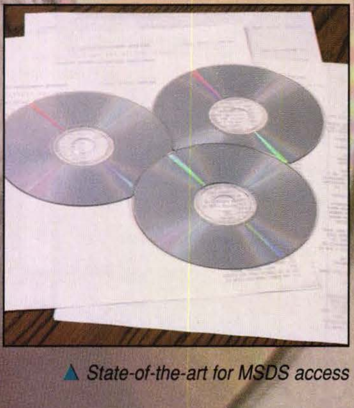
JCT, 66, No. 832, 47 (May 1994)

Consideraciones ambientales han estimulado investigaciones en la modificación de superficie de pigmentos orgánicos también como la aplicación de dispersantes poliméricos para disminuir las viscosidades de modernas dispersiones de pigmentos de altos sólidos. Este acercaiento involucra la adsorción de derivados especificos de pigmentos substituidos (fijadores) en la superficie del pigmento para maximizar la interacción con los dispersantes poliméricos seleccionados. Han sido encontrados fijadores mas efectivos los cuales además bajan las viscosidades de sistemas de pintura base solvente de altos sólidos.

El Angulo del Contacto Dinamico—Una Caracteristica Para Predecir El Tiempo de Vida de un Recubrimiento Terminal Para Madera—G. Hora

JCT, 66, No. 832, 55 (May 1994)

La documentación de los cambios en la protección contra agua es de los mas importante para la caracterización de la durabilidad de un recubrimiento exterior para madera. Se describe el uso del coeficiente de agua W_t y la dinámica del angúla de contacto de una gota de agua liquida para la determinación de la expectación del tiempo de vida. Ambos metodos dan información equivalente relativa a los cambios en la protección contra agua de seis recubrimientos para madera base agua sin poner a la intemperie y seis recubrimientos para madera de exteriores puestos a la intemperie mensualmente. Se deliunean las ventajas del método de ángulo de contacto. Además, un acercamiento teórico es presentado para relacionar la proporcionalidad observada del ángulo de contacto con la raíz cuadrada del proceso controlado del tiempo de difusión en la superficie de recubrimientos.



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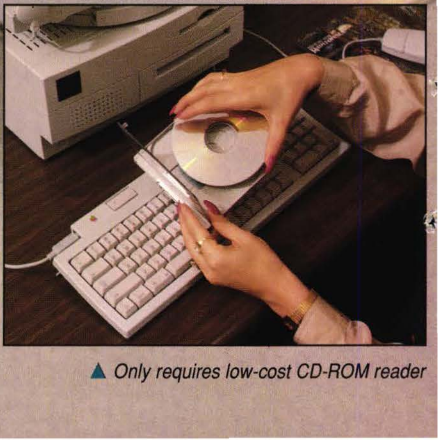

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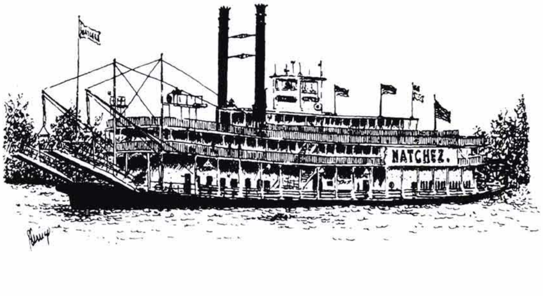

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Government and Industry

Construction Contracts Rebound Four Percent in February

The F.W. Dodge Division of McGraw-Hill, New York, NY, reported a four percent climb in new construction projects in February. Although the housing sector experienced further erosion from the heightened volume reported at the end of 1993, a moderate gain for nonresidential building combined with a surge of public works and utilities to produce the latest month's advance.

February's data lifted the seasonally adjusted Dodge Index to 107 (1987=100), up from January's 103 and marked the first increase since last October when the Index reached 110, its most recent peak.

Nonresidential construction gained five percent in February, due mostly to an increase by the institutional structure types from their generally lackluster performance of recent months. School construction reported improvement from January's subdued volume, while healthcare building moved upward in regaining its mid-1993 strength. Public administration buildings and detention facilities also contributed with their highest amount in over a year. On the commercial/industrial side, stores came through with a robust February, offices held steady, but manufacturing plants and hotels fell sharply from the previous month.

Nonbuilding construction in February jumped 30%, with substantial gains shown by both the public works sector and utilities. Public works construction bounced back 17% from a weak January, as highways and bridges matched their stronger totals of the previous year.

Utility construction, which often reflects the impact of very large projects, benefited from the inclusion of several large power plant starts, including a $275 million project in Virginia and a $250 million project in California.

Residential construction fell six percent in February. The value of single family starts showed moderate slippage for the second straight month as the harsh winter weather continued to have a lingering impact. Meanwhile, multifamily housing retreated from its January upturn in a sign that the modest strengthening of recent months will be sporadic at best.

On an unadjusted basis, total construction contract value during the first two months of 1994 was up five percent over the same period a year ago. Regionally, the West led the nation with a 23% advance, followed by 15% improvement in the Midwest. The South Central and South Atlantic regions were close to the national average with respective gains of six and four percent. The Northeast, posting a 29% decline during the first two months of 1994, still lagged far behind the performance of the other regions.

Chemcentral Opens Philadelphia Facility

Chemcentral Corp., Bedford Park, IL, has opened its new facility located in Fairless Hills (Philadelphia), PA. The facility contains 3,500 square feet of office space, and a warehouse (including temperature controlled storage) and a storage dock totaling 54,000 square feet.

The facility also includes a tank farm consisting of 400,000 gallons of aboveground storage capacity and two metered blending tanks.

A covered tank truck loading/unloading station with spill prevention control and countermeasure area can accommodate three bulk units for loading and unloading purposes. The site also contains a rail siding serviced by Conrail/Philadelphia Railroad.

Union Carbide Increases Capacity at Seadrift, TX Plant

Union Carbide Corp., Danbury, CT, recently completed an 80 million-pound-per-year expansion of butyl glycol ethers capacity at its Seadrift, TX, plant. The increase, a culmination of a series of technological and process improvements, brings the yearly output capability of the butyl glycol ethers unit to 240 million pounds.

The butyls are products in the company's glycol ethers line and are sold under the Butyl Carbitol Solvent and Butyl Cellosolve Solvent trademarks. They are used as solvents in paints, coatings, printing inks, and heavy duty cleaning products, and function as intermediates in a variety of chemical applications.

Grace Enters Marketing Agreement for New Biopesticide; Dedicates First Sealants Production Plant in Indonesia

The biopesticides group of the W.R. Grace & Co., Boca Raton, FL, has entered into a marketing agreement with the Belgian company, BioBest Trading, b.v.b.a. (BioBest), for the registration and sale of *Paecilomyces fumosoroseus* (PFR) microbial insecticides developed by Grace. The agreement gives BioBest the rights to distribute PFR microbial insecticides for applications with greenhouse grown vegetables in Europe, the Middle East, and North Africa.

Paecilomyces fumosoroseus is a natural fungal pathogen of insects. It can infect and kill all life stages of whiteflies, mites, aphids, thrips, mealybugs, and armyworms, among others, but is not harmful to humans, animals, or nontarget organisms such as beneficial insects.

The technology and patent for the fungus were licensed exclusively to Grace in 1989. Since then, the company has conducted research in formulation, manufacturing, and field trials to develop PFR into a commercial product. The U.S. registration application for PFR microbial insecticides was submitted by Grace to the U.S. EPA in February 1994. Several European registrations will also be submitted this year through BioBest.

In other news, W.R. Grace Specialty Chemicals Indonesia P.T., a subsidiary of W.R. Grace & Co., dedicated a new Indonesian production plant.

The 18,000 square foot facility, located in Jakarta, Indonesia, will produce water-based container sealants that seal and protect the contents of canned foods, beverages, and nonfood products. A second production line will produce concrete admixtures that enhance the versatility and performance of concrete as a building material for Grace's construction products business.

NDPA Introduces Australian Affiliate

The National Decorating Products Association, St. Louis, MO, and the Paint Specialists Association of Australia (PSAA) have finalized an agreement to accept the PSAA as a new Australian NDPA affiliate with 55 members. NDPA will give a formal presentation to the PSAA at its annual convention in August.

NDPA is branching out to other international groups of independent retailers as well: the Major Decorating Group in New Zealand is considering an NDPA affiliation.

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Regulatory UPDATE

May 1994

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.

Interstate Commerce Commission
April 6, 1994—59 FR 16164
Electronic Filing of Tariffs
Action: Notice of proposal to establish a negotiated rulemaking committee

The Interstate Commerce Commission (ICC) has proposed the establishment of a Regulatory Negotiation (Reg-Neg) committee to develop rules for electronic tariff filing (ETF). The Office of Management and Budget (OMB) must approve the committee before it can be formed, but there does not appear to be any obstacles to that decision. The ICC is accepting applications and nominations for positions on the proposed committee until May 6, 1994.

Please send original and 10 copies of comments, nominations, or applications, referring to Ex Parte No. 444 to: Interstate Commerce Commission, Office of the Secretary, Case Control Branch, Washington, D.C. 20423. For further information, contact James W. Greene, (202) 927-5597 or Charles E. Langyher, III, (202) 927-5160.

Department of Labor
Occupational Safety and Health Administration
April 6, 1994—59 FR 16334
Personal Protective Equipment for General Industry
Action: Final rule

To remain consistent with the current applicable ANSI standards, the Occupational Safety and Health Administration (OSHA) is revising parts of the general industry standards addressing personal protection equipment (PPE). The revised standards include those containing general requirements for all PPEs as well as standards that set design, selection, and use requirements for specific types of PPEs (eye, face, head, foot, and hand). The revisions will provide guidance for the selection and use of PPE as well as clearer requirements that are performance-oriented, where appropriate.

OSHA is also promulgating requirements covering equipment selection, defective and damaged equipment, and training. Nonmandatory appendices have also been added to provide additional guidance to employers and employees with regard to PPE for eye, face, head, foot, and hand hazards.

The standard becomes effective on July 5, 1994. For further information, contact James F. Foster, U.S. Department of Labor, OSHA, Room N-3627, 200 Constitution Ave., N.W., Washington, D.C., (202) 219-8151.

Department of Labor
Occupational Safety and Health Administration
April 5, 1994—59 FR 15968
Indoor Air Quality
Action: Notice of proposed rulemaking; notice of informal hearing

OSHA is proposing to adopt standards regarding indoor air quality in the workplace. OSHA has determined that employees working in indoor work environments face a significant risk of material impairment to their health due to poor indoor air quality, and that compliance with these rules will significantly reduce that risk.

The provisions of the standard are proposed to apply to all indoor "nonindustrial work environments." However, all worksites, both industrial and nonindustrial within OSHA's jurisdiction, are covered with respect to the proposed provisions addressing control of tobacco smoke. The proposal would require affected employers to develop a written indoor air quality compliance plan and implement that plan through actions such as inspection and maintenance of building systems which influence indoor air quality.

Provisions under the proposed standard also include requirements for employers to implement controls for specific contaminants and their sources such as outdoor air contaminants, microbial contamination, maintenance and cleaning chemicals, pesticides, and other hazardous chemicals within indoor work environments. Designated smoking areas which are to be separate, enclosed rooms exhausted directly to the outside are proposed to be required in buildings where the smoking of tobacco products is not prohibited. Specific provisions are also proposed to limit the degradation of indoor air quality during the performance of renovation, remodeling, and similar activities.

Finally, proposed provisions also address the establishment, retention availability, and transfer of records such as inspection and maintenance records, records of written compliance programs, and employee complaints of building-related illness.

Comments and written data on all regulatory provisions proposed and on all relevant issues pertinent to those provisions will be accepted by OSHA until June 29, 1994. Please submit comments in quadruplicate to the U.S. Department of

Labor, 200 Constitution Ave., N.W., Washington, D.C. 20210, (202) 219-7894.

OSHA has scheduled an informal public hearing for July 12, 1994 at 9:30 a.m. The hearing will be held in the auditorium of the U.S. Department of Labor, 200 Constitution Ave., N.W., Washington, D.C. Notices of intention to appear at the hearing must be postmarked by June 20, 1994. Testimony and evidence to be submitted at the hearing must be postmarked by July 5, 1994. For further information on the proposal, contact James Foster, Director of Information and Consumer Affairs, OSHA, Washington, D.C., (202) 219-8151. For information on the hearing, contact Tom Hall, Division of Consumer Affairs, OSHA, Washington, D.C., (202) 219-8615.

Department of Transportation
April 4, 1994—59 FR 15803
Announcement of Conferences on Implementation of U.S. Department of Transportation Drug and Alcohol Rules
Action: Notice

The U.S. Department of Transportation (DOT) is sponsoring a series of conferences covering the implementation of rules requiring alcohol and drug testing in transportation workplaces. The two-day conferences will assist employers of "safety-sensitive" employees with the implementation of their alcohol and drug testing programs.

The conferences will be held at the following locations: Dallas, TX—June 9-10, 1994, at the Stouffer Dallas Hotel, 222 Stemmons Freeway, Dallas, TX 75207; and Chicago, IL—June 14-15, 1994, at the Omni Orrington Hotel, 1710 Orrington Ave., Evanston, IL 60201.

All conferences will begin at 8:00 a.m. on the first day and conclude at 5:20 p.m. on the second day.

Registration and information should be made through R.I.I. Inc., 1010 Wayne Ave., Suite 300, Silver Spring, MD 20910, (301) 587-4138.

Department of Transportation
Research and Special Programs Administration
April 1, 1994—59 FR 15602
Hazardous Materials Transportation Registration and Fee Assessment Program
Action: Notice of Proposed Rulemaking

The Research and Specific Programs Administration (RSPA) is proposing changes to its current national registration program for persons transporting certain categories and quantities of hazardous materials. If adopted, the rule will become effective July 1, 1994, the beginning of the next registration year.

The proposed changes would delay the requirement for foreign offerors to register and would specify that each person who offers for transportation or transports a hazardous material for which registration is required may offer or transport that material only if both the offeror and transporter are currently registered with RSPA. The latter proposed change is intended to enhance nationwide compliance with the registration requirements.

The fees collected under the registration program fund state and local hazardous materials emergency preparedness programs and response activities.

Comments on the proposal are due by May 2, 1994. Address comments to Dockets Unit (DHM-30), Hazardous Materials Safety, RSPA, U.S. Department of Transportation, Washington, D.C. 20590. Comments should be sent in quintuplicate and identified by docket number HM-208A, Notice No. 94-4.

For further information, contact Joseph S. Nalevanko, Office of Hazardous Materials Planning and Analysis, (202) 366-4484 or Beth Romo, Office of Hazardous Materials Standards, (202) 366-4488.

Department of Labor
Occupational Safety and Health Administration
April 1, 1994—59 FR 15594
Reporting of Fatality of Multiple Hospitalization Incidents
Action: Final rule

OSHA has promulgated final revisions to its Reporting of Fatality or Multiple Hospitalization Accidents rule. The three major changes to the former reporting requirements include:

(1) Whereas the former regulation applied to employment accidents which resulted in one or more fatalities or hospitalizations of five or more employees, the regulation is expanded to require the reporting of work related incidents resulting in the death of an employee or the hospitalization of three or more employees.

(2) The regulation requires the employer to verbally report such incidents within eight hours after the employer learns of it, instead of 48 hours, by either written or verbal communication.

(3) Whether or not an incident is immediately reportable, if it results in the death of an employee or the in-patient hospitalization of three or more employees within 30 days of the incident, OSHA requires that the employer report the fatality/multiple hospitalization within eight hours after learning of it.

The rule becomes effective on May 2, 1994. For further information, contact James Foster, U.S. Department of Labor, OSHA, Office of Information and Consumer Affairs, Room N-3647, 200 Constitution Ave., N.W., Washington, D.C. 20210, (202) 219-8148.

Department of Transportation
Research and Special Programs Administration
March 24, 1994—59 FR 14018
Corrections Advisory: 1993 DOT Emergency Response Guidebook
Action: Corrections Advisory Notice

RSPA is notifying distributors, suppliers, and users of the DOT Emergency Response Guidebook (ERG) that corrections have been made to the 1993 edition. Apparently, after more than one million copies of the ERG were distributed, RSPA discovered several errors and omissions. For copies of the corrections, or further information, please contact Roy J. Burton, Office of Hazardous Materials Initiatives and Training, RSPA, U.S. DOT, Washington, D.C. 20590, (202) 366-4900.

Superfund Reform—Sen. Robert C. Smith (R-NH) and Rep. Bill Zeliff (R-NH) are planning to introduce legislation that would absolve potentially responsible parties of liability for activities conducted before 1980.

Reportedly, the bill would implement a "fair share" liability system under which parties would be responsible only for cleanup of waste they contributed to a site. The bill also would allow states to establish and operate programs without surveillance of the U.S. Environmental Protection Agency (EPA).

The bill would also make broader changes in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) than proposed in administration-backed reform legislation (S. 1834, H.R. 3800). Those bills would retain retroactive liability, establish a non-binding system for allocating liability, and allow for state deferral with EPA oversight. Both Smith and Zeliff are members of congressional committees with jurisdiction over Superfund reform. Smith is a member of the Senate Environment and Public Works Subcommittee on Superfund, Recycling, and Solid Waste Management; and Zeliff is a member of the House Public Works and Transportation Subcommittee on Water Resources and Environment.

Hazardous Materials Transportation Reauthorization—If the Capitol Hill rumor mill is to be believed, a House-Senate compromise on a bill to reauthorize the Hazardous Materials Transportation Act is likely to occur sometime this spring. The House passed its version of reauthorization legislation, H.R. 2178, and the Senate Commerce Committee favorably reported its version, S. 1640, both in November. The Senate version differed from the House version significantly.

Both bills would exempt foreign offerors from U.S. hazmat registration fees, a provision sought by the Clinton administration. The House measure, meanwhile, directs the DOT to begin rulemaking to evaluate performance-oriented standards for fiber drum packaging in hazmat transport. That provision has manufacturers of other types of packaging concerned about the fairness of establishing standards in addition to those currently set in federal regulations for certain types of packaging. Fiber drums are scheduled to be phased out from use in hazmat transport by 1996.

The House bill also would authorize a pilot project on motor carriers to study the feasibility of a computerized system to track hazmat shipments. The provision is opposed by several industry organizations because of the anticipated cost. The bill also would require the Secretary of Transportation to return pre-emption and exemption determinations within 180 days of their submission, and modify DOT's RSPA training grants program to authorize granting funds to national nonprofit employee organizations engaged solely in fire fighting and to employee organizations whose members are engaged in handling hazmat and emergency response—provisions the administration opposes.

The Senate measure, meanwhile, would direct DOT to fund a test under the Intelligent Vehicle Highway Systems Act of 1991 on advanced technology for providing information on hazmat transport shipments. That provision is also opposed by many in industry since there is still the potential to lead to a single, centralized telecommunications tracking system for hazardous materials that could be unacceptably costly.

The Senate bill also would require DOT to adopt two open rule-makings within one year after enactment of the bill, HM-175A on tank car crash worthiness and HM-201 on tank car defects. The Senate bill included a number of additional provisions not addressed by the House bill, including grade-crossing safety; driver's record-of-duty status; safety performance history of new drivers; retention of shipping papers; the need for a toll-free number for reporting incidents; and an exemption from hours-of-service requirements.

Reportedly, House and Senate staff would prefer to work out a compromise behind closed doors instead of before one of the many committees of jurisdiction.

States Proposed Legislation and Regulations

Arkansas

Air Quality (Regulation)—The Arkansas Department of Pollution Control and Ecology (DPCE) has proposed regulations to implement the state's clean air operating permit fee system. For further information, contact Doug Szenher of the DPCE at (501) 562-7444.

California

Graffiti—CA A. 3167 (Epple) finds that graffiti is a serious problem in this state, and states legislative intent. Regulates the sale and display of all aerosol paint, liquid dye or polish, and marker pens containing anything other than a solution that can be removed by water after it dries, and defines these products. The bill was referred to the Assembly Committee on Public Safety. It is being actively supported by the California Paint Council.

CA A. 1515 (Hughes) expresses the finding and declaration of the legislature that the incidence of graffiti is increasing throughout the state and that is one of the principal causes of visual blight. Authorized a redevelopment agency, within a project area, to take any actions that the agency determines are necessary to remedy or remove graffiti from public or private property. The bill was released from the Senate Committee on Local Government on April 6. It is expected to pass.

Plastic Containers—CA S. 1746 (Hart) repeals provisions requiring all rigid plastic bottles or rigid plastic containers to be labeled with a specified code. Prohibits, on or after January 1, 1996, the display of the chasing arrows triangle, as defined, or similar logo implying recyclability or plastic products, as defined. Makes it a misdemeanor to manufacture a plastic product for use in this state in violation of that prohibition, punishable by a fine of $1,000. On April 5, the bill was amended and released from the Senate Committee on Natural Resources and Wildlife and then re-referred to the same Committee.

Connecticut

Lead—CT H. 5561 (Committee on Housing) establishes a comprehensive lead risk reduction plan in housing authorities. The bill was reported favorably from the Joint Select Committee on Housing on March 14. It was also reported favorably from the Joint Committee on Planning and Development on April 7.

CT H. 5081 (Committee on Housing) establishes a program of tax credits for businesses that make contributions for lead abatement activities by public housing authorities. The bill was reported favorably from the Joint Select Committee on Housing on March 14. It is currently in the Joint Committee on Planning and Development.

CT H. 5560 (Committee on Housing) provides incentives and a comprehensive system of lead paint abatement and management in private multi-family residential structures containing 50 or more dwelling units. The bill was reported with substitute from the Joint Select Committee on Housing on March 10. It was reported favorably from the Joint Committee on Planning and Development on April 7.

CT S. 209 (Committee on Banks) concerns lead paint removal in connection with mortgage lenders; avoids further burdening of residential sellers by requiring abatement of lead paint at real estate closings in the current depressed real estate market. The bill was reported with substitute from the Joint Committee on Banks on March 10 and was transferred to the Joint Committee on the Judiciary on April 6.

Labeling—CT H. 5111 (Committee on General Law) requires certain warning labels re: combustibility to be placed on drying oils and drying oil products. The bill was reported with substitute from the Joint Committee on General Law on March 10 and was transferred to the Joint Committee on Judiciary on April 5.

Graffiti—CT H.B. 5670 (Committee on Children) concerns criminal mischief and graffiti; provides penalties for writing or painting graffiti on public buildings and highways. The bill was reported favorably from the Joint Select Committee on Children on March 10. It is currently in the Joint Committee on Judiciary.

Air Quality (Regulation)—The Connecticut Department of Environmental Protection (DEP) has proposed regulations to implement the state's clean air operating permit fee system. The proposal would include fugitive emissions in the amount of emissions that would be subject to the fees. For further information, contact Dennis Demchak of the DEP at (203) 566-3160.

Georgia

Air Quality (Regulation)—The Georgia Department of Natural Resources (DNR) issued final regulations implementing the state's clean air operating permit program that is mandated by Title V of the Federal Clean Air Act Amendments of 1990. The regulations also establish additional VOC controls for the Atlanta ozone nonattainment area. For further information, contact the Air Protection Branch of the DNR at (404) 363-7000.

Hawaii

Lead—HI S. 1609 (Chang) relates to lead-based paint; disclosures; penalties; provides that before any transfer of residential real estate property, the seller shall furnish to a purchaser as part of the real estate contract of sale a residential property disclosure statement to include the results of a test for unacceptable levels of lead-based paint. After a year of inactivity, the bill was re-referred to the Committee on Judiciary on March 8.

Illinois

Lead—IL S. 1554 (Trotter) amends the Illinois Housing Department Act by providing that the Housing Authority may make loans for lead hazard abatement and the cost of rehabilitating housing units for homeless individuals with debilitating AIDS and AIDS related complex; provides that the authority may issue bonds in an aggregate amount not to exceed $1,000,000 per year in fiscal years 1994 and 1995 for financing loans for the removal or covering of paint, plaster, soil, or other materials on residential premises containing lead. The bill was introduced on March 4.

Graffiti—IL S. 3809 (Persisco) amends the Counties Code by providing that a county board may ban graffiti within the county, except within the corporate lists of a municipality and may establish penalties. The bill, introduced March 23, is in the House Committee on Counties and Townships.

Iowa

Packaging—IA S. 2205 (Committee on Environment and Energy Utilities) prohibits a manufacturer or distributor from selling a package or packaging component or a product in a package that includes in the package itself or in the packaging component any lead, cadmium, mercury, or hexavalent chromium that has been intentionally introduced as an element during manufacturing or distribution. Allows the incidental presence of these metals in an amount not to exceed established concentration levels. The bill passed the Senate on March 7 and was released from the House Committee on Energy and Environmental Protection on March 15.

Air Quality (Regulation)—The Iowa Environmental Protection Commission has issued final regulations establishing the state's clean air operating permit program that is mandated by Title V of the Federal Clean Air Act Amendments of 1990. For additional information, contact Christine Spackman of the Air Quality Bureau at (515) 281-8852.

Kentucky

Hazardous Waste (Regulation)—The Kentucky Department of Environmental Protection (DEP) has proposed regulations that would specify standards for corrective actions and release responses to spills from underground storage tanks that contain hazardous substances or petroleum products, and would amend standards relating to the removal of such tanks. The DEP also issued final regulations that significantly amend the state's hazardous waste regulations, including revisions to the criteria for identifying wastes that are subject to the regulations. For further information, contact James Hale of the DEP at (502) 564-6716.

Occupational Safety and Health (Regulation)—The Kentucky Department of Workplace Standards has proposed major amendments to existing regulations that would incorporate a number of federal OSHA standards. For further information, contact William Ralston of the Labor Cabinet at (502) 564-2778.

Lead—KY S. 289 (Neal) originally would have prohibited lead abatement activities by individuals not licensed; required the Environmental Protection Cabinet to develop criteria and procedures for certifying and licensing various categories of individuals involved in lead abatement activities; established minimum elements for qualification; established procedures for license renewals. As passed the Senate on March 14 and the House on March 28, the bill now calls for the appropriate committee of the legislature to "study the problem of lead hazard reduction" and the need for a method of licensing and certifying lead hazard reduction personnel; appropriates $10,000 for the study which is to be completed with a report by October 31, 1995.

Petroleum Storage Tanks—KY H. 402 (Brown) requires the registration of petroleum storage tanks by July 15, 1995. The bill was sent to the Governor on March 30, 1994.

Maryland

Lead—MD H. 760 (Taylor) establishes the Lead Poisoning Prevention Program and the Lead Paint Poisoning Commission; establishes risk reduction standards for affected properties; requires owners of affected properties to satisfy certain risk reduction standards and provides for certain inspections. The bill passed the House on March 28 and the Senate on April 11.

MD H. 1658 (Hubbard) requires the Department of Health and Mental Hygiene to establish and administer a Lead Poisoning Screening Program, using specified criteria and payment mechanisms; requires the department to assure statewide coordinated case management for specified children; requires the department to establish a Lead Poisoning Outreach and Education Program and allows the department to contract with outside sources for that program; requires the department to develop and report on a specified plan by a specific date. The bill passed the House on March 28 and the Senate on April 11.

MD H. 970 (Rosenberg) establishes a Lead Poisoning Prevention Commission; establishes a lead hazard reduction standard with which properties that are affected by the Act must comply; provides specified exceptions; authorizes owners of affected property to make specified offers to lead poisoned children; specifies the procedures for accepting or rejecting an offer; establishes a Lead Poisoning Prevention Fund; specifies the insurance requirements that an owner of an affected property must have; specifies the purpose of the Act. The bill died in the House Committee on Environmental Matters on April 11.

MD S. 313 (Miller) establishes the Lead Poisoning Prevention Program and the Lead Paint Poisoning Commission; establishes a risk reduction standard for affected properties; requires owners of affected properties to satisfy certain risk reduction standards and provides for certain inspections; authorizes the Department of the Environment to provide oversight for lead-contaminated dust testing and inspection; specifies the duties of the Maryland Insurance Commission in enforcing the Act. The bill was reported unfavorably from the Senate Committee on Judicial Proceedings on April 11.

Occupational Safety and Health (Regulation)—The Maryland Department of Licensing and Regulation has issued a final regulation incorporating by reference the federal OSHA standard for exposure to lead in the construction industry, while retaining features of the existing Maryland regulations that are more stringent than the federal standards. Contact Carolyn West of the DLR at (410) 333-4184, for more information.

Minnesota

Packaging—MN H.F. 1682 (Munger) relates to waste and packaging management; requires recyclable pesticide containers after 1995; expands packaging definition to cover materials used for transporting or protecting products in transit; requires that newsprint, glass packaging, rigid plastic containers, and paperboard packaging contain a minimum percentage of post-consumer material. Introduced in April 1993, the bill was released from the House Committee on Environmental and Natural Resources Finance on April 4, 1994. It is expected to pass.

Lead—MN H.F. 2416 (Clark) relates to the Minnesota Joint Underwriting Association (JUA). Includes lead abatement liability insurance for lead abatement contractors as a coverage that the JUA is authorized to provide. The bill was amended and released from the House Committee on Financial Institutions and Insurance on March 28. It is expected to pass.

MN S.F. 2261 (Pappas and Pogemiller) allows a credit of up to 40% of qualifying lead abatement expenses paid or incurred in the tax year against the state income tax; limits credit to $1,000 per application and specifies qualifying costs and makes necessary appropriations to Commissioner of Revenue to make refunds. The bill was introduced on March 9 and referred to the Senate Committee on Taxes and Tax Laws.

MN H.F. 2566 (Clark) allows a credit of up to 40% of qualifying lead abatement expenses paid or incurred in the tax year against the state income tax; makes necessary appropriations to Commissioner of Revenue to make refunds. The bill was introduced on March 10 and referred to the House Committee on Taxes. A companion bill has been introduced in the Senate (S. 2661—Pappas) and referred to the Senate Committee on Taxes and Tax Laws.

MN H.F. 2916 (Clark) relates to lead abatement programs; modifies standards for home assessments; removes specific standards from the statutes; specifies information to be collected and disseminated; requires notice to the Department of Health of all violations identified in home assessments; bars removal of intact paint unless proven to be a source of actual lead exposure; provides for standards for activities which are not lead abatement but which may disrupt lead-based paint surfaces. The bill was introduced on March 17 and referred to the House Committee on Health and Human Services. On April 5, S. 2710 was substituted for this bill (see the following).

MN S.F. 2710 (Solon) relates to lead abatement programs; modifies standards for home assessments; removes specific standards from the statues; requires notice to the Department of Health of all violations identified in home assessments; bars removal of intact paint unless proven to be a source of actual lead exposure; provides for standards for activities which are not lead abatement, but which may disrupt lead-based paint surfaces. The bill passed the Senate on March 31 and was sent to the House.

Pollution Prevention—MN H.F. 2796 (McCollum) relates to the toxic pollution prevention act; defines company officers for purposes of the act; provides that facilities that submit a toxic chemical release form but do not report actual releases or transfer a toxic chemical off-site are exempt from prevention plan requirements. The bill was released from the House Committee on Environment and Natural Resources on March 28. It is expected to pass.

Missouri

Air Quality (Notice)—The Missouri Department of Natural Resources (DNR) has established a registry by which all sources required to obtain a clean air operating permit may request the issuance of their permit in 1995, 1996, or 1997. The registry will be open from May 9 to August 10, 1994, to receive requests. For further information, contact Todd Crawford of the DNR at (314) 751-4817.

New Hampshire

Lead—NH S. 650 (Shaheen) establishes a lead-based substance abatement fund to be administered by the New Hampshire Housing Finance Authority. Provides that the fund is to be used to assist owners of a rental property which is primarily occupied by low-income tenants when such owners are required to undertake lead abatement activities. Makes an appropriation for the startup costs of the fund. The bill passed the Senate on March 22 and was sent to the House Committee on Appropriations.

New Jersey

Hazardous Waste (Regulation)—The New Jersey Department of Environmental Protection and Energy (DEPE) has proposed to delist from its hazardous waste list waste water treatment sludge that is generated in the production of titanium dioxide pigments using a chloride process. For further information contact, Janis Hoagland of the DEPE at (609) 777-0518.

New York

Plastic Containers—NY A. 9967 (DiNapoli) relates to recycled content in glass and plastic containers. Requires each rigid plastic container manufacturer to use 20% recycled plastic beginning September 1, 1996, and 35% recycled plastic beginning January 1, 2000. The bill is in the Assembly Committee on Environmental Conservation.

Environmental Marketing—NY A. 10223 (Brodsky) prohibits advertisements using the term "biodegradable," "degradable," or "photodegradable" unless authorized by the Department of Environmental Conservation. The bill was introduced on March 22 and referred to the Assembly Committee on Environmental Conservation.

Lead—NY S. 5159 (Volker) establishes a lead abatement licensing and certification program to reduce the health and safety hazards associated with lead abatement. The bill, introduced in May 1993, was amended and returned to the Assembly Committee on Health on March 17.

NY S. 6181 (Padavan) makes provisions regarding bridge paint removal projects and repeals an article on environmental lead hazards; provides for study of paint removal techniques. The bill, introduced in July 1993, was amended and returned to the Senate Committee on Transportation on March 10.

Air Quality (Regulation)—The New York Department of Transportation (DOT) has issued final regulations that implement the state's employee trip reduction program that is mandated by the Federal Clean Air Act Amendments of 1990. Under the regulations, employers of 100 or more employees must submit plans to the state demonstrating how they will comply with the requirements by November 15, 1994. For further information, contact Robert Ancar of DOT at (518) 457-2064.

Ohio

Lead—OH H. 162 (Drake) requires lead screening of certain young children; creates a tax credit for lead abatement; provides for licensure of persons performing lead abatement; provides that it is an unlawful discriminatory practice to refuse to sell to or rent housing because it will be occupied by a young child or a pregnant woman. The Senate concurred in House amendments on March 8.

Oklahoma

Lead—OK H. 2497 (Hamilton) establishes the Comprehensive Childhood Lead Poisoning Prevention Program, to be administered by the state Department of Health; requires the State Board of Health to promulgate rules regarding lead toxicity screening of certain children, risk assessment, blood lead tests, health education and counseling and other requirements; and creates a nine-member Childhood Lead Poisoning Prevention Advisory Council. The bill passed the House on March 17 and was sent to the Senate. On April 4, it was released from the Senate Committee on Human Resources.

Graffiti—OK S. 971 (Haney) makes it a misdemeanor to knowingly sell paint containing metallic powders dispensed from a pressurized container, or any glue, to a person under 18 years of age. The bill passed the Senate on March 1 and was released from the House Committee on Criminal Justice on March 24.

Oregon

Air Quality (Regulation)—The Lane Regional Air Pollution Authority (LRAPA) has proposed amendments to its regulations that would provide the authority to enforce against sources that fail pay required air pollutant emissions fees and would expand the list of sources that are subject to the fees. For further information, contact Donald Arkell of the LRAPA at (503) 378-4665.

Texas

Pollution Prevention (Regulation)—The Texas Natural Resource Conservation Commission (NCRR) has issued regulations to implement a streamlined permitting process for companies implementing pollution control programs that are either mandated by the law or are undertaken voluntarily. For further information, contact Jeff Saitas of the NRCC at (512) 239-1288.

Vermont

Lead—VT H. 169 (Ross and Babcock) establishes a program for training, certification, and licensing of lead hazard abatement workers; makes blood lead screening and testing of children available upon request of parents and mandatory if warranted; provides for inspection and testing of child care facilities; ensures that lead-based paint hazards are disclosed in the sale or rental of housing; establishes a standard of reasonable care on the part of owners of rental housing and day care facilities. The bill passed the House on March 24 and was sent to the Senate.

Virginia

Toxics in Packaging—VA H. 1202 (Scott and Plum) prohibits a manufacturer or distributor, after July 1, 1995, from selling or offering for promotional purposes a package or packaging component that includes inks, dyes, pigments, adhesives, stabilizers, or any other additives containing lead, cadmium, mercury, or hexavalent chromium that has been intentionally introduced as an element in manufacturing or distribution, and exceeds 600 parts per million by weight, beginning July 1, 1995; 250 parts per million by weight, beginning July 1, 1996; and 100 parts by July 1, 1997. The House concurred in Senate amendments on March 10.

The following states now have regulations in place or proposed regulations implementing various sections of the Federal Clean Air Act Amendments of 1990: Arizona, California,Connecticut, Delaware, Florida, Georgia, Illinois, IndianaKentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Virginia, West Virginia, and Wisconsin.

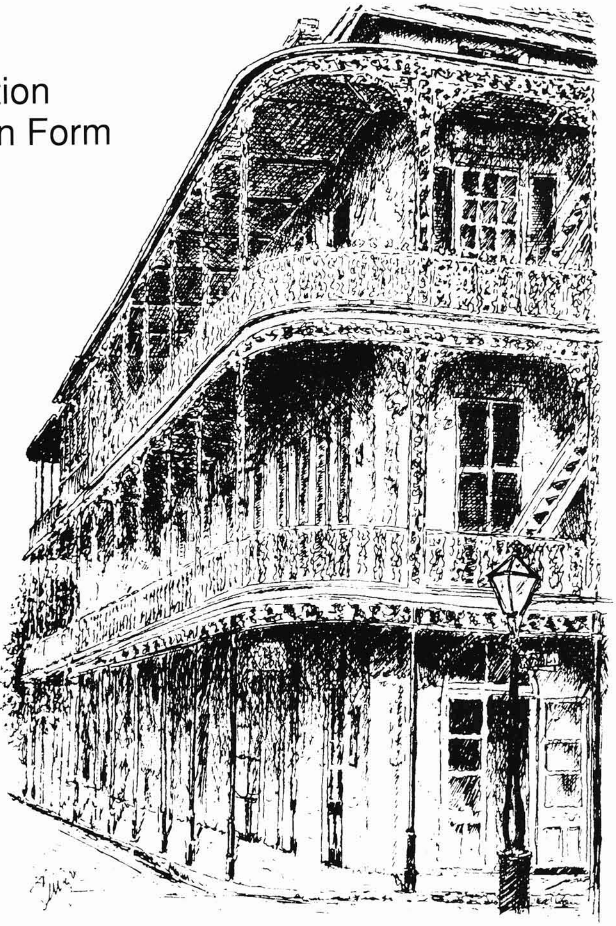
Federation of Societies for Coatings Technology

New Orleans Convention Center
New Orleans, LA
October 12-13-14, 1994

1994 Annual Meeting & Paint Industries' Show

- Hotel Information
- Reservation Application
- Advance Registration Form

"Excellence
Through
Innovation"



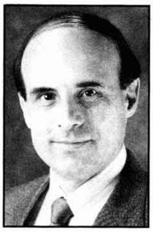
Ernest N. Morial Convention Center
Wednesday, Thursday, Friday • October 12-13-14, 1994
New Orleans, Louisiana

The combined Annual Meeting and Paint Industries' Show, to be held at the Ernest N. Morial Convention Center, is a major educational activity of the Federation of Societies for Coatings Technology. This international coatings manufacturing industry event consists of three days of technical program sessions and exhibits, running concurrently. Registration is required for admission.

From the President:

Welcome to the Big Easy! We invite you to participate in the main event of the coatings industry—the Federation's 72nd Annual Meeting & 59th Paint Industries' Show. Here in New Orleans, we will meet with representatives from over 60 countries to experience the paint and coatings industry's largest exhibition of raw materials, equipment, and services. In addition, the technical programs will offer a variety of dynamic topics sure to assist you in achieving "Excellence Through Innovation."

To be held in the newly expanded Ernest N. Morial Convention Center, this unique program is rivalled in excitement only by a city that offers such attractions as the French Quarter, the Superdome, Bourbon Street, and the bayous! As you might imagine, the 1994 Annual Meeting and Paint Show will be an event to be remembered! Don't delay—make plans now to be a part of it all "way down yonder in New Orleans!"



John A. Lanning
President, FSCT

"Excellence Through Innovation"

Attendees at the 1994 Annual Meeting can attend technical programs on a wide variety of pertinent topics revolving around the theme, "Excellence Through Innovation." Program sessions are being developed to cover the following topics:

- Advanced Topics in Coatings Research
- Color Technology
- Innovations in the Development of VOC Compliant Corrosion Inhibitive Coatings:Testing and Technology
- The Human Side of Process Safety Management
- Formulating for Low VOC Coatings
- Roon Award Competition Papers
- APJ/Voss Award (Society) Competition Papers
- International Papers
- ISO 9000 Case Study

Presentation subjects will include:

- Powder Coatings
- Accelerated Testing
- Epoxy Coatings
- Additives
- Waterborne Coatings
- Dispersion Technology
- UV Technology

To be a competitor in tomorrow's coatings industry, you will have to be well versed in customer satisfaction, committed to continuous improvement, and prepared to work with and develop new technologies. These sessions will give you answers and insights to meet these challenges.

Papers will be presented by industry experts, familiar with what it takes to achieve success. They will convey to you that, more than ever before, customer satisfaction requires a balance of enhanced performance, cost effectiveness, and product consistency. You'll learn the latest in products, processes and packaging, in addition to finding out about the new technologies that will make "Excellence Through Innovation" a reality.

New to the event are "Early Bird" sessions on Thursday, October 13, to give you more detailed information on pertinent subjects. Initial offerings will cover "Empowerment" and "Quality" The program will again open with the popular Technical Focus Speaker on Wednesday, October 12, at 1:00 p.m.

Two additional presentations you'll want to attend are the Keynote Address at Wednesday morning's Opening Session and the Mattiello Memorial Lecture, scheduled for Friday morning at 10:30 a.m. Both sessions are in the "must attend" category of all serious coatings professionals!

Make it a point to visit the Poster Session on Thursday. This all-day event will feature non-commercial work covering new ideas and techniques in coatings research and will let you glimpse at the work of future industry leaders.

World's Premier Paint Show to Feature Products of Over 250 Companies

The largest coatings-related exhibition in the world—the FSCT Paint Industries' Show—will be held in conjunction with the Annual Meeting at the Ernest N. Morial Convention Center—New Orleans. Over 250 supplier companies to the coatings manufacturing industry will be present to discuss their newest products and services. In over 90,000 sq. ft. of exhibits will be displayed a wide variety of raw materials, production equipment, containers and filling equipment, laboratory apparatus, and testing devices for the paint and coatings producer.

Key personnel from the top technical and sales staff of supplier companies will be available to provide attendees with an opportunity to learn of the latest developments in their products and services. Listed on the last page of this brochure are the exhibitors who have currently reserved space in the Paint Industries' Show.

Exhibit hours will be:

Wednesday, October 12	10:00 a.m.-5:00 p.m.
Thursday, October 13	9:00 a.m.-5:00 p.m.
Friday, October 14	9:00 a.m.-12:00 Noon

Hotel Information

Whether you desire the value of a moderately-priced hotel, or the luxury of an upscale property, the choice is yours. The FSCT has arranged for convention rates at 12 official Paint Show hotels. All reservations must be placed through the FSCT Housing Bureau to obtain the preferred rates. The Housing Bureau will confirm all reservations. *(Housing opens June 15.)*

Do it Your Way and Save!

You have the convenience of placing a phone call or faxing your request for hotel accommodations to the FSCT Paint Show Housing Bureau.

Call! 800-345-1187 or 504-566-5005

Have the information requested on the Hotel Reservation Form available before you place your call. Reservationists are available 7:00 a.m. - 7:00 p.m., Monday through Friday, Central Time. Reservations will be immediately confirmed over the phone and also by mail or fax if fax number is provided.

Fax! 504-522-6123

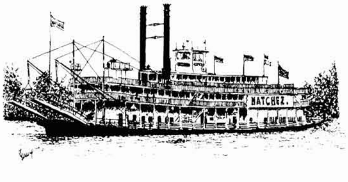
Anytime, any day. Fax the Hotel Reservation Form at your convenience. Be sure to include a phone and fax number and retain your copy of the form for your records. Confirmations will be sent via fax within three working days of receipt of request.

Mail!

Send your form to the FSCT Paint Show Housing Bureau for processing. Be sure to include a phone and fax number and keep a copy of the form for your records. Your confirmation will be mailed or faxed, if a fax number is provided.

Deposits

A $100 deposit per guest room and $100 deposit per suite is required in order to process requests. This is a refundable deposit if the reservation is cancelled 72 hours prior to arrival. The following methods of payment are acceptable: checks made payable to the FSCT Paint Show Housing Bureau or credit cards. Credit card choices include American Express, MasterCard, or Visa. Please note that the deposit will be applied immediately to the credit card used.



Deadlines

To obtain the convention rates, reservations must be placed by September 1. Reservations placed after September 1 will be on a space available basis. To make reservations after September 9, call the hotel directly.

Changes/Cancellations

For changes or cancellations prior to September 9, call the FSCT Paint Show Housing Bureau at 504-566-5005 or fax your change to 504-522-6123. After September 9, call the hotel directly.

Registration Information

The Advance Registration fees include three days of admission to the Paint Industries' Show and the Opening Session, and all concurrent program sessions of the Annual Meeting. To register, simply complete the Advance Registration Form and forward it with payment to FSCT. The Advance Registration prices will be available until **September 1**. The form with accompanying payment must be received at FSCT by September 1. Registration options are listed below:

Full Time	**Advance**	**On-Site**
Member	$ 75	$ 90
Non-member	$100	$125
Social Guest	$ 60	$ 70

Your registration credentials will be mailed to you in advance of the Annual Meeting & Paint Industries' Show. Badges for registrations received after September 1 will be available in the FSCT Paint Show Registration Area.

The Registration Services Area will be located at the Ernest N. Morial Convention Center and will be open over the following days and times to assist you.

Day	**Time**
Tues., October 11	8:00 a.m. - 5:00 p.m.
Wed.-Thurs., October 12-13	7:30 a.m. - 5:00 p.m.
Fri., October 14	7:30 a.m. - 12 Noon

On-site registration will also be available during the times noted above.

Method of Payment

Acceptable types of payment include checks in U.S. funds made payable to FSCT, as well as credit cards: VISA, MasterCard, and American Express. Payment is due with registration form. Forms received without payment will not be processed. Please note: **if payment is made with a credit card, the form may be faxed to FSCT Headquarters Office. If faxing, please do not mail original form.**

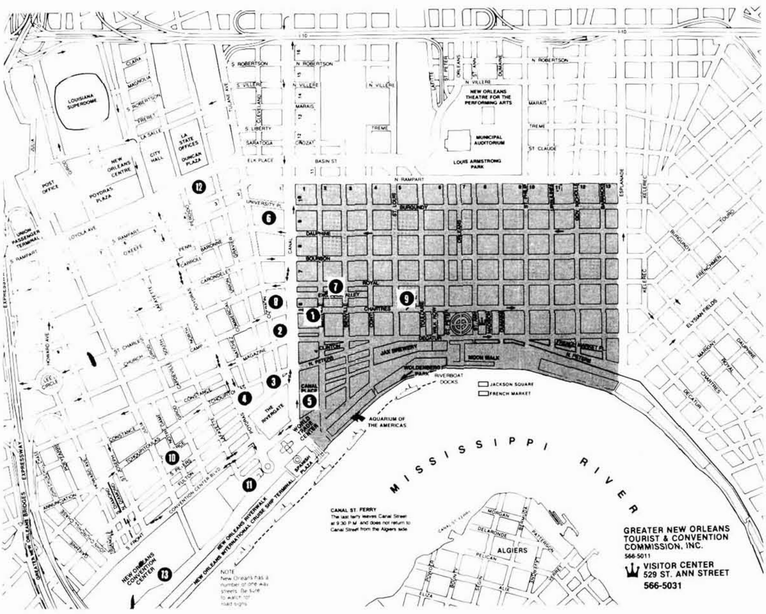
Cancellation and Refund Policy

All cancellations must be submitted in writing to the FSCT Headquarters Office. All badges that have been mailed must be returned to FSCT for refund processing. Cancellations received by September 28 will be subject to a $10 handling charge. A $25 charge will apply after that date.

1994 Paint Show Hotel Summary

	Room Type and Rates						
			Suites		No. of		
Hotel	Single	Double	1 BR	2 BR	Restaurants/ Bars	Swimming Pool	Health Club
*Marriott (Standard) (Concierge level)	$138 146	$158 166	$550-1,100	$688-1,238	3/2	yes	yes
*Sheraton (Standard) (Executive)	138 158	158 178	250-1,000	350-1,185	4/4	yes	fitness center
Doubletree	115	135	225-250	325-375	1/1	yes	yes
Holiday Inn Crowne Plaza	125	145	560	685	2/2	yes	exercise room
Westin Canal Place	130	150	240-400	400-1,500	1/2	yes	yes
Fairmont	125	145	295-1,200	475-1,200	3/3	yes	fitness center
Monteleone	127	147	290-520	430-680	3/2	yes	yes
Le Meridien	140	160	450-500	650-1,500	1/2	yes	yes
Omni Royal Orleans	140	160	325	525	3/4	yes	yes
Radisson Suites	125	145			1/1	yes	no
Hilton (Standard) (Executive) (Towers)	145 165 185	165 185 205	504-1,490	695-1,685	4/5	yes	jogging track
Holiday Inn Downtown	90	105			1/1	yes	no

*Marriott and Sheraton will be co-headquarters. Guest rooms at both hotels will be limited to 10 per company.



Shuttle Schedule

Route 1

Meridien	Sheraton
Sheraton	Canal Street
Doubletree	South Peters
Holiday Inn Crowne Plaza	South Peters

Route 2

Westin	North Peters
Marriott	Canal Street
Omni Royal Orleans	Marriott*
Monteleone	Marriott*

*Limited shuttle service will be available from the Royal Orleans and the Monteleone to the Marriott.

Route 3

Holiday Inn Downtown	Loyola Street
Fairmont	Baronne Street

Schedule

Tues., Oct. 11	8 a.m. - 5 p.m.
Wed., Oct. 12	7:30 a.m. - 6 p.m.
Thurs., Oct. 13	7:30 a.m. - 6 p.m.
Fri., Oct. 14	7:30 a.m. - 3 p.m.

Legend

1 — Marriott
2 — Sheraton
3 — Doubletree
4 — Holiday Inn Crowne Plaza
5 — Westin Canal Place
6 — Fairmont
7 — Monteleone
8 — Le Meridien
9 — Omni Royal Orleans
10 — Radisson Suites
11 — Hilton
12 — Holiday Inn-Downtown
13 — Convention Center

Hotel Reservation Form

(Housing opens June 15)

72nd Annual Meeting & 59th Paint Industries' Show
FSCT
1994

MAIL FORM & DEPOSIT TO:

FSCT Paint Show
1520 Sugar Bowl Dr.
New Orleans, LA 70112

PHONE/FAX:

(800) 345-1187 Continental U.S.
(504) 566-5005 International
FAX: (504) 522-6123

HOTEL PREFERENCE

List the hotels of your preference. First choice will be assigned if available. List other preferences to avoid delay. If your first choice is not available, your deposit will be applied to your next available choice. The deadline is September 1.

(1) ____________ Hotel
(2) ____________ Hotel
(3) ____________ Hotel

RESERVATION REQUEST

Number of rooms requested ☐

Names of Occupants	Room Type	Rate	Arrival	Departure

For additional reservation requests, feel free to copy this form.
Requests for the Marriott and Sheraton will be limited to 10 rooms per company.

DEPOSIT

A deposit of $100 per room is required. No form will be processed without a deposit. Credit cards will be billed immediately for first night's deposit.

Credit Card: ☐ American Express ☐ Mastercard ☐ VISA Cardholder's Signature: ____________

____________ Card Number
____________ Expiration Date
____________ Print Cardholder's Name

or Check made payable to: "Paint Show Housing Bureau" $ ____________ enclosed. Check No. ____________

DIRECT CONFIRMATIONS TO:

Name: ____________ Telephone: ____________
Company: ____________ FAX: ____________
Address: ____________
City/State (Province): ____________ Zip Code (Mailing Code): ____________
Country (if other than U.S.): ____________

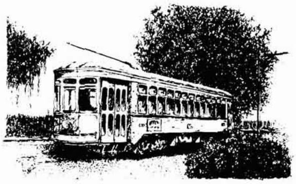
If requested room rate is not available, the nearest rate will be assigned by the FSCTPaint Show Housing Bureau. We cannot guarantee that the accommodations will be assigned in your preferred hotels.

☐ ____________ requires special assistance. Please call: ____________
Name

Airport & City Transportation

From New Orleans International Airport:
Airport Shuttle (service to downtown hotels, provided by Airport Shuttle New Orleans) is $10 each way. The shuttle may be boarded by the baggage claim area. The trip takes approximately 30 minutes.

Taxi Service from the airport to downtown hotels is $21 per person, $10 per person with two passengers, and $6 per person with three passengers.



Slash Air Fare Expense

Minimize your travel expense to the Paint Show by using discounted zone fares offered by **Delta Airlines** to the Paint Show. NO SATURDAY NIGHT STAY IS REQUIRED!

From City	Regular Coach	**FSCT Zoned Fares**
Atlanta	$576	**$408 - 464**
Chicago	$1,210	**$408 - 514**
Denver	$1,006	**$348 - 408**
Los Angeles	$1,196	**$448 - 518**
New York City	$990	**$408 - 514**

To obtain these fares, you, your secretary, or your travel agent must refer to the following file codes when contacting the airlines:

Delta 1-800-241-6760 mention code I5014

FSCT Travel Desk: mention Paint Show
Domestic U.S. 1-800-448-FSCT
International 1-215-628-2549
Fax: 215-628-0310

FSCT Travel Desk is able to provide zone fares on both Delta and United Airlines. If you desire a Saturday night stay, a 5% discount on the lowest fare applicable can be obtained. On all discounted fares, there may be certain restrictions and penalties for changes or cancellations. Airport surcharges may apply.

Mardi Gras MAGIC Annual Luncheon

Curious why droves of people flock to New Orleans in February for its biggest party, Mardi Gras? Then attend the Federation's Annual Awards Luncheon on Thursday, October 13. Along with the re-creation of Mardi Gras Magic, featuring Big Easy music and a Mardi Gras Tableau Presentation, will be the presentation of Federation awards.

Luncheon tickets can be purchased in advance or on-site at $25 each. Social guest registration includes the Luncheon ticket.

Social Program

'Big Easy' Arts and Entertainment

Activities for social guest registrants begin at the Marriott on Wednesday, October 12, with an Afternoon Social for re-acquainting with friends and meeting new ones over refreshments and local entertainment. New Orleans is a city whose mystique has captured the imagination of both its locals and visitors. The Social will feature local artists demonstrating their vocal, culinary and decorative talents to the participants.

On Thursday, October 13, following a continental breakfast at the Marriott Hotel, registered social guests will depart on deluxe motorcoaches for a visit to the exquisite city estate Longue Vue House and Gardens, once home to the prominent Stern family. There, guests will have an opportunity to stroll the beautifully landscaped grounds, tour the mansion, enjoy refreshments under the pavilion, and attend informative programs on various collections displayed at Longue Vue.

After Longue Vue, guests will board motorcoaches for the Convention Center to attend the Federation's Mardi Gras Magic Luncheon. The festivities include Big Easy entertainment and a presentation by a local expert on the symbolism of the Mardi Gras Krewe and colors.

Following the luncheon, participants will have time on their own to explore the many New Orleans attractions and shops.

Social guest registration is $60 in advance and $70 on site, and includes the Wednesday Social, Thursday Breakfast and Tour, as well as the Mardi Gras Magic Luncheon.

Registration is limited to 700 participants.

NPCA to Meet Same Week

The National Paint & Coatings Association will hold its annual meeting on October 10-12, at the New Orleans Hilton and Towers, in New Orleans.

NPCA will admit advance registered attendees of the FSCT Paint Industries' Show to the Forum Sessions being held during its annual meeting at no additional charge. The Forum Sessions will be conducted at the New Orleans Hilton on Monday and Tuesday, October 10 and 11. For admittance to these sessions, FSCT Paint Show attendees must complete NPCA's complimentary registration form available at the NPCA registration area located in the New Orleans Hilton Hotel.

1994 Advance Registration

FSCT Annual Meeting & Paint Industries' Show

New Orleans, LA • October 12-14, 1994

DEADLINE—SEPTEMBER 1

BADGE INFORMATION: This is how your badge will read and where it will be mailed.

FIRST NAME (as you wish it to appear on badge)

FIRST NAME LAST NAME

COMPANY

MAILING ADDRESS (or P.O. Box)

CITY STATE/PROV.

COUNTRY (OTHER THAN U.S.) POSTAL CODE

TELEPHONE NO. FAX NO.

SOCIAL GUEST BADGE INFORMATION:

FIRST NAME (as you wish it to appear on badge)

FIRST NAME LAST NAME

MAILING ADDRESS (or P.O. Box)

CITY STATE/PROV.

POSTAL CODE

BUSINESS CLASSIFICATION DATA FOR INDUSTRY REGISTRANT:

YOUR COMPANY (CHECK ONE ONLY)

- AA ☐ Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants, Adhesives
- BB ☐ Manufacturers of Raw Materials
- CC ☐ Manufacturers of Equipment and Containers
- DD ☐ Sales Agents for Raw Materials and Equipment
- EE ☐ Government Agency
- FF ☐ Research/Testing/Consulting
- GG ☐ Educational Institution/Library
- HH ☐ Paint Consumer
- YY ☐ Environmental Services
- JJ ☐ Other

YOUR POSITION (CHECK ONE ONLY)

- KK ☐ Management/Adm.
- LL ☐ Mfg. & Engineering
- MM ☐ Quality Control
- NN ☐ Research & Development
- PP ☐ Technical Sales Service
- QQ ☐ Sales & Marketing
- RR ☐ Consultant
- SS ☐ Educator/Student/Librarian
- TT ☐ Other

Registration credentials will be mailed to the address noted if received at FSCT Headquarters by **September 1**.

If received after that date, they may be picked up on-site at the Ernest N. Morial Convention Center.

Registration Fees:

A ☐	FSCT Member FSCT Society ________________	$75.00
B ☐	Non-Member	$100.00
D ☐	Social Guest	$60.00
G ☐	Special Fee for Retired Member	$25.00
H ☐	Special Fee for Social Guest of Retired Member	$25.00

FSCT Mardi Gras Luncheon Tickets: (Thurs., Oct. 13)

(Social guest registration includes the luncheon)

☐ NUMBER REQUIRED: ________
$25 EACH

Method of Payment:

Payment is due with registration form. We are pleased to accept faxes for credit card payment only.

Total Amount Due $ ________

Please Check One:

☐ Enclosed is Check #________
payable in U.S. Funds to FSCT

☐ Charge to the following card:

___ MC ___ VISA ___ AMEX

Card No. ________________

Expiration Date: __ __ Mo. __ __ Yr.

Signature (Credit card registrations only) ________________

Please print cardholder's name ________________

All registrations received **by September 1** will be processed and Registration Credentials will be mailed to the address provided. All registrations received **after September 1** will be processed and can be picked up at the Paint Show Registration Services Area. A $10 charge will be made for cancellations received prior to September 28. A $25 charge will be made for cancellations received after that date.

Mail completed form to:

FSCT, 492 Norristown Rd., Blue Bell, PA 19422-2350

(For credit card registrations only—**FAX: 215-940-0292**—do not mail original)

1994 Paint Industries' Show

Current List of Exhibitors

Aceto Corp.
Adhesion International
ACT Labs., Inc.
Advanced Software Designs
Air Products & Chemicals, Inc.
Air Quality Sciences, Inc.
Alcan-Toyo America, Inc.
Alcoa Industrial Chemicals
Allied Signal Corp.
Alt-Chem International
American Chemical Society
Amoco Chemical Co.
ANGUS Chemical Co.
Anker Labelers USA, Inc.
Aqualon Co.
Arco Chemical Co.
Ashland Chemical, Inc.
Atlas Electric Devices Co.
Aztec Peroxides Inc.
BASF Corp., Chem. Div.
Blackmer Pump
Bohlin Instruments
Brookfield Engineering Labs.
Brookhaven Instruments Corp.
Buckman Laboratories
Burgess Pigment Co.
BYK-Chemie USA
BYK-Gardner, Inc.
C&E News
Cabot Corp., CAB-O-SIL & Special Blacks Div.
Calgon Corp.
Cappelle Inc.
Cardolite Corp.
CB Mills, Div. of Chicago Boiler
CCP Polymers
Celite Corp.
Chemical & Engineering News
CIBA-GEIGY Corp.
The Coatings Laboratory Inc.
Coatings Magazine
Color Corp.
Colorgen Industrial Group, Inc.
ColorTec Associates
Columbian Chemicals Co.
Consolidated Research, Inc.
CPI Purchasing Magazine
CR Minerals Corp.
Crosfield Co.
Cuno, Inc.
Custom Fibers International
CYDEC, Inc.
CYTEC Industries
D/L Laboratories
Daniel Products Co., Inc.
Datacolor International
Degussa Corp.
University of Detroit-Mercy
Disti
Dominion Colour Corp.
Dow Chemical USA
Dow Corning Corp.
Draiswerke, Inc.
Drew Industrial Div.
Dry Branch Kaolin Co.
DSA Consulting, Inc.
DSM Resins U.S., Inc.
Eagle Zinc Co./ Meadowbrook
Eastern Michigan University
Eastman Chemical Co.
Ebonex Corp.
ECC International
Eiger Machinery, Inc.
Elcometer, Inc.
Elf Atochem North America
Elmar Industries, Inc.
EM Industries, Inc.
Engelhard Corp.
Engineered Polymer Solutions
Epworth Mfg. Co., Inc.
EQ—The Environmental Quality Co.
Etna Products Inc., Specialty Chemicals
European Coatings Journal
Exxon Chemical Co.
Fawcett Co., Inc.
Federation of Societies for Coatings Technology
Filter Specialists, Inc.
Fischer Technology Inc.
Fluid Management
FMJ International Publications
Fryma, Inc.
Fugi Silysia Chemical Ltd.
H.B. Fuller Co.
Paul N. Gardner Co., Inc.
Georgia Pacific Resins, Inc.
The BFGoodrich Co., Specialty Chemicals
The Goodyear Tire & Rubber Co., Chem. Div.
W.R. Grace & Co., Grace Div.
Guertin Polymers
Haake, Inc.
C.R. Hall Company
Halox Pigments
Harcros Pigments, Inc.
William Harrison Corp.
Henkel Corp., Coatings & Inks
Heraeus DSET Laboratories
Heucotech Ltd.
Hilton-Davis Co.
Hockmeyer Equipment Corp.
Hoechst Celanese Corp., Pigments Div.
Horiba Instruments Inc.
J.M. Huber Corp., Calcium Carbonate Div.
J.M. Huber Corp., Clay Div.
Hüls America Inc.
Hunter Associates Laboratory
Ideal Mfg. & Sales Corp.
INSITEC, Inc.
International Resources, Inc.
International Specialty Chemicals
ITT Marlow/ITT A-C Pump
S.C. Johnson Polymers
K-T Feldspar Corp.
Kady International
Kemira, Inc.
Kenrich Petrochemicals, Inc.
King Industries, Inc.
KTA-Tator, Inc.
LaQue Center/Kure Beach Atmospheric Testing
Leeds & Northrup
Liquid Controls Corp.
Littleford Day Inc.
The Lubrizol Corp.
Luzenac America
3M, Specialty Chemicals Div.
3M/Zeelan Industries, Inc.
MacBeth, Div. of Kollmorgen
Magnesium Elektron, Inc.
Malvern Minerals Co.
The McCrone Group
McWhorter, Inc.
The Mearl Corp.
Michelman, Inc.
Micro Powders, Inc.
Micromeritics
Micromet Instruments, Inc.
Mid-States Eng. & Mfg. Co.
Milton Can Co.
Milwhite, Inc.
Mineral Pigments
MiniFIBERS, Inc.
Minolta Corp.
Mississippi Lime Co.
Univ. of Missouri-Rolla
Modern Paint & Coatings
Morehouse-Cowles, Inc.
Morton International, Inc.
Mountain Mineral Co., Ltd.
Myers Engineering
Nacan Products Ltd.
National Chemical Company
National Paint & Coatings
Netzsch Inc.
Neupak, Inc.
New Way Packaging Machinery
Norman International
North Dakota State University
NYCO Minerals Inc.
Oak Printing
Obron Atlantic Corp.
Ohio Polychemical Co.
Olin Chemicals
Ortech International
OSi Specialties, Inc.
Paar Physica USA, Inc.
Pacific Micro Software Eng.
Paint & Coatings Industry Magazine
Pen Kem Inc.
Peninsula Polymer
Phenoxy Associates
Poly-Resyn, Inc.
PPG Industries, Inc., Silica Products
PPG Industries, Inc., Specialty Chem., Chem. Group
PQ Corp./Potters Industries
Premier Mill Corp.
Progressive Recovery, Inc.
Pyosa, S.A. de C.V.
The Q-Panel Co.
Quantachrome Corp.
K.J. Quinn & Co., Inc.
Raabe Corp.
Ranbar Technology, Inc.
Red Devil Equipment Co.
Reichhold Chemicals, Inc.
Rheox, Inc.
Rohm and Haas Co.
Ronningen-Petter
Charles Ross & Son Co.
Russell Finex Inc.
Sandoz Chemicals Corp.
SCM Chemicals, Inc.
Schuller Filtration Inc.
Scott Bader, Inc.
Semi-Bulk Systems, Inc.
Serac, Inc.
Shamrock Technologies
Sheen Instruments Ltd.
Shell Chemical Co.
Sherwin-Williams Chemicals
Silberline Manufacturing Co.
Sino-American Pigment Systems
Software 2000, Inc.
Sonoco Products Co.
South Florida Test Services
Southern Clay Products, Inc.
Univ. of Southern Mississippi
Specialty Minerals, Inc.
Steel Structures Painting Council
Steeltin Can Corp.
Sub-Tropical Testing Services
Süd-Chemie, Rheologicals
Sun Chemical Corp.
Sunkyong Industries Ltd.
Systech Environmental
TA Instruments, Inc.
Tayca Corp.
Tego Chemie Service USA
Texaco Chemical Co.
Thiele Engineering Co.
Troy Corp.
U.S. Borax, Inc.
U.S. Sack Corp.
Union Carbide Corp.
Union Miniere
Union Process, Inc.
United Mineral & Chemical Corp.
Van Waters & Rogers, Inc.
R.T. Vanderbilt Co., Inc.
Versa-Matic Pump Co.
Viking Pump, Inc., A Unit of IDEX Corp.
Vorti-Siv/MM Industries, Inc.
Wacker Silicones Corp.
Witco Corp.
X-Rite, Inc.
Zeneca Biocides
Zeneca Resins

Coatings Characterization Using Multiple Techniques and Statistically Designed Experiments

Michael Neag, Patti Wilson, and Gary Skerl
The Glidden Co., ICI Paints North America*

This research centered on discovering individual relationships between formulation variables and the coating's performance. Variations in properties related to changes in catalyst, crosslinker, pigment, and an additive were studied using controlled stress rheometry, dynamic mechanical analysis, and tensile tests. A statistical design combining the elements of both a screening design and a response surface design significantly reduced experimental time, while fulfilling a broad array of experimental objectives. Among other things, this work revealed that the coatings were incompletely cured under typical bake conditions, the catalyst had the strongest influence on properties, and pigmentation reduced the performance properties. The results of this work led to significant improvements in the products performance and cost.

INTRODUCTION

A coating's performance depends on the effects (alone or together) of many formulation ingredients, processing conditions, and application variables. Isolating the important factors in product optimization may require many experiments and the analysis of an overwhelming body of data. The more instrumentation used and responses measured, the more difficult the analysis will become. Because of the difficulties associated with analyzing many variables at one time, bringing a coating to market is usually an incremental process which involves a number of separate "step-at-a-time" experiments. This kind of comprehensive one-at-a-time experimental approach, where important factors are tested individually against a "control" is usually cost prohibitive, especially when the number of experimental factors is large. Consequently, more limited designs with just one or two factors are used instead of the unwieldy conventional step-at-a-time multifactor experiments. Whatever information each of the simpler designs fails to provide, the coatings chemist supplies from experience and intuition.

Unfortunately, this kind of incremental experimental approach leaves much to chance: if the proper experimental terms are selected for each experiment, the results will lead along the right path. With continued success at each experimental increment, the work will lead to an acceptable product. If the experiments include the wrong variables or even the wrong levels, for example, pigment or catalyst, the experimental results will lead to poor decisions and worse, further work without relevance. Only after discovering and correcting these design errors can the experimentation lead to real progress. Unfortunately, a conventional one-at-a-time design can too often provide results that perpetuate the experimental process rather than timely product improvements. Statistically designed experiments can give truly significant product improvements with far less effort.

Statistically designed experiments offer a potential solution to this problem, allowing the coatings chemist the opportunity to work with many factors and responses in a single design. A good design examines the entire range of experimental limits, focusing experimental work on the best possible combination of factors while revealing how various factors influence one another. Perhaps most important, a well-designed experiment will yield as much information as a traditional design (e.g., a cure ladder) with far less effort and vastly reduced potential for error. A number of books and articles have been written on the general use of statistical design[1,2] and their application to the coatings industry.[3-6] Several types of designs have been applied to coatings formulation, ranging from factorial designs[7-9] and mixture ex-

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*16651 Sprague Rd., Strongsville, OH 44136.

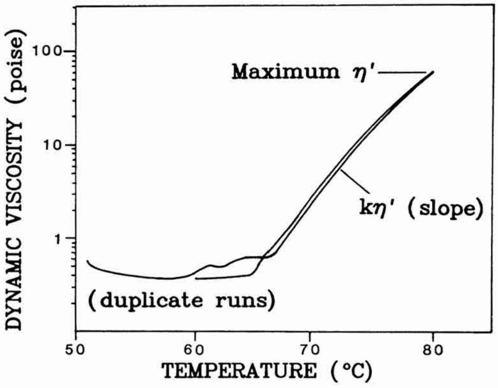

Figure 1a—Typical increase in dynamic viscosity during cure

periments[7,10] to Taguchi experiments[11] and central-composite designs.[12] The work reported here combines the elements of screening and response surface designs to investigate the effects of formulation changes on coating properties. In the acrylic-urethane coating used in this study, little was known about the relationship between the various formulation variables, the cure process, and the performance properties. Earlier work indicated that the pigment dispersant altered the cure process and that the formulation was sensitive to process conditions. The general lack of knowledge about the intrinsic properties of these coatings coupled with occasional production problems suggested the need to study them in more detail. This research effort centered on discovering the relationship between four formulation variables (experimental factors) and the coating's dynamic mechanical properties, tensile properties, and rheological properties.

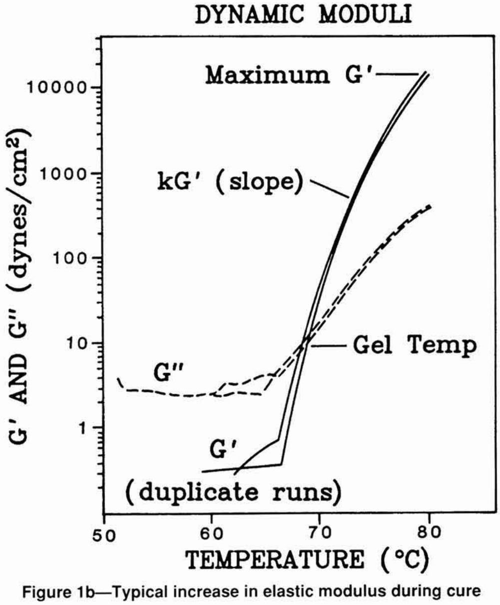

Figure 1b—Typical increase in elastic modulus during cure

The need for quick answers and the complexity of the coating's formulation argued against a traditional experimental approach. Instead, an experimental design combining the elements of a screening design with those of a response surface design was selected. This design significantly reduced the time required to satisfy the experimental objectives, requiring just 13 experiments and about 225 measurements. A more traditional one-at-a-time experimental approach yielding the same amount of information would require 36 separate experiments and nearly 650 measurements. Forgetting the advantage of sophisticated analyses available in a statistical design, simply reducing the experimental effort significantly reduced the probability for mistakes and saved valuable resources.

EXPERIMENTAL

Materials: The coating used in this study was a solvent-borne two-pack urethane based on a mixture of several hydroxy-functional polymers (primarily acrylic). The coating also contained a tin catalyst, a carbon black pigment, and a dispersant. The pigment and dispersant came as a part of a commercially available slurry and were blended with the rest of the formulation components prior to the addition of the isocyanate crosslinker and eventual application. Coating the finished part involves placing the coating into a preheated mold, allowing solvents to evaporate, and subsequently injecting the matrix resin, either a urethane or SMC, into the mold. The entire process involves low temperatures (60°C or less) and short cure times (30 sec to 2 min) with variations depending on the part size and the manufacturer. The coating cures partially—in essence it is a B-staged thermoset—before the matrix resin is injected into the mold.

Experimental Design: A D-optimal design was used to test relationships between formulation and performance. The design was modified to include experiments to test the interaction between the catalyst and pigment dispersant. Four experimental factors (or variables) at two or three levels were incorporated into the design. For the dispersant, formulations with 0, 0.5, and 1 wt% (standard level), correspond to level designations of 0, 1/2, and 1, respectively. The catalyst level was similarly varied, with the standard level being 0.15 wt% based on resin solids. For the crosslinker, the standard level of 15 wt% was compared with 5% excess, denoted as levels 0 and 1, respectively. For the pigment, formulations were either made with or without it, corresponding to levels 0 and 1. *Table* 1 provides an overview of the design while *Table* 2 lists the various experimental formulas and relative level of each of the four factors used. The formulation used in experiment #5 most closely represents a "standard" material.

Instrumentation

Rheology: Dynamic viscosity (η'), elastic modulus (G'), viscous modulus (G"), and four other responses were examined using the high-temperature unit of a Carri-Med Controlled Stress Rheometer. Next, 0.4 ml aliquots were spread

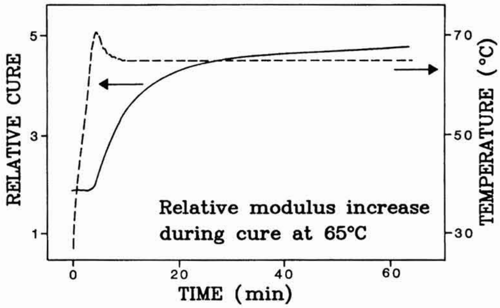

Figure 2a—Increase in relative modulus (ΔHz) during isothermal DMA cure curve

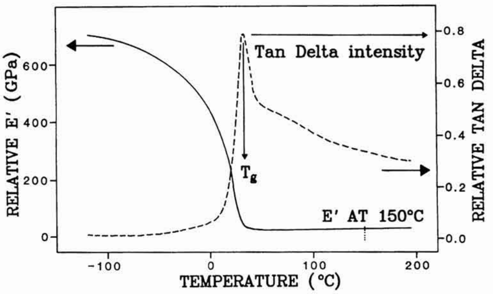

Figure 2b—Dynamic mechanical properties used in statistical design

on 4 cm parallel plates and heated from 50 to 90°C over a five-minute period (ca. 8°C/min). An oscillation amplitude of 15 mrad was used in these experiments with each run terminated at the instrument's maximum torque. Pertinent rheological responses are illustrated in *Figures* 1a and 1b.

Dynamic Mechanical Analysis (DMA): A TA Instruments 983 DMA/2000 system was used to obtain the rate and degree of cure (DOC), T_g, relative modulus, and relative tan δ intensity in the experimental design research. Seven material responses were measured at various points during and after cure in DMA studies. Rates of cure were determined during simulated DMA bakes. Four others—DOC, T_g (after simulated bake and at full cure), and tan δ peak intensity were measured immediately after simulated bake, and two—T_g and tan δ peak intensity—were measured again after the coating was completely cured. Relevant DMA responses are illustrated in *Figures* 2a and 2b.

Three DMA scans were required to describe these systems; all of the DMA runs employed stainless steel mesh ("screen") as a supporting substrate. The first scan—the "cure" scan—emulated in-mold cure as closely as possible. In this scan, the DMA furnace was preheated to 71°C, a 25 μl aliquot was applied to the stainless steel mesh, the unit closed, and the coating cured for one minute at 1 HZ and an oscillation amplitude of 0.2 mm. Two temperature sweeps following DMA were required to characterize the coating's performance properties and the relative DOC of the partially cured coating. Both sweeps were completed at 5°C/min under N_2 following controlled cooling to -125°C. The first temperature sweep established the degree of cure at 71°C and took the coating to complete cure (provided it was not fully cured). The second sweep provided a measure of the coating's properties after reaching complete cure.

In time-temperature superpositioning (TTS) studies, the standard coating formulation was "cured" at 55, 65, and 75°C for 70 min using the 982 DMA. Braided fiberglass substrates were substituted for stainless steel mesh to improve sensitivity. One hundred-μl aliquots were applied to 20 mm regions of braid, heated ballistically to the cure temperature, and held for one hour. Relative modulus values for time at temperature were used in these studies. As in the other portion of the experiment, the DMA oven was preheated to the isothermal temperature before beginning the analysis.

Tensile Tests: An Instron model TM was used in tensile testing; all tests were run under ambient conditions. Coating samples were drawn down over glass using a 5 mil drawdown bar and baked two minutes at 71°C in a forced air oven. A template was used to cut strips measuring approximately 76 × 18 × 0.12 mm. A 25 mm gauge length (distance

Table 1—D-Optimal Screening Design: Factors and Responses

4 Factors

Dispersant	3 levels	0, 0.5, 1
Catalyst	3 levels	0, 0.5, 1
Crosslinker	2 levels	0, 1
Pigment	2 levels	0, 1

Responses

Carri-Med Rheometer	Rheological: gel point G′-rate & max; G″; dyn η, η_{max}
DMA	Dynamic mechanical: gel point cure rate, DOC, tan δ, T_g
Instron	Tensile properties: E, σ_B, ε_B, W_B

Table 2—Coating Formulations and Variable Levels

Experiment Number	Dispersant	Catalyst	Pigment	Crosslinker
1	0.0	0.0	0	0
2	1.0	0.0	1	1
3	0.5	1.0	1	0
4	0.0	1.0	0	0
5[a]	1.0	1.0	1	1
6	0.0	0.5	1	0
7	1.0	0.5	0	0
8	0.5	0.5	0	1
9	0.0	1.0	0	1
10	0.0	0.0	1	1
11	0.5	0.0	0	0
12	1.0	1.0	0	0
13	1.0	0.0	1	0

[a] Standard formulation.

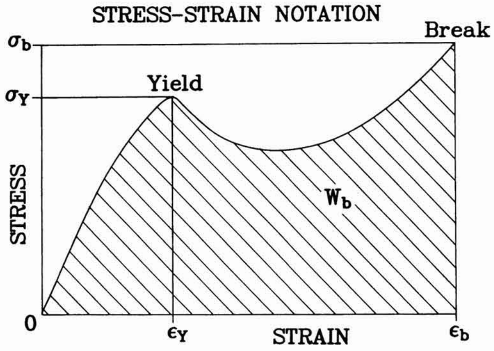

Figure 3—Tensile properties used in statistical design

Table 4—Effects of Formulation Variables on Rheological[a]

Factor	kη'	kG'	Max G'	Max η'
Dispersant	–	–	0	–
Catalyst (catalyst)	+	+	+	+
Pigment	–	0	0	+
Excess crosslinker	+	0	0	0
Catalyst × dispersant	–	–	–	0

(a) Properties: (+) increase; (0) no effect; (–) decrease.

Table 3—R^2 Values for Individual Models

Response	Adjusted R^2
kη′	0.89
kG′	0.88
Max G′	0.79
Max η′	0.64
DOC	0.91
T_g	0.89
Tan δ intensity	0.89
Cure rate	0.87
Young's moldulus (E)	0.82
Work at break (W_B)	0.92
Stress at break (σ_B)	0.96
Strain at break (ε_B)	0.70

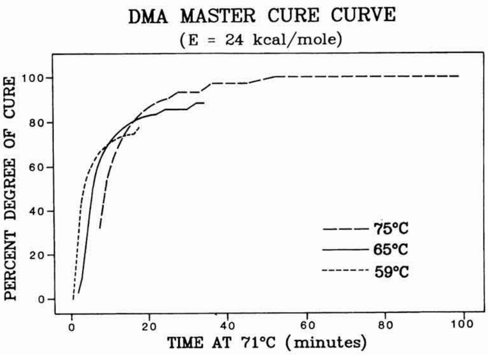

Figure 4b—DMA mastercurve for time at 71°C. Superimposed data for above isothermal temperatures

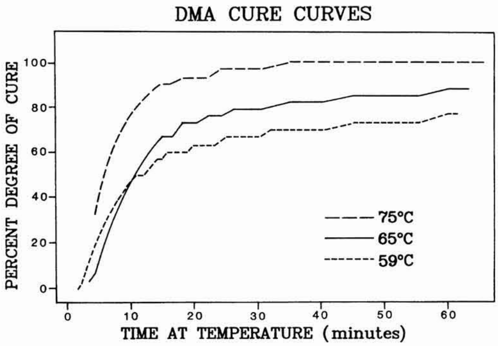

Figure 4a—DMA degree of cure curves for isothermal cure at 59, 65, and 75°C

Table 5—Effects of Formulation Variables on Dynamic[a]

Factor	DOC	T_g	Tan δ Intensity	Cure Rate
Dispersant	0	0	0	0
Catalyst (catalyst)	+	+	–	0
Pigment	–	0	0	0
Excess catalyst	0	0	0	0
Catalyst × dispersant	–	0	–	0
Catalyst × crosslinker	0	0	0	0
Catalyst × pigment	0	0	0	0

(a) Mechanical properties: (+) increase; (0) no effect; (–) decrease.

between the jaws) and a crosshead speed of 25 mm/min (strain rate = 100%/min) were used in all tests. *Figure* 3 illustrates the typical responses measured in tensile testing. Yield stress and stress at break were considered equivalent in these tests since none of these coatings exhibited a true yield point.

Cure Studies

The characteristic forms of dynamic mechanical and rheological cure curves disclose several important aspects of the crosslinking process. From a processing perspective, the most important feature of both cure curves is the gel point. This point denotes the transformation of the polymer from a viscous liquid to an elastic gel and marks the processability limit of the thermosets. Given the short cure schedule in coating applications (ca. 1 min @ 71°C), the rate of cure (ROC) carries great significance as well; especially since it defines the time to reach the gel point. In general, rheological studies describe the cure behavior of these coatings from the beginning of the crosslinking reaction to the gel point and somewhat beyond, while dynamic mechanical methods can follow the cure process from just before or at the gel point through the end of the cure process.

RHEOLOGICAL CURE STUDIES: In these studies, changes in viscosity, elastic modulus, and viscous modulus observed using the Carri-Med rheometer parallel the increase in the development of properties. *Figure* 1a shows the rise in dynamic viscosity as the crosslinking reaction progresses, the slope of this line is proportional to the rate of reaction while Max η′ represents the maximum viscosity measurable with this technique under these conditions. *Figure* 1b illustrates the elastic (G′) and viscous (G″) components of the modulus during cure. The gel point is marked by the point where G′ = G″. The second line in each plot illustrates the repeatability of the technique.

DMA CURE STUDIES: As these coatings cure, an increase in crosslink density leads directly to an increase in the modulus (stiffness) of the coating. A rise in the resonant frequency (ΔHz) or relative ΔE′ parallels the development of mechanical properties during the network formation process. *Figure* 2a shows a characteristic increase in relative modulus in the coating during cure in the DMA. The characteristic rise in relative modulus (E′) at the beginning of the isothermal scan (about three minutes into the experiment) approximates the approach of the gel point.

In dynamic mechanical tests, the relative modulus of the coating increases and approaches a plateau marking the end of the crosslinking process. Thermosets cured to the plateau will possess less damping, have higher T_gs, and be more brittle than thermosets cured to a point below the plateau. In most coatings applications, the crosslinking process rarely goes to completion (i.e., reaches this plateau). Instead, processing conditions or acceptable performance properties mark the upper limits of the degree of cure.

The relative DOC of the coating following the DMA cure was obtained by comparing modulus values after partial cure in the DMA with the modulus values after reaching complete cure. For example, if the total relative modulus increase during bake is 0.2 Hz and 2 Hz at complete cure, then the DOC of the coating is 0.2/2 × 100 or 10%. A degree of cure curve is constructed by plotting specific DOC points against time or temperature from the beginning to the end of the cure process. *Figure* 4a shows DOC curves for the coating used in this work at three isothermal temperatures. The methods used to calculate DOC are described in more detail elsewhere.[13] Rate of cure values were taken as the derivative of the increase in the modulus curve, dE'_c/dt, (GPa/min) where E_c is the relative modulus value 30 sec after reaching 71°C.

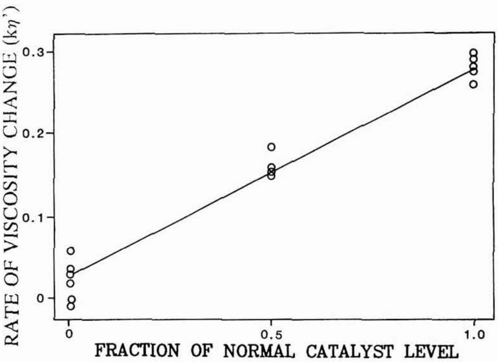

Figure 5—Catalyst effect on kη′

TIME-TEMPERATURE SUPERPOSITION: The TTS model for cure exploits the relationship between temperature and "mechanical cure." In DMA studies, an increase in bake temperature causes a corresponding increase in the rate and degree of mechanical properties development. This simple relationship (shown in *Figure* 4a) forms the basis for the TTS model of the cure process. In this work, time-to-cure data from three isothermal runs were used to predict the time to cure at typical bake temperatures. The model uses the Arrhenius rate constants at isothermal temperatures to generate a shift factor used later in superimposing the experimental data to times at any other isothermal temperature.

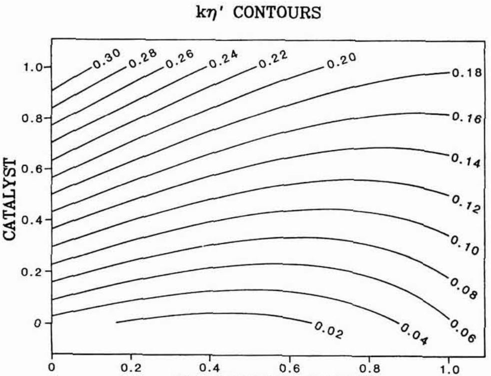

Figure 6—The effect of catalyst and dispersant on cure rate (kη′)

Table 6—Effects of Formulation Variables on Tensile[a]

Factor	Response Young's Modulus E	W_B	σ_B	ε_B
Dispersant	+	0	+	0
Catalyst	+	+	+	+
Pigment	–	–	–	–
Excess crosslinker	+	+	0	–
Catalyst × dispersant	0	0	0	0
Catalyst × catalyst	0	0	0	+

(a) Properties: (+) increase; (0) no effect; (–) decrease.

RESULTS AND DISCUSSION

The work which follows was used to eliminate application problems and improve the performance of a solventborne urethane-acrylic coating. The results of the designed experiments helped chemists implement a number of formulation changes which not only improved performance, but also reduced coating costs. These changes included a reduction in catalyst, the elimination of the pigment dispersant, and a change in the reactivity of the urethane-acrylic polymer.

Time-Temperature Superposition of DMA Cure Curves

The DOC versus time curve showed that the coating fails to reach complete cure under typical bake conditions using the TTS process. The DMA DOC curves shown in *Figure* 4a were shifted using the TTS process to give the superimposed "mastercurve" shown in *Figure* 4b. The activation energy required to superimpose these curves to times at 65°C in *Figure* 4b was 24 Kcal/mole—an activation energy typical of acrylic systems.

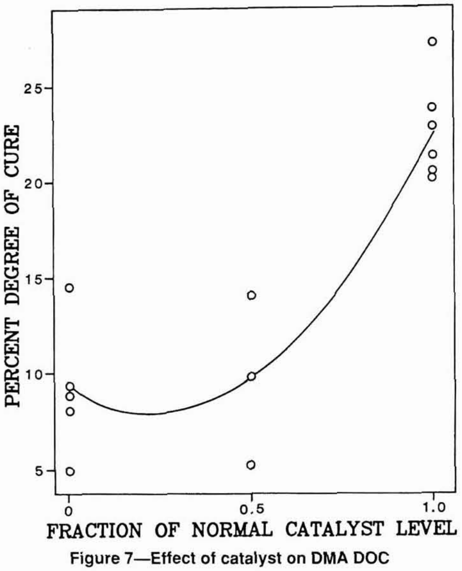

Figure 7—Effect of catalyst on DMA DOC

Inspection of the superimposed curves indicates that the standard coating formulation requires well over an hour to reach complete cure at 71°C—a typical cure temperature for the coating. In fact, these results show that these coatings reach somewhere around 10-15% of their potential mechanical properties development during the "typical" cure process. Degree of cure values obtained in simulated bakes for the experimental design corroborated the TTS results and will be discussed.

Statistical Design Analysis

Generalizations about the effect of formulation factors on the various experimental responses were made by creating a mathematical model for the effects formulation variables on the measured responses. The first step in the modeling process was to determine the effect of each design factor on the various instrumental responses. Factors which were found to be insignificant were removed from the model. Later, the interaction between factors was also tested. In the end, this step-by-step approach yielded a model which included only terms (or factors) which had a significant effect on the responses measured. The adjusted R^2 values for each response in the final model are shown in *Table* 3; the closer this value comes to one, the more significant the effect. Where individual linear effects were reported as statistically significant, the probabilities were quite high ($P < .001$). Statistical probabilities for significant curvilinear effect (i.e., effects which are asymptotic or have minima or maxima) were lower ($P < .05$) but nonetheless significant. Keep in mind that low probability or "P" values indicate high significance. The lower the P value, the higher the significance.

Of the formulation factors tested, the level of catalyst had the strongest influence on both cure and ultimate mechanical properties. Increasing the catalyst level increased the rate and extent of rheological development, the degree of cure, and all tensile properties. The level of pigment dispersant also altered properties significantly, having its greatest effect at one-half the standard level. Unlike the catalyst, it appeared to reduce the development of rheological properties and the extent of cure rather than increase them. The dispersant seemed to increase the overall toughness of the coating, and also interacted to reduce the effectiveness of the catalyst. Pigmentation reduced the value of many responses and appeared to have poor reinforcing properties. Excess crosslinker significantly improved the toughness of the coating and increased the cure rate, but its effect on properties was otherwise negligible. Other than the pigment dispersant's deleterious effect on the catalyst's performance, each of the factors appeared to act independently of one another, although the supporting the data for this conclusion is limited by the design format. *Tables* 4-6 summarize the results from the statistical design, showing the general effect of a given factor on rheological, dynamic mechanical, and tensile properties. A more detailed review of the relationship between formulation variables and response is provided in subsequent sections.

RATE OF CURE: The effect of formulation variables on cure rate are best illustrated by changes in viscosity (η') and

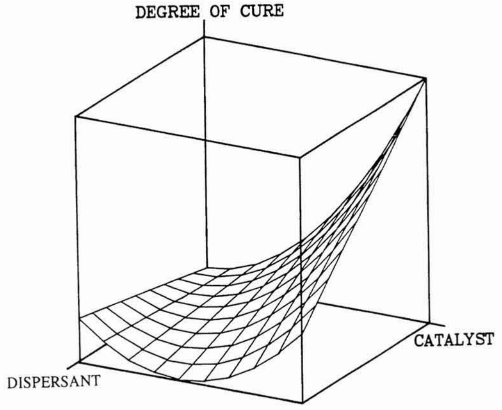

Figure 8—Three-dimensional plot illustrating the effects of the pigment dispersant and catalyst on DOC

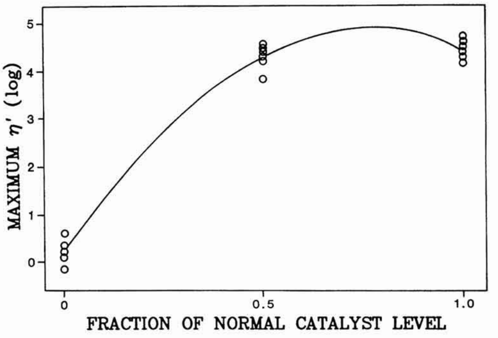

Figure 9—Catalyst effects on η'_{max}

elastic modulus (G'). An increase in η' parallels increases in both chain length and crosslink density, while G' will increase with crosslinking and network development. A change in $k\eta'$ and kG' (where k signifies a rate) denotes a change in the rate of cure: the higher the values of $k\eta'$ and kG', the higher the rate of cure. The effects of formulation on $k\eta'$ and kG' are shown in *Table* 4.

An examination of individual effects (without complicating interactions from other factors) indicates that catalyst and pigment dispersant levels had the greatest effects on cure rate, while pigmentation and excess crosslinker had minimal effects. As the results in *Table* 4 show, raising the catalyst level significantly increased $k\eta'$ and kG'. *Figure* 5 indicates that the highest values for $k\eta'$ coincided with the highest (standard) catalyst level. Catalyst affected kG'—the rate of change in elastic modulus (kG')—in a similar way: higher catalyst levels produced a more rapid increase in modulus.

The dispersant level had the opposite effect on cure rate. Raising the dispersant level reduced both $k\eta'$ and kG', two of the terms describing the rate of cure. Somewhat surprisingly, moderate levels of the pigment dispersant produced the greatest reduction in cure rate. Projections based on the model showed that the minimum cure rate corresponded to about 70% of the standard dispersant level. The effect of the pigment dispersant on kG' was similar, with a minimum ROC predicted at the 60% level.

The pigment dispersant also affected cures rates by reducing the effectiveness of the catalyst, as illustrated in *Figure* 6. With no dispersant present, increasing the catalyst level from 0 to 1 (standard level) increased $k\eta'$ from 0.02 to 0.30. However, at the standard dispersant level of 1, the values of $k\eta'$ increased from 0.06 to only 0.18, significantly below $k\eta'$ values attained with catalyst alone. The interaction of catalyst and dispersant produced similar effects on kG', with kG'

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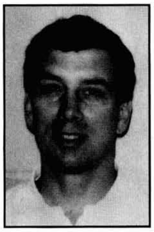

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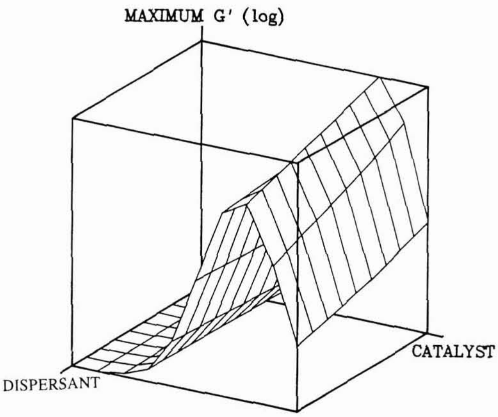

Figure 10—Effects of catalyst and dispersant on G'_{max}

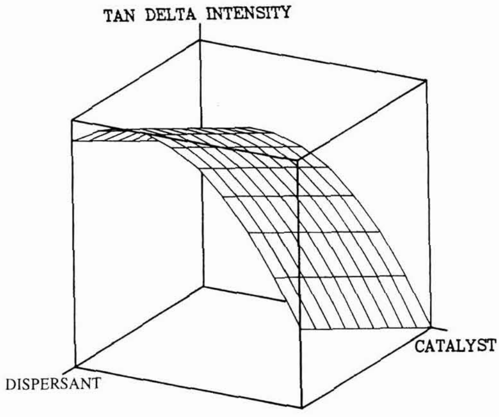

Figure 11—Relationship between catalyst, dispersant, and tan δ

values at the maximum catalyst level dropping from 0.7 to about 0.45 as the pigment dispersant was added. The molecular basis for the effect the dispersant had on the rate of cure remains unclear.

DEGREE OF CURE: DMA degree of cure levels were significantly affected by catalyst and pigment, while the impact of the dispersant and excess crosslinker on DOC was negligible. As *Figure* 7 shows, significant increases in DOC correspond to increasing catalyst level. Conversely, pigmentation had the opposite effect on DOC: as pigment level increased, DOC decreased, although the affect appeared to be relatively small. *Table* 5 summarizes the effects of coating composition on the degree of cure and mechanical properties after simulated bake.

While the pigment dispersant did not have a significant effect on its own, it did affect DOC by reducing the effectiveness of the catalyst (similar to the effects of $k\eta'$ and kG'). The three-dimensional plot shown in *Figure* 8 illustrates the reduced effect of catalyst on DOC at high dispersant levels. Without the dispersant, the degree of cure rises rapidly with increasing catalyst level; with the dispersant, the DOC remains low, regardless of catalyst level. Note that the minimum DOC occurred at one-half the normal dispersant level—an effect observed in all of the systems formulated with the dispersant.

Under typical cure conditions, these coatings attained only a fraction of their potential mechanical properties development, regardless of the formulation tested. DOC values obtained after simulated DMA bakes were at or below 25% for all 13 formulations. The DOC for the standard formulation (#5) was 13%, about the middle of the range predicted by TTS methods. Given the short cure cycles and the rapid cure of these coatings, cure characterization—both mechanistic and kinetic studies—should probably receive a great deal of attention in developing new formulations.

VISCOELASTIC PROPERTIES: The viscoelastic properties obtained by DMA, rheometry, and tensile testing after "bake" provided for an excellent qualitative comparison of the relationship between formulation and performance. Included with these results are viscoelastic properties from DMA (tan δ, T_g) rheological properties (G'_{max} and η'_{max}), and tensile properties. The effects of each factor are summarized in *Table* 4 for rheological properties, *Table* 5 for dynamic mechanical properties, and *Table* 6 for tensile properties, and are described in detail in the following text. High tan δ values from the DMA indicate a soft material and low values point to a hard substance. This effect would be directly related to an increase in G'_{max} in rheological experiments. In the latter case, an increase in crosslink density leads to a decrease in segmental mobility and an increase in the elastic

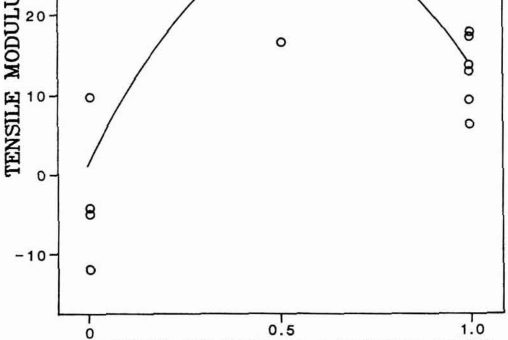

Figure 12—Effect of catalyst level on tensile modulus

modulus (i.e., the coating is stiffer). If the coating is stiffer, less energy can be absorbed when mechanical stresses are applied and the tan δ intensity is reduced. Although many of the rheological maxima were reached prior to reaching the normal cure temperature, they may have provided the best correlation between formulation and performance.

Tensile properties are distinguished from dynamic mechanical and rheological properties in that they measure failure properties rather than bulk properties. The four tensile properties used in this work are illustrated for the standard coating formulation in *Figure* 3. Young's modulus (E) is a ratio of the stress to strain at very small strains ($<<5\%$). The work at break (W_B) is the integral of the area under a stress strain curve (see *Figure* 3) and measures the toughness of the coating. The stress at break is defined by σ_B and the strain (extension) at break is denoted by ε_B. Typically, six tests were averaged to produce the values used in the analyses described. Tensile tests revealed that standard coating formulations produced a soft, weak, elastomeric material. A typical elastomer will have a Young's modulus value of about 300 psi and tensile strength (σ_B) measuring 2000 psi. The tensile properties of formulations tested in this work gave similar (though somewhat lower) values. For example, values for E and σ_B for the standard coating formulation were 22 and 570 psi, respectively.

Just as in cure studies, catalyst—alone or in combination with the dispersant—significantly affected all of the responses (rheological, DMA, tensile). Although catalyst level sharply influenced tensile properties, it was less important in dynamic mechanical and rheological characterization. Catalyst increased both η'_{max} and G'_{max}, indicating an increase in chain length and crosslink density. The fitted data shown in *Figure* 9 reveals that the maximum viscosity (MAXIMUM η') occurred at about 70% of the normal catalyst level, as did the maximum elastic modulus (G'_{max}). The catalyst's affect on η'_{max} and G'_{max} was reduced somewhat in the presence of the pigment dispersant, similar to the effects on rate and degree of cure, as shown in *Figure* 10 (for G'_{max}).

Increasing the catalyst level increased the DMA T_g and reduced the tan δ intensity, as shown in *Figure* 11. This decrease in tan δ intensity corresponds to a reduction in damping (energy absorption upon stress) caused by higher crosslink density.

Increasing catalyst level also significantly increased all of the measured tensile properties. Without catalyst, tensile properties were all but unmeasurable. The filled data in *Figure* 12 shows the general relationship between catalyst level and tensile properties. Like tensile modulus shown in *Figure* 12, each tensile measurement reached a maximum at an intermediate catalyst level. This strongly suggests that a lower catalyst level would improve performance.

Pigment had significant effects on η'_{max} and all tensile properties, but did not affect DMA T_g or tan δ. Adding pigment dropped the η'_{max} value, evidence indicating problems with the pigment dispersion or pigment wetting. The significant reduction in tensile properties supports this conclusion. *Figure* 13 shows the decrease in stress at break (σ_B) when pigment was added to the formulation. On the average, σ_B values fell by about a third. The loss in tensile strength was typical of the effect of pigment on the other tensile properties. These results are surprising. A good pigment-binder interaction usually reinforces tensile properties rather than weakening them. When the reinforcing qualities of the pigment are poor, it is generally due to poor dispersion (e.g.,

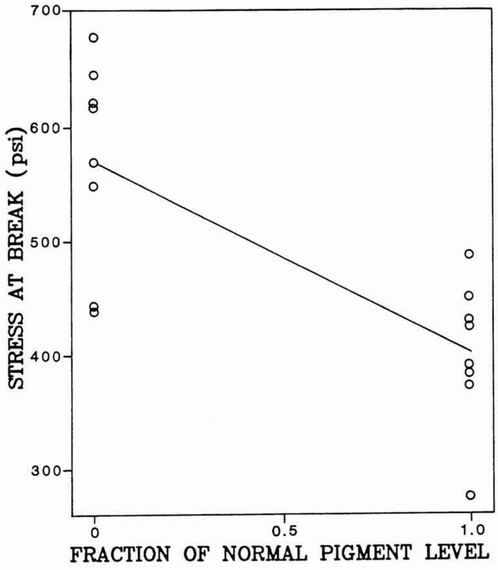

Figure 13—Pigment effects on the stress at break (σ_B)

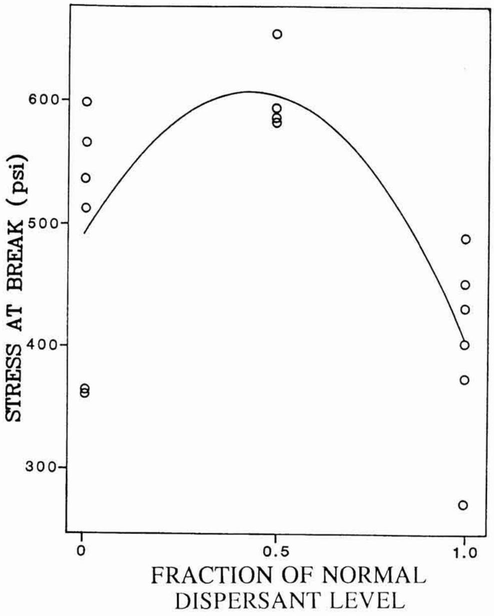

Figure 14—Effects of pigment dispersant on stress at break (σ_B)

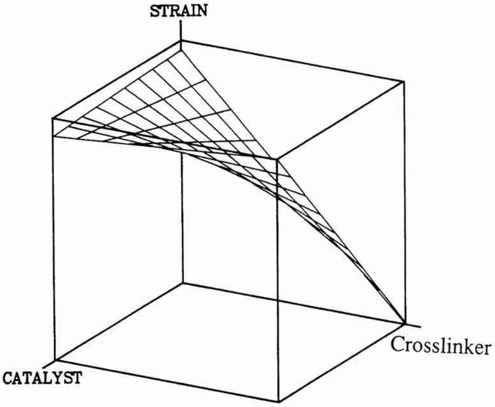

Figure 15—Relationship between catalyst, excess crosslinker, and the strain at break (ε_B)

by agglomeration or settling) or poor interaction between the pigment and the matrix resin.

The level of pigment dispersant had only minor effects on rheological and dynamic mechanical properties, but more significant effects on tensile properties. Increasing the level of dispersant increased the coating's modulus and stress at break. The greatest effect occurred at moderate levels, as shown in *Figure* 14 for σ_B; note that the maximum occurred at about 50% (0.5) of the standard dispersant level. Any interaction between the dispersant and the pigment were statistically insignificant.

Excess crosslinker had no effect on bulk rheological or dynamic mechanical properties, but did affect tensile properties. Excess crosslinker appeared to yield coatings with greater toughness (i.e., higher W_B) and higher modulus (E). There also was an interaction between the excess crosslinker and catalyst, as shown in *Figure* 15, for their combined effect on strain at break (ε_B). Without catalyst, excess crosslinker caused a profound decrease in strain a break, while at high catalyst levels, the excess crosslinker has very little effect.

CONCLUSIONS

Cure studies using time-temperature superposition methods indicate that these systems are only partially cured under typical injection molding conditions. If one minute at 71°C represents a typical cure schedule, then only 10-15% of the potential "mechanical" cure develops. The minimum cure temperature in these systems appears to be between 50 and 55°C.

A statistical design involving 13 formulations revealed that catalyst, pigment dispersant, pigment, and excess crosslinker all affected cure and performance properties. The rheological, dynamic mechanical, and tensile properties varied in different ways, depending on the formulation variable. Catalyst increased the rate and extent of rheological development and all tensile properties. The pigment dispersant had its greatest impact at moderate levels, depressing both rheological development and the extent of cure while increasing the toughness of the coating. Pigmentation reduced most of the properties and was particularly detrimental to tensile properties. The reinforcing properties to the pigment were poor, strongly suggesting that the pigment was poorly dispersed within the matrix. Excess crosslinker significantly improved the toughness of the coating and also increased the rate of cure; its effect on viscoelastic properties were marginal.

Generally, all of the factors, except catalyst and pigment dispersant in some instances, appeared to act independently of one another. Statistical data supporting this conclusion is limited. Statistical significance for linear effects was measured at significance levels at better than P = .001; statistical significance for curvilinear effects (i.e., effects which are asymptotic or have minima or maxima) tended to fall much nearer the P = .05 level. Even though the experimental design was not intended to encourage one-to-one comparisons between experimental formulations, the formulations with the most "acceptable" combination of properties were experimental samples 4, 8, and 9. These formulations had high catalyst levels, no pigment, and may or may not have included the pigment dispersant and excess crosslinker. They had moderate to high cure rates, higher final T_gs, and higher DOCs plus the "best" tensile properties.

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Mechanical Stability of Alkyd Emulsions— Part 1: Influence of Emulsion Droplet Size And the Emulsifier

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The limited colloidal stability of alkyd emulsions compared to that of organic solvent-borne alkyd paints is a well-known problem. For environmental reasons, however, the alkyd emulsions have a great advantage since they are waterborne. In this study, the influence of emulsifier and initial droplet size on the mechanical stability of alkyd emulsions was investigated. Anionic emulsifiers have been shown previously to be more effective than nonionic emulsifiers in the formation of alkyd emulsions. This study showed that an anionic emulsifier also gave more stable emulsions at lower concentrations than did the nonionics. If the concentration was increased, emulsions stabilized with a nonionic emulsifier showed the same stability as the one with the anionic emulsifiers. However, too high a concentration of surfactants is undesirable in paints, since it increases the water sensitivity of the paint film. The mechanical stability of emulsions stabilized with anionic emulsions was less sensitive to the initial droplet size than emulsions stabilized with a nonionic emulsifier.

INTRODUCTION

For health and environmental reasons, there is an increasing interest in waterborne alkyd paints. Alkyd paint films have properties such as high-gloss and good weather resistance, which are not easily obtained with latex paints. Another advantage is that to a great extent, alkyds are produced from renewable raw materials.

Alkyd emulsions, in which the alkyd oil is emulsified in water and stabilized by surface active agents, are the most interesting alternative from an environmental point of view since they contain no cosolvents or neutralizing amines as do the water-soluble alkyds.[1-4] A problem with alkyd emulsions, however, is their limited colloidal stability. This includes both storage and mechanical stability. When an emulsion, for example, is pumped in a paint circulating system, it is subjected to shear forces that can cause destabilization. The main factors determining the colloidal stability are the emulsifier and the emulsion droplet size.[5,6]

This paper presents an investigation of how these parameters influence the shear stability of alkyd emulsions.

EMULSION STABILITY

Generally there are four different destabilizing mechanisms for emulsions: sedimentation (separation by the motion of emulsion droplets that have different density than the surrounding liquid), flocculation (two droplets in an adhesive contact), coalescence (when two droplets merge into one), and Ostwald ripening (transport of materials from small to large droplets).[5,6] These mechanisms influence each other during an emulsion breakdown process and several of these mechanisms may occur simultaneously.

The emulsion is formed by an emulsification process in which the oil phase is dispersed into small droplets. Emulsification reduces the droplet size and thus reduces sedimentation and the coalescence. The emulsifier supports this action by first lowering the surface tension and then protecting the system from flocculation and coalescence by creating a repulsive barrier around the droplets. This is achieved by steric stabilization in the case of nonionic emulsifiers or polymers and by electrostatic stabilization in the case of ionic emulsifiers.[7]

The droplet size is the key parameter determining the kinetics of emulsion destabilization. Large droplets are exposed to sedimentation and coalescence while finely dis-

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persed emulsions are more sensitive to flocculation and Ostwald ripening.[5,6] For shear-induced destabilization, flocculation and coalescence are the most important mechanisms. The coalescence event is usually viewed as the final result of a flocculation event. The coalescence process in a nonflocculated emulsion can be described as a flocculation process if the coalescence rate is assumed to be proportional to the number of impermanent doublets. The number of impermanent doublets is proportional to the number of interparticle collisions. The collisions may be caused by: Brownian motion (perikinetic flocculation), sedimentation motion (gravity induced flocculation), or motion in a shear field (orthokinetic flocculation).

The kinetics of shear-induced flocculation in laminar flow (orthokinetic flocculation) were first described by Smoluchowski[8] as:

$$\frac{dN}{dt} = -\frac{32}{3}N^2Sr^3 \tag{1}$$

where N is the number of particles per unit volume, S is the shear rate in reciprocal seconds, and r is the radius of the particle.

In a coalescing system where it is assumed that all collisions lead to coalescence, the radius is a function of the number concentration of particles and has to be treated as a function of N according to

$$N = \frac{3\phi}{4\pi r^3} \tag{2}$$

where ϕ is the volume fraction of the dispersed phase. The flocculation rate equation then becomes:

$$\frac{dN}{dt} = -\frac{8\phi S}{\pi}\cdot N \tag{3}$$

The solution of the differential equation is then:

$$N(t) = N_0 e^{-\frac{8\phi S}{\pi}t} \tag{4}$$

The shear-induced flocculation in turbulent flow fields has been estimated by Levich[9] by applying Kolmogorov's theory of turbulent flow:

$$\frac{dN}{dt_{Turb.}} = -12\pi\beta\sqrt{\frac{\varepsilon_{intensity}}{\eta}r^3N^2} \tag{5}$$

where $\varepsilon_{intensity}$ is the energy intensity per unit volume in W/m^3, β is a correction constant close to unity, and η is the viscosity of the dispersion. The energy intensity under laminar shear is = S^2 η. Comparison of equations (1) and (5) shows that the flocculation is increased about three times when the flow changes from laminar to turbulent at a constant energy intensity. More dramatic differences appear when the flocculation rates are compared at constant shear-rate (or stirring rate). The energy intensity is about twice as high for turbulent flow in the transition regime as for laminar flow. The shear-rate dependence of the intensity changes from S^2 to $\hat{S}^3$, where $\hat{S}$ is the apparent shear rate (estimated as if the flow were laminar).[10] The consequence is a very rapid increase in flocculation rate when the flow changes from laminar to turbulent.

So far we have described the flocculation process only in terms of the change of particle concentration with time. In practice, however, an emulsion is usually defined by the particle size and the volume fraction of the dispersed phase.

The different flocculation rate mechanisms are recalculated as a function of volume fraction and particle diameter in *Table* 1 using equation (2). Here it is evident that while the Brownian flocculation (in terms of dr/dt) rapidly declines with increasing radius, the shear-induced flocculation increases with increasing particle radius. This gives an exponential increase in radius with time (at constant shear rate) and an even more rapid increase ($\infty e^{\hat{S}^{\frac{3}{2}}}$)with increasing shear.

The description of the orthokinetic flocculation has certain limitations in that it does not include repulsive and attractive surface forces or hydrodynamic interactions. The orthokinetic aggregation of solid particles in a laminar flow field including surface forces and hydrodynamic interactions has been treated by Zeichner and Schowalter[12] and by Van de Ven and Mason.[13] By trajectory analysis they studied whether a collision under certain conditions leads to aggregation and thus have been able to define areas of stable and unstable systems.

Their results show that aggregation is feasible for small particles and that the aggregates are easily disrupted when large particles are involved. Strong repulsive barriers can only be overcome at intermediate sizes and at shear rates between 100 and 500 s^{-1}. Higher shear rates lead to disruption of the aggregates. However, it is also necessary to consider the Brownian flocculation rate which shows a strong size dependence. The shear-induced flocculation is more important than the Brownian flocculation only if the size is approximately above 0.1 µm. It was concluded that shear-induced flocculation is strongly dependent on particle size; to be dominant, the size needs to be between 0.1 and 5 µm (diameter).

Three points need to be emphasized with regard to emulsions:

(1) In the case of liquid emulsion, the adhesive forces between two flocculated droplets are larger than those between solid particles due to the deformation of the droplets. To separate (emulsify) two coalesced, highly viscous droplets, more energy is needed than to separate two flocculated droplets. Consequently, the upper limits of particle size and shear rate that allow for a particle size increase are expected to be significantly higher for emulsion droplets than for the solid systems investigated by Van de Ven and Mason[13] and by Zeichner and Schowalter.[12]

(2) In the kinetic equations in *Table* 1, it is assumed that the stability factor for flocculation followed by coalescence is independent of the particle size. A coalescence event, after adhesive contact has been achieved between two droplets, is conventionally viewed as consisting of two parts: drainage of the film between the droplets and rupture of the film when it has reached a critical thickness. The drainage of liquid films has been reviewed by Ivanov and Dimitrov[14] and the rate decreases with increasing particle size. An interesting observation is that the drainage rate is very sensitive to the surface coverage of the emulsifiers on the droplets. If the oil water interface is not completely covered, the drainage rate is an order of magnitude faster. During a kinetic measurement, the particle size increases and therefore also the surface concentration of the emulsifier. The probability for film

Table 1—Flocculation Rate Mechanisms in Emulsions. Instability is Expressed in Terms of Change in Number Concentration (dN/dt), the Increase in Particle Radius (dr/dt), or as the Particle Radius as a Function of Time

dN/dt[1]	dr/dt	r(t)	Reference	Equation
Brownian Flocculation				
$\frac{dN}{dt} = -\frac{8}{3} \cdot \frac{k_b T}{\eta} \cdot N^2 \cdot \frac{1}{w_B}$	$\frac{dr}{dt} = \frac{2}{3} \cdot \frac{k_B T}{\eta} \cdot \frac{\phi}{\pi r^2} \cdot \frac{1}{w_B}$	$r = \left(r_0 + \frac{\phi 2 k_B T}{9 \pi \eta w_B} \cdot t \right)^{\frac{1}{3}}$	(11)	(6)
Shear-Induced Flocculation: Laminar Flow				
$\frac{dN}{dt} = -\frac{32}{3} \cdot N^2 S r^3 \cdot \frac{1}{w_S}$	$\frac{dr}{dt} = -\frac{8 \phi r S}{3\pi} \cdot \frac{1}{w_S}$	$r = r_0 e^{\frac{8 \phi S t}{3\pi} \cdot \frac{1}{w_s}}$	(8)	(7)
Shear-Induced Flocculation: Turbulent Flow				
$\frac{dN}{dt} = -12 \pi \beta \sqrt{\frac{\varepsilon_{int}}{\eta}} r^3 N^2 \cdot \frac{1}{w_T}$	$\frac{dr}{dt} = 3\beta \sqrt{\frac{\varepsilon_{int.}}{\eta}} \phi r \cdot \frac{1}{w_T}$	$r = r_0 e^{3\beta \sqrt{\frac{\varepsilon_{int.}}{\eta}} \phi t \cdot \frac{1}{w_T}}$	(9)	(8)
Shear-Induced Flocculation in Turbulent Flow Expressed as a Function of the Apparent Shear Rate.				
$\frac{dN}{dt} = -12 \pi \beta \sqrt{\frac{c_1 \hat{S}^3}{\eta}} r^3 N^2 \cdot \frac{1}{w_T}$	$\frac{dr}{dt} = c_2 \frac{\hat{S}^{3/2}}{\eta^{1/2}} \phi r \cdot \frac{1}{w_T}$	$r = r_0 e^{c_2 \cdot \frac{\hat{S}^{3/2}}{\eta^{1/2}} \cdot \phi \cdot t \cdot \frac{1}{w_T}}$		(9)

(1) The repulsive barrier between the droplets is only considered as a stability factor w. Hydrodynamic interactions are not included.

The flocculation rate in terms of particle concentration has been transformed to growths in particle size (assuming that flocculation always leads to coalescence) by using the chain rule $\frac{dN}{dt} = \frac{dN}{dr} \cdot \frac{dr}{dt}$ and by treating the particle concentration as a function of the particle radius: $N = \frac{3\phi}{4\pi r^3} \Rightarrow \frac{dN}{dr} = -\frac{9\phi}{4\pi r^4}$.

N = Particle concentration, t = time, k_B = Boltzmann constant, T = absolute temperature, η = viscosity, ϕ = volume fraction of the disperse phase, w_B = stability factor for the Brownian flocculation according to Fuchs.[11] w_s = a stability factor for shear-induced flocculation, w_T = a stability factor for flocculation in turbulent flow, S = the shear rate, $\hat{S}$ = apparent shear rate in turbulent flow field (the apparent shear rate is calculated as though the flow field were laminar), ß = a constant describing the relation between the diffusive flux in a turbulent flow field and the liquid velocity, and c_1 and c_2 = constants depending on geometry and liquid describing the relation between the stirring and the power requirement for a high shear mixer.

rupture has been investigated by Vrij[15] and has been found to increase by about the square of the particle radius.

(3) Flocculation rate theories have been developed for a two-phase system of emulsion droplets dispersed in a continuous phase. The high-shear experiments in this study generate a three-phase system with air bubbles dispersed in the continuous phase. It is known from dairy emulsions that the introduction of air increases flocculation and the coalescence rate.[16-18] This has also been shown in an investigation of the coagulation of FeOOH sols.[19] Other studies have shown that the exposure of emulsions to shear forces without the introduction of air had very little effect on the coalescence rate.[20,21]

Methods for Mechanical Stability

The methods used for measuring the mechanical stability of latices are often based on some type of high-speed stir-

Table 2—Emulsifiers

Nonionic		Supplier
LA7	Fatty acid[a] monoethanolamide ethoxylate with 7 EO[b]	Berol Nobel AB, Sweden
LA9	Fatty acid[a] monoethanolamide ethoxylate with 9 EO[b]	Berol Nobel AB, Sweden
LA13	Fatty acid[a] monoethanolamide ethoxylate with 13 EO[b]	Berol Nobel AB, Sweden
LA18	Fatty acid[a] monoethanolamide ethoxylate with 18 EO[b]	Berol Nobel AB, Sweden
NP-EO-20	Ethoxylated nonylphenol with 20 EO units	Berol Nobel AB, Sweden
NP-EO-29	Ethoxylated nonylphenol with 29 EO units	GAF Europe, England
C12/C13-EO15	Ethoxylated fatty alcohol with 15 EO units	Akzo Chemie, The Netherlands
Anionic		
DoBS	Sodium dodecylbenzenesulfonate	Berol Nobel AB, Sweden
C16-S	Fatty alcohol sulfate, sodium salt	Berol Nobel AB, Sweden
C16/C18-EO2-S	Fatty alcohol ether sulfate, sodium salt	Berol Nobel AB, Sweden

(a) Linseed oil fatty acid fraction.
(b) Ethylene oxide units.

ring. The time to reach the beginning of or complete flocculation is measured and used as a value of the stability.[22-24] An ASTM standard is also based on this technique.[25] In these tests, however, flocculation rather than coalescence is measured.

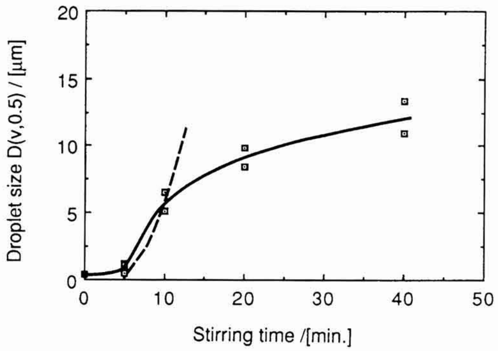

Figure 1—Influence of stirring time on the increase of droplet size at a constant shear rate (14,100 s^{-1}) in the method used for measuring the mechanical stability (continuous line). The dashed line shows the expected initial increase. The model system consisted of the alkyd with 84% oil length and ethoxylated nonylphenol with 23 EO as emulsifier

For protein-stabilized emulsions, a similar method for measuring the coalescence index has been proposed based on stirring at different speeds followed by measuring the increase in droplet size.[26] More information on the stability can be obtained by measuring the increase in droplet size and coalescence than by flocculation alone.

EXPERIMENTAL

Materials

The alkyd emulsions contained 50% alkyd in water and different concentrations of emulsifier. Two alkyds were used, both based on tall oil fatty acid and delivered by Bergvik Kemi AB, Sweden. The one used for measuring the mechanical stability contained ortophthalic acid and pentaerythritol. The oil length was 67.8%, the acid value was 10.6 mg KOH/g alkyd and the hydroxyl value was 32 mg KOH/g alkyd. The viscosity was 680 mPa s at 100°C.

The alkyd emulsions used to check the test method for mechanical stability contained isophthalic acid and pentaerythritol. It had an oil length of 84% and an acid value of 9-10 mg KOH/g alkyd.

The emulsifiers used are listed in *Table* 2. The concentrations of emulsifiers are given in weight-percent on the alkyd weight. The pH was adjusted to 7 with KOH before emulsification.

Methods

EMULSIFICATION: The emulsions were prepared in a high-pressure homogenizer, Microfluidizer TM-110 (Microfluidics, Newton, MA, USA). The emulsifier was dissolved in the aqueous phase which was added to the alkyd. The emulsion was premixed using a magnetic stirrer.

To obtain emulsions with the desired droplet size, the optimal emulsification temperature was first determined with a high concentration of emulsifier. The concentration and/or the pressure was then lowered to obtain the desired droplet size. When the mechanical stabilities of different types of emulsifiers were compared, the emulsifier concentrations were lowered as much as possible without exceeding a droplet size of about 0.6 µm (D (4.3)) to avoid an excess of emulsifier in the samples (*Table* 5). The full results of the influence of the emulsification temperature and emulsifier concentrations on the initial droplet sizes will be reported elsewhere.[27]

DETERMINATION OF DROPLET SIZE: The emulsion droplet size was measured with a laser diffraction instrument, Mastersizer (Malvern Instruments, England). The instrument uses an approximation of the Mie scattering theory, which utilizes the refractive index of the dispersed phase and its absorption. The relative refractive index $n_{alkyd}/n_{water} = 1.13$ for and the absorption value was estimated to be 0.1. The results are recorded as a volume distribution. The droplet size is expressed D(v, 0.5) which is the volume-weighted median. When the initial droplet size is measured, these values are very similar to D(4.3) which is the volume-weighted mean diameter. When the emulsion is sheared, the droplet size distribution becomes broader which results in an in-

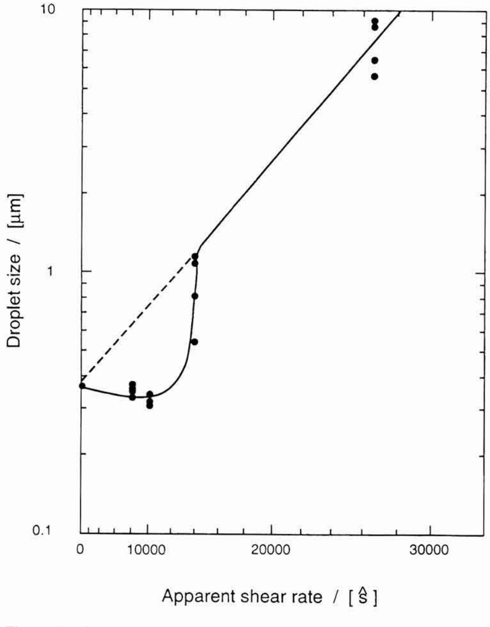

Figure 2—Logarithm of the droplet size as a function of apparent shear rate $\hat{S}^{\frac{3}{2}}$. The model system contained an alkyd with 84% oil length and ethoxylated nonylphenol with 23 EO as emulsifier. The exposure time was five minutes

Table 3—Initial Droplet Size and Calculated Apparent Thickness of the Emulsifier Layer for Emulsions with LA13

Concentration of Emulsifier (wt% on Alkyd)	Emulsification Temperature (°C)	Droplet Size		Calculated Apparent Thickness of the Emulsifier Layer[a] (Å)	Used in the Experiment in Figure No.
		D (4.3) (μm)	D (v,0.5) (μm)		
20[b]	80	0.46	0.42	119	6
13	80	0.34	0.31	60	3
10	80	0.34	0.33	50	3, 6
6.5	80	0.55	0.49	48	3
6.0	80	2.18	1.95	173	3
5.5	80	0.54	0.49	40	3
5.0	80	2.36	2.06	150	3
5.0	80	7.18	6.68	161	3

(a) The apparent emulsifier layer thickness is calculated from the D(3.2) (mean value of the surface area distribution of the diameter) assuming that all emulsifier is present at the interface. If the apparent thickness is larger compared to the length of the molecule this indicates an excess of emulsifier. The excess of emulsifier can, depending on the solution properties, be present in the water phase as a micellar solution, as liposome dispersion aggregates, or as emulsfier layers around the droplets.

(b) The emulsion was prepared with 10% La13/alkyd and the rest of emulsifier was added afterwards.

creasing difference between the values. There is less scatter in the D(v, 0.5) value which is used for the evaluation of mechanical stability. To calculate the apparent emulsifier layer thickness, the mean value of the surface area normalized distribution of the particle diameter D(3.2) is used.

MECHANICAL STABILITY: In this work, the increase in droplet size, the coalescence, as a function of shear rate has been taken to be a measure of the mechanical stability of an alkyd emulsion.

The emulsions were exposed to shear forces in a colloidal mill, UltraTurrax (Janke & Kunkel GmbH, Germany). The dispersing tool used has a diameter of 10 mm and the gap between stator and rotor is 0.35 mm. The shear rate was calculated from the recorded number of revolutions per minute. An alternative description of the shear intensity is the peripheral velocity of the rotor which can be obtained by multiplying the shear rate by $0.35\ 10^{-3}$. The velocity obtained can be compared with the emulsion peripheral velocity in various emulsion destabilizing process equipment. Four grams of the emulsion were added to a test tube which was placed in a water bath at 20°C. The sample was then exposed to stirring for 10 min, during which the test tube was open allowing air to enter the sample. The droplet size was measured after the emulsion had been exposed to different shear rates. The temperature increase in the sample during stirring was checked to determine that it did not influence the increase in droplet size. The results were mean values from two or more individually sheared samples. It was assumed that the measured increase in droplet size was due to coalescence. However, it may also have included a fraction of permanently attached but not fully coalesced droplets. The presence of coalescence was confirmed by microscopy. When the emulsion was very unstable, large flocculated clumps were observed at the lowest shear rate tested. Loosely flocculated droplets may separate due to the dilution and stirring in the droplet size analyzer.

RESULTS AND DISCUSSIONS

Figure 1 shows how the stirring time influences the droplet size at a constant shear rate. The results display a rapid growth in particle size after about 5 min which levels off after about 10 min. The rapid increase over time approximately follows the exponential prediction in *Table* 1. The

Table 4—Initial Droplet Size and Calulated Apparent Thickness of the Emulsifier Layer for Emulsions with DoBS

Concentration of Emulsifier (wt% on Alkyd)	Emulsification Temperature (°C)	Droplet Size		Calculated Apparent Thickness of the Emulsifier Layer[a] (Å)	Used in the Experiment in Figure No.
		D (4.3) (μm)	D (v,0.5) (μm)		
0.5	70	1.06	0.89	6	5
1.0	70	0.93	0.82	11	5
2.0	70	0.93	0.82	23	5
2.0[b]	50	1.81	1.36	37	4
2.0[b]	25	6.71	3.0	61	4
5.0	70	0.99	0.55	36	4
5.0	70	0.93	0.82	57	5
10.0	70	0.33	0.36	48	4

(a) The apparent emulsifier layer thickness is calculated from the D(3.2) (mean value of the surface area distribution of the diameter) assuming that all emulsifier is present at the interface. If the apparent thickness is larger compared to the length of the molecule this indicates an excess of emulsifier. The excess of emulsifier can, depending on the solution properties, be present in the water phase as a miceller solution, as liposome dispersion aggregates, or as emulsifier layers around the droplets.

(b) Emulsified at reduced homogenization pressure.

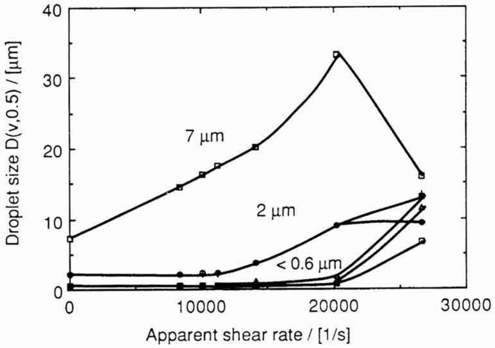

Figure 3a—Mechanical stability of nonionic (LA13) stabilized emulsions with different initial droplet sizes. The emulsifier concentrations used were 10, 6.5, 6, 5.5, 5, and 5% on the alkyd weight. The initial droplet sizes are given in *Table* 3

greater stability after 10 min probably reflects a situation where the re-emulsification more or less balances the coalescence rate. A stirring time of 10 min was chosen for this investigation. According to the rate equations in *Table* 1, the particle size after shearing for 10 min (or less) is expected to be proportional to $e^{\hat{S}^{\frac{3}{2}}}$.

In *Figure* 2 it can be seen that the logarithm of the diameter of the emulsion droplets increases in proportion to $\hat{S}^{\frac{3}{2}}$ as expected from kinetic theory. However, at low shear rates, the emulsion appears to be stable and the apparent shear rate has to overcome a critical value to allow the coalescence to occur.

The existence of a critical shear rate to overcome the repulsive barrier of a dispersion has also been shown by Zeichner and Schowalter.[12]

Figure 2 also shows an example of the reproducibility of the method. At the two lowest shear rates, five similar samples were sheared, and at the two higher rates, four similar samples.

Influence of Initial Droplet Size

The influence of the initial droplet size on the mechanical stability of emulsions stabilized with LA 13 is shown in *Figure* 3. With this emulsifier, it was possible to obtain larger droplets by decreasing the concentration of LA13 (see *Table* 3). An initial droplet size of 7 µm gave an unstable emulsion that increased in droplet size even at low shear rates. The decrease in droplet size at 20,000 s^{-1} is probably due to rehomogenization producing new smaller droplets. Decreasing the initial droplet size to 2 µm improved the stability. A further decrease to 0.3-0.6 µm gave even more stable emulsions. Within this range, however, the stability is similar.

In *Figure* 3b the results in *Figure* 3a are instead plotted as the relative increase (ln d/d_0) as a function of $\hat{S}^{\frac{3}{2}}$. We should obtain a straight line if the measured values are in agreement with equation (9) in *Table* 1. From the figure it can be observed that there is a critical shear rate that has to be overcome before the droplets start to flocculate and coalesce. The critical apparent shear rate necessary to overcome the stabilizing barrier around the droplets increases with decreasing particle size. When the droplets have started to coalesce the relative increase in droplet size seems to be linear to $\hat{S}^{\frac{3}{2}}$ independent of the initial droplet size, in agreement with equation (9).

The hydrodynamic forces bringing the particles together can, as a first approximation, be estimated to be proportional to the surface area of the particle, while the stabilizing barrier is proportional to the diameter of the droplets.[28] In agreement with this we observed an increase in the critical shear rate from <4000 s^{-1} for droplets of 7 µm (diameter) to about 15,000 s^{-1} for droplets of <0.6 µm. In the calculations of Zeichner and Schowalter, a lower critical shear rate for flocculation in the primary minimum with increasing particle size was also obtained, even though the effect was reduced due to hydrodynamic interactions. However, in their calculation, they used electrostatically stabilized particles where the repulsive barrier is relatively long ranged. In this experiment, the repulsive barrier is caused by a short-range steric stabilization.

When the critical apparent shear has been overcome and the shear-induced flocculation has started, the coalescence

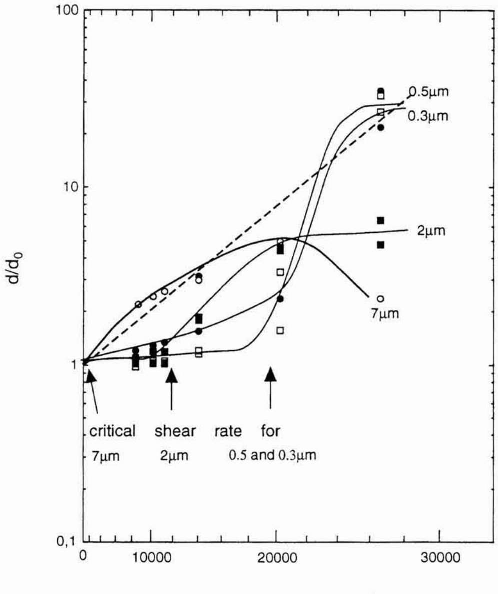

Figure 3b—Logarithm of the relative increase in droplet size as a function of apparent shear rate $\hat{S}^{\frac{3}{2}}$ for emulsions with different initial droplets sizes (continuous lines). The critical shear rate to induce flocculation increases with decreasing droplet size. The dashed line indicates that the relative increase seems to be proportional to $\hat{S}^{\frac{3}{2}}$ independent of the initial droplet size in agreement with equation (9) when the critical shear rate has been reached

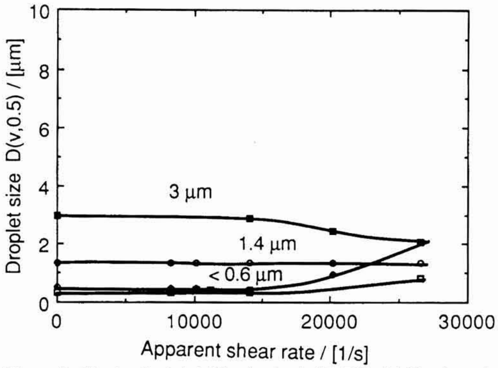

Figure 4—Mechanical stability of anionic (DoBS) stabilized emulsions with different initial droplet sizes. The emulsifier concentrations used were 10, 5, 2, and 2% on the alkyd weight. The initial droplet sizes are given in *Table* 4

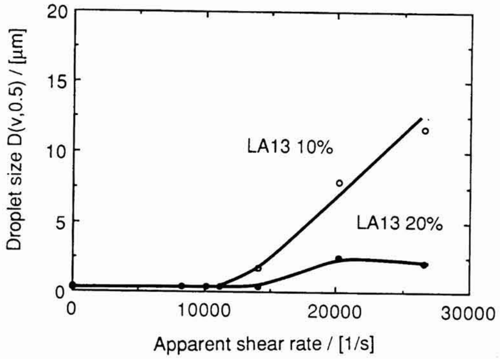

Figure 6—Mechanical stability at different concentrations of a nonionic emulsifier LA13. The emulsion with the higher concentration of LA13 was made by adding more of the emulsifier to one containing 10% LA13 on the alkyd weight

rate seems to be independent of the initial particle size. Consequently, the various aspects of drainage and film rupture that should depend on the particle size seem to give compensating effects to the kinetic description of these experiments.

If it is assumed that all of the emulsifiers are located at the surface of the droplets, which is an overestimation since the emulsifier is also soluble in the water and the oil phase, an average apparent thickness of the emulsifier layer can be calculated. A comparison of this calculated apparent thickness with the length of one molecule of the emulsifier gives an estimation of whether or not there is enough emulsifier to cover the surface. The calculated apparent thicknesses at different droplet sizes are shown in *Table* 3. If these values are compared to 75 Å which is the length (calculated from the bond length) of a fully stretched LA 13 molecule, it can be seen that the emulsions with larger droplets have an excess of emulsifier compared to emulsions with smaller droplets. This shows that the measured instability in *Figure* 3 is actually due to the droplet size and not to a shortage of emulsifier.

The stability of the emulsions with the anionic emulsifier DoBS was not as sensitive to initial droplet size as that of the emulsions with the nonionic emulsifier, *Figure* 4. Larger droplets were obtained by decreasing the pressure and temperature during emulsification since they could not be obtained merely by decreasing the emulsifier concentration. The calculated apparent thicknesses of the emulsifier layer for these emulsions are shown in *Table* 4. All the emulsions in *Figure* 4 had an excess of emulsifier if the thickness is compared with the length of one DoBS molecule which is about 15 Å. The value is from a measurement of the layer thickness in a liquid crystalline phase.[29] The electrostatically stabilized DoBS emulsions are obviously different from the sterically stabilized emulsions. The critical level of the shear rate is high and there is no sensitivity to the initial droplet size.

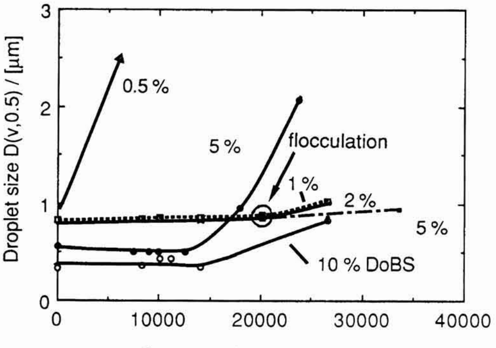

Figure 5—Influence of the concentration of anionic emulsifier (DoBS) on the mechanical stability. The emulsions containing one and two percent emulsifier on alkyd weight flocculated at an apparent shear rate 20,000 s^{-1}

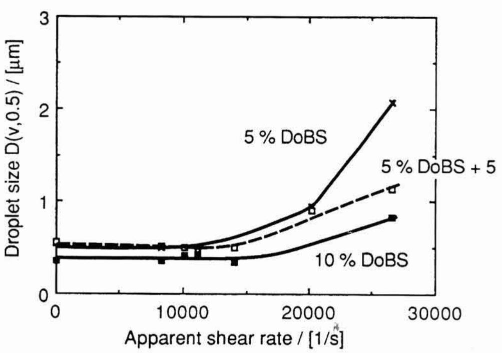

Figure 7—Influence on the mechanical stability of mixing a nonionic (LA13) and an anionic (DoBS) emulsifier. The concentrations are given as percentages on the alkyd weight

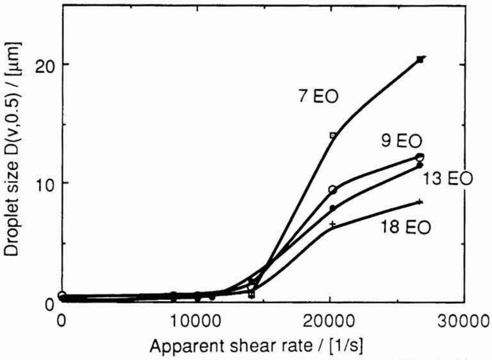

Figure 8—Mechanical stability of emulsions stabilized with fatty acid monoethanolamide ethoxylates with 7, 9,13, and 18 ethylene oxide units. The emulsifier concentrations are given in *Table* 5

Influence of Concentration of Emulsifier

With the anionic emulsifier DoBS, an excess of emulsifier was used in the experiments shown in *Figure* 4. *Figure* 5 shows the results when the concentration was decreased and the droplet sizes were relatively small. It was possible to obtain emulsions with low droplet sizes at considerably lower concentrations with the anionic emulsifier than with the nonionic ones.[27] At two and one percent (w/w) of emulsifier on alkyd, the emulsions were less stable than at five percent but they were still stable up to 20,000 s^{-1}. At this shear rate, the emulsion flocculates, although no marked increase in droplet size of the nonflocculated parts could be measured. At 0.5%, the emulsion flocculated at the lowest shear rate tested (~8000 s^{-1}). The pronounced instability of the emulsion with the lowest DoBS content clearly shows the need for complete coverage to obtain stability towards shear. Ivanov and Dimitrov[14] have shown that the drainage, through the resistance towards coalescence, is orders of magnitude faster between two droplets covered by an incomplete emulsifier layer than between droplets covered by a dense layer.

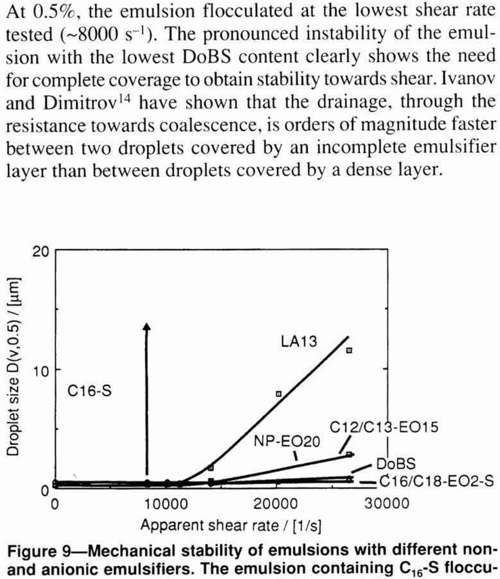

Figure 9—Mechanical stability of emulsions with different non- and anionic emulsifiers. The emulsion containing C_{16}-S flocculated at the lowest shear rate tested. The emulsifier concentrations are given in *Table* 5

The results also show that the emulsions with five and 10% emulsifier display more coalescence than the emulsions with one and two percent emulsifier, which show flocculation but no coalescence. The deteriorating effect of the overload of emulsifier can be due to the decrease in interfacial tension (if the concentrations in the water phase are below the critical micellization concentration) and the resulting loss of film stability.[15] Another possible contribution to the destabilization may come from the increasing ionic strength caused by the emulsifier. Increased ionic strength reduces the electrostatic stabilization of emulsions stabilized by ionic surfactants. However, the critical shear rate (for flocculation or coalescence) does not seem to be influenced by the overload of emulsifier, suggesting that the critical shear rate (for coalescence) corresponds to the critical shear rate necessary to flocculate the system.

The difference between the two emulsions containing five percent DoBS/alkyd is probably due to the large excess of the emulsifier with large initial droplet size compared to the emulsion with smaller initial droplet size; however, the difference in stability is rather small (notice the scale on the x-axis).

With the nonionic emulsifier, LA13, the concentration of 10% emulsifier/alkyd (w/w) was slightly below the limit needed to cover the droplet surfaces since the droplet obtained was so small (giving a large total surface area) (*Table* 3). When the concentration was increased to 20% LA13/alkyd (by adding more emulsifier to an emulsion first prepared at 10%), a more stable emulsion was obtained (see *Figure* 6). At 20%, a large excess of emulsifier is present in the emulsion.

Addition of the same molar concentration of LA13 to the emulsion with 0.5% DoBS does not improve its stability. *Figure* 7 shows the effect on the stability of mixing DoBS and LA13. The addition of LA13 improves the stability but not to the same extent as DoBS does.

Different Types of Emulsifiers

The influence of the EO chain length on the shear stability of emulsions stabilized with a homologous series of nonionic emulsifiers is shown in *Figure* 8. The critical shear rate necessary to destabilize the emulsion is almost constant, independent of the length of the EO chain. This observation agrees with the general view that the long-range interactions determine the flocculation step; thereby the critical shear intensity. The probability of coalescence, on the other hand, seems to decrease with increasing length of the hydrophilic part of the emulsifier, particularly since lower concentrations of those with the longer ethylene oxide chain were used. The emulsification conditions are given in *Table* 5. A similar effect can be seen in *Figure* 9, which shows the results for different types of ethoxylated and sulfonated emulsifiers.

The same stability is also obtained when the anionic emulsifiers (DoBS and $C_{16/C18}EO_2S$) are used. The nonionic steric stabilizers perform well, but the anionic emulsifiers may be just as powerful despite the absence of steric hindrance. These experiments, however, have been performed in the absence of an ionic additive normally used in paints; e.g., driers and dispersing agents. Significant solubility of ionic additives in the water phase reduces the stability of electrostatically stabilized emulsions.

Table 5—Emulsification Conditions for Different Emulsifiers

Emulsifier	Emulsification Temperature (°C)	Concentration of Emulsifier (% of alkyd)	Initial Droplet Size D(v,4.3) (μm)	Initial Droplet Size D(0.5) (μm)
LA7	70	12	0.62	0.54
LA9	70	10	0.60	0.55
LA13	80	10[a]	0.34	0.33
LA18	80	8	0.56	0.51
NPEO20	80	7	0.34	0.31
$C_{12}/C_{13}EO_{15}$	80	8	0.36	0.33
Anionic				
DoBS	70	10[a]	0.33	0.36
C_{16}-S	90	8	0.38	0.33
C_{16}/C_{18}-EO2-S	90	6	0.53	0.43

(a) Not optimized concentration.

The lower stability of the emulsion with the fatty alcohol sulphate compared to the corresponding ethoxylated product is explained by the low solubility of the former product. It has a Krafft point* of about 52°C. An emulsion with small droplets that was intact at 20°C was possible to make, but it flocculated at the lowest shear rate. A feasible explanation is that most of the emulsifier precipitates, resulting in a shortage of emulsifier at the surface and poor stability. The emulsifier may also be in an undercooled state, and the shear forces may induce crystallization of the emulsifier, resulting in flocculation.

CONCLUSIONS

The shear-induced destabilization is an accelerating process showing an exponential growth with time and shear rate. However, the shear intensity must exceed a critical level to cause instability. The critical level is dependent on the particle size, the type of emulsifier, and the emulsifier concentration. The coalescence rate is dependent mainly on the emulsifier type and on the emulsifier concentration. The results using the specific emulsifiers can be generalized as:

(1) Anionic emulsifiers are more effective in preventing shear-induced destabilization (in the absence of ionic additives, e.g., driers and dispersing agents) than nonionic emulsifiers. The same stability can be obtained with a nonionic emulsifier, but high concentrations are needed, which is a drawback in paints since it causes other problems such as water sensitivity of the paint film;

(2) Insufficient emulsifier to cover the droplet surfaces strongly reduces the stability of an emulsion under shear;

(3) The crystallization of an emulsifier below the Krafft point can result in a pronounced shear sensitivity; and

(4) An increase in the chain length of the ethoxylated group of nonionic emulsifiers reduces the shear-induced coalescence due to a greater steric stabilization.

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*The lowest temperature at which the emulsifier crystals dissolve and form a micellar solution.

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Rheologically Effective Organic Pigments

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Environmental considerations have stimulated research in organic pigment surface modification as well as polymeric dispersant application to lower the viscosities of modern high-solids pigment dispersions. The approach involves adsorption of specific substituted pigment derivatives (anchors) onto the pigment surface to maximize interaction with selected polymeric dispersants. More effective anchors have been found which further lower the viscosities of high-solids solvent-based paint systems.

INTRODUCTION

Most automotive paints contain volatile organic compounds (VOCs) which have been identified as contributors to the formation of ground level ozone and photochemical smog. Unlike stratospheric ozone which protects the earth from harmful radiation, excessive ground level ozone is harmful to plant and animal life. While automotive coatings in total contribute only 0.5% of the more than 25 mm tons of VOCs annually released in the U.S.,[1,2] they nevertheless contribute their part to ground level ozone formation, and potentially exacerbate health problems due to their effect on air quality.

As a consequence, there have been, and continue to be, governmental pressures and regulations to reduce emissions from automotive plants both in the U.S. and abroad.

One approach to reduce emissions is to increase pigment concentration in pigment dispersions and paints. The challenge is to maintain acceptable flow properties while not compromising the aesthetic value of the resulting finishes. Another approach is the conversion to waterborne paints where VOC is limited to the organic cosolvent.

To increase pigment concentration, the viscosity of millbase dispersions must be reduced. The greatest contribution to viscosity of a dispersion, consisting essentially of a binder (resin), solvent(s), and pigment, is due to the particulate nature of pigments which are small particle size materials whose dimensions range from 0.01 to 0.5 μm.

The most important pigment properties that affect the rheological characteristics of a pigment millbase dispersion are: chemical structure, pigment/polymer/solvent interaction, particle size, particle shape, and surface characteristics.

In North America most automotive finishes systems are based on acrylic resins, thus the current study focused primarily but not exclusively on these systems.

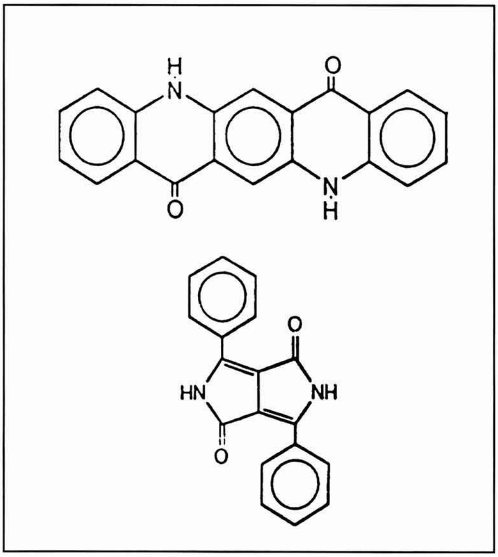

Figure 1—Structures of quinacridone and 1,4-diketo-3,6-diphenylpyrrolo[3,4-c]pyrrole(DPP)

Presented at the 71st Annual Meeting of the Federation of Societies for Coatings Technology, on October 27-29, 1993, in Atlanta, GA.

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Table 1—Energy of Bonding Forces

Type of Bond	Approximate Dissociation Energy Kcal/mole[9]
Physical absorption	2
Hydrogen bonding	6
Chemisorption (acid-base)	up to 20
Chemical bond (covalent etc.)	80-90

Table 2—Rheological Data for Surface Modified Gamma Quinacridone in an Acrylic System

	Viscosity in CPS at 50 sec^{-1}		Yield Stress dyn/cm^2	
	20.0%[a]	25.0%[a]	20.0%[a]	25.0%[a]
γ QA surface treated	50	64	19	19
γ QA untreated	220	320	96	173

(a) Pigment weight percent concentration in millbase; polymeric dispersant = 30% of pigment concentration.

Table 3—Rheological Data for Surface Modified Gamma Quinacridone in an Acrylic System

	% Yield Millbase Recovery			
	20.0%[a]		25.0%[a]	
	Agitated	Stationary	Agitated	Stationary
γ QA Surface treated	92	92	87	83
γ QA untreated	88	53	79	29

(a) Pigment weight percent concentration in millbase; polymeric dispersant = 30% of pigment concentration.

Table 4—Rheological Data for Surface Modified Quinacridone in an Acrylic System

	Pigment/ Binder	Brookfield Viscosity at 10 rpm, cps	% Yield Millbase Recovery
γ QA surface treated	0.8	120	90.0
γ QA surface treated	1.2	240	89.8
γ QA untreated	0.8	700	82.5

Table 5—Rheological Data of Surface Modified Quinacridone

Pigment	Weight Percent Pigment Concentration	Viscosity in CPS 10 RPM	50 RPM	100 RPM
γ QA surface treated with polymeric dispersant[a]	30.98[b]	520	328	272
γ QA untreated, no polymeric dispersant	30.98[b]	15,720	4,520	2,640
γ QA untreated, no polymeric dispersant	15.00[c]	2,820	694	368

(a) 1.86 weight percent concentration.
(b) Pigment/binder = 1.18.
(c) Pigment/binder = 0.47.

Pigment Surface Modification

For some time, our research was concerned with an examination of the effect of modified pigment surfaces on the flow properties of dispersions. Our efforts were centered on intermolecularly bonded chromophores such as quinacridone (QA) and its analogs, pigments which have been known for some time, and the more recently discovered 1,4-diketo-3, 6-diarylpyrrolo[3,4-c]pyrroles (DPPs) as well as combinations of the two (*Figure* 1). Studies with other classes have also been included.

The stability of small (nearly colloidal) particles dispersed in a liquid is governed by steric and electrostatic repulsion forces which exceed the attractive London dispersion forces between particles. Due to the low value of the dielectric constants of nonaqueous media, it is widely believed that pigment dispersions in the presence of polymers are stabilized by steric repulsion[3] only. Electrostatic forces are believed to be relatively weak.

Although organic pigments tend to be relatively nonpolar, they can adsorb vehicle resin which provides steric inhibition to flocculation. However, the attachment between pigment and polymer is usually weak and dissociation can and does take place. In addition, modern high-solids systems which use low molecular weight polymers in the dispersion stage, create a definite need for special polymeric dispersants and pigment surface modification to effect greater pigment resin interaction.

Quinacridone in pigmentary form, like many other pigments, has a great affinity for its polar substituted derivatives. Thus, the pigment has been treated with a variety of derivatives such as the mono and disulfonic acids,[4] amide derivatives[5] of the acids, phthalimidomethyl,[6] dialkylaminoalkyl[7] derivatives, etc., to increase the polarity of the pigment surface. These treatments alone are effective in lowering viscosity of some paint systems, but the effects are much more pronounced and the viscosity more stable when specific polymeric dispersants are included in the dispersions.

Of course the identities of the substituent groups, such as those previously mentioned, and the polymeric dispersants are critical in maximizing the reduction in viscosity versus untreated pigments and/or dispersions not containing polymeric dispersants. Of the latter, there is a variety of different polymers available from DuPont (Elvacite®), ICI (Solspere®), BYK-Chemie (Disperbyk®), etc. The polymeric dispersants usually contain basic, acidic, or nonionic moieties. These can associate individually with the solvent, the binder, the pigment, or a combination of these ingredients.

Clearly, a pigment treated with an acid derivative of the compound that makes up the pigment, which is adsorbed onto the surface of the pigment, referred to as the anchor group, would have a great propensity to react with a polymeric dispersant which has a built-in basic moiety. The opposite is true when the pigment surface is treated with a derivative carrying a basic substituent. Thus, in the dispersion process of initial pigment wetting followed by particle deaggregation, individual particles treated with the anchors become exposed and available for reaction with the polymeric dispersants, which in most cases are block copolymers of specific molecular weight. The molecular weight of the reactive portion of the polymer in addition to the solvated

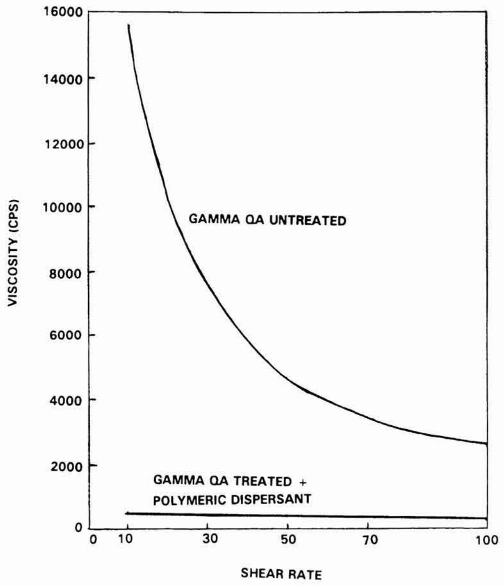

Figure 2—Viscosity vs shear rate of modified gamma quinacridone in a high-solids enamel system; pigment weight percent concentration = 30.98; dispersant weight percent concentration = 1.86

portion must be kept within fairly narrow limits for optimum effects, the overall molecular weight must provide chain extension from the surface of the pigment of at least 10 nm,[8] that is at least 65 carbons. The polymer must be strongly attached to the pigment surface, and the solvated portion must extend into the medium to form the required barrier to the attractive forces between individual particles. If the chains are too long, they can fold in such a way as to compress the steric barrier and negate the intended stabilization.

The solvent also plays a critical role in dispersion stabilization. If it is relatively poor with respect to the solvated part of the polymeric dispersant, it can cause chain collapse and consequent pigment flocculation. If the solvent is very effective, it can compete with the surface of the pigment and diminish the effectiveness of the polymeric dispersant. The latter problem is largely eliminated by reactive substituted pigment derivatives (anchors) imposed onto the pigment surface. Favored are derivatives which, in a broad sense, are subject to acid/base reactions on the surface of the pigment. As stated earlier, in older paint systems, the pigment particles usually adsorbed vehicle resin for pigment dispersion stabilization; however, the strength of the adsorbed bonding forces differ from system to system. Although adsorption is possible, desorption also takes place depending on the strength of the bonding forces (*Table* 1) and the nature of the polymer.

Clearly, attachment of polymeric chains to a pigment particle via a covalent bond would insure steric or entropic stabilization of the system, but the cost of this approach would be prohibitive and therefore impractical. On the other hand, the bonding forces are simply not strong enough either by physical adsorption, or by hydrogen bonding. (See viscosities of dispersions devoid of polymeric dispersants or the presence of anchor-free pigments in *Tables* 5, 9, and 13). Thus, chemisorption appears to be the most promising approach.

Opaque Quinacridones

When reasonably large particle size gamma quinacridone (0.4-0.6 μm) with a surface area of about 25 m^2/g was treated with a specific quinacridone acid derivative and then incorporated into a high-solids enamel acrylic system containing a basic block polymeric dispersant,[10] the viscosity was dramatically reduced. Shown in *Table* 2 are viscosity comparisons between gamma QA untreated and surface treated, everything else being kept constant, in the preparation of the millbase dispersion containing two levels of pigment concentration. To demonstrate the practical effect of the viscosity differences (*Table* 3), the millbases were recovered from the grinding metal media with and without agitation.

Obviously, at 20% pigment concentration, we are dealing essentially with Newtonian flow of the surface treated pigment dispersion since the millbase recovery is not affected by shear. In addition, the viscosity and yield stress are essentially independent of concentration within the studied pigment concentration limits. Even at 25% pigment concentration, the recovery of the dispersion containing the surface treated pigment remains high and fairly constant, whereas the thixotropic nature of the untreated pigment dispersion is attested to by the steep drop-off in yield recovery when comparing the agitated versus stationary millbase recovery. As a consequence, the surface treated pigment can be increased in concentration.

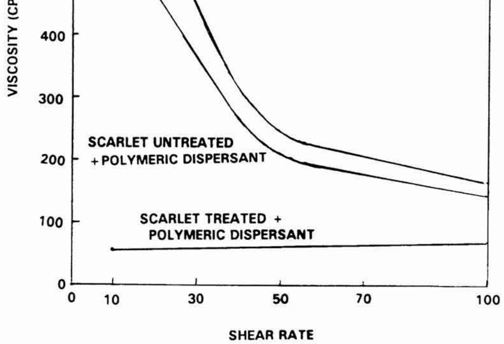

Figure 3—Viscosity vs shear rate of modified scarlet quinacridone solid solution in a polyester/alkyd system; pigment weight concentration = 8.3; dispersant weight percent concentration = 0.5

Table 6—Finish Characteristics of the Modified Quinacridone in High-Solids Enamel System

	Masstone		50/50 Blend with C.I. Pigment Orange 36	
	20°Gloss	DOI[a]	20° Gloss	DOI[a]
γ QA surface treated, with polymeric dispersant	84	98	78	98
γ QA untreated, no polymeric dispersant	66	87	62	87

(a) Distinctness-of-image.

Table 7—Storage Stability of Dispersion Containing Surface Treated Quinacridone in a Polyester/Alkyd System

	Initial Brookfield Viscosity in CPS		Final Brookfield Viscosity in CPS	
	6 RPM	60 RPM	6 RPM	60 RPM
γ QA surface treated	220	205	220	214
γ QA untreated	225	269	500	516

Table 8—Rheological Data for a Surface Modified Quinacridone Solid Solution in a Polyester/Alkyd System[a]

	Brookfield Viscosity in CPS		
	10 RPM	50 RPM	100 RPM
Scarlet QA solid solution untreated, no polymeric dispersant	720	250	166
Scarlet QA solid solution untreated, with a polymeric dispersant[b]	570	214	143
Scarlet QA solid solution treated, with a polymeric dispersant[b]	60	58	73

(a) 8.3 Weight percent pigment concentration; pigment/binder = 0.5.
(b) 0.5 Weight percent concentration.

Table 9—Rheological Data of Surface Modified Substituted DPP in an Alkyd Melamine Enamel System[a]

	Brookfield Viscosity in CPS			
	1.5 RPM	6 RPM	12 RPM	60 RPM
Substituted DPP, untreated	16,800	5,600	3,300	1,050
Substituted DPP untreated, with polymeric dispersant[b]	12,400	4,200	2,550	900
Substituted DPP surface treated, no polymeric dispersant	15,200	4,700	2,800	900
Substituted DPP surface treated, with polymeric dispersant[b]	400	380	390	400

(a) 21.3 Weight percent pigment concentration; pigment/binder = 0.67.
(b) 3.2 Weight percent concentration.

Table 4 provides experimental data on a somewhat different high-solids enamel system. It can be seen that when the pigment concentration relative to binder is increased by 50% while the amount of solvent is kept constant, the surface treated pigment shows a relatively slight increase in viscosity with essentially the same millbase recovery. The viscosity of the untreated pigment, on the other hand, is about three times higher than that of the millbase containing 50% more surface treated pigment. Not only is the amount of solvent reduced, but also the higher concentration of pigment allows a greater opportunity for styling due to the enhanced hiding power available with the surface treated pigment dispersion.

Another example of appropriate surface treatment of the same gamma quinacridone large particle size pigment appears in the following. Both the treatment and the polymeric dispersant[11] have been altered, but the result is similarly impressive. This is apparent from the experimental data compiled in *Table* 5 and the graphic representation of the data shown in *Figure* 2.

At the lowest shear (10 rpm), the treated pigment shows a viscosity about 30 times lower than the untreated counterpart; and is still about five times lower relative to the untreated pigment dispersion at half the pigment concentration. In addition, the paint derived from the surface treated pigment yielded a finish of considerably greater gloss and distinctness-of-image in a one-coat automotive system (*Table* 6).

Thus, the greater stability (lack of flocculation) of the dispersion containing the surface treated pigment and the polymeric dispersant has provided an ultimate article of greater aesthetic appeal. In addition, it has been demonstrated in another low-solids (polyester/alkyd) system that the lower millbase viscosity is stable on aging, whereas the untreated pigment dispersion viscosity has a tendency to climb on storing at or about 40°C for two weeks (*Table* 7).

To separate the effect of pigment surface treatment from the effect of the polymeric dispersant, a scarlet quinacridone solid solution consisting of 60% quinacridone and 40% 4,11-dichloroquinacridone was surface treated and then dispersed with and without a polymeric dispersant in a relatively low-solids polyester/alkyd system. The results are summarized in *Table* 8.

Although the viscosities are fairly low for all cases cited due to the low pigment concentration, it is apparent that only the combination of surface treatment and inclusion of a polymeric dispersant reduces the viscosity drastically and generates a dispersion showing Newtonian flow. This is graphically represented in *Figure* 3.

Other Pigments

So far, our discussion has dealt with relatively large particle size gamma quinacridone; we have observed essentially the same phenomenon with relatively large particle size 1,4-diketo-3, 6-di(p-chlorophenyl)pyrrolo[3,4-c]pyrrole (substituted DPP). Upon treating the pigment surface with a specific derivative and then incorporating the pigment in an alkyd system in the presence of a polymeric dispersant, the rheological data given in *Table* 9 were obtained (also see the data shown in graphic form in *Figure* 4).

Clearly, the surface treatment alone does not produce a significant reduction in millbase viscosity, nor does the in-

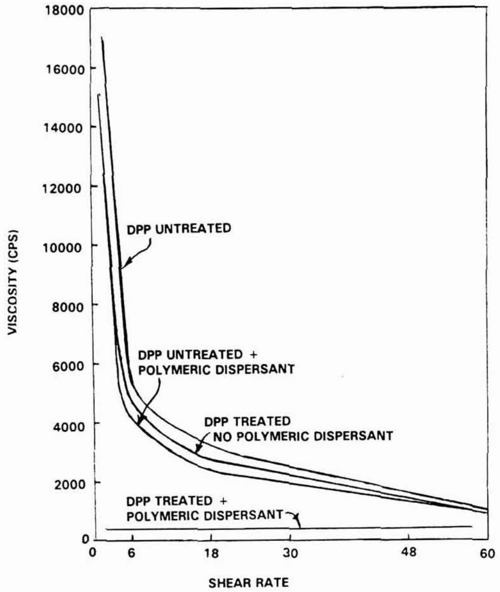

Figure 4—Viscosity vs shear rate of modified DPP red in alkyd/melamine system; pigment weight percent concentration = 21.3; dispersant weight percent concentration = 3.2

Table 10—Appearance Characteristics of Surface Modified Substituted DPP in an Alkyd System

	20° Gloss	
	Panels Sprayed	Panels Poured
Substituted DPP, untreated	76	43
Substituted DPP untreated with polymeric dispersant	69	64
Substituted DPP surface treated, no polymeric dispersion	77	15
Substituted DPP surface treated, with polymeric dispersant	94	100

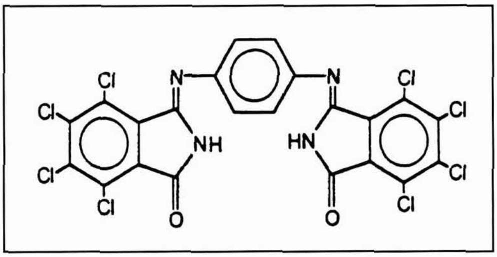

Figure 5—Isoindolinone structure

Table 11—20° Gloss Measurements of Surface Treated Isoindolinone Containing Finish

	No Polymeric Dispersant	With Polymeric Dispersant
Untreated isoindolinone pigment	57	48
Surface treated isoindolinone pigment	45	92

Table 12—Rheological Data for Modified Magenta Pigment in High-Solids Enamels[a]

	Millbase Viscosity, CPS at 50 sec^{-1}	Relative Viscosity	Yield Stress Dyn/cm^2	% Yield Millbase Recovery
Modified magenta	690	1.0	288	84
Original magenta	2500	3.6	1730	58

(a) 20% Pigment concentration; 50.1% total nonvolatiles.

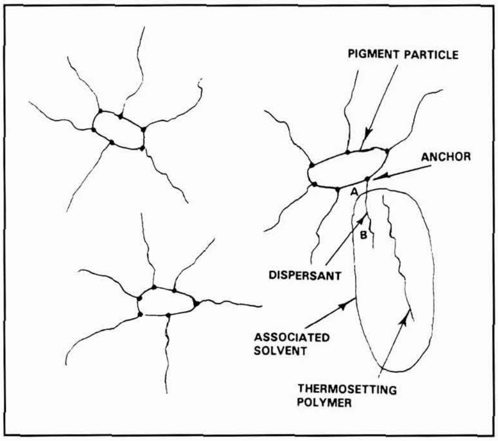

Figure 6—Proposed mechanism of pigment surface treating agent action on a pigment in a polymeric dispersant containing paint system

Table 13—Rheological Data for a Newly Modified Pigment in a Basecoat[a]/Clearcoat System

	Brookfield Viscosity in CPS			
	1 RPM	10 RPM	20 RPM	50 RPM
Newly modified magenta, with polymeric dispersant[b]	300	60	45	42
Newly modified magenta, without polymeric dispersant	500	310	270	192
Modified magenta, with polymeric dispersant[b]	*700*	*415*	*400*	*310*
Modified magenta, without polymeric dispersant	26,500	3,470	2,000	998

(a) 12.0 Weight percent pigment concentration.
(b) 3.6 Weight percent concentration.

Table 14—Rheological Data for Transparent Red Pigment in a Basecoat[a]/Clearcoat System

	Brookfield Viscosity in CPS			% Yield Millbase
	1 RPM	10 RPM	50 RPM	Recovery
New transparent red untreated	102,000	12,300	2,840	72
New transparent red surface treated	1,600	720	416	89

(a) 8.0 Weight percent pigment concentration; 2.4 weight percent polymeric dispersant concentration.

corporation of a polymeric dispersant alone significantly affect viscosity versus the untreated pigment in the absence of a polymeric dispersant. Only the combination of a surface treated pigment with a polymeric dispersant leads to a millbase with significantly lowered viscosity and Newtonian flow. As a consequence of the dispersion stabilization and the desired flow characteristics signifying substantial absence of flocculation, the resulting coatings showed excellent 20° gloss as shown in *Table* 10, whether the coatings were sprayed or poured.

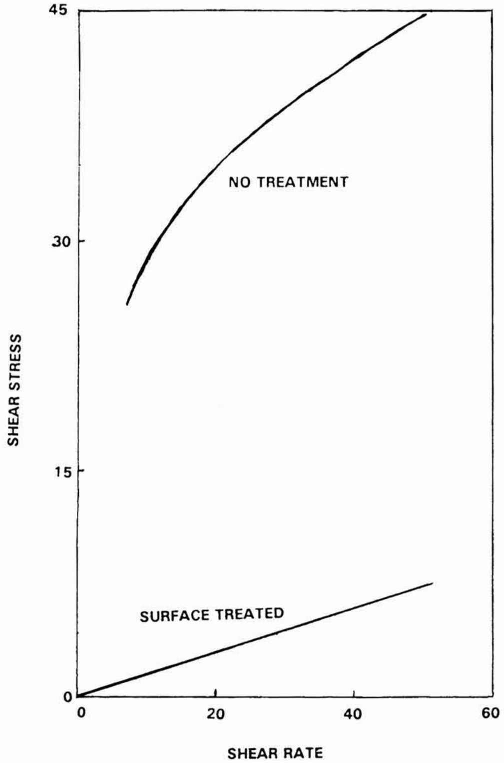

Figure 7—Viscosity of solid solution magenta dispersion in an acrylic system; pigment weight percent concentration = 11.3

Thus, it has been demonstrated with two different pigments that it is highly desirable to surface treat the pigments by adsorbing onto its surface a substituted pigment derivative (anchor) with which appropriately selected polymeric dispersants can interact to provide steric or entropic stabilization, particularly in high-solids enamel systems. A structurally unrelated yellow pigment, an isoindolinone (*Figure* 5), surface treated with a derivative of this compound has shown significant rheological improvement over the untreated counterpart in an alkyd dispersion. As a consequence, 20° gloss measurements (*Table* 11) of the final one-coat finish were substantially enhanced. Again, significant improvement was achieved only when the surface treated pigment was incorporated into a dispersion containing an appropriate polymeric dispersant. Data are provided for both the treated and untreated pigment with and without a polymeric dispersant. The desirable high-gloss is obtained only when the surface treated pigment is dispersed in the presence of a polymeric dispersant.

Mechanism of Dispersion Stabilization

Based on the cited experimental evidence and in agreement with others, a suggested mechanism is depicted in *Figure* 6. The selection of the polymeric dispersant must assure its firm attachment to the anchor group on the pigment particle surface (anchor interaction with the reactive end A of the polymeric dispersant). The polymeric tail (B) must be compatible or soluble in the paint solvent and must be of sufficient length to provide an effective steric barrier to counteract the attractive forces between individual pigment particles. Polymeric dispersants have to be optimized for particular paint systems as a function of the vehicle and particularly the solvent used. The concentration of the dispersants must be determined for maximum effect at the lowest concentration, since an excess may be counterproductive in terms of long-term durability or possibly lead to adverse effects on the coating. The amount of polymeric dispersant as an approximate general rule is about 2 mg/m^2 of pigment surface area.[12] Thus, for a relatively opaque pigment with an anchor agent having a surface area of 25 m^2/g one would require 50 mg/g or 5% of polymeric dispersant. The need for polymeric dispersant is particularly great for the high-solids systems which use reasonably low molecular weight polymers not particularly known as effective pigment dispersants. The polymer chains attached to individual pigment particles, reduce their degrees of freedom of movement and keep particles apart thus reducing or avoiding flocculation and structure formation in the dispersion. The mechanism is referred to as entropic or steric stabilization.

Transparent Quinacridones

For pigments with considerably smaller particle sizes, that is, surface areas of 75-100 m^2/g, intended primarily for metallic finishes, where minimization of light scattering is desired to enhance geometric metamerism or two-tone quality, the problem of pigment dispersion stabilization is more difficult. Very fine pigment particles have a stronger tendency to flocculate due to higher surface energies and consequently impart higher viscosities to paint systems relative to opaque, light scattering pigments. However, the same gen-

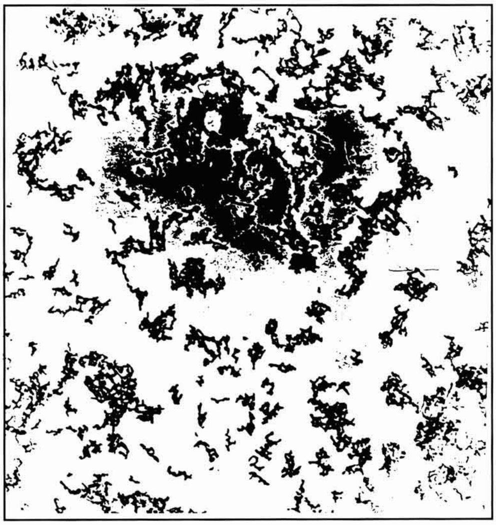

Figure 8—Surface untreated quinacridone solid solution magenta in an acrylic system; 40,000 magnification

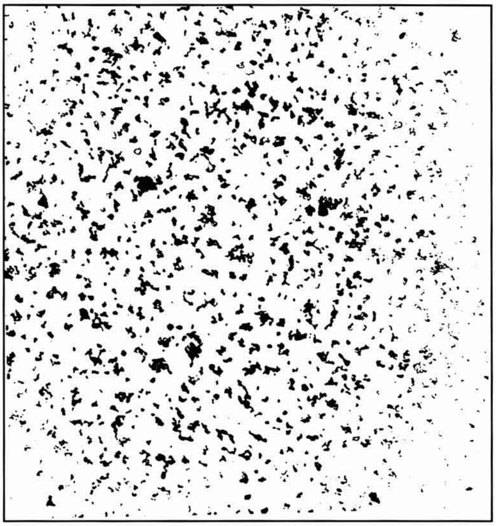

Figure 9—Surface treated quinacridone solid solution magenta in an acrylic system; 40,000 magnification

eral approach is also effective with transparent or semitransparent pigments. To maximize the effectiveness of the pigment surface anchors and further reduce pigment dispersion viscosity, more effective pigment derivatives are constantly sought. The following discusses current approaches and the latest developments in this field.

Quinacridone magenta, a solid solution consisting of 2,9-dichloroquinacridone and the parent compound was used primarily in automotive metallic finishes because of its excellent outdoor durability despite its very small particle size. Its dispersion viscosity, however, was rather high permitting only very low pigment concentrations in its millbase dispersions. To overcome this problem, we resorted to surface treatment. In a low-solids acrylic system, an immediate improvement was realized as shown in *Figure* 7. The surface modified pigment dispersion shows Newtonian flow, while the identical pigment dispersion without surface treatment shows a relatively high yield value. In fact, the millbase dispersions showed a #4 Ford cup flow time of 17 sec and 109 sec for the surface treated and untreated counterpart, respectively. In addition, electron microscopic examination* of the same dispersions confirm the effective deflocculation conferred upon the pigment by the surface treatment. From *Figure* 8,* it is apparent that the untreated product shows individual particles behaving like little magnets attached to one another. The surface treated counterpart, on the other hand, depicted in *Figure* 9,* shows mostly individual particles with relatively little flocculation or particle attachment. However, as new high-solid systems were phased in, it became necessary to make additional adjustments in the magenta pigment properties. To optimize the rheological properties with available technology, the following changes were implemented: (1) the solid solution composition was changed; (2) particle size was increased; (3) particle shape was changed; (4) surface treatment was optimized; and (5) proper basic polymeric dispersant was included in the dispersion.

A comparison of rheological data before and after the changes were instituted in high-solids enamel is given in *Table* 12.

Clearly, the new product shows significant improvement in rheological characteristics and consequently is a desirable pigment for modern automotive finishes.

Recent requirements for further pigment concentration increases led us to reexamine the available pigment derivatives (anchors) with a view toward further improvements. Indeed a new anchor has been discovered,[13] the effect of which in combination with an available polymeric dispersant is described.

The new, improved modified quinacridone magenta was obtained by treating the pigment surface with the new anchor agent and then incorporated into a high-solids enamel. The results are summarized in *Table* 13.

The new anchor provides a significant step forward in rheological improvement of magenta. In fact, the newly modified pigment without polymeric dispersant shows lower dispersion viscosity than the modified magenta with a basic block polymeric dispersant.[10] The newly modified magenta with a polymeric dispersant shows outstandingly low viscosity and flow approaching Newtonian character.

The great advantage of the newly modified magenta becomes apparent when the pigment concentration is increased by 33% (from 12 to 16% pigment concentration). The difference in rheological behavior can be judged from *Figure* 10. Clearly, the newly modified magenta can be increased substantially in pigment concentration before it will approach the dispersion viscosity characteristics of the modified magenta.

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*Electronmicrographs *Figures* 8 and 9 were obtained on carefully diluted millbases with resin and solvent concentration equal to those present in the dispersion.

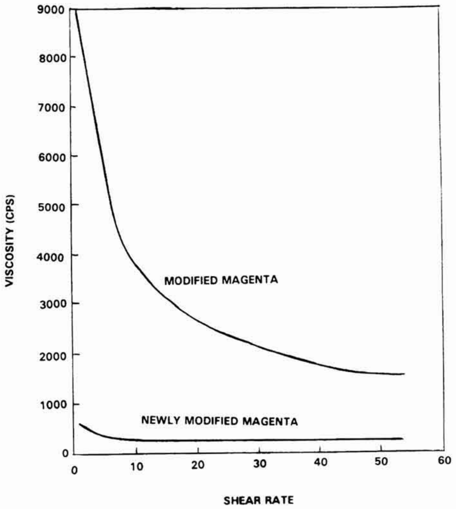

Figure 10—Viscosity vs shear rate of small particle size quinacridone solid solution magenta in a BC/CC acrylic system containing polymeric dispersant; pigment weight percent concentration = 16.0; dispersant weight concentration = 4.8

Recently, we developed a very small particle size, transparent, high surface area (77.4 m^2/g), red pigment which is a combination of a substituted quinacridone and substituted DPP. Typically for such a pigment, the viscosity of its dispersion in a high-solids enamel (two-coat) system is high, whether a polymeric dispersant is included or not. However, treatment of the surface with the new anchor agent has caused a drastic reduction in viscosity as shown in *Table* 14.

The low viscosity makes it possible to increase the pigment concentration, while lowering solvent requirements for paint preparation.

CONCLUSION

The demonstrated approach at viscosity reduction of pigment dispersions and paints is both effective and practical. New pigments are or will become available that can be used in increasingly higher concentrations; thus, mitigating the environmental problems without lowering the standards of finishes to which people have become accustomed.

ACKNOWLEDGMENT

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The Dynamic Contact Angle—A Characteristic to Predict the Lifetime Of a Wood Topcoat

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Documentation of changes in liquid water protection is of utmost importance for the characterization of the durability of an exterior wood coating. The use of the water uptake coefficient, w_t, and the dynamics of a liquid water drop contact angle, $\vartheta(\sqrt{t})$, for the determination of lifetime expectation is described. Both methods are found to give equivalent information regarding changes in water protection of six mainly waterborne unweathered and six-month weathered exterior wood coatings. The advantages of the contact angle method are outlined. Furthermore, a theoretical approach is presented to relate the observed proportionality of the contact angle with square root of time to diffusion controlled processes on the coatings surface.

INTRODUCTION

The main task of an exterior wood coating is to protect the substrate from degrading climatic factors such as moisture, UV-irradiation, and temperature change. Additionally, these degrading factors are responsible for an alteration of the physical structure, called physical aging of polymeric materials, e.g., coatings. This is due to the fact that most coatings are polymeric in nature, possessing an amorphous structure with, at the initial stage, a low degree of orientation of the existing polymeric chains.[1] These chains are in metastable energetic states with an easy to activate tendency of chain regrouping into more stable states yielding an increased degree of orientation. Such a process is mainly initiated by absorption of energy provided by the low frequency part of the solar radiation spectrum.

Structural changes occur during outdoor exposure of coatings, leading to significant changes in major protective physical properties. Liquid water protection ability is an important physical property alteration that can be closely connected with the lifetime of a coating. Many authors[2,3] have written about the role of water in the prediction of a coating's durability. Knowledge of the deterioration in liquid water protection during natural weathering of exterior wood coatings can give valuable information about the durability.

The evaluation of the shielding function of an exterior wood coating against liquid water is commonly carried out by measuring the water uptake coefficient, w_t, in accordance to DIN 52617.* For practical applications, w_t can indicate tendencies and the extent to which different types of coatings change in their moisture protection ability. It is a widely used technique that also depends on the coating thickness and substrate water sorption ability. This is especially true in cases where liquid water molecules are able to penetrate relatively unhindered through the coating, therefore reaching the substrate easily.

A microscopic measuring technique often used to determine the wettability of surfaces is the measurement of the contact angle ϑ of a distilled liquid water drop on the substrate.[4-6] In many investigations, the equilibrium or static value of the contact angle ϑ was used to obtain improvements in glueability or in adhesion.[7] Little has been reported about the nonequilibrium or dynamic behavior of ϑ. This is a consequence of restricted importance to specific applications.

This article reports about the experimental and theoretical findings of the dynamics of a distilled liquid water drop contact angle ϑ alterations subsequent to a natural weather-

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This work was presented, in part, at the PMSE Symposium "Durability of Coatings," in Denver, CO, Mar. 28-Apr. 2, 1993, and at the International Conference on Woodworking Technologies, May 22, 1993, in Hanover, Germany.

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*DIN is the abbreviation for German Industrial Standards. An equivalent ASTM standard does not exist. However, ASTM C 1195 and ASTM C 413 are suited for comparison.

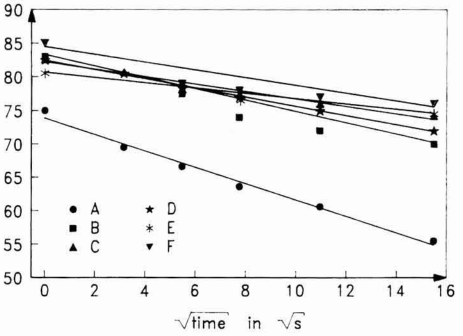

Figure 1—Contact angle time function of the unweathered wood topcoats

ing trial. A qualitative correlation between the standardized w_t-method was established and is discussed. In addition, the advantages of the dynamic contact angle measurement technique compared to the standardized w_t-method are outlined.

EXPERIMENTAL

The evaluation of the water uptake coefficient, w_t, and the dynamic behavior of the contact angle, ϑ, was executed on five different waterborne (products A-C, E, and F) and one solvent-based (product D) wood topcoats. The binders used in these products were mainly 100% acrylates or copolymers. These products give a representative choice of modern wood topcoats—low amount of volatile organic content (VOC)—used for the reconstruction and restoration of ancient wooden timber constructions in Germany. Each product was applied on 20 plain-cut spruce boards (80 mm × 35 mm × 20 mm) on one tangential and on both radial surfaces. All other surfaces were made waterproof with a two-component lacquer on PUR-basis mixed with an aromatic isocyanate hardener. All products were applied in amount and number of layers in accordance to the data given by the paint manufacturer. The amount of coating used on each board ranged between 100 and 130 g/m^2. After application of the first coating layer, the boards were cured for one day in a climatic chamber at 20°C and 65% RH. Afterwards, a second coating layer was applied and cured again for one week in the climatic chamber. Half of the test samples were exposed outdoors for a six-month period from June 1991 until December 1991 on a weathering rack (45°, southwest) at the WKI Institute in Northern Germany. The remaining 10 samples of each product were left unweathered and were stored in a climatic chamber (20°C/65% RH).

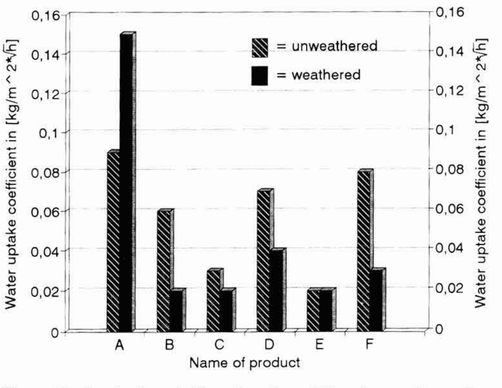

Figure 2—Contact angle time function of the six-month weathered wood topcoats

The w_t of each coating was determined on five unweathered and five weathered test samples in accordance with DIN 52617. Prior to this measurement, the coated radial spruce surfaces were also waterproofed with the PUR-lacquer. The coated side of the samples were stored in 2 mm deep water and were weighed after 0, 1, 2, 6, 24, and 48 hr.

The measurements of the contact angles ϑ were carried out on the remaining five unweathered and five weathered samples. The surfaces of the unweathered and weathered samples were not cleaned or chemically treated prior to the measurement of the contact angle. A 5 µl distilled liquid water drop, which was deposited singly from a microliter pipet on the coated surface, was filmed with a video camera (1:2/36 mm). Subsequent to this procedure, the image of the drop was viewed on a television screen in slow motion.[6] The videorecorder was equipped with a built-in stop watch, so after any desired time elapsed, the contact angles could be measured with a transparent overlay sheet resembling a protractor.[4,6] On four of the six products, the contact angles ϑ were measured after 0, 10, 30, 60, 120, and 240 sec. On the remaining products, ϑ was determined after 0, 60, 120, 180, and 240 sec. To improve the analysis of products C and E, it was useful to measure the contact angle value after 600 sec. The contact angle of these products changed little over time. At least one drop was investigated per sample; so, each data point in *Figures* 1 and 2 represents the mean of five to seven individual values for the contact angle.

RESULTS

Water Uptake Coefficient w_t in Accordance to DIN 52617

With the chosen scaling intervals, a linearity between the change in weight W_t and square root of time was adjusted from the beginning of the experiments. Thus, the approximated term on the right-hand side of equation (1), given in DIN 52617, can be used to estimate w_t. *Figure* 3 contains the w_t-values of all six products obtained by regression analysis of the mean values and their solids content. A comparison between the unweathered and the weathered w_t-values yields a significant influence of a six-month natural weathering period on this parameter. The w_t-value of product A rises by a factor of 1.5 after the samples were naturally aged, whereas w_t of the weathered samples of products B, D, and F decline up to 1/3 compared to values of the unweathered samples. Products C and E show little change in water uptake ability after a six-month weathering period.

$$w_t = \frac{\Delta W_t}{\Delta\sqrt{t}} \approx \frac{W_{48} - W_1}{\sqrt{48h} - 1} \qquad (1)$$

W_t = mass of the species referred to the water uptake area at time t in [kg/m^2]
w_t = water uptake coefficient in [kg/(m^2* $\sqrt{h}$)]
t = time in hours

Dynamics of the Contact Angle ϑ

An approximation of test results indicate a linearity between ϑ and the square root of time $t^{0.5}$, which has been made apparent by regression analysis on the basis of the measured mean values of ϑ $(\sqrt{t})$ with a $r^2 \geq 0.98$ in all experiments.[8] The gradient angles of the regression lines are significantly altered in some cases after a six-month natural weathering period (see *Figures* 1 and 2). The gradient angles of the unweathered and weathered samples are given in *Figure* 4. The data points for the contact angle in *Figures* 1 and 2 represent a mean of five to seven values with an average standard deviation of six percent. The standard deviation σ depends upon the time in consideration. The value of σ is found to be higher for the initial values of ϑ at time zero (10%) and to be relatively low for the values of ϑ at longer times (two percent).

In addition, the initial values at time zero of the contact angles ϑ are outlined in *Figure* 5. These values indicate the physical state of a solid's surface.[5,7] A higher contact angle yields a more hydrophobic state, whereas a lower contact angle results from a more hydrophilic state on the coating surface. In product A the initial value of the contact angle does not change after a six-month natural weathering period. In products B, D, and F the initial value is noticeably higher on all weathered samples. In products C and E, slightly lower contact angles were obtained on the weathered samples.

DISCUSSION

The increase in water uptake and the slope of the time function of the contact angle ϑ $(\sqrt{t})$ after a six-month outdoor exposure clearly indicates limited durability for product A. Besides a slight change in gloss, no signs of mechanical destruction (blistering, peeling, etc.) appeared on this product. Spruce panels weathered for one and one-half years substantiated the proposed restricted durability. These panels already had a few weak spots. Such weak spots showed first signs of beginning mechanical destruction (mainly peeling). Panels painted with all other products did not have any indication of degradation after one and one-half years of natural exposure.[9]

The obtained qualitative correlation between the water uptake coefficient w_t and the dynamic behavior of ϑ, called the function $\vartheta(\sqrt{t})$, indicates that both measuring techniques register equivalent physical water transport mechanisms for liquid water. From the literature it is known that the transport of liquid water in organic polymers is mainly controlled by diffusion.[3] The diffusion process is initiated by a concentration gradient of the diffusing particles. The proportionality of water uptake with $t^{0.5}$ results from an approximate solution of Fick's second law, which yields a mathematical solution of the three-dimensional diffusion process. Equation (2) mathematically describes the diffusion process in one dimension assuming a nonconcentration dependent diffusion coefficient D.

$$\frac{\delta c}{\delta t} = D * \frac{\delta^2 c}{\delta x^2} \qquad (2)$$

where c = concentration in [g/cm^3]
D = diffusion coefficient in [cm^2/s]
t = time in [s]
x = space in [cm]

Equation (2) is not totally integratable, but general solutions can be obtained for a variety of initial and boundary conditions. These solutions are restricted to the assumption that D is constant. Such a solution is often in a standard form that is comprised of a series of error functions (erf). For practical applications, an important solution for the distance of penetration $\bar{x}$ of any given concentration of the diffusing molecules is given at surface boundaries[12] by the following term:

$$\bar{x} \approx 2,3 * \sqrt{D*t} \qquad (3)$$

where $\bar{x}$ = distance of penetration in [cm]
D = diffusion coefficient in [cm^2/s]
t = time in [s]

One fundamental assertion that is included in equation (3) is the proportionality between $t^{0.5}$ and the distance of penetration $\bar{x}$. This conclusion is the basis for the fundamental relation in the standardized w_t-method previously described. Hence, absorbed water in organic polymers penetrates a distance $\bar{x}$ within the square root of time. Therefore, if a relationship exists between the dynamics of the contact angle ϑ and the water uptake coefficient, the change in contact angle can be correlated with a change in drop space on the surface. In the next section, a geometrical approach to this problem is presented.

Figure 6 is an illustration of the situation under consideration. For a geometrical description of the distance of penetration $\Delta\vec{r}$ (former $\bar{x}$), it is necessary to choose a suitable system of coordinates that allows a vectorial writing of $\Delta\vec{r}$. Since a relationship between space and angle change must be obtained, a system of polar coordinates is used. The origin of the polar coordinates system is obtained by the point of intersection of the tangential lines $\vec{r}(t_o+\Delta t)$ and $\vec{r}(t_o)$, that are

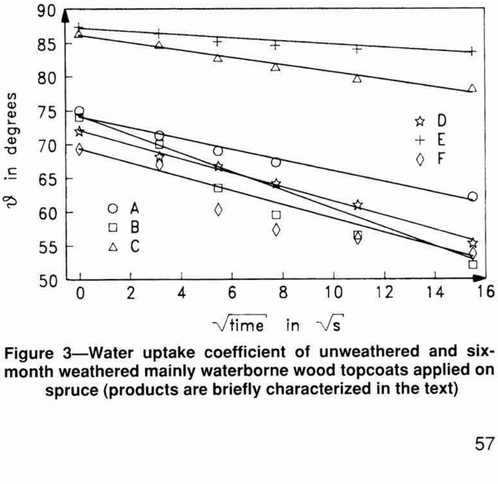

Figure 3—Water uptake coefficient of unweathered and six-month weathered mainly waterborne wood topcoats applied on spruce (products are briefly characterized in the text)

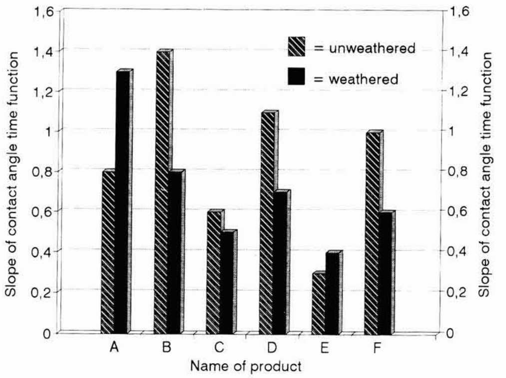

Figure 4—Slopes of the contact angle time function of the unweathered (left bars) and weathered (right bars) wood topcoats

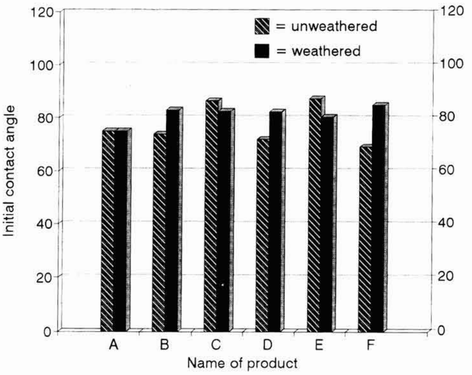

Figure 5—Initial contact angle (t=0 seconds) of the unweathered (left bars) and weathered (right bars) wood topcoats

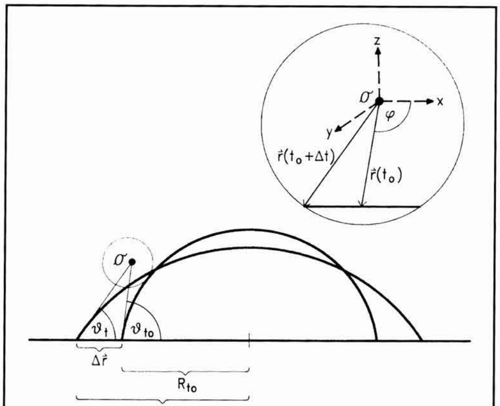

Figure 6—Geometrical illustration of the water drop spreading on the coatings surface (symbols are explained in the text)

laid on the drop to determine ϑ. Assuming an isotropic diffusion process in all three-dimensional directions, it is possible to restrict the problem to be two-dimensional. With this boundary condition, we can express $\vec{r}(t)$ as follows:

$$\vec{r}^{\,T}(t) = (x, y) = (\rho * \cos\varphi(t), \rho * \sin\varphi(t)) \qquad (4)$$

The distance of penetration $\Delta\vec{r}$ and the change in contact angle $\Delta\vartheta$ will be defined to:

$$\begin{aligned} \Delta\vec{r}(t) &= \vec{r}(t_0 + \Delta t) - \vec{r}(t_0) \\ \Delta\vartheta(t) &= \vartheta_t - \vartheta_{t_0} \end{aligned} \qquad (5)$$

In addition, a relation between the experimental contact angle and the angle introduced in the system of polar coordinates can be set:

$$\varphi = 180° - \vartheta \qquad (6)$$

The quantity of a vector $\vec{r}$ is generally defined as:

$$|\vec{r}(x,y,z)| = \sqrt{x^2 + y^2 + z^2} \qquad (7)$$

For the following problem, the z-component in equation (7) is neglected. With equations (4-7), the distance of penetration $\Delta\vec{r}$ is obtained:

$$\left|\frac{\delta\vec{r}}{\delta t}\right| = |\Delta\vec{r}| = \sqrt{\left(\frac{\delta\rho}{\delta t}\right)^2 + \rho^2 * \left(\frac{\delta\varphi}{\delta t}\right)^2} \qquad (8)$$

Considering relatively small changes in contact angle ϑ, e.g., for short time intervals, it can be assumed that $\rho \approx$ constant. This boundary condition and the assumption that φ is totally differentiable leads to the following expression:

$$|\Delta\vec{r}| \sim \rho * \frac{d\varphi}{dt} \qquad (9)$$

With the assumptions about certain approximately valid boundary conditions, a correlation between the change of the water drop radius on a surface and the contact angle ϑ is established geometrically. Assuming that diffusion controlled processes are causing the spreading of a distilled liquid water drop in surface regions, it is possible to equate the right term of equation (3) with the right term of equation (9). Hence, equation (10) is derived:

$$\rho * \frac{d\varphi}{dt} \approx 2,3 * \sqrt{D * t} \qquad (10)$$

$$\frac{d\varphi}{dt} = C * \sqrt{t} \qquad (11)$$

where $C = \dfrac{2,3 * \sqrt{D}}{\rho} \approx$ constant

Equation (11) states a theoretical relationship between ϑ and $t^{0.5}$ with respect to equation (6). Therefore, the experimental findings, which gave $\vartheta \sim t^{0.5}$, are strengthened by the geometrical analysis results.

Even though both techniques give equivalent information about alterations in liquid water protection ability due to natural aging, the contact angle measurement technique should be preferred since it is more precise. One aspect not mentioned, but having an influence on the water uptake coefficient w_t of a coating, is the substrate.[2,3,10] A comparison between a variety of commercial coatings measured as free films and adherent to wood revealed a significant effect on the water permeability. Some coating systems applied on wood were more than twice as permeable compared to free films.[2]

The effect of the substrate on the dynamics of the coating's contact angle should be negligible. This assumption is mainly due to the relatively short measuring times between seconds and a few minutes. Taking into account that the diffusion coefficient, D, of organic coatings[11] ranges between 0.15×10^{-8} cm^2/s and 1.5×10^{-8} cm^2/s, the distance of penetration $\bar{x}$ of water should be approximately 10 μm per min. For our investigations, the maximum observation time for the liquid water drop contact angle was 240 sec, thus a distance of penetration $\bar{x}$ of approximately 40 μm can be assumed [see equation (3)]. In contrast, the microscopic determination of film thickness implied an average coating layer thickness between 70 and 100 μm depending upon the coating type. Therefore, no substrate influence on the behavior of the contact angle should be recognized.

SUMMARY

To recommend a topcoat for application on exterior wooden surfaces, e.g., half-timbered buildings, it is essential to determine its behavior towards moisture. Valuable information about the change in liquid water protection caused by weathering factors of waterborne and solvent-based exterior wood topcoats can be gained by measuring the alteration of the water uptake coefficient w_t. Investigations on a variety of commercially available, mainly waterborne wood topcoats indicate a significant influence on the w_t-value due to a six-month outdoor exposure. A noticeable rise in the w_t-value after this short period of natural aging can be linked with a beginning loss in adhesion and, therefore, with limited durability.

The main objective of our studies was to find an alternative and more precise technique giving equivalent information about liquid water protection for exterior wood coatings. By measuring the dynamics of a distilled liquid water drop contact angle ϑ, a method is derived to monitor changes in liquid water protection due to aging of the coating. The following conclusions from the experimental and theoretical findings were noted: (1) for short measuring times, the change in contact angle is proportional to the square root of time; (2) a theoretical explanation of this experimental outcome can be derived by a geometrical approach based on the assumption that an isotropic diffusion process on the surface causes drop spreading; (3) as far as changes in water protection caused by natural aging are concerned, both methods correlate qualitatively; and (4) in contrast to the water uptake coefficient, the dynamics of the coatings contact angle are not affected by the water transport mechanism of the substrate.

GUIDO HORA studied at the University of Braunschweig in Germany. He received the M.S. Degree in Physics in 1991. Afterwards, Mr. Hora joined the Wilhelm-Klauditz Institute for Wood Research, where he is working on his Ph.D. in the field of "Aging of Wood Coatings."

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January 1994 Subcommittee Reports of ASTM Committee D01

The January 1994 meeting of ASTM D01 on Paint and Related Coatings, Materials, and Applications was held January 23-26, 1994 at the Crown Sterling, Fort Lauderdale, FL. During this time, 180 members and guests met in about 200 scheduled meetings of D01 and working task groups. The current membership of D01 is 521.

Highlights

D01.08—The Second Edition of the ASTM Manual, *Determination of Volatile Organic Compounds (VOC) in Paints, Ink and Related Products*, edited by J.J. Brezinski, is now available from ASTM.

D01.13—T. Sliva has agreed to become Chair pro tem and is soliciting support from consumer groups to revive the subcommittee.

D01.20—A small group has been formed to revise D 3980, the practice on interlabor-atory testing of paint and related materials.

D01.24—The first draft of a guide for odor evaluation has been prepared. The subcommittee will welcome participation by interested volunteers.

D01.42—A draft for testing exterior wood stains is being prepared.

D01.45—The subcommittee heard two presentations on proposed test methods for determining leach rate of copper antifouling paints. One was given by Julian Hunter and the other by Charles Anthony.

D01.61—A method for determining cleanability of brushes is being developed. A task group has been formed to develop a program on paint application tools for the 1996, D01 mini-symposium.

New Standards

The following new standards have been published since the January 1993 meeting.

D 5325, Test Method for Determination of Weight Percent Volatile Content of Waterborne Aerosol Paints.

D 5380, Test Method of Identification of Crystalline Pigments and Extenders in Paint by X-Ray Diffraction Analysis.

D 5381, Guide for X-Ray Fluorescence (XRF) Spectroscopy of Pigments and Extenders.

D 5401, Test Method for Evaluating Clear Water Repellent Coatings on Wood.

D 5402, Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs.

D 5403, Test Methods for Volatile Content of Radiation Curable Materials.

Dates and Locations of Future Meetings

June 26-29, 1994—Raleigh, NC.
January 22-25, 1995—San Antonio, TX.
June 25-28, 1995—Atlanta, GA.
January 21-24, 1996—Fort Lauderdale, FL.

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DIVISION 1 ADMINISTRATIVE

SUBCOMMITTEE D01.08 ENVIRONMENTAL CONCERNS

E.G. Praschan, Chairman

The newly appointed chairman expressed appreciation for the extensive efforts of J.J. Brezinski, who has resigned as Chairman of D01.08. Task group 01 on Durability and VOC discussed the recent SSPC study that addressed this subject. S. Boocock advised that the data is apparently failing to show a significant correlation between durability performance and VOC content. This group will continue to examine potential relationships with VOC levels.

The second edition of the ASTM Manual, *Determination of Volatile Organic Compounds (VOC) in Paints, Inks and Related Products*, has been published and is now available. Thanks to J.J. Brezinski, Editor, and the other contributors.

Preparations for the June meeting in Raleigh, NC were discussed. J. Berry, of EPA, offered suggestions on how to best focus on providing appropriate information to EPA personnel and addressing their needs on paint-related environmental issues and pollution prevention. Presentations and panel discussions will be organized accordingly.

SUBCOMMITTEE D01.13 CONSUMER AFFAIRS

T. Sliva, Chairman

D01.13—Consumer Affairs—T. Sliva, Chairman, made contact with personnel from both Consumers Union and the Consumer Safety Products Commission to solicit their participation in the subcommittee. The Chairman will work with J. Weaver to solicit support from various other consumer organizations over the next few months. A decision will be made at the June meeting on whether to disband the subcommittee.

SUBCOMMITTEE D01.15 LECTURES AND SYMPOSIUM

T. Sliva, Chairman

D01.15—Lectures and Symposium—T. Sliva, Chairman, served as moderator for a mini-symposium held at the January 1994 meeting of D01 on slip resistance. The first speaker was William English, who presented a talk on test methodology and the development of instrumentation to measure the coefficient of friction on walkways. The second speaker, Paul R. Guevin, Jr., presented a talk on laws and various regulations related to slip resistance that have developed over the years.

The mini-symposium to be held at the January 1995 meeting will be on rheology and its effect on paint properties. J. Peters, of Byk-Gardner, will discuss the instrumentation, uses and calibration of Stormer™, Brookfield, and cup-type viscometers. A speaker from Bohlin Rheologi will present a talk on high-speed viscometers.

Subcommittee D01.61, Paint Application Tools, has established a task group to organize a mini-symposium on paint application tools for the January 1996 meeting.

SUBCOMMITTEE D01.96 RESEARCH

M.E. McKnight, Chairman

The subcommittee heard two presentations. First, Lesley Crewdson spoke on video imaging of coating defects. South Florida Test Service is developing an automated video imaging system and standard operating procedures to assist them in their 40,000 monthly panel readings. They have investigated and developed systems for lighting, and obtaining and analyzing images. Research is also being conducted to characterize the pattern of some defects, i.e., cracking. South Florida Test Service has also organized a consortium, Video Image Enhanced Evaluation of Weathering (VIEEW). T. Nguyen spoke on a new procedure developed at NIST to measure wet adhesion of coatings applied to a steel substrate using a laboratory tensile testing machine. He reported that differences in adhesion between areas that had cathodically delaminated and adjacent areas having reduced wet adhesion—as compared with dry adhesion—could be detected. The subcommittee recommended that standards based on these ideas should be developed in the appropriate subcommittees.

The chairman thanked everyone for participating in the discussions and invited those present to invite others who they thought would be interested in the activities of the committee. This subcommittee meeting provides a forum for discussing new procedures and standards needs.

DIVISION 20 RESEARCH

SUBCOMMITTEE D01.20 QUALITY ASSURANCE AND STATISTICS

R.K. Morrison, Chairman

R.K. Morrison presented the results of the concurrent main/society ballots for the reapproval of D 3980, "Standard Practice for Interlaboratory Testing of Paint and Related Materials." There was a negative on the D01 ballot, and another negative on the society ballot. After much discussion, the subcommittee found both negatives persuasive, and the item was withdrawn for modification. Some of the questions posed in the meeting were:

(1) Are the ASTM sanctioned practices E 691 and D 3980, which purport to do the same thing, compatible?

(2) Are there computer programs that assist the user in the analysis of the data, and are they workable?

(3) Can the underlying assumptions of D 3980 be easily understood?

Because of the complexity of these questions, a task group was formed. The members of the group will deal specifically with the needs of D 3980.

D01.21.10—Lead Paint Policies—J.C. Weaver, Chairman, observed that his 1989 "White Paper on White Lead" remains the only major contrarian publication against the dogma from about 1970 that "lead-based paint" is the principal source of excess lead in the blood of small children. His sequel paper on attribution and speciation of lead from gasoline fallout was the only contrarian paper among over 30 papers in a July 1993 symposium on lead held by ASTM Committee D22 on Atmospheres in Boulder, CO. However, more papers published in recent years emphasize the prevalence of lead in soils, dust, and aerosols. And yet, the asbestos rippers-turned-paint chipper syndrome persists across various advocacy organizations, the U.S. Congress, and numerous state legislatures. In Ohio, the Ohio Department of Health is trying to secure $15 million, under HUD's Title X, to abate lead in Cleveland and Cincinnati. A current bill in the Ohio legislature will require use of the abatement standards developed by ASTM E06.23.

It was reported that Subcommittee E06.23 on Abatement of Lead Hazards in Buildings, which is chaired by M.E. McKnight, intends to issue, by late 1994, a separate compilation of its growing list of standards developed by its 14 task groups, as indicated in *Standardization News*, December 1993, pp 32-37. Twenty or more standards are at various levels of adoption.

The EPA is required by law to issue rules on training and protection of lead workers and identification of lead hazards by April 28, 1994. In addition, by October 1994, the EPA must publish 25 million copies of a lead hazard pamphlet for homeowners and tenants. How can ASTM harmonize its standards with HUD vs EPA programs, or even divergent lead policies within the vast EPA?

D01.57.08 and D01.57.12 on Toxicity Determination and Labeling are close to balloting a standard on the bioavailability of lead, cadmium, et al. in artists' materials, which stems from European practice via ISO/TC35/SC9/WG14 and the EC. Bioaccessibility in children of lead from mine waste solids is in the 0.5 to 9% in vivo (rabbit) and in vitro (flask) extractions made by M.V. Ruby, et al. (ES&T, Dec. 1993). Typical oxide/phosphate/-sulfate/sulfide lead minerals in residential soils near mines were extracted at 37°C with a mixture of pepsin, organic acids, and water adjusted to pH 1.3 with HC1 in first stage analyses. EPA's assumption of 30% accessibility might better recognize more wide-spread fallout from gasoline as more soluble lead compounds such as lead chloride and bromide (P.R. Buseck, et al.).

Guidelines for Lead in Soil, Environment Science & Technology (ACS), January 1994, by Wixom and Davies summarizes a massive, 16-person panel study in "Society for Environmental Geochemistry and Health." The study recognizes the disparity between lead in soils in city playgrounds and side yards vs remote mine/smelter tailings, both accessible to children. Their formula for a "Target Soil Dust Lead Guideline Mode" correlates lead in blood at 25 μg down to 10 μg and even 2 μg/dL vs ppms of lead in soil or dust. No mention is made about the lead chloride/bromide fallout from leaded gasoline used in the past.

Blood level backgrounds or baselines across populations vary with the ages of both children and adults and their circumstances. A recent Wake Forest University study of many journeyman painters found an average of 7.8 μg/dL of blood lead and none over the OSHA limit of 40 μg/dL.

Speciation of lead in soil and dust was reported in 1985 by P.R. Buseck, but given scant attention since. A recent, small grant by CDC to Case Western Reserve University will enable attempts at isotopic speciation of lead in samples of dust from inner city Cleveland, OH, homes where excess lead in the blood of children requires abatement of "lead-based paint" therein.

D01.21.13—Coordination of VOC Standard & Information—K. Hiroshi, Temporary Chairman, noted that with J.J. Brezinski retiring from the ASTM, a new volunteer chairman is needed for this important task group. K.H. Fujimoto opened the meeting by conveying the requests of Cori Choa, of SCAQMD Laboratories:

(1) *A test method is needed to measure the ammonia and water generated during cure.* Previously there was no concern. Because of credits given in the fee schedule for the weight of ammonia and water present (less than 10%), there is an interest in measuring these two compounds. After a lengthy discussion, it was agreed that there were no acceptable test methods available to measure ammonia and water given off during a bake.

(2) *There is a need to have a test method which will measure any hazardous air pollutant (HAP) given off during cure of a paint film.* Presently, results obtained from using U.S. EPA's Reference Method 24 are adequate, but after six years there will be a need to fund out what residual HAPs are given off and whether they are a health hazard. The CAAA of 1990 does not state what is to be done if it is found that residual HAPs are a health hazard. It was agreed that any test method developed for measuring HAPs will be a compromise in test parameters to measure the maximum HAPs present under specified test conditions. D01.21.52 is developing test methods for quantitating solvents present in paints which will be the first step in measuring any HAPs. Eventually, the task group hopes to address the quantitation of HAPs given off during cure by using head space/gas chromatograph/mass spectroscopy techniques.

(3) *Is there a method available to measure the aluminum pigment in paints in the presence of copper, zinc, and/or aluminum stearate?* In the SCAQMD, regulations for the VOC of aluminum paint are higher provided that the paint contains a minimum amount of aluminum pigment. There is a need to measure the amount of aluminum present. Many ideas were discussed, but it was agreed that there was no test available which would quantitate the aluminum pigment alone.

M. Harding reported on the revision of California's southern-basin rules for emitted VOC. If a facility emits more than four tons of VOC annually, it can average its VOCs under a "bubble" plan, but must decrease its emitted VOC over a 15-year period. Under this plan, if a facility finds a way to better reduce emitted VOC, it can sell/trade these credits with other companies. This gives facilities more flexibility and encourages measurable record keeping.

In other actions, J. Bender reported on the numerous VOC measurement requirements imposed on printing ink facilities such as measuring stack emissions and fugitive emissions, and the group discussed: (1) EPA Publication #1842 which specifies emission factors per car, (2) architectural Reg-Neg negotiations going on to its final phase by which the EPA hopes to reduce VOCs of all major products over a 10-year period, and (3) the work going on to establish federal guidelines on VOCs of refinishing products.

D01.21.14—New Publication & Workshop—K.H. Fujimoto, Chairman, announced the publication of the second edition of the manual on Determination of Volatile Organic Compounds (VOC) Content in Paints, Inks and Related Products, J.J. Brezinski, Editor. The manual can be purchased from ASTM headquarters in Philadelphia. This manual is a "must" for anyone involved in VOC matters. The new manual covers, in more detail, information on the purposes of lowering VOCs in paints, inks, etc., test methods used, and the U.S. EPA's approach to solving VOC problems.

A report was given on the last ASTM Paint VOC Measurement Workshop held at the Sheraton Industry Hills, City of Industry, CA. Fifteen people attended, including two representatives from the California ARB and three chemists from the SCAQMD Laboratories. ASTM's new Manager for Technical Training, Scott Murphy, did an excellent job in organizing and preparing the workshop at the hotel. The laboratory demonstration at the SCAQMD Laboratories was a success with Cori Choa's staff putting on a professional demonstration on the ASTM test methods used in measuring the VOCs in paints and coatings. The next VOC Workshop will be held in Chicago, IL, May 4-5, 1994, with Rust-Oleum acting as the host laboratory for the VOC test method demonstrations.

D01.21.24—Revision of D 2369, Volatile Content of Coatings—M.E. Sites, Chairman, a reviewed the latest revision of D 2369-93 which was undertaken to revise Note 10 in Section 7.3 to read "other induction periods are used. See U.S. EPA Reference Method 24." This note previously referenced the U.S. EPA as allowing an induction period of up to 24 hours on multicomponent paints. Since the precision statement included in this revision for multicomponent paints was generated using a one-hour induction period, it was felt the 24-hour induction period should not be referenced directly in this method.

At the D01.21.80, Exploratory Analytical Chemistry meeting, it was noted that it has been 15 years since ASTM D 2369 was developed and over six years since a round-robin has been run. Although this method has been criticized as inadequate for some low VOC containing paints and coatings, no data has been submitted to D01.21 in answer to K.H. Fujimoto's request for information on this problem.

D01.21.80 recommended D01.21.24 take action to find out whether D 2369 can accurately measure the low VOC and high-water containing paint products on the market today by running a round-robin on these products. M.E. Sites requested members and guests to designate whether: (1) they can supply the low-VOC paint samples, and (2) they are willing to participate in a round-robin. The plans are to start a round-robin as soon as possible and have the results available by the next June meeting. *Contact M.E. Sites at (617) 861-6600 if you wish to participate in the round-robin and/or have a paint sample you wish to submit.* Another question raised involved the use of D 2369 on multicomponent paints which cure in minutes. K.H. Fujimoto is investigating this problem and hopes to be able to report on this at the next meeting. The issue of whether or not to include powder coatings in this round-robin was also discussed. No definite decision was reached since this is really under the jurisdiction of the powder group. D01.21.24 approved J.J. Benga's motion to remove reference to 2-ethoxyethyl acetate in Paragraph 6.4 since this solvent is not being used today and since it has been classified as a health hazard. J. Berry objected to the inclusion of a reference to D 4713, "Test Methods for Nonvolatile Content of Heatset and Liquid Printing Ink Systems," in Paragraphs 1.4 and 2. This method is not sanctioned by the EPA while D 2369 is used in EPA's Reference Method 24. Users of D 2369 might misinterpret reference to D 4713 as a license to use this method when determining VOCs. D01.21.24 approved removing this reference to D 4713 in D 2369, and sending D 2369 to D01.21/D01 ballot.

D01.21.24A—Ion Chromatography, Electrocoat Bath Samples—J. Furar, Chairman. Negatives received in D01.21 ballot on a guide for the "Determination of Anions in Cathodic Electrocoat Permeates by Ion Chromatography" were discussed. The negative vote from P. Guevin referred to listings in the Reference Document section which are not used in the main body of the guide. This negative was withdrawn when three of the four referenced documents were eliminated and the remaining reference documents were incorporated into the main body of the guide. In addition, the following revisions were made: (1) a comment was received to add the acronym "IC" after "ion chromatography" in Section 1.1 since "IC" is used to mean other things, and (2) it was suggested that the term "nitrate" be added to the"Keyword Section."

Future work of D01.21.24A will continue to explore the determination of phosphate ions since past efforts have proven unsuccessful. Phosphate test kits from HACH will be evaluated to determine their usefulness in this area.

D01.21.26—Review of D 2697, Volume Nonvolatile Matter in Clear or Pigmented Coatings—Chairman, B. Neff, reviewed the scope of D01.21.26 which is to develop a relatively fast, simple and more reliable method to determine the density of a baked film in order to calculate the % volume nonvolatile (%VNV) matter in paints. The helium gas pycnometer is under study as a quick and accurate method to determine the density of the baked paint film, and from which the % VNV can be calculated. The original D 2697 requires the baking of the paint film on a two-inch diameter metal disk, and then the determination of its density by weighing it in air and in water. The method works for low pigment/binder (P/B) paints, but due to the incomplete wetting of the high P/B paint films, gives erroneous and variable results.

Studies show the helium gas pycnometer works. However, the biggest variable is the preparation of the wet paint to obtain free paint films of specified film thickness. In B. Neff's latest revision, the wet paint is drawn down on Tedlar™, from which a free paint film can be obtained. To eliminate the sample preparation variable, the chairman video-taped the procedure in his laboratory, and sent a copy to each of the five round-robin participants. To make D01.21.26's work easier, Micromeritics has generously loaned their helium gas pycnometer instrument to those collaborators who did not own one. Three collaborators returned round-robin data. Although the % VNV data on three paint samples, generally, showed good correlation, there was no information on the individual film density measurements. K.H. Fujimoto suggested that the collaborators list the actual film density measurements to help isolate possible sources of errors in the measurements.

A lengthy discussion followed on the proposed method. B. Neff will incorporate the suggestions, revise the method, and submit it for D01.21 ballot.

D01.21.27B—New Approach to VOC—R.K.M. Jayanti, Chairman. Temporary Chairman K.H. Fujimoto summarized the activities of D01.21.27B to develop a direct method to measure VOCs, and the result of a D01.21 ballot. The method has been withdrawn for revision as a result of nine negatives and comments received which were based on: (1) the apparatus was not commercially available; (2) the apparatus needed improvement especially for leak checks prior to the test run; (3) the test was too slow and only one sample could be run at a time; (4) the charcoal tubes used did not absorb methanol and (5) the reproducibility of 50% was no improvement over Reference Method 24. Based on the lack of activity for one year, Chairman Jayanti was notified that unless some action was taken at this meeting, the group would be placed on "inactive" status. Chairman Jayanti replied that: (1) EPA has provided funds for Research Triangle Institute to develop a simplified volatilization chamber and (2) Midwest Research Institute will conduct an interlaboratory study of the method. Results will be reported at the next meeting.

In a discussion, additional troubles with the present method were identified including the type of charcoal used in the absorbent tubes, the larger 2g sample size (Reference Method 24 uses 0.3000 g), and the use of glycol to keep the paint film open during the heating stage.

D01.21.49—Sample Preparation for Trace Metal Analysis—B. Neff, Chairman, reviewed the activity and scope of D01.21.49, which is to develop a sample preparation method for the analysis of trace metals. Instead of the ignition method, the proposed sample preparation method is an enclosed wet acid digestion scheme at atmospheric pressure, which uses commercially available equipment. In the round-robin testing, it was found that the method cannot be used for lead analyses due to the formation of lead sulfate precipitates. B. Neff distributed copies of the proposed method for comments, deletions and additions. After a short discussion, D01.21.49 voted to place the method on the next D01.21 ballot. A precision statement will be written with the data available. Another round-robin will be run to quantitate silicon. The test sample will be a coating resin spiked with a silicone oil.

D01.21.51—Determination of Formaldehyde in Paints—D. McCunn, Chairman, reviewed the objectives and progress made by the group, and distributed data on the measurement of formaldehyde from a closed system. The gas chromatographic (GC) approach, OSHA approved method #52, suffered from poor recovery and limitations with the baseline and peak shape. The liquid chromatographic (LC) approach also demonstrated problems with low recovery and shifting retention time of the derivative peak. Results of an experiment that collected and measured the evolved formaldehyde using chromatropic acid indicate that the low recovery problem shown by the GC and LC methods are not readily explained by the incomplete evolution of formaldehyde. No specific suggestions were made by the group, but methods used by Hüls America and Reichhold will be submitted to the chairman for review.

Data from the industrial round-robin for the analysis of formaldehyde in emulsions conducted by seven companies were distributed and discussed by L. Mink. More testing with "pre" and "post" column derivatization is planned. Although emulsions may be somewhat less complicated than a complete paint system, results from this study might provide a solution to measuring evolved formaldehyde. Also discussed was a general purpose method that is used for measuring formaldehyde released from fabrics. The use of a "static" sealed chamber approach which collects the formaldehyde in industrial hygiene sampling tubes and a dessicant to absorb the water given off might be worthy of investigation.

D01.21.52—Paint Solvent Analysis by Gas Chromatography—J. Benga, Chairman, distributed a proposed method for a capillary gas chromatographic (GC) procedure for solvent analysis that could be used to develop the groundwork for the determination of some of the 189 hazardous air pollutants (HAPs) listed in the 1990 amendment of the Clean Air Act. The method recommended by the chairman uses capillary column technology with flame ionization detection. The column is 30 m × 0.25 μm with DB-5.

At the recommendation of the group, the method will be modified to allow (1) the use of alternate columns provided they have the same separation capabilities, (2) the option to use mass selective detection, and (3) the flexibility to use other carrier gases besides the recommended hydrogen. With the revisions completed, the proposed method will be submitted for concurrent D01.21/D01 ballot. The available data will be used to develop a precision statement. A round-robin is planned to test low VOC paint products which may also contain HAPs. Four laboratories have volunteered to participate in the round-robin. More volunteers are needed. Interested parties are requested to contact Joe Benga at 412-492-5511 or K.H. Fujimoto at 313-788-9707.

D01.21.54—Revision of D 4017, Water in Paints and Paint Materials by Karl Fischer Titration—R. Osterman, Chairman. The consensus of the group was to include the methanol extraction method using Hydranal reagents, developed by W.C. Golton, as an alternate method to handle samples which do not yield reproducible results. J. Lambert mentioned that the K series Hydranal reagents should be used when aldehydes or ketones are present in the paint materials.

The precision statements of the current method require revision to reflect the excellent results obtained from a previously run round-robin on four water-reducible paints. These data have been published in the second edition of ASTM's MNL-4, *Manual on Determination of Volatile Organic Compounds (VOC) in Paints, Inks and Related Products.*

Recently, another round-robin test was conducted by J. Benga on paints containing 50-75% water using the Hydranal reagents. The excellent precision statement generated will be incorporated into the Hydranal section of D 4017. J. Benga agreed to revise the Hydranal method. When this is done, it will be submitted for concurrent D01.21/D01 ballots.

D01.21.56—Revision of D 3960, Standard Practice for Determining Volatile Organic Compounds (VOC) Content of Paints and Related Coatings—M.E. Sites, Chairwoman, distributed copies of the latest version of D 3960-93 for comments, additions, or corrections. This edition of the practice can be purchased from ASTM Headquarters as a separate document; it will be published in the *1994 ASTM Book of Standards*, Volume 6.01. D 3960 has undergone annual revisions since 1985 to keep it up-to-date. The purposes of the latest revision were: (1) to delete the term "VOS," which stands for "volatile organic substance," from the scope since New Jersey no longer uses the term; (2) to add ASTM Test Method D 5095 to the list of Referenced Documents since the EPA has approved the use of this method for the determination of VOC content of silane and siloxane coatings; and (3) to replace, in "Appendix X3," the regulatory definition of VOC with the revised definition published by the EPA under 40 CFR, Part 51, *Federal Register*, Vol. 57, No. 22, February 22, 1992, pp 3941-3946.

A discussion followed, in the presence of J. Berry, on the current and critical issue of "how low in VOCs must a paint or coating be before the 'minus water' concept requirement can be removed and the straight VOC measurement used?" It has been found that as the VOC decreases, slight variations in test measurements are magnified in the calculations. Some recommendations made to exempt paints and related materials from the "minus water" concept were: (1) those containing less than 1% volatiles; (2) materials where the water/solvent ratio is 20:1 or greater; (3) materials containing less than 1 lb/gal VOC; and (4) materials which contain less than 25% total solids, as applied. Constructive input from the paint industry would be of great help since some regulatory agencies are looking for an answer to this question, and would like to establish a cut-off point where the "minus water" concept can be dropped. The U.S. EPA is studying the problem, but is not ready to give an answer to this question at this time. The paint industry is aware of the difficulty in measuring low VOC containing products. However, the ability to measure these low quantities accurately is a necessity in light of new concepts such as "bubbling" which is to be used in California's southern basin.

D01.21.80—Exploratory Analytical Chemistry—K.H. Fujimoto, Chairman, led discussions that resulted in the following decisions:

- Since it has been over 15 years since D 2369 was developed, U.S. EPA's Reference Method 24 will be evaluated on today's low VOC paint products. D01.21.24 will set up a round-robin as soon as possible.
- A separate task group will not be set up to address the requirement of Title 5 of the CAAA of 1990 for reporting and quantitating any of the 189 listed HAPs. Rather, it was suggested to use the work being done in D01.21.52 under Chairman Benga. For the present, capillary gas chromatography (GC) will be used. As the complexity of the analyses increases, headspace/GC/mass spectroscopy may also be considered. Volunteer collaborators are needed to participate in the round-robin testing. Interested parties should contact Joe Benga at 412-492-5511.
- D01.21.27A will not be reactivated to measure the exempt solvent, 1,1, difluoroethane, Dymel 152a, now being used in aerosols. The test method is available since it has been developed by the BAAQMD Laboratories as Method 35. This is because the use of this expensive propellent is limited at this time.
- Task group 80 voted not to evaluate the method proposed by Professor Max T. Willis, of California Polytechnic State University, for the determination of water in paints. In the proposed method, 1-methoxy-2-propanol (MPA) is mixed into the paint specimen, thoroughly dispersed, and the water/solvent/MPA distilled/extracted. Aliquots of the distillate are tested for its water content using the Karl Fischer Titration method. The task group noted that even though 1-methoxy-2-propanol is used to extract the water, the final water concentration is determined by using the Hydranal Karl Fischer Titration Method. The time consuming extraction is unnecessary and adds more sources of error in the procedure. D01.21.80 recommends direct titration for water in paints using the Karl Fischer Titration Method.
- Brinkman uses a homogenizer, which is attached to the Karl Fischer titration vessel, to homogenize a paint specimen in seconds. It is claimed that all the water is extracted from the most difficult paint specimens to give excellent and reproducible results. The added cost of about $4,000 for the Brinkman Homogenizer was questioned when, in difficult cases, the present methanol extraction method could be used. The chairman was asked to approach Brinkman on using their homogenizer on specified difficult paint samples.
- In response to a Carl Curda, of Findley Adhesive, report that D 2369 does not work for adhesives containing less than 1% VOCs, it is noted that GC may be an easier way to determine, directly, the VOCs in products containing less than 1% VOCs. Apparently, what is happening is that under Title 5 of the 1990 CAAA, all VOC sources must be reported. Since nonpaint products do not have a test method for VOCs, the regulatory bodies are pointing to the use of U.S. EPA's Reference Method 24 (RM 24).

D01.21.80 suggested that GC might be an easier way to determine, directly, the VOCs in products containing less than 1% VOCs.

B. Neff reported on his investigation of the Laser Spark Analyzer used at Los Alamos for trace metals (especially lead) on surfaces. This is a prototype portable (40 lb) unit. It generates a small plasma on the surface which is analyzed by emission spectroscopy. Since the depth of penetration is unknown, quantitative determination cannot be done; basically, it is a qualitative method. The inventor of the instrument is looking for a company to commercially manufacture it.

SUBCOMMITTEE D01.23 PHYSICAL PROPERTIES OF APPLIED PAINT FILMS

Paul R. Guevin, Jr., Chairman

D01.23.10—Adhesion—G. Nelson, Chairman. Sheldon M. Smith, of the Ames Division of NASA, made a presentation on the work performed by his group on adhesion testing.

H. Ashton discussed the various proposed changes to ASTM D 3359, "Test Method for Measuring Adhesion by Tape Test." D. Chance handed out an improvement in Figure 1 of the method that has been used by his company to make it easier to classify adhesion. It was decided to submit the proposed changes to D01.23 ballot before the next meeting.

P. Guevin reported that D 5179, "Test Method for Measuring Adhesion of Organic Coatings to Plastic Substrates by Direct Tensile Testing," is due for reapproval in 1996. H. Ashton reported that he is in the process of statistically analyzing the data in Table 2 of the method to improve its precision and bias statement.

D01.23.12—Dry Film Thickness—S. Boocock, Chairman, reported that the revision to Test Method D 1186, "Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base," had successfully completed society ballot. The revision to Test Method D 1400, "Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base," had received a negative based upon an error in Table 1 designations for between and within laboratory coefficients of variation. The standard will be reballoted with a correction to Table 1.

The task group discussed the parameters of the round-robin required to update the reproducibility and repeatability statements and develop a Research Report for both D 1186 and D 1400. Matters concerning the identity of instruments, standards, methods of calibration, and calibration verification as well as submission of coated samples were referred to a round-robin caucus group. This group will meet later and draft a matrix for the round-robin.

D01.23.14—Hardness, Abrasion and Mar Resistance—B. Gregorovich, Chairman, reported Draft No. 2, proposed "New Standard Test Method for Mar Resistance of High Gloss Coatings," was submitted to D01.23 ballot and received three negative votes. The task group agreed the added information requested would improve the method. The chairman distributed a table which summarized the results of a statistical analysis of the second round-robin on the new method. He will conduct a third round-robin and report the results in June.

The task group expressed the need to incorporate a description of the contact surfaces of the Sward Type Rocker rings into a revision of ASTM D 2134, "Test Method for Determining the Hardness of Organic Coatings with a Sward-Type Rocker." This information will be researched and included in a new draft of the method.

G. MacKenzie brought to the attention of the task group the difference in the dampening specification of the Persoz Pendulum Hardness Tester described in ASTM D 4366, "Test Method for Hardness of Organic Coatings by Pendulum Damping," and those stated in BS 3900/ISO 1522. A revision to D 4366 to rectify this difference will be submitted to D01.23 ballot.

D01.23.15—Slip Resistance—P. Guevin, Jr., Chairman, reported three negatives were received on the proposed Horizontal Pull Slipmeter test method. The task group stated that the method should inform the user that the numbers obtained are not absolute values but relative ones that can be used for comparison of coatings. The method will be revised and submitted for D01.23 approval.

The chairman reported he is still editing the research report on the drop sled and horizontal pull slipmeters under wet conditions for inclusion in ASTM D 4518, "Test Method for Measuring Static Friction of Coating Surfaces." When the edit is completed, it will be submitted to ASTM.

A discussion followed on the test methods to measure the coefficient of friction under wet conditions using the Mark II and Ergodyne instruments. The two test methods involving these instruments, included in the package sent to all subcommittee members, will be submitted to D01.23 ballot.

D01.23.16—Water Vapor Transmission—T. Sliva, Chairman, reported the revisions to D 1653, "Test Method for Water Vapor Transmission of Organic Coating Films," had successfully completed society ballot.

H. Ashton reported on his recently published paper in the May issue of the *Journal of Testing and Evaluation*, where moisture vapor transmission was measured using an infrared detector. T. Nguyen reported a Johns Hopkins University paper references the use of FTIR to measure MVT.

D01.23.19—Drying Time—T. Sliva, Chairman, distributed copies of the proposed revisions to ASTM D 1640, "Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature." The method will be revised to incorporate editorial changes and to drop the section on the powder test method, which is no longer in use nor is the equipment to perform the test still being manufactured. In addition, the section relating to "Dry to Handle" will be revised.

The chairman distributed Draft No. 1 of the proposed "Standard Test Method for Drying, Curing, or Film Formation of Organic Coatings using Mechanical Drying Time Recorders." The method had previously been submitted to task group members for review and will be revised to include their comments. The results from two of the four cooperators in the first round-robin using the new method were reviewed. The cooperators also ran drying time in accordance with procedures outlined in D 1640 at the same time. No conclusions on the round-robin could be made until the remaining two cooperators submit their data. This will be reported on at the June meeting.

D01.23.20—Exploratory Research—P. Guevin, Jr., Chairman. D. Beamish, of DeFelsko, demonstrated the PosiTector® 100 and described the work done with this ultrasonic thickness instrument to measure the thickness of organic coatings on concrete nondestructively. After some discussion, the task group decided to prepare three specimens with three different coatings at three different thicknesses, evaluate the instrument and the manufacturer's instructions, and send a test protocol to four collaborators for round-robin testing. If successful, the project will be turned over to D01.23.12.

Contact-angle measurement was discussed. While some members said there was no relationship between contact angle and adhesion, others said contact-angle measurement can be used to evaluate contamination and surface and preparation suitable for painting. T. Nguyen mentioned that there is an ASTM test method which describes the technique. The subject will be further researched and findings reported at the June meeting.

SUBCOMMITTEE D01.24 PHYSICAL PROPERTIES OF LIQUID PAINTS

C.K. Schoff, Chairman

D01.24.18—Dispersion Phenomena—R.K. Morrison, Chairman, discussed the revision of D 1210, "Fineness of Dispersion of Pigment-Vehicle Systems," which will include a new step gauge for cleanliness and provision for a lighting box for improved viewing of the dispersion pattern. In addition, a number of the pitfalls and problems in measuring fineness of dispersion will be pointed out and remedies discussed. Two oil absorption methods, D 281 and D 1483, are also up for reapproval or revision. Chairman Morrison will review the methods to see if any revision is necessary beyond the addition of bias statements.

D01.24.19—Viscosity by Efflux Cups—C.K. Schoff, Chairman, discussed the revision of D 1200, "Viscosity by Ford Viscosity Cup." The omnibus non-dip cup revision (Ford, Fisher, and DIN cups) is not ready, so it was decided to go ahead with a minor revision of the current D 1200 to include a bias statement and a few corrections. D 5125, "Viscosity of Paints and Related Materials by ISO Flow Cups," was also discussed. The method needs to be revised to include the new 5 mm orifice diameter cup which has been added to the latest edition of ISO 2431. Consideration will also be given to an 8 mm cup that is not in the ISO method, but is available in the United States and is specified in at least one international shipping regulation.

D01.24.21—Stormer™ Viscometer—A major revision of D 562, "Viscosity by Stormer™ Viscometer," which will include the new digital electronic Stormer-type viscometers (Brookfield KU-1 and Cannon/Thomas Electronic Stormer), was discussed. Interlaboratory testing was carried out to generate precision data for the digital instruments and to compare them to the standard (manual) Stormer. It turned out that the repeatability and the reproducibility for both the manual and digital instruments were essentially identical and considerably better than the original precision statement developed for D 562. The new data indicate a repeatability of 2% and reproducibility of 5% which is extremely good for a viscosity method. The draft of the revision will be reviewed by the D01.24.21 members and the resulting document will be sent to D01.24 ballot.

D01.24.23—Viscosity by High Shear (ICI Cone/Plate) Viscometer—The task group discussed the revision of D 4287, "High Shear Viscosity Using the ICI Cone/Plate Viscometer." This method was balloted last year and received a negative and a number of comments. The negative was because the method is based on the ICI viscometer rather than on cone/plate viscometers in general. This, plus the fact that Brookfield and Sheen Instruments are both in the process of introducing ICI-type cone/plate viscometers, indicated the need to develop a more generic method. However, after much discussion, it was decided to keep the title of the method as is, make the method somewhat more generic, but keep the ICI cone/plate viscometer as the focus of the method. This is acceptable under ASTM regulations and recognizes the use of the ICI viscometer as a standard technique in the industry. The method revised in this manner will be balloted, and future discussions will consider whether there should be a second method for completely generic cone/plate viscometers.

D01.24.26—Electrical Properties of Liquid Paints—Draft 14 of the proposed "Electrical Resistivity of Liquid Paint and Related Materials" was discussed and recommended a D01.24 ballot.

D01.24.33—Odor Evaluation—D.E. Darr, Chairman, discussed the first draft of the proposed "Standard Guide to the Detection, Identification and Characterization of the Odors of Paints, Inks, and Related Materials." The group decided that the guide should be detailed and that it should provide useful advice for someone faced with an odor problem. The chairman and A.F. Rutkiewic will work together to flesh out the draft. P.R. Guevin volunteered to do a literature search on odor, odor testing, etc.

SUBCOMMITTEE D01.26 OPTICAL PROPERTIES

R. Kumar, Chairman

D01.26.02—Color Measurement—R. Kumar, Acting Chairman, reported that the latest ballot of the "Standard Guide for the Preparation, Maintenance and Distribution of Physical Product Standards for Color and Geometric Appearance of Coatings" received no comments or negatives and will go to society ballot.

The revision of D 1544, "Test for Color of Transparent Liquids (Gardner Color Scale)," received three negatives. There was much discussion concerning the glass standards and the glass tube specifications. J. Peters will revise the method to clarify the glass standards specifications. The group found the negative by J. Weaver on the glass tubes not persuasive. Concurrently, the existing method will be balloted for reapproval because it was estimated that the revision of this method will require a long time and it is important that this method remain on the books. A letter explaining this will accompany the ballot.

D 3964, "Practice for Selection of Coating Specimens and Their Preparation for Appearance Measurement," will be balloted for reapproval.

D01.26.11—Gloss and Goniophotometry—A.F. Rutkiewic, Chairman, reported on an analysis written by M. Morse of a 1990 round-robin correlating the data from various distinctness-of-image measuring instruments with perceived visual image distinction. The data contained in this report is very relevant to the draft "Method for Instrumental Measurement of Distinctness of Image Gloss of Coating Surfaces." Draft No. 8 of this incorporates all the comments and negatives received on the previous ballot. The draft also added two methods (B & C) which were submitted by Suga Test Instruments Co. Ltd. The report by M. Morse was included as an appendix to the draft and provides the data to justify the inclusion of methods B & C. Some additional detailed information on the instruments described in methods B & C is desired and will be requested.

A bibliography of appearance-characterization instruments prepared by the chairman was discussed. The validity of the information will be confirmed by the chairman by direct contact with the cited suppliers.

D 523, "Test Method for Specular Gloss," and D 4449, "Method for Visual Evaluation of Gloss Differences between Surfaces of Similar Appearance," will be balloted for reapproval.

D01.26—D 344, "Test Method for Relative Hiding Power of Paints by the Visual Evaluation of Brushouts," and D 2805, "Test Method for Hiding Power of Paints by Reflectometry," will be balloted for reapproval.

The latest revision of D 387, "Test Method for Color and Strength of Color Pigments with a Mechanical Muller," will be submitted for concurrent D01.26/D-1 ballot. D 3022, "Test Method for Color and Strength of Color Pigments by use of a Miniature Sandmill," will be balloted for reapproval.

Because some customers of members of D01.34, Naval Stores, are using the results of D 1544 as though they are more precise and accurate than the method can produce, J. Peters and R. Kumar will compose a letter explaining and qualifying the precision and accuracy of the method. The letter can then be used to educate those customers that misuse the results.

SUBCOMMITTEE D01.27 ACCELERATED TESTS FOR PROTECTIVE COATINGS

D. Grossman, Chairman

D01.27.02—Water Tests—D. Grossman, Chairman, reported that a D01.27 ballot received no negatives on a new "Method B" for D 2247, "100% Humidity." This new procedure gives important instructions for generating humidity by bubbling compressed air through an un-heated water bath, while maintaining chamber temperature by a heated water jacket around the walls. This design often fails to produce adequate condensation on the specimens, unless the water jacket is drained to below the level of the specimens. The draft will go on to D01 ballot with editorial changes.

S. Boocock reported that D01.46 would like to make major changes to D 870 "Immersion" to tighten up the procedure and to standardize the broad variety of immersion tests now being conducted as simulations of various immersion service environments. D. Grossman will contact G. Gardner, Chairman of D01.46, about possible transfer of D 870.

D01.27.04—Light and Water Exposure Apparatus—L.E. Thieben, Chairman. New standard for "Xenon Exposure Apparatus" received four negatives at D01.27 ballot. J. Robbins will prepare another draft for D01.27 ballot. D 822, "Open Flame Carbon Arc," and D 5031, "Enclosed Carbon Arc" are at the time limit for reapproval. W. Ketola will draft revisions for both standards for D01.27 ballot.

D01.27.10—Accelerated Outdoor Weathering—J. Robbins III, Chairman, reviewed negatives and comments of the recent D01.27 ballot of D 4141, "Standard Practice for Conducting Accelerated Outdoor Exposure Tests of Coatings." One item in this new ballot was a change to Section 5.3, which would have made the use of reference materials recommended instead of mandatory. A negative vote submitted by S. Hinckle asked that this change not be made in order to maintain the current requirement for using reference materials. After discussion, the negative was found not persuasive because: (1) test laboratories which perform this test have no control over whether or not suppliers submit reference materials with their other specimens, and (2) other weathering standards (such as those in G03) strongly recommend but do not require the use of reference materials.

D01.27.17—Evaluation of Weathering Effects—M. Crewdson, Chairman. D 772, "Evaluation of Flaking" passed concurrent D01/D01.27 ballot for reapproval without any negatives. Work on a revision with major changes will continue.

D01.27 ballot of D 660, "Evaluation of Checking," produced two negatives and four comments. All were deemed necessary and a new draft incorporating the revisions will be sent to D01.27 ballot.

There was discussion on a second mini-instant round-robin for evaluating weather defects. It was decided that there will be a repeat of a previous program, to determine precision in the use of D 714, "Blistering." A more detailed questionnaire will be drafted to determine the true experience level of each participant. This mini-instant round-robin will take place at the next meeting.

There was a discussion on a future reorganization of the five similar evaluation standards under D01.27.17 jurisdiction. These are D 660, "Checking"; D 661, "Cracking"; D 662, "Erosion"; D 772, "Flaking"; and D 714, "Blistering." Because most of the instructions for each method are similar, it was proposed that a single standard be drafted with a separate appendix for each failure type.

D01.27.17 has two standards which are overdue and will be withdrawn if no ballot action is taken. D 714, "Evaluation of Blistering," will be balloted for revision, and D 4214, "Evaluating Degree of Chalking of Exterior Paint," will be balloted for reapproval.

D01.27.18—Outdoor Exposure Tests—J. Martin, Chairman, will revise D 1014, "Outdoor Exposures of Paints on Steel," to be a Practice, not a Method, and send it to D01.27 ballot with other necessary revisions.

D01.27.29—Test Substrates—D. Grossman, Chairman. In D 2201, "Zinc Coated Steel Panels for Paint Tests," F. Lutze will draft a revision for concurrent D01.27/D01 ballot of Appendix X1, Characterization of Zinc Coating, that will show many of the newer metric designations used in the auto industry. A revision of D 609, "Steel Test Panels," will be sent to D01.27 ballot to address storage of bare steel panels with VCI.

D 3891, "Glass Test Panels," is in need of revision. L. Pattison will draft a revision for D01.27 ballot, incorporating procedures for preparing glass panels to test automotive coatings.

D01.27.30—Corrosion Tests–Automotive—F. Lutze, Chairman. Four negatives from "Standard Practice for Accelerated Outdoor Cosmetic Corrosion Exposure Testing of Organic Coatings on Metal" were discussed. This standard will be revised and resubmitted for D01.27 ballot. A number of negatives for "Laboratory Cyclic Corrosion Test Guide" were received and the guide will be revised by P. Brennan and resubmitted for D01.27 ballot. A number of negatives for "Laboratory Cyclic Corrosion Test Guide" were received and the guide will be revised by P. Brennan and resubmitted for D01.27 ballot.

Details of a project conducted by the American Iron & Steel Institute and the Society of Automotive Engineers to develop a new cosmetic corrosion test were discussed; more information related to this project will be presented at the June 1994 meeting.

D01.27.31—Corrosion Tests–Non-Automotive—S. Boocock, Chairman. K. Trimber and D. Grossman gave an update on the status of the two new draft standards for cyclic exposure tests: (1) the cyclic salt spray with alternating UV/Condensation exposure, and (2) the cyclic immersion test with alternating exposure to heat and light. Both documents will be revised to conform to negatives received on the last ballot, and will be sent out for another D01.27 ballot.

A report was delivered, by W. Van der Linde, on the mini round-robin on Cyclic Salt Spray exposures in accordance with the salt spray cycle described in the Draft G 85 Annex A5 cyclic salt spray standard (1 hr fog at "ambient," 1 hr dry off at 35°C). W. Van der Linde distributed statistical analysis of the results from the mini round-robin which involved six laboratories. Some laboratories reported results from duplicate runs of the cyclic salt spray exposure. From the data presented, it was clear that: (1) two classes of equipment exist in the marketplace, and (2) it is likely that good rank order correlation between systems could be developed.

W. Van der Linde has been requested to present this data following analysis in accordance with ASTM E 691. In addition, Mr. Van der Linde was requested to perform this analysis on a subset of the data, which only examines "prohesion/mebon" style equipment. Finally, W. Van der Linde was requested to perform a rank order correlation analysis on system performance. The results from these re-analyses of data are expected at the June 1994 meeting.

S. Boocock presented an update on the status of the round-robin comparing cyclic laboratory tests and outdoor exposures. A revised schedule for preparation of industrial maintenance samples was presented by Mr. Boocock. Delivery of samples to outdoor sites could begin by June 1994. D. Grossman stated that the coil-coated samples can also be delivered at that time. Final details of the laboratory phase of the exposure program are to be defined at the June 1994 meeting. Distribution of samples for laboratory testing will occur after the June meeting.

An update was given on the status of the G 85 Annex A5 draft cyclic salt spray standard. This standard forms part of the draft cyclic salt spray/UV/condensation combined cycle exposure being developed in D01.27.31. The Draft G 85 standard has been sent back to G01 ballot for revisions to closely define temperature limits during the salt spray portion of the cycle. Issuance is anticipated following reballoting only on this change.

D01.27.31 was informed that the Cleveland Society of the Federation of Societies for Coatings Technology has a round-robin test underway involving many outdoor sites and five laboratory exposures. The technical contact for the Cleveland Society efforts, Ben Carlozzo, has promised to furnish data on this program to D01.27.31 at a future date.

SUBCOMMITTEE D01.28 BIODETERIORATION

M.C. McLaurin, Chairman

D01.28.01—Package Stability—M.C. McLaurin, Chairman, led a discussion of the proposed revision of D 2574-93, "Resistance of Emulsion Paints in the Container to Attack by Microorganisms." The changes include the addition of ATCC culture numbers and an example of an antiseptic solution. The revised method will be submitted to concurrent D01.28/D01 ballot before the next meeting.

D01.28.02—Rapid Determination of Enzymes—C.W. Vanderslice, Chairman, reviewed the status of a proposed method being developed to distinguish between cellulase enzymes and other chemical species capable of causing viscosity loss in water-based paints. The method, based upon the varying rates of solution degradation of regular- and enzyme-resistant grades of hydroxyethylcellulose on exposure to cellulase contamination, will be written up in ASTM format for discussion at the June meeting. A round-robin was also scheduled using vinyl-acrylic paints contaminated with known amounts of either cellulase or chemical agents such as t-butyl hydroperoxide, a catalyst often used in emulsion polymerization.

Due to a persistent scheduling conflict with D01.42, the chairman regretfully announced his intention to resign following the June 1994 meeting. A new chairman will be selected in the interim.

D01.28.03—Microbial Quality of Raw Materials—M.C. McLaurin, Acting Chairman for J. Hinkle, reviewed revisions to the new method that are intended to address the negative vote from a D01 ballot. The following note will be added after Section 5.5:

> Note: "To decrease the chances of inadvertent contamination, a suggestion would be to carefully wipe the area of the bag to be cut, and the knife used for cutting it, with isopropyl alcohol. Care should be exercised to avoid skin contact, since the isopropyl alcohol could carry hazardous materials through the skin. Also, avoid excess alcohol which could affect test results.

The revised method will be submitted to concurrent D01.28/D01 ballot before the next meeting.

D01.28.04—Resistance of Paint Films to Algae Attack—M.C. McLaurin, Acting Chairman for J. Hinkle, reviewed revisions to the new method which include adding the option to use other strains of algae as agreed upon by the parties involved and the addition of reference to artificial weathering methods. The revised method will be submitted to concurrent D01.28/D01 ballot before the next meeting.

L. Weinert expressed concern that the cautionary statement regarding correlations between accelerated weathering and outdoor exposure may not be strong enough. He also reported that D01.152.17, Factory-Coated Wood Building Products, needs help distinguishing dirt from fungal/algal growth on paint films.

D01.28.05—Revision of ASTM D 3273 (Mildew Chamber)—M.C. McLaurin, Acting Chairman for J. Hinkle, reviewed revisions and agreed to include the option to use other strains of algae as agreed upon by the parties involved. Other key changes were: (1) update of chamber design; (2) deletion of the fan due to uneven defacement in various positions within the chamber as well as maintenance problems; (3) possibility of using duplicates instead of triplicates due to the improved reproducibility due to removal of the fan and; (4) supplemental information on the design and components of the new equipment. The revised method will be submitted to concurrent D01.28/D01 ballot before the next meeting.

D01.28.06—Resistance of Paint Films to Fungal Attack—M.C. McLaurin, Acting Chairman for J. Hinkle, reviewed revisions based on some excellent suggestions by L. Wienert which helped clarify several sections. The revised method will be submitted to concurrent D01.28/D01 ballot before the next meeting.

D01.28.07—Revision of D 3274 (Defacement Ratings)—B. Matta, Chairman. The task group discussed the proposed editorial changes to D 3274. The fungal definitions will be expanded to include both mycelium and fruiting body. The removal of gametes and gametangium from the proposed revision were found persuasive. D 4610, "Guide for Determining the Presence of and Removing Microbial (Fungal or Algal) Growth on Paint and Related Coatings," will be added in a supporting document section along with a caution statement as to the invasiveness of this technique. Computer imaging drafts of various degrees of defacement representing both uniform and non-uniform (spotty) mildew growth will be attempted in order to replace the current photographic plates.

D01.28—Biodeterioration—M.C. McLaurin, Chairman. Special thanks to J. Hinkle for providing written summaries of the revisions for his task groups though he was not able to attend the meeting. It was noted that D01.28.01 has completed the revisions to the method so the task group will disband. Thanks for an excellent job and significant improvements in D 2574-93.

DIVISION 30 PAINT MATERIALS

SUBCOMMITTEE D01.33 POLYMERS AND RESINS

J.G. Lamberton, Chairman

D01.33.12—Urethanes—Due to the resignation of R.C. Brazelli, J.G. Lamberton chaired. A new method for the determination of free isocyanates by HPLC has been developed. Round-robin testing required for a precision statement is still needed. Due to the limited committee membership, further work will not be attempted. The method is to be revised to a standard practice for review at the June meeting. Standard D 3432 is to be reviewed.

D01.33.14—Alkyd—J.G. Lamberton, Chairman, discussed the status of the standards currently requiring ballot action. Keywords and caveat changes are needed in D 1306 and D 1639. In addition to these changes, D 0563 and D 2690 need to be modified to include alternate solvents for benzene. These methods are to be balloted as standard practices using toluene or isooctane as solvents. Precision statements will be developed as resources are available. Capillary gas chromatographic procedures are to be added to D 2455 and D 2998 and submitted as standard practices. D 1312 and D 1615 were revised to replace specific notations with molarity where concentrations of acid were used.

D01.33—J.G. Lamberton reported the status of the standards and noted those requiring ballot action. Two standards, D 0207, "Specification for Dry Bleached LAC," and D 0360, "Specification for Shellac Varnishes," were to be submitted on the next ballot for withdrawal. Standards D 1306, D 1312, D 1546, D 1641, D 1725, and D 0154 were approved for subcommittee ballot with minor modifications. Due to the lack of precision statements, standards D 1615, D 0563, and D 2690 were changed to practices and were approved for subcommittee ballot in that format. Review and revision of standards D 2455, D 2998, and D 1639 were to be completed by the June meeting. The chair request to change the jurisdiction of D 1546, "Standard Method for Performance Tests of Clear Floor Sealers," to D01.42 was approved.

SUBCOMMITTEE D01.34 NAVAL STORES

J. Russell, Chairman

D01.34.01—Capillary Gas Chromatography of Rosin and Fatty Acids—W. Trainor, Chairman, had distributed a draft of the latest version prior to the meeting. After review, it was decided to amend the draft and specify a programmed temperature ramp for the gas chromatograph rather than an isothermal analysis. It was also agreed to submit the amended version for a subcommittee ballot. Further, it was agreed that a preliminary round-robin should be carried out using samples of fatty acid and rosin to be supplied by Georgia Pacific and using TMPAH (trimethylphenyl ammonium hydroxide) as the methylating agent. The analysis would be based on area percent. Only oleic acid and nonconjugated linoleic acid would be reported on the tall oil fatty acid, and only abietic acid and dehydroabietic acid would be reported on the rosin.

D01.34.05—Softening Point of Rosin and Rosin Derivatives by Automatic Ring and Ball Apparatus—P. Zawislak, Chairman, reported on the status on this project. A previous round-robin had indicated that the Herzog apparatus gave poorer precision and higher average softening points than the standard manual Ring and Ball method, E 28. It was thought that the use of a more stable heat transfer medium was desirable and that the Herzog equipment might require a modified stem correction.

Chairman Zawislak announced that Dow Corning had supplied all interested members with a silicone fluid for evaluation but it had arrived too late for most members to study it thoroughly. Preliminary results were encouraging but the chairman asked all members to use this fluid on a wide range of resins and report their results at the next meeting.

Encouraging results were also reported for the stem correction modification developed by Herzog. J. Bryson, of Goodyear, reported that he had received the chips necessary to achieve the stem correction and had evaluated it using 49 hydrocarbon resins. He found that the results obtained had about the same scatter and same average as the results obtained with the manual Ring and Ball method. It was agreed to ask Herzog to supply all interested D01.34 members with this new chip. The modified Herzog fitted with the new chip would then be included in the next softening point round-robin.

D01.34.04—Iodine Value of Tall Oil Fatty Acids Using Isooctane as a Solvent—J. Bowers reported that the new method, using isooctane as a solvent rather than carbon tetrachloride, had been circulated to the subcommittee prior to the meeting. By unanimous vote, it was agreed to submit the method, as written, to D01.34 ballot.

D01.34.06—Color Measurement of Rosin and Fatty Acids—Co-chairmen J. Russell and W. Mark reviewed the recent activities in this area. Specifically, several D01.34 members had voted negative on a revision of standard method D 1544, "Color of Transparent Liquids (Gardner Color Scale)," and had attended a D01.26 task force meeting to discuss their negative votes. The reason for the negative votes was that many of the Gardner color discs now in use, even recently purchased ones, do not meet the color specifications published in the standard. D01.26 found the negatives persuasive and agreed to withdraw the revision and resubmit the current published method for reapproval. In addition, D01.26 agreed to remeasure the color coordinates of the glass being used to produce Gardner color discs.

At the D01.34 meeting, a motion was made and passed unanimously asking the chairman to contact the chairman of D01.26 and notify him that "Subcommittee D01.34 considers the current version of D 1544 to be technically deficient and when it is submitted for reapproval, it should include a paragraph indicating these technical deficiencies and the limitations of the method."

The aim of the current project is to identify instruments that might replace the Gardner color discs and the human error associated with their use. Six companies were identified as having such equipment and it was agreed to invite representatives of these companies or users of these instruments to make presentations at future D01.34 meetings.

D01.34—J. Russell, Chairman, reported that all current standard methods for which the D01.34 is responsible are up-to-date. However, D 3008, "Resin Acids in Rosin by Gas Liquid Chromatography," will require ballot action in 1995.

The next meeting will be held in Charleston, SC, May 12 and 13, 1994. D01.34 will not meet during the June 1994 D01 meeting.

SUBCOMMITTEE D01.35 SOLVENTS, PLASTICIZERS & CHEMICAL INTERMEDIATES

R.G. Montemayor, Chairman

D01.35.10—Hydrocarbon Solvents and Ketones—S.A. Yuhas and R.L. Hinrichs, Co-Chairmen. One standard, D 3257, "Test Method for Aromatics in Mineral Spirits by GC," passed society ballot. Four standards were on D01 ballot. All passed except D 235, "Specification for Mineral Spirits," which received two negatives. One negative was by Z. Murphy on the inconsistency between the range for aromatic hydrocarbon shown for Class A Mineral Spirits in Section 3.2.1 (8 to 20 vol%) and that shown in Table I (8 to 22 vol%). The latter range is correct and the standard will be sent to D01.35 ballot to correct this error. The other negative was by P. Hudson with regards to mineral spirits "Type III C Odorless." He believes "a maximum KB value of 35 instead of 29 is more appropriate for this type of product." After much discussion, the task group found Mr. Hudson's negative not persuasive, because: (1) the present KB value of 29 max in the revised standard is correct for the type of mineral spirits specified; i.e., isoparaffinic hydrocarbon product containing no aromatics. This is what is meant by "odorless mineral spirits," and (2) the task group believes that he is actually referring to what is termed "low-odor mineral spirits," which is generally a hydrogenated product containing naphthenes and a low aromatic content. This product can have values as high as 35 or even 40. It is specified in the revised D 235 as Type IC, IIC, or IVC mineral spirits.

The results of the interlaboratory program to evaluate a capillary GC method for determining aromatics in mineral spirits by GC (for addition to D 3257) was reviewed by R.G. Montemayor. The test precision is very good and comparable to the precision of the present packed-column method. However, long-term stability of the column is a problem resulting in shifting retention times. This requires calibration of the method before each use. R.G. Montemayor and R. Bartram will draft a revision of D 3257 to include capillary GC methodology.

J. Berry, of U.S. EPA, addressed the group with regard to the Amended Clean Air Act of 1990. In particular, he said that MEK is considered a "toxic chemical and a hazardous air pollutant," among about 189 other listed materials. He suggested that ASTM committees recognize this in ASTM standards. It was suggested that D01.35 set up a task group to consider this matter. R.G. Montemayor will solicit input from members of D01.35 on how they perceive the Amended Clean Air Act of 1990 will impact their use or manufacture of solvents, to provide D01.35 information to work with in determining the need for a task group to work on this issue.

D01.35.20—Reactive Monomers—J.E. Frugé, Chairman. Seven standards passed society ballot. As an item of new business, there was much discussion on the use of an electronic temperature measuring device in place of a mercury-in-glass thermometer for use in D 1078, "Distillation Range of Volatile Organic Liquids." An inquiry was received from Elf Atochem in their effort to eliminate the use of designated substances in test methodologies. Glass thermometers use mercury, a designated substance. It was noted that D 86, "Distillation of Petroleum Products," allows the use of electronic temperature measurement in automatic equipment. Since there is no data on the use of an electronic temperature measurement device in D 1078, data from Elf Atochem comparing mercury-in-glass thermometer results and electronic measurement devices will be reviewed as they become available. A single capillary GC method is being evaluated for the analysis of various acrylate esters.

D01.35.30—Chemical Intermediates—J. Morrison, Chairman. Nine standards passed society ballot. R.G. Montemayor reported on the review of three potential GC methods for the analysis of acetone in diacetone. A recommendation was made to use a nonpolar, bonded methyl silicone column and cool oncolumn injection. D01.35.60 will conduct a robustness test on the recommended method.

D01.35.40—Plasticizers and Ester Solvents—J.E. Lawniczak, Chairman. Nine standards passed society ballot. Two standards passed the D01 ballot and will proceed to society ballot. A revision of D 1209, "Color of Organic Liquids (Platinum-Cobalt Scale)," will be made to reflect precision value in terms of Pt-Co scale units rather than percentage. Data from the supporting research report were reviewed by R.G. Montemayor.

D01.35.50—Coordination—L. Forrest, Chairman. A number of standards from committees D02, D16, and E15 were discussed. The results of the round-robin to determine improved precision on D 86 using a wider neck flask and a thermometer centering device were reported at the D02.08 meeting in Dallas, TX. The results indicated that the thermometer centering device improved the repeatability of the method. D 86 will be revised to include the mandatory use of the thermometer centering device. A revision of D 93, "Flash Point by Pensky-Martens Tester," to include the use of automatic equipment, is being balloted at the D02.08 level. A new task group was formed to establish precision for the Graebner miniflash. In D16, the results of a study on automatic and manual methods of D 850 were discussed. In E15, many standards need to be revised due to the revision of E 180, "Precision of ASTM Methods for Analysis and Testing of Industrial Chemicals." The E 180 changes included changes to precision terminology and formats for reporting results and calculations. The Guide for Including Government Requirements in ASTM Standards is in the process of being changed and balloted.

D01.35.60—Method Development—R. Bartram, Chairman. R. Bartram assumed the responsibility of D01.35.60. There are five new methods under development by the task group:

(1) Acetone in Diacetone Alcohol—one recommended method by R.G. Montemayor is being evaluated and a robustness test will be attempted before June 1994.

(2) Capillary GC Method for Acrylate Esters—GC methods for this analysis were reviewed. A single GC method/parameters will be attempted.

(3) A revision of D 3257 to include capillary GC and the precision values obtained from the D 3257 interlaboratory program will be made by R.G. Montemayor and R. Bartram.

(4) A capillary GC method for the purity of MAK/MIBK has been selected and potential participants in an interlaboratory program are being solicited.

(5) Capillary GC methods for D 3545, "Alcohol Content and Purity of Acetate Esters," are being solicited.

D01.35—R. Bartram, of Supelco Inc., is the new secretary of the subcommittee.

SUBCOMMITTEE D01.36 CELLULOSE AND CELLULOSE DERIVATIVES

G.Y. Moore, Chairman

D01.36—In old business, the following standards passed D01 ballot and will be submitted for society ballot in March: D 1795-90, "Test Method for Intrinsic Viscosity of Cellulose"; D 4794-88, "Test Method for Determination of Ethyl Substitution in Cellulose Ether Product by Gas Chromatography"; and D 4795-88, "Method for Nitrogen Content of Soluble Nitrocellulose–Alternative Method."

Four standards, to which only keywords were added, received negatives on society ballot. The following action will be taken on these negatives:

- D 1926-89, "Test Method for Carboxyl Content of Cellulose," received a D01 negative from R. Montemayor and a society negative from J.C. Abbott. The negatives were found to be persuasive, and the technical issues raised require a major revision of this method. J. deWit was appointed as task group chairman to resolve the issues to update this method.
- D 1348-89, "Test Method for Moisture in Cellulose," received a society negative from J.C. Abbott, which was found persuasive. The method will be rewritten and sent to D01.36/D01 ballot.
- D 1787-89, "Test Method for Pentosans in Cellulose," and D 2438-89, "Test Method for Silica in Cellulose," were withdrawn from ballot because of persuasive negatives from J.C. Abbott.

In new business, eight standards will be submitted for D01.36 ballot. D 1348-89, "Test Method for Moisture in Cellulose"; D 2364-89, "Method of Testing Hydroxyethylcellulose"; D 3876-79, "Test Method for Methoxyl and Hydroxypropyl Substitution in Cellulose Ether Products by Gas Chromatography"; D 1439-A, "Methods of Testing Sodium Carboxymethylcellulose"; D 1795-77, "Terminology of Cellulose and Cellulose Derivatives"; D 2929-89, "Test Method for Sulfur Content of Cellulosic Materials by X-ray Fluoresence"; D 3516-89, "Practices for Ashing Ceullose"; and D 3971-89, "Test Method for Dichloromethane–Soluble Matter in Cellulose." Two standards will be balloted for withdrawal: D 2438-89, "Test Method for Silica in Cellulose"; and D 1787-89, "Test Method for Pentosans in Cellulose."

SUBCOMMITTEE D01.37 INK VEHICLES

A.N. Scarlatti, Chairman

D01.37.01—Resin Solutions—J.T. Daust, Chairman. Four recommended practices were submitted for D01.37/D01 ballot. Two negatives were received on the "Standard Practice for the Preparation of Oil-Based Resin Dispersions Using a Hot Air Gun," on the "Standard Practice for the Preparation of Oil-Based Resin Dispersions Using an Industrial Blender," and on the "Standard Practice for the Preparation of Oil-Based Resin Dispersions Using a Hot Oil Bath." A fourth practice, "Standard Practice for the Preparation of Oil-Based Resin Dispersions by the Hot Plate/Stirrer Method," received one negative. All of the negatives were discussed and all of the practices were withdrawn from ballot. They will be resubmitted for D01.37 ballot as soon as possible.

Also discussed during this meeting was the need to change the industrial blender practice to say that dispersions should be prepared to a constant time rather than a constant temperature. This change will be made before the practice is published. Further, Scott Orthey, of ASTM, was questioned regarding how the four practices can be kept sequential when published, so that they all appear in the same place. He said that as long as all four are balloted together they should have consecutive numbers. The alternative of showing all four practices under one method number was vetoed.

D01.37.02—Resin Dilutability—J.W. Daugherty, Chairman. Although no meeting was held during the January D01.37, the poor reproducibility of method D 5062 on Resin Dilutability was discussed. A decision was made to run a new round-robin on dilutability using a 1:2 resin: ARLO cut of an insoluble resin, and a 1:1 resin Magiesol 47 oil cut of a soluble resin. Resins will be supplied by Hercules and Akzo. Eight laboratories will participate in the round-robin. The results will be used to write a new and better precision statement for method D 5062.

D01.37.03—Gelability of Resin Solutions—A.N. Scarlatti, Chairman. No new activities were discussed during this meeting. Unless new methods are proposed for discussion, this task group may not meet in June.

D01.37.04—Standard Ink Oil—E.W. Casserly, Chairman. Orders for standard Magiesol 47 oil are going well. Magie will give five gallons per year to a customer, additional needs can be purchased. Exxon will have their standard Exx-Print 392D available soon. The subject of getting a representative of the vegetable oil suppliers was reopened. We need to investigate the feasibility of getting a standard supply of vegetable oil set aside for quality control purposes. The question was also asked if a standard solvent for testing news ink resins is possible.

D01.37.05—Quality Control of Ink Oils—J.B. Sardisco, Chairman. The first D01.37 ballot of the PKP method resulted in numerous typos and three negative votes. The first negative vote was to change from volumetric to weight. This was unanimously voted not persuasive. The other two negatives wanted Paragraph 3.1 rewritten. This was also unanimously voted not persuasive. The revised method will be resubmitted for D01.37 ballot.

D01.37.06—Pigment Dispersibility of Paste Ink Vehicles—A. Mercado, Chairman. A standard pigment was tested using three vehicles varying widely in dilution using a Hoover Muller at 250 cycles. All three resulted in the same pigment strength. More work is planned using fewer cycles and/or less weight. Magruder will supply their procedure utilizing a high-speed disperser. Magruder will also supply their test procedure utilizing a sigma blade type flusher. All three procedures will be available at the next meeting.

D01.37.07—Resin/Solvent Compatibility—D.P. Frisch, Chairman. The committee discussed the possibility that the cold-point method for determining resin/solvent compatibility could be better than the resin dilutability method D 5062. Along with a round-robin on dilutability (see D01.37.02), it was decided to test one soluble and one insoluble resin in a proposed precipitation temperature method. The same resins used to test resin dilutability will be used in the round-robin. Hercules and Akzo will supply resins for this round-robin.

The question of resin/alkyd compatibility was raised. Magruder offered to provide a method at our next meeting. The same eight laboratories participating in the resin dilutability round-robin will participate in the precipitation temperature round-robin.

D01.37.08—New Membership—D.P. Frisch, Chairman. Several vegetable oil suppliers (Reichhold, ADM, and Cargill) were contacted about joining D01.37. The technical contacts were very positive but none showed up at our meeting. These companies will be recontacted.

We need greater participation from vehicle manufacturers. Superior Ink (Covar) will be contacted by A. Mercado regarding potential membership. D. Frisch will also contact Varchem, Custom Blending, and Sun Chemical. Akzo (Chicago) will be contacted by J. Daust. Even if companies are unable to attend, they will be asked if they want to participate in round-robins.

D01.37—Ink Vehicles—A.N. Scarlatti, Chairman. Task group meeting minutes were reviewed. No new task groups were proposed.

DIVISION 40 PAINT PRODUCTS APPLIED ON SITE

SUBCOMMITTEE D01.42 ARCHITECTURAL FINISHES

L. Schaeffer, Chairman

D01.42.03—Porosity of Paint Films—R. Hopkins, substituting for C. Tatman, Chairman, reported that test paints and panels for the round-robin are on their way to cooperators. Due to availability and consistency concerns over the fluorescent dye saturant, it will not be considered for use until more background is obtained. Further discussion on opaque polymer was also tabled until its performance in the round-robin can be gauged. Although correlation of the proposed test method with other staining methods like the K & N Ink Test have been examined, it was suggested that instrumental checks also be done. Those cooperators having SEM, pore-volume, or profilometric instruments will make parallel measurements on films of the paints being used in the round-robin.

D01.42.04—Wet Adhesion of Latex Paints—W. Vanderslice, Chairman, reviewed the proposed test method using a Gardner Scrub Machine rather than a "weighted pull-off" technique to measure wet adhesion. New test data from the chairman's lab following a revised scoring, submersion, and non-abrasive scrubbing procedure were distributed and discussed. The problem of finding a fast-drying, "universal" alkyd gloss primer to serve as the substrate in this test was explained. Adhesion data comparing experimental UV- and soya alkyd-coated panels from The Leneta Company versus a conventional gloss alkyd primer were reviewed. The UV-coated panels ranked test paints more like the gloss alkyd primer. The possibility of producing more of this type of panel using a thicker plastic substrate to prevent "cut-through" when scoring will be explored. The consensus was that a round-robin should be conducted using the new UV-cured panel and new test procedure. The types of test paints should be expanded to include not only semi-glosses, but also eggshell and satin flats based on a wider variety of latexes having wet adhesion.

D01.42.05—Adhesion of Latex Paints to Chalky Surfaces—A. Leman, Chairman, distributed packets of weathered chalky panels to be evaluated by cooperators for their chalk rating according to ASTM D 4214-89. Test results on the interlaboratory reproducibility of the chalk rating method will be presented at the next meeting. The chairman made a presentation on the effects of the composition of chalky weathered paints on topcoat adhesion. The consensus was that the group should evaluate several candidate paint formulations known to chalk rapidly on exterior exposure, preferably in Florida. A standard formulation will then be selected for publication as part of the test method. A second consensus was that naturally weathered panels would be preferred over artificially weathered ones, and that a substrate of interest besides chalky wood panels would be weathered aluminum siding.

D01.42.09—Color Development of Tinted Latex Paints—L. Schaeffer, Chairman, reported that a revision of Method D 5326-92 had passed concurrent D01.42/D01 ballot, all negatives having been withdrawn. A number of comments and suggestions were discussed which will be incorporated into a proposed new revision and submitted again to concurrent ballot.

D01.42.21—Project Planning—S. LeSota, Chairman, polled the group to determine what test methods should be pursued in the future. These included wet-edge time, early water resistance, and alkali resistance. E. Countryman agreed to chair a new task group (D01.42.30) on the "Wet-Edge Time/Open Time of Latex Paints." V. Scarborough suggested that a new task group (D01.42.31) on "Water-Beading of Water Repellents" be established and volunteered to be chairman.

D01.42.22—Guides for Testing Architectural Coatings—H. Ashton, Chairman, reported first that a largely editorial revision of D 3730, "Guide to Testing High-Performance Interior Architectural Coatings," had passed society ballot and will appear in the *1994 ASTM Book of Standards*. Additional revisions to Table 2 not relayed in time for printing will be made in a subsequent edition. The next agenda item was a review of the results of a D01.42 ballot on technical revisions to D 3730 designed to reduce differences between it and D 5146, "Guide to Solvent-Borne Coatings." Comments from several affirmative voters suggested revisions to the Touch Up, Curing Properties, and Washability segments of Section 8 and Color Change portion of Section 9. A negative vote, cast because a referenced method for determining After-Yellowing had been withdrawn, was found persuasive. A ballot with several alternative methods for rating this parameter will be mailed out to the group once the literature is reviewed by the chairman. With these revisions and the addition of suggested keywords, D 3730 will be ready for D01.42 ballot.

D01.42.23—Gloss Definitions—L. Schaeffer, Chairman, opened discussion on a proposal to classify the gloss level of architectural paints into eight numerical gloss levels instead of using popular descriptive terms. The consensus was that such classifications would not be useful and might cause confusion. The subject was tabled for further consideration and possible future involvement of D01.42.22.

D01.42.25—Scrub Resistance of Latex Paints—D. Licata, Chairman, distributed test data from the June 1993 round-robin which was designed to improve interlab reproducibility by minimizing procedural variables. Cooperators used the same lots of scrub medium, commercial calibration panels, detergent solution, and wet paint samples. Each lab used the Dow Latex Film Applicator and new scrub brushes were supplied by one vendor, meaning the only variables were the type of scrub machine and operator. The new results showed the interlab reproducibility to be no better than the current precision statement. Although a number of courses of future action were discussed, no agreement was reached on how to proceed. The chairman requested comments and suggestions prior to doing additional testing.

D01.42.26—Burnish Resistance of Latex Paints—W. Vanderslice, Chairman, reviewed a modified test procedure using four-ply cheesecloth, rather than moleskin, and only 50 cycles versus 200 on the Gardner Scrub Machine. Data from the chairman's lab, using this modified procedure with six commercial interior and exterior flat paints under both dry and wet conditions, were introduced for discussion. Under both test conditions, the procedure was able to differentiate the burnish resistance (i.e., change in 85° gloss) of the test paints. It was suggested that more practical burnishing conditions be adopted using either fewer set numbers of cycles or the minimum number of cycles needed to induce sufficient burnishing with highly pigmented paints. Paints less likely to burnish or be burnished, like semi-glosses, exterior house paints, and interior ceiling paints, will be excluded from this first round-robin. It was suggested that the round-robin include both over-the-counter and professional quality wall paints ranging from eggshell to contractor flat. These will be supplied by The Sherwin-Williams Co. Test procedures and equipment were discussed. To simplify measurements for this round-robin, it was agreed that the 85° gloss change would be measured at one area near the center of the panel rather than at three separate areas.

D01.42.28—Coating Removers—V. Scarborough, Chairman, discussed the need for more cooperators to run the round-robin. Preparation of the test panels is time consuming and expensive, and enough cooperators are needed to gather sufficient data to rate the method. Another cooperator volunteered, permitting a round-robin to be run with results to be available at the June meeting.

D01.42.29—Testing of Exterior Wood Stains—A. Leathers, Chairman, reviewed definitions of stains as given by the EPA regulatory negotiation group and CGSB. Discussion centered on whether the definition should include that stains are intended to fail by erosion or are intended for application directly to wood. The consensus was to keep the definition simple and broad. T. Sliva will check definitions in D 16 on "Terminology," H. Ashton on those from CGSB, and the chairman on those from Forest Products. The chairman will distribute proposed definitions to members by April 1 so that a final vote can take place in June. V. Scarborough volunteered to review relevant "Guides to Testing Architectural Coatings" in order to begin compiling a list of applicable tests for stains via adoption, revision, or task group development. It was agreed to change the task group name from "Testing of Exterior Stains" to "Testing of Exterior Wood Stains," and that other substrates, like concrete, will not be included.

D01.42—Architectural Finishes—L. Schaeffer, Chairman, reported that standards for reapproval D 1848, D 4062, D 4400, D 4946, and D 5007, and revised Standard D 5326, had passed concurrent D01.42/D01 ballot with no negatives. Additional revisions to D 5326 will be submitted to concurrent ballot. Standards for withdrawal D 2833, D 2931, and D 3358 passed D01.42 ballot with no negatives, while D 1736, "Efflorescence of Interior Wall Paints," received two negatives on its withdrawal. These negatives were found persuasive. It was agreed that the standard should be thoroughly reviewed and up-dated. J. Cogar was appointed Steward for this purpose. D01.42 voted unanimously to approve T. Sliva's request to revise the procedure in Section 8.4.2 of D 4828 on "Practical Washability of Organic Coatings." T. Sliva reported that M. McKnight was seeking subcommittee volunteers to assist Committee E06 in writing a specification on "Lead Encapsulants."

SUBCOMMITTEE D01.45 MARINE COATINGS

R. Gangi, Chairman

The "Standard Test Method for Measurement of Barnacle Adhesion Strength in Shear" had been submitted to a joint D01.47/D01 ballot. One D01.47 negative (McGreger), with two parts was received. The subcommittee found the negative not persuasive. The first part concerned the feasibility of using a hand-held test device to apply a shear force. D01.47 decided that although a mechanical method could be used to apply a shear force to the barnacle, this is a field test method and reliable and repeatable data have been obtained using a handheld device. The second part of the negative questioned how one test could be compared with another. D01.47 responded that the method, as written, requires comparisons of fouling on test panels in a given location against a standard. It does not suggest or require comparisons of test results from different geographical areas.

C. Perez has prepared a format for reporting marine test data (degree of fouling) which differs from that in three current ASTM methods. The format will be reviewed by a task force consisting of Perez, Swain, Pate, and Heckey. This group will develop a consensus format, then, if indicated, they will make a proposal to modify the existing reporting formats in three existing ASTM standards.

In other new business, Julian Hunter lectured on "A Proposal for Determining the Copper Leach Rate of Antifouling Paints." The proposal's objective was to provide a standard procedure for regulatory agencies to use in evaluating antifouling paints. Charles Anthony, Case Consulting Laboratories Inc., presented a second proposal entitled "Leach Rate Determination of Anti-Foulant Paint Containing Copper." The method's objective is to determine the rate at which copper is released from a sample of antifoulant coating in synthetic sea water using graphite furnace atomic absorption spectrophotometry.

Note: Minutes from the June 1993 meeting were omitted from the last D01 report and are included with these minutes for completeness.

The June 1993 meeting of D01.45 reviewed the D01 ballot returns for "New Standard Practice for Testing Biofouling Resistance of Marine Coatings Partially Immersed." It received one negative from W.D. Ketola. This negative was based on a reference to ASTM D XXX in Section 8.3. At this meeting the method was identified as ASTM D 3623. As a result, the negative was withdrawn.

From a D01.45 ballot, "Standard Test Method for Measurement of Barnacle Adhesion Strength in Shear," received one negative from H. Stoner. Mr. Stoner withdrew his negative after discussion indicated his response was an editorial comment. The method will go to D01 ballot.

SUBCOMMITTEE D01.46 INDUSTRIAL PROTECTIVE COATINGS

G.W. Gardner, Chairman

D01.46.02—Surface Preparation—K.A. Trimber, Chairman, suggested that SSPC be contacted to determine their interest in allowing ASTM to incorporate the new Vis 3 "Power Tool Cleaning" visual standards into D 2200, "Pictorial Surface Preparation Standards for Painting Steel Surfaces." The task group unanimously endorsed this suggestion and Chairman Trimber will contact SSPC.

S.K. Boocock, Steward for D 2092, "Practices for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting," reported that the revised D 2092 was sent out for D01.46 ballot and received one negative from an official voting member (D.K. Griffin) and two negatives from non-official voting members (L.A. Wienert and S.K. Boocock). The task group found the Griffin, Wienert, and Boocock negatives persuasive. S.K. Boocock will revise D 2092 to change it from a "practice" to a "guide," remove SSPC SP 7 Brush-Off Blast Cleaning and replace it with a descriptive sweep blast method, remove "crystalline" from Method A title, and make several editorial improvements (D.M. Berger, B.R. Appleman, K.A. Clement, C.J. Ray, S.G. Hamburger, and W.C. Spangenberg). Revised D 2092 will then be sent to D01.46 ballot.

K.A. Trimber is making changes to D 4417, "Test Methods for Measurement of Surface Profile of Blast Cleaned Steel," and will send to D01.46 ballot. D 4940, "Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives," was published in 1989 and needs to be reviewed. W.C. Johnson will review prior to D01.46 ballot.

D01.46.03—Repainting—G.W. Gardner, Chairman, reported that D 4752, "Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub," passed D01.46. D 4752 was automatically sent to D01 ballot where it received one negative (Gardner). The Gardner negative, pointing out that Section 6.3 should reference 10 seconds, and not 10 minutes, was persuasive. D 4752 will be revised to require 10 seconds and to include C.J. Ray's comments before sending to D01.46 ballot.

D.W. Chance reported results of intralaboratory, single operator, solvent-rub tests on three inorganic (per ASTM D 4752) and three organic coatings (per ASTM D 5402, "Practice for Assessing the Solvent Resistance of Organic Coatings Using Solvent Rubs"). Tests were run three different times to determine the precision of these test methods by a single operator. M.E. McKnight will discuss results with W.S. Orthey to determine if a precision statement can be generated from this information.

G.W. Gardner reported that discussions with Doug Hendersen, of DJH Designs, indicate that the MEK Rub Test Machine is suitable only for benchtop applications using panels. Since both D 4752 and D 5402 are intended for field use as well as laboratory use, the task group decided not to do an evaluation of this machine at this time. D01.55 should consider evaluating this machine since it may be applicable to coil coating applications.

G.W. Gardner reported that D 610, "Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces," failed to pass the D01.46 ballot, receiving one negative (D.M. Berger). The Berger negative recommended 24 photographic reference standards instead of the present four and the proposed six. The task group found this negative not persuasive because this large number of standards is outside the scope of D 610's intent to show degree of rusting. The task group's discussion and comparison of the photographic standards and pictorial representation from the ASTM/SSPC photo book with the ASTM D 610 test method revealed considerable discrepancies within and between these items. D 610 will be balloted in D01.46 while the work to eliminate these discrepancies continues.

D01.46.04—Pull-Off Adhesion—M.E. McKnight, Chairman, reported that D 4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers," to be published in 1994, is the old version of D 4541 and does not contain the changes balloted and approved in 1993. Chairman McKnight will work with the ASTM staff to get the correct version ready for 1995 publication.

D01.46.07—Inspection—G.W. Gardner reported that D 3276, "Standard Guide for Painting Inspectors (Metal Substrates)," received two negatives from official voting members (J.E. Montle and H.R. Stoner) on D01.46 ballot. These negatives were considered persuasive and several changes in mandatory items, 100% inspection, as well as comments from A. Beitelman will be incorporated into D 3276 before it is sent to D01.46 ballot.

The new "Guide for Painting Inspectors (Concrete and Masonry Substrates)," received two negatives from official voting members and one negative from a non-official voting member on D01.46 ballot. The task group ran out of time and was not able to discuss this guide. It will be discussed at the June meeting.

D01.46.12—Sampling—G.W. Gardner reported that the new "Practice for Field Sampling of Coating Films for Analysis of Heavy Metals" received one negative (C.J. Ray) on D01.46 ballot. Mr. Ray questioned the need for dry film thickness reporting. The task group found C.J. Ray to be not persuasive because dry film thickness is important in estimating "total" amount of heavy metal on the structure. Mr. Ray also questioned how surface area is measured and the task group unanimously agreed that this was specified in Section 5.3 as "a square one inch (25 mm) on a side." A few editorial changes indicated by C.J. Ray and H.E. Ashton will be made before sending to D01 ballot.

D01.46—G.W. Gardner, Chairman, welcomed three new members to the D01.46 roster: Jerry Bird, of Corrosion Control, Port St. Lucie, FL; Estrella Katigbak, of Ameron Protective Coatings, Brea, CA; and Henri Pius Tjahjana, of H.P. Tjahjana & Associates, Indonesia. D01.46 now has 80 members.

Updates from each task group were given. D01.46 voted to find C.J. Ray not persuasive in his D01.46 negative on the new "Practice for Field Sampling of Coating Films for Analysis of Heavy Metals."

Two new task groups will be established. M.E. McKnight will start gathering information for a "Guide to Testing Industrial Protective Coatings" (Task Group D01.46.13 Guide). S.K. Boocock will review test methods for immersion to develop a "Practice for Immersion Testing of Industrial Protective Coatings" (Task Group D01.46.14 Immersion).

SUBCOMMITTEE D01.47 MASONRY TREATMENTS

E. McGettigan, Chairman

D01.47.01—Water Repellency of Treated Masonry—V. Scarborough, Chairman, distributed copies of Draft No. 3 of the proposed "Test Method for the Determination of the Water Repellency of Treated Masonry." Data developed by the chairman and task group members using the method were distributed.

The group discussed the specified immersion period, curing conditions and treatment application. Treatment application is an important issue to achieving reliable and reproducible results. It was decided that the coverage rate would be confirmed by weighing following application, as the immersion time required will differ significantly for various water repellents.

V. Scarborough will evaluate the immersion times for treating the cubes and send treated cubes to cooperators for an additional round-robin. Four cooperators have agreed to participate. The results of the round-robin will be reported upon at the June meeting.

D01.47.04—Surface Preparation—T. Subasic, Chairman, distributed copies of the proposed "Standard Guide for Preparatory Surface Cleaning of Brick Masonry." The document was developed by T. Subasic with the assistance of F. Gale. The document was reviewed by the task group. Various editorial and technical comments received will be incorporated into the next draft, which will be submitted to D01.47 ballot.

D01.47.05—Water Vapor Transmission of Treated Masonry Substrate—E. McGettigan, T. Sliva, Temporary Co-Chairmen, submitted Draft No. 7 of the proposed "Test Method for Determination of Water Vapor Transmission of Clear Water Repellent Coatings When Applied to Masonry Substrates" for review. Revisions of this draft included allowing the bricks to drain five minutes following immersion and a specification for a silicone sealant that will adhere to damp surfaces.

E. McGettigan circulated the results of the recently conducted round-robin. Products tested included a urethane, an 8% solids silane/siloxane blend and a 20% solids silane/siloxane blend. Regarding the test specimens, it was suggested that water absorption of untreated specimens be evaluated and an acceptable range of absorption established. Outlyers should be rejected. For the next screening test, five test specimens will be broken in half and one-half from each will be used as an untreated control.

D01.47.06—Freeze/Thaw, Resistance of Treated Masonry—L. Stark-Kasley, Chairman, discussed the results of the second round-robin conducted on the proposed "Test Method for the Evaluation of the Freeze/Thaw Resistance of Treated Masonry." Mortar cubes (2 in × 2 in) used in the round-robin were treated in one lab with three different treatments; namely, a silane, a siloxane, and silicone. After curing, the cubes were sent to the cooperating laboratories for testing.

The objective was to subject the cubes to 50 freeze/thaw cycles and measure the weight change of the cubes weekly along with visual examination for cracking, spalling, or degradation of the test substrate. Based on the sufficient correlation between laboratories from both round-robin tests, the next step is to make editorial revisions to the test method. These will include modifying the descriptions in the visual rating table to match typical deterioration steps and adding the cube preparation procedure. A Precision and Bias statement will be developed and the method submitted to ballot.

D01.47.07—Alkali Resistance of Masonry Treatments—B. Berglund, Chairman, reviewed the status of the work previously conducted by the task group under V. Repkin. The chairman distributed Draft No. 2 of the proposed "Test Method for Determining the Alkaline Resistance of Treated Masonry Surfaces" and the data developed during the first two round-robins. The chairman will revise the proposed method to include a method of substrate preparation and state the limits for weight change in order to obtain constant weight. He will incorporate the editorial and technical comments discussed at the task group meeting and submit a revised Draft No. 3 of the method to the group. A screening of the method will be conducted by several task group members. The screening will evaluate coated specimens after immersion in both 1 N KOH and reagent grade water. The results of this screening will be discussed at the June meeting.

D01.47.10—Evaluation of Field Applied Treatments—E. McGettigan, Chairman, distributed Draft No. 2 of the proposed "Test Method to Determine the Water Absorption of Hardened Concrete Treated in the Field with a Water Repellent." The method specifies that 2 3/4 in. × 3 in. concrete cores will be used as the standard test substrate. A description of the coating technique will be included in the method. It was the decision of the task group to initiate a round-robin of the method.

D01.47.11—Research and Planning—E. McGettigan, Chairman. Bruce Berglund, of Wacker Silicones, submitted a request to amend ASTM D 5095, "Test Method for Determining the Nonvolatile Content in Silanes, Siloxanes and Silane-Siloxane Blends Used in Masonry Water Repellent Treatments," to accurately measure the nonvolatile content of buffered masonry water repellents. This would be accomplished by modifying the procedure to increase the concentration of p-toluenesulfonic acid for buffered silane/siloxane systems from 0.5 to 3.5%.

Dr. Berglund presented data and graphs generated at Wacker to show that the change will not affect non-buffered materials. It was decided that several laboratories will run screening tests on various buffered and non-buffered materials to determine the effect of additional acid on the values obtained.

DIVISION 50 PAINTS FOR FACTORY APPLICATION

SUBCOMMITTEE D01.51 POWDER COATINGS

N.D. Emily, Chairman

D01.51.02—Hiding Power of Powder Coatings—M.P. Sharma, Chairman, reviewed a draft proposal of a test method for measuring "Hiding Power of Powder Coatings." This draft contains two procedures based on film thickness and one on a coating film weight. A round-robin will be conducted in which precise testing directions will be furnished to five collaborators.

D01.51.03—Spray Characteristics of Powder—C.R. Merritt, Chairman, submitted a new draft method containing a technique for determination of "First Pass Powder Transfer Efficiency" in laboratory facilities. Comments regarding this draft should be returned to the task group chairman by April 15, 1994.

D01.51.05—Specific Gravity of Powder—D. Schneider, Chairman, reported on the powder material parameters which contribute to variations in test data results. The accuracy and sensitivity of the weight balance is very significant. The challenges associated with metallic-containing powders were reviewed. Discussion of techniques for dispersion in the liquid media resulted in three collaborators volunteering to experiment with and report the results of a new procedure in June 1994.

D01.51—N.D. Emily reported that the following powder characteristics have been identified for future task group investigations: (1) uncured powder thickness measurement; (2) powder shelf stability; (3) fluidization characteristics; and (4) smoothness standardization.

The Chairman also reported affirmative action by D01 on D 5382, "Guide to Optical Properties of Powder Coatings." J. Hagerlin will be the document steward.

SUBCOMMITTEE D01.52 FACTORY-COATED WOOD BUILDING PRODUCTS

S.B. Schroeder, Chairman

D01.52B—Hardboard—S.B. Schroeder, Chairman, reported that the research report on statistics for the round-robin for the new "Cobb Ring" water permeability method is still incomplete. It is planned to complete the report and place the method on ballot in 1994.

It was reported that D 2793, "Standard Test Method for Block Resistance of Organic Coatings on Wood Substrates," has been approved after the inclusion of the editorial comments in an earlier negative ballot by P.R. Guevin.

A negative ballot was also cast by P.R. Guevin on reapproval of D 4144, Standard Test Method for Estimating Package Stability of Coatings for Ultraviolet Curing." His reminder that a bias statement is required was found persuasive and was incorporated into the method for immediate reballot.

Also discussed was a letter from J. Weaver suggesting that a guide or practice be prepared to summarize all of the pertinent hardboard test methods. After discussion, it was felt that the existing D 2336-87 (1991), "Practice for Specifying Properties from Liquid Through Cured State," for the coatings factory applied to wood products, accomplishes much of Mr. Weaver's request. In addition, S.B. Schroeder and L. Wagner reported a decided lack of interest when such a guide was proposed at the American Hardboard Association Technical Committee meeting last fall. Mr. Wagner will continue to monitor and report on both ABA and D07 activities as they relate to this task group.

D01.52.13—Prefinished Hardboard—T. Rieth, Chairman, reported resolution of a number of negatives and comments by P.R. Guevin, on Revision 4 of the proposed "Standard Practice for Performing Accelerated Outdoor Weathering of Factory Coated Embossed Hardboard Using Concentrated Natural Sunlight and a Soak-Freeze-Thaw Procedure." The comments were accepted as editorial changes and the persuasive negatives regarding addition of cautionary statements on quantification of results will be incorporated into a revision for D01.52 ballot.

R. Matejka reported verbally on a weathering study using the new accelerated technique on a wide range of substrate and coating combinations. Results are believed to substantiate the utility of the new procedure. A written report will be supplied at the June meeting. Extension of the new accelerated weathering technique to factory primed hardboard is also being considered. Test fence exposure data from a large AHA study will be utilized for comparison with results of the accelerated technique. L. Wagner will provide a progress report on the AHA series in June. Attempts to develop a related accelerated weathering technique utilizing freeze-thaw, but substituting xenon arc weathering for sunlight, are being reinitiated with a progress report in June.

D01.52.17—Dirt Collection—S.B. Schroeder, Acting Chairman, reported a serious problem in resolution of negatives and comments on D 3719-87, "Standard Test Method for Quantifying Dirt Collection on Coated Exterior Panels." None of the attending members of D01.52 was able to cite personal experience and expertise in the use of this method. It was recommended that the method be immediately balloted for withdrawal and that persons casting negative ballots be urged to attend the summer meeting to assist in making the necessary revision.

D01.52—"Standard Specification for Wood to be Used as Panels in Weathering Tests of Coatings" was briefly discussed in response to a letter from R. Kinmonth. Certification by the supplier of wood panels meeting specified density requirements and a source of these certified panels was the issue raised. Scott Orthey will be instructed to respond that no such source of certified density panels is known.

D 3719, "Standard Test Method for Quantifying Dirt Collection on Coated Exterior Panels," was discussed in considerable detail. The members concluded that the test should be balloted for withdrawal by the main committee. A copy of the withdrawal letter will be mailed to D01.42 and to J. Scott, J. Bednariak, L. Schaeffer, S. LeSota, and M. Crewdson in hopes of generating an action plan if indeed the method is viable. Thirty minutes will be allocated at the June Meeting for additional discussion.

D 2691, "Standard Test Method for Microscopical Measurement of Dry Film Thickness of Coatings on Wood Products," under task group D01.52, will also be allocated 30 minutes at the June meeting for discussion of a round-robin. In new business, several members questioned the dwindling participation in D01.52 by the hardboard manufacturing industry. Several industry members questioned the relevance of some of the standards assigned to D01.52 regarding their utility in the hardboard manufacturing industry. All members agreed to continue their participation in D01.52.

SUBCOMMITTEE D01.53 COIL COATED METALS

R.J. Tucker, Chairman

D01.53.04—Dry Film Thickness Measurement—G.R. Pilcher, Chairman, reported that internal methods used to dictate the use of the boring device from DJH Industries by various companies will be gathered, forwarded to him, reviewed, and a draft ASTM document will be prepared. Working standards for the study are in hand and are being carefully characterized for dry film thickness. It was also reported that another company is now involved in producing a similar device. Their name is Micro View and, once the draft document is completed, it will be forwarded to both manufacturers for their review and comments.

D01.53.03—Task Group on Accelerated Weathering—D.A. Cocuzzi, Chairman, reported that, due to continued difficulty in obtaining the necessary set of test panels, nothing has yet been exposed at real-time conditions in South Florida. Every effort will be made to have the necessary samples in hand by the next meeting.

D01.53.01—Task Group on Pretreatment on Substrates—H.E.G. Rommal and D.C. Steele, Co-Chairmen, discussed the results of the D01 ballot of the proposed practice "Standard Practice for Determination of Chromium Treatment Weight on Metal Substrates by X-Ray Fluorescence." Of the comments received, one was directed at the need for a Precision and Bias Statement (one will be offered) and another concerned a minor typographical error and grammatical change. A third comment, however, dealt with some confusion surrounding which type of Scotch Brite™ pad should be used. Mr. Rommal will clarify this for the next ballot. One negative was received, and it involved the calibration, amperage control adjustment, linearity of response, and standards used with an X-ray fluorescence device. After much discussion, we resolved that, in fact, further clarification is needed.

D01.53—R.J. Tucker reported that the "Standard Practice for Determination of Chromium Treatment Weight on Metal Substrates by X-Ray Fluorescence" will be revised and resubmitted for balloting. D 3794, "Standard Guide for Testing Coil Coatings," has received a host of negatives and will be revised one last time and submitted for balloting.

SUBCOMMITTEE D01.56 PRINTING INKS

J.M. Fetsko, Chairman

D01.56.02—Lightfastness of Prints—J. Robins, Chairman, reported that the available data are insufficient to develop a Precision Statement for D 3424, "Test Method for Lightfastness and Weatherability of Printed Matter." Since it covers a variety of test methods, it might qualify as a practice or a guide.

D01.56.12—Viscosity of Liquid Inks—J. Daugherty, Chairman, reported that round-robin data on inks does not seem to reflect the better sensitivity of the Shell cup versus the Zahn due to the larger numerical values (in seconds) with the Zahn. D01.56 voted to add this procedure to D 4212, "Standard Test Method for Viscosity by Dip-Type Viscosity Cups" (under jurisdiction of D01.24), rather than establishing a separate test.

D01.56.14—Setting of Heatset Inks—D. Ness, Chairman, reported that an exploratory round-robin was conducted in which four labs correctly rated the relative heat setting of three inks using the Sinvatrol on wedge plates prints. The method will be written up as a practice.

D01.56.15—Density (wt/gal) of Paste Inks—P. Ford, Chairman, reported that a previous round-robin showed excellent precision of ink densities by the weight-per-gallon cup. This procedure should be added to D 1475, "Standard Test Method for Density of Paints, Varnishes, Lacquers, and Related Products," which is under jurisdiction of D01.24. On the other hand, precision of VOC40 was inversely related to the VOC40 level and is better expressed on a relative basis.

D01.56.17—Guide for Printing Inks—J. Fetsko, Chairman, reported that D 5010, "Guide for Testing Printing Inks and Related Materials," now includes the new Test Method D 5328 on VOC40, Method D 2090 for clarity of paint and ink liquids, and D 5264 on the Sutherland Rub Tester. It was suggested that D 1308, "Effect of Household Chemicals on Clear and Pigmented Organic Finishes," be added.

D01.56.19—Printing Strength and Opacity—G. Wouch, Chairman, distributed via J. Bender a progress report which demonstrated that the Delta E of cyan inks varied when printed over gray bars but not over a black bar. The group decided to split off Opacity into a separate task force (D01.56.31) and A. Semijalac as Chairman. J. Daugherty agreed to chair the task force on Printing Strength and will distribute his company's test method prior to the next meeting.

D01.56.20—Technical Coordination—B. Blom, Chairman, reported that several NPIRI task forces are working on test methods of interest to D01.56 and that closer cooperation between the two groups be arranged.

D01.56.21—Print Abrasion—G. Vandermeersche, Chairman, distributed copies of a proposed standard covering the use of the GV-CAT for testing cans and other metal decorated products. It was suggested that the title be changed to reference the printed surface as "applied graphics and/or coatings" and that the interpretation of results include a section on the assignment of a numerical value. A round-robin will be held in order to establish a Precision Statement.

D01.56.22—Drying of Oxidizable Inks—B. Blom, Chairman, distributed copies of a proposed test method in which the drying of oxidizable inks is evaluated by squalene resistance using a modified Sutherland Rub Tester. In order to develop a Precision Statement, a new round-robin must be run in duplicate. It was also suggested that the manual rub off method be included even though the precision was poor.

D01.56.25—Degree of Radiation Curing—E. Kobylarz, Chairman, reported that the Control Cure Analyzer correctly rated the degree of curing of a blue ink and a clear coating run at different belt speeds. The use of the Sutherland Rub Tester did not work well because test results were influenced by the addition of wax to the test ink. The MEK rub test was found to be difficult due to rapid evaporation of the solvent. Suggestions included use of a blended solvent, a Crock Tester made by Atlas, and the GTA Abrasion Tester.

D01.56.26—Chemical Resistance—J. Cichon, Chairman, reported that he met with D01.55, who were receptive to his suggestion that D 1308 (see D01.56.17) be revised to accommodate printing inks. He also distributed copies of internal test methods for Alkali Resistance and Bleed Resistance.

D01.56.27—VOC40 of Non-Heatset Paste Inks—P. Ford, Chairman, reported that the round-robin data discussed in D01.56.15 will be the basis for 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, Chairman, reported that an exploratory round-robin on the spectrophotometric determination of tinting strength showed poor results due to incomplete mixing of the test samples with a titanium dioxide slurry. Different cuvettes will be tried to improve the accuracy of instrumental readings.

D01.56.30—Instrumental Color Measurement—J. Cichon, Chairman, distributed results of a NPIRI task force pilot study which tested the color constancy of prints made on various laboratory devices. He also reported on the work of ISO Technical Committee 130, which is developing a method for using proofing instruments. It was also agreed to establish a separate task force, D01.36.32, for the Laboratory Preparation of Printing Ink Films, to be chaired by J. Cichon. The NPIRI procedure for the Little Joe is a good starting point toward the development of an ASTM standard.

SUBCOMMITTEE D01.57 ARTISTS' PAINTS AND RELATED MATERIALS

M.D. Gottsegen, Chairman

D01.57.02—Lightfastness of Pigments—T. Vonderbrink, Chairman. Current deficiencies in D 4303 were discussed: different tests may not be controlled in the same way due to failure to specify wavelength at which radiation is measured, differences in xenon-arc apparatuses, and the fact that the fluorescent lamps specified for one of the test methods are no longer available. Major revisions are required, and T. Vonderbrink distributed a written proposal. One suggestion is to reference D 4674 as a test method to supplement or replace the existing fluorescent lamp method. Test data show a correlation of this method with existing methods. It was also suggested that reference pigments (e.g., PY 3 and PR 170) be included to replace or supplement the existing method of controlling exposure duration. J. Luke further suggested the inclusion in the revision of a standard reporting form to help track test conditions.

D01.57.04—Specification for Artists' Paints—A. Spizzo, Chairman, reported that the incorporation of a method for evaluating the bleeding of pigments into D 5098 is proceeding in the balloting process. R. Gamblin submitted a written proposal for modifying labeling specifications in D 4302, D 5067, and D 5098, which would allow the listing of pigment common names on the rear of a container label in certain instances. The proposal was tabled until Mr. Gamblin could be present for the discussion. J. Luke clarified her negative vote regarding common name type size. She would prefer half the measured size of the lettering, rather than half the type size. Since the item has been withdrawn from ballot, the group decided to investigate type size requirements for product hazard labeling with the thought of using the same requirements for name labeling.

Three conservators from the National Gallery of Art (R. Merrill, J. Kruger, and R. de la Rie) were introduced and expressed their interest in acquiring samples of modern materials to increase their collection. They are also interested in participating in some of the research relevant to the activities of D01.57.

Eighty-nine changes in Tables 1 of D 4302, D 5067, and D 5098 were discussed and voted upon. Many of the changes were corrections to Colour Index numbers or names, but most involved the removal of a specific hue designation from the list of Common Names required in labeling. Since some pigments called red can range in hue from orange to purple, this will allow paint manufacturers to assign a hue based on the appearance of the pigment as received from its supplier. For example, "quinacridone red" will now be listed as "quinacridone (hue designation)." All of the changes will be balloted.

D01.57.08—Toxicity Labeling—W. Stopford, Chairman. Balloting on changes to D 4236 (a footnote advising that toxicologists must submit labeling criteria to the CPSC, and changes in Annexes 1 and 2) is proceeding. There was inconclusive discussion on making the statement "Conforms to ASTM D 4236" more user friendly, although it was explained that the wording that manufacturers use must meet the requirements of D 4236-88, the version cited in the Labeling of Hazardous Art Materials Act.

D01.57.10—Consumer Evaluation—J.T. Luke, Chairman, described some observations she has made in the ISO series of Blue Wools. Numbers 6, 7, and 8 seem to be darkening under cover, which would make them seem to fade sooner than they really do. This effect is particularly noticeable in Blue Wool #7. She has also determined that xenon-arc exposure induces premature yellowing in the wool strips.

A revised copy of the research report associated with the development of D 5383 and D 5398 was distributed. Voting on acceptance will take place at the next meting of D01.57.

D01.57.11—Gouache Paints—T. Takigawa, Chairman, was absent, but Draft 4.2 of the proposed Gouache Specification was distributed and discussed. There was a question about how some of the pigments were classified for lightfastness in relation to the procedures specified in D 4303. The specification is very close to being ready for ballot.

D01.57.12—Determination of Toxicity—W. Stopford, Chairman, distributed a fifth draft of a proposed standard test method for determining the extractability of metals from art materials. A negative vote from a D01 ballot was discussed and found not persuasive. ASTM has recommended that a paragraph concerning "purity of reagents" be included (editorial); W. Spangenberg suggested that a "Significance and Use" section also be added to address M. Rossol's concern that the method has not been proven to directly correlate with animal testing.

A first draft of a standard test method for determining the extractability of aromatic amines from art materials was also distributed. Three alternative treatment and extraction techniques for this proposed test method were described: thin layer chromatography (not statistically supportable); high performance liquid chromatography (good repeatability); and gas chromatography. The next draft will specify HPLC and refer to the appropriate ASTM Standard.

W. Stopford explained that a statement addressing repeatability must be added—three laboratories are known to be pursuing use of the method, but this is not enough to establish interlaboratory repeatability. Dr. Stopford expressed the desire to have the method published in order to help generate interlaboratory repeatability data. A significance and use statement will also be incorporated into the next draft.

D01.57.14—Colored Pencils—J. Seymour, Chairman, reported on the work in progress to determine procedures for rating lightfastness. Three manufacturers are participating in a test of the application methods, and a study has been done to determine the repeatability that can be expected when measuring samples. Work is continuing to determine the best test method and rating system.

D01.57—M. Gottsegen, Chairman. B. Gavett assumed chairmanship of D01.57 effective immediately. The next meeting of D01.57 will be held Sunday, May 22, 1994, in conjunction with the National Art Materials Trade Association's International Trade Show, at the Hyatt Regency Hotel in Chicago, IL.

DIVISION 60 PAINT APPLICATION

SUBCOMMITTEE D01.61 PAINT APPLICATION TOOLS

F.B. Burns, Chairman

D01.61.01—Paint Brushes—T. Sliva, Chairman, distributed Draft No. 2 of the "Proposed Test Method for Comparing the Leveling Efficiency of Paint Brushes" to the task group for review. The scope will be changed to state that the method is applicable to brushes of the same width and other heat dimensions. D 5301, "Physical Characteristics of Paint Brushes," will be referenced in the document. References to levelness standards will be eliminated. An equation for determining the spreading rate needed will be incorporated and the report section expanded. The chairman will revise the document and submit to D01.61 ballot.

The chairman distributed Draft No. 1 of the "Proposed Test Method for Evaluation of the Cleanability of Paint Brushes" for review. Changes to the title and the description of brushes in the scope were discussed. All references to the "standard paint brush" will be eliminated from the document. An equation for determining the spreading rate will be included. A discussion on the cleaning and drying procedure followed. The chairman will revise the document incorporating the changes and submit it to D01.61 ballot.

D01.61.03—Woven Paint Applicator Fabrics—The chairmanship was passed by E. Lowder to M. Murray, of Collins & Aikman. The formative meeting was used to outline the characteristics to be addressed in the standard. D 5301-92 was used as a starting point and modified as an initial rough draft. A new scope, definition, and terminologies were suggested by the group. It was agreed that a formal draft will be presented to group members by March 1994 with comments and input to be addressed to the chairman. At the June 1994 meeting, further review of this standard will be discussed. An invitation was extended to all non-competing members to visit the Collins & Aikman facility at the June 1994 meeting. The details of the visit will be arranged.

D01.61.05—Bulk Density of Filaments and Bristle—C.F. Nelson, Chairman, reviewed Draft No. 6 of the proposed test method for bulk density. Several corrections were made. The data from the round-robin for bulk density of tapered filaments was reviewed. Five cooperators submitted data. The average of one data set was significantly different from the other four sets of data. We will investigate the reason for this difference in data sets and revise the draft method as noted.

D01.61.06—Buckling Resistance of Filaments—E. Harsch, Acting Chairman. T. O'Brien will become Chairman of the task group replacing B. Bond, who has retired. W. McLaggan said that one additional test device was available from Simms. The issue of clamp slippage was discussed and recommendations to resolve this problem will be made prior to any further testing. Another round-robin test will be initiated as soon as possible.

D01.61—F. Burns reported that the D01.62 ballot to revise the scope was 100% affirmative with a 71% return of ballots. This matter was approved by the Executive Committee on January 23, 1994. The revised scope reads as follows:

> *To develop test methods, nomenclature, definitions, and recommended practices (including use) for paint application tools, and components thereof, used for on-site application of coatings by contact transfer to a surface.*

T. Sliva, Chairman of the Symposium Subcommittee, proposed that D01.61 sponsor a one to one-and-one-half hour symposium of paint application tools for the January 1996 meeting of D01. It was the group consensus that we accept the invitation. Following discussion on the subject, it was concluded that each member bring ideas for this activity to the June 1994 meeting of a new task group, D01.61.07, entitled Symposium Planning. T. Sliva was named Task Group Chairman and the meeting will be scheduled for 12 noon.

W.B. Bond has retired from active membership and has been replaced by C.F. Nelson as Chairman of D01.61.05. T. O'Brien is his replacement for D01.61.06. Mr. Bond's leadership and participation for many years was acknowledged.

January 1994 Subcommittee Reports of ASTM Committee G03

The January meeting of G03 on Durability of Nonmetallic Materials was held on January 23-27 at the Crown Sterling, Fort Lauderdale, FL. The present membership of the committee is about 80.

Future Meetings

June 26-29, 1994—Raleigh, NC.
January 22-25, 1995—San Antonio, TX.
June 25-29, 1995—Atlanta, GA.
January 21-24, 1996—Fort Lauderdale, FL.
June 23-26, 1996—San Francisco, CA.

SUBCOMMITTEE G03.01 EDITORIAL AND DEFINITIONS

M.J. Crewdson, Chairman

G03.01.01—Terminology—M.J. Crewdson, Chairman. A revision to the definition for black box was balloted to change sample to test specimen as the term for the actual item being exposed. This is in accordance with the other definitions within this standard.

G03.01.02—Conditioning and Handling—M.J. Crewdson, Chairman, led a discussion of the proposed Practice for Conditioning and Handling. The task group agreed that specimen shipping and packaging also needed to be addressed in this document.

G03.01.03—Statistics—M.J. Crewdson, Chairman, reviewed the ballot returns of the first draft of a proposed "Guide to Application of Statistics to Weathering Test Results." The need for an appendix for each referenced statistical method was discussed. W. Ketola agreed to assist with the revisions.

SUBCOMMITTEE G03.03 SIMULATED AND CONTROLLED ENVIRONMENTAL TESTING

R.M. Fischer, Chairperson

The G03.03 ballot of draft "Standard Practice for Conducting Light-Exposure Tests of Non-Metallic Materials Using Horizontal Specimen Tray Xenon-Arc Exposure Apparatus" received one negative. The negative, which reflected G03.03's current move to write performance–based standards and move away from "device specific" documents, was found persuasive and this item will be redrafted and reballoted.

The draft "Guide for Addressing Variability in Natural and Accelerated Testing of Non-Metallic Materials" received several G03.03 negatives. The negatives were en masse deemed persuasive. This item is withdrawn, will be redrafted using the suggested changes, and will be reballoted.

The G03.03 ballots for the inclusion of precision and bias statements in G 23, G 26, and G 53 returned with three negative votes. The negatives, in general, stated that these were standard practices and required no Precision and Bias Statement. In addition, the negatives asserted that precision and bias is material dependent and judgment about precision cannot be assumed to be the same for different material types. These negatives were found not persuasive, because it was generally felt that the Precision and Bias Statements were not written in absolute terms, but offered guidance to the users about current limitations required in the structure, design, and interpretation of results from accelerated weathering tests. These revisions will pass on to G03 ballot.

The revision of G 26 to include Suga Test Instruments Co. as a device supplier in footnote (8) and to eliminate footnote (10), which listed suppliers of xenon-arc optical filters, received no G03.03 negatives and will pass on to G03 ballot.

The G03.03 ballot of G 53 to make Figures 2 and 3 (lamp placement schematics for apparatus types A and B) more generic received one negative vote which was withdrawn. This revision will proceed on to G03.03 ballot.

P. Brennan and W. Ketola distributed proposed revisions for G 23, G 26, and G 53 that will move these standards from "specific equipment-based" to "performance-based" documents. Messrs. Brennan and Ketola solicited input on these proposals from meeting attendees prior to the submission of these documents for G03.03 ballot this spring.

SUBCOMMITTEE G03.05 REFERENCE MATERIALS FOR EXPOSURE TESTS

W. Ketola, Chairman

W. Ketola presented a report of the complete analysis of the results from exposures of polystyrene in xenon arcs according to SAE J1960. Results from regression analysis of the round-robin data were used to determine the 95% confidence interval for the radiant exposure necessary to produce a defined level of yellowing in the polystyrene. Even though the R^2 for regression was quite high, the 95% confidence interval for the radiant exposure necessary to produce a specified level of yellowing was quite broad (70-80% of the mean radiant exposure) for either the reflectance or transmission data. If yellowness data from a single colorimeter was used, the 95% confidence interval for the radiant exposure to produce a specified amount of yellowing was still 50% of the mean radiant exposure. Analysis of the round-robin data according to E 691 showed excellent repeatability within a laboratory, indicating that the operator and chip replicates caused very little of the variability. The reproducibility between laboratories was not nearly as good, as indicated by the much higher reproducibility standard deviation. A component of variance analysis showed that the exposure device (instrument, instrument operator, lab environment) and the colorimeter were the major sources of variability in the yellowness data. At short exposures, the colorimeter is the largest source of error. At longer exposures, the exposure device becomes the largest source of error.

During the discussion, it was pointed out that the polystyrene yellowing is sensitive to short wavelength radiation, and that this might explain some of the variability between laboratories. W. Ketola noted that this is very possible, because the short wavelength UV output of the water-cooled xenon lamp is very dependent on the age of the filters. It was also pointed out that some other reference materials such as blue wool are only sensitive to long wavelength UV or visible light and may show better reproducibility between exposure devices. This emphasizes the need to use reference materials that are appropriate to the type of material and property change being evaluated. No single reference material can be satisfactory for all situations.

W. Ketola distributed a summary of analysis of the most up-to-date results from exposures of polyethylene in carbon arcs according to JIS K7200. The results presented show a very large between–laboratory variability in the "carbonyl index" for identical exposure times. Preliminary analysis of the data indicate that the operator and film specimen contribute significantly to the overall variability, especially when compared to the results for polystyrene.

The format for a draft standard for use and evaluation of reference materials based on results/analysis of round-robin data was discussed. A draft for subcommittee ballot will be presented at the next meeting.

SUBCOMMITTEE G03.08 SERVICE LIFE PREDICTION

J.W. Martin, Chairperson

J.W. Martin presented a detailed overview of the service life prediction problem for those who were not able to attend the first meeting of G03.08 which was held in June 1993 in Philadelphia. The following topics were covered in this presentation: why a service life prediction (SLP) methodology is necessary, establishment of criteria for judging the effectiveness of any proposed or existing methodology, the attributes and shortcomings of the current SLP methodology, and the attributes and advantages of a reliability-based methodology.

The proposed scope of G03.08 is to develop standards to facilitate comparisons between laboratory and field exposures and ultimately to predict the service life for materials exposed anywhere outdoors. To accomplish this objective the following task groups were proposed:

(1) Characterization of the initial properties of a material;

(2) Quantitative characterization of degradation;

(3) Experimental design;

(4) Quantitative characterization of outdoor exposure environments;

(5) Analysis of service life data;

(6) Derivation of mathematical models useful in predicting service life;

(7) Development of computer databases for storing and retrieving data useful in predicting service life; and

(8) Discovering new insights from stored data.

Two of these task groups were activated at the January meeting. J.W. Martin will lead the task group on experimental design and B. Pourdeyhimi will lead the task group on the quantitative characterization of degradation via computer image processing.

Society Meetings

CDIC .... APR.

"Polyurethane Coatings"

Nomination Committee Chairman James Flanagan, of Flanagan Associates, Inc., announced the nominations for 1994-95 Society Officers. They are: President—Alan L. Machek, of Dow Corning Corp.; Vice President—John C. Avery, of Cintech Industrial Coatings; Secretary—William Jelf, III, of Akzo Coatings, Inc.; Treasurer—Steve Prodromo, of Hilton-Davis Co.; Past-President—Paul R. Guevin, Jr., of Paul R. Guevin Associates; and Delegate to the Ohio Paint Council—Hugh Lowery, of Perry & Derrick Co., Inc.

Elections will take place during the May meeting.

During the meeting, the Philadelphia Society's "Formulators Data Disk" was on display. Technical Committee Chairman Kenneth Pendleton, of K.A. Pendleton Co., noted that the Society is considering putting its data collected on white pigments in a similar format.

The first speaker of the evening was Tom Johnson, of ANGUS Chemical Co. He spoked on "REACTIVE OXAZOLIDENE MOISTURE CONTROL ADDITIVES FOR POLYURETHANE COATINGS."

The speaker began by pointing out that moisture control is an even more critical factor in newer, VOC-compliant, high-solids urethanes than in conventional solids coatings. In two-component urethanes, stated Mr. Johnson, bubbling and pinholes in the film, and lower gloss, were the results of inadequate moisture control. On the other hand, one-component products produced gassing, foaming, and eventual gelation. According to the speaker, unavoidable sources of potential moisture contamination are (ambient) humidity and moisture carried by the pigments, polyols, and solvents. The purpose of this research was to develop molecules that would react rapidly and preferentially with contaminant moisture.

Mr. Johnson described the products as ketone based oxazolidenes, which are highly reactive with water. The reaction products formed either react with the isocyanate and remain in the film or volatilize. At this point, the speaker graphically demonstrated the advantages of ketone based oxazolidenes versus aldehyde oxazolidenes.

In the two-component system, explained Mr. Johnson, gloss of coatings with the additive exhibited an improvement over those without the additive at 85% relative humidity. The effectiveness as a hydrator (removal of moisture during manufacture) was shown. Presence of the additive was observed to slightly speed cure response but have little effect on pot life. The speaker noted that improved abrasion, solvent resistance, and improved gloss retention—on accelerated weathering—also resulted.

Mr. Johnson reported that, when the additive was used in a one-component system, shelf life improved significantly.

The educational speaker for the meeting was William Mirick, of William Mirick, Inc., and his talk was entitled "APPLIED INFRARED TECHNOLOGY." This presentation dealt with the use of infrared lights to cure paint films.

JOHN C. AVERY, *Secretary*

CHICAGO .... JAN.

"Color Matching"

Winners of Society scholarships and grants-in-aid will be announced during the May meeting.

The guest speaker for the night was John W. Du, of Hüls America, Inc. His presentation was on "HOW GOOD OF A COLOR MATCH CAN YOU AFFORD?"

Mr. Du began by stating that with the development of color matching computers, color matching has progressed from an art to a science. Paint companies have historically made and used their own pigment dispersions to shade and adjusted the batches in process. Previously, according to the speaker, premanufactured colorants or pigment dispersions were used because of the consistency of color, strength, and universality. Savings in time, materials held in inventory, and quality control more than off-set the apparent higher cost of purchased colorants.

NATU C. PATEL, *Vice President*

CLEVELAND .... JAN.

Lead Prevention Program

Society President Freidun Anwari, of BFGoodrich Co., announced the passing of the following Society members: Fred G. Schwab, Tex Reed, George G. Selden, and Helen Skowronska. A moment of silence was held in honor of these members.

Mr. Anwari mentioned that the Society is seeking individuals to work with high school students for the local Science Fair. Those interested should contact Diane Provder, of The Sherwin-Williams Co.

Joseph P. Walton, of Jamestown Paint Co., encouraged all members to become active in the Ohio Paint Council.

The evening's guest speaker was Robert Staib, Deputy Commissioner of the Division of the Environment for the City of Cleveland. Mr. Staib spoke to the members on Cleveland's "LEAD POISONING PREVENTION PROGRAM."

The speaker began his talk by presenting a brief history on the use of lead. He traced this usage back approximately 5,000 years ago when lead was used in products such as wine decanters and plates, and continued with discussion of the use of white lead in cosmetics.

Today, stated Mr. Staib, the City of Cleveland has taken an aggressive approach to fighting the lead problem. The current city program employs 14 full-time workers, health aides, outreach workers, inspectors, and abatement monitors to combat the lead problem. The city also works in cooperation with the University of Cincinnati, Case Western Reserve University, and nonprofit housing groups.

Mr. Staib emphasized that children are more susceptible to the effects of lead. He said that children are exposed to sources in ways adults are not: children play/crawl on floors where lead dust may be; children have normal hand-to-mouth activity (teething,

HOW GOOD OF A COLOR MATCH CAN YOU AFFORD—John Du, of Hüls American, gave the technical presentation during the January Chicago meeting

MEXICO SOCIETY OFFICERS (seated from left): V.H. Carbajal, J. Lucio, R. Cortés, G. Vera, and J. Hijuelos. Standing: M. Saucedo, E. Aviles, L. Huerta, M. Herrera, and E. Tron

thumb sucking, etc.); and children are not able to wash their hands. A poor diet may also make children even more vulnerable to lead in their environment, added Mr. Staib.

The speaker turned his attention to the situation in Cleveland. He mentioned that Cleveland is sixth in the nation in the number of children living in housing built before 1950; and third highest in the nation and first in Ohio for childhood lead poisoning.

Mr. Staib continued by outlining the seven elements of the city's lead program. They are: (1) screening—two examinations per year; (2) laboratory analysis of blood samples; (3) medical follow-up and case management; (4) environmental investigation; (5) lead hazard reduction; (6) outreach by community health aides; and (7) public education.

In conclusion, Mr. Staib remarked that the City of Cleveland recently received a $3.8 million grant to pay for the abatement of some 200 homes and for further educational, follow-up, and research activities.

MICHAEL A. WOLFE, *Secretary*

CLEVELAND .... FEB.

“Pollution and Waste Reduction”

A moment of silence was observed for the passing of Harold M. Werner, of the Glidden Co.

President Freidun Anwari, of BFGoodrich Co. mentioned that the educational symposium will be held May 17 at BFGoodrich.

It was reported that the Memorial Scholarship fund is available for individuals to make contributions in the name of a deceased Cleveland Society member. To apply for these scholarships, contact Skip Glover, at Mahoning Paint.

Charles Beck (retired) presented a new resolution that will streamline new members into the Cleveland Society. It reads as follows:

Whereas, it is no longer necessary to have the secretary notify the membership in advance relative to voting on candidates for membership, now therefore

Let it be resolved that the second sentence of the fifth paragraph of page four (Duties of the Secretary) of the Operations Manual be amended to read as follows:

He shall incorporate in these notices items submitted by the Program Committee Chairman and the By-Laws Committee Chairman, together with other item submitted by any member of the Society when the latter have been properly approved for publication by the President or the Board of Directors.

Let it be further resolved that the second and third sentences of the seventh paragraph of page four (Duties of the Secretary) of the Operations Manual be amended to read as follows:

This business includes, but is not limited to, voting on changes in the Constitution and By-Laws and election of officers. Notice of voting on changes in the Constitution and By-Laws shall be mailed five days prior, and on the election, including the slate of nominees, 20 day prior, to the meeting at which the vote shall be taken.

And let it finally be resolved that this resolution shall become effective immediately following adoption.

Robert L. Toth, of The Glidden Co., updated the members on the February meeting of the Ohio Paint Council. A highlight of the meeting was an update on the status of reg-neg negotiations concerning architectural coatings VOC levels. Mr. Toth mentioned that the VOC reduction schedule is as follows: 25% reduction by 1996; 10% additional reduction by 2000; and 10% additional reduction by 2003. Corporate averaging could be used in 2000 and 2003; and the small business timetable is 1998, 2001, and 2003.

Mr. Toth reviewed the following actions of the Issues Committee:

(1) Lead abatement: Both SB 162 (Sen. Drake) and HB 447 (Rep. Campbell) bills have passed their respective legislation bodies. SB 162 is not a mandatory bill, as its sole intent is to license lead abatement contractors and qualify Ohio for HUD grants.

(2) Environmental Crimes Legislation: A united Ohio industry coalition has all but shut off any activity on this bill.

(3) Removal of Hazardous Substances Cessation of Operations (HB 98): No new activity.

The technical presentation for the meeting was, “POLLUTION AND WASTE REDUCTION,” and was delivered by Charles Rooney, of Orr & Boss.

The speaker proposed the following actions which can reduce waste: (1) reformulating (making formulations robust); (2) reducing inventory/maintaining good material; (3) low waste cleaning methods; (4) statistical process control; (5) calibrate meters; (6) recycling solvents; and (7) improving waste reporting . Mr. Rooney described that Quality Function Deployment (QFD) may be used to help tackle a company's pollution and waste reduction program. QFD is a methodical way of translating the customers true requirements into a list of the critical properties of the coating.

The following are just some of the practical principles that Mr. Rooney suggested in reducing waste:

PHILADELPHIA SOCIETY OFFICERS (from left): Robert D. Thomas, Neil Shearer, Janet Webb, Wayne Krause, Peter Kuzma, Richard D. Granata, Barrett C. Fisher, III, Sue Neilsen, Thomas G. Brown, Richard Kiefer, and Patricia Peterson

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GG ☐ Educational Institution/Library
HH ☐ Paint Consumer
JJ ☐ Other

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LL ☐ Mfg. & Engineering
MM ☐ Quality Control
NN ☐ Research & Development
PP ☐ Technical Sales Service
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002	022	042	062	082	102	122	142	162	182	202	222	242	262	282
003	023	043	063	083	103	123	143	163	183	203	223	243	263	283
004	024	044	064	084	104	124	144	164	184	204	224	244	264	284
005	025	045	065	085	105	125	145	165	185	205	225	245	265	285
006	026	046	066	086	106	126	146	166	186	206	226	246	266	286
007	027	047	067	087	107	127	147	167	187	207	227	247	267	287
008	028	048	068	088	108	128	148	168	188	208	228	248	268	288
009	029	049	069	089	109	129	149	169	189	209	229	249	269	289
010	030	050	070	090	110	130	150	170	190	210	230	250	270	290
011	031	051	071	091	111	131	151	171	191	211	231	251	271	291
012	032	052	072	092	112	132	152	172	192	212	232	252	272	292
013	033	053	073	093	113	133	153	173	193	213	233	253	273	293
014	034	054	074	094	114	134	154	174	194	214	234	254	274	294
015	035	055	075	095	115	135	155	175	195	215	235	255	275	295
016	036	056	076	096	116	136	156	176	196	216	236	256	276	296
017	037	057	077	097	117	137	157	177	197	217	237	257	277	297
018	038	058	078	098	118	138	158	178	198	218	238	258	278	298
019	039	059	079	099	119	139	159	179	199	219	239	259	279	299
020	040	060	080	100	120	140	160	180	200	220	240	260	280	300

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Technology

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February 1994 Issue

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CC ☐ Manufacturers of Equipment and Containers
DD ☐ Sales Agents for Raw Materials and Equipment
EE ☐ Government Agency
FF ☐ Research/Testing/Consulting
GG ☐ Educational Institution/Library
HH ☐ Paint Consumer
JJ ☐ Other

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—Don't over order materials;

—Purchase raw materials in pellet form;

—Check materials received for container damage from transit;

—Don't do your suppliers quality checks for them; carry out supplier quality audits;

—When storing materials, use large mobile containers for internal movements of liquids;

—Reuse drums internally when you are your own customer;

—When dispensing and issuing materials, empty all bags and containers properly;

—Use drum heaters to help drain high viscosity materials;

—As far as process capability, know it and work within it;

—Don't do it unless you can do it;

—Use SPC to eliminate noncompliance if your process is capable;

—When considering process losses in blending, use the cheapest mix.

MICHAEL A. WOLFE, *Secretary*

PACIFIC NORTHWEST PORTLAND SECTION..........JAN.

Training Course on HM 181/126

Environmental Committee Chairman Roald Berg, of Associated Chemists, reported that Van Waters & Rogers will provide a training course on HM 181/126 during the February 15 seminar. Randy Smith, of UPS, and Mike Eyer, of the State PUC, will also present talks at the program.

KEN WENZEL, *Section Secretary*

PHILADELPHIA....................FEB.

"Zero Discharge Coatings"

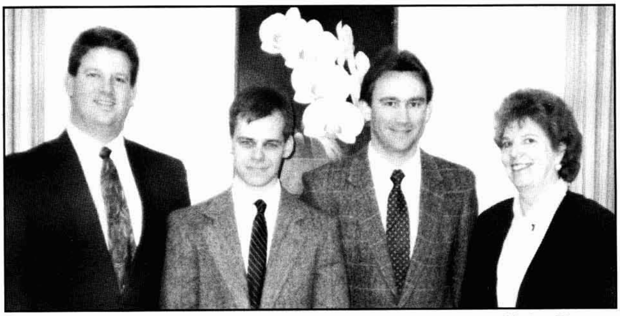
Technical Committee Chairman Neil Shearer, of the 3E Group, updated the members on the Society's annual technical seminar to be held May 23, 1994, at the Holiday Inn—Philadelphia Stadium, Philadelphia, PA. The theme of this year's program is "Filler Pigments—More Than Dead Space." The purpose of this seminar is to examine the different types of filler pigments and their contribution to the physical characteristics of paint and coatings. Each speaker will present the unique characteristics of one of the eight major filler pigments and examine what their physical characteristics are regarding coating performance and formulation technique.

An introductory talk will be presented by Society member Carl Fuller, who has prepared an overview of the mineralogical origins of filler pigments and their evolution of use in coatings.

Program Committee Chairman Barrett C. Fisher, III, of Van Horn, Metz & Co., Inc., reported on the Society's Manufacturing Night to be held in May. He stated that this year's event will be different in that there will be table top displays of equipment and components related to paint manufacturing. Also featured will be a presentation on re-engineering.

Due to inclement weather, the scheduled speaker was unable to attend. Instead, Philadelphia Society Member, Richard Granata, of Lehigh University, volunteered to be a last minute substitute. Dr. Granata spoke briefly about a new program at Lehigh to investigate the potential of zero discharge coatings (zero VOC) and nonpolluting coatings. At the request of certain military agencies, the university is investigating the practicality of powder coatings, E-coat, and UV coatings for military applications for steel and aluminum substrates.

HOWARD J. SALMON, *Secretary*



NEW ENGLAND SOCIETY OFFICERS (from left): John P. Lukens, Michael Iannuzzi, Charles Shearer, and Joanne Monique

TORONTO..............................FEB.

"Concrete Coatings"

Society Past-President Vik Rana (1992-93), of Reichhold Ltd., presented the Past-President's Plaque to Gerry Parsons (1991-92), of Para Paints Inc.

Society Vice President David P. Jack, of Technical Coatings Co., Ltd., updated members on the Society's Annual Symposium. The program, scheduled for March 7, 1994, will be held at The Speranza Restaurant, in Brampton, Ontario.

Educational Committee Chairman Walter Fibiger, of ITE Consultants, presented Certificates in Coatings Technology to the ten graduates of the "Coatings Technology" program held at George Brown College.

The meeting's guest speaker was Ray Crowne, of Cappar Ltd. He spoke on "CONCRETE COATINGS."

Mr. Crowne began his talk by describing the various properties of concrete and the challenges of coating and protecting it. Due to the porous nature of concrete, collection and containment of water is the biggest challenge. Trapped within these pores, the water cannot be displaced. The speaker stated that although several in number, these pores can essentially be classified under two headings: gel and capillary.

WESTERN NEW YORK SOCIETY OFFICERS (from left): Marko K. Markoff, Jayne Mallwitz, Edward L. Walker, Joanne Augustine, and Gerald F. Ivancie

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Martin's West, Baltimore, MD). Albert Holder, U.S. Navy, David Taylor Research Ctr., Code 2841, Annapolis, MD 21402-5067.

BIRMINGHAM (First Thursday—Strathallan Hotel, Birmingham, England). P. Hassall, Newtown Industrial Paints Ltd., Silica Rd., Amington Ind. Est., Tamworth, Staffs. B77 4DT, England.

CDIC (Second Monday—Location alternates between Columbus, Cincinnati, Dayton, and Indianapolis). John C. Avery, Cintech Industrial Coatings, Inc., 2217 Langdon Farm Rd., Cincinnati, OH 45237-4792 .

CHICAGO (First Monday—Sharko's Restaurant, Villa Park, IL). C. David Stromberg, Standard T Chemical, 290 E. Joe Orr Rd., Chicago, IL 60633.

CLEVELAND (Third Tuesday—Brown Derby, Independence, OH). Michael A. Wolfe, Seegott Inc., 5400 Naiman Pkwy., Solon, OH 44139.

DALLAS (Second Thursday following first Wednesday—Radisson Hotel, Dallas, TX). Paul Kaplan, Cookson Pigments, Inc., 2001 San Miguel Dr., Plano, TX 75704.

DETROIT (Second Tuesday—meeting sites vary). Tedd L. Strobehn, Boehle Chemical Inc., 19306 W. 10 Mile Rd., Southfield, MI 48037.

GOLDEN GATE (Monday before third Wednesday—alternates between Francesco's in Oakland, CA, and Holiday Inn in S. San Franscisco). Eve Stromquist, Flecto Corp., 100 45th St., Oakland, CA 94608.

HOUSTON (Second Wednesday—Houston Medallion Hotel, Houston, TX). Edward E. Boss, Bossco Industries, Inc., P.O. Box 680023, Houston, TX 77268-0023.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). William T. Porter, Hillyard Industries, Inc., P.O. Box 909, St. Joseph, MO 64502.

LOS ANGELES (Second Wednesday—Steven's Steakhouse, City of Commerce, CA). Robert J. Skarvan, McWhorter Inc., 5501 E. Slauson Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). Andrew Traister, Courtaulds Coatings, Inc., 400 S. 13th St., Louisville, KY 40201.

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—Le Bifthèque Steakhouse, Ville St. Laurent, Quebec). Esther Rouleau McCarthy, Stochem Inc., 1455 32nd Ave., Lachine, Que. H8T 3J1, Canada.

NEW ENGLAND (Third Thursday—Sheraton Lexington Hotel, Lexington, MA, and other locations in Massachusetts and Rhode Island). Charles Shearer, ZENECA Resins, 730 Main St., Wilmington, MA 01887.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). Cary Grobstein, Cardinal Color & Chemical, Inc., 50-56 First Ave., Paterson, NJ 07524.

NORTHWESTERN (Tuesday following frist Monday—Jax Cafe, Minneapolis, MN). Harold H. Christhilf, The Valspar Corp., P.O. Box 1461, Minneapolis, MN 55440.

PACIFIC NORTHWEST (Portland Section—Tuesday before third Wednesday—Rose's, Portland, OR; Puget Sound Section—Third Wednesday—Barnaby's, Tukwila, WA; Vancouver Section—Thursday after third Wednesday—Delphi Steak & Pizza, Vancouver). Richard C. Tomczak, Specialty Polymers, Inc., 17316 E. Riverside Pl., Bothell, WA 98011.

PHILADELPHIA (Second Thursday—Williamson's Restaurant, GSB Bldg., Bala Cynwyd, PA). Howard Salmon, Akzo Coatings, Inc. 100 Belmont Dr., Somerset, NJ 08873.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). Bob Bishop, Ashland Chemical Co., P.O. Box 19959, Greensboro, NC 27419.

PITTSBURGH (Second Monday—Montemurro's Restaurant, Sharpsburg, PA). W. Ray Lyman, Jr, Ray Lyman & Co. 3462 Hills Church Rd., Export, PA 15632.

ROCKY MOUNTAIN (Monday following first Wednesday—Zangs Brewery, Denver, CO). Paul Delmonico, Old Western Paint Co., Inc., 2001 W. Barberry Pl., Denver, CO 80204.

ST. LOUIS (Third Tuesday—Salad Bowl Cafeteria, St. Louis, MO). James Lindsley, Akzo Resins, 2904 Missouri Ave., E. St. Louis, IL 62205.

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). Robert Wayne West, Thompson & Formby, Inc., 10136 Magnolia Dr., P.O. Box 667, Olive Branch, MS 38117.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). Kevin Pelling, Inortech Chimie Inc., 4135 LaStrada Hts., Mississauga, Ontario L5C 3V1, Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary). Marko Markoff, 182 Farmingdale Rd., Cheektowaga, NY 14225.

Since the effectiveness of any coating can be measured by its degree of adhesion to the substrate, Mr. Crowne examined the factors involved in the adhesion of polymers to concrete. He also presented an overview of "wetting" and "adhesion" and the effect each of these two properties has on the performance of concrete coatings.

The degree of wetting a coating offers concrete is related to the penetration ability of many of the components within that coatings, sited Mr. Crowne. To illustrate this point, the speaker used a chart listing various types of binders, additives, etc., along with their respective molecular sizes. Representative products that were included in this list were: silanes, silicone resins, linseed oil, etc.

Mr. Crowne explained that the degree of adhesion a coating offers over concrete is related to the type and nature of the surface/substrate the concrete has been, or is about to be, poured over. Concrete that lies over damp or water-laden earth is prone to forces such as "wicking," moisture absorption, osmotic pressure, capillary action, and so on. The speaker emphasized that any one or more of these in combination with each other can result in the coating being "blown off" the surface of the concrete through sheer forces of pressure.

Having discussed the substrate (concrete) itself, Mr. Crowne highlighted the various types of binders and vehicles that can be used in the manufacture of concrete coatings. The features, benefits, and differences of the following resin types included in this study were discussed: epoxy, novolac epoxies, urethanes, acrylics—100% NV, polyesters, and vinyl esters. From this information, the speaker was able to point out why some vehicles are better than others for coating certain substrates and locations of concrete flooring.

Mr. Crowne showed photographs illustrating the manner is which concrete coatings are applied, worked, and finished. He also presented slides showing specific structures and applications for some of the coating used over concrete.

In conclusion, Mr. Crowne discussed the various test methods used to examine the suitability and performance of coatings designed for use over concrete. Many of these tests, he said, are used to predict the performance, or failure, of a given system under specific conditions of use.

Q. Do you, or have you ever, used urethane or acrylic-modified asphalt as a coating over concrete?

A. No, we are strictly involved with epoxy and have never worked with asphalt, or coal-tar based systems over concrete. However, we have coated over asphalt, or sealed asphalt, but have not used asphalt-based coatings such as the type you described.

Kevin Pelling, *Secretary*

Elections

BIRMINGHAM

Associate

Stanley, Richard E.—Wengain Ltd., Cambridge.

CHICAGO

Active

Bellman, William C.—Atlas Products, Des Moines, IA.
Brunette, Joe S.—Rust-Oleum Corp., Pleasant Prarie, WI.
Chaoui, Antoine G.—Hickson Specialties, Milwaukee, WI.
Hall, John E.—Tioxide Americas Inc., Lisle, IL.
Hibben, Quentin L.—Color Corp. of America, Rockford, IL.
Schmidt, James E.—Color Corp. of America, Rockford.
Stromberg, C. David—United Coatings, Kankakee, IL.

Associate

Heffernan, James P.—Trilla Steel Drum Corp., Chicago, IL.
Jones, Warren F.—Hickson Specialties, Milwaukee, WI.
Schiffer, Karl L.—Miles Inc., Canton, MI.
Swanson, John T.—The Valspar Corp., Barrington, IL.

CLEVELAND

Active

Black, David K.—Morton International, Orrville, OH.
Clingerman, Michael C.—Ashland Chemical Inc., Ashland, OH.
Simmons, Harry C.—The Sherwin-Williams Co., Cleveland, OH.
Zaleski, Richard R.—Continental Products, Euclid, OH.

Associate

Dressel, Tom—D.A. Campbell & Co., Inc., Solon, OH.
Stephandadis, D.S.—The Lubrizol Corp., Wickliffe, OH.

Retired

Bennett, Clifton—Bay Village, OH.

DETROIT

Active

Gerow, Daniel M.—Siebert-Oxidermo, Romulus, MI.
Hoffman, Colleen M.—Ford Motor Co., Westland, MI.
McCurdy, Paul W.—Coatings Technology, Royal Oak, MI.
Robinson, Lorraine A.—Mercury Paints, Detroit, MI.
Rouge, John M.—Akzo Coatings, Inc., Troy, MI.
Shirzad, Alireza—United Paint & Chemical, Southfield, MI.

Associate

Corrigan, Brian P.—Nacan Products Ltd., Hudson, OH.
Martines, James M.—Sharrow and Associates, Centerline, MI.
Webb, Kathryn J.—BASF Corp., Troy, MI.

LOS ANGELES

Active

Koci, Teresa M.—American Racing Equipment, Rancho Dominguez, CA.
Lieser, Bernhard H.—Dunn-Edwards Corp., Los Angeles, CA.
Montoya, Rolando M.—Altawood Aerosols, Inc., Upland, CA.
Nacorda, Romeo C.—Courtaulds Aerospace, Burbank, CA.
Nanna, Michael E.—Behr Process Corp., Santa Ana, CA.
Teran, Ivan—Courtaulds Defense Products, Inc., Burbank.

Associate

Edwards, Richard P.—Whittaker, Clark, & Daniels, Inc., Laguna Hills, CA.
Glaviano, Gary A.—TCR Industries, Inc., LaPalma, CA.
Lavengood, J. Robin—Total Control Systems, Newport Beach, CA.
Springer, Janet K.—Advanced Color & Chemical, Baldwin Park, CA.
Tijerina, Pedro—Pyochem, Inc., Yorbalinda, CA.
Younger, Alonzo E.—Samson Chemical Co., Sante Fe Springs, CA.

LOUISVILLE

Active

Dunn, David R.—Progress Paint Co., Louisville, KY.
Franklin, Tim L.—Fosroc Inc., Georgetown, KY.
Geiger, Steven T.—Fosroc Inc., Georgetown.
Invergo, Ben J.—Fosroc Inc., Georgetown.
Steinmetz, Alan L.—United Catalysts Inc., Louisville.

Associate

Blecha, Walter K.—Polar Minerals Inc., Louisville, KY.

MONTREAL

Active

Knauer, Joachim E.—Protech Chemicals, Saint Laurent, Que.

NEW YORK

Active

Dutton, Eileen M.—Karnak Corp., Clark, NJ.
Hawley, George C.—George C. Hawley & Associates, Saranac, NY.
Nicolas, Penny—Cookson Pigments, Newark, NJ.
Ostrowski, John—Technical Coatings Co., Flanders, NJ.
Rubin, Larry M.—Ink Consultants, Allendale, NJ.

Associate

Fedorchak, Gregory A.—Daniel Products Co., Jersey City, NJ.
Fuda, Paul J.—Focus Chemical Corp., Fairfield, CT.
Miller, Michael D.—Chusei (USA) Inc., Pasadena, TX.
Miller, Robert S.—CIBA-GEIGY Corp., Hawthorne, NY.
Sawyer, Anthony J.—Southern Clay Products, Nashua, NH.
Webb, Edward C.—Sun Chemical Corp., Carlstadt, NJ.
Wisnewski, Ted—RHEOX, Inc., Hightstown, NJ.

NORTHWESTERN

Active

Barksdale, A.D. Kipp—ADKB, Minneapolis, MN.
Dolan, Janet M.—Tennant Co., Minneapolis.
Rupp, Michael I.—Diamond Vogel Paints, Minneapolis.

PHILADELPHIA

Active

Bailey, Lee E.—Kurz Hastings, Philadelphia, PA.
Buckley, William O.—Morton International, North Brunswick, NJ.

Buszta, Thomas S.—Elf Atochem North America, Inc., King of Prussia, PA.
Cleaver, Randolph P.—Netzsch Inc., Exton, PA.
Cook, Michael I.—Air Products & Chemicals, Allentown, PA.
Koch, Charles J.—Rohm and Haas Co., Doylestown, PA.
LeFever, JoAnne—Armstrong World Industries, Lancaster, PA.
Masse, Gary M.—Suvar Corp., CJ Osborn, Merchantville, NJ.
Molettieri, Tony M.—Arco Chemical Co., Newtown Square, PA.
Murphy, Mark E.—Max Products, Birdsboro, PA.
Nehez, Nicholas J.—Gryphin Co., Philadelphia.
Pangrazi, Ron—Garden State Tanning, Fleetwoood, PA.
Say, Terry E.—Rhone-Poulenc Inc., Cranbury, NJ.
Zechman, Craig A.—Air Products & Chemicals, Allentown.

Associate

Albert, Charles J. Jr.—Design Data Corp., Lancaster, PA.
Jennings, Ken L.—Technichem Inc., Merchantville, NJ.
Kramer, Jeffrey—Air Products & Chemicals, Allentown, PA.
Marchesani, Nino A.—Trimet Technical Products, Allentown.
Misiti, Vincent S.—ICI Surfactants, Wilmington, DE.
Tuccio, Albert S.—Sartomer Corp., Exton, PA.
Wyland, Frank J.—Trimet Technical Products, Allentown.
Winick, Rick—Allied Signal Inc., Yardley, PA.

PITTSBURGH

Active

Burke, Joseph S.—Barnacle Ban Corp., Pittsburgh, PA.
Hudac, Gerald J.—Asphalt Products Co., Mars, PA.

ROCKY MOUNTAIN

Active

Chiarelli, Dale A.—Interactive Services, Lakewood, CO.
Jackson, David A.—Brite Line Industries, Lakewood.
Watling, Marilyn J.—Ashland Chemical Co., Englewood, CO.

SOUTHERN

Active

Barden, William C.—Langston Companies, Memphis, TN.
Cebula, Casey M.—Advanced Consulting Concepts, Merritt Island, FL.
Graves, Gary G.—Maybelline Sales Inc., Memphis.

Associate

Buerkle, C. Michael—Deeks & Company, Inc., Stone Mountain, GA.

TORONTO

Active

Matheson, James S.R.—Aquarius Coatings Inc., Markham, Ont.
Parsons, Gerald A.—Para Paints, Brampton, Ont.
Sorokin, Edward—Vaughan, Ont.

Associate

Blake, Robert M.—Centrifugal Coaters, Oakville, Ont.
Colquhoun, Gerry S.—Harcros Pigments, Cambridge, Ont.
Froio, Joe A.—DuPont Canada Inc., Mississauga, Ont.
Heaps, Jim E.—Stochem Inc., Brampton, Ont.
Papa, Tony—Union Carbide Canada Ltd., Willowdale, Ont.
Smith, Jacqueline S.—Union Carbide Canada Ltd., Willowdale.
Waller, Fred D.—Hunter Drums Ltd., Bramalea, Ont.

People


R. Miles

Union Carbide Corporation's UCAR Emulsion Systems, Garland, TX, has announced the promotion of **Ronda K. Miles** to Regional Technology Manager of the Garland, TX, Regional Laboratory of UCAR Emulsion Systems. Most recently, Ms. Miles served as a Staff Chemist with Union Carbide. She is a Past-President of the Dallas Society for Coatings Technology and currently serves as Chairperson for the FSCT's 1994 Annual Meeting Program Committee.

In addition, **Jeffrey G. Ransom** has accepted the promotion to Senior Regional Technology Manager of the Somerset, NJ, Regional Laboratory. Prior to his new position, Mr. Ransom was Regional Technology Manager of the Garland laboratory. In this capacity, he will be responsible for UCAR Emulsion Systems' technical service in the Northeastern United States.

Both Ms. Miles and Mr. Ransom are members of the Dallas Society.

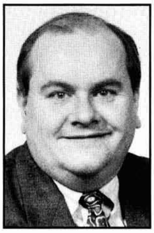
The position of Regional Sales Manager within the Carbon Black Division of the Pigments Group of Degussa Corp., Ridgefield, NJ, has been accepted by **Pamela Weiler**. Ms. Weiler will plan and manage sales activities related to the company's specialty black products and services marketed primarily to the ink, rubber, and plastics industries. Charged with the selection and development of sales personnel, she will be responsible for a geographical territory encompassing the entire Eastern seaboard and Southern United States. Ms. Weiler is a member of the New York Society.

John L. Von Wald has been named President of DuPont Kansai Automotive Coatings (DKAC), a joint venture between DuPont Automotive, Troy, MI, and Kansai Paint of Japan. In his new position, Mr. Von Wald will oversee DKAC's operations, which include sales, marketing, and manufacturing of a broad range of finishes products to Japanese automotive assembly plants in North America. He joined the company in 1962 and has held various technical development, marketing, and business management positions. In addition, Mr. Von Wald served as the Director of DuPont Polymers in Tokyo for three years.

Brian P. Corrigan has been named Technical Sales Representative in Ohio, Michigan, Indiana, and Illinois for conventional and solvent-free paint resins manufactured by Nacan Products Ltd., Brampton, Ont. Mr. Corrigan has worked in a technical sales capacity in the area for six years, gaining experience in the use of ink and lacquer bases, protective coatings, architectural resins, and industrial resins. He is a member of the Cleveland and CDIC Societies.

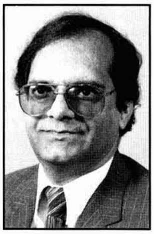
Philadelphia Society member **Carl W. Fuller** has returned from Columbia where he served as a volunteer with the International Executive Service Corps (IESC). Mr. Fuller was recruited by IESC to assist Pigmentos Y Quimicos SA. He helped in the production of high quality synthetic iron oxide.

The Specialty Chemical Division of Etna Products, Inc., Chagrin Falls, OH, has appointed **Mark Messerly** as Senior Chemist to join its technical effort in new resin development and coatings applications of Etna's products. Mr. Messerly was most recently Lab Manager for Industrial Coatings at the Harrison Paint Corp. He is a member of the Cleveland Society.


G. Fedorchak

Gregory A. Fedorchak has joined the staff of Daniel Products Co., Inc., Jersey City, NJ, as Regional Sales Manager for the Northeast. Mr. Fedorchak was previously Account Manager, Northeast Region for Hilton Davis Co. Prior to that, he was an independent consultant, setting up sales and marketing programs in niche coatings markets. Mr. Fedorchak is a member of the Baltimore Society.

William R. Toller, Chairman and CEO of Witco Corp., New York, NY, has been elected to the Board of Directors of the U.S. Chamber of Commerce, Washington, D.C. In 1984, Mr. Toller joined Witco as a Corporate Vice President and General Manager with its acquisition of the Continental Carbon Co., a subsidiary of Conoco Inc. In 1986, he moved to New York as Witco's Chief Financial Officer. He was elected to the company's board in 1987, became Vice Chairman in March 1990, and was elected to his present position later that year.


M. Mazhar Rasul

Raabe Corp., Menomonee Falls, WI, has named **Mohammad Mazhar Rasul** to the position of Research and Development Chemist. Mr. Rasul will be responsible for the formulation of high-solids and waterborne industrial coatings. He was formerly with Cardinal Industrial Finishes. Mr. Rasul is a member of the Los Angeles Society.

In other news, **Marchelle Litzau** has accepted the position of Customer Service Representative. Ms. Litzau will be responsible for maintaining existing customer accounts and processing orders.

Peter D. Houchin was elected Senior Vice President of W.R. Grace & Co., Boca Raton, FL. Since joining the company in 1991 as a Corporate Vice President and Treasurer, Mr. Houchin has been responsible for corporate finance, tax, and treasury. He will continue in his position as Treasurer and assume additional responsibility for corporate business development, including mergers and acquisitions.

The Roof Coatings Manufacturers Association, Rockville, MD, recently elected and installed their 1994 Officers, Members of the Board of Directors, and Committee Chairmen. Elected as officers are: President—**Lewis Ripps,** Bayonne, NJ; Vice President—**James Van Pelt Jr,** Joliet, IL; and Treasurer—**Joseph T. Mooney III,** Kimberton, PA. **Richard D. Snyder** continues as Executive Director and **Russell D. Snyder** remains as General Manager.

Also, members of the RCMA Board of Directors are: **Tim Nelligan,** of The Henry Co.; **Lewis Ripps,** of Palmer Asphalt Co.; **James Van Pelt, Jr.,** of Grundy Industries; **Richard Kaplan,** of Aluminum Coatings Mfg., Inc.; **William Kirn,** of Rohm and Haas Co.; **Joseph T. Mooney III,** of Monsey Products Co.; **Kenneth Sokoloff,** of Prospect Industries Corp.; **Ray Hyer,** of Gardner Asphalt Corp.; and **David Mehtlan,** of American Stone-Mix, Inc.

The Committee Chairmen include: Government Affairs—**Edward P. Mooney,** of Monsey Products Co.; Technical—**Brian Anthony,** of The Brewer Co.; Publicity/Communications—**David L. Mehtlan;** Associates Council—**Christopher Sullivan,** of Interfibe Corp.; Past Presidents' Council—**Tim Nelligan.**

Henry A. Kasprzak has accepted the promotion to Vice President, Coatings Raw Materials for Hüls America Inc., Piscataway, NJ. In this capacity, Mr. Kasprzak is responsible for all North American marketing, sales, and technical service-related functions for Hüls' isophorone derivative product line. He most recently served as General Manager, Coatings Raw Materials.

Also, **Joaquín Noriega Sánchez** was named Exclusive Sales Representative for coatings raw materials and specialty polymers products marketed to Mexico. Based in Mexico City, Mr. Noriega will be responsible for the sales activities related to Hüls' Vestanat®, Vestamin®, Vestagon®, and Vesticoat®, isophrone diamine and diisocyante based raw materials for coatings applications, Dynapol®, and Dynacoll®, polyesters for coatings and adhesives, Vestamid™ polyamide products, and Vestamelt® for hot melt adhesives.

In other news, **Klaus Schrage** was appointed Executive Vice President of Division II—Specialty Chemicals and Polymers. Dr. Schrage will oversee all research and development, marketing, sales, and production activities related to this division of Hüls America. Previously, Dr. Schrage was Executive Vice President, Operations.

The National Decorating Products Association, St. Louis, MO, has promoted **Nicholas R. Cichielo** to Vice President of Sales. Mr. Cichielo will oversee the total sales effort of the association for booths and advertising in publications. He will continue his responsibilities in working with the Eastern Council and the 1994 Eastern Decorating Products Show.

Mike Favreau has joined Dowd and Guild, Inc., San Ramon, CA, in a sales capacity in Southern California. Mr. Favreau will be based in the Pico Rivera, CA, office.

Zeneca Resins, Wilmington, MA, has appointed four new Technical Sales Representatives to handle the company's full line of waterborne and specialty polymers for adhesives and sealants, graphic arts, industrial, and architectural coatings. Taking on new responsibilities are the following: **Arthur Wollenweber**—Middle Atlantic Region Representative, Bedminster, NJ; **Shea Walker**—Southwest and Mid-South Region Representative, Dallas, TX; **Peter Shulman**—Upper Midwest Region Representative, Chicago, IL; and **Yves Pierre**—Quebec Representative, St. Julia, Quebec.

Colorgen Industrial Group, Inc., Newburyport, MA, has announced the appointment of **Robert Olmsted** to Senior Applications Specialist. Mr. Olmsted will be responsible for database preparation, software testing, and customer training. He has technical experience in printing, color matching, and in-plant ink operations.

Obituary

Maurice Morton, a pioneer in polymer research and education, passed away on March 23, 1994. He was 81 years old.

Dr. Morton's service to The University of Akron (UA) and the scientific community spanned four decades. Among his many achievements was the establishment of UA's Institute of Rubber Research, a forerunner of the Institute of Polymer Science, which last year was named in his honor.

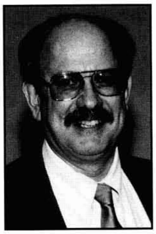
In 1952, Dr. Morton was selected to head the University's relatively new polymer chemistry program. In 1956, he established the Rubber Science Hall of Fame. In 1988, the American Chemical Society's Polymer Division presented him with the P.J. Flory Polymer Education Award. The University of Akron awarded Dr. Morton an Honorary Doctorate in 1991.

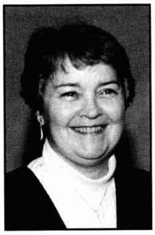
Gordon Pioch Named General Chairman of WCSSS; P. Shaw and A. Adkins Accept Other Committee Positions

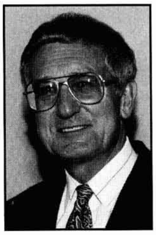
When attendees and exhibitors convene in San Francisco, CA, next February, for the 22nd Western Coatings Societies' Symposium and Show (WCSSS), much planning, hard work, and effort will have taken place to organize such an event

Gordon N. Pioch is leading the way as General Chairman. Currently the Technical Service Manager for Eureka Chemical Co., South San Francisco, CA, Mr. Pioch has been actively working in the paint and coatings industry for 30 years in both research and development and technical service. He is a Past-President of the Golden Gate Society for Coatings Technology and had served as the Co-Chairman of the 20th Biennial Western Coatings Societies' Symposium and Show.

Serving as Treasurer of the WCSSS is Patricia Shaw. She is currently the Quality Control Manager for Radiant Color, Richmond, CA. Ms. Shaw is a Past-President of the Golden Gate Society, Past-Chairman of the 20th Biennial Symposium and Show. In addition, she served as Chairman of both the Los Angeles and Golden Gate Technical Committees and has been active in the Technical Committee of the Federation.


G. Pioch


P. Shaw


A. Adkins

Adrian S. Adkins is spearheading the Technical Committee as Chairman. Since 1988, Mr. Adkins has served as a Marketing Manager for Schoofs, Inc., Moraga, CA. He is involved in the technical sales of specialty raw materials for the coatings, inks, sealants, mastics, and adhesive industries. Mr. Adkins is a Past-President of the Golden Gate Society and has served on the Scientific Committee of the National Paint and Coatings Association.

Members assisting Mr. Pioch, Ms. Shaw, and Mr. Adkins are Don Nolte, of John K. Bice Co., Inc., as Co-Chairman and Patricia Stull as an Advisor. Other Committee Chairmen are: Exhibits—Tom Dowd, of Dowd & Guild, Inc.; Registration/Publicity—AMC Services; Entertainment—Barry Adler; and Spousal Program—Evelyn Adler.

A biennial event sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies, the 22nd Western Coatings Societies' Symposium and Show will be held on February 20-22, 1995 at the Hilton Hotel and Towers, San Francisco, CA. For more information, contact Gordon Pioch, c/o Eureka Chemical Co., P.O. Box 2205, S. San Francisco, CA 94083.

Brookfield Releases Schedule for 1994 Rheology Seminars

Brookfield Engineering Laboratories, Stoughton, MA, will hold a series of technical rheology seminars for Q.C. managers/supervisors, R&D managers/supervisors, process plant operators, lead technicians, and engineers/scientists.

These seminars will provide an overview of rheology including: Newtonian and non-Newtonian flow, time-independent and time-dependent viscosity behavior, measuring techniques, and data analysis. Detailed information will be given on sample fluid mechanics, laminar flow, non-laminar turbulent flow, and the effects of shear rate, pressure, temperature, pH, and fluid density on viscosity.

The seminar schedule is as follows: May 24, Philadelphia, PA; May 26, Washington, D.C.; June 14, Indianapolis, IN; and June 16, Cleveland, OH.

For details on these rheology seminars contact Barbara Cunningham, Brookfield Engineering Laboratories, Inc., Dept. NR-101, 240 Cushing St., Stoughton, MA 02072.

Marine and Offshore Maintenance Coatings Conference To Feature Speaker David P. Donohue of the U.S. Navy

The National Paint and Coatings Association (NPCA), Washington, D.C., has scheduled its annual Marine and Offshore Maintenance Coatings Conference for June 8-10, at the Virginia Beach Hotel and Conference Center in Virginia Beach, VA.

The conference is designed to bring together representatives from all market segments of the marine coatings industry, including raw material suppliers, coatings manufacturers, and owners and operators of shipyards and offshore maintenance facilities.

David Bloodgood, Chairman of NPCA's Marine Coatings Committee, will open the conference. Following Mr. Bloodgood's welcoming remarks, Rear Admiral David P. Donohue, of the U.S. Navy, will present the keynote address.

Other features include the discussion of the EPA registration process moderated by Steve Johnson, Director, Registration Division, U.S. Environmental Protection Agency, and presentations on high pressure water blasting, the future direction of U.S. Navy paint specifications, and an evaluation of ablative and antifouling paints. Attendees will also view a Navy operating base and participate in a harbor tour aboard a navy vessel as part of the three-day conference.

For additional information on the "Marine and Offshore Maintenance Coatings Conference," contact Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C., 20005-5597.

Public Seminars Schedule Announced By DuPont

The Quality Management and Technology Center of DuPont, Wilmington, DE, has announced a series of public seminars scheduled throughout 1994.

"Strategy of Experimentation" seminars are slated for June 14-16, Philadelphia, PA; July 19-21, Chicago, IL; Sept. 20-22, Nashville, TN; Oct. 18-20, Boston, MA; and Nov. 15-17, San Antonio, TX.

The schedule for "Strategy Formulations Development" seminars is June 21-23, St. Louis, MO; and Oct. 25-27, Boston.

A "Statistical Process Control" seminar is slated for Oct. 11-14 in Wilmington.

For information on registration, or for on-site seminars, call 800-601-3733.

First PRA International Research Colloquium Held in February

The Paint Research Association (PRA), Teddington, England, hosted the International Research Colloquium on February 24-25, 1994. This forum was established to exchange knowledge and generate ideas for research in areas of common interest in the coatings industry.

After John Bernie, Managing Director of PRA, opened the colloquium, Robert McIntyre, of Courtaulds Coatings, began the session with "Polymer Blending Technology." Dr. McIntyre explained that blends of resins are commonly used in the surface coating industries without any theoretical understanding of the outcome of blending. He said commercial software packages can predict the behavior of blends only when the system contains just a few well-characterized components.

The topic of "Intelligent Coatings" was presented by Andrew Doroszkowski, of PRA. The timely, remote identification of early degradation of coating systems could result in significant cost savings in terms of labor, materials, and the provision of access. The work cited by Dr. Doroszkowski was the culmination of a feasibility study carried out by PRA. The study revealed five candidate techniques from which intelligent paints could be developed. They are thermography, photoluminescent approach, magnetic signatures, microwave-ferrite thermography (MFT), and piezochromic approach.

The concept of "Neural Networks" was described by Clifton Hughes, of Logica Ltd. Neural networks are computing routines that carry out pattern processing and currently have applications in many areas. Applications include signal recognition, demand prediction, quality monitoring, process or machinery control, and fault diagnosis.

Richard Holman followed with a review of a current application of a neural network in a BTTG-PRA project involving on-line color assessment and prediction.

The first day concluded with PRA President Maurice Wilkinson, of Akzo Nobel, discussing the need for further optimization of titanium dioxide (TiO_2) within surface coatings for both environmental and economical reasons. Major steps, such as optimizing the efficiency of TiO_2 and replacing TiO_2 with organic opacifiers have been taken to improve TiO_2 utilization. However, rising costs and possible long-term shortages mean that TiO_2 reductions must be pushed even further. It was also pointed out that probably only 10% of coatings currently use TiO_2 to its full potential.

The second day of the colloquium began with Jeff Kelsey, of BP Chemicals, discussing "Compliant Solvent-Based Coatings." Mr. Kelsey stated that the choice of a compliant coating is determined by a combination of fashion, technology, and legislation in conjunction with minimum cost, maximum performance, and minimum effect on the environment. It was considered that high-solids coatings will satisfy both current legislation and involve the least amount of change for the applicator.

In the United States, high-solids coatings are meeting the needs of wood coaters and are likely to beat water-based coatings into some areas of the automotive arena. In the Do-It-Yourself (DIY) market, waterborne paints have been accepted and durability has not become a deciding factor. The European outlook for automotive OEM was considered to be in favor of water-based coatings which offer improved quality over high-solids.

A discussion on the potential use of life cycle analysis (LCA) followed. It was generally agreed that, until standard methodology is adopted, the LCA approach is meaningless. ISO is addressing this issue.

Derek Walbridge, of PRA, and Brian Vincent, of University of Bristol, began the next session by proposing a two-year study into the controlled swelling of microgel particles. The objective of this project is to develop an understanding of the interactions between microgel particles and free polymer chains in surface coatings. A study of the degree of particle swelling and its effect on the resultant rheological properties of the dispersion will also be conducted.

The concept of a "Self-Stratifying Coating" was explained by Chris Carr, of PRA. The objective of the four-year research program, which was carried out at PRA, in conjunction with several other European Research Institutes under the EC BRITE scheme, studied liquid pigmented coatings. This study determined that a coating could be applied in a single operation, and after application, the coating would spontaneously stratify into two functional layers giving economical advantages.

V. Verkholantsev, of Tambour Paints, a pioneer of the original work on self-stratifying coatings, also gave a short presentation on the potential use of heterogeneous coatings rather than layered coatings to achieve improved coating properties.

The final session on "Durability—The Ultimate Coatings Challenge" was presented by Richard Holman, of PRA. He highlighted the gaps that exist in current knowledge of durability. There are gaps between laboratory and reality, short-term testing and long-term events, artificial and natural weathering, that need to be filled before there is a complete understanding of how a coating behaves. Traditionally, durability has been monitored by measuring simple film properties (gloss, chalking, film thickness, and color), although the underlying processes are of a complex chemical and physical nature. Dr. Holman cited the following new tools which may aid in predictive testing: photoacoustic Fourier transform infrared measurements, atomic force microscopy, scanning tunneling microscopy, and electron spectroscopy for chemical analysis.

The first PRA International Research Colloquium was closed by John Bernie. It is anticipated that this colloquium will become an annual event.

Chicago Society Hosted "SYMCO '94, Changing Times"

On March 3, the Chicago Society for Coatings Technology, in conjunction with the Chicago Paint and Coatings Association, hosted "SYMCO '94, Changing Times" at the Chicago Marriott-Oakbrook, Oakbrook, IL.

The following presentations covered topics in both the industrial and architectural field:

"The Regulation of VOCs in Architectural and Industrial Maintenance Coatings"—James Sainsbury, The Glidden Co.;

"Performance Improvement in Environmentally Friendly Coatings"—Edward Orr, BYK-Chemie;

"Ethylene Vinyl Acetate Terpolymers and Their Application in Solvent-Free Paint Systems"—W.D. Currie, Nacan Products, Ltd.;

"Fundamentals of Radiation Curing"—Kevin P. Murray, Applied Polymer Systems, Inc.;

"The Future: Survival, Growth, and Trends"—Jim St. Clair, UCAR Emulsion Systems;

"Powder Coatings: A Compliant Finishing Technology Comes of Age"—Steven Kiefer, Morton International; and

"Controlling Biological Contamination in Coatings Manufacturing Process"—William E. Machemer, Troy Corp.

The symposium concluded with a "Meet the Speaker" cocktail hour.

Members of the SYMCO '94 Committee (from left)—John J. Hanacek, Bill Heiden, Suzanne M. Rodgers, Jeanine H. Thielmann, Alison M. Azar, Robert E. Vail, and Steve Hodges

"FILLER PIGMENTS—MORE THAN DEAD SPACE"

Sponsored by the Philadelphia Society for Coatings Technology

May 23, 1994
Holiday Inn—Philadelphia Stadium

Contact Neil R. Shearer, The 3E Group, 850 Glen Ave., Moorestown, NJ 08057; (609) 866-7600, for more information.

Plastics Short Courses Offered by University of Akron

Five new short courses in plastics processing technology will be offered in June by The University of Akron, Akron, OH. The seminars will focus on practical training for technicians, operators, and non-technical managers who deal with materials, processes, and equipment used in plastics processing.

The "Introduction to Plastics" course, which is scheduled for June 20-22, will cover bonding, chemical nomenclature, thermoplastics, thermoset, polymerization, and materials testing.

On June 23-24, "Introduction to Compounding" will take place. This course will provide a practical working understanding of compounding, including raw material influences, mechanical design, operator input, and processing techniques.

"Extrusion Processing," slated for June 23-25, will focus on materials (thermoplastics), equipment (screw design, venting, gear pumps, heating and cooling systems) with emphasis on quality concerns and practical applications.

The "Introduction to Injection Molding" course, scheduled for June 27-28, will concentrate on materials, molding cycle, viscosity, filling and packing, machine components, screw design, and performance as well as troubleshooting injection molding equipment.

"Principles of Color Technologies," slated for June 27-29, will provide an overview of various processes of adding dyes and pigments to basic polymer compounds with a focus on reactions (melt flow, viscosity, etc.).

Registration is offered on a first-come, first-serve basis. Course costs for the sessions, including parking, range from $304 to $315, plus textbooks. Contact Nancy Clem, The University of Akron, Akron, OH 44325-3109 for more information.

Datacolor Announces Color Seminar Schedule

Datacolor International, Lawrenceville, NJ, has released the schedule for its 1994 Industrial Color Technology Seminars.

Seminar dates and locations are: Sept. 13-14—Toronto, Ont.; Sept. 28-29—Charlotte, NC; Oct. 18-19—Lawrenceville, NJ; Nov. 8-9—Chicago, IL; and Dec. 7-8—Minneapolis, MN.

Seminar topics to be discussed include the following: colorimetry and factors affecting color; colorant characteristics and elements of formulation; color differences; spectrophotometry and metamerism.

The registration fee is $395 and includes course materials, breakfast, and lunch. Contact Donna DiPolvere, Marketing Dept., Datacolor International, 5 Princess Rd., Lawrenceville, NJ 08648, for additional information on the Industrial Color Seminar.

CALL FOR PAPERS

Western Coatings Societies' 22nd Symposium and Show

"NEW OPPORTUNITIES— CHALLENGES AND SOLUTIONS"

February 20-22, 1995
San Francisco, CA

All prospective authors are invited to submit papers for presentation at the 22nd Western Coatings Societies Symposium and Show on February 20-22, 1995, in San Francisco, CA.

Please submit a 200-300 word abstract, detailing the main theme and principal points of your proposed presentation. A brief biography and photograph of the author(s) with speaker's name underlined should accompany the abstract.

Abstracts are due by August 12, 1994, and should be sent to either Adrian S. Adkins, Schoofs, Inc., P.O. Box 67, Moraga, CA 94556; (510) 376-7311 or Ronald Hughes, Ashland Chemical, Inc., 8600 Enterprise Dr., Newark, CA 94560; (510) 796-9333.

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Literature

Specialty Oligomers

A 12-page product bulletin outlines a company's specialty oligomers. These aromatic acid methacrylate and acrylate half esters, supplied in a variety of monomer and solvent blends, are designed to have a high degree of carboxyl, anhydride, and ester-reactive functional groups, providing versatility in curing capabilities. A copy of the Sarbox™ Oligomer Product Bulletin may be obtained by contacting Sartomer Co., 468 Thomas Jones Way, Exton, PA 19341.

Circle No. 30 on Reader Service Card

Diamond Knives

Specialized knives with two diamond edge configurations, one straight and one angled, are described in a product release. These knives can be used to prepare micro samples for FTIR microscopy and light microscopy, or for scraping and shaving off thin sections of samples. For further information, contact Spectra-Tech, Inc., 652 Glenbrook Rd., Stamford, CT 06906.

Circle No. 31 on Reader Service Card

Architectural Coatings

The use of a company's grind aid in architectural coatings is described in a data sheet. In addition to the product's typical physical properties and performance characteristics, the information contains formulations for exterior flat, semigloss, and high-gloss architectural coatings, as well as a low VOC paint. A copy of the data sheet, "Surfynol® CT-111 Grind Aid for Architectural Coatings," can be obtained from Air Products and Chemicals, Inc., Performance Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501.

Circle No. 32 on Reader Service Card

Resins Data Base

The availability of a resins data base, which lists bulking information, as well as chemical and physical properties for U.S. produced resins used as coatings binders, is highlighted in a product release. Sixty suppliers and over 3200 resins are included, and six-month updates of resins, suppliers, and data are scheduled for the data base. This disk reportedly provides the necessary data to bulk a formula, calculate volume solids, and determine VOC. Information on this disk, which was developed by the Philadelphia Society for Coatings Technology, is available from Design Data Corp., P.O. Box 8080, Lancaster, PA 17604.

Circle No. 33 on Reader Service Card

Dispersion Mill

A company presents a high-speed rotor-stator dispersion mill for fluid/solid systems. Tanks, dispersion units, and wetted parts are standard in stainless steel in this product, which features a batch working capacity of 60 U.S. gallons or may be set up to run continuously with throughput rates up to 20 GPM. The system is reportedly capable of processes which include deaeration, reactions, solutions, aeration, or inert atmospheres and high or low temperatures. For more information on the Kady Model OC, write Kady International, 1237 Pleasant Hill Rd., P.O. Box 847, Scarborough, ME 04070-0847.

Circle No. 34 on Reader Service Card

Helium Pycnometer

Literature focuses on an automated microprocessor-based helium pycnometer which uses gas displacement to measure the true volume of solids, powders, and other porous materials. The instrument reportedly measures helium displacement in the entire gas line and reports true volume in 99 seconds. Horiba Instruments Inc., 17671 Armstrong Ave., Irvine, CA 92714, can be contacted for additional information on the VM-100 helium pycnometer.

Circle No. 35 on Reader Service Card

Label Printer

An electronic label printing system is the subject of literature. The printer features a standard print speed of 4 in. per sec. and a 32-bit microprocessor, as well as nine alpha-numeric fonts. Options include memory modules for storing downloaded formats and graphics, a front rewind, and a label cutter/dispenser. To obtain more details on the Diagraph® LPT/1040 Direct Thermal/Thermal Transfer Label Printer, write Diagraph Corp., 3401 Rider Trail South, St. Louis/Earth City, MO 63045-1110.

Circle No. 36 on Reader Service Card

Air Release Agent

An air release agent for use in nonaqueous paints and coatings is described in a product release. This product is silicone-free and comprised of a blend of surface active agents and solvents, which provide wetting and flow/leveling properties. Contact Marketing Services, Drew Industrial Division, One Drew Plaza, Boonton, NJ 07005, for more details on Drewsperse® S-683 air release agent.

Circle No. 37 on Reader Service Card

Cleaning Solvent

A new safety solvent for use in cleaning urethane residues and crystallized isocyanates from polyurethane processing equipment is the topic of a product release. This solvent is a non-chlorinated, non-flammable, non-carcinogenic, non-ozone depleting solvent designed to replace solvents such as methylene chloride, acetone, MEK, and 1,1,1-trichloroethane. Contact Dynaloy, Inc., 7 Great Meadow Lane, Hanover, NJ 07936, for more information on Dynasolve CU-6.

Circle No. 38 on Reader Service Card

LC/MS Application Note

An LC/MS application note discusses electrospray ionization and HPLC flow rates. This publication provides information on column diameter versus sensitivity, column capacity, and post-column splitting, and outlines the effects and results of flow splitting on different-sized columns using peptide standards and small molecule pharmaceuticals as examples. For a free copy of "The Realities and Misconceptions of Electrospray Ionization and HPLC Flow Rates," request form no. L-1650 from The Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012.

Circle No. 39 on Reader Service Card

Walnut Shell Filter

The installation of a black walnut shell filter to remove solids and free oil from a 20,000 bwpd (barrels of water per day) stream of produced (recycled process) water is discussed in literature. This filter reportedly cleans the water down to about 10-15 ppm of solids before it is re-injected for enhanced oil recovery. U.S. Filter, P.O. Box 560, 4669 Shepherd Trail, Rockford, IL 61105-0560, can provide more details on the Auto-Shell black walnut shell filter.

Circle No. 40 on Reader Service Card

Colorants Guide

A six-page product information guide focuses on colorants with thermal stability for processing of thermoplastics. The combination of these products gives an alternative to heavy metal pigments in selected amorphous polymers. Product ranges, properties, and color chips are included. For a free copy of the new Macrolex® Dyestuffs and Lightfast™ Yellow Pigments product guide, contact Marketing Communications, Organic Products Div., Miles Inc., Mobay Rd., Pittsburgh, PA 15205.

Circle No. 41 on Reader Service Card

Melamine-Based Polyols

A 32-page brochure describes a new class of melamine-based polyols designed for crosslinking isocyanate, phenolic, amino, and carboxylic resins. Charts and tables provide information on topics such as physical properties and formulation data in this brochure, which is available from CYTEC Industries Inc., Five Garret Mountain Plaza, West Paterson, NJ 07424.

Circle No. 42 on Reader Service Card

Polymer Emulsions

Literature details a comprehensive line of polymer emulsions which reportedly have a higher percentage of solids than conventional emulsions. These can be used in adhesives, laminates, and coatings, and a variety of compositions are offered. For more information on the 60% solids line, write Rohm Tech Inc., Polymers, 83 Authority Dr., Fitchburg, MA 01420.

Circle No. 43 on Reader Service Card

Fire Test Standards

A compilation of fire test standards has been published. This publication covers 149 current fire test standards for paint and related coating materials, building seals and sealants, thermal insulation, plastics, hazard potential of chemicals, and more. Contact ASTM, 1916 Race St., Philadelphia, PA 19103-1187, for information on how to obtain a copy of "ASTM Fire Test Standards, 4th Edition."

Circle No. 44 on Reader Service Card

Brown Dispersions

Two synthetic Van Dyke brown in-plant dispersions for wood stains have been introduced through literature. One is designed for in-plant tinting of alkyd paints, nitrocellulose lacquers, and oil-based stains; the other is used for in-plant tinting of water-based coatings and stains. Additional details on GPD® 824-1615 and Aquasperse® II 877-1615 colorants are available from Hüls America Inc., 80 Centennial Ave., Piscataway, NJ 08855-0456.

Circle No. 45 on Reader Service Card

Coating Thickness Gage

Information is available on an instrument which measures dry paint thickness on nonferrous surfaces. This instrument is designed for nondestructive measurement of coatings on concrete, wood, plastic, glass, and ceramic. Contact KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275, for details on the PosiTector 100.

Circle No. 46 on Reader Service Card

Surfactants and Specialties

Surfactants and specialties products are examined in a brochure. The publication provides details on product performance, features, and applications information on a company's range of amphoteric, anionic, cationic, and nonionic surfactants. For a copy of the brochure, write Rhône-Poulenc Surfactants and Specialties, CN 7500, Cranbury, NJ 08512-7500.

Circle No. 47 on Reader Service Card

Homogenizers

Information on a disposable generator probe, as well as benchtop laboratory, mixer, macro, bench scale, mechanical shear, micro, tissue, and general laboratory homogenizers has been issued. All units are designed to be durable and quiet in operation. Contact Omni International, 6530 Commerce Ct., Gainesville, VA 22065, for more details on their line of homogenizers.

Circle No. 48 on Reader Service Card

pH Meters

A full-color brochure discusses handheld portable pH meters. This pamphlet also features microprocessor-based conductivity meters, as well as meter kits which include meters and all components needed to calibrate and operate them. For a copy of the brochure, contact Paul N. Gardner Co., Inc., P.O. Box 10688, Pompano Beach, FL 33061-6688.

Circle No. 49 on Reader Service Card

Cleaning Machines

Literature highlights a line of automated, multiple-stage cleaning machines. This product line is designed to clean or degrease basketed, racked, and individual parts, and features a programmable controller for automation and regulation of the cleaning process and continuous bath monitoring and control. Contact Man-Gill Chemical, 23000 St. Clair Ave., Cleveland, OH 44117, for more information on the Magnus NuMatic™ cleaning machine.

Circle No. 50 on Reader Service Card

Drum and Pail Liners

Information is now available on round-bottom, heat-sealed drum and pail liners that reportedly offer resistance to chemical permeation and degradation. These liners are manufactured from a multilayer coextrusion with nylon as the primary barrier in order to improve flexibility, pinhole/puncture/tear resistance, and strength, and are designed to help reduce volatile emissions of in-house materials, cleanup, and disposal. Technical information and a free sample are being offered by CDF, 100 Enterprise Dr., Marshfield, MA 02050.

Circle No. 51 on Reader Service Card

Column Application Note

An environmental application note focuses on a comparison of columns used to analyze samples from leaking underground storage tanks. It also provides a boiling point distribution range for petroleum-based fuel products. For further information on the DB™-5ms Megabore® column, write J&W Scientific, 91 Blue Ravine Rd., Folsom, CA 95630-4714.

Circle No. 52 on Reader Service Card

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Solution to April's *"CrossLinks"*

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact Federation of Societies for Coatings Technology, 492 Norristown Rd., Blue Bell, PA 19422 (215) 940-0777, FAX: (215) 940-0292.

1994

(May 12-15)—Federation "Spring Week." Spring Seminar on the 12th and 13th; Incoming Society Officers Meeting on the 14th; Board of Directors Meeting on the 15th. Marriott City Center Hotel, Minneapolis, MN.

(Oct. 12-14)—72nd Annual Meeting and 59th Paint Industries' Show. New Orleans Convention Center, New Orleans, LA.

1995

(Oct. 9-11)—73rd Annual Meeting and 60th Paint Industries' Show. Cervantes Convention Center, St. Louis, MO.

1996

(Oct. 23-25)—74th Annual Meeting and 61st Paint Industries' Show. McCormick Place North, Chicago, IL.

SPECIAL SOCIETY MEETINGS

1994

(May 17)—"Advances in Coatings Technology." 37th Annual Educational Symposium. Sponsored by the Cleveland Society. BFGoodrich Research Center, Brecksville, OH. (Sharie Moskaluk (216) 566-3661).

(May 23)—"Filler Pigments—More Than Dead Space." Sponsored by the Philadelphia Society. Holiday Inn—Philadelphia Stadium, Philadelphia, PA. (Neil R. Shearer, The 3E Group, 850 Glen Ave., Moorestown, NJ 08057; (609) 866-7600).

(June 10-11)—"Progress Through Innovation." Joint Meeting of the St. Louis and Kansas City Societies. Holiday Inn, Lake of the Ozarks, MO. (Tom Hilton, Program Chairman, Weskem-Hall, Inc., 310 Armour Rd., Ste. 211, N. Kansas City, MO 64116; (816) 221-6713, or Steve Bussjaeger, Program Coordinator, Davis Paint Co., P.O. Box 7589, N. Kansas City, MO 64116; (816) 471-4447).

1995

(Feb. 20-22)—Western Coatings Societies' 22nd Biennial Symposium and Show. Sponsored by the Golden Gate, Los Angeles, Pacific Northwest, and Rocky Mountain Societies. Hilton Hotel and Towers, San Francisco, CA. (Gordon Pioch, WCSSS Chairman, Eureka Chemical Co., P.O. Box 2205, S. San Francisco, CA 94083; (415) 761-3536).

OTHER ORGANIZATIONS

1994

North America

(May 16-19)—"Coatings Science for Powder Coatings." Short course sponsored by University of Southern Mississippi (USM). Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, USM, Dept. of Polymer Science, Box 10076, Hattiesburg, MS 39406-0076).

(May 16-20)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(May 16-21)—"Interpretations of IR and Raman Spectroscopy." Course and workshops sponsored by Vanderbilt University, Nashville, TN. (Clara Craver, Director, Fisk Infrared Institute, P.O. Box 265, French Village, MO 63036).

(May 18-20)—1994 Weather-Ometer® Workshop. Sponsored by Atlas Electric Devices Co. Holiday Inn O'Hare, Chicago, IL. (Margaret MacBeth, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(May 23-27)—"Adhesion Principles and Practice for Coatings and Polymer Scientists." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, Kent State University, P.O. Box 5190, Kent, OH 44242-0001).

(June 5-17)—Intensive Coatings Science Course. Sponsored by North Dakota State University (NDSU). Fargo, ND. (Marek W. Urban, NDSU, Dept. of Polymers and Coatings, 54 Dunbar Hall, Fargo, ND 58105).

(June 6-9)—"Coatings Science for Coatings Chemists." Short course sponsored by University of Southern Mississippi (USM). Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, USM, Dept. of Polymer Science, Box 10076, Hattiesburg, MS 39406-0076).

(June 6-10)—"Advances in Emulsion Polymerization and Latex Technology." Short course sponsored by Lehigh University, Bethlehem, PA. (Mohamed S. El-Aasser, Emulsion Polymers Institute, Lehigh University, 111 Research Dr., Bethlehem, PA 18015).

(June 8-10)—"Marine and Offshore Maintenance Coatings Conference." Conference sponsored by National Paint and Coatings Association (NPCA). Virginia Beach Hotel and Conference Center, Virginia Beach, VA. (Ken Zacharias, NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005-5597).

(June 13-15)—"Evaluating Coatings for Environmental Compliance: VOC & Lead Abatement." Conference sponsored by Steel Structures Painting Council (SSPC). Buena Vista Palace, Walt Disney World Village, Lake Buena Vista, FL. (Dee Boyle or Krista Hughes, SSPC, 4516 Henry St., Ste. 301, Pittsburgh, PA 15213-3728).

(June 13-16)—"Coatings Science for Coatings Formulators." Short course sponsored by University of Southern Mississippi (USM). Hattiesburg, MS. (Shelby F. Thames or Debbie Ballard, USM, Dept. of Polymer Science, Box 10076, Hattiesburg, MS 39406-0076).

(June 20-22)— "Introduction to Plastics." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 21-25)—"Basic Polymer and Coatings Chemistry." Short course sponsored by California Polytechnic State University, San Luis Obispo, CA. (James Westover, Chemisty Dept., California Polytechnic State University, San Luis Obispo, CA 93407).

(June 23-24)—"Introduction to Compounding." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 23-25)—"Extrusion Processing." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-28)—"Introduction to Injection Molding." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-29)—"Principles of Color Technologies." Short course sponsored by The University of Akron (UA), Akron, OH. (Nancy Clem, UA, Akron, OH 44325-3109).

(June 27-29)—"Coating Process Fundamentals." Short course sponsored by the University of Minnesota. Minneapolis, MN. (Jackie O'Brien, Dept. of Chemical Engineering and Materials Science, University of Minnesota, 421 Washington Ave., S.E., Minneapolis, MN 55455).

(July 11-15)—MACROAKRON '94 International Symposium. Sponsored by the International Union of Pure and Applied Chemistry. The University of Akron, Akron, OH. (Dr. Joseph P. Kennedy, Organizing Chairman for the Symposium, or Cathy Manus-Gray, Symposium Coordinator, Institute of Polymer Science, The University of Akron, Akron, OH 44325-0604).

(July 18-20)—"Basic Coatings for Sales and Marketing Personnel." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(Aug. 17-19)—1994 Weather-Ometer® Workshop. Sponsored by Atlas Electric Devices Co. Holiday Inn O'Hare, Chicago, IL. (Margaret MacBeth, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

(Sept. 26-30)—"Introduction to Paint Formulation." Short course sponsored by University of Missouri-Rolla (UMR), Rolla, MO. (Cynthia N. Campbell, UMR Coatings Institute, Dept. of Chemistry, 142 Schrenk Hall, Rolla, MO 65401-0249).

(Sept. 28-30)—"Accelerated and Natural Weathering Techniques." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, Kent State University, P.O. Box 5190, Kent, OH 44242-0001).

(Oct. 4-5)—"Advanced Radiation (UV/EB) Curing Marketing/Technology." Seminar sponsored by Armbruster Associates Inc. Marriott Hotel, Newark Airport, Newark, NJ. (David Armbruster, Armbruster Associates Inc., 43 Stockton Rd., Summit, NJ 07901).

(Oct. 4-7)—"Introduction to Coatings Technology." Short course sponsored by Kent State University, Kent, OH. (Carl J. Knauss, Director, Cooperative & Continuing Education—Chemistry, Kent State University, P.O. Box 5190, Kent, OH 44242-0001).

(Oct. 11-13)—Powder Coating '94. Technical conference sponsored by The Powder Coating Institute. Cincinnati Convention Center, Cincinnati, OH. (Andy Goyer or Vicky Thatcher, Goyer Management International, Inc., P.O. Box 54464, Cincinnati, OH 45254).,

(Nov. 13-17)—Third North American Research Conference on Organic Coatings Science and Technology. Sponsored by the American Chemical Society, PMSE Division. Hilton Head, SC. (A.V. Patsis, Institute of Materials Science, State University of New York, New Paltz, NY 12561).

(Nov. 15-18)—"Second Color Imaging Conference: Color Science Systems and Applications." Sponsored by the Society for Imaging Science and Technology (IS&T), Springfield, VA, and the Society for Information Display (SID), Playa del Rey, CA. (Pam Forness, IS&T, 7003 Kilworth Ln., Springfield, VA 22151).

(Nov. 16-18)—1994 Weather-Ometer® Workshop. Sponsored by Atlas Electric Devices Co. Holiday Inn O'Hare, Chicago, IL. (Margaret MacBeth, Atlas Electric Devices Co., 4114 N. Ravenswood Ave., Chicago, IL 60613).

Asia

(May 18-19)—Fourth Asia/Pacific Coatings Show. Organized by the Paint Research Association. Hong Kong Convention and Exhibition Center, Hong Kong, China. (Jane Malcolm-Coe, FMJ International Publications Ltd., Queensway House, 2 Queensway, Redhill, Surrey, RH1 1QS, England).

Europe

(May 15-19)—XXIInd FATIPEC Congress and Exhibition. Budapest Convention Centre, Budapest, Hungary

.(May 16-18)—"Waterborne Coatings—Stability and Rheology." Course sponsored by Institute for Surface Chemistry. Stockholm, Sweden. (K. Arvidsson, Institute for Surface Chemistry—YKI, P.O. Box 5607, S-114 86, Stockholm, Sweden).

(May 23-25)—International Symposium on Polymer Analysis and Characterization. Les Diablerets, Switzerland. (ISPAC Registration, 815 Don Gaspar, Sante Fe, NM 87501).

(June 13-16)—"Science and Technology of Pigment Dispersion." Luzern, Switzerland. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(June 14-17)—Workshop on "Polymer Blends and Alloys." Luzern, Switzerland. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(June 20-22)—16th International Conference on Advances in the Stabilization and Controlled Degradation of Polymers. Luzern, Switzerland. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(June 21-22)—Surfex '94. Exhibition organized by Surfex Ltd., a wholly owned subsidiary of the Oil & Colour Chemists' Association. Harrogate, North Yorkshire. (H. Pooley, Surfex Ltd., Priory House, 967 Harrow Rd., Wembley HAO 2SF, England).

(July 4-8)—20th International Conference on Organic Coatings Science & Technology. Athens, Greece. (A.V. Patsis, State University of New York, New Paltz, NY 12561).

(Aug. 22-26)—"Advances in Emulsion Polymerization and Latex Technology." Davos, Switzerland. (G.W. Poehlein, OIP/CRB, Georgia Institute of Technology, Atlanta, GA 30332-0370).

(Sept. 14-15)—"Waterborne Coatings and Additives." Symposium sponsored by the Royal Society of Chemistry and the Society of Chemical Industry. Manchester Conference Centre, UMIST, UK. (Carol L. Sharp, Conference Secretary,The Royal Society of Chemistry, 41 Exeter Rd., Davyhulme, Manchester, UK, M41 ORF).

(Sept. 28-30)—"Fluorine in Coatings." Conference organized by the Paint Research Association in conjunction with Chemical-Polymer and Chemserve (UMIST). Salford, England. (Conference Secretary, Paint Research Association, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, UK).

(Oct. 4-5)—"Polypropylene '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Oct. 24-28)—"Surfactants and Polymers in Aqueous Solution." Course sponsored by the Institute for Surface Chemistry. Athens, Greece. (K. Möller, Institute for Surface Chemistry—YKI, P.O. Box 5607, S-114 86, Stockholm, Sweden).

(Oct. 24-26)—"Speciality Plastics '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

(Dec. 6-7)—"Styrenics '94." Conference sponsored by Maack Business Services. Swissôtel, Zürich, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

Pacific Rim

(Nov. 6-10)—International Adhesion Symposium. Sponsored by The Adhesion Society of Japan. Tokyo, Japan. (Hiroshi Mizumachi, Professor, Chemistry of Polymeric Materials, The University of Tokyo, Yayoi 1-1-1, Bunkyo-ko, Tokyo 113, Japan).

1995

North America

(Jan. 14-18)—RCMA 1995 Annual Conference & EXPO. Sponsored by the Roof Coatings Manufacturers Association (RCMA). The Ritz-Carlton Laguna Niguel, Dana Point, CA. (Sally Choquette, RCMA Meetings Coordinator, RCMA, 6000 Executive Blvd., Ste. 201, Rockville, MD 20852-3803).

(Feb. 1-3)—"Bridging the Environment." The Fourth World Congress on Coating Systems for Bridges and Steel Structures. Sponsored by the University of Missouri—Rolla (UMR). Marriott Airport Hotel, St. Louis, MO. (Michael R. Van De Mark or Norma Fleming, 119 ME Annex, UMR, Rolla, MO 65401).

(Feb. 24-26)—"Spring Decor 1995." Sponsored by the National Decorating Products Association (NDPA). Atlanta, GA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Mar. 26-31)—"Corrosion '95." Annual Conference sponsored by National Association of Corrosion Engineers (NACE) International. Orlando, FL. (NACE International, P.O. Box 218340, Houston, TX 77218-8340).

(Sept. 29-Oct. 1)—"Fall Decor 1995" Sponsored by the National Decorating Products Association (NDPA). Atlanta, GA. (Teri Flotron, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

Asia

(Jan. 16-18)—"Paintindia '95." Nehru Centre, Bombay, India. (R. Rajagopal, Colour Publications Pvt. Ltd., 126-A, Dhuruwadi, A.V. Nagwekar Marg, Prabhadevi, Bombay 400 025 India).

Europe

(Mar. 13-17)—"Recycle '95." Forum and Exposition. Sponsored by Maack Business Services. Congress Centre, Davos, Switzerland. (Maack Business Services, Moosacherstrasse 14, CH-8804 AU/Zürich, Switzerland).

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'Humbug' from Hillman

This column is being written in March during our 16th Vermont snowfall this winter. With today's dump of snow, we should have accumulated a total of more than four-and-a-half feet of what has been, up to now, white stuff. For the most part, perverse as I am, it has been enjoyable for me to look out on the beautiful white expanse and to ski cross-country through the woods.

Others (perhaps more normal folks) have been affected by what is known as cabin fever, an affliction which may bring on mild depression and sometimes a zaniness that is exhibited by a wild imagination. Witness, for example, the following note received from New Jersey resident, Lou Eronemok, an Honorary Member of the New York Society. Lou, obviously not accustomed to so much of nature's winter bounty, seems to be suffering from the disease. I quote him exactly as written with sincere apologies to the Federation Staff, plus one has-been.

"After 14 snowfalls, with a total of at least 50 inches, my mind depicted a—

Turmoil at the Blue Bell Corral

When Boozer played "Americane (sic) the Beautiful" on her Viola, Ziegler found results simply Maddening and things couldn't be Wackier. He had mustang wrangler Borrelle call for his Coachman and sent Brady the bill."

Wow! Summer can't come too soon for Lou.

I don't know if the cabin fever epidemic reached Philadelphia, but Dick Kiefer must have been suffering from something when he sent me the following golf course caution. Dick has been assured that the treatment is accurate.

Tee Tick Talk

Tiny ticks traveling through this territory tend to transmit terrible troubles. To trap tough ticks, tweeze the tick's tippy top. Tug till tick's tenacious tentacles terminate their tenure to tissue. Temper temptation to twit tick's thorax.

Trousers tangle tick's transit to tissue, triggering terrible travesty to them. Tetracycline treatment triumphantly truncates tick trauma. Tend to these tick tips!

From West Virginia, Dr. Joe Koleske, Editor of the *Paint Testing Manual*, brings us some educational relief that he found in the *Charlestown Gazette* in a column by Terry Marchal. Terry writes that the *Gazette* staff includes some people who are not natives of the state. For them, "the natives on the staff compile a *West Virginia Dictionary*." For example:

Are—60 minutes.
Arn—what you do after you wash clothes.
Doesn't—a word that don't have a place in the language no more.
Dreklee—soon, as in "He'll be home dreklee."
Far—a chemical reaction involving flame and heat.
Fur—a long way, generally used with "piece."
Hail—a place where people go after they die.
Idden—used to change statements into questions, such as, "He's funny, idden nee?"
Jail—what gelatin does to get hard.
Jell—place where they lock up bad guys.
Jeet—"Have you partaken of any food?" Often used with "chet," as in, "Jeet Chet!"
Joo—and you reply to above with, "No, Joo!"
Less—invitation for you to join me, as in, "Less go to the tractor pull."
Mourn—in excess of; "That's mourn I can handle."
Nair—lower or downriver location, often used with "dow," as in, "They live dow nair in the holler."
Neckkud—no clothes on, often used with "buck."
Nell—what you hit with a hammer.
Nern—one more, as, "Jeet that cookie? Want nern?"
Oar—belonging to us.
Pair—as in, "He lives uh pair on the mountain."
Pertneer—nearly.
Prawley—likely, as in, "We'll prawley go dow nair."
Reckleck—recall.
Smairchew—what's wrong?
Speck—anticipate, believe, as in, "I speck he'll be home dreklee."
Uhl—petroleum.
Val—a, e, i, o, u.

And:

—Overheard at the library: "Please give me the name of a good book on personal hygiene. I think I've got it."

—Overheard in a department store: "I'd like a refund on this perfume I bought. I don't like the man I attracted."

—A Mountaineer and his teenage son came into the entranceway of one of Charlestown's bank buildings—you know, the place where the elevators are.

There was a bing and the two of them jumped as the elevator door opened. An elderly, wrinkled old lady shuffled into the elevator and the doors shut. The man and his son watched intently. A minute later, there was another bing and the doors opened. Out stepped a lovely young woman.

The Mountaineer turned to his son, "You wait here, boy. I'm gonna get your Ma and toss her in that box."

—Herb Hillman
Humbug's Nest
P.O. Box 135
Whitingham, VT 05361

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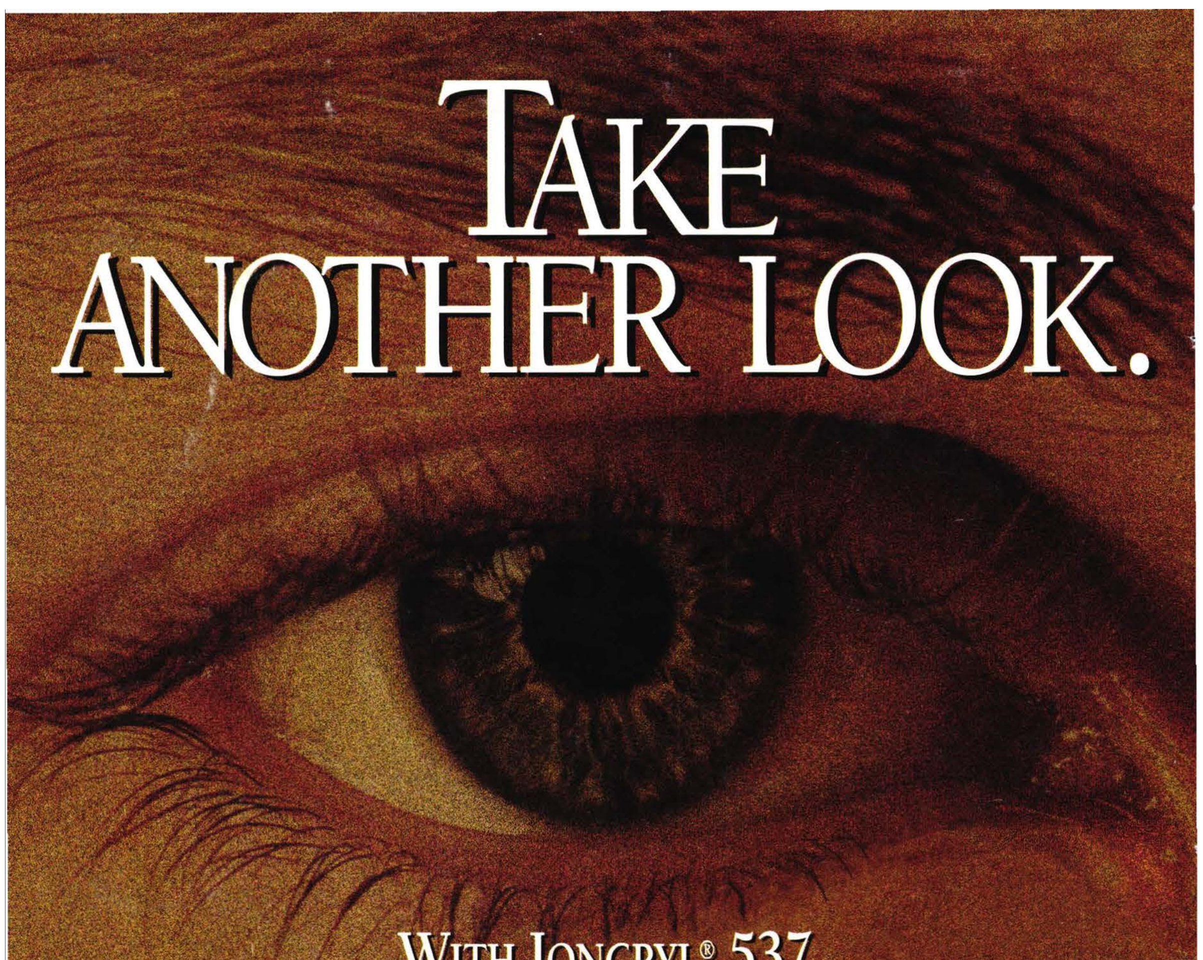

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- Pigment grinding ability
- Excellent application properties

Joncryl 537 enables you to offer your customers a *way to differentiate their products.* In addition to metal, Joncryl 537 offers superior coating performance for plastic and wood. And it can provide alkyd-like high gloss and flow, at lower VOC levels to help meet environmental regulations.

So take another look. With its excellent corrosion resistance and performance benefits, Joncryl 537 could be a real eye-opener for you. And your customers.

*Ask your SC Johnson Polymer District Account Manager for test results. Or call 1-800-231-7868 in North America, (31)2979-91-141 in Europe for more information.

SC Johnson Polymer

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